Carrying Capacity of Land in Bali based on Ecological Footprint

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Abstract. In 2000-2010, based on data from the Population Census in Bali, the average population growth rate was 2.15\% per year, this value was greater than the average population growth rate at the national level of 1.49\% per year. The increasing number of population growth results in increased development. This causes an increase in the need for land to accommodate these development activities. The reduced availability of productive land because it is used for development facilities has resulted in reduced land carrying capacity in Bali. The purpose of this study was to analyze the value of the carrying capacity of land in Bali using the Ecological Footprint analysis approach. The research methodology is quantitative focusing on secondary data analysis, based on the mathematical calculation method developed by the Global Footprint Network, which has the term biocapacity which means supply and ecological footprint which means demand. After comparing biocapacity and ecological footprint, the results show that the carrying capacity of land in Bali is generally in deficit. Things that can be done to increase the carrying capacity of land are to reduce the rate of population growth, increase land productivity by intensifying agricultural land, and be wiser in carrying out land conversion in the future.

Keywords: land carrying capacity, ecological footprint, land biocapacity and productivity

1. Introduction

This article focuses on the study of environmental carrying capacity or can be referred to as carrying capacity, especially on the aspect of land carrying capacity in Bali using an ecological footprint analysis approach. Similar studies have been carried out in other areas as the object of study, such as Pattalassang District, Takalar Regency [1] and Gresik Regency [2]. However, similar research on the carrying capacity of land has never been carried out in Bali as the object of study. Another thing that supports this research is the average annual population growth of Bali during the last decade of 2.15\%, which exceeds the average rate of growth of Indonesia's population per year in the same period of 1.49\% (BPS Province of Bali., 2020). This population growth has an impact on increasing population needs such as housing, work places and consumer goods. This triggers an increase in activities in all aspects of community life, both physical, economic, social, political and cultural development, which leads to an increase in the need for land as a place for all these activities and a decrease in the carrying capacity of land in Bali.

According to Rees, the carrying capacity of the environment and environmental conditions are strongly influenced by changes in land use. In the context of ecology, environmental carrying capacity is defined as the ability of an ecosystem or environment and the resources and services in it to ensure the survival of a number of populations or communities in it [3]. In Article 1 of the Minister of Environment Regulation number 17 of 2009, it is stated that the carrying capacity of the environment is the ability of the environment to support the life of living things, both humans and other living things.
One part of the carrying capacity of the environment is the carrying capacity of the land, which can be interpreted as the capacity of the land to accommodate humans who live on it and all these human activities. The carrying capacity of this land is also one of the basic principles to achieve sustainable development.

In order to support the development of the island of Bali as a province that puts forward the principles of sustainable development, it is very important to know the status of the carrying capacity of land in the province of Bali. By understanding the status of the carrying capacity of this land, preventive and strategic efforts can be designed early so that Bali can be maintained as an ecosystem that is able to support a harmonious life in accordance with the Tri Hita Karana concept.

In order to measure the carrying capacity of land, the approach used in this research is the principles of ecological footprint analysis. This method is used as an approach in measuring the boundaries of sustainable ecosystems, through measuring population demand for the environment or nature expressed in units of global biocapacity area. The ecological footprint approach, a concept first expressed by William Rees and Mathis Wackernagel in 1996, according to Febrianto has now become a very important reference in measuring global sustainability [4].

This article consists of several parts, namely, an introduction that discusses and demonstrates the background of the research, a research methodology that contains the research approach used, research results and a discussion that contains data and results from the research, the last is a closing which contains conclusions from the results. study. Through this article, it is hoped that the public can find out the status of the carrying capacity of land in Bali in 2019, and the importance of the carrying capacity of land on the environment in Bali, so that the community can take steps that can support the value of the carrying capacity of land so as to create sustainable development in Bali.

