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Future Food Security Challenges in Riau Province, Indonesia

Lucia Sandra Budiman*, Raden Roro Anna Dyah Retno Manuhoro, Unggul Widyanarko, and Aries Dwi Wahyu Rahmadhana

Geographic Information Science Study Program, Faculty of Science, Technology, Engineering, and Mathematics, Mahakarya Asia University, Yogyakarta, Indonesia

ORCID

Lucia Sandra Budiman: https://orcid.org/0009-0006-1842-1614

Abstract.

The food crisis is a real problem in various regions around the world, including Indonesia. This phenomenon is influenced by the rate of population growth which is increasing while farmlands are depleting due to the conversion of land into settlements, especially in Riau Province which is experiencing food security threats. Food security projections are made to provide an overview of the future condition of food security in Riau Province to support sustainability. The basic data used are data for 2018 and 2019. The measurement method used is the scenario method and then the availability calculation method according to Minister of Agriculture Regulation Number 43/Permentan/OT.140/7/2010. Meanwhile, the calculation of food needs uses a formula taking into account the average consumption per capita per year from the regional agriculture service multiplied by the population in the year concerned. Then, the projections are measured using the arithmetic population growth formula approach for food availability and the geometric population growth formula for the food needs of the population. The food commodity in Riau Province used in the analysis is rice. The calculation results show that in the future food availability in Riau Province will not be able to meet its food needs.

Keywords: availability of rice, rice needs, food security

Corresponding Author: Lucia Sandra Budiman; email: luciasandrabudiman@unmaha.ac.id

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1. Introduction

Food crises are starting to occur in various regions throughout the world. This phenomenon is influenced by the rate of population growth which is increasing every year while land for food crops tends to become scarce due to land being converted into residential areas for people to live in. This increase in population must be balanced with the availability of food to create stable food security for a country [1]. Therefore, all people throughout the world need to be aware of this condition. More importantly, policy makers must include these indicators to determine related policies. The analysis that needs to be carried out by each region is a food security analysis. Thus, it is necessary

to calculate the availability of food in an area and also the food requirements needed by an area.

Several studies have been carried out to calculate food needs. Previous studies carried out projections of food needs in Bali Province for 2021-2025 [2]. Food production is estimated using exponential projections, while food needs are estimated using population growth projections. Another previous studies carried out projections of food needs in Purworejo Regency for 2018-2030 [3]. Food needs are estimated using projections at the sub-district level. The research carried out produced information on the distribution of food needs at the sub-district level.

Based on two previous studies, this study tries to project food needs by including spatial distribution. So, we can know which areas are priorities in meeting food needs. The method of projecting food needs and availability will be applied in Riau Province. The unit of analysis used is the district. So, it can be seen which districts are priorities in meeting food needs.

Each region will have its own food security strategy to adapt the superior commodities of each region. In Indonesia, because the main food commodity is rice [4], the land that must be developed is rice farming land. However, several regions in Eastern Indonesia also have superior commodities other than rice, including sago, which is also developed to meet the food needs of their people. By paying attention to each potential superior commodity, the food balance for a particular commodity can be measured. Furthermore, food security projections for certain commodities in an area can be calculated. Food security projections can be used as a picture of the future condition of a region's food security so that regional policies that will be implemented can be adjusted and determined appropriately to support sustainability.

2. Methods

The analysis carried out in this paper is an analysis of food availability and needs in Riau Province. The basic data used is data for 2018 and 2019. The measurement method used is the availability calculation method according to Peraturan Menteri Pertanian Nomor 43/Permentan/OT.140/7/2010 [5].

Paddy Availability (Pnet)= P – (s+f+w) (1)

Information:

P = Rice production

s = Grain shrinkage for seeds

f = Depreciation of grain for animal feed

w = Depreciation of grain for the scattered ones

Availability of Rice (Rnet)= C x Pnet (2)

Information:

C = Determination of paddy to rice conversion

Pnet = Rice Availability

Meanwhile, food needs are calculated using the formula:

Food Needs = Average per capita consumption per year × Population (3)

Next, the food balance / Rice Balance is calculated using the formula:

Rice Balance = Rice Availability – Rice Needs (4)

Furthermore, if the figures for availability and need in 2018 and 2019 are known, then the projections are measured using the arithmetic population growth formula approach for food availability and the geometric population growth formula for population food needs to calculate projections until 2030. Food commodities in Riau Province used in analysis, namely the rice commodity.

