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Sustainable Food Agricultural Land Preservation at Sleman Regency, Indonesia: An Attempt to Preserve Food Security

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Abstract

Urban development and increasing population impact improving the demand for non-agricultural land. Through the issuance of Law No. 41 of 2009 concerning the Protection of Sustainable Food Agricultural Land, the government has attempted to reduce the conversion rate of agricultural land by protecting paddy fields that are considered the potential for food supply. This study aims to examine the impact of the transformation of agricultural land to non-agricultural land on food security and the implementation of the Law No. 41 of 2009. The research method used is survey and descriptive. The focus of discussion includes population growth, land change, land area, harvested area, production and food availability needs data. The data was gathered from field observations, interviews and a literature study. The results showed that the average decrease in paddy fields in the last three years was 98.87 ha. The population density in Sleman Regency is classified as high. In 2018 to 2019 the population density increased by 22.88 people km^{-2}. In 2019 to 2020 the population density decreased by 163.35 people km^{-2}. In 2018 to 2019 rice productivity increased by 625 tons ha^{-1}, although harvested area and production have declined. There is no correlation between the location of paddy fields, population and rice productivity. The food security condition in Sleman Regency is generally stable, but the site of paddy fields that continues to decrease yearly must still be a concern.

Keywords: food security; land conversion; land use policy; population

INTRODUCTION

Sleman Regency is part of the D.I. Yogyakarta, with a relatively good agricultural system. Based on data from the Statistics of D.I. Yogyakarta Province (2018), Sleman Regency has the most extensive paddy field area, 19,131 ha among all regencies in the D.I. Yogyakarta. Rosidah et al. (2019), reported that many agricultural systems in the northern part of Sleman Regency are located in mountainous areas near volcanoes that are still actively emitting volcanic ash so that it supports soil fertility. In the south is a lowland surrounded by major rivers, including the Progo, Code, Yellow, Opak and Tapus. These rivers filled water reserves for the agricultural sector. Sleman Regency has fertile soil with sufficient water reserves making the farm sector the leading industry.

Urban development started to threaten the existence of agricultural land in the Sleman Regency. Sleman Regency has been influenced by the adjacent city of Yogyakarta's expansion. In addition, the increasing population is driving

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land conversion in Sleman Regency. The increasing population followed by agricultural land transformation into public services needed. This condition encourages Sleman Regency to develop city facilities such as roads and public service facilities such as trade, health, and market. According to Hidayah et al. (2022), the number of residents affects the area of conversion of agricultural land. The number of development interests has led to an increase in the value of conversion of agricultural land to non-agricultural land. Muryono and Utami (2020) reported to minimize the relocation of settlements is a consideration of development carried out in agricultural areas. Recently, researchers have faced the conversion of agricultural land into a phenomenon (Wulandari and Rahman, 2014). Many potential rural lands were converted, which would impact decreasing agricultural production. In the end, it threatens to national food security.

Protection of food agricultural land sustainability defines resilience as a condition for fulfilling food that reflects households from the availability of sufficient quantity and quality, safe, equitable and affordable. Function of land as a food security provider must continue to be pursued. According to Oktiana et al. (2020), the availability of sustainable food-agriculture land is essential for ensuring national food independence, security and sovereignty. Continuous agricultural land conversion without developing new agricultural land would provide a crisis of agricultural food land (Rizkiani and Sudrajat, 2015). Changing agricultural land to non-agricultural land requires considerable consideration, particularly in Sleman Regency. By the release of Law No. 41 in 2009 concerning the Protection of Sustainable Food Agricultural Land, the government has attempted to reduce the conversion rate of agricultural land to non-agriculture by protecting paddy fields considered the potential for food supply.

Agriculture represents one of the primary industries in the Sleman Regency. Conversely, urban expansion rapidly displaces agricultural land, which threatens food security stability. As stated by Law No. 41 of 2009, it is necessary to examine the impact of agricultural land conversion on food security and the execution of Protection of Sustainable Food Agricultural Land as a government effort to minimize the rate of agricultural land conversion to non-agriculture. This research seeks to ascertain the effect of changing agricultural land to non-agricultural land on food security and implementing sustainable food agricultural land protection.

MATERIALS AND METHOD

Time and study location

This research was conducted from February to March 2022. The time needed for this research is 30 days. The observation locations are made in the Sleman Regency area covering 17 sub-districts, especially in the conversion area of agricultural land into settlements.