2. Literature review

2.1. Sustainable development

Sustainable development has been widely accepted by many countries in the world as a human target and a new model of development in their country [5]. In simple terms, sustainable development according to Ms. Brundtland aims to meet the needs of humans living today without compromising the ability of future generations to meet their needs for life and development [5][6]. This concept will involve at least four key elements, namely population, resources, environment and economy, known as PREE. Most of the existing studies believe that economic development should be based on good ecological environmental cycles [7]. These elements are very complex sub-systems so that the interaction between these sub-systems in the sustainable development system causes the sustainable development model to become a very complex system [8], both in understanding, assessing and choosing strategies to achieve it [9]. In 2030, there are 17 sustainable development goals that have been set as a world transformation agenda to address the challenges of various interests in the sustainable development sub-system, namely no poverty, no hunger, health and well-being, quality of education, quality of gender, clean water and sanitation, affordable clean energy, decent work and economic growth, industry-innovation and infrastructure, reducing diversity, sustainable communities and cities, responsible consumption and production, action on climate, underwater life, life on land, peace-justice and strong institutions, and partnerships for achieving goals [10]. Taking into account the many targets of sustainable development and the existence of conflicts in implementing them, assessing the success of implementing sustainable development is very complex and there must be trade-offs between sub-systems and between targets [5][11]. The use of the concept of carrying capacity (CC) is not accurate enough to assess sustainable development [5]. Carrying capacity is simply defined as the maximum population that an ecosystem can support. Carrying capacity from the point of view of regional or urban planning, is a tool to measure the achievement of the implementation of the concept of sustainable development, because CC can be used to determine the level of human activity, population growth, land use patterns and developments, physical development that can be supported by the urban environment without causing degradation. serious environment [12]. Various methods are used to estimate the carrying capacity of an area that is non-linear. Principle component analysis (PCA) is used in research conducted by Liu et al [13] to estimate the carrying capacity of an element in the concept of sustainable
development in various regions in China. The results of his research indicate that the carrying capacity of water resources and environmental quality is relatively low compared to the carrying capacity of infrastructure which is the highest among the components considered. Furthermore, Wei et al. [14] used urban-carrying capacity as a benchmark for sustainable urban development in Beijing, while Andreson et al. [15] used carrying capacity for modeling population development. In Indonesia, carrying capacity is used to assess the sustainability of an inland fishery area based on the productivity of chlorophyll and phosphate in the sub-system [16]. In addition, the ecological footprint is also widely used to assess the sustainability status of an area or its elements such as the carrying capacity of agricultural land on the island of Java [17], the environmental carrying capacity (DDL) of Tamangapa Village [4], the carrying capacity of the city of Bandung [18], optimization land use in Gresik [2], and land carrying capacity status in Pattalassang sub-district [1], to determine the status of urban food consumption [19]. On the other hand, Wijaya et al. [20] used satellite data analysis to assess land capacity in Kotabaru, South Kalimantan.

Regional planning regulations in Indonesia take into account environmental and spatial/regional issues. The concept of carrying capacity which includes supportive carrying capacity (SCC) and assimilative carrying capacity (ACC) has been clearly defined in it [8]. SCC is the capacity/ability of the environment to support human life and other living things in it. Meanwhile, ACC is the capacity/ability of the environment to absorb elements, energy and/or components that enter the environment, either independently or with human intervention. The goal of spatial planning in Indonesia is the effective and efficient use of space, which is very important in sustainable environmental management, prevention of space wastage and degradation of space quality. Spatial planning is based on the characteristics of the available land, the carrying capacity of the land and the relevant supporting technology. Spatial planning in Indonesia is expected to result in the suitability of space utilization, harmony, and balance of the sub-systems in it [8].

