Land use change trend of paddy field and its influence on food security in Gerbangkertosusila Region

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Abstract. Economic growth encourages development growth in the Gerbangkertosusila (or can be shortened as GKS) region, which is a challenge for the agricultural sector. The phenomenon of changing the function of paddy fields to developed land because of the high demand for land can threaten the food security of a region. This research will model the trend of land use change and its impact on food security in GKS region in the next 20 years using cellular automata methods and quantitative statistics. Data collection was carried out by literature studies, field observations and interviews through questionnaires to relevant stakeholders. The results of the spatial modeling analysis of the paddy field conversion trend show that there are three regions that have the highest conversion rate of paddy fields in the GKS region, namely Sidoarjo, Gresik and Surabaya City. After further analysis related to food demand projections and rice production projections is carried out, Surabaya and Sidoarjo Regency is currently experiencing a food deficit which could last even in the years ahead. Having this result, the role of several other regencies such as Lamongan and Mojokerto Regency is needed in maintaining food security in the GKS region.

Keywords. paddy field, land use change, food security

1. Introduction
The Surabaya Metropolitan Area or better known as Gerbangkertasusila (GKS) Region is a large-scale urban area located in Jawa Timur Province. The Region consists Surabaya City, Mojokerto City, Bangkalan Regency, Sidoarjo Regency, Gresik Regency, Lamongan Regency, and Mojokerto Regency. GKS region is the center of the Jawa Timur Province economy with the main driving force in the industrial and service trade sectors [1]. Based on data from a World Bank study (2012), it is stated that the economic contribution of the GKS region is the second highest in Indonesia after the Jakarta Metropolitan Area (Jabodetabek). In addition, the GKS region is an area that contributes nearly 50% of the economy in Jawa Timur Province [2].

The vital role of the GKS region naturally encourages development growth, both physically and non-physically. Physically, the expansion of industrial and trade areas is evident in most of the GKS areas, as well as the development of residential areas because of the increasing population in the GKS region and the availability of job opportunities that are concentrated in the GKS region. The population growth in the GKS region from 2010 to 2019 have increased by almost 1 million people [3].

Economic growth that drives development growth in the GKS region is a challenge for the
agricultural sector. The development of industry, trade and settlements often outweighs the interests of the agricultural sector, which are considered to have less impact on the regional economy. As a result, conversion of agricultural land has become a real phenomenon recently, especially in areas with fast economic growth such as the GKS region.

In Surabaya, agricultural land has decreased in the period of 2012-2016 by 300 Ha, meaning that every year the rate of shrinkage of agricultural land is 75 Ha [4]. The reduction of agricultural land also occurs in Sidoarjo Regency amidst the increasing need for food in this regency, where the current demand for rice in Sidoarjo Regency is almost 300 thousand tons / year, while the existing rice production is only 239 thousand tons and this continues to decline due to the shrinking area of agricultural land [5]. Agricultural productivity is significantly influenced by the extent of farming land area [6].

Conversion of land functions is one phenomenon that cannot be avoided amid the dynamics of urban growth. However, land use change becomes a big problem when it results in environmental damage that touches human survival, especially food supply [7]. A study states that food security is influenced by agricultural land ownership [8]. In this perspective, agricultural land is seen as a critical factor determining food sustainability [9] One type of agricultural land that is most prone to conversion is paddy field [10]. This occurs due to the low incentives or income received by farmers for managing paddy fields compared to their use for other sector activities [11]. Thus, if the conversion of agricultural land is not controlled, it can threaten the capacity to supply food, even in the long term it can result social disasters.

The development of food security is the mandate of Law No.7 of 1996 where the government guarantees the fulfillment of food for every household, both in quantity and quality, safe, equitable and affordable. However, government policies in the agricultural sector have not yet been fully implemented due to a lack of coordination between the Central and Local Governments, as well as a lack of commitment by the Regional Government in protecting agricultural land, especially land for sustainable food agriculture. In addition, it is felt that the existing policies have not touched the realm of farmer welfare. Therefore, the efforts to achieve food security are hampered by the problem of conversion of productive agricultural land, especially paddy fields [7][12].

