

ANALYSIS OF THE IMPACT OF SPACE APPLICATION PATTERNS IN PLACING THE LOCATION OF ECONOMIC ACTIVITIES THROUGH THE CONVERSION MECHANISM OF RAW LAND FIELD LAND CONVERSION

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Abstract. Conversion of agricultural land into built-up land is a regional economic development mechanism, where to increase Gross Domestic Product can be done by allocating the widest possible pattern of space designation "*industry, trade and settlement*", the implication is the conversion of agricultural land into built-up land. land (rice fields) increases and rice production facilities decrease so that food fulfillment is constrained, in other words there is a trade off in the use of paddy fields. In an effort to optimize the allocation of space for rice fields, the purpose of this study is to analyze the factors of space allocation in influencing the location of economic activities (industry and housing) in rural areas. Through the mechanism for conversion of paddy fields and the determination of the priority scale for the revision of the designation pattern of paddy fields in the regional spatial plan. This study uses spatial overlay analysis, quantitative calculations, multiple linear regression and spatial analysis of 4 criteria (space allocation, road access, population density and land prices). The research locations are distinguished in rural areas with high and low industrialization and urbanization. Input data using spatial software with overlay techniques including spatial data on administrative boundaries of the sub-district area, paddy land use in 2013 and 2018, road access (tolls, arteries and collectors) in 2018, spatial allocation based on the Regency Spatial Plan, value zone land in 2018 and population density. The results showed that the location of economic activities (industrial and housing) was relatively influenced by the space allocation factor compared to the road access factor. Revision of Spatial Plan is recommended in rural areas with high rice field conversion potential in rural areas with high industrialization and urbanization.

Keywords: road access; spatial multi-criteria analysis; rice field conversion; spatial designation, multiple linear regression.

INTRODUCTION

The concept of spatial planning rests on cultivation areas which include the allocation of production forests, agriculture, mining, settlements, industry, tourism and trade. Regional-based development is based on "*location theory*" with the basic idea of optimizing space utilization through space allocation in such a way that all available space can be utilized optimally for various sector activities. The economic development of rural areas is intended to improve welfare and food fulfillment. Gross Domestic Product (GDP) and the transformation of the economic structure are indicators of increasing welfare. The transformation of the economic structure is illustrated by changes in the contribution of the sectors that make up GDP, namely the contribution of the industrial sector is increasing and the contribution of the agricultural sector is decreasing, which has implications for increasing conversion of agricultural land (rice fields) and decreasing food production facilities (rice). In line with (Hur et al., 2011); (Kim & Nguyen, 2018) land use conversion is based on the value of land rent, where land use with land rents will displace land uses with land rents smaller "*Industrial*" land use has the land rent followed by "*trade, settlement, intensive agriculture, extensive agriculture*". Conversion of agricultural land into built-up land is a common mechanism in regional economic development activities.

Regional economic development in the form of industrial, trade and settlement activities can open up the labor market, reduce unemployment, increase people's

income, increase GDP and encourage changes in the economic structure from traditional sectors with low productivity to high productivity economic sectors (Gereffi, 2013); (Adefolaju, 2011). According to (Kasi et al., 2020) the placement of industrial locations is based on the principle of minimizing transportation costs, labor wages and the strength of agglomeration, while according to (Manurung et al., 2019) the choice of residence is influenced by accessibility to the surrounding economic growth centers. Transportation costs and accessibility are important factors in the placement of economic activities. According to (Merrill & Smith, 2017), the selection of industrial locations not only emphasizes the personal preferences of industry players but is also influenced by strategies in large organizational environments (central and local government bureaucracies). Location theory is a basic theory in spatial analysis where spatial planning and the location of economic activities are the main elements. (Capello, 2011) says that location theory seeks to explain the distribution of activities in space.

Based on the regulations for organizing spatial planning, namely Government Regulation no. 15/ 2010 Jo. Government Regulation No. 21/2021 mandates that every activity plan including industrial and housing development in the context of doing business (investment) must pay attention to the "*Compatibility of Spatial Utilization Activities*" (KKPR) based on the Spatial Plan. KKPR is also one of the conditions for the issuance of land rights (land certificates), where certified land can be guaranteed to obtain capital from

financial institutions, facilitating land buying and selling transactions, in other words certified land can increase the value of land assets (land rent).

The conversion of agricultural land into built-up land in West Java is dominantly changing its function into industrial activities and permanent housing (Santosa et al., 2014). The question is how the factors of space allocation and road access affect the location of industrial and residential activities in an effort to optimize economic value.

This study aims to analyze the factors of space allocation and road access affect the location of economic activities (industrial and residential) through the mechanism of rice field conversion and analyze the priority of re-arranging the pattern of rice field space designation in terms of the potential for rice field conversion.

