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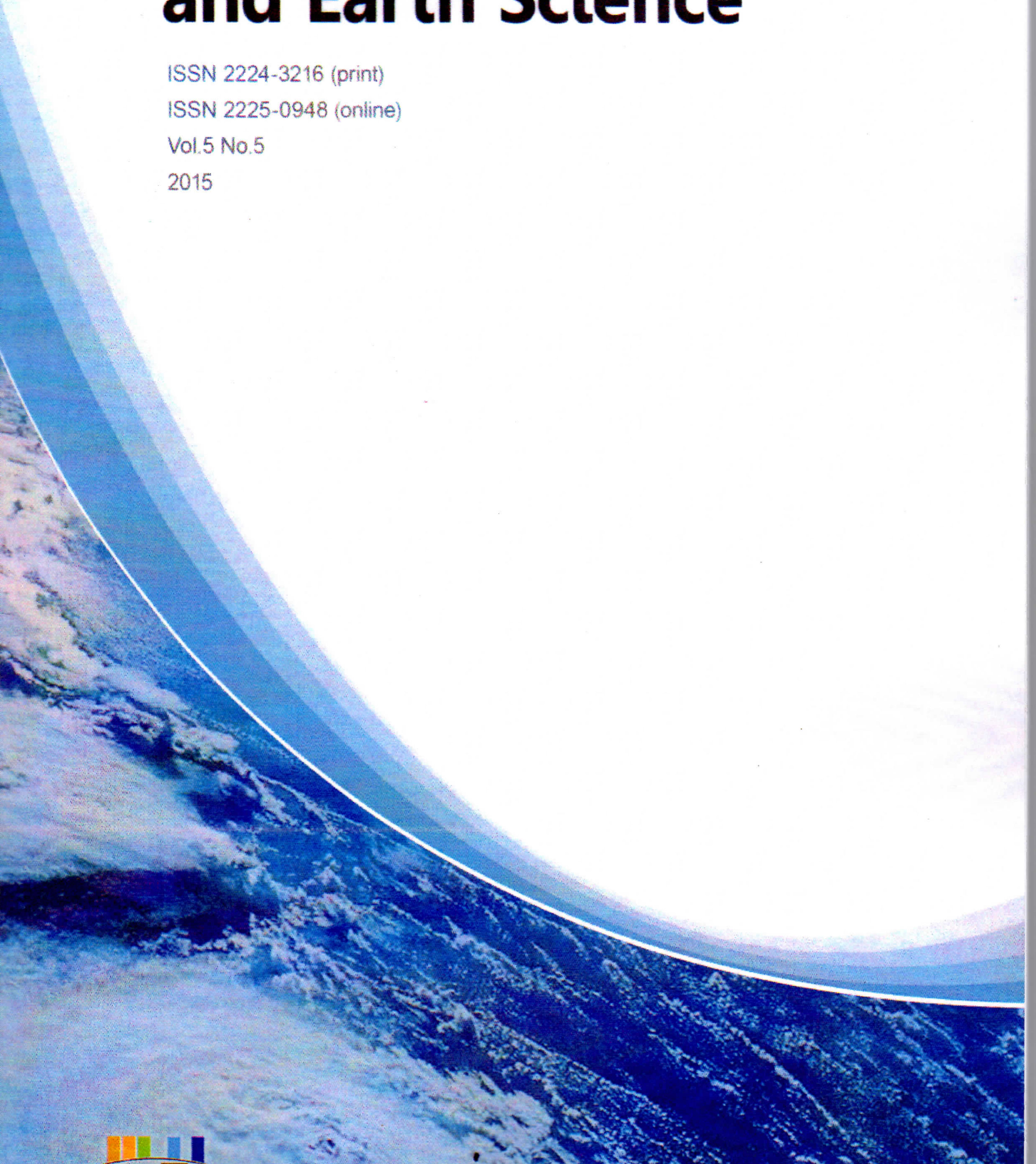

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Modeling on Establishment of Sustainable Paddy Field Zone in Bekasi Regency, Indonesia

Sigit Santosa[1*] Ernan Rustiadi[2] Budi Mulyanto[2] Kukuh Murtilaksono[2] Widiatmaka[2] Noer Fauzi Rachman[3]

1. Study Program of Soil Science, Graduate School, Bogor Agricultural University, Bogor 16680, Indonesia
2. Department of Soil Science and Land Resources, Bogor Agricultural University, Bogor 16680, Indonesia
3. Department of Community Development and Communication Sciences, Bogor Agricultural University, Bogor 16680, Indonesia

* E-mail of the corresponding author: sigit.santosa@gmail.com

Abstract

The background of this study is paddy fields conversion that continues to occur along the northern coast of Java that threatens national food security. Regional Spatial Plan (RTRW) and Sustainable Food Agricultural Land Protection Program (LP2B) are unable to control paddy field conversion. This research was conducted to establishment a sustainable paddy field zone model using logistic regression and multicriteria evaluation. The research location is in Bekasi Regency, one of West Java's rice production centers which is Jakarta buffer area with a high level of paddy field conversion. The model builds upon the characteristics of local paddy field conversion by considering the concept of sustainable development. Important variables that support the paddy field conversions are the distance to settlements, housings, roads, regency/city capitals and industrial estates. Results of logistic regression then become the input for weighted criteria to develop three policy scenarios of paddy fields protection; standard, protective and permissive in order to support regional development. This model will obtain protected paddy field priorities as well as a buffer for other paddy fields in surrounding area.

