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Impact of Land Conversion on Agricultural Carrying Capacity and Sustainable Food Agricultural Land in Sleman Regency

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ABSTRACT

Land conversion is frequent in rural and urban areas where an increase in population is directly connected to the growing demand for additional land. A region with the highest rate of land conversion is Sleman Regency which is among the 3 regencies in the Special Region of Yogyakarta. Therefore, this study aimed to examine conversion of agricultural land to determine the qualification as sustainable and how the resources could be relocated for other uses. The analysis was conducted quantitatively and descriptively using secondary data from a time series database spanning 2015 to 2020. The results were presented through a combination of tables, graphs, images, and map visualizations. The study further showed that 4.412 hectares of agricultural land experienced a functional change over 5 years with the most significant change occurring in Pakem Subdistrict (1.540 hectares) and the least in Kalasan Subdistrict (4 hectares). Carrying capacity value of agricultural land in Moyudan, Godean, Cangkringan, Minggir, Seyegan, Ngaglik, Mlati, Prambanan, and Ngemplak was also influenced by the quantity of agricultural land available in each subdistrict. A maximum carrying capacity showed that adequate food was produced to sustain the population. Conversely, Depok and Turi Subdistricts possessed the lowest land-carrying capacity, showing that the subdistricts depended on food production to meet the population's needs.

INTRODUCTION

The fulfillment of land resources significantly influences the development of a region as growing land use is evolving as a primary obstacle to sustainable growth. The reduction of agricultural land directly further leads to declines in food production, carrying capacity, and security (Wang et al., 2021; Widiyantoro et al., 2020). This is because changes in land use can directly affect various environmental factors, including biodiversity and climate change (Kong et al., 2022). There is a direct correlation between population growth and the need for land. As both subjects and objects of development, residents play a crucial role in the success of sustainable development programs. From an economic, socio-cultural, and environmental perspective, population activities depend heavily on natural resources such as land. However, agricultural land is highly susceptible to conversion into other types of land. Mulyani et al. (2016) further estimated that approximately 96,512 acres of agricultural land were converted annually in Indonesia.

The Special Region of Yogyakarta is also experiencing rapid development, particularly in infrastructure (Rijanta et al., 2019). This infrastructure growth stimulates the expansion of built-up areas and drives habitation and commercial concentration (T. Y. Liu & Su, 2021). The population density in Sleman Regency has increased significantly, specifically in agglomeration areas such as Mlati, Godean, Gamping, Depok, and Pakem Subdistricts. The Gamping Subdistrict features land use plans to preserve agricultural land, mainly perennial rice fields.

An essential condition for ensuring food sovereignty, security, and independence at the national level is the availability of suitable land for food production. However, land use also contributes to agricultural fragmentation, reduced productivity, diminished carrying capacity, and land degradation (Paz et al., 2020). Agricultural land's changing carrying capacity and usage are critical, as agricultural food production is fundamental to food security. Addressing food security requires strategic land use modifications. Food security has played a crucial role in shaping human history, and by 2050 or 2060, the global population is projected to reach approximately 9 billion. The 21st century is expected to witness a doubling of demand for food and feed, placing additional pressure on water consumption, land use, and nutrition (Lone & Mayer, 2019). Land degradation is caused by geomorphological processes that lower land carrying capacity and quality (Widastuti et al., 2017).

Indonesia faces a decline in agricultural land availability as its population grows, while the total area of arable land remains fixed. When the trend continues, an imbalance will occur between the number of farmers and the amount of arable land available in a given region. This situation further intensifies the strain on agricultural land, making the resources insufficient to sustain the population. The condition is highly contradictory as food availability is essential for survival, and population growth inevitably increases food demand. Consequently, regions should maximize and expand the potential of existing resources, particularly agricultural land. When production cannot meet the population's needs, the carrying capacity of agricultural land will decline (Moniaga, 2011).

The population growth rate outpaces the expansion of land used for food crops. Community land use practices impact the land's carrying capacity, observed through land control and ownership, migration, density, and demographic composition, including age, gender, education, and livelihoods (Sudrajat et al., 2019).

Studies by (Talumingan & Jocom, 2017; Herlindawati, 2018) outlined that an increase in the proportion of farmers coupled with a decrease in total available land could lead to factors such as population growth, socio-economic infrastructure expansion, agricultural land conversion, industrialization, and imbalances reducing agricultural land-carrying capacity. However, soil carrying capacity remains one of the most critical factors in promoting sustainable agriculture. This occurs because sustainable farming methods necessitate access to sufficient, high-quality agricultural land. To predict the availability of agricultural land in the future, the amount of agricultural land capacity in a region should be carefully assessed (Muta'ali, 2015).

Padjarajani (2008) and Moniaga (2011) further identified that areas with dynamic population density, limited agricultural land ownership, shifts from agricultural to non-agricultural activities, high population mobility, and diverse land use patterns experienced significant changes in agricultural sustainability and carrying capacity. Settlements and other economic activities are also closely tied to these changes. When this trend continues, local agriculture's sustainability and carrying capacity will face severe risks.

For the national food supply to be independent, secure, and continuous, an adequate supply of Sustainable Food Agricultural Land (LP2B) (Apriyanto, 2022). This requirement is crucial because land is also needed for the social and economic activities of the population (Hidayat & Noor, 2020). Therefore, sustainable development balances the economy and the environment by avoiding an undue reliance on natural land or conserving land resources to pursue expansion (Haberl et al., 2020). When implementation is inappropriate, these conditions will further affect the determination of sustainable agricultural land. Land ownership is residents' rights, and those with a land ownership certificate can legally sell or convert land.

To address this problem, an LP2B protection policy has been introduced in several Indonesian regencies, including Sleman Regency. Regency policy determination is crucial for accomplishing national development objectives (Tampubolon et al., 2022). As a target zone for urbanization in Yogyakarta City, Sleman Regency is experiencing declining agricultural land dedicated to food production (Astuti & Lukito, 2020).

Legislation, central and regional government, and special ministerial regulations are all created to control land conversion. Government Regulations regarding Incentives for LP2B are in PP Number 12, issued in 2012. At the provincial level, it is realized that Regional Regulation Number 5 of 2019 and Number 6 of 2021 collectively address Regional Spatial Planning (RTRW) for the Special Region of Yogyakarta. These regulations outline the rapid infrastructure development that will take place from 2019 to 2039 (Rijanta et al., 2019). Concerning LP2B, regency, and regional administrations continue to coordinate while Sleman Regency establishes the guidelines for sustainable agriculture in its region by Regional Regulation Number 6 of 2020 About the Protection.