The arithmetic formula (assuming that the population is always the same each year) is as follows.

Pn = P0 {1 + (r.n)} (5)

Information:

Pn = Population after the next n years.

P0 = Population in the initial year.

r = Population growth rate.

n = Time period in years.

Calculating the population using a geometric formula uses the basis of compound interest for population growth (compound interest) as follows.

Pn = P0 (1 + r)n (6)

Information:

Pn = Population after the next n years.

P0 = Population in the initial year.

r = Population growth rate.

n = Time period in years.

The amount of rice needed for a particular year is calculated by multiplying the amount of rice consumption per capita by the population in that year. Food projections are calculated by subtracting rice production from the rice demand for a particular year. If the resulting number is negative, it is said that the area's food condition is experiencing a deficit or deficiency. On the other hand, food conditions are said to be surplus if the food projection figure is positive.

3. Results and Discussions

Land has an important function for the community as life support for livelihoods and as a home for the community. Land for farmers is a source of livelihood to produce food and sustain life for the benefit of many people. According to private parties or entrepreneurs, land is a barn for collecting and circulating capital. According to the government, land is proof of a country's sovereignty and is useful for supporting people's welfare. In the Law of the Republic of Indonesia [6] concerning the protection of sustainable food agricultural land, it is stated that agricultural land is land used for agricultural businesses, apart from rice fields and moorland, also all plantation land, ponds for fisheries, land for livestock grazing, land thickets of former fields and forests which are a place of livelihood for those who are entitled to it. The large number of people involved in land in an area with their own interests in land use, causes conflicts of interest to occur.

3.1. Rice balance sheet analysis

Management of paddy fields is basically land that requires water in the processing process. Thus, rice fields generally have a flat surface and have barriers in the form of embankments which function as barriers to standing water [7]. The resources found on agricultural land provide various benefits for human life and the surrounding environment. The function of agricultural land is divided into two categories including; first, use value which is income from natural resource exploitation activities and also agricultural activities that run on available agricultural land resources, second, innate benefits or what can be called intrinsic values, where benefits are created independently of the desires or objectives of the exploitation and use of the land [8]. Therefore, food security projection scenarios are needed to achieve better food security through agricultural policy planning, where the intended food projection scenarios are in the form of estimates or descriptions of how food production, distribution and consumption

may develop in the future. The results of the rice balance calculation per district/city in Riau Province in 2018 show that each region experienced a deficit which can be seen on the map in Figure 1 and Table 1.

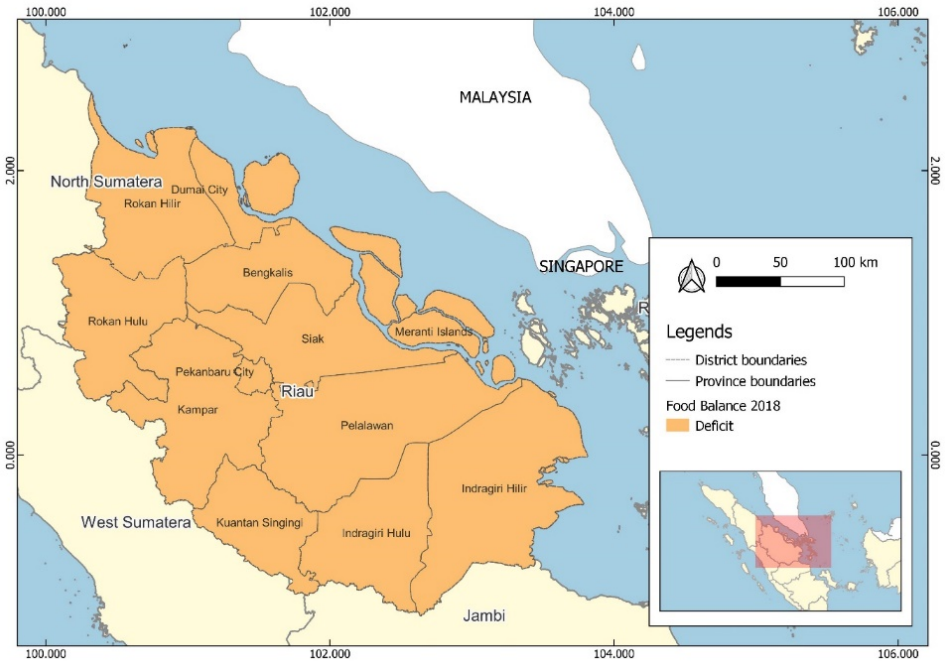

Figure 1: Food balance of Riau in 2018.

