



# Study of Food Carrying Capacity in Batu City

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**Abstract.** The development of demand in various sectors continues to increase along with the increase in population to meet primary and secondary human needs. This has resulted in a sharp increase in the exploitation of environmental resources, so that the current environmental conditions are indicated to have decreased, including the use of space for human life and other living creatures. Information about food carrying capacity is very important to get serious attention. This study aims to calculate the food carrying capacity of agricultural land in Batu City with the price as conversion factor to equate non-food products with rice in calculation method used. The determination of the carrying capacity of food is carried out through an indicative approach based on the units of analysis, parameters, indicators and benchmarks for each of these units of analysis. Then the total food carrying capacity value is the cumulative of all commodities (crops and non-crops) and compared with the total existing human population (residents and tourists). The conclusion of this study is Batu City is considered capable of meeting the food needs of its population, both residents and tourists based on data food carrying capacity (706,213.93 people) which is greater than the total population (680,020 people).

**Keywords:** agricultural carrying capacity · food security · horticulture

## 1 Introduction

Development is an optimization, interactions and interactions between components development, namely natural resources, human resources, community values, and technology to improve quality of life [1]. Study of development and the carrying capacity of natural resources is expected able to support the region and hope it gets better people welfare. Currently, development developments in various sectors continue to increase with the number of residents to meet primary and secondary human needs. This has resulted in the exploitation of environmental resources increasing sharply, so that the current environmental conditions are indicated to have decreased, including the use of space for human life and other living creatures. Information about the carrying capacity of food is very important to get serious attention. Another thing that becomes a challenge in managing natural resources and the environment is maintaining a balance between meeting human needs in the short term and using them to support sustainable life in

development and paying attention to social and economic welfare. And the preservation of environmental functions in the future. Therefore, the ability of the environment to support human life, other living things and the balance between the two (Environmental Supporting Capacity), as well as the ability of the environment to absorb substances, energy and/or other components that enter or are included in it (environmental capacity) it is important to know, understand and serve as the basis for planning the use of natural resources, development planning and spatial utilization planning.

In Law Number 32 of 2009, the carrying capacity of the environment is written in a number of articles, including Article 12 which states that if the Environmental Protection and Management Plan has not been compiled, the utilization of natural resources is carried out based on the carrying capacity and capacity of the environment. In addition, in Articles 15, 16 and 17 it is explained that the carrying capacity and capacity of agriculture is one of the contents of the study that underlies the preparation or evaluation of regional spatial plans (RTRW), long-term and medium-term development plans (RPJP and RPJM) and policies, plans and/or programs that have the potential to cause environmental impacts and/or risks, through the Strategic Environmental Assessment (KLHS). The carrying capacity are also stated in Article 19, which states that in order to maintain the preservation of environmental functions and public safety, every regional spatial planning must be based on the KLHS and determined by taking into account the carrying capacity and capacity of the environment.

Based on the description, it can be seen that there are limitations that must be considered in the preparation of the food carrying capacity in an area, such as the diversity or differences in the character and ecological function of each region, the distribution of the population and the potential of natural resources in each region. So it is hoped that the food carrying capacity in an area will describe its existing condition.

Guidelines on determining the food carrying capacity will become a reference in planning the use of natural resources, development planning and spatial use planning, including planning for inter-regional cooperation by taking into account aspects of population and regional characteristics. Batu City is one of the cities that is a tourist center in East Java. Land use change to non-agricultural. So, through this research, the ability of the food carrying capacity in agriculture, Batu City is studied, whether it is still able to support food needs for permanent and tourist residents. The price as conversion factor to equate non-food products with rice in calculation method used. The majority of agricultural products in Batu City are horticultural commodities such as fruit, vegetables and ornamental plants so that the process of calculating the food carrying capacity is carried out by the conversion method to the energy value of a number of rice that can be available from the sale of horticultural agricultural production.

## **2 Method**

### **2.1 Data Analysis Method**

Determination of the food carrying capacity is an instrument that explains the process/method of scientific studies to determine/know the ability of an area to support the needs of human life and other living creatures. Therefore, the determination of the food carrying capacity is carried out through an indicative approach based on the unit

of analysis, parameters, indicators and benchmarks in each of these units of analysis. Considering that the food carrying capacity are dynamic and complex and highly dependent on the geographical characteristics of a region, the number of inhabitants and the existing conditions of natural resources in the regions.

In general, the calculation technique for food carrying capacity depends on the function or purpose to be measured whether it involves economic, demographic and so on. Each of these objectives has its own formulation due to the different characteristics of units and sizes.

