Carrying Capacity of Agricultural Land in Disaster-Prone Areas of Land Movement at Karangsambung-Karangbolong Geopark

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Abstract. A disaster-prone area is an area that has a high level of vulnerability to potential threats to life, welfare, and residents’ assets when a disaster occurs. Land damage due to landslides has the potential to reduce the region's ability to supply human resources, especially in the agricultural sector. This condition has an impact on decreasing the carrying capacity of agricultural land. This study aimed to analyze the distribution pattern and carrying capacity of agricultural land in the disaster-prone area of the Karangsambung-Karangbolong Geopark. Data sources used were secondary and primary data. The secondary data were obtained from the Central Bureau of Statistics of Kebumen Regency and the Regional Disaster Management Agency of Kebumen Regency. The primary data were obtained from observation and in-depth interviews. Data analysis was carried out in a quantitative descriptive manner. The carrying capacity of agricultural land was obtained using the Odum-Howard-Isaard agricultural land productivity approach with a classification based on Decent Living Needs (DLN). The results showed that the available land carrying capacity (LCC), especially rice fields, was lower than the farmers' needs thus the LCC value was a deficit. In geopark areas that had low LCC and was indicated by low levels of agricultural production could not be able to carry out food self-sufficiency. The carrying capacity of agricultural land in disaster-prone areas can be increased through policies to prevent land conservation and intensify agricultural land processing.

1. Introduction
The Karangsambung-Karangbolong Geopark area is an area that is supported by the wealth and peculiarities of geology, biodiversity, and culture that can be developed into an area that has economic value without compromising conservation efforts. This is because the Karangsambung-Karangbolong Geopark area is also an area that is prone to disasters, one of which is landslide disasters, thus conservation efforts are needed in managing the resources in it.

The Karangsambung-Karangbolong Geopark area has considerable agricultural potential. This is supported by the vision of the Kebumen Regency government in 2005-2025, namely “Independent and Prosperous Kebumen Based on Agribusiness”. This considerable agricultural potential is also supported by soil types in Kebumen Regency, including alluvial soil, latosol soil, podsolic soil, regosol soil, and association of glei humus and gray alluvial as well as association of litosol and mediteran brown. The potential of the land indicates that some of the existing areas are classified as fertile enough thus it is
suitable to function as agricultural land except in some areas in Sempor, Karanggayam, Sadang, and Alian sub-districts whose soil is not suitable or capable of being planted [1]. As an agricultural country, agricultural sector activities in various regions in Indonesia still dominate [2]. Kebumen Regency is one of the regencies in Central Java whose livelihood is dominated by the agricultural sector, which is 23.83 percent in 2018 [3] thus when viewed from the form of land use in Kebumen Regency, it is more dominated as agricultural land. Based on Regional Regulation Number 23 of 2012 concerning Spatial Planning of Kebumen Regency in 2011–2031, several sub-districts located in the geopark area are sub-districts that are directed for agricultural activities [4]. This means that each sub-district can take advantage the available land to be cultivated in agricultural activities in meeting food needs while still paying attention to the suitability of regional functions. The agricultural sector is one sector that has an important role for society [5, 6] and seeded in most areas in Indonesia [7] in the economy to improve welfare. The distribution value of the percentage of gross regional domestic product (GRDP) according to business fields in Kebumen Regency in 2016-2020, the agriculture, forestry, and fishery sectors gave the highest contribution. Where in 2016, the agricultural sector contributed 24.67 percent to GRDP and continued to decline to 21.79 percent in 2020 [8]. Availability of land or carrying capacity of agricultural land is the ability of an area to provide land that can be used to support agricultural activities [9]. The carrying capacity of agricultural land can also be interpreted as the ability of the region to produce rice to meet food needs in order to achieve rice self-sufficiency [10]. Kebumen Regency has a population of 1,350,438 people in 2020 [8]. This population has increased from the total population in 2016 which was 1,188,603 people. The population growth rate of 0.032 is categorized as a positive population growth or in other words, there was an increase in population from the previous year. This is one of the threats or population problems [11] to the availability of sustainable agricultural land in addition to the landslide disaster where the condition of the population continues to increase while the area of agricultural land tends to remain. A disaster-prone area is an area that has a high level of vulnerability to potential threats to life, welfare and residents' assets when a disaster occurs [12]. Land damage caused by disasters has the potential to reduce the region's ability to supply human resources, especially in the agricultural sector. The impact of the eruption, which mostly damaged agricultural land, resulted in reduced land productivity. So if this condition continues, the carrying capacity of agricultural land in disaster-prone areas will reach a point where the land is unable to meet the needs of life. The carrying capacity of agricultural land becomes very important for development planning which can provide an overview of the relationship between population, land use and the environment. Knowing the level of carrying capacity of a land is very important in development planning, because with an analysis of the carrying capacity of land it can be used to estimate various possibilities that can occur or estimate the level of population needs adapted to using existing land conditions [10, 13]. Understanding the land capability and carrying capacity of agricultural land can provide an overview to the government and local communities regarding the condition of the availability of agricultural land that is capable of producing food needs as well as one of the references in controlling land use so that there is no decline in the need for agricultural land to produce food in the future. This research focused on understanding the comparison between the availability and the need for land and the carrying capacity of agricultural land to the food needs of the people in Kebumen Regency.