TABLE 1: Rice balance per regency/city in Riau Province in 2018.

Regency/City	Availability of Rice	Rice Needs	Rice Balance Sheet	Information
Kuantan Singingi	26.900.951	29.002.254	-2.101.303	Deficit
Indragiri Hulu	7.180.109	38.793.342	-31.613.233	Deficit
Indragiri Hilir	64.787.789	65.387.160	-599.371	Deficit
Pelalawan	14.898.344	41.193.732	-26.295.388	Deficit
Siak	18.588.008	42.703.698	-24.115.690	Deficit
Kampar	20.206.509	76.154.496	-55.947.987	Deficit
Rokan Hulu	7.931.598	59.577.054	-51.645.456	Deficit
Bengkalis	7.766.565	50.620.962	-42.854.397	Deficit
Rokan Hilir	41.037.197	62.331.468	-21.294.271	Deficit
Kepulauan Meranti	5.943.541	16.482.678	-10.539.137	Deficit
Pekan Baru City	0	99.891.984	-99.891.984	Deficit
Dumai City	64.244	27.114.126	-27.049.882	Deficit
Riau Province	215.304.863	609.252.954	-393.948.091	Deficit

The results of rice balance calculations per district/city and even provincial data in Riau Province show deficit results. Thus, there has been a food crisis in Riau Province since 2018. This condition is very worrying and there is a need for a food security policy to overcome this problem. The same results also occurred in the 2019 calculations which are presented on the map in Figure 2 and Table 2.

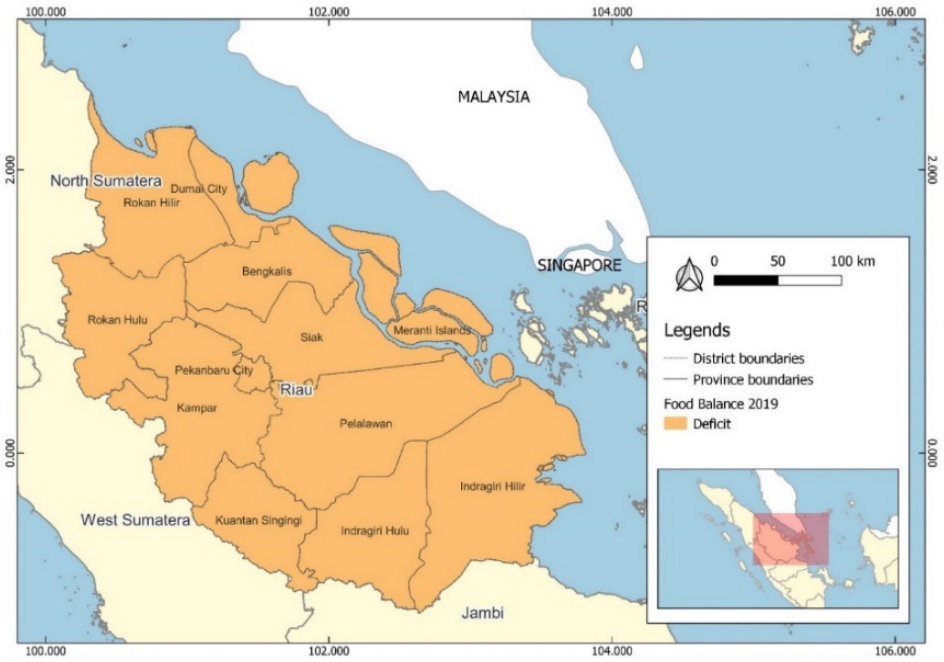

Figure 2: Food balance of Riau in 2019.

Similar to 2018, the rice balance per district/city in Riau Province in 2019 also showed a deficit. Because there has been a food crisis since 2018, 2019 is even worse. This condition shows that there is still no policy to overcome this problem. The population continues to increase even though consumption power is decreasing, but the lack of rice production is the main obstacle.

3.2. Analysis of trends in rice availability and demand in Riau Province

Trends in availability vs. demand in Riau Province, projection data for 2018-2030 can be observed in Figure 3. Based on Figure 3, It can be seen that since 2018 the demand for rice has been quite far above the availability of rice. Conditions like this indicate a deficit where the results are the same as the calculations carried out previously. The trend in the availability of rice in Riau Province in 2018-2030 can be observed to have experienced a quite sharp decline. This is caused by the amount of production not

Table 2: Rice balance per regency/city in Riau Province in 2019.

