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CLASSIFICATION OF FOOD SECURITY BASED ON LAND CONVERSION USE IN COLOMADU SUBDISTRICT, KARANGANYAR DISTRICT, INDONESIA

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Abstract

Colomadu Subdistrict is a rice production area (rice surplus area).Today many of the agricultural lands are experiencing land use conversion resulting in a decrease in rice production and a decline in food security. The objectives of the research are to know: 1) the pattern of land use conversion, 2) the factors that influence land use conversion, 3) the classification of food security in the Subdistrict of Colomadu. The research method is related to the distribution pattern of land use conversion of agricultural land to non-agricultural, and is analyzed using the continuum nearest-neighbor (C-NN). The data distribution of agricultural land use conversion to non-agricultural is carried out with the help of ALOS satellite imagery. Several factors that influence the conversion of ricefield to non-ricefield land use are analyzed by multiple regression.The independent variables are: population density, area of agricultural land (ricefield), and accessibility.The dependent variable is the conversion of agricultural land use to non-agricultural. The population of this study was entire villages. All villages are observed as research units (survey method). The results of the study are based on hypothesis 1, and were analyzed by calculating the value of T (nearest neighbor distribution index) from the C-NN analysis, the T value of the calculation result is 1.32. It can be concluded that the conversion of land use in Colomadu Subdistrict tends to be random. This shows that development planning based on land use conversion in Colomadu Subdistrict, Karanganyar District (Regency) has not been assessed in Colomadu Subdistrict, but it is evenly distributed throughout. Hypothesis 2 stated that land use conversion is influenced by population density, agricultural land area and accessibility. Hypothesis 3 is the classification of food security as one way to determine the area development planning in the Subdistrict of Colomadu.
Keywords: Land use conversion ; Rice surplus

A. Introduction

Land is a part of the earth's space and is a place for people to do activities. Land is a basic need for biotic survival. As a development determinant, humans should be able to maintain the physical/abiotic environment sustainability. Humans also have the ability to choose for housing, clothing, and food. Choosing is a human expression related to culture (Soemarwoto, 1995). Sustainable food availability is an environmental condition related to the physical soil (abiotic environment). Food needs and the availability of housing are two conflicting factors in land requirements. One is needed to retain the continuity of self-sufficiency. But on the other hand, land is converted from agricultural land to non-agriculture land for housing.

Agricultural land resources provide a very wide range of socio-economical and environmental benefits. Therefore, the loss of agricultural land due to land conversion to non-agricultural uses will have an impact on various developmental aspects. Broadly speaking, the benefits of agricultural land can be divided into 2 categories which are as follows: 1) indirect benefits and 2) direct benefits. Indirect benefits are

the benefits that are gained as secondary effect of the exploitation activities carried out by landowners. One example is the preservation of biodiversity or the existence of certain types of plants whose benefits are not known directly, but will be useful to meet human needs (nature and environment sustainability) in the future. Direct benefits can also be referred to as used values. Direct benefits are generated from exploitation or farming activities on agricultural land resources, so the activity can describe the socio-economic life of the area. However, human desire to improve economic life does not mean humans should sacrifice nature reserves (Munasinghe 1992, and Juhadi 2007).

Agricultural cultivation (land productivity) is the safest land use, because it maintains environmental sustainability. Some limiting factors on the environment need to be taken into account, so that regional development brings sustainable results. Prevention of environmental change in the form of land use conversion is expected to reduce urbanization. Lack of employment in rural areas in farming sectors might lead to urbanization.Urbanization often causes various socio-economic problems in urban areas (Soerjani et al. 2001)

According to Sandy (1983), the purposes of relating land as a place is divided into two things, namely those related to legal rights of the land and those related to the land's use. If a transaction is carried out on the land in the sense of a place, then several other parameters (in addition to the area) are needed and must also represent the land. Buying and selling, compensation, collateral, guarantee, pawning or mortgages are some examples of transactions on land that require a "price" or "value" as a reflection of the benefits or use of the land.

The development of rapid development and high rate of population growth are factors contributing in the increased demand for land both in urban and rural areas, which in turn will decrease food security in the area. The more land use conversion, the less food security (Irawan. 2005; Sihaloho. Dharmawan and Rusli. 2007; Rohmadiani. 2011; Astuti. 2011)

The land used for development is largely obtained from the conversion of agricultural land. Land that has been converted to non-agricultural land tends to decrease its productivity and has an effect on the reduced food security. Some of the factors that influence the decline in food security are population density, land area, and accessibility.

The pattern of land use conversion from agricultural to non-agricultural ultimately determines food security. Conversion of land use from agricultural to non-agricultural in Indonesia tends to be clustered, because most land use conversions from agriculture to non-agriculture have "contagious" or "follow-up" nature. Food security is influenced because of the conversion of land use from agricultural to non-

agriculturalthat has a "follow-up" pattern (Irawan. 2005). Conversion of land use from agricultural to non-agriculturalthat has random and uniform/regularpattern tends to have different food security compared to those with clustered pattern.

In general, due to development, the availability of land in urban and rural areas is limited. This raises urban and rural land issues, including an increase in land prices, uncontrolled food security, and various conflicts of interest. Lands needed for industry and various economic activities compete with lands needed for housing (Sari et al. 2010).

Environmental development rate in the Subdistrict of Colomadu has an impact on land use conversion, especially changes in agricultural land to non-agricultural land. Ritohardoyo (2009) stated that the environment is identical to land. Human activities cannot be separated from land, whether the land is for agricultural, housing, or for industry. In food gathering, the land for agricultural cultivation is the main factor, but the conversion of land use always occurs on agricultural land.