Administratively, Sleman Regency consists of 17 sub-districts which have 86 villages. Geographically, Sleman Regency is located between 110°13'00" and 110°33'00" E, 7°34'51" and 7°47'30" S. Sleman Regency is bordered to the north by Boyolali Regency, to the east by Klaten Regency, to the west by Kulon Progo Regency and the south by Yogyakarta City (Figure 1).

Methods

Two methods were used to collect data in this study, direct and indirect. Field observations and interviews are the direct methods. Field observations were conducted to observe and identify existing problems directly. The interview approach involves interrogating field-related individuals about topics that will be investigated for implementation or are now being studied. The indirect method is carried out by recording secondary data, which includes population growth, land change, land area, harvested area, production and food availability need data. In addition, a literature search is conducted for the indirect approach. A literature review is conducted by searching for references that provide supplementary and comparative information for alternative problem-solving. These references are obtained from books, journals, magazines, newspapers and the internet. Data acquisition can be made by searching for data from previous research results related to the topic to be discussed. The success indicator on this research is the knowledge of the impact of converting agricultural land to non-agricultural land on food security and the implementation of sustainable food agriculture land protection.

Data analysis

This research implemented an institutional survey methodology. All obtained data were

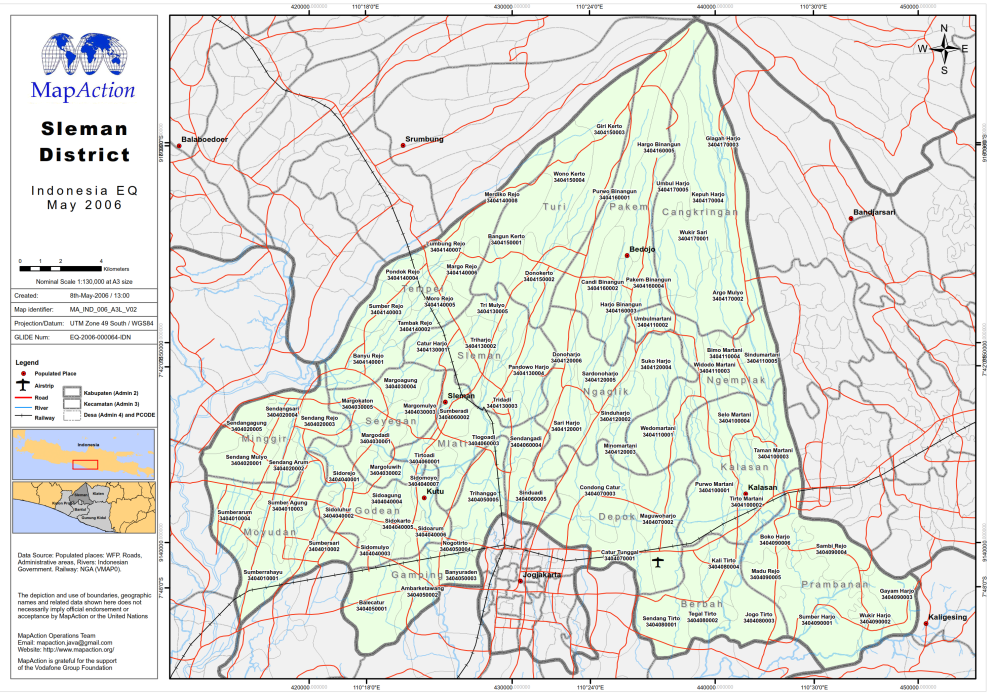

Figure 1. Administrative map of Sleman Regency
Source: MapAction, 2006

pooled to describe the scope and outcomes of land use change analyses in food security and security zones. The descriptive technique examines a group of people, things, conditions, a system of ideas or a sequence of occurrences (Jayusman and Shavab, 2020). The area of rice production and the need for food availability are calculated over three years (2018 to 2020). Over three years, the area of rice production and the necessity for food availability were determined (2018 to 2020). The presentation of existing data in descriptive statistics comprises tables, images, graphs and the estimation of the mean and percentage.