Regency/City	Availability of Rice	Rice Needs	Rice Balance Sheet	Information
Kuantan Singingi	11.388.295	29.131.480	-17.743.185	Deficit
Indragiri Hulu	4.622.388	39.319.310	-34.696.922	Deficit
Indragiri Hilir	41.340.003	65.913.400	-24.573.397	Deficit
Pelalawan	9.958.857	43.042.180	-33.083.323	Deficit
Siak	16.675.513	43.610.000	-26.934.487	Deficit
Kampar	5.639.297	77.529.680	-71.890.383	Deficit
Rokan Hulu	6.929.548	61.598.680	-54.669.132	Deficit
Bengkalis	12.716.049	50.997.000	-38.280.951	Deficit
Rokan Hilir	23.314.939	63.590.500	-40.275.561	Deficit
Kepulauan Meranti	2.848.951	16.511.280	-13.662.329	Deficit
Pekan Baru City	783	101.759.040	-101.758.257	Deficit
Dumai City	643.227	27.484.090	-26.840.863	Deficit
Riau Province	136.077.856	620.485.750	-484.407.894	Deficit

increasing but instead tending to decrease. In fact, the trend in demand for rice in Riau Province in 2018-2030 actually shows an increasing trend, although it is not as drastic as the decline in its availability. The increase in demand is caused by the continuing increase in population every year, although there is a decrease in the number of rice consumption per capita per year by 0.4% per year, but because the population continues to increase, it is still experiencing an upward trend.

This condition shows that the food crisis, especially rice commodities, occurred in Riau Province even from 2018 to 2030. The crisis was marked by a deficit that occurred. The government must focus more on handling this food crisis. So far, the government's strategy in overcoming this problem has been to rely on rice supplies from nearby surplus areas, including [9]. This solution cannot continue to be relied on so the results of this calculation should be able to become a more serious policy benchmark in overcoming the food crisis in Riau Province. One of the efforts that the government has made quite well is providing 30,000 Ha of land to support the central government's food security program in Riau Province [10]. This policy is expected to be able to overcome food security problems in Riau Province.

Food security analysis can then be carried out on a district/city scale through the results of calculations of projected availability vs. demand for rice per district/city in

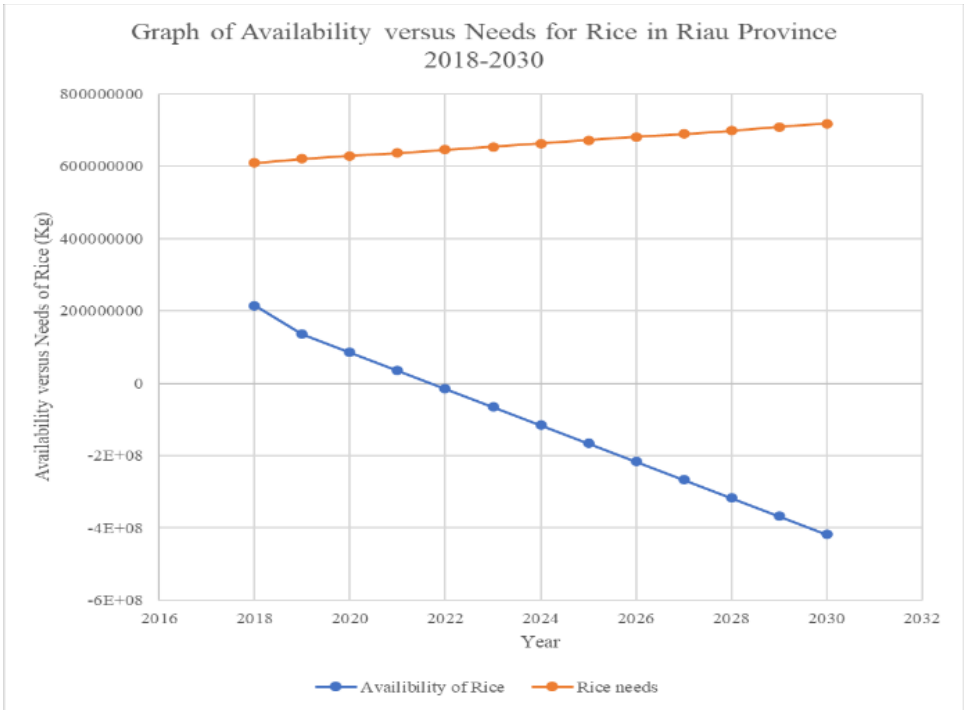

Figure 3: Trends in availability vs. demand for rice in Riau Province 2018-2030.