Implementing government regulations must be emphasized to realize RTRW and design certain areas. Rewards and punishments, such as outreach to the community, need to be created for the implementation to be achieved. It is acknowledged that land has changed from being used for agriculture to other purposes to fulfill human wants and desires. The human tendency to prioritize desires over needs has led to an increase in land conversions.

Agricultural activities are no longer enjoyable to the younger generation, further intensifying this condition. Part of the reason humans are becoming less interested in working in agriculture is the unpredictable revenue from this industry. Agricultural income is very dependent on the price of the harvest. On the other hand, farmers are powerless to determine the price of the harvest, as the market (traders) determines the price.

Production factors and agricultural productivity, which are highly dependent on natural physical conditions and pest attacks, also cause the agricultural sector to be unstable at each harvest. The waiting period for the harvest, approximately three months, further intensifies the condition of marginalization. Meanwhile, non-agricultural sectors such as trade and industry have promising economic value, further increasing agricultural land conversion.

Sleman Regency experienced a significant increase in land conversion, with 816.84 hectares of agricultural land converted into developed land between 2014 and 2019, coinciding with a population increase of 156,838 people (Puspitasari & Danoedoro, 2019). This tends to directly impact agricultural land's ability to meet food demand, threatening the implementation of LP2B. Part of the reason why the carrying capacity of agricultural land has decreased is the extensive development occurring in Sleman Regency. Considering these conditions, more studies are necessary to ascertain the potential effects on LP2B and agricultural carrying capacity of changing the usage of agricultural land in Sleman Regency. Therefore, this study aimed to examine the conversion of agricultural land and how the resources could be used for other purposes. Publication relating to land changes and carrying capacity has been conducted several times. However, this study emphasizes the LP2B area, officially protected by the government under the law, to ensure its sustainability.

METHODOLOGY

This study applied quantitative descriptive methods based on secondary time series data. Sleman Regency was selected as the study object due to the high rate of land conversion, including Yogyakarta City's propensity to develop north and west and the area's vulnerability to agricultural land conversion. Furthermore, the role of agricultural land would inevitably change to built-up land as it became a hub for economic development and education. Yogyakarta City's tendency to develop northward and westward, combined with limited land availability, prompted expansion into suburban areas such as Sleman and was supported by improved accessibility between cities and regencies. Consequently, areas further from the city became alternative locations for residence and business, serving as catalysts for changes in agricultural land use. Sleman Regency further functioned as a food basket for the Special Region of Yogyakarta, supported by its highly fertile rice fields, as observed in Figure 1. Proximity to Mount Merapi contributed to soil fertility, while the ease of irrigation allowed most areas in Sleman Regency to maintain rice fields capable of producing three harvests annually.

Time series data on rice field use in Sleman Regency was used to calculate the first objective related to agricultural land conversion. Over the past 4 years, land use changes in Sleman decreased by approximately 13,47%. In 2019, the area of agricultural land was recorded as 18.137 hectares, but by 2023, it had declined to 15.984 hectares (Central Statistics Agency of Sleman Regency, 2023; Department of Agriculture of Sleman Regency, 2024). The data collected was subsequently represented in graphs or diagrams and spatially mapped to visualize land use changes. Odum, Christeiler, Ebenezer Howard, and Issard combined mathematical formulas into an equation used to calculate the carrying capacity level of agricultural land (Kuncoro, 2017) as follows.

$$\delta = \frac{X}{K} \qquad (1)$$

In Equation (1), δ or the carrying capacity value of agricultural land represented the variable under analysis. X indicated the land used for food crops per person, while K represented the area required for land to be self-sufficient.

$$X = \frac{Total\ Harvest\ Area\ (Ha)}{Population\ (people)} \qquad (2)$$

$$K = \frac{Minimum\ Physical\ Requirements (KFM)}{Food\ Crop\ Production/\ Ha/Years} \qquad (3)$$

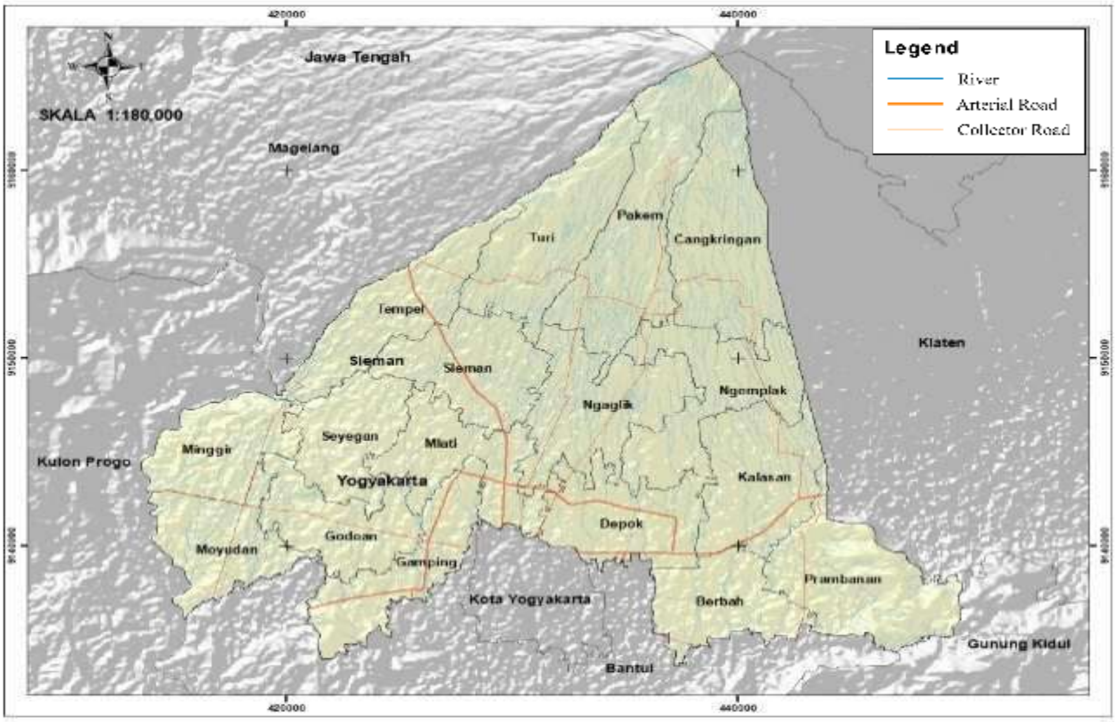

Figure 1 Administrative map of Sleman Regency (Source: Research Data, 2024)