RESULTS AND DISCUSSION

Land conversion occurs a lot in Indonesia, especially in Sleman Regency. Land conversion is a shift in land uses, specifically a change in the function of a portion or entire land from its existing function to another. According to Suprianto et al. (2019), the necessity for land for non-agricultural activity is diminishing. Land use change can hurt the environment around the land. Lots of productive lands have been converted into housing, outlet, buildings and other facilities, which have caused obstacles to increasing crop yields.

Land conversion tends to be a problem (dangerous) to the agricultural sector. However, many agricultural lands are still converted due to economic pressure during times of monetary crisis. The conversion of paddy fields impacts the loss of food production. The greater the land use change, the greater the community's potential loss of food production.

A developing region typically has a rapid population increase, followed by a rising need for land for settlements and other public infrastructure, such as industries. Based on Table 1, known that paddy fields in Sleman Regency in 2018 to 2020 has been decreased. Counted in 2018 to 2019 decreased by 241 ha, and in 2019 to 2020 it was 55.6 ha. The average decrease in paddy fields in the last three years was 98.87 ha. The higher reduction of the paddy field was in 2018, and the lowest was in 2020. According to Octorio and Christanto (2014), strategic and comfortable make Sleman Regency has rapidly grown in residential housing.

Compared to other districts, Sleman Regency has the highest agricultural wealth. The land is a vital resource for farmers and agricultural growth in the agricultural industry. Light of the fact that Indonesia is an agricultural nation in which all agricultural activities are still land-based

Table 1. The variability of land use in Sleman Regency 2018 to 2020

Land use (ha)	2018	2019	2020
Yard	18,822.55	19,151.14	19,253.93
Paddy field	24,517.36	24,276.36	24,220.76
Moor	3,917.45	3,829.85	3,782.67
Forest	52.99	52.99	52.99
Barren land	1,263.84	1,263.84	1,263.84
Another	8,907.81	8,907.81	8,907.81
Total	57,482.00	57,482.00	57,482.00

Source: Ministry of Agrarian Affairs and Spatial Planning of Sleman Regency (2021)

(Putri, 2015). Maintaining urban development is essential to minimize adverse impact, primarily brief environmental factors (Kusrini et al., 2011). According to Sadali (2014), a rise in population might increase land demand. Population density is the ratio between the total population and the area occupied by a legal community, with geographical boundaries authorized to control and manage the local community's interests (Aprianti and Maliha, 2016). According to Janah et al. (2017), the rate of land use change is associated with the population growth rate, resulting in increased fulfillment of needs based on land use, such as settlements and other public facilities. The conversion of land functions has an impact on several aspects, the reduction or narrowing of agricultural land, decreasing farmer income, changes in the orientation of the use of commercial buildings, and farmers' desire to sell their land (Purwaningsih et al., 2015).

Based on Table 2, population density of Sleman Regency is categorized as high. The statement is consistent with Subkhi and Mardiansjah (2019) conclusion that the population density of 54.45 person km^{-2} is inside the high group. Based on population census data in 2021, Sleman Regency experienced an increase in population density from 2018 to 2020. In 2018 to 2019 the population density increased by 22.88 person km^{-2}. In 2019 to 2020 the population density decreased by 163.35 person km^{-2}. Indrianawati and Mahdiyyah (2019) convey the fast growth of the population, followed by development activities in various fields which can cause the demand for land to increase. Population density could lead to socioeconomic problems, welfare, security, landsustainability, water and food needs (Christiani et al., 2014). The demand for land continues to increase while the available decreases. It should be appropriately maintained and wisely to suppress land use problems, especially land conversion. Urbanization could not be avoided in Sleman Regency. According to Astuti and Lukito (2020), urbanization is defined as going to an urban area, changing occupation from farming to another, and changing human behavior patterns. Sleman Regency, as an educational center, residential destination, tourist destination and a place for cultural development, makes urbanization unavoidable.

Land conversion is also caused by low agricultural land rent. A land lease system is another name for land rent. Low-quality paddy fields are found in Sleman Regency. This condition makes paddy fields suitable for establishing new communities. According to Habibatussolikhah et al. (2016), paddy fields are frequently requested for land conversion to residential houses. This is due to the availability factor and the low level of land rent for paddy fields. According to Badoa et al. (2018), the majority of converted land is agricultural land. Conversion of paddy fields is economically beneficial since agricultural land has a lower land rent value than other sectors such as housing and industries (Anggari et al., 2016).