2. Methodology
This research was conducted in the Karangsambung-Karangbolong Geopark Area in Kebumen Regency, Central Java. The Karangsambung-Karangbolong Geopark area stretches from the north side of Kebumen Regency to the coastal area on the south side. In general, the Karangsambung-Karangbolong Geopark Area is divided into three segments, namely the Karangsambung area (the Karangsambung Geological Reserve Area in the north), the Sempor area (middle part) and the Ayah Coastal Area which is an old karst and volcanic area (southern part). The Karangsambung-Karangbolong Geopark has an area of 543,599 km² located in 12 sub-districts with 117 villages. This geopark area consists of 41 geological sites equipped with eight biological sites and 10 cultural sites [14].
The data were collected through literature studies and supported with field observations. The main data used were secondary data collected indirectly through agencies, books, and scientific journals.

The carrying capacity of agricultural land is an analysis of the carrying capacity of the environment which has a function to calculate the availability of agricultural land in supporting the needs of the population. The method of calculating the carrying capacity of agricultural land is based on the Regulation of the State Minister of the Environment Number 17 of 2009 concerning Guidelines for Determining Environmental Carrying Capacity in Regional Spatial Planning [15].

Calculation of the carrying capacity of the land is done by calculating the availability of land and land requirements. Land availability is calculated using the formula:

\[
SL = \sum \frac{(P_i \times H_i)}{H_b} \times \frac{1}{P_{tv_b}}
\]

where:
- \( S_L \): Land Availability (Ha)
- \( P_i \): Actual production of rice commodity (kg)
- \( H_i \): Unit price of rice commodity at producer level (IDR/kg)
- \( H_b \): Unit price of rice at producer level (IDR/kg)
- \( P_{tv_b} \): Rice productivity (kg/Ha)

Land demand are calculated using the formula:

\[
D_L = N \times KHL_L
\]

Where:

\( N \) is the population

\( KHL_L \) is the carrying capacity of land.
DL: Total land demand equivalent to rice (Ha)
N: Total population (people)
KHL: The area of land needed for decent living needs per resident (Ha/capita)

Notes:
- The area of land needed for a decent living per resident is obtained from the population's decent living needs divided by local rice productivity
- The need for decent living per population is 1,000 kg/capita/year of rice.
- Regions that do not have data on local rice productivity, can use the average national rice productivity data, which is 2,400 kg/ha/year

Determination of land carrying capacity (LCC) is done by comparing land availability (SL) with land demand (DL).

\[ \text{LCC} = \frac{\text{SL}}{\text{DL}} \]  

(3)

LCC analysis results interpretation is as follows.
- If SL > DL, the carrying capacity of the land is surplus or
- If SL < DL, the land carrying capacity is deficit.

To determine the ability of the region to implement food self-sufficiency, this research compared the optimum population with the results of food production. The concept used to understand the critical threshold for land carrying capacity is the existence of a limited population that can be supported without degrading the natural environment thus the ecosystem can be maintained [10]. The carrying capacity of the area can be determined by the following formula:

\[
\ell = \frac{L_p/P_d}{KFM/pr}
\]

(4)

where:
- \( \ell \): carrying capacity
- \( L_p \): area of harvested land (ha)
- \( P_d \): total population (people)
- \( KFM \): minimum physical requirement (kg/capita/year)
- \( pr \): average land production per hectare (kg/ha)

The amount of Minimum Physical Requirements (MPR) used was 320 kg/capita/year. According to Sayogyo, the number of MPR is close to reality in rural areas. The calculation results interpretation of the carrying capacity of agricultural land is as follows.
- \(< 1\) means that the area is not able to carry out food self-sufficiency or the population exceeds the optimal population.
- \(= 1\) means that the area has optimal carrying capacity.
- \(> 1\) means the area is able to carry out food self-sufficiency or the population is below the optimal population.

