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Analysis Of the Sufficiency of Paddy Production to Fulfill the Needs of the Population in Padang City Year 2020 to 2025

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ABSTRACT
This study aims to see; changes in the use of agricultural land (rice fields), population growth, the carrying capacity of lowland rice agricultural land to meet the food needs of the Population, and projecting food needs (rice) for the residents of Padang City from 2020 to 2025 as well as analyzing the level of food sufficiency (rice) based on land change patterns agriculture, then see how the growth rate of food production and population growth rate in the city of Padang. The research method used in this research is descriptive quantitative. Spatial data is processed by Geographic Information Systems (GIS), and demographic formulas process population data. The land's carrying capacity is obtained from the comparison between available land, production, and Population. The results of this study indicate the shrinkage of the agricultural land area of 100.86 ha/year. The most extensive agricultural land depreciation range occurred from 2010 to 2011. The population growth ratio of Padang City between 2000-2010 was successfully reduced to 1.57 per year, with a population increase of 112,779 people or 15.64%. The population growth of Padang City is in the range of 1.57 and is not supported by the growth of lowland rice production. In 2025, the city of Padang is still classified as a class III region ($\sigma < 1$) or an area that has not been able to meet its own food needs (self-sufficiency). Land shrinkage and a decrease in harvested area and productivity have caused the carrying capacity of paddy fields in Padang City to continue to decline.

INTRODUCTION

Food is an essential basic human need for residents of a country. In Indonesia, food security is one of the most important topics. (Handani et al., 2017; Sawitri et al., 2018). The United Nations Food and Agriculture Organization (FAO) explains that food security is a condition in which all people can obtain safe and nutritious food to live a healthy and active life (Syarief et al., 2017).

The 1945 Constitution has mandated that the state is obliged to exercise food sovereignty and strive to fulfill food needs for the Population (Rosyadi &z Purnomo, 2012; Bariyanti et al., 2018). This obligation includes ensuring the availability, affordability, and fulfillment of food consumption that is sufficient, safe, quality, and nutritionally balanced (U.U. RI No. 7 of 1996 concerning food).

Food security reflects a country's socio-economic conditions (Anandhiya et al., 2021). Food availability must be appropriately managed so that food production is distributed and available in sufficient and stable quantities for the community from time to time (Sawitri et al., 2018). Furthermore, improving food security must be accompanied by community participation and facilitation from the central and regional governments (Rusdiana & Maesya, 2017).

Rice fields are the primary producer of food, especially rice. The availability of relatively narrow paddy fields will result in a chronic food deficit (Ritung, 2010). BPS RI 2018 data shows a significant decrease in

Indonesia's specific area of rice fields (Marinda et al., 2020).

In general, West Sumatra is an area traversed by the Bukit Barisan Mountains, part of the Mediterranean Mountain Circum. Geology and volcanic soil with sufficient rainfall have caused the West Sumatra region, including the city of Padang, to have fertile land and soil. Based on the 2013 Agricultural Census figures, 19, 602 agricultural businesses in Padang City are managed by households, agricultural companies with legal entities manage 8 (eight) units, and 7 (seven) units are managed by other than households and legal entities. Koto Tangah, Kuranji, and Pauh are the three sub-districts with the highest order having the highest number of agricultural business households.

In terms of Population, based on the population censuses (S.P.) in 2000 and 2010, Padang City has a population of more than 850,000. With a population growth rate of 1.57 (BPS, Padang in Figures 2010). On the other hand, the city of Padang as a center for education, trade, and city center activities makes the high population size accompanied by the growth rate of residential land from time to time. Urban pressures affect the sustainability of paddy fields and irrigation systems (Yuhendra, 2010). In addition to the pressure factor on the environment, including agricultural land, another thing that is no less important and needs to be observed from population growth is the direct proportionality of births with the need for food, especially rice. The size of the Population is directly related to the provision of food (Khairati & Syahni, 2016). Then, the increase in Population will undoubtedly increase the number of food needs in an area (Ismail, 2018; Pujiati et al., 2020).

Under these conditions, it is essential to conduct an in-depth study of population growth and its impact on changes in land use, primarily the depreciation of agricultural land, increased agricultural production, and demand growth, as well as projections of future needs. Food shortages can not only have an economic impact but can also threaten social security (Rachmaningsih & Priyarsono, 2012). Land suitability and land carrying capacity are essential considerations for the sustainable use of regional space (Sillia & Yuliastuti, 2020).

The purpose of this research is to describe; the changes in agricultural land (paddy fields) in the city of Padang, population growth in the city of Padang in the period 1990 to 2010 and 2015, and the carrying capacity of lowland rice agricultural land to meet the food needs of the Population in the city of Padang, as well as projecting the need for food (rice) for the residents of the town of Padang in 2020 and 2025 and analyze the level of food sufficiency (rice) based on changes in agricultural land patterns, food production growth rates, and population growth rates.

Researchers are interested in studying the adequacy of lowland rice production to meet the Population's needs in the city of Padang because there has been no research examining rice production with a comparison of the Population in the city of Padang. In addition, this study also analyzes paddy fields' carrying capacity to meet the Population's food needs. Then, projecting food needs in Padang City from 2020 to 2025.

RESEARCH METHODS

This research was conducted in the city of Padang, West Sumatra Province. Geographically, Padang City is located between $00^{0}44'00''$ and $1^{0}08'35''$ South Latitude and between $100^{0}05'05''$ and $100^{0}34'09''$ East Longitude (Figure 1). The data used in this study are secondary data obtained from relevant agencies (Table 1).