According to market economy laws, land is converted from activities with lower land rentals to activities with higher land rents (Erfrissadona et al., 2020). According to Hossaimah and Subari

Table 2. The population density in Sleman Regency in 2018 to 2020

Product	2018	2019	2020
Land area (km^2)	574.82	574.82	574.82
Total population (person)	1,206,714	1,219,699	1,125,804
Density (person km^{-2})	2,099.29	2,121.88	1,958.53

Source: Statistics of Sleman Regency (2021)

(2017), land rent is the economic value a plot of land generates when used for industry. Compared to land maintained by farmers, the rent for agricultural land used for non-agricultural purposes is relatively expensive. Land conversion operations in Sleman Regency are frequently unequal since agricultural land rental prices do not represent their actual worth (Harini et al., 2013). According to Mujahid and Prasoyo (2019), the worth of paddy fields can be determined by comparing the average land rent value to other land rent values. The resulting ratio value is 1:32.7. This means that the economic value of land will increase by 32.7 times by changing paddy fields to non-paddy fields. With these conditions, land conversion increases.

Farmer behavior is another component that promotes the conversion of paddy fields. As landowners, farmers have complete control over all actions that alter the operation of their land. Farmers are primarily responsible for determining whether or not agricultural land is protected (Suharyanto et al., 2017), as well as supporting the execution of various government initiatives to limit land conversion (Nuraeni et al., 2018). Farmers' actions that result in a rise in the conversion of agricultural land are driven by economic elements (Prihatin, 2016), such as land prices, income proportions, land acreage, land status and the lack of incentives farmers receive (Nurchamidah and Djauhari, 2017).

The high cost of production, while the price of agricultural products is relatively low, causes farmers incomes relatively low. The low income earned causes farmers to experience economic pressure to support their families, so they quickly sell their paddy fields. The low incentives obtained from farming compared to businesses in other sectors make the conversion of agricultural land to non-agricultural interests continue to occur. The low incentives are due to high production costs, while prices for agricultural products are relatively low and fluctuate. In addition, the factor of land productivity also influences the actions of farmers in converting their land. Lukman (2022) explains that the highest factor that causes farmers to convert or sell their land easily is that many think their paddy fields are no longer productive. Farmers will generally decide to sell their land immediately if a paddy field is no longer productive (Pradana et al., 2021).

Age, land area and agricultural experience influence decisions of farmers on land conversion (Kusumastuti et al., 2018). The higher the age level, the higher the level of land conversion and the weaker physical conditions limit the ability of farmers to work in the agricultural sector, which requires substantial human resources. Thus, farmers tend to convert their land. The greater the size of the land, the less likely it is to be developed. The larger the land, the higher the production yield, and consequently, the money created is more than that of farmers with smaller land holdings. The longer farmers have been cultivating land, the more excellent their farming skills are, allowing them to continue to defend their land (Peniarti et al., 2018).

One of the causes of land conversion in the Sleman Regency is the lack of interest in agriculture among the younger generation. Farmers are the primary actors who are crucial to the agricultural sector's operation. Despite rising food requirements, the number of farmers in Indonesia is declining. This could be related to the very low interest of the younger generation in the agricultural sector (Setiani et al., 2021). Regarding sustainable agricultural development, the age range of 16 to 30 includes the younger generation. Oktavia and Suprapti (2020) in their research stated that today's farmers are dominantly aged 45 years and over. Hence, their grasp of technology remains limited and is passed down through the family.

The higher the level of education, the less the younger generation is interested in agricultural pursuits. According to Werembinan et al. (2018), the younger generation with permanent work in non-agricultural fields despises agricultural activities because they believe they have a low social standing. The agriculture sector contributes the most to employment at 35.3%, although changes in the demographic structure that are detrimental to the agricultural sector and result in the aging of farmers remain an issue (Arvianti et al., 2019). According to Widiarsa and Suartika (2018), urbanization alters attitudes and habits, particularly among the younger generation, consequently diminishing the agricultural sector's appeal.

The younger generation currently depends on the non-agricultural sector in urban areas for income. The younger generation's interest in the agricultural sector is low because agriculture

is synonymous with villages and poverty (Mukti et al., 2022). The existence of young farmers is related to agricultural regeneration, which is very important in preserving agricultural land to create future food security (Anwarudin et al., 2020).