3. Results and Discussion

The form of agricultural land use in the Karangsambung-Karangbolong Geopark Area consists of wet land (rice fields) and dry land (fields). Table 1 below provides more detailed information.
Table 1 Agricultural Land Use (ha) in the Karangsambung-Karangbolong Geopark Area

| Districts | Agricultural Land | Total |
|-----------|-------------------|-------|
|           | Rice Field | Fields and Dry Land |       |
| Ayah      | 2,561      | 377         | 2,938 |
| Buayan    | 2,351      | 2,554       | 4,905 |
| Rowokele  | 2,036      | 1,392       | 3,428 |
| Sempor    | 2,438      | 1,868       | 4,306 |
| Gombong   | 2,160      | 3           | 2,163 |
| Karanganyar | 1,675  | 687         | 2,362 |
| Karanggayam | 2,189   | 1,980       | 4,169 |
| Sruweng   | 2,811      | 794         | 3,605 |
| Pejagoan  | 1,371      | 784         | 2,155 |
| Alian     | 2.865      | 1,659       | 4,524 |
| Karangsambung | 3.405 | 1,792       | 5.197 |
| Sadang    | 1.819      | 914         | 2.733 |
| Geopark Area | 27,681 | 14,804 | 42,485 |

Source: Kebumen Regency in Figures, 2020

Based on Table 1, the geopark area has a rice field area of 27,681 hectares or 33.37 percent of the total agricultural land area in Kebumen Regency. This means that of the total paddy fields in Kebumen Regency, more than a quarter are in the Karangsambung-Karangbolong Geopark Area. Other agricultural lands are fields and dry land. Rice fields are used for rice plants to support the food needs of the local community. The average production amount of rice in the geopark area is 5.44 tons/ha. This amount is the same as the average production in Kebumen Regency which total rice production is 451,233 tons.

The need for food will continue to increase in line with the increasing population. The total population in the Karangsambung-Karangbolong Geopark Area is 642,620 people or 47.59 percent of the total population in Kebumen Regency (Figure 2). The condition of the population tends to experience a positive growth rate, while the availability of paddy fields as a food producer tends to remain constant. This is in accordance with the theory put forward by Malthus where the rate of population growth follows a geometric series while food growth follows an arithmetical series [16, 17]. The increase in population is in line with the increasing need for land for development. To meet the need for land, generally the conversion of agricultural land to non-agricultural land is carried out. This is because the value of agricultural land is considered lower when compared to non-agricultural land [18, 19].
Population growth in the Karangsambung-Karangbolong Geopark Area during the last five years tends to increase with a population growth rate of 0.03 which is the same as the population growth rate of Kebumen Regency. According to the population growth rate, the projection of the population number in the geopark area for the next 19 years was calculated using geometric calculations as shown in Table 2.

Table 2 Population Projection of the Karangsambung-Karangbolong Geopark Area

| Districts      | Total Population (People) | Population Growth Rate | Population Projection (People) |
|----------------|----------------------------|------------------------|--------------------------------|
|                | 2015          | 2020        | 2025  | 2030  | 2035  | 2040  |
| Ayah           | 55,267        | 63,890      | 73,858 | 85,382 | 98,704 | 114,104 |
| Buayan         | 54,569        | 64,640      | 76,570 | 88,516 | 102,327 | 118,293 |
| Rowokele       | 42,626        | 50,300      | 59,356 | 68,616 | 79,322 | 91,699 |
| Sempor         | 59,622        | 68,120      | 77,829 | 89,972 | 104,010 | 120,239 |
| Gombong        | 47,695        | 50,200      | 52,837 | 61,080 | 70,610 | 81,627 |
| Karanganyar    | 34,251        | 37,270      | 40,555 | 46,883 | 54,198 | 62,654 |
| Karanggayam    | 48,781        | 57,990      | 68,937 | 79,693 | 92,128 | 106,502 |
| Sruweng        | 53,833        | 60,780      | 68,623 | 79,330 | 91,708 | 106,017 |
| Pejagoan       | 48,442        | 54,830      | 62,060 | 71,743 | 82,937 | 95,877 |
| Alian          | 54,440        | 65,780      | 79,482 | 91,883 | 106,219 | 122,792 |
Table 2 shows that the projection of population number will continue to increase until 2040. This will directly affect the need for agricultural land because with the increase in population, the need for food consumption will increase. In his research, Suratha (2014) states that the increasing number of people not only affects the amount of food needed, but also affects the decreasing food availability because the increasing population will increase the need for residential land and ultimately lead to an increase in agricultural land conversion which ultimately reduces land area and production of food commodities [20, 21]. Population growth that continues to increase with limited land area decreases the ability of an area.

