Carrying Capacity of Agricultural Land in Supporting Economy and Food Self-Sufficiency the Boti Tribe

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Abstract. This paper analyzes the carrying capacity of the Boti Tribe's agricultural land. The analysis of the carrying capacity of agricultural land is carried out to measure the risk and level of vulnerability of indigenous peoples with their choice of traditional farming techniques. This paper is the result of research conducted through mixed methods. The survey was conducted on 30 Boti Tribe families. The results showed that the carrying capacity of agricultural land in Boti Village had a value of <1 or very low. This value indicates that the people of Boti Tribe will find it difficult to achieve food self-sufficiency and achieve a decent living. The threat of food scarcity can occur during the dry season. This condition was anticipated by the pople of Boti Tribe through a communal food garden management strategy, in which they can store food to be used in an emergency.

Keywords: indigenous peoples, local wisdom, subsistence agriculture

1 Introduction

The carrying capacity of agricultural land is one of the important aspects in determining the sustainability of agriculture. In addition to agricultural sustainability, the carrying capacity of land is also an important aspect to determine the welfare of the community in a certain area. This is closely related to ensuring food needs as one of the important indicators of welfare [1], [2]. The carrying capacity of agricultural land is not a fixed quantity, but it changes over time due to technological and cultural changes. Population volume affects the reduced carrying capacity, land area and the percentage of farmers [2]. Meanwhile, it is possible to overcome the decrease in the carrying capacity of land through: 1) Land conversion, namely changing the type of land use towards a more profitable business but adapted to the area; 2) Land intensification, namely in using new technology in farming; 3) Land conservation, namely efforts to prevent land damage [2].

Self-sufficient areas must meet the physical needs of the population [2]. Areas that are able to provide a decent life for its population depend on areas of food crops that are able to meet the needs of the population at a decent level, which is equivalent to 650 kg of rice/person/year or 2,466 times KFM. The carrying capacity of agricultural land can be a significant tool in determining the vulnerability of tribal or indigenous peoples. This is related to the poverty dimension of indigenous peoples, which is the limitations of natural causes. This dimension relates to the vulnerability problems faced by indigenous or tribal communities, which are food insecurity and low agricultural productivity [3].

The carrying capacity of agricultural land is an important-aspects to determine the ecological carrying capacity of indigenous peoples' living areas. The Boti tribe is a tribal people living in Timor Island, an island in Central Indonesia. The Boti tribe lives in rocky areas in

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lowland forests. Its height reaches 400 meters above sea level [4]. The Boti tribe lives in the village of Boti. Boti Village is one of 13 villages in the Kie District area. Data from the Ministry of Villages and Development of Disadvantaged Regions in 2022 shows that out of a total of 13 villages in Kie District, 61% of them are classified as underdeveloped villages. Meanwhile, 30% of the remaining villages are developing, and 7.6% are highly underdeveloped.

The villages in the Kie District are known for producing superior food crops such as corn and cassava. The area of land used for corn cultivation is 4638 hectares with a total annual production of 13,914 tons. Meanwhile, the area of land used for cassava cultivation is 278 hectares with annual production of around 1390 tons. Other food crops produced in the villages of this region include: sweet potatoes, peanuts, green beans, and taro. The plantation crops that are mostly produced in this sub-district include coconut, cocoa and coffee. The plantation land used for coconut plantations is 647 hectares. Meanwhile for 18 hectares of cocoa and 13 hectares of coffee. Most of the people in Boti Village (99%) are farmers. As an agricultural village, land is a very important production factor for the Boti community. If the comparison between the area of agricultural land and the number of farmers is calculated, the agricultural density in Boti Village is categorized as quite low, which is around 22 people/km². Boti topography, as mostly in Timor Island, is dominated by dry land with low soil fertility and organic matter content [5]. Henceforth, the questions that will be answered through this research are: 1) How is the carrying capacity of agricultural land in Boti Village? 2) How does Boti Tribe's strategy adapt to the carrying capacity of its agricultural land?