Riau Province for 2018-2030. The projected results of rice availability vs demand per district/city in Riau Province for 2018-2030 are presented in Figure 4. Trends in availability vs demand for rice from projections per district/city show that the trend is the same as provincial data where demand tends to increase while availability continues to decline. However, there are also trends such as what occurred in Indragiri Hilir Regency where initially the needs and availability were almost the same and there was not much of a deficit, but the trend that occurred was that the deficit was getting bigger every year. This area shows the potential to increase more resilience because the difference in 2018 is not large, but if it is not utilized it could be a lost opportunity.

An area of great concern is Pekanbaru City, the capital of Riau Province. This is because in 2018 the production output was 0 kg while the population was highest in Riau Province. Thus, this area has absolutely no food security and in 2018 it relies 100% on supplies from surrounding places which are surplus. Therefore, it is necessary to provide land and a system to increase productivity so that production continues to increase. These results raise the assumption that food security is threatened by population pressure where more and more people are reducing agricultural land and agricultural production.

If an area is unable to support and meet the needs of the population, there will be pressure which will result in the population having to move to another area or look for

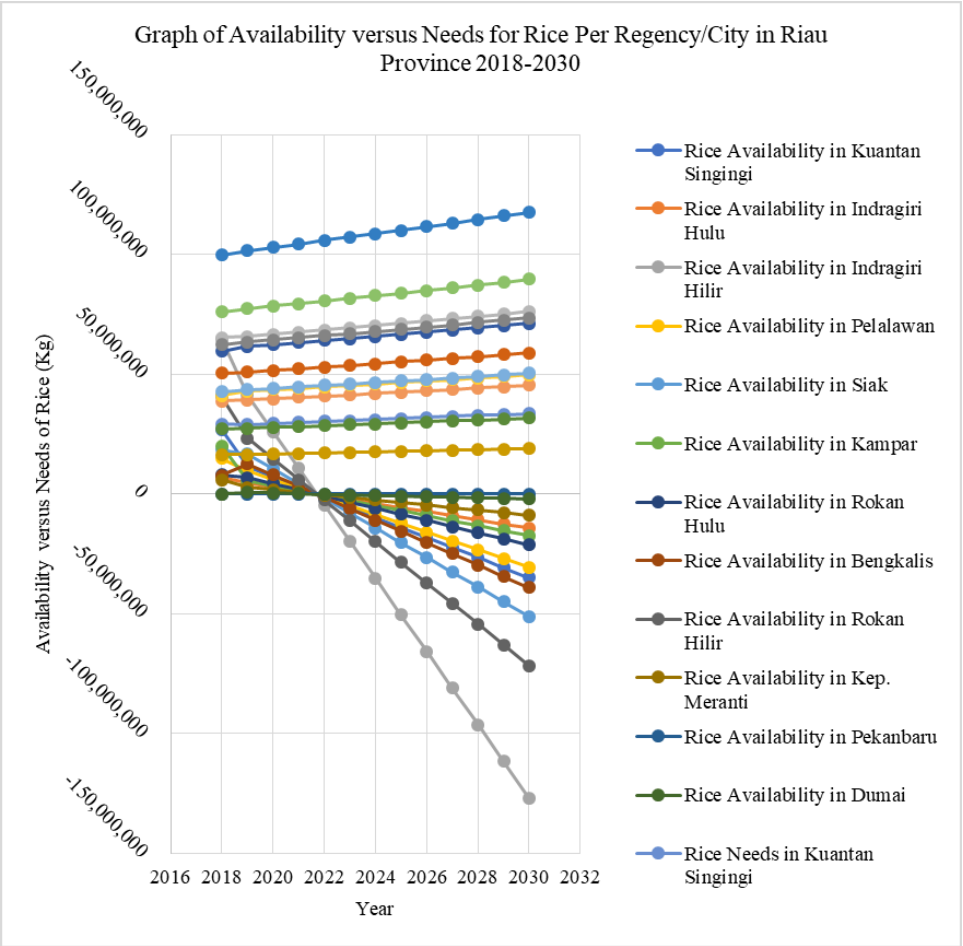

Figure 4: Trends in availability vs. demand for rice per regency/city in Riau Province 2018-2030.

new work outside the agricultural sector [11]. Population pressure is an encouragement to clear land or/and to go to the city [12]. The reality of population pressure is a complex problem experienced by the population in obtaining a decent life [11]. This is influenced by population density which continues to increase in a region which is not balanced by the region's ability to support and provide a decent life for the population.