Table 1. Data types and data sources

Data	Data Type	Source
Total Population	Secondary data	Padang city statistical center
Land Use	Secondary data	Landsat image
Data on lowland rice production	Secondary data	Department of Agriculture

Source: Research Results, 2018.

Figure 1. Research location in Padang City

The data used include Total population of Padang City in 1990, 2000, and 2010, land use maps of Padang City in 1990, 2000, and 2010 then data on lowland rice production in Padang City. Data were analyzed using descriptive methods, spatial data analysis using Geographic Information Systems (GIS), and population data were analyzed using demographic formulas.

To find out the area of paddy rice farming land can be obtained from the land use of the research area by:

a. Analysis of two land-use maps of Kuranji Subdistrict, Padang City, in 2002 and 2012 using Arc GIS 10.1 to determine the pattern and distribution of land use in the research location.
b. An analysis of the land use map was carried out, so the map results on rice fields in Kuranji District, Padang City, in 2002 and 2012 were obtained.
c. Overlay map of rice field area in Kuranji sub-district, Padang City in 2002 and 2012, using Arc GIS 10.1 analysis tool.
d. To find out the changes in the area of lowland rice farming in Kuranji District, Padang City, an analysis of the map on the size of lowland rice farming was carried out. Meanwhile, to remove the attribute data was analyzed with Arc GIS 10.1.

The carrying capacity of lowland rice farming uses the formula from (Muta'ali, 2012). In particular, the carrying capacity of the agricultural sector is obtained from a comparison between the available land and the number of farmers, so the data that need to be known are harvested area, Population, and physical needs. Minimum and average land production per hectare (Muta'ali, 2012; Muta, 2013).

Calculation of the carrying capacity of agricultural land using the following formula.

$$\tau = \frac{\text{Lp/Pd}}{\text{KFM/Pr}}$$

Explanation:

τ : Carrying Capacity of Rice Field Agricultural Land (ha/person)
Lp : Rice Field Harvest Area (Ha)
Pd : Number of Population (people)
KFM : Minimum physical requirement (kg)
Pr : Average Land Production/Hectare (kg)

The value of Minimum Physical Needs (MPN) is a value that shows a person can

generally live so that he can work to fulfill his life. For this reason, food is needed as a basic human need.

a. Class, I σ > 2,47: An area that can be self-sufficient in food and provide a decent life for its inhabitants.
b. Class II 1 ≤ σ ≤ 2,7: Regions that can be self-sufficient in food but have not been able to provide a decent life for their residents
c. Class III σ < 1: Regions that are not able to be self-sufficient in food

RESULTS AND DISCUSSION

Analysis of the Sufficiency of Paddy Production for the Needs of the Residents in Padang City

1. Paddy rice farming land change

The results of processing satellite image data with the Geography Information System (GIS) system with Arc GIS 10.1 software found that in the period 2010 to 2015, there had been a decrease in agricultural land of 504.3 ha from 6,605.4 ha in 2010 to 6,101.1 Ha in 2014. With a calculation like this, it can be stated that there is a shrinkage of agricultural land covering an area of 100.86 ha/year. The increasing demand for land for non-agricultural activities will eventually lead to the conversion of agricultural land (Rokhmah, 2012). The imbalance between population growth and increased food production dramatically affects the state of the environment (Hartanti et al., 2013).

The most significant depreciation of agricultural land occurred between 2010 and 2011, during this period, the paddy fields decreased from 6,605 ha to 6,284.6 ha or decreased by 320.4 ha. While the last two years (2013-2014), this depreciation value decreased from 6,166.7 ha to 6,101.1 ha or decreased by 65.6 ha. This is in line with Setiadi's research where the conversion of paddy fields in Indonesia began to look significant in the 1990-2000 period, marked by the rate of decline on a national scale of 78,184 hectares per year (Setiadi et al., 2021).

Details on changes and depreciation of agricultural land in Padang City between 2010-2014 can be seen in the following table and figure:

Table 2. Changes in paddy farmland in Padang City 2010-2014

Districts	Year Land area (ha) 2010	2011	2012	2013	2014	Land Change 2010 to 2014 (Ha)	Average Change (Ha)
Bungus Teluk Kabung	848,3	835,8	26,8	825,5	824,9	- 23,4	-4,68
Lubuk Kilangan	516,6	472,3	471,6	470,5	470,5	- 46,1	-9,22
Lubuk Begalung	431	397,9	386,9	379,6	370,2	- 60,8	-12,16
Padang Selatan	16,1	16,1	15,1	14,8	14,8	-1,3	-0,26
Padang Timur	107,8	98,8	99,3	98,4	96,9	-10,9	-2,18
Padang Barat	0	0	0	0	0	0	0
Padang Utara	20,5	19,1	17,1	16,9	16,4	-4,1	-0,82
Nanggalo	254,1	237,6	234,8	234,8	223,7	-30,4	-6,08
Kuranji	1.653	1.604	1.552	1.543	1.525	-128	-25,6
Pauh	998	963	958,7	955,2	952,7	-45,3	-9,06
Koto Tangah	1.760	1.640	1.628	1.628	1.606	-154	-30,8
Kota Padang	6605,4	6284,6	6190,3	6166,7	6101,1	-504,3	-100,86

Source: Research Results, 2018.