Harvested area, production, productivity

Due to the expansion of non-agricultural enterprises, agricultural land is gradually declining. Land conversion in Sleman Regency substantially impacts rice yield and the area harvested. Ansori (2021) explains that land contributes significantly to farming. Rice yield production may be influenced by the amount of land used. According to Fauzi et al. (2019), food is derived from water and biological sources, whether packaged, processed or unprocessed, meant for human consumption as food or drink, including food additives.

According to Table 3, rice productivity declined by 2 tons ha^{-1} from 2019 to 2020. According to Nurzannah et al. (2020), an increase in the area of assault by plant-disturbing organisms can reduce rice yield (OPT). In 2018 to 2019, rice productivity grew by 625 tons ha^{-1} despite declining harvested area and output. This condition can develop due to using rice seeds of unique kinds and employing various cultivation methods (Hambali and Lubis, 2015).

Correlation between land area, population and productivity

Table 4 describes the correlation coefficient and significant value between the variables of a paddy field area, population and rice productivity in Sleman Regency. Significant test findings obtained (Sig. 2-tailed) values of 0.741 for the variable area of paddy fields with population, 0.115 for the variable area of paddy fields with productivity, and 0.626 for the variable area of paddy fields with population and productivity. There is no correlation between paddy field area, population and rice yield, as all three variables have a significance level > 0.05. This is in stark contrast to the established assumption that a decrease in available paddy fields might have an impact on the harvest area and agricultural product yield. In actuality, the situation is the opposite. Even though paddy field acreage has reduced, Sleman Regency has boosted agricultural productivity. According to Rizkiani and Sudrajat (2015), the productivity of agricultural products can be increased despite shrinking agricultural land through good agricultural intensification, increasing harvest frequency, using a superior seed variety, adequate production equipment, and the availability of adequate irrigation.

Food security

Food is a fundamental human need. Because they must be satisfied, food requirements are vital (Miyasto, 2014). The availability and cost of food are vital measures of national stability. According to Nurpita et al. (2018), the most common danger to national food security is the shrinking of agricultural land, particularly paddy fields. The lack of planting areas increases food security susceptibility. As a result of the considerable decline in rice farming in the non-agricultural sector, farmer income decreased, diminishing their drive to expand production. A region's food security is inextricably linked to its total output, total consumption, affordability of food distribution and food reserves.

Based on Table 5, the highest rice production in Sleman Regency in 2018 to 2020 was achieved in 2018 at 249,878 tons, while the lowest production value was in 2019 at 244,507 tons. The rice stock as a food ingredient in Sleman Regency during 2018 to 2022 was 145,289.69; 143,100.82 and 143,534.86 tons, respectively. Followed by the consumption needs of the people of Sleman Regency during 2018 to 2020 was 62.75, 65.61 and 63 kg $capita^{-1}$ $year^{-1}$, respectively. Food reserves of Sleman Regency government have increased significantly. In 2018 to 2019 the government's food reserves increased by 10 tons. In 2019 to 2020 the increase in food reserves in Sleman Regency was 25.01 tons. According to Salim and Darmawaty (2016), an indicator to measure the affordability of food security at the household level can be seen

Table 3. Rice productivity in Sleman Regency 2018 to 2020

Product	2018	2019	2020
Land area (ha)	46,820	41,011	41,156
Production (tons)	249,878	244,507	245,292
Productivity (tons ha^{-1})	5.337	5.962	5.960

Source: Statistics of Sleman Regency (2021)

Table 4. Correlation between land area, population and productivity in Sleman Regency

		Paddy field area in 2018-2020	Total population	Productivity
Paddy field area in 2018-2020	Pearson correlation	1	.396	-.984
	Sig. (2-tailed)		.741	.115
	N	3	3	3
Total population	Pearson correlation	.396	1	-.554
	Sig. (2-tailed)	.741		.626
	N	3	3	3
Productivity	Pearson correlation	-.984	-.554	1
	Sig. (2-tailed)	.115	.626	
	N	3	3	3

Table 5. Total production, stock of rice as a food ingredient, consumption and food reserves in Sleman Regency 2018 to 2020

Product	2018	2019	2020
Production (ton)	249,878	244,507	245,292
Stock of rice as a foodstuff (ton)	145,289.69	143,100.82	143,534.86
Consumption (kg capita^{-1} year^{-1})	62.75	65.61	63.00
Government food reserves (ton)	62.83	72.83	97.84

Source: Department of Agriculture, Food and Fisheries (2021)

from the ease with which they access food. The level of rice consumption required is lower than the amount produced, means that balanced supply and demand, so that food availability in Sleman Regency is still sufficient (Rosyadi and Purnomo, 2012).