2 Method and Materials

The research was conducted in Boti Village, Kie District, South Central Timor Regency, East Nusa Tenggara. The research was conducted in May 2022. The researcher used a mixed research design 'complementary research design'. Quantitative data and qualitative data are not only related to each other but are combined or combined to provide a better understanding of the ecological problems of the Boti indigenous peoples. The researcher used a mixed method because it considers the complexity of ecological problems and indigenous peoples which will not be sufficient if only explored from the aspect of the subject's perception. The quantitative approach was carried out through the survey method, while the qualitative approach was carried out through the observation and interview methods. The survey was conducted on 30 families of Boti Tribe.

The data analysis process is carried out separately starting with the separation between secondary data (document study) and primary data (field study). The data analysis stage begins with organizing the file, performing initial coding by reading the entire text and making margin notes, describing the case and its context, using categorical aggregation to form themes and patterns, conducting direct interpretation, developing naturalistic generalizations, and presenting an in-depth picture in illustrations.

3 Results and Discussion

3.1. The Boti Agricultural Economic

Most of the people in Boti Village (99%) are farmers. As an agricultural village, land is a very important production factor for the Boti community. If the comparison between the area of agricultural land and the number of farmers is calculated, the agricultural density in Boti Village is categorized as quite low, which is around 22 people/km². The total number of farmers

in Boti Village as a whole is 2,205 consisting of 1,067 male farmers and 1,138 female farmers. With this agrarian density, there is still enough agricultural land accessible to be managed or processed to produce food for the community. Low agrarian density has significant potential for farmers to develop adequate agricultural operations.

Unfortunately, the low agrarian density does not correspond to agricultural income. Agriculture business cannot be a reliable source of income. On-farm income is always much less than household needs or expenses, as can be seen in Table 1. The percentage of expenditure for both food and non-food items is much higher than the income from agriculture received by the two respondents. This shows that if the people of Boti Village only depend on agriculture, they will not be able to fulfill all their needs. Under these conditions, the community is in a very vulnerable condition if there is no other source of income.

Table 1. The Income Calculation of Boti Tribe

Respondent Profile No 11 (TS – 39 y'o)		Respondent Profile No 6 (YB -54 y'o)	
Expenses (per year)		**Expenses (per year)**	
Expenses on food ingredients (rice, side dishes, seasonings, cooking oil, noodles, sugar, cigarettes, tobacco, betel nut)	IDR. 4.884.000	Expenses on food ingredients (rice, side dishes, seasonings, cooking oil, noodles, sugar, cigarettes, tobacco, betel nut)	IDR. 4.128.000
Non-food expenses (electricity, water, transportation, education, health, clothing, social/home improvement)	IDR. 6.405.000	Non-Food Expenses (electricity, water, transportation, education, health, clothing, social/home improvement)	IDR. 8.130.000
Total expenses	IDR. 11.289.000	**Total expenses**	IDR. 12.258.000
Income (per year)		Income (per year)	
On-farm income	IDR. -	On-farm income (selling candlenut and tamarind)	IDR. 5.500.000
Off-farm income (farm labour)	IDR. 1.000.000	Off farm income	IDR. -
Non-farm income (Carpenter, motorcycle taxis, government assistance)	IDR. 17.200.000	Nonfarm income (government assistance)	IDR. 1.000.000
Total Income	IDR. 18.200.000	**Total Income**	IDR. 6.500.000
The difference between expenses and income	IDR. 6.911.000	The Difference between expenses and income	-IDR. 5.758.000

One of these vulnerabilities is highlighted as one of the triggering factors for indigenous peoples' poverty. Natural causes are important factor because extreme situations such as seasons or other natural conditions can cause high levels of food scarcity. In Boti tradition, not all food crops can be sold. Some food crops, such as corn and sweet potatoes, are only grown for their own consumption. Corn is used as a daily staple food, while sweet potatoes are used for livestock feeding (pigs).