Based on the table above, Koto Tangah and Kuranji sub-districts are the two sub-districts that experienced the most significant shrinkage of agricultural land. In 2010 the area of agricultural land in the Koto Tangah sub-district was 1,760 ha, decreasing

to 1,606 ha in 2014 or reduced by 154 ha, equivalent to 30.8 ha/year. Meanwhile, in the Kuranji sub-district, paddy fields were reduced from 1,653 ha (2010) to 1,525 ha (2014) and 128 ha. Furthermore, the change in land area of rice fields can be seen more clearly in the following figure 2.

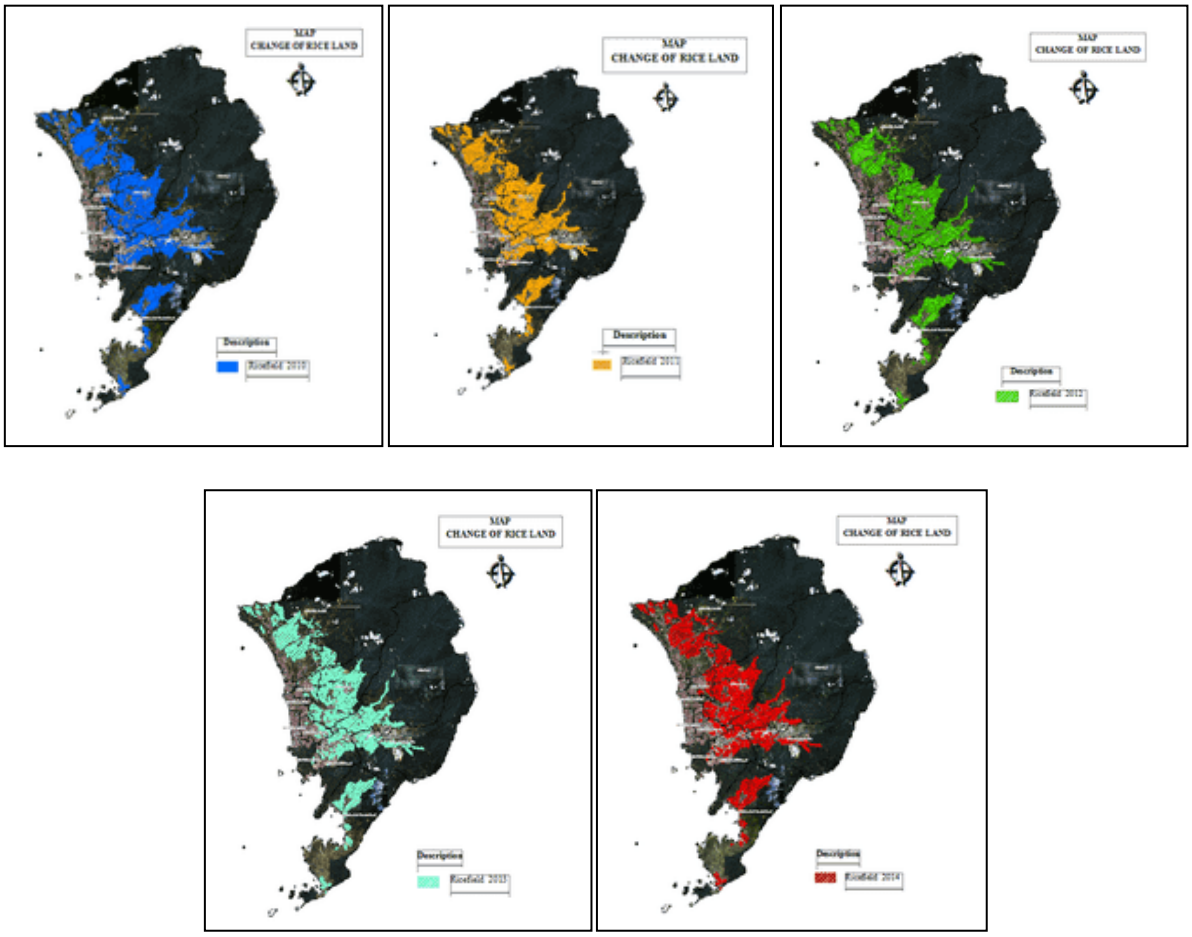
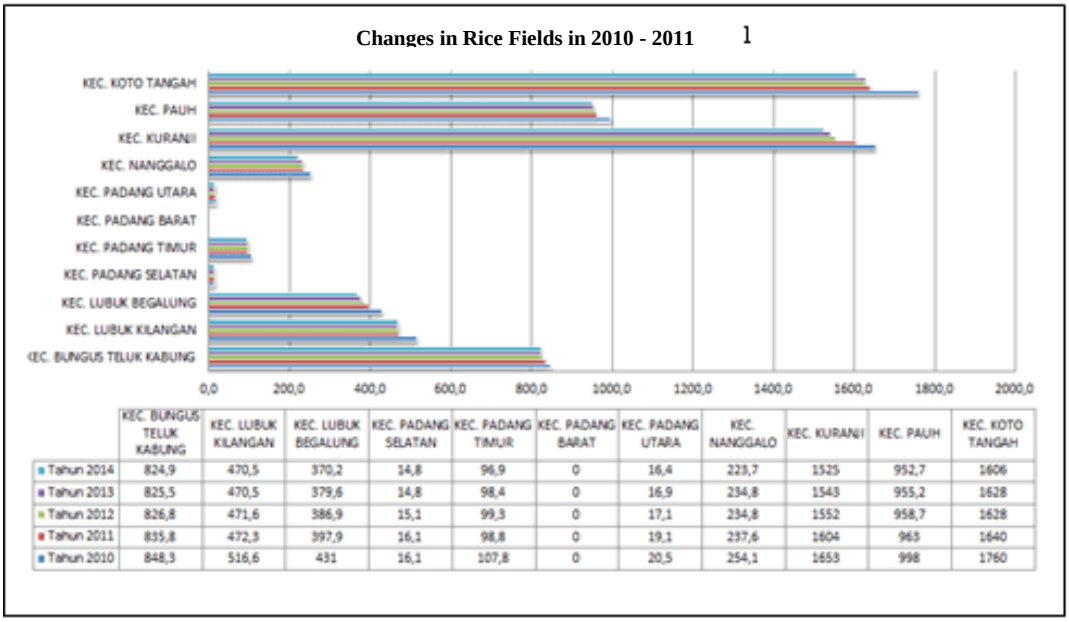