The development plan launched by the government is an essential effort to manage natural and environmental resources to be carried out consciously and wisely. It is expected that every human action will not cause environmental damage. But in reality, the conversion of agricultural land use has an unfavorable impact on the environment resulting in a decrease in food security.

Existing natural resources in the form of land and water can be used to obtain agricultural productivity, especially rice. Both inextensification and intensification methods. Colomadu Subdistrict cannot increase agricultural production through extensification because Colomadu Subdistrict is classified as a very dense population (National Land Agency RI, 2009). The possible effort to increase agricultural production in Colomadu Subdistrict is by intensification, which should emphasize in land use planning to increase land productivity.

Ownership of agricultural land cannot guarantee farmers to be able to support their families. Many farmers sell their land because the land has a high price. Since the land is sold, the farmers are forced to change profession. The buyers of the land have a tendency to convert agricultural land to non-agricultural. Some opinions conclude that land use conversion from agricultural land to non-agricultural land is an incremental conversion process, meaning that if there is land use conversion at a location, then some subsequent conversions will be followed and there is a positive relationship between land conversion from agricultural land to non-agricultural. The more conversion of land use from agricultural land to non-agricultural, the more decreases seen infood security (Irawan, 2005; Sihaloho. Dharmawan.danRusli. 2007; Rohmadiani. 2011; Astuti. 2011)

One of the problems faced in Indonesia, including Colomadu Subdistrict, is an increase of population every year. These problems indirectly trigger land use conversion because of land is needed by the population. Increased population growth results in increased development in housing and industry. The development of housing and industry will simultaneously reduce food security due to the conversion of land use from agricultural to non-agricultural.

The research area is the administrative area of Colomadu Subdistrict. Geographically Colomadu Subdistrict is located between 7031'21 "up to 7033'3" South Latitude and 110043'33 to 110048'12 "East Longitude with the borders are as follow:

1. North side is bordered by Boyolali District.
2. East side is bordered by Surakarta City.
3. South side is bordered by Sukoharjogetan District.
4. West side is bordered by Boyolali District.

The study area is the administrative work area of the Colomadu Subdistrict of Karanganyar District, more information of the study area can be seen in Table 1.

Table 1. The size of the research area of Colomadu Subdistrict in each district

No.	Village Name	Size (ha)	Percentage (%)
1	Baturan	129,2	8,26
2	Blulukan	163,9	10,48
3	Bolon	163,2	10,43
4	Gajahan	72,6	4,64
5	Gawanan	131,3	8,39
6	Gedongan	179,3	11,46
7	Klodran	117,7	7,52
8	Malangjiwan	206,4	13,2
9	Ngasem	152,5	9,75
10	Paulan	97,7	6,25
11	Tohudan	150,4	9,62
Jumlah		1564,2	100,00

Source: Karanganyar District Statistic Bureau. 2014

Based on the background, the research objectives are as follows: (1) analyzing the conversion of agricultural land use in a random pattern in Colomadu Subdistrict; (2) analyzing factors of population density, rice field area, and accessibility in Colomadu Subdistrict; (3) analyzing the classification of food security in Colomadu Subdistrict with the criteria of high food security, medium food security, and low food security as consideration of the direction of development in Colomadu Subdistrict.

From the background and research objectives above, the hypothesis can be formulated as follows:

1. The pattern of land use conversion from agricultural to non-agricultural is random.
2. Factors that influence the conversion of agricultural land use to non-agriculture are: population density, rice field area, and accessibility.
3. Classification of food security in Colomadu Subdistrict, Karanganyar District is one way to maintain food security.

B. Research methods

The research area is Colomadu Subdistrict of Karanganyar District. Satellite imagery was used to determine the research area. The satellite imagery used is the ALOS (Advanced Land Observing Satellite) satellite image with the PRISM sensor (The Panchromatic Remote Sensing Instrument for Stereo Mapping) and has a spatial resolution of 15 meters. The instrument is accurate to map the surface of the earth on a scale of 1: 25,000 or smaller (Jalzarika. 2008). The sample in question is all villages in Colomadu Subdistrict that have experienced land use conversion to non-agricultural from 2004 to 2014. As a consideration of the research area, that is, Colomadu Subdistrict is quite high in conversion to agricultural land use because it is located in an area bordering an urban area (Surakarta City). Sampling method used in this study is a census method which observes all research populations as samples (research objects). Because each population/sample has almost the same degree and qualifications, all population has the same chance to be a sample.

Agricultural areas in Colomadu Subdistrict have a strategic role in supporting food productivity in Colomadu Subdistrict. Besides agricultural land,Colomadu Subdistrict also has complex characteristics, both in terms of physical land, socio-economic conditions, and society. This is thought to be influenced by the conversion of agricultural land use to non-agricultural. For more detailed maps of the administration area of the Subdistrict of Colomadu can be seen in Figure 1.