## 2.2 Food Carrying Capacity Calculation

The calculation of the food carrying capacity of crops plants uses the formulas in numbers 2.1 and 3. While for vegetable, fruit and ornamental plants, uses the formulas in numbers 1, 2.2 and 3. The calculation formula is as follows [2]:

$$NB = \frac{(Pi \times Hi)}{Hb} \quad (1)$$

$$TK = \frac{Pi \times Kb \times 1000}{100} \quad (2.1)$$

$$TK = \frac{NB \times Kb \times 1000}{100} \quad (2.2)$$

$$DL = \frac{TK}{KKbT} \quad (3)$$

Keterangan:

NB = Rice purchasing power value (kg).

Pi = Actual production of each type of commodity (unit depends on the type of commodity). Commodities that are calculated include crops, fruit, vegetables and ornamentals.

Hi = Unit price for each type of commodity (Rp/unit) at the producer level

Hb = Unit price of rice (Rp/kg) at producer level.

Kb = Calorific value of rice per kg.

TK = Total calories.

KKbT = Annual calorie requirement per person (2000 x 365)

DL = Carrying capacity of land in terms of population.

In this calculation, the conversion factor used to equalize non-crops products with rice is price. Then the total food carrying capacity value is the cumulative of all commodities (crops and non-crops) and compared with the total existing human population (residents and tourists).

The carrying capacity status is obtained from comparisons between Population (PL) and land carrying capacity (DL).

If  $DL > PL$ , Surplus.

If  $DL < PL$ , Defisit.

**Table 1.** Area by District in Batu City

District	District Capital	Land Area (km <sup>2</sup> )	%
Batu	Sisir	45,46	22,83
Junrejo	Junrejo	25,65	12,88
Bumiaji	Punten	127,98	64,28
<b>Batu City</b>		<b>199,09</b>	<b>100,00</b>

Source: Batu City in Numbers, 2018

### 3 Results and Discussion

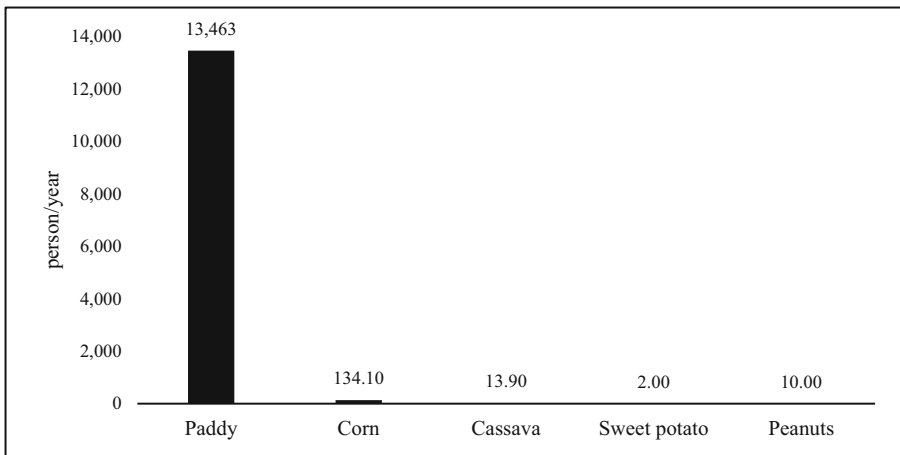
#### 3.1 Batu City Area

The area of Batu City is 19,908,72 Ha consists of Batu District covering an area of 4.545,81 Ha, Junrejo an area of 2.565,02 Ha and Bumiaji distric 12.797,89 Ha.

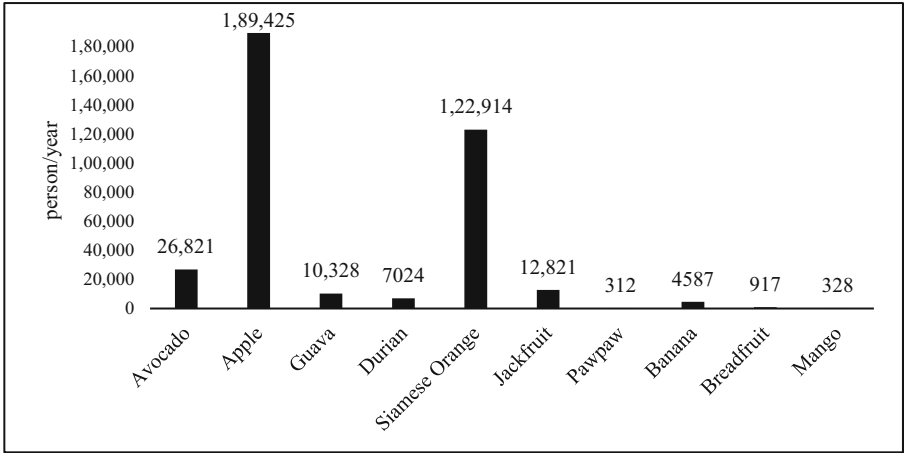
#### 3.2 Carrying Capacity

The results of food carrying capacity in Batu are as follows (Fig. 1). Data on productivity and harvested area of rice, corn, cassava, sweet potatoes and peanuts were obtained from data from the Central Statistics Agency, 2019.