Figure 2. Map of changes in paddy field area of Padang City 2010-2014



	KEC. BUNGUS TELUK KABUNG	KEC. LUBUK KILANGAN	KEC. LUBUK BEGALUNG	KEC. PADANG SELATAN	KEC. PADANG TIMUR	KEC. PADANG BARAT	KEC. PADANG UTARA	KEC. NANGGALO	KEC. KURANJI	KEC. PAUH	KEC. KOTO TANGAH
Tahun 2014	824,9	470,5	370,2	14,8	96,9	0	16,4	223,7	1525	952,7	1606
Tahun 2013	825,5	470,5	379,6	14,8	98,4	0	16,9	234,8	1543	955,2	1628
Tahun 2012	826,8	471,6	386,9	15,1	99,3	0	17,1	234,8	1552	958,7	1628
Tahun 2011	835,8	472,3	397,9	16,1	98,8	0	19,1	237,6	1604	963	1640
Tahun 2010	848,3	516,6	431	16,1	107,8	0	20,5	254,1	1653	998	1760

Figure 3. Graph of changes in rice field

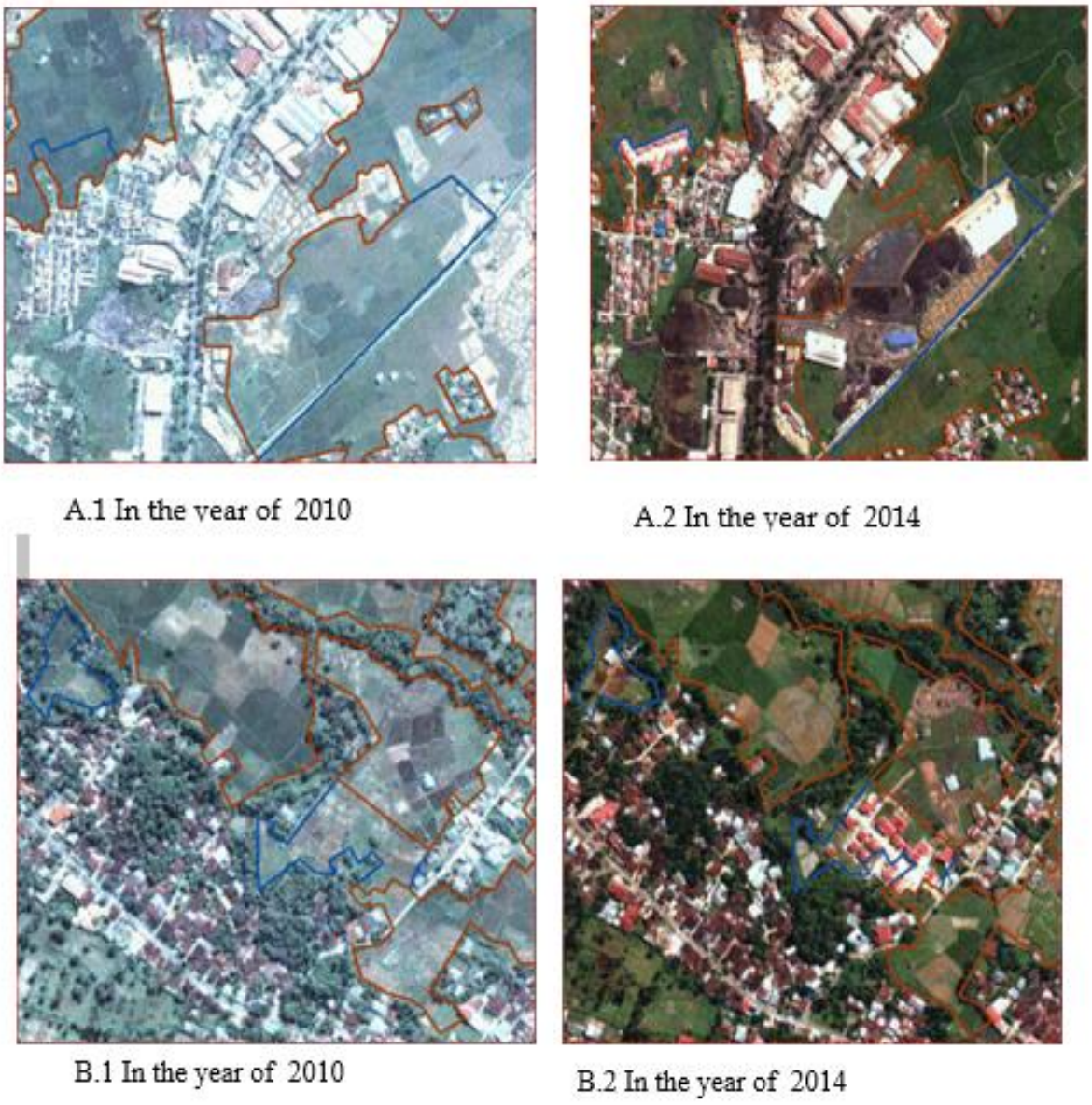


Figure 4. Illustration of changes in agricultural land to settlements

The development of the Population that has triggered the growth of residential areas, the development of road infrastructure, markets, government centers, and so on has eroded the site, which was initially a rice field area. The earthquake in 2009 plus the development of the tsunami issue also had a significant impact, at least, this affected the development of residential areas that were initially concentrated on the coastal plain in the west, now began to move to the east.

This finding is in line with the results of research conducted by (Yuhendra, 2010) in the Mount Nago Irrigation Area, which showed that agricultural land was shrinking due to pressure from settlements (housing), roads, and another non-agricultural land) (Ritung, 2010). Conversion of paddy fields to other uses continues because of the need for land for housing, industry, and infrastructure (Mulyani et al., 2011). This opinion is in line with Widiastuti's research, where with the increase in Population and the increasing need for land for various sectors, the conversion of paddy fields tends to increase, on the other hand, the printing of new paddy fields (extensification) has slowed (Widiastuti, 2017).

The results of Yuhendra's research show the shrinkage of agricultural land in six villages in the irrigated area of Mount Nago. Look at the following Table 3.

Table 3. Depreciation of agricultural land in the irrigation area of Mount Nago

Name of Village	Paddy Field			Reduction in 1976 - 1998		Drop in 1998 - 2009	
	1976	1998	2009	Area (Ha)	%	Area (Ha)	%
Kampung Dalam	137,54	129,33	119,50	(8,21)	-5,97%	(9,83)	-7,60%
Pisang	215,45	187,92	173,67	(27,53)	-12,78%	(14,25)	-7,58%
Piai	83,50	70,93	68,86	(12,57)	-15,05%	(2,07)	-2,92%
Tanjung Sabar	76,50	54,49	43,28	(22,01)	-28,77%	(11,21)	-20,57%
Lubuk Begalung	72,50	52,35	40,95	(20,15)	-27,79%	(11,40)	-21,78%
Parak Karakah	156,63	109,29	66,38	(47,34)	-30,22%	(42,91)	-39,26%
	742,12	604,31	512,64	(137,81)	-18,57%	(91,67)	-15,17%