2.2. Biocapacity and ecological footprint
The supply aspect describes the ability of an ecosystem or environment to support the life of living things which is called biocapacity. The ecological footprint is an analytical tool to measure and communicate the impact of resource use on the environment, the ecological footprint is one of the coefficients needed to analyze the carrying capacity of the environment based on the ecological footprint, the ecological footprint also describes the demand aspect. To determine the value of biocapacity, several variables are needed, namely land area of each category of bioproductive land use, equivalence factor, and yield factor (harvest factor). Determining the value of the ecological footprint also requires several variables, namely the amount of product production per each land category, the number of exports and imports of food products from each land category, product productivity, equivalence factor, and yield factor (harvest factor).

2.3. Land carrying capacity in ecological footprint
Based on the publication of the Living Planet Report [21], the comparison between biocapacity (supply) and ecological footprint (demand) can reflect the carrying capacity of an area's land. In the calculation, if the ecological footprint is greater than the biocapacity, there will be an overshoot, which means that the carrying capacity of the land has been exceeded. In this condition, there is an ecological deficit or unsustainable status. Conversely, if the ecological footprint is smaller, then there is a certain amount of biocapacity in nature that is reserved to support future life (ecological debt) or has a sustainable status. The value of the carrying capacity of the land can be analyzed from the results of the value of the analysis of biocapacity divided by the value of the results of the analysis of the ecological footprint.

3. Method
The research methodology used is quantitative research that focuses on secondary data analysis, where secondary data is valid data relating to the variables to be analyzed. The secondary data needed is from the Central Statistics Agency which contains the amount of production and product productivity from each category of bioproductive land in Bali in 2019, then data from the National Land Agency for the use of each land category in Bali in 2019, and data from the National Land Agency for the use of each
land category in Bali in 2019. from the Bali Province Trade and Industry Office to find out about exports and imports of food products in Bali in 2019.
The data analysis used in this study is based on a mathematical calculation method called Ecological Footprint Analysis. This method has been developed by the Global Footprint Network (GFN) (2019) in the Working Guidebook to the National Footprint and Biocapacity Accounts [22].

3.1. Biocapacity
Biocapacity for all land categories was calculated using the following equation:

\[ BC = A \times YF \times EQF \]  

Information:
\[ BC = \text{Biocapacity} \]
\[ A = \text{Land use area per land category} \]
\[ YF = \text{Yield factor} \]
\[ EQF = \text{Equivalence factor} \]

3.2. Ecological footprint
The ecological footprint can be calculated using the following equation:

\[ EF = \frac{P}{YN} \times YF \times EQF \]  

Information:
\[ EF = \text{Ecological footprint} \]
\[ P = \text{Total consumption of the product (after adding imports and deducting exports) (tons/year), if not available, land area can be used} \]
\[ YN = \text{Productivity of the calculated area (tons/ha/year)} \]
\[ YF = \text{Yield factor} \]
\[ EQF = \text{Equivalence factor} \]

3.3. Equivalence factor
The value of the equivalence factor in this study refers to the data in the Working Guidebook to the National Footprint and Biocapacity Accounts [22] as presented in Table 1.

| No | Land Use            | EQF |
|----|---------------------|-----|
| 1  | Agricultural land   | 2.52|
| 2  | Forest              | 1.29|
| 3  | Meadow/Farm/Field   | 0.46|
| 4  | Aquatic Land        | 0.37|
| 5  | Built-up Land       | 2.52|

3.4. Yield Factor
Based on the method developed by the Global Footprint Network, the harvest factor or yield factor can be calculated by dividing the productivity of a land category in the calculation area with the average productivity of the same land in the world in the same year, the harvest factor can be calculated by the following formula:

\[ YFL = \frac{YNL}{YWAL} \]  

Information:
\[ YFL = \text{Yield factor (harvest factor) for land category L} \]
\[ YNL = \text{Land productivity in the calculation area for land category L (tons/ha/year)} \]
\[ YWAL = \text{World land productivity for land category L (tons/ha/year)} \]

There are several assumptions for calculating the yield factor in completing equation (3) above, the assumption in question is that the built-up land has the same yield factor as agricultural land, due to the
assumption that urban land usually converts agricultural land. Fishery land has a yield factor value of 1 or the productivity of the world's fishery land is the same as the calculation area, this is assumed due to the limitations of world fishery data, especially in remote countries or regions [2].