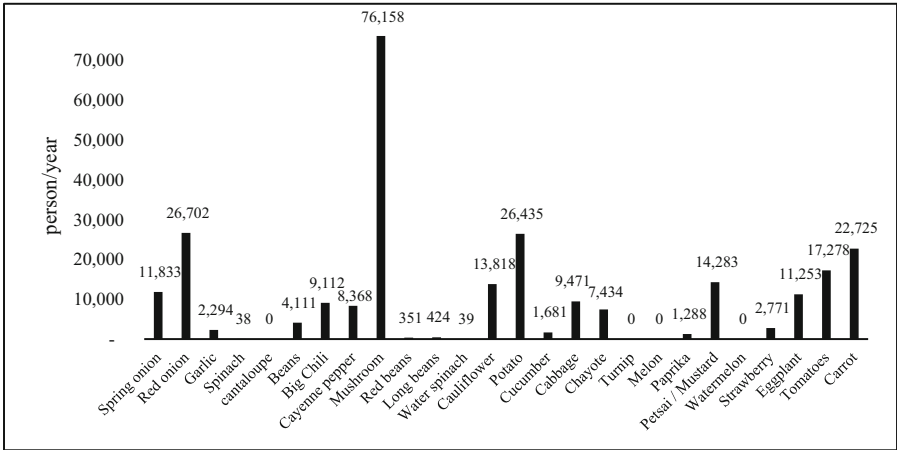
Batu City has good potential in production of vegetable, ornamental plants and fruit due to the suitability of the climate. The three types of horticulture commodities are also included in the calculation of food carrying capacity using the calculation of purchasing power which is converted to rice before calculating the calories. The results of the calculation of the three types of plants are shown in the Fig. 2, 3 and 4.