Table 4. Depreciation of agricultural land in the irrigation area of Mount Nago

Name of Village	Paddy Field			Reduction in 1976 - 1998		Drop in 1998 – 2009	
	1976	1998	2009	Area (Ha)	%	Area (Ha)	%
Kampung Dalam	14,62	20,77	23,77	6,1(5	42,07%	3,00	14,44%
Pisang	8,66	31,81	42,57	23,15	267,32%	10,76	33,83%
Piai	27,00	31,16	33,33	4,16	15,41%	2,17	6,96%
Tanjung Sabar	12,28	49,80	59,14	37,52	305,54%	9,34	18,76%
Lubuk Begalung	34,05	49,80	59,14	15,75	46,26%	9,34	18,76%
Parak Karakah	10,46	45,52	67,87	35,06	335,18%	22,35	49,10%
	107,07	228,86	285,82	121,79	113,75%	56,96	24,89%

The table above shows that the shrinkage of agricultural land in the six kelurahan is 229.48 ha (-30.92%), or 6.95 ha per year, while settlements grew to 285.82 ha (+266.95%).

2. Population Growth of Padang City in 1990, 2000, 2010, and 2015

Based on data from the Central Statistics Agency, in 1990, the city of Padang had a population of 583,675 people. In 2000 this figure increased by almost 150 thousand people to 720,783 people. In the range between 1990-2000, the Population of Padang City grew by 23.49%, with a growth rate of 2.35 per year. In 2010 the Population increased to 833,562 people, this figure decreased compared to the previous year, where in 2009, the city of Padang had a population of 875,750 people. The big earthquake towards the end of 2009 caused many out-migration to leave the city of Padang. The population growth ratio of Padang City from 2000-2010 was also successfully reduced to 1.57 per year, with a population increase of only 112,779 people or 15.64%.

Between 2010 and 2014, there was an increase in the Population by 56,084 people or 6.73%, equivalent to 1.68 per year. In 2010 the Population of Padang City was 833,562 people, BPS in 2014 increased to 889,646 people the end of 2014. Koto Tangah District is still the district with the largest Population of 178,456 people, equivalent to 20% of the total Population of Padang City and Bungus Teluk District. Kabung, with the smallest Population, is only 24,137 people.

Population growth in Koto Tangah District from 2010 to 2014 was even higher than the population growth of Padang City within four years, the Population of Koto Tangah increased by 10.01% or 2.53 per year. For clarity, details on the Population of Padang City by sub-district from 1990 to 2014 can be seen in table 4.6 on the Population of Padang City by year and sub-district.

Conversion of agricultural land into non-agricultural will affect the performance of the agricultural sector. This conversion will reduce the land area for food production activities, significantly affecting local and national food supply (Wahyunto & Widiastuti, 2014).