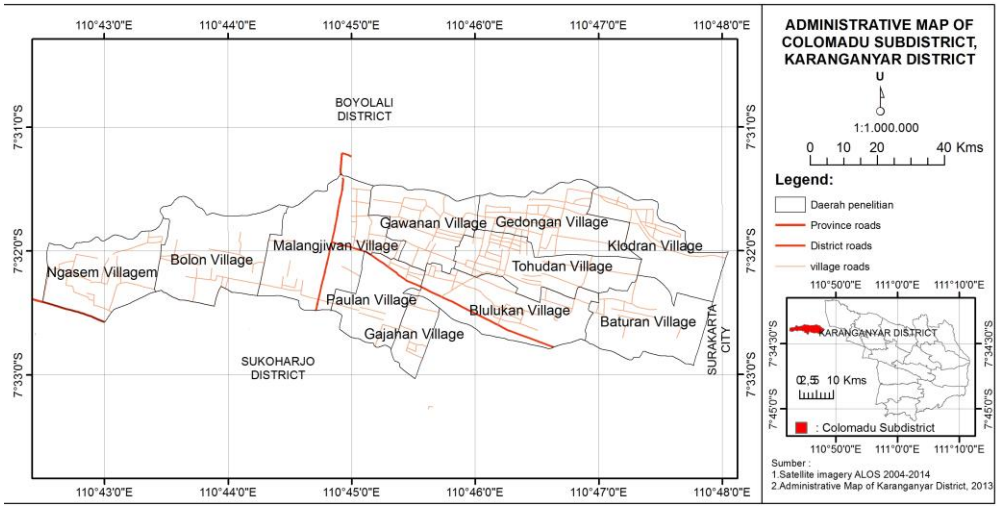

Figure 1. Map of Colomadu Subdistrict Administration, Karanganyar District

Data and variables used in this study were classified into 4 (four) groups based on the research objectives as follows.

1. The pattern of agricultural land use conversion in Colomadu Subdistrict is obtained by calculating the distance at each land use conversion location through the land use conversion map interpreted by ALOS Satellite Imagery. Then analyzed by Continum Nearest Neighbor Analysis. Land use conversion is only distinguished from agriculture to non-agriculture.

   In this study linking the distribution patterns of land use conversion in Colomadu Subdistrict with the nearest neighbor analysis. This analysis is used to determine the distribution pattern of land use conversion whether it follows a clustered, random or uniform pattern. as indicated by the magnitude of the T value (Hagget in Bintarto and Hadisumarno, 1982). The results of this analysis can provide an overview of the tendency of a conversion to the use of land, the reason of a tendency to a certain pattern, associated with factor analysis that explains the preferences of the community in choosing a location for land use conversion. T value (nearest neighbor distribution index) itself is obtained through the following formula.

$$T = \frac{\bar{j}_u}{\bar{j}_h} \quad \text{.....(1)}$$

T : neighboring dispersion index

$\bar{j}_u$: the average distance measured between a point and its nearest neighbor;

$\bar{j}_h$: the average distance obtained when all points have a random pattern= $\frac{1}{2\sqrt{p}}$

p : the point density in each km2 is the number of points (n) divided by the area of the area in km2 (A). so that it becomes: $\frac{\sum n}{A}$.

In conducting analysis of nearest neighbors, it is important to note several important steps as follows:

a. Determining the boundaries of the land being studied;
b. Changing the distribution pattern of observation units in the topographic map to point distribution pattern;
c. Giving sequence numbers for each point for an easier analysis;
d. Measuring the closest distance in a straight line between one point and to its closest neighbor;

e. Counting according to Hagget in Bintarto and Hadisumarno (1982) is interpreted with the Continum Nearest Neighbor Analysis as in Table 2 below.

Table 2. Conversion distribution based on T value

No.	Pattern	T
1	Follow-up (clustered)	0-<1
2	Random	≥1-<2.15
3	Uniformed	≥2.15

a) The pattern of distribution land use conversion is analyzed by Continuous Nearest Neighbor (C-NN) analysis with the principle of grouping one cell with neighboring cells based on the similarity they have.

2. Several factors that influence land use conversion are determined by population density, rice field area, and accessibility variables. The data are collected from relevant agencies. Field data collection or field data checking and satellite image delineation / digitization was done. In this study the variables that affect land use conversion are used in the classification of food security. Further variables that affect land use conversion can be explained as follows:
   a. Land use conversion variable; land use conversion from agriculture to non agriculture can be obtained from the interpretation of ALOS Satellite Imagery. From the delineation of Citra Salelit ALOS in 2004 and 2014, a land use conversion will be obtained. Conversion of land use for 15 years will then be obtained per year and per village. From the average land use conversion per year and a percentage of the area per village calculated, a variable land use conversion per district will be obtained
   b. Population density variable; population density is obtained from population and area size and village potential from monographic data / village profiles. The operation of this variable can affect the pressure on food security, due to the high rate of growth and population growth due to unplanned expansion of residential areas (Mantra 1991). The most complete and accurate source of population data is obtained from the population census. Population census is conducted every 10 years. so that the data needed urgently needs to be surveyed (census). Population data in this study is needed because the population is the subject and object of a plan. The rate of population growth is influenced by birth. death and

migration. According to Rumbia (2008) population density will change according to population growth.

c. Rice field variable; the existence of agricultural land (rice fields) is obtained from the interpretation of ALOS Satellite Imagery. From the delosation of the ALOS Satellite Image in 2014 at the time of the study, an area of agricultural land per village in 2014 will be obtained.

d. Accessibility variables; accessibility is calculated based on the proximity of the land unit to the main road, while also based on the dominance of the area with the existence of the road (Weber. 1909). The existence of roads is grouped into provincial roads, district roads, sub-districts. village roads and footpaths / villages.

3. Determining classification of food security by these criteria: classification of high food security, medium food security, and low food security through overlapping of variables that affect land use conversion, while variables that do not affect land use conversion are not used in the classification of food security.