Furthermore, population pressure is a symptom characterized by overpopulation in an area, considering the availability of existing land resources to meet the population's needs. In connection with carrying capacity, population pressure figures will increase when the area has a population that exceeds the carrying capacity value of the land [13]. Population pressure figures are actually the impact of population growth rates which continue to increase all the time. When the absolute population continues to increase, while land area and productivity remain constant, it is certain that land will experience pressure on population activities, especially residents who are dependent on land, where more and more land is needed and is even experiencing degradation.

Population pressure was caused by population growth in rural areas which resulted in a decrease in the land to population ratio (man land ratio) [12]. This is what encourages farmers to expand their cultivated land or work outside the agricultural sector. If there is still agricultural land, it is not too much of a problem, but if there is no agricultural land, it will ultimately lead to structural unemployment. Structural unemployment occurs when jobs migrate from an old job to a new job, but the perpetrators are not ready to adapt to the new job opportunity environment. Population pressure is divided into two types, namely absolute population pressure and relative population pressure.

Analysis of food security through calculating availability and needs needs to be carried out routinely and using real data to make it more accurate. The use of projections is only as a prediction of the situation to plan appropriate policies. Policy evaluation should also be carried out regularly to improve or select successful programs to continue and can even be used in other areas with similar problems. In this way, Riau Province's food security can increase for the sustainability of future generations.

The study of population and natural resources and the environment has important meaning. The use of natural resources and the environment by the population, if they do not pay attention to their characteristics, will result in a decline in the quality of natural resources and the environment [14]. Natural resources and the environment are dynamic, both in quantity and quality, and changes in natural resources and the environment experience a transitional period from being initially dominated by nature, then dominated by humans [15]. Limited resources, especially agricultural land resources, greatly influence household resilience patterns and strategies [16]. Household resilience as the level of ability of rural households to maintain the continuity of meeting consumption needs and the continuity of the production process [17].

The influence of land area, planting intensity and productivity on the growth of lowland rice production in Indonesia in the period 1980-2001 [18]. The results of this research concluded that planting intensity has an important role. Land area and productivity tend to decline in growth. This proves that fluctuations in the use of total production do not have a significant effect on the rate of production growth. In other words, there has been a levelling from productivity. Land quality is assessed based on influencing land characteristics. Land quality can be a limiting factor if it does not or can barely meet the requirements to obtain optimal production in the management of a particular land use.

Land characteristics are different from land quality. Land characteristics are land parameters used to determine land quality. A land characteristic can influence the

quality of other land but cannot influence the quality of the land. Land characteristics are generally not used directly in land resource evaluation activities, while land quality can sometimes be measured directly. Even so, only two or three land characteristics in a group are described [19].

The capability and suitability of land in terms of carrying capacity, where from the comparison between the carrying capacity of the land (supply) and its useful value (demand) its feasibility can be assessed [20]. A mismatch between land carrying capacity and land use will result in inefficiency. This is because the level of utilization is still far below the carrying capacity of the land. The function of human burden is not only population size but also per capita consumption. Furthermore, there are trade and industrial development factors. One thing that needs to be noted is that technological innovation does not increase the carrying capacity of the region but plays a role in increasing the efficiency of using natural resources.

Based on the results of the rice balance projection calculations in Riau Province, it appears that there are challenges in increasing food security. The ratio of insufficient rice availability to meet rice needs is also a food security challenge in Riau Province that needs to be considered. Government policies in limiting population and preventing conversion of agricultural land are important. Development of commodities other than rice, or food diversification, is also needed [21]. When planting commodities, it is necessary to pay attention to the appropriate soil type. The use of natural resources needs to pay attention to environmental sustainability so that balance is maintained.

4. Conclusion

Food security calculations in Riau Province show that this province experienced a food deficit in 2018 and 2019. All districts in Riau Province have rice availability that is lower than their needs. Food security projections for 2018-2030 show that the food deficit will continue to increase. This food deficit is partly caused by population pressure. The increasing population, with agricultural production tending to stagnate, will unbalance the food balance. To overcome the food deficit, it is necessary to implement policies related to increasing food security. Some policies that can be implemented include limiting the conversion of agricultural land, controlling population, and increasing agricultural land productivity.

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