3.5. Land Carrying Capacity

To find out the value of environmental carrying capacity based on the ecological footprint in Bali Province, it can be calculated by the following formula.

\[ DDL = \frac{BC}{EF} \]  

Information:
DDL = Land carrying capacity
BC = Biocapacity
EF = Ecological footprint

Based on equation (4) above, if the carrying capacity of the land (DDL) > 1, it can be interpreted as a surplus carrying capacity condition, where the ecosystem is able to support human life living in it. If DDL < 1, it can be interpreted as an overshoot or deficit carrying capacity condition, where the land is not able to support the human life that lives in it [18].

3.6. Regional Development Potential

Based on the DDL value, it can be determined the optimal number of residents, the population is not accommodated, the optimal land area, and additional land area, described in Table 2. What is meant by optimal is the amount of biocapacity equal to the ecological footprint. Thus, the optimal population means the maximum population that can be supported by the ecosystem, while the optimal land area means the minimum land area needed to support the population living on it [4].

| Formula | Information |
|---------|-------------|
| \[ JPO = DDL \times JP \] | JPO : Optimal population size that can be supported |
| \[ JPTT = (1 - DDL) \times JP \] | JPTT : The number of people who cannot be supported |
| \[ LLO = L_{total} \times DDL^{-1} \] | LLO : Optimal land area |
| \[ LLT = \left( \frac{1}{1 - DDL} \right) \times L_{total} \] | LLT : Additional land area needed to support population |

4. Data, discussion, and results/findings

4.1. Land Use in Bali Province in 2019

Bali has an area of 563,666 hectares with a population of 4,336,900 people in 2019. The following is data on land use in Bali based on data from the State Land Agency of Bali Province in 2020 [23], presented in Table 3.

| No | Land Use         | Area (Ha) |
|----|------------------|-----------|
| 1  | Agricultural land| 89.138,42 |
| 2  | Forest           | 106.241,34|
| 3  | Tegal/Field      | 144.363,10|
| 4  | Plantation       | 137.440,64|
| 5  | Inland Water     | 5.553,53  |
| 6  | Built-up Land    | 80.928,78 |
|    | Total            | 563.666   |
4.2. Product Production and Productivity in Bali in 2019
The following is data on product consumption per land use category in Bali. The data used are production and product productivity data in 2019 from the Bali Provincial Central Statistics Agency [24], and food export and import data in 2019 from the Bali Provincial Industry and Trade Office [25] which are presented in Table 4.

| No | Land Use     | P (ton)    | YN (ton/ha/Year) |
|----|--------------|------------|------------------|
| 1  | Agriculture  | 714,837,3  | 6,74             |
| 2  | Tegal/Field  | 727,536,87 | 5,09             |
| 3  | Plantation   | 94,853,15  | 4,47             |
| 4  | Inland Water | 15,538     | 2,80             |

4.3. Yield Factor Analysis
The following analysis of the yield factor, using equation (3), is presented in Table 5.

| No | Land Use     | YNL | YWL | YFL |
|----|--------------|-----|-----|-----|
| 1  | Agriculture  | 6,74| 4,63| 1,46|
| 2  | Forest       | -   | 1,82| -   |
| 3  | Tegal/Field  | 5,09| 6,19| 0,82|
| 4  | Plantation   | 4,47| 6,19| 0,10|
| 5  | Inland water | 2,80| 2,80| 1   |
| 6  | Built-up Land| -   | -   | 1,46|