The determinants of the conversion magnitude of agricultural land use to non-agricultural land were determined using Multiple Regression Analysis (Ritohardoyo. 2011). The multiple regression model that is built is as follows.

$Y = \beta o+\beta 1x1+\beta 2x2+\beta 3x3+ E$ .....(2)

The above formula or formula (2) can be solved using 3 equations by 3 variables that composed it, but to simplify the calculation, the SPSS software was used:

$\sum Yi = n\beta_o + \sum\beta_1 X_{1i} +\sum\beta_3 X_{3i}$

$\sum X_{1i}\, Y_i= \beta_o X_{1i} + \beta_1(\sum X_{1i})2 + \beta_3\sum X_{1i}X_{3i}$

$\sum X_{2i}Y_i = \beta_o X_{2i} + \beta_1\sum X_{1i}X_{2i} +\beta_3\sum X_{2i}X_{3i}$

$\sum X_{3i}Y_i = \beta_o X_{3i} + \beta_1\sum X_{1i}X_{3i} + \beta_3\sum(X_{3i})$

Y: land use conversion;

X_1: population density;

X_2: accessibility;

X_3: spatial order.

β_o. β_1. β_2.β_3: coefficient determined based on observational data.

Food security classification is determined through overlays of several maps. The maps in question are the result of several factors that cause the land use conversion. As a reference, (estimation) the causes of land use conversion are: maps of population density, rice field area, and accessibility. To find out the contribution of each variable to land use conversion, multiple regression was used. To find out the role and strength of the relationship of every variable to the factors formed, a calculation was performed using partial test. Determination of food security classification through scoring and map overlay,

while determining food security classification it is necessary to determine the class interval using the following formula:

$$I = \frac{t_{maks} - t_{min}}{k} \quad \text{.....(3)}$$

I = Class interval;

t_{maks} = totalscore of all variables with maximum value (High);

t_{min} = totalscore of all variables with minimum value (Low);

k = the ammount of classes is 3 (three) classes according to the final results of the classification, i.e.: classification of high, medium and low food security

According to Saaty (1994). In determining the score (scoring) on each attribute of a variable the Analytical Hierarchy Process (AHP) can be used. The definition of AHP is to abstract the structure of a system to study the functional relations between components and the impact on the system as a whole. The AHP approach uses a scale proposed by Saaty (1994) ranging from a weight value of 1 to 9. A weight value of 1 represents "equally important". It means that the attribute with the same scale has a weight value of 1. While the weight value of 9 represents the case of attributes that has "absolute importance".

In AHP, the determination of policy priorities is done by discovering people's perceptions rationally. After that convert the intangible (unmeasured) factors into the general rules so they can be compared. The recommended values (grades) to make a pairwise comparison matrix are as follow:

grade 1 : equally important (equal);

grade 3 : slightly more important (slightly);

grade 5 : strongly more important (strongly);

grade 7 : very strongly important (very strong);

grade 9 : extremely important (extreme).

In addition to the grading values, each value in between can also be used. i.e. 2. 4. 6. and 8. Some of these values illustrate the relationship of interest between the odd values that have been mentioned. Scoring techniques can be seen in Table 3.

Table 3. Scoring and data source

	Variable	Assumption of calculation	Grouping of research results (attributes)	Score	Data source
1	Population density	Population density per village	Less dense	9	Grouping based on data from each villages
			Dense	5	
			Very dense	1	
			Moderate	5	
			Low	1	

2	Rice field area	Rice field area resulting from the sum of rice fields per village	High	9	Grouping based on data from each villages
			Moderate	5	
			Low	1	
3	Accessibility	Road availability at the village level	High	9	Colomadu Subdistrict Administration Map
			Moderate	5	
			Low	1	

Source: Score determination using AHP from Saaty (1994)

In every variable score, the total score will be obtained subsequently, afterwards the total score is used as the foundation for determining the classification of food security. Food security classification is determined based on the total score generated by the overlay map of the determining factors. Food security classification is determined based on the results of class intervals calculation according to formula (3) to obtain the classification as shown in Table 4.

Table 4. Classification of food security in Colomadu Subdistrict

No.	Classification	TOTAL SCORE
1	High food security	$> (t_{min} + 2I) - \leq (t_{min} + 3I)$
2	Moderate food security	$> (t_{min} + I) - \leq (t_{min} + 2I)$
3	Low food security	$\leq t_{min} + I$

Source: Classification is based on formula (4)

The assumptions that were formed were ColomaduSubdistrict administration with high, medium, and low food security classifications, so the highest total score is the classification of food security in areas with low population density, vast rice fields, and low accessibility (dominant roads) compared to other regions (villages). On the contrary the condition that has the lowest total score is a region with a high level of density, low land area, and high accessibility compared to other regions.

C. Study results and discussion

Results and discussion of the study performed in the administrative area of each village in Colomadu Subdistrict are as follows.

1. Land Use Conversion Distribution Pattern

In order to obtain land use conversion from each research unit an overlay was carried out between the 2004 Land Usage Map (Appendix 1) and the 2014 Land Usage Map (Appendix 2) and the results of the overlapping differences between the Maps of 2004 and 2014 in the form of Map of Land Use Conversion from agricultural to non-

agricultural in 2004-2014 for each research unit in Colomadu Subdistrict as shown in Figure 2.