Keywords: logistic regression, multicriteria evaluation, sustainable paddy fields zone

1. Introduction

The problems of paddy field conversions in Indonesia remain a great concern due to increasing population and the speed control function that threaten national food stability. Developing new paddy fields in order to expand the paddy field area is difficult to implement because of the varied characteristics of soil resources, the availability of irrigation, and culture of paddy cultivation are concentrated only in a few areas in Indonesia (Agus, 2007; Ministry of Agriculture, 2013). The largest paddy field area is located in Java, which also is the most densely populated island in Indonesia. Java with its population and rapid economic growth has led paddy field conversion in large numbers. According to Rustiadi & Wafda (2008), during 1999-2000 paddy field conversions in Java mostly occurred in West Java which covered up to 0.199 million hectares. According to National Land Agency (2007), throughout 1994 to 2004 the paddy field conversions in Java and Bali reached 36,000 hectares or about 3,600 hectares/ year. Specifically, Dewi (2010) has mentioned that paddy fields area had gradually decreased in Bekasi for 21-year period during 1988 to 2009 which reached 27.853 hectares. The government's success in protecting paddy fields in Java, especially along northern coast of Java is the key to the success of improving national food security.

Government efforts to maintain the paddy fields are held by Regional Spatial Plan and Sustainable Food Agricultural Land Protection Program. Nevertheless, the existence of Regional Spatial Plan has not been able to effectively prevent the paddy field conversions. Dewi's research (2010) showed that the community has a lack of understanding about the Regional Spatial Plan, while Isa (2007) stated that there are 42% of the areas ofirrigated paddy land are not appointed for paddy field function. Establishment of sustainable paddy fields through local regulations is also running slow. Until September 2012, there were only 66 regencies / cities that have committed to protect sustainable food agricultural land in its regional spatial plan (Director General of Agricultural Infrastructure Ministry of Agriculture, 2012). Until 2014, Bekasi does not have regulations on sustainable food agricultural land. In fact, Regional Spatial Plan existence has not been fully used to manage land use. This happens, because the priority tends to accommodate economic interests (Firman, 2004; Zhu & Simarmata, 2015). Preparation of Regional Spatial Plan and Sustainable Food Agricultural Land Protection Program is ideally based on the principles of sustainable development by looking into the characteristics of the local paddy field conversions. Paddy field conversions characteristics can be traced by logistic regression, which becomes an input of multicriteria evaluation for establishment of sustainable paddy fields.

Paddy field conversions characteristics analysis can be performed by using logistic regression method. Logistic regression is a mathematical model to analyze relationship of the independent variables including continues, discrete, dichotomous data, or its combination that affects the dependent variables (Mc Cullagh & Nelder, 1989 in Arsanjani *et al*., 2013). This analysis technique has been done on forest conversions (Kumar *et al*., 2014; Siles, 2009), the growth of cities (Arsanjani *et al*., 2013; Guo, 2012; Hu & Lo, 2007). These studies have successfully revealed the determinants of land use conversions. These factors are then used to predict land use with specific time in the future. Guo (2012) and Hu & Lo (2007) underlines that the logistic regression method is able to deal with various variables either physical, spatial, demographic, social, and economic aspects as well as land use policy and environmental preservation with a relatively fast data processing. However, logistic regression has less concern to the temporal dynamics and personal preferences of land use development.

In establishment of sustainable paddy fields, the consideration of the three pillars of sustainable development; economic, social and environmental, can be executed using multicriteria evaluation which is basically an expression or point of view to determine a lot of input or influence in designating the outcome. The term is more related to the decision-making process which combines many factors lead to various options or outcomes. Researches using this method have been carried out by Shiddiq (2011) in terms of determining the availability of paddy fields, Akinci *et al*. (2013) who studied the suitability of land for agricultural land use and Gorsevski *et al*. (2012) in the evaluation of the suitability of landfills. Through these studies it was proved that the multicriteria evaluation contributes to the decision-making process flexibly.

In terms to support the national food security, efforts to preserve paddy fields in the northern coast of Java play an important role. The government's success in protecting the paddy fields in the region is the key to success of improving national food stability. To support this, this research aims to develop a model on establishment of sustainable paddy fields in Bekasi. Sustainable paddy field model was designed by considering aspects of sustainable development and the characteristics of the local field conversions. Characteristics of field conversions were analyzed using logistic regression where results are used as values in determining the establishment of sustainable paddy fields using multicriteria evaluation.