According to (Montana, 2011), a region was considered food self-sufficient when it could provide for the physical demands of the population, amounting to 265 kilos of rice per person annually or 1600 calories per day. An area requires adequate food crop fields to meet the population's needs at a respectable level, such as a per capita rice demand of 650 kg annually, or 2.466 times KFM, to provide a fair standard of living. The carrying capacity of agricultural land was further categorized into three groups based on the value of σ. These included (1) A value of $\sigma > 2.47$ suggested that the area could support a high population density while maintaining a respectable standard of living, (2) A value of $1 \leq \sigma \leq 2.47$ showed that the area could support a high population density but could not currently maintain a respectable standard of living, and (3) A value of $\sigma < 1$ indicated that the area was in Class III with insufficient carrying capacity.

Additionally, the study calculated the carrying capacity of soil and the optimal population (JPO), representing the number of people that could be supported by food crops grown on the area's agricultural land. The optimal population size could be further determined by considering the carrying capacity of land and the total number of people. Consequently, the following formula was applied to determine the optimal population as calculated in Equation (4).

JPO = Land Carrying Capacity x Population ... (4)

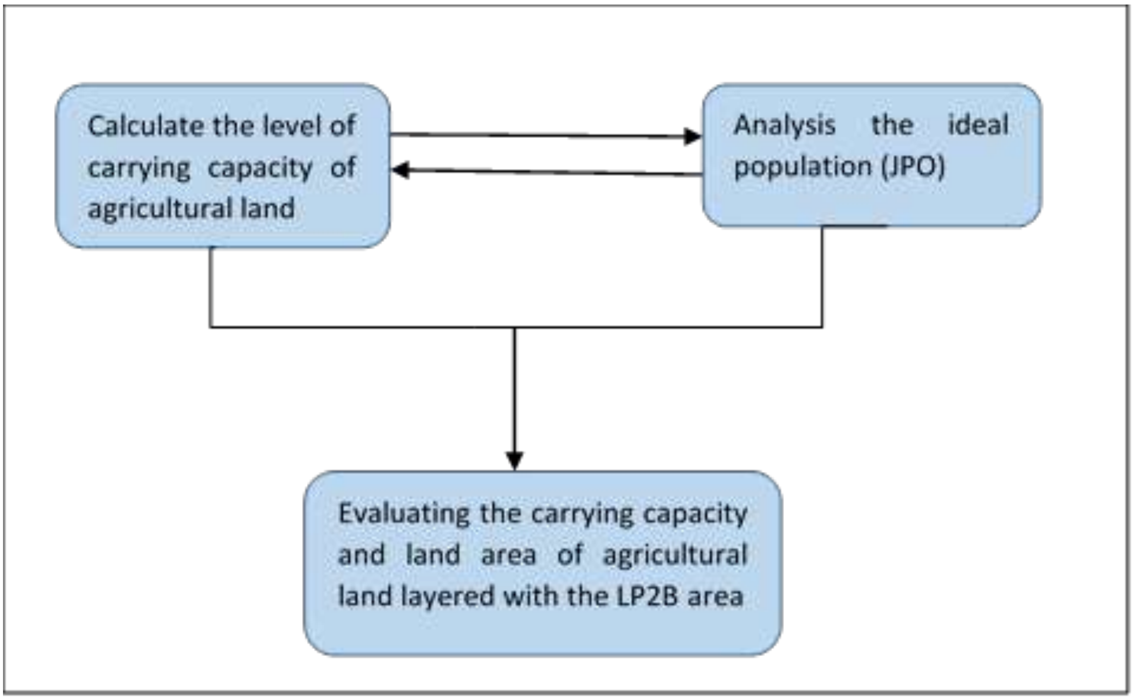

Figure 2. Study Flowchart (Source: Research Data, 2024)

The third objective for the region's LP2B implementation was to evaluate the carrying capacity and land area of agricultural land layered with the LP2B area in the Sleman Regency. The flowchart summarized the study process in simple terms, as shown in Figure 2.

RESULTS AND DISCUSSION

Transfer of Agricultural Land Functions (2015 – 2020)

In 2015, the agricultural land area in Sleman Regency covered 21,907 hectares, accounting for approximately 38.11% of the regency's total administrative area, as observed in Figure 3. Ngemplak Subdistrict had the most significant agricultural land area in the regency, with 1.897 hectares representing 8,66% of the total agricultural land. In contrast, Depok Subdistrict had the smallest agricultural land area, with 437 hectares or 1.99% of the total land area, as observed in Table 1. By 2020, agricultural land use in Sleman Regency had decreased to 17,495 hectares or 30.44% of the regency's total administrative area. Over 5 years, agricultural land diminished by 4,412 hectares, a reduction of 20% as suggested in Figures 5 and 6.