Based on this phenomenon, it is interesting to study the trend of land conversion and its impact on food security in the GKS region. So far, research on food security has been studied through economic and social aspects. Spatial studies are rarely carried out, especially in relation to predicting land use change. Therefore, this research will examine spatially the trend of the change in function of paddy fields for the next few years, and how the effect of the conversion of paddy fields on food security through a projection model of rice production in the GKS region.

2. Methods
The method for assessing the trend of the conversion of paddy fields in the GKS area was carried out by means of literature studies, data collection, and analysis. Literature study is used to determine research variables according to the theory and concept of conversion of paddy fields and food security. The data collection method was carried out in two ways, namely primary surveys, and secondary surveys. Primary data collection in this study was obtained through direct field observations, structured interviews, and ground checks for the updating and field validation processes. Meanwhile, a secondary survey was carried out to obtain existing land cover map data from SPOT imagery in 2019, forest area map, 2018 rice fields map, irrigation map, 2018 per capita consumption data, infrastructure map, and 2015-2019 population data.

This research consists of four stages of a structured analysis, first overlay analysis of 2018 paddy field map and 2020 land cover map to obtain the characteristics of the paddy field function conversion pattern. Second, AHP (Analytical Hierarchy Process) analysis with the help of Expert Choice software (to identify the driving factors for conversion of paddy filed land use). Third, spatial modeling of paddy field conversion trends using the cellular automata method with the help of LanduseSim software [13][14], and finally to analyze the effect of the conversion trend of paddy fields on food security by
comparing the need for food with rice production per year in the GKS region.

3. Results

3.1. Land Use Change of Paddy Field Analysis in the GKS Region

The pattern of paddy field conversion in the GKS region is based on the results of the overlay of the paddy field map in 2018 and the land cover map in 2020 by means of ArcGIS software. Existing land cover in the GKS area is dominated by paddy fields and settlements. The paddy fields area reaches 246,085.075 Ha, or around 38.2%, while the settlements area reaches 123,476.993 Ha or 19.15% of the total area of the GKS region. Meanwhile, the area of paddy fields according to the Decree of the Minister of ATR/BPN-RI No.399/Kep-23.3/X/2018 is 250,102.135 Ha which are widely spread in Lamongan and Gresik Regencies. After overlaying, the results of the land use change pattern area can be explained in the table below.

### Table 1. Paddy Field Land Use Conversion Distribution in GKS Region

| Regency/City | Extent (Ha) | Total Conversion |
|--------------|-------------|-----------------|
|              | 1   | 2  | 3   | 4  | 5   | 6  | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  |     |
| Bangkalan    | 105.5| 0  | 14.9| 22.7| 0.38| 0   | 3.45| 1.53| 0   | 0   | 0   | 0.66| 0   | 0   | 149.36|
| Gresik       | 126.0| 59.0| 0   | 1.21| 0.51| 0   | 0.44| 0.04| 0.32| 0   | 0.74| 0  | 0   | 0   | 188.45|
| Lamongan     | 22.24| 29.3| 13.6| 1697| 24.1| 0.65| 0.28| 81.8| 20.8| 3.64| 0.51| 0.00| 0   | 0   | 1894.3|
| Mojokerto    | 96.16| 3.57| 18.9| 50.3| 22.0| 0.04| 4.80| 0.22| 0.01| 0.96| 2.25| 0  | 0   | 0.02| 0   | 199.38|
| Sidoarjo     | 164.7| 100.| 0   | 0   | 0.18| 0   | 0   | 0.11| 0.06| 0.00| 0.00| 0  | 0   | 0   | 0   | 265.44|
| Mojokerto City | 7.33| 0   | 0   | 0   | 0.45| 0   | 0   | 0.01| 0.0 | 0.17| 0.18| 0  | 0   | 0   | 0   | 8.17|
| Surabaya City | 116.0| 138.| 8   | 90. | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0  | 0   | 0.59| 0   | 255.58|
| Total        | 638.1| 331.| 47.5| 1771| 47.7| 0.70| 9.01| 83.7| 21.2| 4.79| 3.70| 0.00| 0.67| 0.02| 0.59| 2960.7|

*Description: 1 = Settlements  6 = Plantation  11 = Seasonal Dry Land Farming  2 = Industry  7 = Mixed Plantation  12 = Other Non-Cultivated Vegetation  3 = Protected Forest  8 = Water Body  13 = Mangrove  4 = Production Forest  9 = Open Land  14 = Mining  5 = Field  10 = Scrub  15 = Toll Road

