

# Analysis of carrying capacity of agricultural land in Bali Province, 2021-2022

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**Abstract.** An analysis of the carrying capacity of agricultural land needs to be carried out to find out whether an area is self-sufficient in food or not based on the calorie needs of its population. This study aims to determine the carrying capacity of the weapons fields in the Province of Bali in 2021-2022. The research method used for the analysis of the carrying capacity of the Bali Province land is quantitative research. Calculation of the value of Agricultural Land Carrying Capacity based on the combined theory of Odum, Christeiler, Ebenezer Howard, and Isard. The results of this study indicate that the level of carrying capacity of agricultural land in the Province of Bali according to districts/cities in 2021-2022 is dominated by class III, which means that the Province of Bali has not been able to be self-sufficient in food and has not been able to meet the food needs of the community properly.

## 1 Introduction

Astronomically, Bali Province is located at 8° 3' 38"– 8° 50' 56" South Latitude and 114° 25' 53" – 115° 42'39" East Longitude. In general, it can be seen that Bali island is famous for its tourism sector, but Bali island is also famous for its agricultural sector. This is evidenced by the subak system which has become a world cultural heritage. The subak system itself can be defined as an irrigation system that is related to customary law and has characteristics, namely social-agriculture-religious [1]. Bali also has agricultural indicators which do not only consist of rice fields, but also plantations, tubers, and crops. The potential of Province Bali in the tourism and agricultural sectors needs to be balanced so that there is no imbalance between the two sectors.

The population continues to increase and the development activities carried out have confiscated the function of agricultural land to produce food which is replaced by other uses, such as housing, offices and others [2] [3] [4]. Many agricultural lands with high land potential in Bali Province have been converted as non-agricultural land for various activities. This will have a negative impact, which will reduce the ability of agricultural land to meet the food needs of the population. The area of agricultural land that remains constant with a large population growth will cause the availability of agricultural land to become smaller. If this is allowed, there will be an imbalance in the population working as farmers in an area with the existing agricultural land area. As a result, population pressure on agricultural land will be even greater or in other words the area will no longer be able to meet the food needs of its population.

Responding to the above phenomenon, development in the agricultural sector must be further enhanced by knowing the characteristic factors of agricultural sector development in Bali Province. The characteristics of agricultural development can be reviewed through the analysis of the carrying capacity of agricultural land. Therefore, it is necessary and important to carry out an analysis of the carrying capacity of agricultural land to determine the ability of the land to provide food to meet the needs of the population in a certain area and at a certain time and to be able to describe the actual state of agriculture in an area. The purpose of this research is to determine the level of carrying capacity of agricultural land (rice) in Bali Province in 2021-2022. Thus, the availability of paddy fields to support the needs of the population can be calculated, and the balance between the tourism sector and the agricultural sector in the Province of Bali can be determined [5].

## 2 Materials and methods

The research method used for the analysis of the carrying capacity of Province Bali land is quantitative research. The data collected and used is secondary data from various publications issued by Badan Pusat Statistik (BPS) Province Bali, which includes rice harvested area, population, and average rice production by district/city in 2021 and 2022. Calculation of the value The carrying capacity of agricultural land is based on the combined theory of Odum, Christeiler, Ebenezer Howard, and Isard, which is formulated as follows [6]:

$$\sigma = \frac{Lp}{\frac{Pd}{KFM} Pr} \quad (1)$$

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$\sigma$  = Carrying capacity of agricultural land  
 $L_p$  = Paddy harvested area (ha)  
 $P_d$  = Total population (people)  
 $P_r$  = Average rice production per hectare (kg/ha)  
 $KFM$  = Minimum Physical Needs (kg/capita/year), which is 265

The land carrying capacity values obtained are then classified into three classes, namely:

1. Class I ( $\sigma > 2.46$ ): areas that are self-sufficient in food and able to provide a decent life for its inhabitants.
2. Class II ( $1 \leq \sigma \leq 2.46$ ): areas that are capable of self-sufficiency in food, but have not been able to provide a decent life for its inhabitants.
3. Class III ( $\sigma < 1$ ): areas that have not been able to be self-sufficient in food and have not been able to meet the food needs of the community properly.

The analytical method used is spatial-temporal.

### 3 Results and discussion

[7] suggests that land capability implies land carrying capacity. Land capability is defined as land quality which is assessed as a whole with the definition of land capability in fulfilling human needs. In general, the carrying capacity of agricultural land can increase or decrease depending on the factors that influence it. Food crops are plants that produce main food ingredients, such as: paddy (producing rice), pulses (producing corn), beans and tubers. Meanwhile, self-sufficiency in food is an attempt to meet one's own food needs by cultivating food crops such as seleria (rice and the like).

[8] revealed that a decrease in the carrying capacity of agricultural land can be caused by an increase in population, population growth can result in a decrease in the area of land that can be cultivated, the percentage of the number of farmers and the area of land needed for a decent life. According to [9], to overcome the decline in the carrying capacity of land can be done in several ways, such as: 1). Land conservation, namely changing the type of land use towards a more profitable business but still adjusted to the area, 2). Land intensification, namely in using new technology in farming, and 3). Land conservation, namely efforts to prevent land loss.