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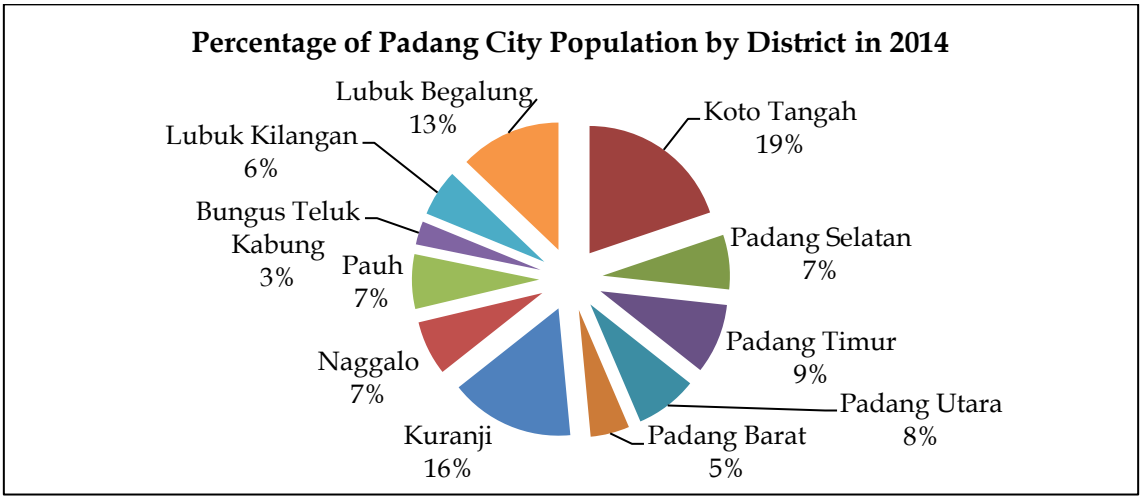

Figure 5. Percentage of Padang City population by district year 2014

3. Carrying Capacity of Paddy Agricultural Land in Padang City

Based on data from the Department of Agriculture and Forestry of the City of Padang in 2014, the harvested area for rice farming was 16 528.57 Ha, with a yield of 5449 Kg/ha and a population of 889,646 people. Meanwhile, the Minimum Physical Need (KFM) required to determine the carrying capacity of agricultural land is strongly influenced by the Population and the condition of the area. For areas where most of the Population lives in the agricultural sector, the carrying capacity is calculated from the production of food ingredients. In terms of calculation, it can be calculated from the Minimum Physical Needs (KFM), which is based on the calorie needs per person per day, which is 2600 per person per day or 265 kg of rice per person per year.

$$\tau = \frac{Lp/_{Pd}}{KFM/_{Pr}}$$

$$\tau = \frac{16.528{,}57\ Ha/_{889.646\ Jiwa}}{265\ kg/_{5.449\ Kg}} = \mathbf{0,38}\ \text{Ha/people}$$

Thus, the carrying capacity of lowland rice farming land (τ) in Padang City in 2014 was 0.38 ha/person, meaning that each person (Population) is supported by 0.38 ha of lowland rice farming land (harvested area). With the same formula, calculations were also carried out to determine the carrying capacity of land in previous years, namely, to see the relationship between Population, population growth, and its impact on the land's carrying capacity. This figure also intends to compare whether population growth from year to year can still be balanced by production growth and land carrying capacity growth.

To find out how the Population, harvested area, and rice production in Padang City in 1990, 2000, and 2010 can be seen in the following table, which describes per sub-district."

Table 5. Relationship between population, harvest area, and rice production in Padang City in 1990, 2000, and 2010

District	1990			2000			2010		
	Total Population (people)	Harvested Area (Ha)	Production	Total Population (people)	Harvested Area (Ha)	Production	Total Population (people)	Harvested Area (Ha)	Production
Bungus Teluk Kabung	17.393	1.689	9.536	21.757	1.434	8.306	22.896	1.515	8.408
Lubuk Kilangan	30.697	1.283	6.967	41.494	1.167	6.818	48.850	1.104	6.127
Lubuk Begalung	70.581	1.585	8.927	90.992	1.096	6.491	106.432	797	4.423
Padang Selatan	59.895	70	389	59.988	12	75	57.718	20	111
Padang Timur	81.139	495	2.817	87.961	267	1.565	77.868	176	977
Padang Barat	75.380	-	-	65.660	-	-	45.380	-	-
Padang Utara	67.937	163	920	72.654	44	259	69.119	18	100
Nanggalo	47.250	752	4.100	55.947	306	1.834	57.275	457	2.536
Kuranji	63.044	5.693	31.107	105.134	4.622	26.748	126.729	4.869	27.023
Pauh	31.716	2.119	12.214	44.447	2.802	16.448	59.216	2.323	12.893
Koto Tangah	86.231	3.578	20.076	131.010	2.511	14.640	162.079	2.610	14.486
Kota Padang	631.263	17.427	97.053	777.044	14.261	83.184	833.562	13.714	77.084

Source: Central bureau of statistics of Padang City.

Although the area of paddy fields in Padang City continues to decline, in 2000, the productivity of lowland rice per hectare increased. From 5,569.11 kg/ha in 1990 it increased to 5,827.49 kg/ha. This figure illustrates the government's success in overcoming land shrinkage by increasing agricultural productivity, which is related to intensification, which can increase the area of rice fields and decrease puso.