2. Methodology

2.1 Research Area

This research is conducted in Bekasi Regency which is a bordering regency of Jakarta capital city. Bekasi has areas with high soil fertility, extensive irrigated land, high economic growth that contributes to high level of paddy field conversions. Bekasi is a buffer area which becomes a target to Jakarta sub urbanization process since 1980-1990 as the first stage and 1990-2000 as the second stage (Rustiadi *et al*., 1999). Study site map is shown in Figure 1, while the whole processes of this research are presented in Figure 2. The research flowchart is general overview of further explanations in this article.

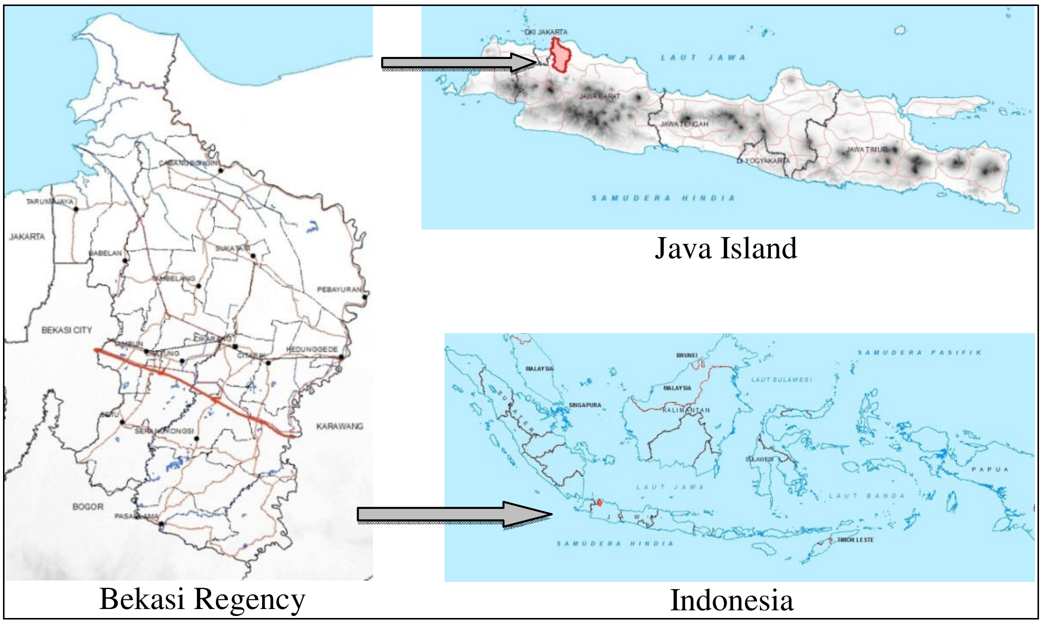


Figure 1. Location of Bekasi Regency

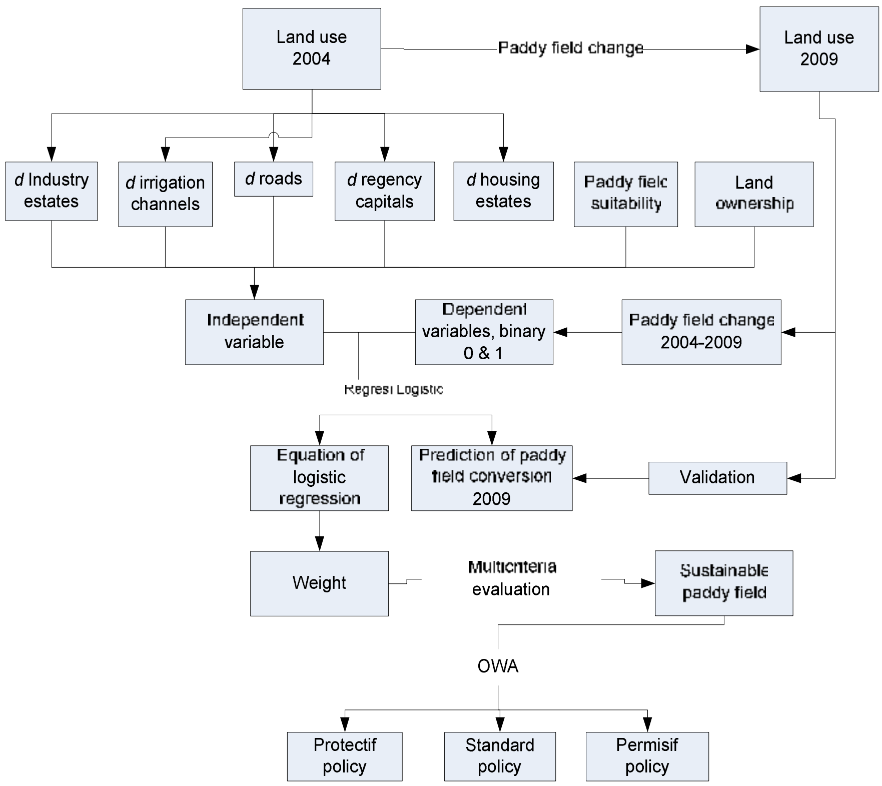


Figure 2. Research flowchart

2.2 Tools and Materials

This study uses Idrisi Selva 17.02 and ArcGIS version 10.1 software. Land use maps in 2004 and 2009 used as the main data, with the scale of 1: 50,000 which taken from the Directorate of Land Use Planning, Indonesian National Land Agency (BPN). Paddy map of 2014 is the paddy map updates of 2009 from the Ministry of Agriculture.

Other data used is the Overview of Land Tenure Map and Spatial Plan Map of Bekasi Regency taken from BPN Land Office of Bekasi. Land Suitability Map for paddy was made using primary data. Matching method (Hardjowigeno & Widiatmaka, 2007) is used to analyze land suitability class. Before executing the logistic regression and multicriteria evaluation, all data must use similar data format (Table 1).

Table 1. Data format of the analysis

Parameter	Value
Column	1800
Rows	2640
Reference System	UTM Zone 48 S
Reference units	Meters
Distance units	1.00
Minimum x	716000
Maximum x	761000
Minimum y	9281000
Maximum y	9347000
Y resolution	25
X resolution	25

2.3 Logistic Regression

Logistic regression is a regression variant which used in the dependent variable, is binary (dichotomous), i.e. 1 = paddy field change and 0 = no paddy field change. The analysis was performed for the data of land use in 2004-2009. Logistics function gives the probability of changes in the paddy field as a function of explanatory or independent variables. In other words, the possibility of paddy field change at each pixel is a function of value from the explanatory variables on the same pixel. The result of the model is continuous probability value between 0 and 1. Thus, logistic regression is used to reveal the paddy field conversions variables in Bekasi. Logistic regression formula is presented in Equation 1.

$$p = E(Y)\frac{e^{\beta_0+\beta_1 x_1+\beta_2 x_2+\beta_3 x_3+\beta_4 x_4}}{1+e^{\beta_0+\beta_1 x_1+\beta_2 x_2+\beta_3 x_3+\beta_4 x_4}} \quad (1)$$

Where: p is paddy field conversion probability, E(Y) is expected value of Y dependent variable, β_0 is estimated constant, βi is coefficients for each Xi variable. The formula can further be transformed linearly known as logit transformation as shown in Equation 2 and Equation 3.

$$p' = \log_e\left(\frac{p}{1-p}\right) \quad (2)$$