4.4. Biocapacity Analysis
The following analysis of biocapacity, using equation (1), is presented in Table 6.

| No | Land Use     | A    | YF   | EQF | BC     |
|----|--------------|------|------|-----|--------|
| 1  | Agriculture  | 89,138,42 | 1,46 | 2,52 | 326,988,90 |
| 2  | Forest       | 106,241,34 | -   | 1,29 | 137,051,33 |
| 3  | Tegal/Field  | 144,363,10 | 0,82 | 0,46 | 54,615,54  |
| 4  | Plantation   | 137,440,64 | 0,10 | 0,46 | 6,533,30   |
| 5  | Inland water | 5,553,53  | 1    | 0,37 | 2,054,80   |
| 6  | Build up Land| 80,928,78 | 1,46 | 2,52 | 297,753,16 |
|    | Total        |       |      |     | 824,977,03 |

4.5. Ecological Footprint Analysis
The following analysis of the ecological footprint, using equation (2), is presented in Table 7.

| No | Land Use     | P       | YN    | YF   | EQF   | EF     |
|----|--------------|---------|-------|------|-------|--------|
| 1  | Agriculture  | 714,837,3 ton | 6,74 | 1,46 | 2,52 | 389,069,11 |
| 2  | Forest       | 106,241,34 ha | -   | -   | 1,29 | 137,051,33 |
| 3  | Tegal/Field  | 727,536,87 ton | 5,09 | 0,82 | 0,46 | 54,065,74  |
| 4  | Plantation   | 94,853,14 ton | 0,64 | 0,10 | 0,46 | 7,048,86   |
| 5  | Inland water | 15,538 ton  | 2,80 | 1    | 0,37 | 2,053,23   |
| 6  | Build up Land| 80,928,78 ha | -    | 1,46 | 2,52 | 297,753,16 |
|    | Total        |         |       |      |       | 887,041,43 |

4.6. Land Carrying Capacity Analysis
The following is an analysis of the carrying capacity of land in Bali per land use category, the analysis using equation (4) is presented in Table 8.
Table 8. Land Carrying Capacity Analysis.

| No | Land Use          | BC        | EF        | DDL       | STATUS |
|----|-------------------|-----------|-----------|-----------|--------|
| 1  | Agriculture       | 326.988,90| 389.069,11| 0,84      | Defisit|
| 2  | Forest            | 137.051,33| 137.051,33| 1         |        |
| 3  | Tegal/Field       | 54.615,54 | 54.065,74 | 1,01      | Surplus|
| 4  | Plantation        | 6.533,30  | 7.048,86  | 0,92      | Defisit|
| 5  | Inland water      | 2.054,80  | 2.053,23  | 1,00      | Surplus|
| 6  | Build up Land     | 297.753,16| 297.753,16| 1         |        |
|    | **Total**         | **824.977,03** | **887.041,43** | **0,93** |        |

4.7. Analysis of Land Carrying Capacity per Regency/City

The analysis of the carrying capacity of land in Bali per district/city also uses equation (4), the details are presented in Table 9.

Table 9. Analysis of Land Carrying Capacity per Regency/City.

| No | Land Use in         | BC        | EF        | DDL       | STATUS |
|----|---------------------|-----------|-----------|-----------|--------|
| 1  | Jembrana            | 120.612,98| 106.980,08| 1,13      | Surplus|
| 2  | Tabanan             | 116.038,83| 93.925,19 | 1,24      | Surplus|
| 3  | Badung              | 98.203,56 | 125.877,12| 0,78      | Defisit|
| 4  | Gianyar             | 89.494,13 | 86.276,20 | 1,04      | Surplus|
| 5  | Klungkung           | 60.254,78 | 67.572,26 | 0,89      | Defisit|
| 6  | Bangli              | 71.406,22 | 54.782,71 | 1,30      | Surplus|
| 7  | Karangasem          | 79.705,88 | 80.853,97 | 0,99      | Defisit|
| 8  | Buleleng            | 143.003,65| 152.647,49| 0,94      | Defisit|
| 9  | Denpasar            | 55.676,01 | 144.416,46| 0,39      | Defisit|
| 10 | Bali                | 824.977,03| 887.041,43| 0,93      | Defisit|

4.8. Analysis of Regency/City Area Development Potential

By knowing the value of the carrying capacity of land per district/city in Bali Province, it can be seen how much population can be accommodated per district/city, or the optimal number of residents, as well as the optimal land area per district/city. Based on this information, it can be predicted in how many years the surplus regional conditions will become a deficit if the population growth rate remains as it is today, in detail presented in Table 10.