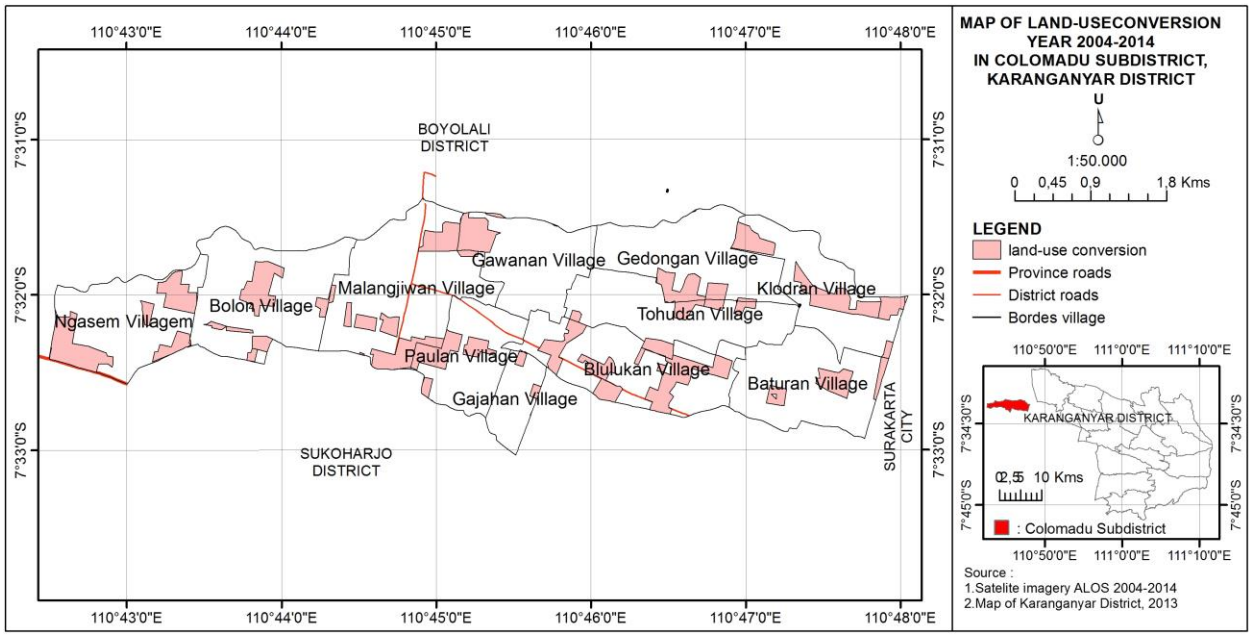

Figure 2. Land Use Conversion Maps in 2014-2014 in Colomadu Subdistrict, Karanganyar District

From Figure 2, we can determine the extent of the conversion of land from agriculture to non-agriculture usage in Colomadu Subdistrict, Karanganyar District for 2 (two) periods, 2004 to 2014 as can be seen in Table 5.

Table 5. Area of land use conversion in Colomadu Subdistrict in 2004 and 2014

No	Villages	Area of Conversion (km^2)	Area of Conversion	
			Ha	%
1	Baturan	0,00013781895	1,378	9,481443
2	Blulukan	0,00015543025	1,554	10,69304
3	Bolon	0,00017122120	1,712	11,7794
4	Gajahan	0,00004215380	0,422	2,900028
5	Gawanan	0,00011221380	1,122	7,719902
6	Gedongan	0,00013903675	1,390	9,565223
7	Klodran	0,00012013510	1,201	8,264858
8	Malangjiwan	0,00020648465	2,065	14,20539
9	Ngasem	0,00014282495	1,428	9,825838
10	Paulan	0,00009501165	0,950	6,536456
11	Tohudan	0,00013123405	1,312	9,028426
Jumlah			14,536	100,000

Table 5 shows that land use conversion for 10 years from 2004 to 2014 was 14,536 ha or the average annual rate was: 1,454 ha. To find out the pattern of land use conversion, we use the Nearest Neighbor Analysis (K-NN) continuum by Hagget in Bintarto and Hadisumarno (1982). In analyzing K-NN, it is necessary to map the distribution of land use conversions in Colomadu Subdistrict from the results of overlapping maps of land usage in 2004 and land usage in 2014 with results as shown in Figure 2. The results of land use conversion from agricultural to non-agricultural analysis patterns using K-NN by calculating the value of T (nearest neighbor distribution index) using formulas as in Formula (1) with ArcGIS Software results: T = 1.32. T equal to 1.32 is located between ≥1- < 2.15 so it can be said that land use conversion in Colomadu Subdistrict tends to be random. T = 1.32 indicating the development in Colomadu Subdistrict, Karanganyar District based on the land use conversion is evenly distributed (random) in all villages in Colomadu Subdistrict (Figure 2).

2. *Several factors leading to conversion of land usage*

The results of delineation and digitization of LANDSAT Satellite Imagery in 2004 and 2014 in the form of maps is able to illustrate the condition of the area (location) of research on land usage / utilization for agricultural and non-agricultural purposes in the area of each village in Colomadu Subdistrict, Karanganyar District, while population density, rice field area, and accessibility are obtained from Colomadu Subdistrict in the form of numbers, resulting in data collection as shown in Table 6.

Table 6. Results of research data collection in Colomadu Subdistrict, Karanganyar District

No.	Conversion	Population density (people/ha)	Rice field area (ha)	Accessibility
1	1,38	76,07	27,55	2
2	1,55	34,55	61	2
3	1,71	37,59	83,4	3
4	0,42	27,13	35,75	1
5	1,12	39,15	31,75	2
6	1,39	37,53	66	2
7	1,2	40,04	39,95	2
8	2,06	52,37	47,6	3
9	1,43	30,89	80,3	1
10	0,95	28,61	49,15	1
11	1,31	34,41	78,3	1

From the data collected as shown in Table 6, then the dependent and independent variables are determined, the independent variable (Y) is the conversion of land usage, while the dependent variables are: population density (X_1), rice field area (X_2), and accessibility (X_3). The results of the regression correlation calculation using SPSS are shown in Table 7.