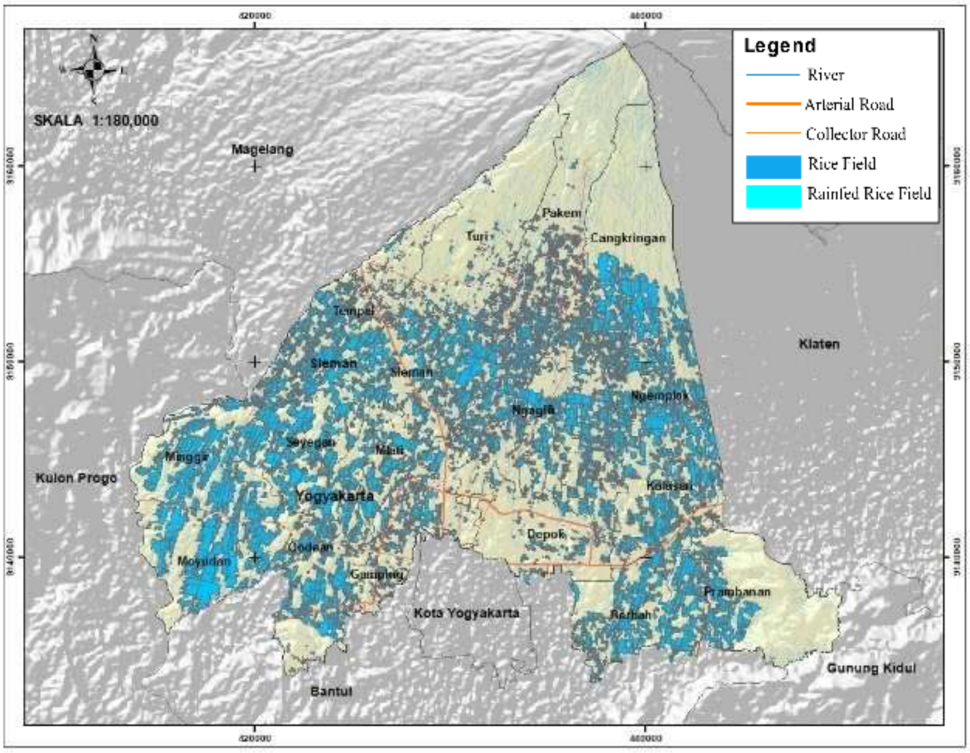

Figure 3. Map of Agricultural Land Distribution in 2015 in Sleman Regency
(Source: Research Data, 2024)

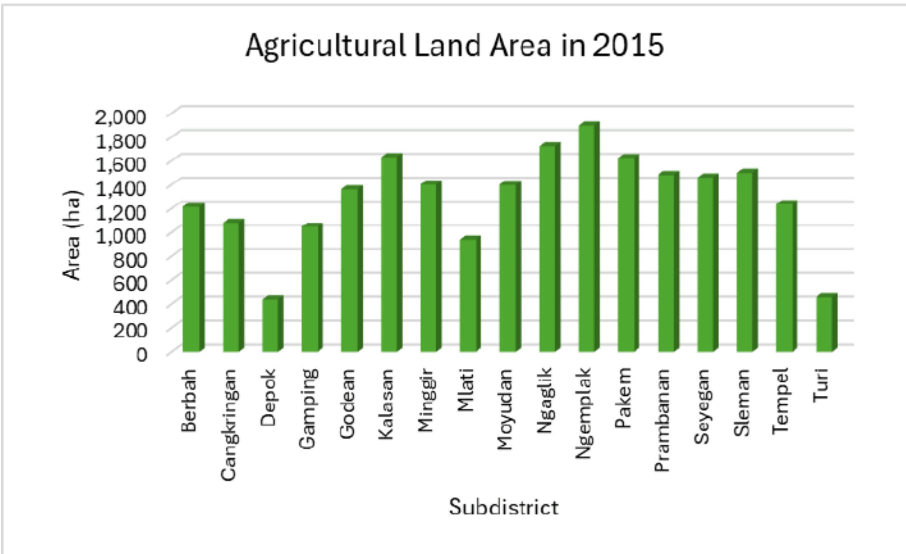

Figure 4. Graph of Agricultural Land Area by Subdistrict in Sleman Regency in 2015
(Source: Research Data, 2024)

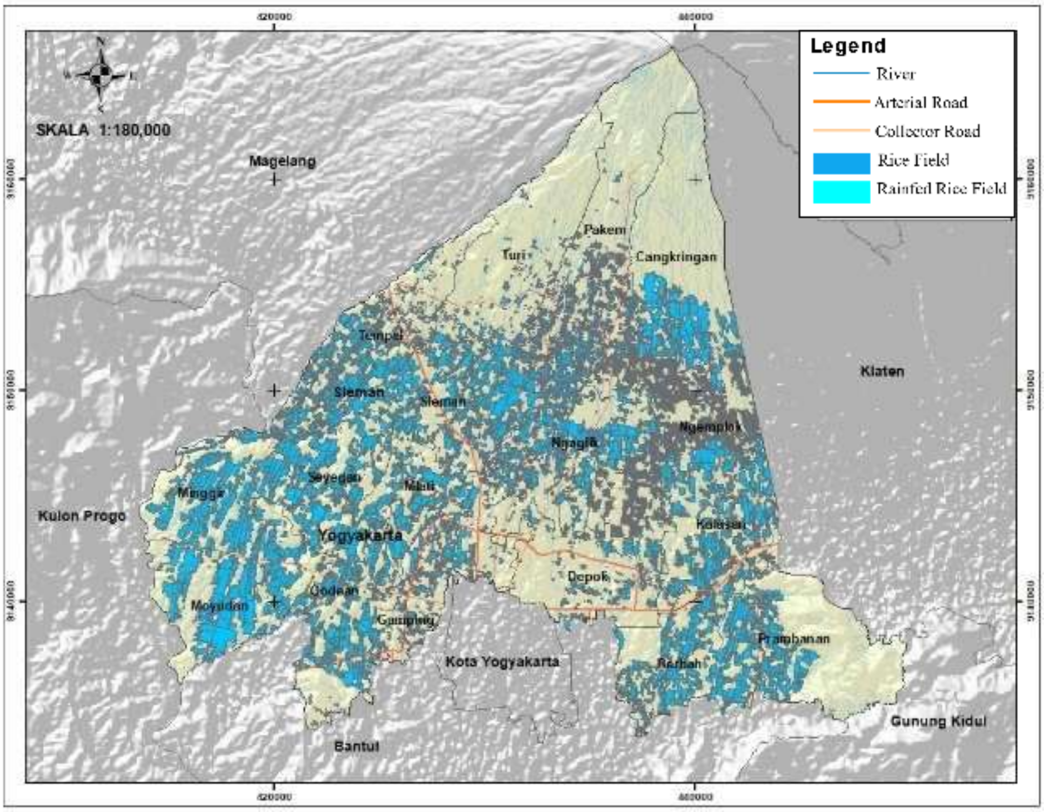

Figure 5 Distribution of Agricultural Land Area in Sleman Regency in 2020 (Source: Research Data, 2024)