Protection of sustainable food agricultural land as an effort to reduce the rate of land conversion

The land is a natural resource with a fixed amount and cannot be created. Therefore, land use regulation is needed to control changes in land use, especially converting agricultural land to non-agricultural land (Burdatun, 2016). On the large, the area of paddy fields, which continues to decrease yearly, can cause a decrease in food production (Janah et al., 2017). Regarding this problem, agricultural food land needs to be protected. The issue of Law No. 41 of 2009 concerning the Protection of Sustainable Food Agricultural Land (LP2B), the government reacted to protect agricultural land being converted. LP2B is a system and process for planning, establishing, developing, utilizing and fostering, controlling, and supervising agricultural land and its areas sustainably. The law also stipulates the protection of Sustainable Food Agriculture Reserves (LCP2B). LCP2B is an island considered the potential for the agricultural sector. Its use is protected so that its suitability and availability remain controlled for future use as sustainable food agriculture land.

The Sleman Regency government released Sleman Regency Regional Regulation No. 12 of 2012 about the Sleman Regency Spatial Plan for 2011 to 2031 as part of the subsequent LP2B. In this regional rule, the area for food crop farming has been specified under article 36, paragraph 2: roughly 21,113 ha covering rice, corn, soybeans, peanuts and tubers in practically all sub-districts. The regional law's regulation for protecting agricultural land is limited to land with allotments for agricultural activity. There has been no identification of sustainable food farming land in recent years. As a result, the Sleman Regency administration released a new regional regulation concerning LP2B as a policy update. The revised LP2B is the Regional Regulation of Sleman Regency No. 6 of 2020 concerning the protection of sustainable food agricultural land. In article 8, paragraphs (1) and (2) of Sleman Regency Regional Regulation No. 6 of 2020, the area of the Sleman Regency Sustainable Food Agriculture Area is specified as 18,482.04 ha, which includes 17,947.54 ha of sustainable food agricultural land and 534.50 ha of LCP2B. LP2B in Sleman Regency has been determined to be spread over 16 out of 17 existing *kapanewon*

(Sinuraya, 2021). The exception for *Kapanewon* Depok is not included in the LP2B designation area. In comparison, LPC2B is only found in *Kapanewon* Cangkringan, with an area of 534.50 ha.

Establishing the area of paddy fields to become LP2B and LCP2B can be an alternative to controlling the conversion of functions. Otherwise, it should follow the intention of managing land use. Therefore, the government provides incentives and disincentives to farmers who own agricultural land. Compensation as intensive is a reward for the farmer who follows the rule. Based on article 7 of Government Regulation No. 12 of 2012 concerning Incentives to Protect Sustainable Food Agricultural Land, the regency/city governments provide incentives to farmers in the form of (1) land and building tax relief assistance; (2) agricultural infrastructure development; (3) financing research and development of superior seeds and varieties; (4) easy access to information and technology; (5) provision of agricultural production facilities; (6) financial assistance for the issuance of certificates of land rights on sustainable food agricultural land; and (7) awards for high achieving farmers. The government also applies to remove incentives for those who do not follow the rule. Maulana and Samsul (2019) explain that the government imposes three forms of disincentives, namely revocation of incentives that have been given, replacing paddy fields that have been converted, and replacing the value of infrastructure investment.

CONCLUSIONS

The area of paddy fields, population growth, and agricultural product production do not exhibit a link, indicating that the three factors do not influence one another. Each year, the administration of the Sleman Regency has dramatically boosted its food reserves. Despite a decline, the total paddy stock controlled by the government remains quite considerable. The ratio of the community's rice consumption to rice production and rice storage as food is still relatively low, so food is still available in Sleman Regency. Nevertheless, the annual decline in paddy field acreage remains a cause for concern. Implementing Sustainable Food Agricultural Land Protection in Sleman Regency under Sleman Regency Regional Regulation No. 12 of 2012 and Sleman Regency Regional Regulation No. 6 of 2020 must be stressed to sustain land availability and food.

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