From the table, it can be explained that there are 2 types of land use change patterns in the GKS region. First, the conversion of paddy fields to built-up land, namely settlements and industry. The land use change of rice fields to settlements occurred in Gresik Regency with 126.07 hectares, Sidoarjo Regency with 164.72 hectares, and Surabaya City with 116.08 hectares. Meanwhile, the conversion of paddy fields to industry occurred in Surabaya City with 138.9 hectares and Gresik Regency at 59.09 hectares. Second, the conversion of paddy fields to non-constructed land, namely paddy fields that are in Production Forest Areas and Protected Forest Areas (paddy field in forest areas). This type of conversion occurs a lot in Lamongan Regency of 1697.09 Ha and Mojokerto Regency of 50.37 Ha.

3.2 Identification of Factors Driving Paddy Fields Land Use Change

The driving factors for the conversion of paddy fields in the study area were carried out by using AHP analysis techniques on 6 variables from the literature study as input analysis, namely road networks, transportation facilities, development of settlements, industrial development, irrigation networks, and water sources [15][16]. From the results of the AHP analysis, the factors that influence the conversion of paddy fields in GKS region are as follows.
Table 2. Weight of Factors Driving Paddy Field Land Use Change

| Factors Driving Paddy Field Land Use Change | Weight |
|--------------------------------------------|--------|
| Road Network                               | 0.328  |
| Transportation Facilities                  | 0.063  |
| Settlement Development                      | 0.474  |
| Industrial development                      | 0.050  |
| Irrigation Network                         | 0.027  |
| Water Supply / Source                       | 0.058  |

From the table above, it can be explained that the development factor of residential areas is the most dominant factor in encouraging the conversion of paddy fields in the study area, with an influence weight of 0.474, followed by the road network factor which has an influence weight of 0.328. The overall inconsistency value in the AHP is 0.07. This means that it is still within the inconsistency threshold, which cannot be more than 0.1. The results of this analysis will later be used as a reference in further analysis, namely modeling the trend of conversion of paddy fields in the research area.

3.3 Paddy Field Land Use Change Trend Modelling in GKS Region

The trend of conversion of paddy fields in the GKS area was obtained by the Cellular Automata method using LanduseSim software. Modeling only includes built-in land use classes (residential and industrial) that can be seen in real development and based on previous analysis of land change patterns, thus ignoring non-built land use classes. The land use conversion modeling process is based on a trend-oriented approach based on land change patterns in the GKS area. The land change pattern will be used as the basis for compiling the rules for modeling land use change. This is done by identifying land classes. The model will determine which land classes that are converted, and which are not converted due to the development of other land classes. Furthermore, the annual average growth for growing land class can also calculated. The driving factors for land use change in the land use conversion model are used to prepare a suitability map for each land class that is predicted to develop. The followings are land development prediction maps in the GKS area.
Figure 1. Spatial Modelling of Land Use Development Prediction in GKS Region

Based on the results of the spatial modeling of land development that has been carried out, the prediction of land development in the GKS region for the next 20 years can be seen. This development shows the conversion of land use areas from non-built to built in line with the development of residential and industrial land in all districts / cities in the GKS region as described in the following table.

Table 3. Prediction of Paddy Fileds Change Driven by Settelements and Industries in GKS Region

| Regency/City     | Paddy Field Extent (Pixel) | Harvest Extent (Pixel) |
|------------------|---------------------------|------------------------|
|                  | 2020 | 2025 | 2030 | 2035 | 2040 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Bangkalan        | 37387 | 37298 | 37245 | 37170 | 37084 | 44699,03 | 44634,58 | 44586,47 | 44503,44 | 44416,62 |
| Gresik           | 45485 | 45281 | 45082 | 44861 | 44638 | 81687,59 | 81444,60 | 81014,35 | 80650,97 | 80281,46 |
| Lamongan         | 108071 | 108015 | 107952 | 107888 | 107834 | 183374,38 | 183308,43 | 183232,28 | 183165,86 | 183109,22 |
| Mojokerto        | 38622 | 38467 | 38312 | 38151 | 37989 | 67094,52 | 66865,47 | 66632,57 | 66407,90 | 66168,51 |
| Sidoarjo         | 23770 | 23373 | 22988 | 22612 | 22254 | 42365,89 | 41751,01 | 41124,16 | 40519,70 | 39913,91 |
| Mojokerto City  | 470  | 462  | 456  | 453  | 448  | 770,97 | 758,07 | 750,80 | 745,79 | 740,25 |
| Surabaya City   | 2023 | 1872 | 1702 | 1496 | 1219 | 3537,45 | 3327,80 | 3060,75 | 2717,11 | 2219,93 |
| **Total**       | 255828 | 254768 | 253737 | 252631 | 251466 | 423529,84 | 421989,96 | 420401,37 | 418708,77 | 416849,90 |