Table.2 Distinguishing Between Food Crops for Subsistence and Commercial Needs

No	Type of plant	Allocation	
		Consumption	For sale
1	Corn	√	
2	Sweet potato	√	
3	Banana	√	
4	Coconut	√	
5	Tamarind		√
6	Hazelnut		√

Source: Primary data, 2022

Commodities or plants that are commonly sold by the public are candlenut and tamarind. These two types of plants are the mainstay of the agricultural economy of the Boti community. Tamarind is sold at a price of IDR 5000, 00 – IDR 8000, 00 per kg, meanwhile candlenut is sold at IDR 12,000 – IDR 20,000 per kg. One pecan harvest yields 500 kg or 0.5 tons, while one tamarind harvest yields 700 kg or 0.7 tons.

3.2. The Carrying Capacity of Boti Tribe's Agricultural Land

In relation to the fulfillment of human needs, the land capability is interpreted as an understanding of the carrying capacity of the land. The balance between the level of land use and the carrying capacity of the land is a measure of the feasibility of land use. However, if the land use has exceeded the carrying capacity of the land, the land use will be ineffective. The analytical technique used in determining the carrying capacity of agricultural land is used a mathematical formula from the combined concept of the theory of Odum, Christeiler, Ebener Howard, and Issard in Soeharjo and Tukiran (1990) in [2]. The calculation of the KFM value (Minimum Physical Needs) by converting human food needs expressed in calories to tons per year adjusted for the type of commodity. The type of commodity used for analysis is corn. Corn was chosen because it is the main food crop commodity and rice is not found in Boti Village. For 1 kg of corn 3,610 calories. Based on data from FAO and Permenakertrans No. 13 of 2012, the value of the community's KFM is 1,500 calories/day so that if it is calculated using the type of commodity, 1 kg of corn contains 3,610 calories, so that 1,500 calories is equivalent to 0.4155 kg of corn/day then the KFM in a year is 151,662 kg of corn/day. year (0.151662 ton/year) [6].

Table.3 Comparison of the Carrying Capacity of Agricultural Land in Kie District and Boti . Village

	Kie District	**Boti Village**
Harvested Area	10166 ha	10000 ha
Total population	21141	2199
KFM (Minimum Physical Needs)	151,662 kg/year	151,662 kg/year
Average Production Per hectare	3 ton/ha	3 ton/ha
Agricultural Land Carrying Capacity	0,008	0,089

Source: Processed from the secondary data, 2022

By using the classification of carrying capacity of agricultural land, it is seen that the carrying capacity of agricultural land at the sub-district and village levels shows a value of < 1 (less than one). This value refers to [7], which is referred to as an area that is unable to achieve food self-sufficiency and has not been able to provide a decent living for its residents. Table 3 demonstrates that one of the triggers this condition is the very low productivity of corn, which is around 3 tons/hectare. This result is below the national maize productivity of 6.4 tons/hectare. This low maize productivity, if explored further, can be seen from the thin corn cobs and the

relatively smaller use of non-hybrid maize varieties. According to the Boti community, these local corns are considered more resistant to pests and also do not require excessive care. Corn is simply planted in the fields and will be harvested when the time comes.

The use of very minimal fertilizer can be one of the triggers. Manure from livestock such as cows, which can be used for fertilizer, is just left on the roadside until it dries up. There is no visible use of these animal wastes to fertilize the soil or promote plant growth. Boti villagers feel that throwing this manure into the garden ruins the soil and will require even harder work for farmers in the following years.

According to the results of the carrying capacity of agricultural land analysis, Boti Village has a low carrying capacity of agricultural land, making it difficult to achieve food self-sufficiency and a decent living. In fact, this condition is also recognized by the community. The survey results show that the land managed by the Boti community is not sufficient for their needs. As seen in Figure 1, the majority of the population, 60% of population stated that their land could not always provide their food needs.