Ten years later, in 2010, the productivity of lowland rice in Padang City fell again. This is related to the shrinkage of agricultural land and harvested area, then the decline in production. For more details, see the following table below.

Table 6. Rice paddy productivity per hectare (kg/ha) by district of Padang City in 1990, 2000, and 2010

District	1990	2000	2010
Bungus Teluk Kabung	5.645,94	5.792,19	5.549,83
Lubuk Kilangan	5.430,24	5.842,33	5.549,81
Lubuk Begalung	5.632,18	5.922,44	5.549,56
Padang Selatan	5.557,14	6.250	5.550
Padang Timur	5.690,91	5.861,42	5.551,14
Padang Barat	-	-	-
Padang Utara	5.644,17	5.886,36	5.555,55
Nanggalo	5.452,13	5.993,46	5.549,23
Kuranji	5.464,08	5.787,10	5.550,01
Pauh	5.764,04	5.870,09	5.550,15
Koto Tangah	5.610,95	5.830,35	5.550,19
Kota Padang	5.569,11	5.829,47	5.661,00

Source: Secondary Data Processing, 2020.

Figure 6. Graph of Paddy Productivity Development 1990, 2000, 2010, 2011, 2012, and 2013

The carrying capacity of the rice fields of Padang City between 1990-2010 was still around 0.34 - 0.58, and 0.38 in 2014. This means that Padang City is still a class III area ($\sigma < 1$) which means that Padang City is included in not self-sufficient in food. As an administrative area of a Big City with population growth and growth of facilities as well as dynamic physical development triggers high land conversion, which supports the justification of this situation.

The population growth of Padang City from 2000 to 2010 reached 1.57% per year, but not supported by the development of lowland rice production. This includes the shrinkage of agricultural land and a decrease in the harvested area, which ultimately reduces the production amount, causing rice fields' carrying capacity to continue to decline. In 1990 the carrying capacity of agricultural land was still at 0.58 but decreased to 0.4 in 2000 and continued to fall to 0.34 in 2010. If in 1990, Padang City was still able to meet more than 50% of the need for rice, then in 2010, only 34% of the rice needs for the Population of Padang City, so 66% of the rice needs must be supplied from other regions, whether in West Sumatra or other provinces.

Rosegrant in Shideed stated that the growth in food demand caused by population growth and shifting consumption patterns would require increased food production. Still, limited available land, which is not exploited, puts increasing pressure on yield increases driven by technology (Shideed et al., 2010). Throughout history, human populations have experienced shortages in food production (Schneider et al., 2011).

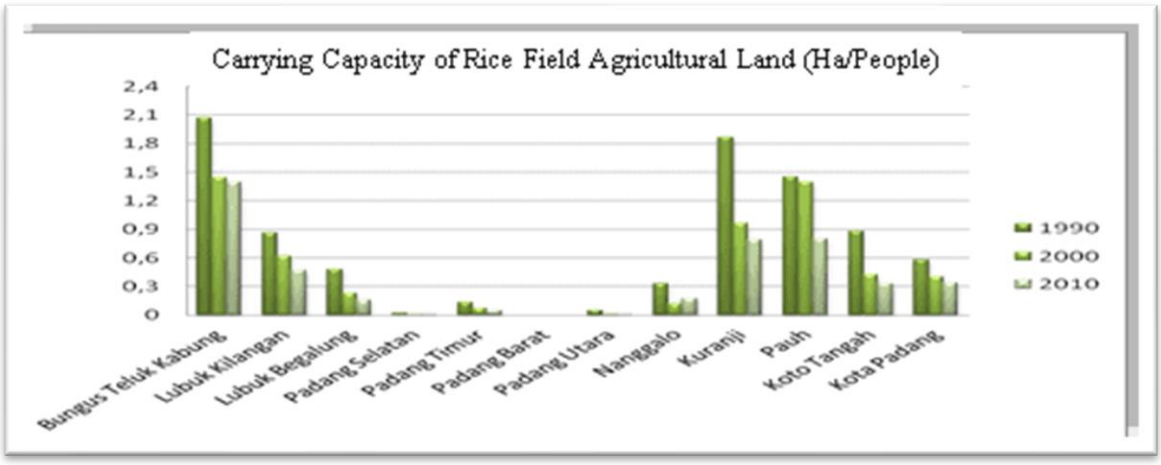

Figure 7. Graph of the development of carrying capacity of paddy

4. Projection of Population, Rice Needs, and Carrying Capacity of Rice Field Agricultural Land in Padang City in 2025

Considering the development of shrinkage of paddy fields in the last five years, the average shrinkage of agricultural land in Padang City is 29.73 ha/year. Suppose it is assumed that the shrinkage of lowland rice farming land continues to occur in the same area every year, then in the next ten years, namely in 2025. In that case, the area of lowland agricultural land in Padang City will experience a depreciation of around 290-300 ha, from 6,101.1 ha. in 2015 to 5,803.77 in 2025. Libryanto, in his research, suggests that changing the land use of an area will change its function from its original purpose and harm the environment and land potential (Libriyanto et al., 2022).

Despite the shrinking land area, the harvested area of lowland rice between 2010-2014 showed a good increase. In that year, the harvested area increased from 13,899 ha in 2010 to 16,529 ha in 2014, with an average growth of 525,914 ha/year. However, this growth does not constantly occur every year. From 2010 through 2010, there were specific years that production and harvested area increased, but in other years the development of harvested area and production tended to remain constant. This means that although agricultural land depreciates continuously, there are still efforts to maximize production. If this growth in harvested area can be increased, in 2025, the city of Padang will have a harvested area of ± 17,411.31 ha or in the range of 17,000-18,000 ha. This is in line with Thompson's research where food production will outstrip the Population, mainly due to the development and use of better crop varieties (Thompson, 1960).