1 pixel = 100x100 = 1 hectare

From the table above, it can be explained that in general the decrease in the area of paddy fields due to the development of paddy fields and industry in GKS an average of 218.1 hectares per year, where the largest average conversion of paddy fields occurs in Sidoarjo Regency which is predicted to lose 75 of paddy fields 8 hectares per year. Large amounts of conversion also occur in Gresik Regency, with an average conversion rate of paddy fields predicted to reach 42.35 hectares per year. Furthermore, the city of Surabaya is predicted to experience a loss of rice fields of 40.2 hectares per year due to the development of residential and industrial land.
In more detail, Sidoarjo Regency turns out to have a land conversion growth rate that has decreased from year to year with the largest conversion predicted to occur in the period 2020-2025 and 2025-2030. Meanwhile, Gresik Regency is predicted to have a paddy field conversion rate that tends to increase from year to year with the largest conversion occurring in the period 2035-2040. The rate of conversion of paddy fields in the area around Surabaya City, especially Sidoarjo and Gresik Regencies, will be another interesting study if it is discussed more deeply.

From these results, it is very rational if we look at the possibilities that will happen to paddy fields in the GKS region. The high rate of paddy fields conversion in Sidoarjo and Gresik Regencies due to the development of built-in land is the impact of Surabaya City development. The development is currently heading to the periphery of Surabaya City which administratively borders Sidoarjo and Gresik Regencies [17]. The massive growth rate of Surabaya City which is supported by the lack of non-developed land in the area, as well as the high land value encourages urban expansion towards the suburbs, namely Sidoarjo and Gresik Regencies [18]. The predicted rice field area for the next 20 years is multiplied by the productivity (harvest intensity of one rice field in 1 year) to calculate the extent of harvested area in the GKS region.

3.4 The Influence of Paddy Field Land Use Change to Food Security in GKS Region
To know how paddy field land use change related to food security, the food demand is compared to rice production per year in GKS region.

3.4.1 Population Projection

To calculate the need for food in the GKS area, a population projection is required. The calculation of population projections in the study area uses three approaches, namely the Linear Method, Multiple Interest, and Linear Regression. Of the three approaches, the linear regression method was chosen because it has the lowest deviation. The results of population projections can be seen in the following table.

| Regency/City        | Population Prediction (Person) |
|---------------------|--------------------------------|
|                     | 2020  | 2025   | 2030   | 2035   | 2040   |
| Bangkalan           | 994056.9587 | 1032838.661 | 1071620.364 | 1110402.066 | 1149183.769 |
| Gresik              | 1315538.552 | 1366862.397 | 1418186.241 | 1469510.086 | 1520833.93 |
| Lamongan            | 1217130.673 | 1264615.275 | 1312099.878 | 1359584.48 | 1407069.083 |
| Mojokerto           | 1125734.881 | 1169653.808 | 1213572.735 | 1257491.663 | 1301410.59 |
| Sidoarjo            | 2235570.555 | 2322788.124 | 2410005.694 | 2497223.264 | 2584440.834 |
| Mojokerto City      | 1303311.8217 | 1354165.5302 | 1405012.388 | 145585.9473 | 150670.6559 |
| Surabaya City       | 2942595.859 | 3057397.004 | 3172198.149 | 3286999.294 | 3401800.439 |
| Total               | 9960959.3 | 10349571.8 | 10738184.3 | 11126796.8 | 11515409.3 |

From the table, it can be explained that all regencies/cities in the GKS will experience population growth until 2040 with an average population growth of 20% per year. The largest population prediction is in Surabaya City, followed by Sidoarjo Regency. The growth is inseparable from the influence of the Surabaya City development which tends towards Sidoarjo Regency. Meanwhile, the lowest population in the GKS region is in Mojokerto City, which is associated with a narrow administrative area, so the population density figure remains high. The results of this analysis will become a reference for calculating the amount of food needed.