$$p' = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \quad (3)$$

The transformation function through linear regression function is able to estimate the value of each βi. The equation is applied to each pixel until the probability (p) of paddy field conversion in each pixel is reached. Logistic regression model requires that all variables are calibrated to become conformable with paddy field change. Thus, all variables are normalized between 0.1 and 0.9. Distance variables are transformed using natural log methods, whereas categorical variables are using evidence-likelihood method (Kumar *et al.*, 2014; Siles, 2009). Variables and their transformation is presented in Table 2.

Table 2. Independent variables and their transformation

No	Variable	Transformation
1	Distance to industry	natural log
2	Distance to irrigation channel	natural log
3	Distance to road	natural log
4	Distance to capital	natural log
5	Distance to housing estate	natural log
6	Land suitability for paddy	evidence likelihood
7	Distance to settlement	natural log
8	Formally defined wetland area 1999	evidence likelihood

Practically, logistic regression test is conducted on various combinations of independent variables both in number and type. The variable combinations are held from 2 to 8 variable combinations. Due to space limitations, this study only delivers 8 best combinations. The best combination has a pseudo R-square result approaching 0.2 with positive or negative type of influence according to field observations (Hu & Lo, 2007).

The final results of logistic regression are an equation explains the relationship of independent variables with paddy field conversions, paddy field conversion prediction and residue in 2009. The residue is the difference between existing maps of paddy in 2009 with paddy field conversions predictions in 2009. Prediction result maps are validated by ROC (Relative Operation Characteristic) method which compares the pixel values between the two maps by sampling a certain amount.

2.4 Multicriteria Evaluation

Multicriteria evaluation is carried out to establish sustainable paddy field area to the whole region of Bekasi using Idrisi on the decision wizard menu. Weighting in this analysis uses the results of the logistic regression equation. Sustainable paddy field establishment using multicriteria evaluation methods (Multi Criteria Evaluation / MCE) with a weighted analysis spatial analysis method approach. MCE consists of two things: goals setting and criteria setting. These criteria are divided into factors and constraints. Factors consist of sub-factors which are the criteria to achieve goal. Mathematical equation of Weighted Linear Combination (WLC) analysis is shown in Equation 4.

$$WLC = \left(\sum_{i=1}^{n} X_{ij} \times W_{ij}\right) \times C_j \qquad (4)$$

Where: Xij is the suitability degree of j-th factor in i-th location, Wij is the weight of j-th factors / sub factors in factor location, Cj is the constraint on the j-th factors / sub factors.