Table 7. The results of the calculation of each influence variable on the affected

No	Variable	Variable	
		T	Sig T
1	PDDK	2,001	0,0856
2	RICE FIELD	3,217	0,0147
3	ACCESS	2,838	0,0251
(Constant)		-1,168	0,2809

Source: Data processing using SPSS

Using a significance level of 10% (0.10) and compared it to sig T in Table 7, if sig T < significance level of 10% then the variables are related and vice versa. From Table 7 we can notice that all variables (sig T) are smaller than the significance level (10%), statistically it can be concluded that X_1, X_2 and X_3 variables affected the Y variable, the greater the value of T (column3) Table 7, the greater the effect for land use conversion, the sign (+) / (-) (Table 7, column 4) is used to determine the direction of the relationship, (+) means the the relationship has the same direction and (-) the opposite direction. In this study X_1, X_2 and X_3 are unidirectional (+) so that it can be interpreted as the more densely populated, the more rice field area and the more roads are paved the higher the conversion.

3. Zoning of land appraisal

The conversion of agricultural land usage to non-agricultural land is essentially caused by competition in land usage (land) between the agricultural and non-agricultural sectors. The competition in land usage is affected by (two) main factors, i.e.: (a) limited agricultural land resources; and (b) population growth. The area of agricultural land in each area that is available is relatively fixed or limited, so population growth that requires land will shift land requirements from agricultural to non-agricultural land. The residents apart from housing (housing and industry) also need a land to fulfil the need for staple food (rice). Ilham in Irawan (2005) said that the conversion of agricultural to non-agriculture usage is strongly influenced by population growth and urban areas are defined as areas that have high accessibility. Land use conversion is a part of development activities that cannot be avoided, as long

as there are development activities the conversion of agricultural to non-agricultural land usage will go on. Population growth stimulates an increase in land requirements for the construction of housing, industry, trade areas, and other public facilities (Simatupang and Irawan, 2003). Conversion of agricultural to non-agricultural land usage can be triggered by the pulling of land zoning for non-agricultural activities. The phenomenon of conversion of agricultural land cannot be separated from the policies adopted by the government. For example, the subsidy policy for the construction of low-cost housing will increase the demand for land, while social policies (family planning) are unable to reduce the rate of population growth, nor can policies on the construction of transportation facilities and other public facilities that are not well planned (Irawan 2005).

The reduction of agricultural land area is permanent, meaning that it is not possible to reverse non-agricultural land into agricultural land, so food quantity tends to decrease because the conversion of land usage for a certain period of time (year 1 to year n) will be cumulative. Figure 2 illustrates the cumulative land use conversion. Reducing agricultural land area will be difficult to stop as long as there is a growing population since conversion of agricultural land usage is permanent and cumulative. The conversion of permanent and cumulative agricultural land is often not realized as it is usually done based on the assumption of a temporary effect (Sudaryanto, 2003). Conversion of agricultural land usage caused by population factors can cease if there is no population growth (zero growth). If the population increase is 0, then all that remains is to regulate the conversion of agricultural to non-agricultural land usage so as to establish sustainable agricultural land, however, zero growth is difficult to achieve, especially with the family planning program of an increasingly powerless government.

The pattern of conversion of agricultural land usage in this study area is random (Figure 2) meaning that the area of conversion of agricultural land usage will increase every year because it is generally contagious (Irawan. 2005) in other words once the conversion occur, the area of agricultural land converted at that location will be even greater due to the 'contagious' conversion of agricultural land usage that occurs in the surrounding location. Symptoms of transmission of conversion of agricultural land usage are in line with population growth which is a characteristic of the development of an area consequently in the need for land for non-agricultural activities and will increase from year to year. This tendency cause conversion of agricultural land usage difficult to avoid, in other words yearly agricultural land conversion is inevitable.

The development of remote sensing technology (remote sensing) allows the collection of geographical data to be less time-consuming, costs and energy-saving compared to terrestrial (field) methods. Data collection can be done through a variety

of images (images) such as aerial photographs, satellite images and radar images. Remote sensing is a form of science and art, as well as skills to obtain information about regional objects or symptoms by analyzing data obtained using tools without direct contact with the area or symptom under study (Lillesand and Kiefer, 1993). The results of the interaction between power and objects recorded by the sensor and the results of the recording are referred to as remote sensing data. The data must be translated into information about regional objects or symptoms that are sensed. The process of translating data into information is called data analysis or interpretation. The role of remote sensing is vast in data information systems and its management, i.e. to detect changes, calibrate, and develop new models in scientific disciplines (Sutanto 1998)

Spatial data processing systems through remote sensing (satellite imagery) results can be based on maps and can be used to obtain geographic information of an area according to need, and use it as a directive meaning to determine policies that need to be taken according to the environmental conditions (Narulita, et al. 2008). Zoning in the form of spatial data is a form of geographic information and can be stated in numerical data or in tabular form. Tables (physical data) and spatial data in this study will facilitate further discussion. The discussion in this study will focused solely on the direction of food security zoning in Colomadu Subdistrict. The term zones means the separation of an environmental space into several parts or several area. Zoning of agricultural food security per village has a variety of potentials and activities but prone to conflicts of interest between land users. This difference in interests can lead to conflicts in spatial usage which ultimately will cause environmental damage. Zoning of food security is expected to restrain or reduce the rate of conversion of agricultural land usage for development in the study area so that the direction / design of food security zoning per village is in accordance with the allotment for a comprehensive and integrated needs, especially for land requirements for a sustainable development (Motik et al. 2007). Zoning with the additional (grouping) of several maps that have some value (score / grade) can help in analyzing food security, while the results are shown in Table 8.