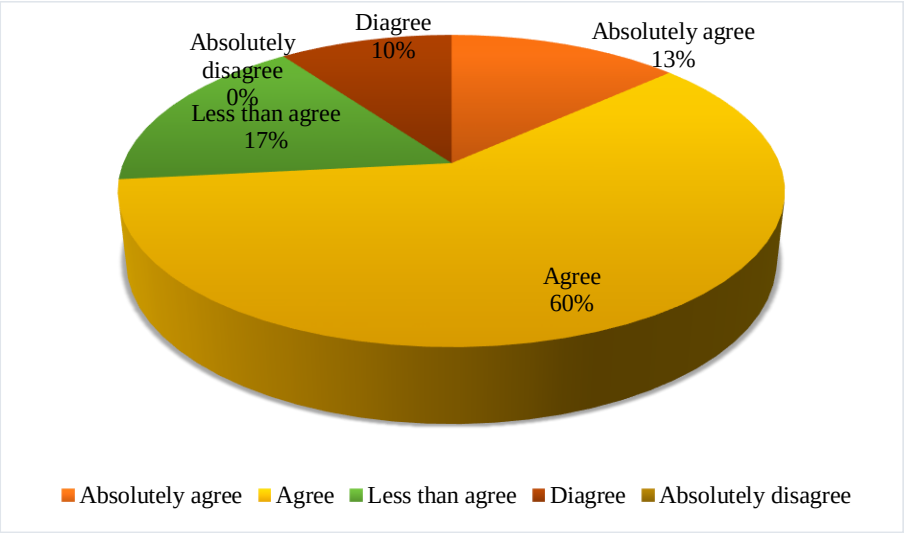

Fig.1. Land is always insufficient for Community Needs
Source: Data Survey, 2022

The symptoms of insufficient land that is managed by the community to meet this need have been realized from the decline in agricultural production in the last year's harvest. The decline in production occurred mainly in food crops. This condition is certainly a concern for the community itself. If this situation continues, it will certainly become a poverty trap for the community.

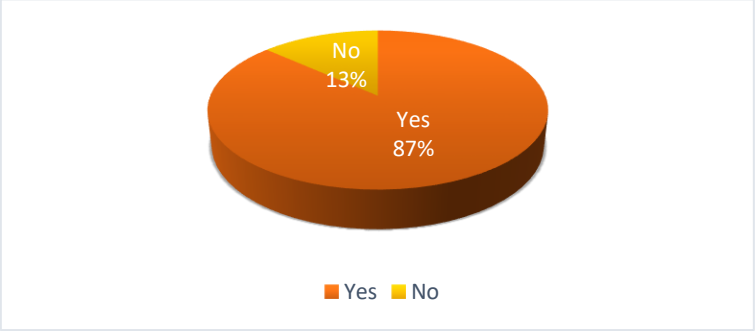

Fig.2. Occurrence of Production Decrease/Failure to Harvest in the Last One Year
Source: Survai Data, 2022

The decline in agricultural production was mostly or 82% due to seasonal changes. The lack of rainfall and wind are the main drivers of low yields. Yield reduction ranges from 50%-70%. The corn harvest which was originally able to get 40 *kuda* (bundled), dropped to 6 *kuda* (bundled). In addition to seasonal changes, soil fertility factors, drought, pest attacks and a lack of labor are also causing the decrease of crop yields even though in a small percentage.

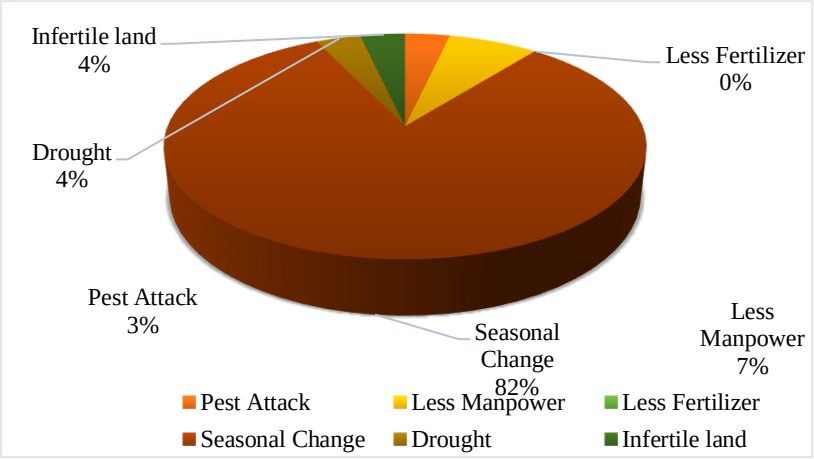

Fig.3. Causes of Decreased Production/Harvest Failure
Source: Data Survey, 2022

3.3. Food Autonomy Strategy for the Boti Tribe

The risk of food insecurity is a major threat to the Boti community. This condition seems to have been anticipated and managed well by the Boti community. There is local wisdom in addressing the limitations of natural causes. The local wisdom is a form of environmental wisdom that exists in social life in a place or area [8]. Local wisdom reflects the values or behavior of local people in interacting with the environment in which they live wisely. The concept of local wisdom is rooted in local or traditional knowledge and management systems. Mitigation of the risk of food insecurity is carried out through the communal garden system. The gardens with each Neighborhood Unit are known as *len lis*. The Boti tribe uses this local