WLC method is based on the assumption that each factor has a different weight. Weighting process is performed by using the results of logistic regression analysis. The logistic regression results will obtain the order and magnitude of variables roles on paddy field conversions in Bekasi. This value is then used as weights in multicriteria evaluation. Weighting results and normalization are presented in Table 3.

Table 3. Weighting of independent variables in establishment of sustainable paddy field zone

Variable	Weight		
	LR values	weight	normalization
Land suitability for paddy	1,4544	1,4544	0,4865
d settlement	-0,6037	0,6037	0,2019
d housing estate	-0,5506	0,5506	0,1842
d road	-0,1584	0,1584	0,0530
d capital	-0,0906	0,0906	0,0303
d industry	-0,0681	0,0681	0,0228
d irrigation channel	0,0636	0,0636	0,0213
Total		2,9894	1

LR is logistic regression, d is distance

In multicriteria evaluation, the parameters used to support sustainable development include: (a) Physical factors covering the land suitability; (b) Economic factors covering the land use; (c) Social factors covering the land right and the regional spatial plan. The complete multicriteria evaluation design is shown in Figure 3.

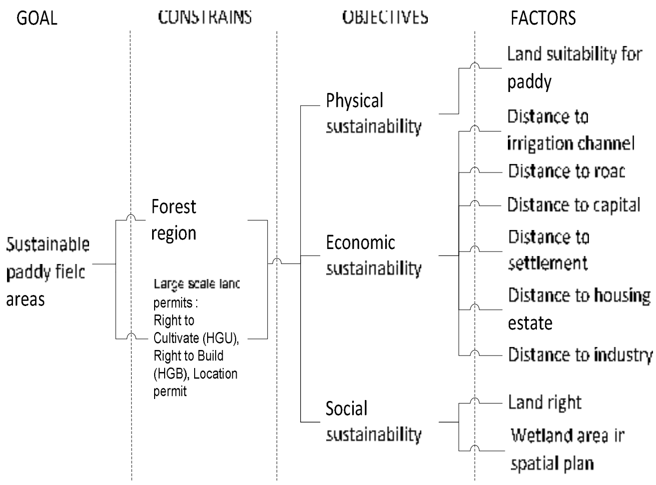


Figure 3. The design of multicriteria evaluation on sustainable paddy field establishment

In the multicriteria evaluation, the variables are first standardized and fuzzy functions are determined (Gorsevski *et al*., 2012). Standardization is a transformation process and scaling the original criteria into comparable units. For example, raster criteria standardization becomes a value between 0 and 1 for each pixel using a fuzzy membership function that is sigmoidal, j-shaped, and other complex forms. Another function of standardization is to manage the uncertainty. Standardization and fuzzy function are based on the characteristics of the variables influence on the paddy field conversions. Generally, the variables are divided into two types, the distance variables and categorical variables. For distance variables, control point setting and fuzzy function are based on the conversion amount over distance. For example, at a road distance variable, paddy field conversions commonly occur in paddy fields up to 2500 m in distance. Establishment of a control point at a distance of 50 meters based on the average length of paddy field parcels, so that at some point between 0 and 50 meters, it is less necessary for paddy fields to be preserved since it is not economical if maintained as paddy fields. Therefore, control point a is 50 m and control point b is 2500 m, with fuzzy function is increasing sigmoidal whereas the suitability value is higher. Paddy field conversions magnitude that has a distance up to 2.5 km from the street side in Bekasi differs from what happens in other regions. According to Widiatmaka et.al (2013) the amount of paddy field conversions in Karawang occurred at a radius of 1 km from the street.

In categorical variables, the establishment of standardization value between 0-255 is done by considering how big the influence of each class is towards the conversions of paddy land suitability variables. Standardization is also done by using the assumption that the best score in each variable is 255. In land suitability variable for paddy crops, Cramer’s V test is used in each class. This test is a chi - square transformation statistical test (for tables contingency greater than 2 columns x 2 rows) which worth 0-1, where the results indicates agreement between the two nominal variables (Liebetrau, 1983 in Siles, 2009). The results in Table 4 show the influence of land suitability classes towards the paddy field conversions.

As shown in Table 4 that paddy land suitability S1 class gives the greatest influence in paddy field conversions process. It is understood that the S1 class regions has a flat slope, close to the capital of Bekasi Regency, Bekasi City leads to Jakarta and it is supported by good access.