Rice productivity in Padang City from 1990 to 2014 experienced a good increase, namely in 2000 and 2011. In 2011, for example, rice productivity reached 6,107 kg/ha, while in 2000, from 14,261 ha of harvested rice production reached 83,184 kg with productivity of 5,829,47. Rice production in Padang City declined considerably in 2010, if in 2000, rice production in Padang City was 83,184 tons, then in 2010, it was only 73,495, but in the following years, rice production again increased to 81,209 tons (2011), 81,741 tons (2012), 84,506.66 tons (2013) and 90,064.15 tons (2014). The average growth of rice production can be formed by giving an exception in 2010 due to certain assumptions so that the average growth of rice production in the last four years is 2,213.75 tons/per year.

By considering the shrinking area of rice fields as a whole, which tends to decrease, the area of technically irrigated rice fields will grow to remain at an area of 4,934 ha (stipulation of the Spatial Planning Law concerning the prohibition of conversion of irrigated paddy fields) and the harvest area that can be maximized to 17,411.31 hectares. , and using the maximum rice productivity that can be achieved in Padang City, which is 6,107 kg/ha (rice productivity in 2011), it can be estimated that rice production in Padang City in 2025 with a land area of 5,803.77 (Citra analysis data) with an estimate of three harvest times per year, the harvested area is approximately 17,411.31 hectares. If the harvested area is multiplied by the highest productivity ever achieved (6,107 kg/ha), it is predicted that the total paddy production in 2025 will be approximately 106,330.87 tons.

Based on population projection data published by the Population and Civil Registry Agency of Padang City, the Population of Padang City in 2025 is estimated to be 1,191,515 people. By referring to the minimum physical needs (MPN), which is 265 kg of rice per person per year, it can be estimated that the demand for rice for the people of Padang City in 2025 is 315,751.48 tons.

Using the land carrying capacity equation, it is possible to estimate the carrying capacity of the paddy fields of Padang City to the demand for rice in 2025, as follows.

$$\tau = \frac{Lp/Pd}{KFM/Pr}$$

$$\tau = \frac{17.411{,}31/1.191.515}{265/6.107}$$

$$\tau = \frac{0{,}015}{0{,}043}$$

$$\tau = 0{,}348$$

$$\tau = 0{,}35$$

The result showed that in 2025, Padang City is still a class III region (σ < 1) or an area that has not been able to meet its own food needs (self-sufficiency). The land's carrying capacity even decreased compared to 2014 from 0.38 to 0.35 in 2025. This also means that in 2025 only 35% of the food needs of the people of Padang City can be met, while the remaining (65%) must be supplied. From other areas. For more details, see the table and graph below.

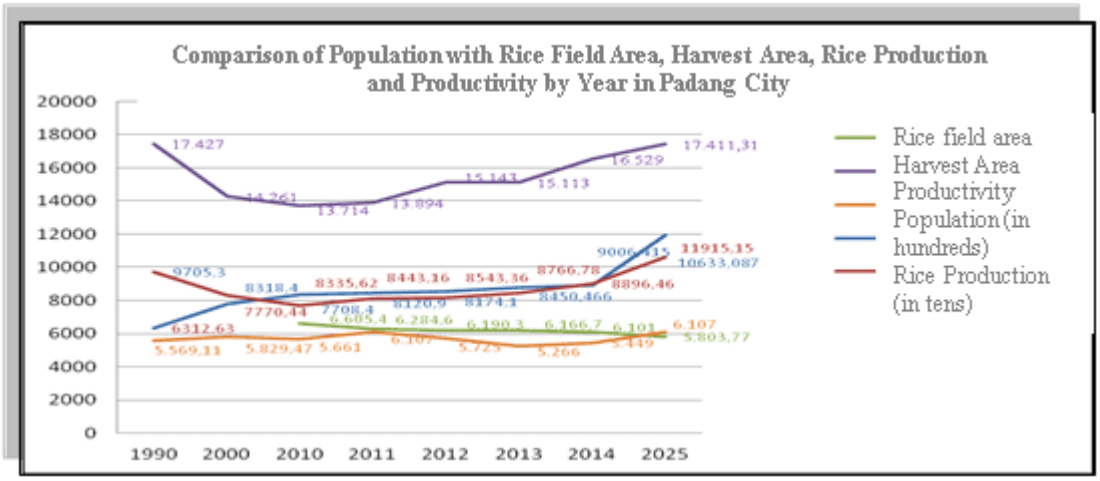

Figure 8. Graph of comparison of population with rice field area, harvest area, rice production, and rice productivity by year in Padang City

CONCLUSION

The results of the study showed there was a decrease in agricultural land area of 100.86 ha/year. The most extensive agricultural land depreciation range occurred in the field from 2010 to 2011. The population growth of Padang City between 2000-2010 was also successfully suppressed to 1.57 per year, with a population increase of only 112,779 people or 15.64%. The population growth of Padang City is in the range of 1.57, which is not supported by the development of lowland rice production. Land shrinkage and a decrease in harvested area and productivity have caused the carrying capacity of paddy fields in Padang City to continue to decline.

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