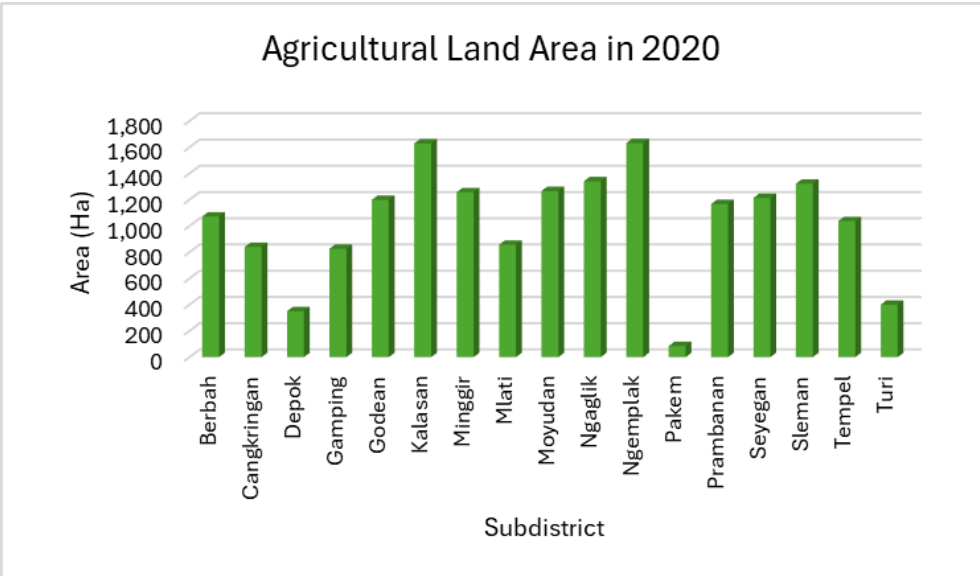

Figure 6 Agricultural Land Area in 2020 (Source: Research Data, 2024)

In 2020, the Ngemplak Subdistrict had the most significant agricultural land area, with 1.632 hectares. The lowest agricultural land area was the Pakem Subdistrict, with a value of 85 hectares, representing 0.26% of the total area of Sleman Regency, as shown in Table 2 and Figure 6. The results correlated with (Wafdan, 2020), which identified the Pakem Subdistrict as part of the urban fringe or peri-urban areas. Urban fringe areas often experience rapid growth and land conversion due to the transitional position between urban and rural regions, leading to less agricultural land.

The results of the examination of changes in the amount of agricultural land between 2015 and 2020 are shown in Figure 7. The reduction in agricultural land amounted to 20.14%, with 4,412 hectares lost. Every subdistrict in Sleman Regency experienced a decline in agricultural land. Pakem Subdistrict witnessed the most significant shift, losing 1,540 hectares or 34.90% of its agricultural land area. In contrast, the Kalasan Subdistrict experienced the least change, losing only 4 hectares or 0.09% of its agricultural land.

Sleman Regency has experienced rapid development, making it an attractive destination for investors. As the site of most universities in the Special Region of Yogyakarta (DIY), the regency benefited from a favorable climate close to Mount Merapi's slopes and abundant groundwater resources. These factors have driven the swift conversion of agricultural land (Prafitasari et al., 2020).

Due to its proximity to the urban core, the southern part of Sleman bordering Yogyakarta City had exceptionally high rates of land conversion. Facilities such as large university campuses further fueled this trend. However, land conversion was not confined to the city fringes; it also occurred in rural areas far from Yogyakarta City's center (Bonawati, 2013).

Implementing the LP2B policy in Sleman introduced new dynamics, including conflicts among LP2B agricultural landowners. These landowners faced the dilemma of supporting the policy by preserving land or converting it for higher profits. According to Law No. 11 of 2020 on Job Creation, agricultural land designated LP2B could not be converted for non-agricultural purposes (Putri & WIbisono, 2022).

This restriction created a reciprocal relationship between LP2B designations and less affluent farming communities. Designating land as LP2B restricted its use, which could hinder agribusiness growth compared to other industries such as tourism, services, construction, and information technology. This disparity was evident in the contribution of agriculture to Sleman Regency's GRDP, which lagged behind other sectors (Sinuraya, 2021).

Table 1. Agricultural Land Area in Sleman Regency by Subdistrict in 2015

No	Subdistrict	Area (Ha)
1	Berbah	1.216
2	Cangkringan	1.083
3	Depok	437
4	Gamping	1.049
5	Godean	1.362
6	Kalasan	1.633
7	Minggir	1.403
8	Mlati	941
9	Moyudan	1.399
10	Ngaglik	1.723
11	Ngemplak	1.897
12	Pakem	1.625
13	Prambanan	1.483
14	Seyegan	1.462
15	Sleman	1.501
16	Tempel	1.238
17	Turi	455

Source: CSRT BIG 2013-2015

The Yogyakarta Urban Agglomeration (APY) area included several subdistricts in Sleman Regency. Consequently, the area was experiencing rapid urban growth, which affected the accessibility of high-quality communication and transportation infrastructure. Many people outside the area also came to Sleman Regency to pursue higher education, contributing to the region's population expansion. The population growth raised the possibility of land conversion due to the rising need for houses.

Table 2. Agricultural Land Area in Sleman Regency by Subdistrict in 2020

No	Subdistrict	Area (Ha)
1	Berbah	1.072
2	Cangkringan	840
3	Depok	350
4	Gamping	826
5	Godean	1.199
6	Kalasan	1.629
7	Minggir	1.257
8	Mlati	857
9	Moyudan	1.267
10	Ngaglik	1.341
11	Ngemplak	1.632
12	Pakem	85
13	Prambanan	1.167
14	Seyegan	1.214
15	Sleman	1.322
16	Tempel	1.037
17	Turi	400

Source: Updating Land Data, (2020)