Table 4. Results of Cramer’s V test on different class of land suitability for paddy

No	Variable	Cramer's V	p
1	S1	0,3544	0,0000
2	S2	0,1439	0,0000
3	S3	0,0310	0,0000
4	N1	0,1657	0,0000
5	N2	0,1668	0,0000

Influence magnitude is then transformed proportionally to the value of 0-255, where the greatest influence is 255. Land suitability class S1 influences paddy field conversions the most so it is given the value of 255. This also shows that paddy field conversions tend to occur in S1 paddy fields. The establishment of fuzzy sets and functions of the variables are presented in Table 5.

Table 5. Fuzzy set and function variable in establishment of sustainable paddy fields

Sustainability objectives	Variable	Control point a	Control point b	Standardization/ Fuzzy function
Physical	Land suitability S1 S2 S3 N1 N2			 255 104 22 119 120
Economic	Distance to irrigation channel	0 m	4250 m	Sigmoidal decreasing
	Distance to settlement	0 m	200 m	Sigmoidal increasing
	Distance to housing estate	0 m	200 m	Sigmoidal increasing
	Distance to road	50 m	2500 m	Sigmoidal increasing
	Distance to capital	0 m	15500 m	Sigmoidal increasing
	Distance to industry	0 m	750 m	J-shaped increasing
Social	Right of ownership (HM) and customary land (adat) Large scale land permits : Right to Cultivate (HGU), Right to Build (HGB), Location permit. Forest region			1 0 (constrain) 0 (constrain)
	Wetland area 1999 in regional spatial plan			255

The results of multicriteria evaluation were then tested by Ordered Weighted Average analysis (OWA). OWA method is a technique to rank the criteria and manage the uncertainty interactions. OWA method will produce continuous scale scenario between slices (risk adverse) with the union (risk-taking), further details can be seen in Gorsevski *et al.* (2012). OWA method provides many options between two extreme sides i.e. only focusing on protecting the best paddy fields and protecting almost all existing paddy fields. OWA is a part of MCE in Idrisi, which able to give an outlook how big the risk of policy scenarios is taken, whether it is standard, protective or permissive. OWA method is an effective method to adjust the trade-off and the compensation between criteria. Another advantage is the ability to integrate heterogeneous datasets either qualitative or quantitative criteria using expert knowledge, the flexibility to choose a certain criteria in various study areas or different problems, the flexibility to change the criteria interest level, and the freedom to develop various scenario models for risk level (Gorsevski *et al.*, 2012). In this case, the chosen scenario is based on the purpose of paddy field protection which is standard, protective and permissive. The order of weight given to each suitability protection class is presented in Table 6.

Table 6. Ordered weight of OWA for three different scenarios

Ordered weight	Policy		
	standard	protective	permissive
Weight 1	0.1111	0.0430	0.1
Weight 2	0.1111	0.0478	0.09
Weight 3	0.1111	0.0531	0.081
Weight 4	0.1111	0.0590	0.0729
Weight 5	0.1111	0.0656	0.0656
Weight 6	0.1111	0.0729	0.0590
Weight 7	0.1111	0.081	0.0531
Weight 8	0.1111	0.09	0.0478
Weight 9	0.1111	0.1	0.0430

3. Result and Discussion

3.1 Drivers of Paddy field conversions in Bekasi

Through logistic regression analysis of various numbers and types of variables combinations, the best equation is obtained. Table 7 shows that the best equation is the equation in Set 8 combination columns which marked with the highest pseudo R-square value approaching the minimum standard of 0.2. The combination within Set 1 to Set 8 is a combination that has the best value, one level under the Set 8 that can be displayed. The paddy field prediction in 2009 can also be done using logistic regression analysis. By using the ROC method, prediction result validation of 0.755 is obtained. ROC results give less optimal outcome of prediction models. This is caused by the quality of the data. The paddy field prediction results in 2009 is shown in Figure 4a, it is clear that the paddy field conversions threat based on the largest logistic regression equation is located in the centre of Bekasi. This region is the center of growth marked as the capital regency, an industrial area with highway access.