Damage to natural resources and the environment is closely related to the increase in population growth and the pattern of distribution that is not evenly distributed. The most critical environmental damage problem is population pressure, especially in the agricultural sector. This problem continues to increase over time, as a result of which population growth and land use for development are higher than the availability of agricultural land. The ever-increasing population has led to a much higher population growth rate than the expansion of land for food crops.

Community behaviour factors towards the land affect the carrying capacity of the land itself. The decline in the quality of land resources due to the increasingly complex demand for land ownership has resulted in a decrease in land support data.

Population pressure generally occurs in areas that have low land carrying capacity in terms of soil fertility. However, in practice this theory is not fully applicable. Such is the case in the Province of Bali which has fertile agricultural land but is still experiencing high population pressure due to the development of the tourism sector. The existence of population growth will require an increase in the need for clothing, food, and boards. The imbalance of population growth with increasing needs greatly affects the state of the environment, namely the environment will be exploited on a large scale.

The sustainability of the carrying capacity of land is strongly influenced by human owners or land managers and geomorphological processes that occur in the form of erosion and soil movement, these processes are the causes of land degradation. The form of land use is basically a tangible manifestation of the interaction process that occurs between human activities and land resources in an effort to meet needs and improve their standard of living [10]. Within the same area, the carrying capacity of the land can be of different values. This is due to the different approach, for areas where the majority of the population lives from the agricultural sector, the carrying capacity of the land can be calculated through food production. In terms of calculation, it can be calculated from the minimum physical requirements (KFM) in terms of calorie needs per person per day, namely 2600 or 265 kg of rice per person per year.

The area of food crop land is an important component in measuring the carrying capacity of agricultural land. The smaller the value of the area of food crop land, the better the level of carrying capacity of agricultural land. Another important component in calculating the carrying capacity of agricultural land is the harvested area of food crops which is based on the amount per capita. The value of the harvested area of food crops tends to change both between regions and over time. The value of the area harvested for food crops is inversely proportional to the area of food crop land. The greater the value of the harvested area, the better the level of carrying capacity of agricultural land in the area [11].

The results of the research carried out based on secondary data obtained in BPS publications show that the level of carrying capacity of agricultural land in the Province of Bali in both 2021 and 2022 is classified based on the Regency/City dominated by class III according to the classification of the level of carrying capacity of agricultural land. This means that the Province of Bali has not been able to be self-sufficient in food and has not been able to meet the food needs of the community properly. However, there is one district that has grade II scores, namely Tabanan. In 2022 Tabanan has a value of 1,361 agricultural land carrying capacity which can be classified based on its class,

namely class II. This means that Tabanan has been able to be self-sufficient in food but has not been able to provide a decent life for its inhabitants.

**Table 1.** Carrying capacity of agricultural land according to the Regency/City of Bali Province in 2021

No	Regency / City	Carrying capacity of agricultural land	Classification
1	Jembrana	0.589	Class III
2	Tabanan	1.353	Class II
3	Badung	0.620	Class III
4	Gianyar	0.086	Class III
5	Klungkung	0.446	Class III
6	Bangli	0.283	Class III
7	Karangasem	0.308	Class III
8	Buleleng	0.388	Class III

Source: BPS Bali Province

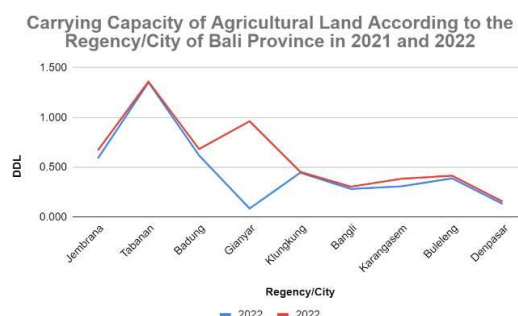
**Table 2.** Carrying capacity of agricultural land according to the Regency/City of Bali Province in 2022

No	Regency / City	Carrying capacity of agricultural land	Classification
1	Jembrana	0.669	Class III
2	Tabanan	1.361	Class II
3	Badung	0.683	Class III
4	Gianyar	0.963	Class III
5	Klungkung	0.454	Class III
6	Bangli	0.306	Class III
7	Karangasem	0.384	Class III
8	Buleleng	0.415	Class III

Source: BPS Bali Province

Furthermore, the trend of land carrying capacity that occurs in the Province of Bali from 2021 to 2022 can be seen through Figure 1. The total population in the Province of Bali in 2021 will be lower than the Province of Bali in 2022. However, in general, this growth will not increase too much. Based on the value

of the carrying capacity of the land in the Province of Bali, the Tabanan region has a higher DDL value compared to other districts/cities. The high carrying capacity of agricultural land is due to a decrease in population between 2021 and 2022. This decrease can be caused by the Covid-19 pandemic outbreak. This figure has no significant effect on the classification of the carrying capacity of agricultural land.



**Fig. 1.** Graph of carrying capacity of agricultural land by regency/city of Bali Province in 2021 and 2022

#### 4 Conclusion

The level of carrying capacity of agricultural land in the Province of Bali according to districts/cities in 2021-2022 is dominated by class III, which means that the Province of Bali has not been able to be self-sufficient in food and has not been able to meet the food needs of the community properly. However, there is one district that has grade II scores, namely Tabanan. This means that Tabanan Regency has been able to be self-sufficient in food but has not been able to provide a decent life for its inhabitants.

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