3.4.2 Food Needs Projection

Food needs analysis is used to determine the estimated food needs of the population in the GKS region. This calculation is based on the total population multiplied by per capita consumption (kg) obtained...
from the results of the 2018 national socio-economic survey (SUSENAS). From these data, it can be seen that the per capita consumption of East Java residents for rice commodities is 91.30 kg per year. The results of the prediction of food demand in the GKS region can be seen in the following table.

Table 5. Prediction of Food Needs (Rice) in GKS Region in 2020 – 2040

| Regency/City       | Rice Consumption Per Capita (Kg) | Prediction of Food Needs (Rice) (Kg) | 2020 | 2025 | 2030 | 2035 | 2040 |
|--------------------|----------------------------------|--------------------------------------|------|------|------|------|------|
| Bangkalan          | 91.3                             | 90,757,400.33                        | 94,298,169.77 | 97,838,939.20 | 101,379,708.64 | 104,920,478.08 |
| Gresik             | 91.3                             | 120,108,669.82                       | 124,794,536.82 | 129,480,403.82 | 134,166,270.82 | 138,852,137.81 |
| Lamongan           | 91.3                             | 111,124,030.41                       | 115,459,374.63 | 119,794,718.84 | 124,130,063.06 | 128,465,407.27 |
| Mojokerto          | 91.3                             | 102,779,594.64                       | 106,789,392.69 | 110,799,190.74 | 114,808,988.80 | 118,818,786.85 |
| Sidoarjo           | 91.3                             | 204,107,591.64                       | 212,070,555.76 | 220,033,519.87 | 227,996,483.99 | 235,959,448.10 |
| Mojokerto City    | 91.3                             | 11,899,295.32                        | 12,363,529.21 | 12,827,763.10 | 13,291,996.99 | 13,756,230.88 |
| Surabaya City      | 91.3                             | 268,659,001.92                       | 279,140,346.46 | 289,621,691.01 | 300,103,035.55 | 310,584,380.09 |
| **Total**          |                                   |                                      | 909,435,584.09 | 944,915,905.34 | 980,396,226.59 | 1,015,876,547.84 | 1,051,356,869.09 |

Based on the results of the analysis, it can be seen that the need for food (rice) in the GKS region until 2040 reaches 1051356.87 tons. In line with the distribution and population, it can also be seen that the Surabaya City is an area that has the highest amount of food needs up to 310584.38 tons, followed by Sidoarjo Regency which has a total food requirement of 235959,448 tons.

3.4.3 Rice Production Projection in GKS Region

This analysis aims to determine the amount of rice production in the GKS Area from the available land for the next 20 years. The calculation of rice production is based on the harvested area, productivity, and yield coefficient. Other technical factors such as the use of seeds, fertilizers and other technologies in agricultural activities are not considered. The following is the projection of rice production in the GKS region from 2020 to 2040.

Table 6. Projection of Rice Production in GKS Region from 2020 to 2040

| Regency/City       | Paddy Production (Ton) | Yield Coefficient (%) | Rice Production (Ton) |
|--------------------|------------------------|-----------------------|-----------------------|
|                    | 2020 | 2025 | 2030 | 2035 | 2040 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Bangkalan          | 26582 | 26544 | 26515 | 26466 | 26414 | 64,10 | 17039 | 17014 | 16996 | 16964 | 16931 |
| Gresik             | 48988 | 48782 | 48584 | 48366 | 48144 | 64,10 | 31401 | 31269 | 31142 | 31002 | 30860 |
| Lamongan           | 11158 | 11154 | 11149 | 11145 | 11142 | 64,10 | 71524 | 71499 | 71469 | 71442 | 71421 |
| Mojokerto          | 39867 | 39731 | 39593 | 39459 | 39317 | 64,10 | 25555 | 25467 | 25379 | 25293 | 25202 |
| Sidoarjo           | 28588 | 28173 | 27750 | 27342 | 26933 | 64,10 | 18325 | 18059 | 17788 | 17526 | 17264 |
| Mojokerto City    | 4890, | 4808, | 4762, | 4730, | 4695, | 64,10 | 3134, | 3082, | 3052, | 3032, | 3009, |
| Surabaya City      | 18596 | 17494 | 16090 | 14283 | 11670 | 64,10 | 11920 | 11213 | 10313 | 9155, | 7480, |
| **Total**          | 25604 | 25511 | 25415 | 25313 | 25200 | 64,10 | 16412 | 16353 | 16291 | 16225 | 16153 |