Table 10. Regional Development Potential Analysis.

| No | District / City    | Optimal Population (Person) | Unaccommodated Residents (person) | Optimal Land Area (ha) | Additional Land Area (ha) | Deficit Prediction (tahun) | Population growth (%) |
|----|--------------------|-----------------------------|-----------------------------------|------------------------|--------------------------|--------------------------|----------------------|
| 1  | Jembrana           | 313.539                     | -                                 | 74.665                 | -                        | 18                       | 0,68%                |
| 2  | Tabanan            | 550.635                     | -                                 | 67.938                 | -                        | 33                       | 0,64%                |
| 3  | Badung             | 522.863                     | 147.337                           | 53.645                 | 9.201                    | -                        | 2,36%                |
| 4  | Gianyar            | 531.296                     | -                                 | 35.477                 | -                        | 4                        | 0,97%                |
| 5  | Klungkung          | 159.705                     | 19.395                            | 35.325                 | 3.411                    | -                        | 0,55%                |
| 6  | Bangli             | 296.273                     | .                                 | 39.956                 | -                        | 44                       | 0,60%                |
| 7  | Karangasem         | 410.684                     | 5.916                             | 85.163                 | 1.192                    | -                        | 0,55%                |
| 8  | Buleleng           | 618.865                     | 41.735                            | 148.066                | 8.763                    | -                        | 0,63%                |
| 9  | Denpasar           | 365.416                     | 581.684                           | 33.119                 | 7.848                    | -                        | 2,06%                |
| 10 | Bali               | 3.962.569                   | 374.331                           | 619.238                | 48.835                   | -                        | 1,21%                |

5. Discussion
So the results of the analysis of the carrying capacity of land in Bali based on land use categories are in deficit status, with a value of 0.93 gha/capita. The value of the carrying capacity of forest land is 1 because the available data on forest land use in Bali is in the form of non-production forest forest, therefore forest land and built-up land are assumed to be non-bioproductive land. The categories of land that are declared surplus are dry land/fields and land waters. The two land categories only have a land carrying capacity value slightly above the number one, this will not be able to support sustainable development in the future if the carrying capacity value of the land is not increased.

In general, out of 8 regencies and 1 city, only 4 (four) regencies have surplus status, namely: from the most surplus regencies, Bangli, Tabanan, Jembrana and Gianyar. Of the 5 (five) regencies/cities included in the deficit category, Denpasar City is the city with the most deficit, followed by Badung, Klungkung, Buleleng and Karangasem regencies. Overall, Bali Province is also in deficit, although some districts in Bali have a surplus. This shows that the surplus regencies in Bali have not been able to support the regencies/cities with deficit status in Bali Province.

The calculations in Table 10 refer to the formula in Table 2. Prediction of deficit is a prediction of how many years the regency/city whose land carrying capacity status is surplus turns into a deficit, if the population growth rate and land productivity conditions are assumed to remain the same as in 2019. Data on population growth and land productivity conditions are obtained from the Central Statistics Agency (BPS) of Bali Province in 2010-2019. To be able to determine the value of the predicted deficit, the population projection formula is used, namely, \( P_n = P_0(1+r)^n \). The value of \( P_n \) is the optimal population, the value of \( P_0 \) is the total population in 2019, the value of \( r \) is the average population growth rate per year, and the value of \( n \) is the number of years in the calculation area that is predicted to experience a deficit. The analysis to determine the value of the predicted deficit year (\( n \)) is to use goal seek analysis in the Microsoft Excel application. So, the essence of this deficit prediction is how many years, the time needed by districts/cities that have surplus land carrying capacity status to reach the optimal population, if the population growth rate and land carrying capacity in the region remain the same as in 2019.