wisdom to adapt to the environment. Values in local wisdom are the main capital in building the community's economy without destroying the social order and natural environment [9]. This wisdom has become a kind of guide that has been practiced for generations [10].

Len lis is located in each Neighborhood Unit can be half to one hectare in size. This *Len lis* will be carried out by every Neighborhood Unit resident who is considered to have productive energy. *Len lis* results in the form of corn, bananas and sweet potatoes are used to help the Boti community who experience crop failures and entertain guests who come to Boti Village. If the harvest of *len lis* in one year is abundant, this harvest will be sold and the finances are managed by the local Neighborhood Unit to help Boti tribe who are in need.

The harvested corn will be stored in *ume kbubu* in each Nieghborhood Unit. Furthermore, it is the responsibility of the Nieghborhood Unit to ensure that the fireplace in the *ume kbubu* remains lit to prevent the corn from being damaged. The harvested *len lis* in the form of corn that is left and stored in *ume kbubu* in the following year will be sold and the money will be used for the Nieghborhood Unit community.

The Boti community is careful in setting aside their harvest. In addition to the Neighborhood Unit (communal) food barn, each resident usually also has food storage at home. The survey results show that the community chooses to consume their own harvest. Meanwhile, about 35% of the harvest will be directly inserted or stored in the food barn or food storage area in their respective homes. Only 3% of the harvest is for sale. From this, it can be seen that the moral economy is the basic argument of the farmers' strategy. Safety first by maintaining household food sufficiency is an option in the midst of the ecological problems that they face. This strategy also shows the autonomy strategy of the Boti Tribe. Autonomy is basically a manifestation of farmer agency [11]. Agencies attach actors with the capacity to experience social processes and instruments for coping with life.

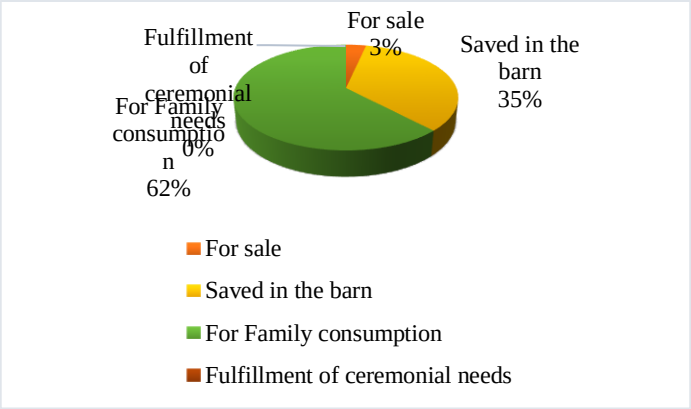

Fig.4. Allocation of Harvest Utilization for Food Crops
Source: Data Survey, 2022

4 Conclusion

The carrying capacity of agricultural land in Boti Village has a score of <1 or very low which indicates that Boti tribe will be very vulnerable to fall into the poverty trap if they do not have strong social security. Food self-sufficiency and a decent living have been realized because of the limited ecological character/nature causes.

The Boti Tribe anticipates the limited carrying capacity of agricultural land through their local wisdom in controlling the use and utilization of agricultural land. The Boti tribe has a communal garden system that ensures food needs for all members of the community. Through these communal gardens, vulnerabilities due to crop failure and low yields can be overcome. The Boti tribe develops community-based social security through a system of land redistribution and food redistribution. Through this local wisdom, they are able to maintain food sufficiency and even have autonomy by maintaining food self-sufficiency in the community.

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