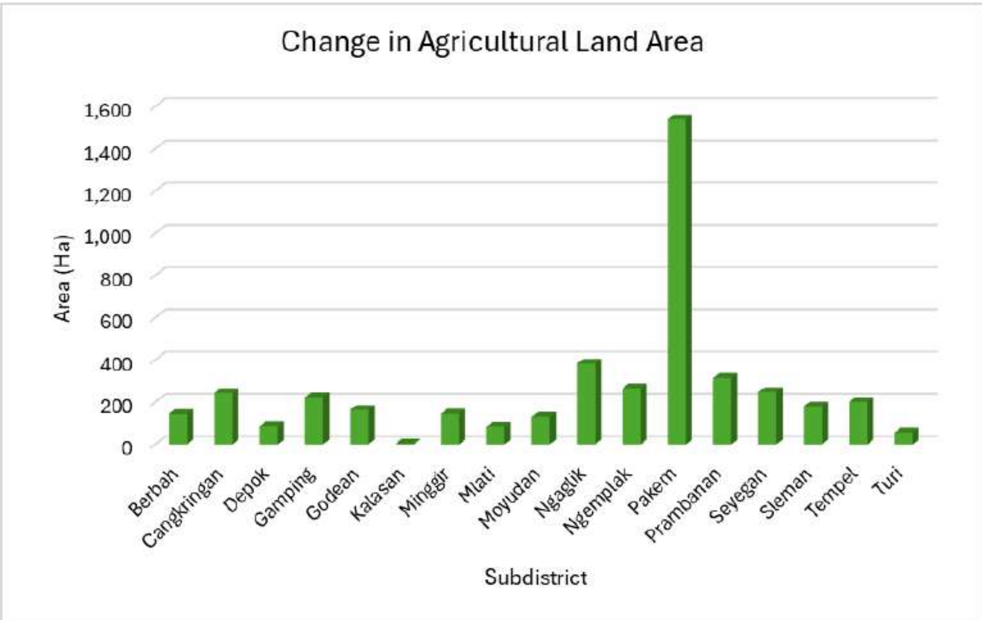

Figure 7 Changes in Agricultural Land Area 2015 – 2020 (Source: Research Data, 2024)

Carrying Capacity of Agricultural Land in Sleman Regency

The carrying capacity of a territory plays a significant role in determining the sustainability of living demands. Food obtained from land use was crucial for meeting daily human needs (Widiastuti et al., 2016). The carrying capacity of agricultural land generally varied depending on several factors, with population pressure being the primary reason for exceeding its capacity. Land for rice production was crucial to achieving self-sufficiency and regional independence. On average, rural communities require a minimum of 320 kilograms of food per person annually to maintain a usual standard of living and meet basic needs (Mubarokah et al., 2020).

Land carrying capacity analysis examined the relationship between an area's land area and the population. This measure provided a straightforward assessment of a region's ability to be self-sufficient in rice production. Two key elements determined agricultural land's carrying capacity: the area required for food self-sufficiency (K) and the area available for harvesting food crops (X). The area used for food production was calculated by dividing the total annual food crop harvest area by the population. Conversely, the minimum physical consumption divided by the annual output of food crops determined the land area required for food self-sufficiency.

In 2020, the carrying capacity of agricultural land in Sleman Regency was calculated as 88.30. This classified Sleman Regency as Class I agricultural land in terms of carrying capacity. The region could satisfy food needs and provide a decent standard of living for the population. Among the 17 subdistricts in Sleman Regency, nine, namely Moyudan, Godean, Cangkringan, Minggir, Seyegan, Ngaglik, Mlati, Prambanan, and Ngemplak, were categorized as Class I in carrying capacity. These areas could support the populations with food self-sufficiency and a decent living standard.

Six subdistricts in Sleman Regency were in Class II agricultural land carrying capacity, including Berbah, Gamping, Kalasan, Pakem, Sleman, and Tempel. This classification indicated that the regions could achieve food self-sufficiency but could not ensure a decent standard of living for the populations, as suggested in Table 3. Turi and Depok Subdistricts were areas with Class III carrying capacity levels as the subdistricts could not sustain food self-sufficiency, as observed in Figure 8. Adji et al. (2024) also showed that Depok was an area classified as Class III, unable to achieve food self-sufficiency despite being the center of the economy and a key transportation route.

A previous study by (Sriartha et al., 2017) similarly observed significant urban development in Denpasar City, which led to reduced agricultural land due to conversion to non-agricultural uses. These results were consistent with studies by (Lesmana et al., 2019). One of the most significant transformations from rice fields to residential structures was observed in irrigation systems. In West Sleman, irrigated rice fields were frequently converted into other land uses on small parcels. These small and irrigated rice fields were often considered economically less profitable because production costs outweighed harvest yields. Population growth and increasing demand for land—particularly for housing—were key drivers of land use changes (Khan et al., 2020). This pattern correlated with broader trends of land transformation observed in West Sleman (Sarastika et al., 2023).

Table 3 Subdistricts in Sleman Regency Based on the Classification of Agricultural Land Carrying Capacity Levels in 2020

Class	Carrying Capacity of Agricultural Land	Number of Subdistricts	Subdistricts
I	δ > 2,47	9	Cangkringan, Godean, Minggir, Mlati, Moyudan, Ngaglik, Ngemplak, Prambanan, Seyegan
II	1<δ<2,47	6	Berbah, Gamping, Kalasan, Pakem, Sleman, Tempel
III	δ < 1	2	Depok, Turi
Total		17	

Source: Secondary Analysis (2023)

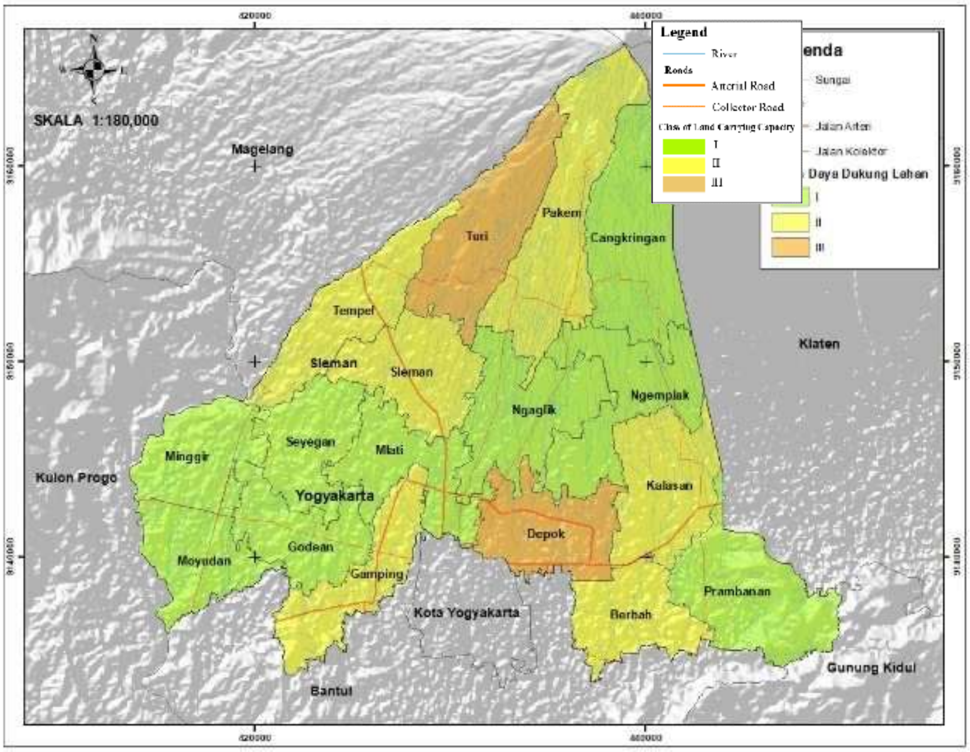

Figure 8. Map of Carrying Capacity of Agricultural Land in Sleman Regency in 2020 (Source: Research Data, 2024)