In districts/cities that have a deficit or overshoat land carrying capacity status, there are several efforts that can be made to improve the land carrying capacity status, namely: Supressing the rate of population growth; To intensify bioproductive land by utilizing relevant technology; and reduce the use of agricultural land. Intensification of bioproductive land in question is to increase the amount of production from bioproductive land by utilizing agricultural technologies, so that in the future it can increase the productivity of bioproductive land and will directly increase the value of the carrying capacity of the land.

Regencies/cities that have surplus land carrying capacity status can become suppliers or suppliers of products from bioproductive land, and can become destinations for transmigration from deficit districts/cities. This can improve the status of the land carrying capacity of the Province of Bali as a whole, and it is hoped that efforts will continue to increase the carrying capacity of the land so that it can continue to support sustainable development.

Riyadi [26] mentions that there are 3 indicators that can become a strategy in developing the region, namely, the first indicator is to increase productivity in all land categories in Bali Province, this is important because increasing productivity is the main step that must be taken if you want to increase the value of power, support land. The second indicator is efficiency, the efficiency that can be applied in the province of Bali is by intensifying bioproductive land. Intensification is meant by utilizing the right technology and human resources in cultivating a land, the productivity of the land will definitely increase. The third indicator is community participation, however the government develops strategies to develop an area, if the community does not participate or does not want to participate, these strategies will not be realized. Community participation is very important, therefore it is necessary to hold outreaches about future impacts if regional productivity is not increased.

A Ghozali and P G Aristita [2] stated that the application of the agropolitan concept can be a solution in developing rural areas without reducing the productivity of the land. The development of agropolitan areas can also be applied in various areas in the province of Bali, especially in rural areas that have extensive agricultural land. In addition to applying the agropolitan concept, implementing regulations or providing counseling so that public consumption in the use of natural resources is more circular than linear (Marganingrum, 2019) can also be a strategy in regional development in Bali Province in order
to overcome the deficit status of land carrying capacity. Many efforts have been made to implement a circular pattern in public consumption, one of which is the 3R (reuse, reduce, recycle) program. This regional development strategy can be used as a reference for environmental aspects in sustainable development. For a more complete regional development strategy, it is also necessary to pay attention to the economic and social aspects which are part of the three basic aspects of sustainable development.

There are several limitations to the research on the carrying capacity of the land using the ecological footprint analysis method. First, this research only focuses on the analysis of the carrying capacity of land which refers to the production and productivity of products on bioproductive land, so the results of this study are only limited to the value of the carrying capacity of land in Bali Province, there are still many factors needed if you want to determine the value of the carrying capacity. an environment such as carbon footprint, carrying capacity of water sources, and so on. Second, the lack of data sources that can support, especially regarding exports and imports of food at the district and provincial levels, because there are still many third parties who carry out export-import activities for food products that do not collect data from the Bali Provincial Industry and Trade Office, this causes inaccuracy. data on the consumption of food resources in Bali in this study.

6. Conclusion

So, the carrying capacity of land in Bali in this analysis can be expressed in general as a deficit or overshoot. If viewed from the carrying capacity of land per district/city, the order of regions from the largest in deficit value is Denpasar City, followed by Badung, Klungkung, Buleleng, and Karangasem Regencies. The order of surplus areas from the largest to the surplus value is Bangli, Tabanan, Jembrana, and Gianyar Regencies. Even though the deficit situation does not mean that development in Bali must be stopped, because development is also a major factor in the development of a region. The development carried out must be sustainable development, by carrying out various development strategies, such as increasing productivity, efficiency, and involving community participation. As a suggestion, the government should conduct better data collection, especially in terms of export and import of food products, so that in the future it will be easier to conduct research on the carrying capacity of land based on ecological footprint calculations.

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