Table 7. Results of logistic regression in some variables combinations

No	Variable/parameter	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6	Set 7	Set 8
	Intercept	5.207	5.1411	4,1959	4.8425	4.7868	6.4663	4.2834	5.3005
X_1	Distance to industry		-0.0904	-0,0834	-0.0928	-0.2092	-0.0721	-0.0212	-0.0681
X_2	Distance to irrigation channel	0.0647		0,0522	0.0569	0.0300	0.0535	0.0571	0.0636
X_3	Distance to road	-0.1607	-0.1503		-0.1563	-0.1267	-0.1548	-0.2954	-0.1584
X_4	Distance to capital	-0.1341	-0.0476	-0,0614		-0.4547	-0.2086	-0.1959	-0.0906
X_5	Distance to housing	-0.5595	-0.5408	-0,5505	-0.5678		-0.4994	-0.6223	-0.5506
X_6	Land suitability	1.5023	1.4362	1,4917	1.5446	0.4074		1.2257	1.4544
X_7	Distance to settlement	-0.6094	-0.6019	-0,6391	-0.6060	-0.6283	-0.5848		-0.6037
X_8	Wetland area 1999 in regional spatial plan	5.3040	5.6083	5,6142	5.1860	7.1257	5.2267	5.2425	5.2372
Model chi-square		18,229	194,618	18,315	195,162	13,269	18,444	14,649	195,315
Goodness of fit		98,521	1,032,277	99,825	1,033,365	108,288	98,593	99,246	1037,454
Pseudo R-square		0.1966	0.1984	0,1954	0.1990	0.1810	0.1972	0.1565	0.1992
AUC		0.8066	0.8075	0,8042	0.8085	0.7910	0.8054	0.7701	0.8079

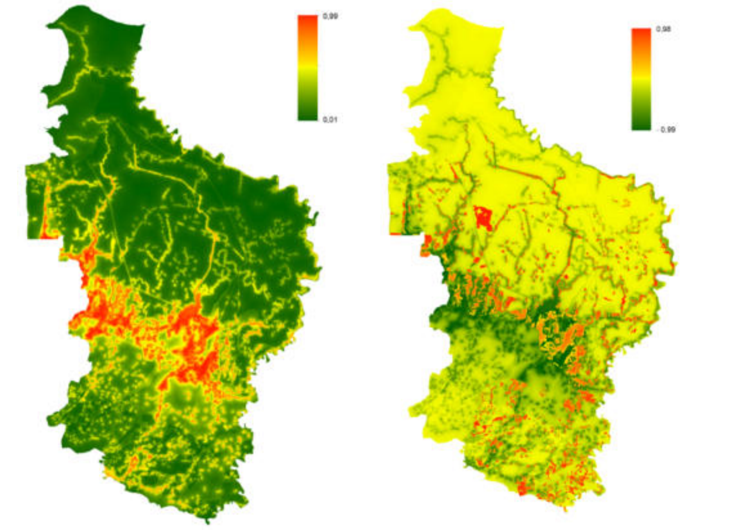
Set (1-8) is variables combination X (1-8)

Set 8 Column in Table 7 can be rearranged as follows:

$$p' = 5{,}3005-0{,}0681X_1+0{,}0636X_2-0{,}1584X_3-0{,}0906X_4-0{,}5506X_5+1{,}4544X_6-0{,}6037X_7+5{,}2372X_8 \quad (5)$$

Equation 5 describes the variable role in controlling paddy field conversions, both positive and negative. The weak variables that influence paddy field conversions are the distance from the capital of Bekasi, Karawang and

Bekasi City and distance to settlement. The most influential variable in paddy field conversions in Bekasi is the establishment of wetland through spatial planning. The influence of spatial plan due to small area designated for wetland. Next variable is paddy field suitability, which showed that paddy field conversions mostly occur in paddy fields with highest level of land suitability. Both variables are positive factors by means of preventing paddy field conversions. While negative variables that supports paddy field conversions is the distance from settlements and housing estates followed by distance to road and distance to industrial areas. It is comprehended by looking at the industrial area rapid growth and followed by a high demand for housings. However, to acknowledge the results of the logistic regression should be understood that the paddy field conversions determinants are specific in both location and period. These factors will vary between regions in both types and weights as well as between periods.



(a) (b)

Figure 4. Prediction (a) and residue (b) of paddy fields in 2009 from logistic regression

Figure 4 shows prediction and residual results from the logistic regression equation Equation 5. Prediction of paddy field conversions is shown with increasing red color with a value approaching 1. Conversion is predicted to happen a lot in the central region to east-west lengthwise of Bekasi. Figure 4b shows the prediction results compared to the data of paddy field in 2009. The red color approaching 1 indicates that the conversions happened in these areas are beyond prediction. This proves that the paddy field conversions acceleration in Bekasi happened rapidly.

3.2 Establishment of Sustainable Paddy fields

Generally, it is said that paddy field conversions in Bekasi happened rapidly. GIS overlay method calculated the sum of paddy field conversions in 2004-2009 in Bekasi is 14.006 hectares or 2801 hectares / year or 7.78 hectares / day. The magnitude of paddy field conversions existed along with loss of farm households. Based on Agriculture Census 2013 data (Indonesian Bureau of Statistics, 2013), in 2013 was recorded that farming households were 85.587 householders, but decreased since 2003 which reached more than 203.000 householders. Therefore, there has been a reduction of 117.413 farm family households for 10 years or 11.741,3 / year or 32,17 / day.

Three policy scenarios can be arranged from sustainable paddy field protection model, namely, standard policy, protective policy and permissive policy. Standard policy is the result of multicritera evaluation without OWA, which can be used directly with a standard protection level. Standard policy basically is a safeguard which is equal to threat magnitude. Protective scenario is chosen to protect almost all existing paddy fields, whereas permissive scenario provides government flexibility to converse in order to encourage the region development.