Statistics on the carrying capacity of Agricultural land and people were used to calculate the appropriate population size. In Sleman Regency, the maximum population agricultural land could sustain in 2020 was 100,608,673 people, as shown in Table 4. Ngaglik Subdistrict had the highest optimal Population at 1,622,060 people, while Turi had the lowest optimal population at 6,211 people. Efforts to intensify food crop production were motivated to meet population needs and increase the carrying capacity of agricultural land. Residential areas consistently showed high carrying capacity, while agricultural regions exhibited low capacity. Wangge et al. (2016) found that population pressure on agricultural land was more excellent in foothill areas than on foot slopes. The rapid development of towns in the foothills provided further evidence of these areas' limited agricultural carrying capacity.

A common belief in society was that land served as a production factor with high demand to meet the ever-increasing needs of the population. Consequently, people continued to exert pressure on land quality by engaging in agricultural practices that often neglected environmental considerations, increasing the degradation of agricultural land (Mubarokah et al., 2020).

The carrying capacity of agricultural land had declined due to a lack of understanding among the community and local government about the implications of rapid population growth. This decline was compounded by insufficient measures to improve rice productivity. Consequently, the population of Sleman Regency exceeded the optimal level. The lack of study on the potential of existing agricultural resources posed challenges for rural areas (Imansyah et al., 2020).

The Influence of Land Use Changes and Carrying Capacity on Sustainable Food Agricultural Land Areas in Sleman Regency

The overall area of Sleman Regency accounted for approximately 18% of the Special Region of Yogyakarta, covering about 57,482 hectares. Rice fields spanned 17,495 hectares in this area, making Sleman the third largest regency for rice cultivation after Gunungkidul and Kulon Progo. To support the maintenance of rice fields and food supply in the region, 11,535.69 hectares in the western and eastern regions of Sleman Regency were designated as LP2B.

A total of 61% of agricultural land in Sleman Regency was used for sustainable food production. From the time LP2B designation was established until 2020, there was a decline of 3,497.19 hectares in agricultural land area, leaving 8,038.51 hectares still in use for agriculture, as observed in Figure 8. A study by (Astuti and Lukito, 2020) similarly indicated a decline in the LP2B area, showing that changes in land use in food security areas of Sleman Regency reached 33.93% between 2012 and 2018. The region's development trajectory, particularly toward urbanization, was a driving factor in these changes. Low land rent in rice fields further incentivized conversion to other uses.

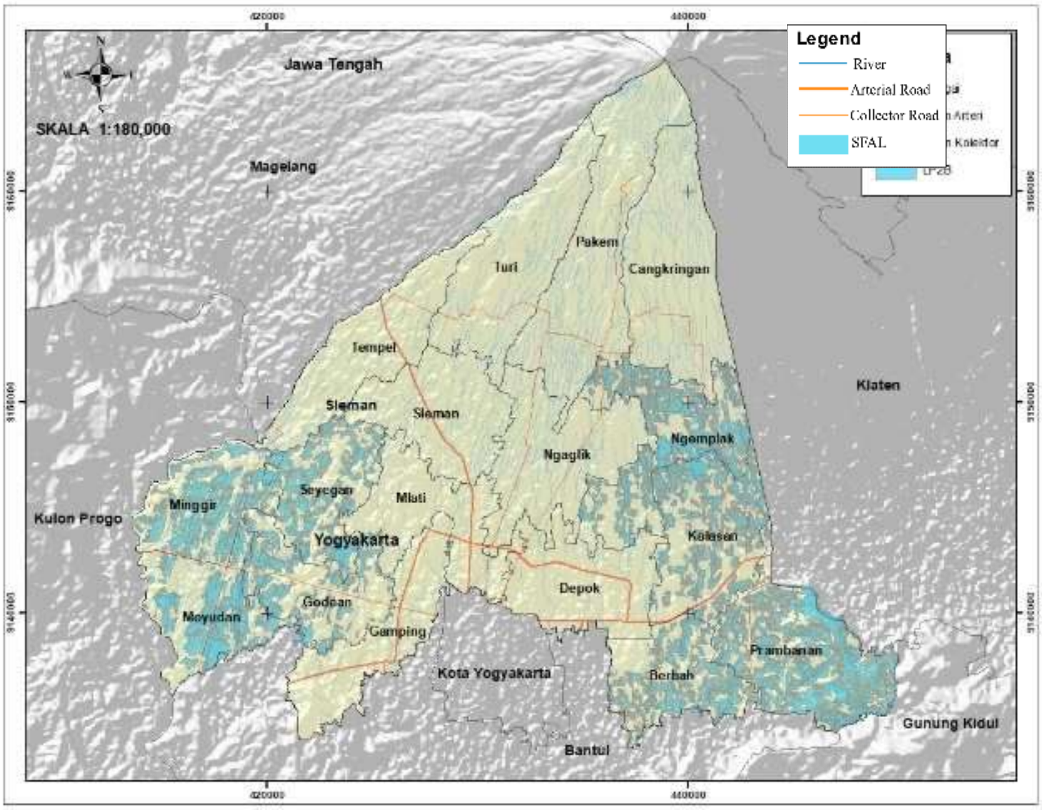

Figure 9 Distribution of LP2B Sleman Regency (Source: Research Data, 2024)

Table 4 Optimal Population Number According to Subdistrict in Sleman Regency in 2020