The actual area of paddy fields is agricultural land used for the production of rice commodities. The calculation results of the availability of paddy fields can be seen in Figure 3. The area of available paddy fields is 27,681 ha or 33.37 percent of the total paddy fields in Kebumen Regency.

**Table 3 Land Needs for Karangsambung-Karangbolong Area**

| Districts | Total Population (People) | Minimum Land Area for Decent Living (ha) | Land Requirement (ha) |
|-----------|---------------------------|----------------------------------------|-----------------------|
| Ayah      | 63,890                    | 0.73                                   | 46,639.70             |
| Buayan    | 64,640                    | 0.73                                   | 47,187.20             |
| Rowokele  | 50,300                    | 0.73                                   | 36,719.00             |

Source: Analysis results, 2021

The actual area of paddy fields is agricultural land used for the production of rice commodities. The calculation results of the availability of paddy fields can be seen in Figure 3. The area of available paddy fields is 27,681 ha or 33.37 percent of the total paddy fields in Kebumen Regency.
| Districts          | Total Population (People) | Minimum Land Area for Decent Living (ha) | Land Requirement (ha) |
|-------------------|---------------------------|------------------------------------------|-----------------------|
| Sempor            | 68,120                    | 0.73                                     | 49,727.60             |
| Gombong           | 50,200                    | 0.73                                     | 36,646.00             |
| Karanganyar       | 37,270                    | 0.73                                     | 27,207.10             |
| Karanggayam       | 57,990                    | 0.73                                     | 42,332.70             |
| Sruweng           | 60,780                    | 0.73                                     | 44,369.40             |
| Pejagoan          | 54,830                    | 0.73                                     | 40,025.90             |
| Alian             | 65,780                    | 0.73                                     | 48,019.40             |
| Karangsambung     | 46,530                    | 0.73                                     | 33,966.90             |
| Sadang            | 22,290                    | 0.73                                     | 16,271.70             |
| **Geopark area**  | **642,620**               | **0.73**                                 | **469,112.60**        |
| **Kebumen District** | **1,350,438**             | **0.73**                                 | **985,819.74**        |

Source: Analysis results, 2021

The agricultural sector has a role in providing food through agricultural commodities [22]. The value of rice production is used for conversion of grain to rice. This is in accordance with the guidelines of the Central Statistics Agency in 2018 carried out in two stages, namely drying conversion of 83.38% and milling yield of 64.02%. The determination of the price of rice per kilogram referred to the price in the Karangsambung-Karangbolong Geopark Area or the surrounding area in Kebumen Regency. The minimum land area to meet the needs of a decent living for farmers is 0.73 ha [23].

![Figure 4 Land Requirement Map](image-url)
Table 4 shows that the available agricultural land (paddy fields) has a deficit status in terms of carrying capacity of agricultural land. This shows that the existing agricultural land had not been able to support the need for agricultural land for a decent life. The carrying capacity of agricultural land in general can change depending on the influencing factors. In this case, the number of populations is one of the influencing factors.