Paddy field protection priority has been obtained using sustainable paddy field protection model that has been demonstrated earlier. The paddy fields are mostly located on land suitability class S1, which has the most suitable land physical characteristics. The value of the results from standard, protective and permissive scenarios is classified with range of 0-255 to 4 paddy field protection class. The classification result and its calculation of each class can be seen in Figure 5 and Table 8. By using three scenarios, the model has high flexibility to accommodate other land use interests of development. Paddy field protection is limited to areas with high to medium protection weight. Likewise, the regional development, should aim the paddy fields with low protection weight.

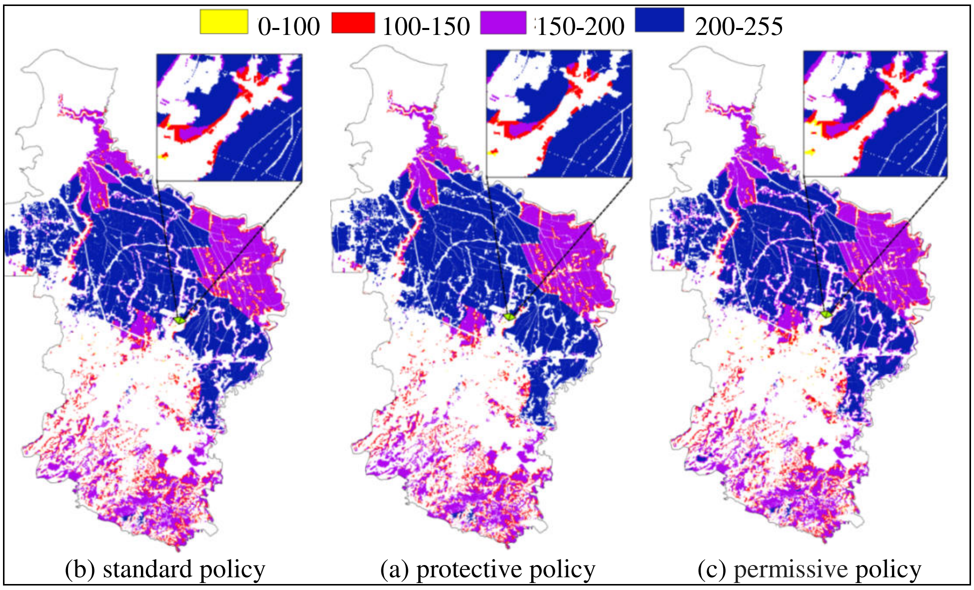


Figure 5. Different policy scenarios to preserve paddy fields

Table 8. The area of each protection class in three different scenarios

Class	Values	Policy scenario area (Ha)		
		Standard	Protective	Permissive
1	201-255	30,911.56	33,003.94	28,819.25
2	151-200	21,989.06	20,105.00	24,520.75
3	101-150	6,575.50	6,409.25	6,022.50
4	51-100	106.19	64.13	219.81
Total		59,582.31	59,582.32	59,582.31

The implementation model in Bekasi Regency showed that the magnitude of paddy field conversions threat was reflected in standard protection model response where almost the entire paddy field has the highest protection class. The application of protective scenario expands the paddy field area that must be protected, especially in class 1 paddy fields. The development interest is accommodated through permissive models where land located near the settlements, roads and housing estates, was given lower protection weights so that it can be converted.

Basically, the three policy scenarios can be adjusted based upon time and interest. For example, if the protective policy scenario was successfully applied in paddy field protection but causing the slow movement of regional development, within a few years it can be evaluated and then standard or permissive policy scenarios can be applied for development interests. By these methods, the best paddy fields remain protected. Overlooking the paddy field with protection priority, these paddy fields are located not far from the central east-west lengthwise of Bekasi. The region can be considered as a buffer for the existing paddy fields either in the north or south part.

4. Conclusion

This study has presented an establishment of sustainable paddy field model which created using logistic regression and multicriteria evaluation by focusing on the local paddy field conversions characteristics and sustainable development concept. Logistic regression can reveal the key variables in paddy field conversions of an area quickly. Negative determinant variables of paddy field conversions in Bekasi Regency are the distance from settlements, housings, roads, and industrial estates. Through multicriteria evaluation can be obtained priority paddy fields that must be protected and also as a buffer to other paddy fields behind. Sustainable paddy field protection policies can then be applied through three policy scenarios, standard, protective and permissive policies. This eases the government to provide appropriate and efficient subsidies by means of opening investment opportunities in regional development.

The model built in this study involved spatial and temporal data which is easily acquired while implemented to other regions. The more complete and accurate supporting data is, the more optimal results will be received. The model was designated with clear stages so it is possible to be tested in other regions with different characteristics.

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