**Fig. 1.** Carrying Capacity of Crops Plant (person/year)

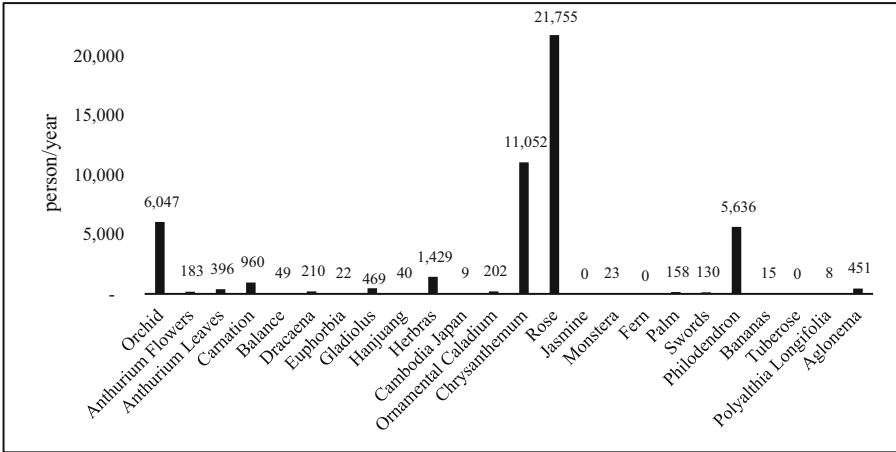


**Fig. 2.** Carrying Capacity of Fruit Plant (person/year)



**Fig. 3.** Carrying Capacity of Vegetable Plant (person/year)

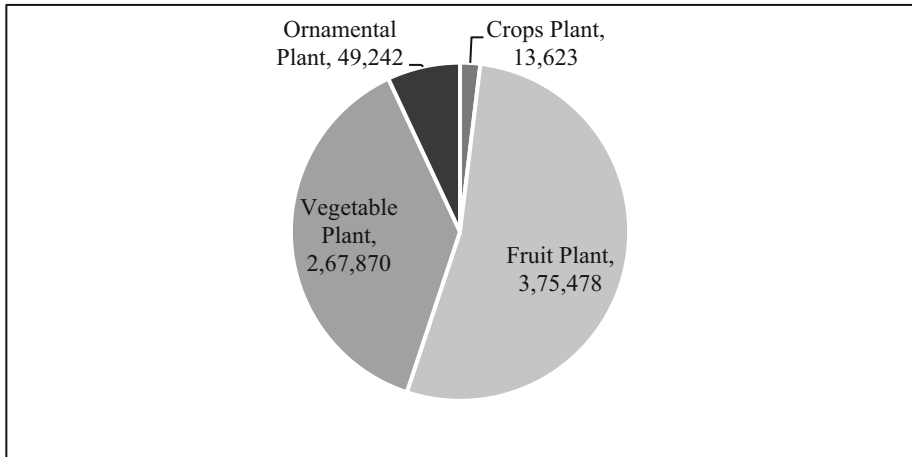
Food carrying capacity is the ability of the environment in supporting human's life, other living creatures, and the balances between the two [3]. Based on the Fig. 1-4, the recapitulation of the carrying capacity of food, fruit, vegetable and ornamental plants will be compared with the total population in Batu City. The population of Batu City is 205,788 person and the number of tourists who are counted as guests at the hotel is 474,232 person [4]. The total population of Batu City is 680,020 person. The carrying capacity of crops commodities is 13,623.32 person; fruit commodity 375,478.48 person; vegetable commodity 267,869.64 person and ornamental plant commodity 49,242.49



**Fig. 4.** Carrying Capacity of Ornamental Plant (person/year)

person. The total carrying capacity of the four commodities is 706,213.93 person. Batu City is considered capable of meeting the food needs of its residents, both local residents and tourists.

Based on data, food carrying capacity is greater than the total population. According to Iswandi [5] one of the things that can affect the carrying capacity of agricultural land is the population, the population is a factor that causes land changes, one of which is rice fields. Rapid population growth will encourage changes in land use, among others, for housing and educational, economic and other facilities. Then Dauly and Sanny [6] said that the population has two roles in the agricultural production process, namely from production factors that produce agricultural products and consumption to meet basic needs, therefore the population determines food needs. In addition, population growth also plays an important role in accelerating the conversion of agricultural land. The need to protect agricultural land that has a high suitability value for agricultural production. In this study Batu City has a feasibility in terms of land carrying capacity. Pawlikowska, Popok and Bieda [7] states that appropriate areas in terms of carrying capacity of agricultural land must continue to strive to be protected and it is necessary to apply the principle of sustainable development. The main thing is that government policies in implementing land protection policies must be carried out seriously so that there is no change in land function from agriculture to non-agriculture (Fig. 5).



**Fig. 5.** Carrying Capacity Percentage of All Commodities (person/year)

## 4 Conclusion

Batu City is considered capable of meeting the food needs of its population, both residents and tourists based on the carrying capacity data (706,213.93 person) which is greater than the total population (680,020 person). Batu City is considered capable of meeting the food needs of its population from both local residents and tourists based on carrying capacity data that is greater than the total population.

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## References

1. Muta'ali, Lutfi. 2012. Daya Dukung Lingkungan Untuk Perencanaan Pengembangan Wilayah. Yogyakarta : Badan Penerbit Fakultas Geografi
2. Kurniawan, Andri. 2005. Fungsi Daya Dukung Sumberdaya Alam Terhadap Perkembangan Ekonomi Wilayah di Kabupaten Sleman. Yogyakarta : Fakultas Geografi UGM
3. Ernamaiyanti E., N. I. Asyari and T.P. Purba. 2016. Field Carrying Capacity Analysis of Agricultural Sector Based Spatial in Nagari Mataram, District of Lima Puluh Kota, West Sumatra. Gontor AGROTECH Sci J. 2: 21–36.3
4. Badan Pusat Statistik. 2019. Batu Municipality in Figures.
5. Iswandi. 2017. Evaluasi Kesesuaian Lahan Untuk Kawasan Permukiman Dengan Metode Multi Criteria Evaluation di Kota Padang J. Pengelolaan Sumberdaya Alam dan Lingkungan. 7(2)

6. Daulay M.T. and A. Sanny. Analysis of Structural Equation Modeling Towards Productivity and Welfare of Farmer ' s Household in Sub-District Selesai of Langkat Regency. *Int J Res Rev* 2019; 6: 117–123.
7. Pawlikowska E., P. Popek and A. Bieda 2017. Analysis of The Legal Methods of Agricultural Land Protection in Central Europe on The Example of Polan and Bulgaria. *Real Estate Manag Valuat.* 25: 58–71.

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