### Table 4 Status of Carrying Capacity of Agricultural Land in The Karangsambung-Karangbolong Area

| Districts    | Land Availability (ha) | Land Requirements (ha) | LCC Status |
|--------------|------------------------|------------------------|------------|
| Ayah         | 2,561                  | 46,639.70              | Deficit    |
| Buayan       | 2,351                  | 47,187.20              | Deficit    |
| Rowokele     | 2,036                  | 36,719.00              | Deficit    |
| Sempor       | 2,438                  | 49,727.60              | Deficit    |
| Gombong      | 2,160                  | 36,646.00              | Deficit    |
| Karanganyar  | 1.675                  | 27,207.10              | Deficit    |
| Karanggayam  | 2.189                  | 42,332.70              | Deficit    |
| Sruweng      | 2,811                  | 44,439.40              | Deficit    |
| Pejagoan     | 1.371                  | 40,025.90              | Deficit    |
| Alian        | 2,865                  | 48,019.40              | Deficit    |
| Karangsambung| 3.405                  | 33,966.90              | Deficit    |
| Sadang       | 1.819                  | 16,271.70              | Deficit    |
| Geopark area | 27,681                 | 469,112.60             | Deficit    |
| Kebumen District | 82,938               | 985,819.74             | Deficit    |

Source: Analysis results, 2021

The need for land for rice production in an area is important. This is because the ability of a region to produce rice is one of the factors to support the realization of regional independence in achieving food self-sufficiency. In general, the minimum food requirement in rural communities is 320 kg/person/year. This basic need is the minimum measure of a person's ability to live a normal life. The calculation of the region's ability to support the food needs of the community in the Karangsambung-Karangbolong Geopark Area can be seen in Table 5.

### Table 5 The Carrying Capacity in the Karangsambung-Karangbolong Geopark Area

| Districts    | Harvested Area (ha) | Total Population (People) | Minimum Physical Needs (kg/people/year) | Production (kg) | Productivity (kg/ha) | Carrying Capacity |
|--------------|---------------------|---------------------------|----------------------------------------|----------------|----------------------|------------------|
| Ayah         | 2,561               | 63,890                    | 320                                    | 7,440,620.92   | 2,905.36             | 0.36             |
| Buayan       | 2,351               | 64,640                    | 320                                    | 6,831,556.53   | 2,905.81             | 0.33             |
| Rowokele     | 2,036               | 50,300                    | 320                                    | 5,913,422.66   | 2,904.43             | 0.39             |
| Sempor       | 2,438               | 68,120                    | 320                                    | 7,084,043.34   | 2,905.68             | 0.32             |
| Gombong      | 2,160               | 50,200                    | 320                                    | 6,275,338.22   | 2,905.25             | 0.39             |
| Karanganyar  | 1.675               | 37,270                    | 320                                    | 4,866,643.29   | 2,905.46             | 0.41             |
| Karanggayam  | 2.189               | 57,990                    | 320                                    | 6,358,610.83   | 2,904.80             | 0.34             |
| Sruweng      | 2,811               | 60,780                    | 320                                    | 8,166,587.23   | 2,905.22             | 0.42             |
### Table 5

| Districts     | Harvested Area (ha) | Total Population (People) | Minimum Physical Needs (kg/people/year) | Production (kg) | Productivity (kg/ha) | Carrying Capacity |
|---------------|---------------------|---------------------------|----------------------------------------|----------------|---------------------|-------------------|
| Pejagoan      | 1.371               | 54,830                    | 320                                    | 3,981,604.95   | 2,904.16            | 0.23              |
| Alian         | 2.865               | 65,780                    | 320                                    | 8,325,125.46   | 2,905.80            | 0.40              |
| Karangsambung | 3.405               | 46,530                    | 320                                    | 9,892,892.42   | 2,905.40            | 0.66              |
| Sadang        | 1.819               | 22,290                    | 320                                    | 5,286,209.12   | 2,906.11            | 0.74              |
| Geopark area  | 27,681              | 642,620                   | 320                                    | 80,422,654.98  | 2,905.34            | 0.39              |
| Kebumen District | 82,938            | 1,350,438                 | 320                                    | 240,867,615.87 | 2,904.19            | 0.56              |

Source: Analysis results, 2021

Table 5 explains that the Karangsambung-Karangbolong Geopark area has not been able to achieve food self-sufficiency due to the limited area of agricultural land (rice fields). Referring to the results of the analysis, the total food needs of the community in the Karangsambung-Karangbolong Geopark Area is 205,638,400 kg while the rice production is only 80,422,654.98 kg. Food consumption in rice is much lower than the ideal need thus to fulfill this, people must import rice. This is also in accordance with research conducted by Laksmiari (2017) which states that several provinces in Indonesia still carry out large rice import activities [24, 21].