Table 8. Zoning of food security and skoring

No	Village	Population density (people/ha)	Rice field area (ha)	Accessibility	Population density (people/ha)	Rice field (ha)	Accessibility	Sum	Food security score
1	Baturan	76,07	27,55	2	9	9	5	23	High
2	Blulukan	34,55	61,00	2	1	5	5	11	Moderate
3	Bolon	37,59	83,40	3	1	1	9	11	Moderate
4	Gajahan	27,13	35,75	1	1	9	1	11	Moderate

5	Gawanan	39,15	31,75	2	1	9	5	15	Moderate
6	Gedongan	37,53	66,00	2	1	1	5	7	Low
7	Klodran	40,04	39,95	2	1	9	5	15	Moderate
8	Malangjiwan	52,37	47,60	3	5	5	9	19	High
9	Ngasem	30,89	80,30	1	1	1	1	3	Low
10	Paulan	28,61	49,15	1	1	5	1	7	Low
11	Tohudan	34,41	78,30	1	1	1	1	3	Low

In Hypothesis 2 (statistical conclusions) it is stated that the independent variables X1, X2, and X3 affected the dependent variable (Y). All independent variables related to dependent variable at the statistical conclusion are population density (X1), rice field area (X2) and accessibility (X3). Census data was collected at 'kecamatan' level (all taken). For more details on the size of the food security zoning score of each independent variable see Table 8, while the results of food security zoning in the study area (Colomadu Subdistrict) can be seen in Figure 3.

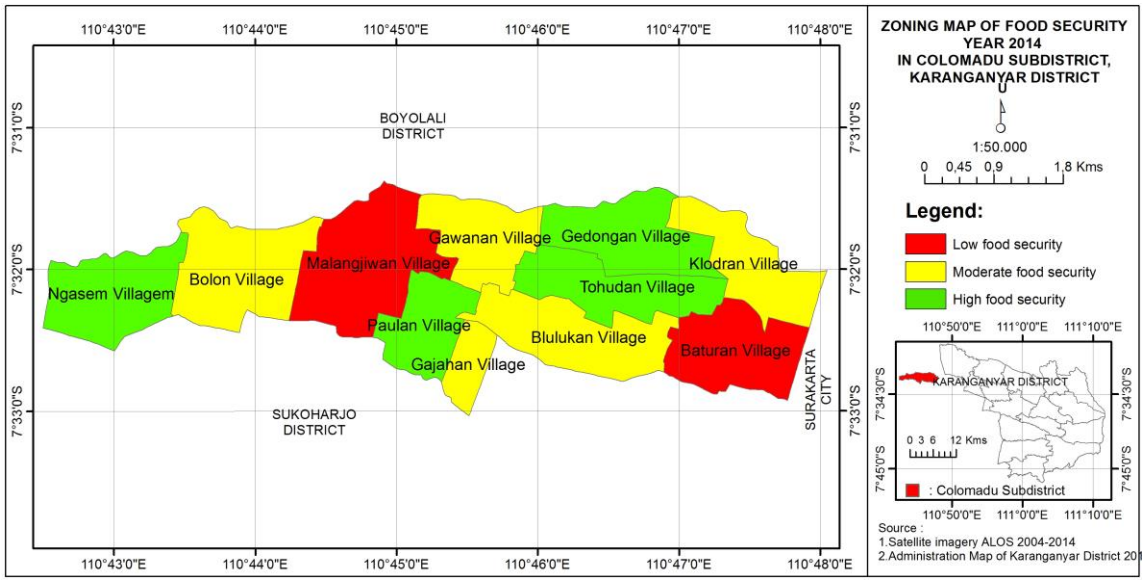

Figure 3. Zoning map of food security per village in Colomadu Subdistrict

Zoning of food security is expected to be utilized for the development of regional development (industry, housing, and offices) especially in the Colomadu Subdistrict area, so that development related to land needs. Zoning of food security in Colomadu Subdistrict can be used as a consideration in decision making on the location of development in accordance with funds available (Figure 3). Funding considerations can be adjusted according to the type or characteristics of development, development for the market will be different from the development for educational and health (Hospital) purposes. Variable population density, rice field area, and accessibility are

variables that affect food security, however the determination of these variables can be reproduced again so the decisions / regional development policies can be more varied.

D. Conclusion and suggestion

1. Conclusion

a. The land use conversion patterns are random.
b. Factors influencing land use conversion are: population density, rice field area, and accessibility.
c. Classification of food security based on land use conversion patterns in Colomadu Subdistrict Karanganyar District, is a way to maintain food security in Colomadu Subdistrict.

2. Suggestion

a. Land use conversion can cause a conflict of interest between social status and food needs, the direction of food security is expected to be implemented in the Colomadu Subdistrict area to maintain sustainable agricultural land.
b. Strict regulations are needed on areas that may be converted to achieve food security in Colomadu Subdistrict, Karanganyar District.