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From the calculation table, it can be explained that rice production in all districts / cities in the GKS Region is predicted to experience a decrease in the amount of production. This is in line with the decline in land area in the area as a result of the development of developed land (residential and industrial) over the next 20 years. The calculation results show that the largest rice production is in Lamongan Regency, followed by Gresik Regency and Mojokerto Regency. If we look in more detail, it can be explained that the largest decline in rice production was in Sidoarjo and Gresik Regencies. Sidoarjo Regency is projected to experience a decrease in rice production by an average of 530.3 tons per year, and Gresik Regency is projected to experience a decrease in rice production per year by an average of 270.26 tons. Meanwhile, Surabaya City and Mojokerto Regency are projected to experience a decrease in rice production by 221.99 tons and 176.35 tons per year, respectively. This phenomenon shows the magnitude of the influence of paddy field conversion on rice production in the GKS region.

3.4.4 Comparison of Food Needs Projection and Rice Production
The results of the analysis of food needs and rice production are compared to measure food security in the study area with indicators of food surplus or deficit. The results of a comparative analysis of food needs and rice production can be seen in the figure below.
Based on the comparison, it can be explained that in general the GKS Region is in a rice surplus condition. This can be seen from the amount of excess rice stock in the GKS within the next 20 years to 2040 amounting to 575944.12 tons. However, this surplus condition is not the same in every Regency/City in GKS. From this analysis, it can be seen that Surabaya City, Mojokerto City, and Sidoarjo Regency are currently in a state of rice deficit.

Urban areas such as the Surabaya City and the Mojokerto City which tend not to be oriented towards the agricultural sector have made the role and function of the agricultural sector in these areas receiving low attention. On the other hand, the function of urban areas as centers of activity encourages the creation of a very high demand for food. The demand is particularly in line with the high population in the region. Sidoarjo Regency as an area that is directly affected by the expansion of the urban area of Surabaya has experienced the development of industrial and residential land which have an impact on the imbalance of food supply and demand in this region.

Areas with rice surpluses include Lamongan, Gresik, Mojokerto and Bangkalan Regencies. The low rate of conversion of paddy fields and population growth in Lamongan Regency has resulted in a very high rice surplus in this area, reaching 585749.36 hectares. In other words, the condition of food self-sufficiency (rice) in the GKS region is very dependent on Lamongan Regency.

Apart from Lamongan Regency, Gresik Regency is one of the areas that is currently predicted to experience a rice surplus for the next 20 years. However, considering the high rate of conversion of paddy fields and the high rate of population growth in this area, a massive effort to support and maintain the existence of Gresik Regency as surplus area in the GKS region is needed.

4. Conclusion
Paddy fields need to be understood as a land commodity that is inseparable from the land conversion phenomenon due to its passive characteristics and cannot develop naturally. Based on the phenomenon that occurs, where almost every district/city in the GKS region has experienced quite high conversion of paddy fields, it is important to understand the concept of urban rural linkage in a regional context, so that the role and function of each region in the GKS can be mapped clearly. Urban areas such as Surabaya City and Mojokerto City as regional activity centers are areas that are not oriented to the agricultural sector, but the need for food is the highest among other areas in the GKS, so the role of other areas around urban areas is very important in the process of meeting food needs in the region.

Sidoarjo Regency and Gresik Regency are areas that have the highest rate of conversion of paddy fields in the GKS region, this is a result of the massive development of the city of Surabaya which has experienced expansion in its surrounding areas. Meanwhile, the potential of these two regions in the agricultural sector and the demand of food in the GKS region is still quite high, so that proper planning...
is needed in dealing with these two phenomena. Lamongan Regency is the area that has the biggest contribution in meeting food needs in the GKS area, this can be seen from the large area of rice fields and the amount of rice production in this region. Thus, it needs efforts to support Lamongan Regency as a rice granary in the GKS region or even the national through appropriate policies in the agricultural sector.

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