No	Subdistrict	Population	DDL	JPO
1	Berbah	59.004	2,02	118.898
2	Cangkringan	31.767	3,65	115.969
3	Depok	131.005	0,11	14.717
4	Gamping	94.312	1,43	134.990
5	Godean	70.258	3,91	274.361
6	Kalasan	86.163	1,93	166.661
7	Minggir	32.449	8,47	274.717
8	Mlati	100.524	8,05	809.420
9	Moyudan	33.557	9,76	327.632
10	Ngaglik	105.612	15,36	1.622.060
11	Ngemplak	90.377	3,46	312.325
12	Pakem	38.107	2,20	83.753
13	Prambanan	53.113	2,70	143.612
14	Seyegan	50.993	30,82	1.571.843
15	Sleman	70.385	2,02	141.858
16	Tempel	54.517	1,66	90.276
17	Turi	37.274	0,17	6.211

The average area of agricultural land in the western region remained above the LP2B area except in the Minggir Subdistrict, where there was a decrease of 65 hectares from the designated 1,321.92 hectares in 2020, as observed in Table 4. However, the agricultural land area fell below LP2B designation in most subdistricts in the eastern region, with Kalasan Subdistrict being an exception, maintaining 1,790.43 hectares in 2020, as indicated in Figure 10.

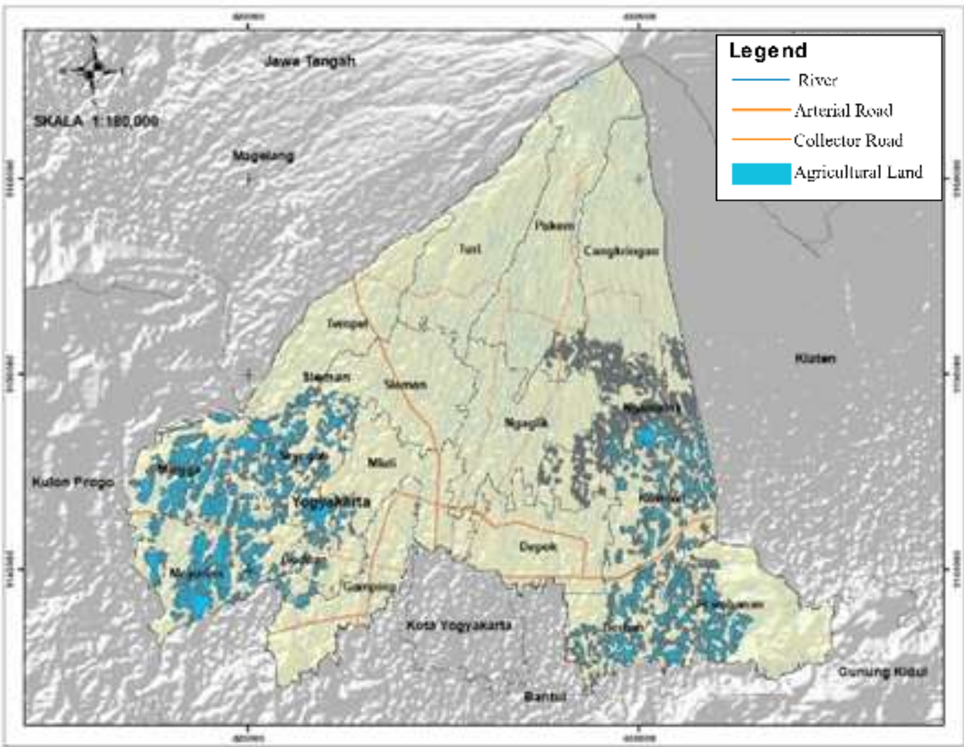

Figure 10 Agricultural Land Area in Sleman Regency Overlay Results with LP2B West and East Regions (Source: Research Data, 2024)

In Godean and Seyegan Subdistricts, irrigated rice fields were increasingly replaced by residential structures. Over the past five years, residential development in these areas grew rapidly due to developers constructing single-family homes and housing clusters. In contrast to nearby Yogyakarta City, West Sleman became a target for investors seeking affordable housing opportunities.

Sleman Regency faced challenges in meeting LP2B requirements outlined in the Special Region of Yogyakarta Provincial Regulation Number 5 of 2019 regarding RTRW. Although the regency had 18,137 hectares of agricultural land available in 2018, only 17,947.79 hectares were designated LP2B. Some of this land had been converted to other uses or rendered unproductive, creating tension between policy objectives and practical realities (Sarastika et al., 2023).

LP2B classification often conflicted with the farming community's income needs, as land could not be used for non-agricultural purposes. Meanwhile, other sectors, such as tourism, services, and construction, grew faster than agriculture (Sinuraya, 2021). When implementing the LP2B policy in Sleman Regency, landowners' desire to support the policy's implementation in compliance with the technical standards for LP2B determination should also be considered.

Landowners' understanding of land potential, problems, LP2B determination, and space adoption plans (RDTR) influenced their willingness to participate in the policy. However, studies have not been conducted on how the LP2B policy should be applied or how knowledge of regional characteristics could impact these understandings. The distinctive characteristics of this region could influence the willingness of landowners to support the implementation of the LP2B policy (Putri et al., 2022).

Palupi (2017) further found that while landowners in Sleman Regency were willing to adopt LP2B policies, the owners were conflicted about maintaining agricultural land versus modifying it for higher income potential. This tension formed the foundation for more efficient implementation of LP2B policies.

Following the policy's introduction, the Sleman Regency became one of several regions in Indonesia to adopt LP2B protection measures. Regency-level policy determination was critical in achieving national development objectives (Tampubolon et al., 2022). As a target zone for urbanization, Sleman Regency experienced a steady decline in agricultural land used for food production (Astuti & Lukito, 2020). The change in land use in Sleman Regency was estimated to reach 356.17 hectares over the last 4 years (Bappeda DIY Province, 2022).

Table 5. Overlay Results of Sustainable Food Agricultural Land with Agricultural Land

Description	Area (Ha)
Rice Field Area	17.495
LP2B	11.535,69
Overlay Results	8.038,51
Difference	3.497,19

CONCLUSION

In conclusion, studies conducted over the last 5 years showed that 4,412 agricultural land had been converted. Despite this conversion, the carrying capacity of agricultural land remained in Class I, indicating that the area could continue to be self-sufficient in food and provide a prosperous life for the population. However, the current conversion of agricultural land showed that the establishment of LP2B areas was insufficient to prevent agricultural land conversion. Alternative strategies, such as increasing agricultural productivity, were necessary to support the carrying capacity of agricultural land in addition to relying solely on field acreage.

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