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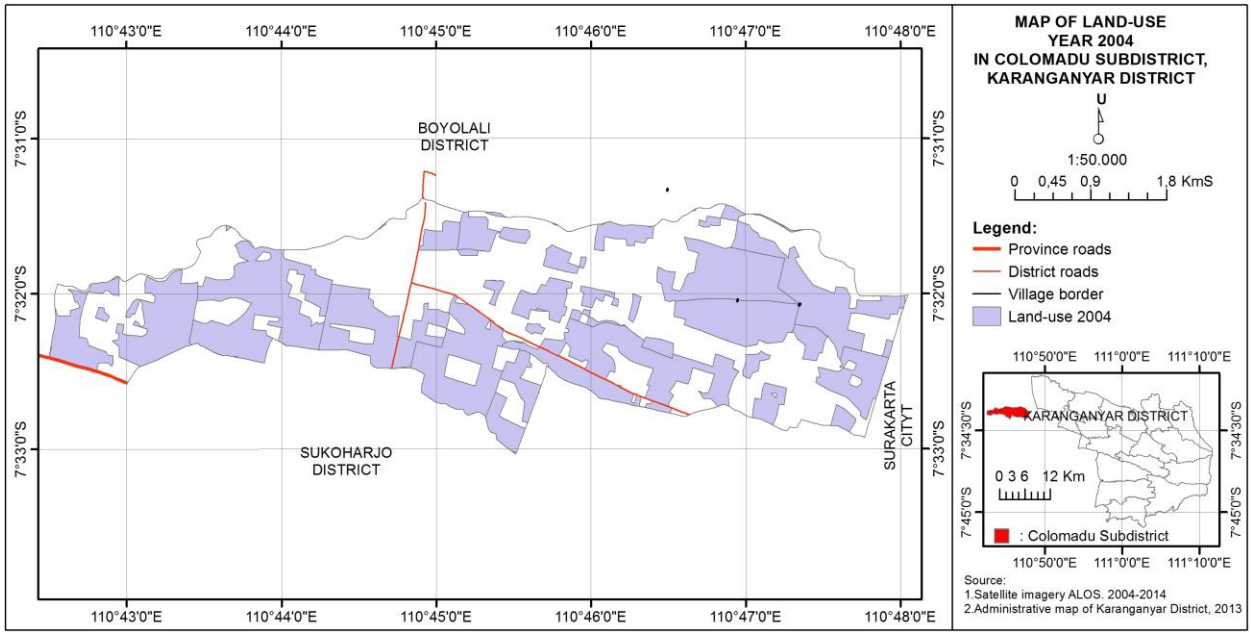
Appendix 1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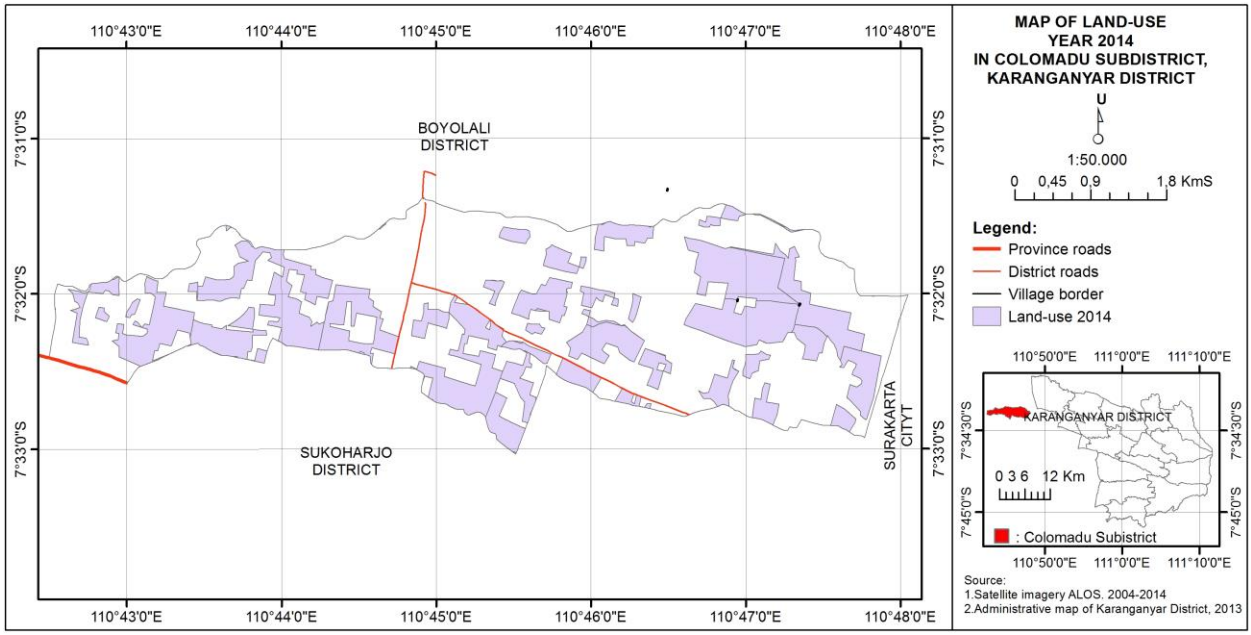
Source:
1.Satellite imagery ALOS. 2004-2014
2.Administrative map of Karanganyar District, 2013

Appendix 2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KARANGANYAR DISTRICT
0 3 6 12 Km
: Colomadu Subistrict
Source:
1.Satellite imagery ALOS. 2004-2014
2.Administrative map of Karanganyar District, 2013