### Table 6

| Districts     | Population Projection | Rice Demand Projection |
|---------------|-----------------------|------------------------|
|               | 2025                | 2030                   | 2040 | 2025 | 2030 | 2040 |
| Ayah          | 73,858              | 85,382                 | 98,703 | 114,104 | 23,634,687 | 27,322,275 | 31,585,217 | 36,513,281 |
| Buayan        | 76,569              | 88,516                 | 102,327 | 118,292 | 24,502,900 | 28,325,245 | 32,744,674 | 37,853,642 |
| Rowokele      | 59,355              | 68,616                 | 79,322 | 91,698 | 18,993,778 | 21,957,271 | 25,383,141 | 29,343,530 |
| Sempor        | 77,829              | 89,972                 | 104,010 | 120,238 | 24,905,354 | 28,791,197 | 33,283,325 | 38,476,336 |
| Gombong       | 52,936              | 61,080                 | 70,610 | 81,627 | 16,907,071 | 19,545,715 | 22,595,323 | 26,120,745 |
| Karanganayar  | 40,555              | 46,882                 | 54,197 | 62,653 | 12,977,634 | 15,002,461 | 17,343,211 | 20,049,175 |
| Karanggayam   | 68,937              | 79,693                 | 92,127 | 106,501 | 22,059,999 | 25,501,897 | 29,480,815 | 34,080,542 |
| Sruweng       | 68,623              | 79,330                 | 91,707 | 106,016 | 21,959,517 | 25,385,737 | 29,346,532 | 33,925,306 |
| Pejagoan      | 62,060              | 71,743                 | 82,937 | 95,877 | 19,859,321 | 22,957,860 | 26,539,846 | 30,680,709 |
| Alian         | 79,482              | 91,883                 | 106,219 | 122,792 | 25,434,289 | 29,402,658 | 33,990,458 | 39,293,489 |
| Karangsambung | 57,353              | 66,302                 | 76,466 | 88,605 | 18,353,151 | 21,216,690 | 24,527,011 | 28,353,823 |
| Sadang        | 27,199              | 31,442                 | 36,348 | 42,019 | 8,703,679 | 10,061,666 | 11,631,531 | 13,446,333 |
| Geopark area  | 743,347             | 859,327                | 993,403 | 1,148,398 | 237,871,031 | 274,984,714 | 317,889,036 | 367,487,480 |
| Kebumen District | 1,539,058       | 1,779,184              | 2,056,772 | 2,377,687 | 492,497,070 | 569,338,625 | 658,169,337 | 760,859,807 |

Source: Analysis results, 2021

Table 6 shows that along with the increase in population, the need for food also increases (in this context is rice). One of the policies that can be applied by the local government is to utilize the fields for rice production through a rainfed system so that it does not only use wet fields to plant rice. In order to obtain optimal results, it is necessary to conduct an assessment of the ability and suitability of the land to be
developed as agricultural land. This is to make sure that the cultivated land will not cause environmental damage. To identify the suitability of agricultural land for selected commodities can be done by analyzing the physical capabilities of the land based on the criteria [25].

In maximizing or optimizing agricultural production to increase food production, especially rice, it requires optimal use of resources and capital. Meanwhile, to increase capital resources with the aim of increasing productivity can be done by planting superior varieties of seeds, using organic and chemical fertilizers in a balanced manner thus environmental degradation will not occur, and monitoring the plants through pest control [6].

4. Conclusion

Agricultural Land Carrying Capacity (LCC) in the Karangsambung-Karangbolong Geopark area is in deficit. This means that the available agricultural land (SL) is lower than the required agricultural land (DL). These results indicate that the Geopark Karangsambung-Karangbolong area had not been able to achieve regional independence in food self-sufficiency. The increasing population is one of the factors that reduce the carrying capacity of the land. In increasing the carrying capacity of agricultural land, the necessary considerations are not only by suppressing the population, but also by paying attention to the condition of existing agricultural land and knowing certain methods or techniques so that agricultural land in the Karangsambung-Karangbolong Geopark area remains sustainable. Selection of farming commodities that are in accordance with the potential and suitability of the land can be done to increase the carrying capacity of agricultural land. Generally, the selection of this commodity is related to climatic factors such as rainfall, temperature and altitude and is also related to the physical, biological and chemical properties of the soil. However, success in achieving regional independence in food self-sufficiency also depends on mastering technology and its implementation on the biophysical and cultural conditions of local farmers. Therefore, the synergy between local governments and farmers is needed to increase agricultural production.

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