METHODS

The research location is located in West Java Province, which is a province with an economic growth rate and Gross Domestic Product higher than the national average, and the contribution of the dominant

industrial sector. West Java Province is geographically directly adjacent to DKI Jakarta, the capital city of Indonesia, and has the largest population compared to other provinces in Indonesia. In the last two decades, West Java Province has carried out massive regional development activities so that the conversion of agricultural land into built-up land in various sectors, namely infrastructure (roads, toll roads, airports, ports, dams), industry, housing, trade is a natural thing. The research locations are located in rural areas (districts) which are differentiated based on the level of industrialization and urbanization of the region, with indicators of GDP, the percentage of the industrial sector's contribution to Gross Domestic Product, and the percentage of labor in the agricultural sector, the number and density of the population (Table 1). The rural areas of high industrialization and urbanization are represented by Bekasi Regency and Bogor Regency, while the rural areas of low industrialization and urbanization are represented by Sukabumi Regency and Tasikmalaya Regency.

Table 1 . Indicators Of The Level Of Industrialization And Urbanization

Regency	Indicators					
	GDP (2018) Million Rp.	Contribution of the industrial sector to GDP (2019) (%)	Labor sector per-agriculture (2019) (%)	Total population (people)	Population density (people/km ²)	& urbanization
Bekasi	242,023,294	42.99	2.58	3,113,071	2,542	High

Bogor	148,204,833	54.04	6.95	5,427,068	2,002	High
Sukabumi	44,107,869	17,17	24,72	2,725,450	657	Low
Tasikmalaya	23,319,635	8.40	28.66	1,865,203	731	Low

Source: West Java Province In Figures, BPS 2019.

The basis for determining the location, from the 2019 Gross Domestic Product data processing constant prices in 2010 based on districts in West Java shows an average GDP of Rp. 58,805,813 (in million). The classification of Gross Domestic Product is divided into "high and low",

where GDP is classified as "high" if it is above the average GDP and classified as "low" if it is below the average Gross Domestic Product. Rural areas (districts) based on Gross Domestic Product classified as "high" are Bekasi Regency, Karawang Regency, Bandung Regency and Bogor Regency (Figure 1).

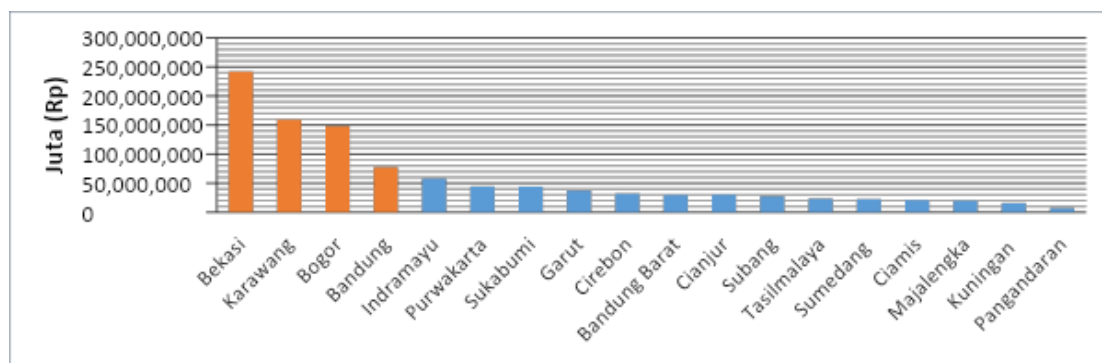


Figure 1 . Distribution of 2010 constant price GDP by district in West Java in 2018

The basis for determining the location of population density data for 2019 based on districts in West Java Province. The average population density in West Java Province by district is 1,225 people/km², in this study it is classified into "high and low", where population density is classified

as "high" if it is above the average population density and is classified as "low" if it is below the average population density. Rural areas (districts) based on population density classified as "high" are Bekasi Regency, Cirebon Regency, Bandung Regency, Bogor Regency and Karawang Regency (Figure 1).

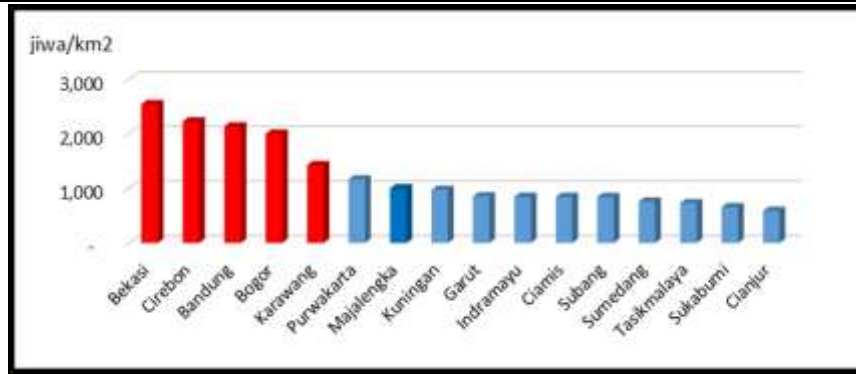
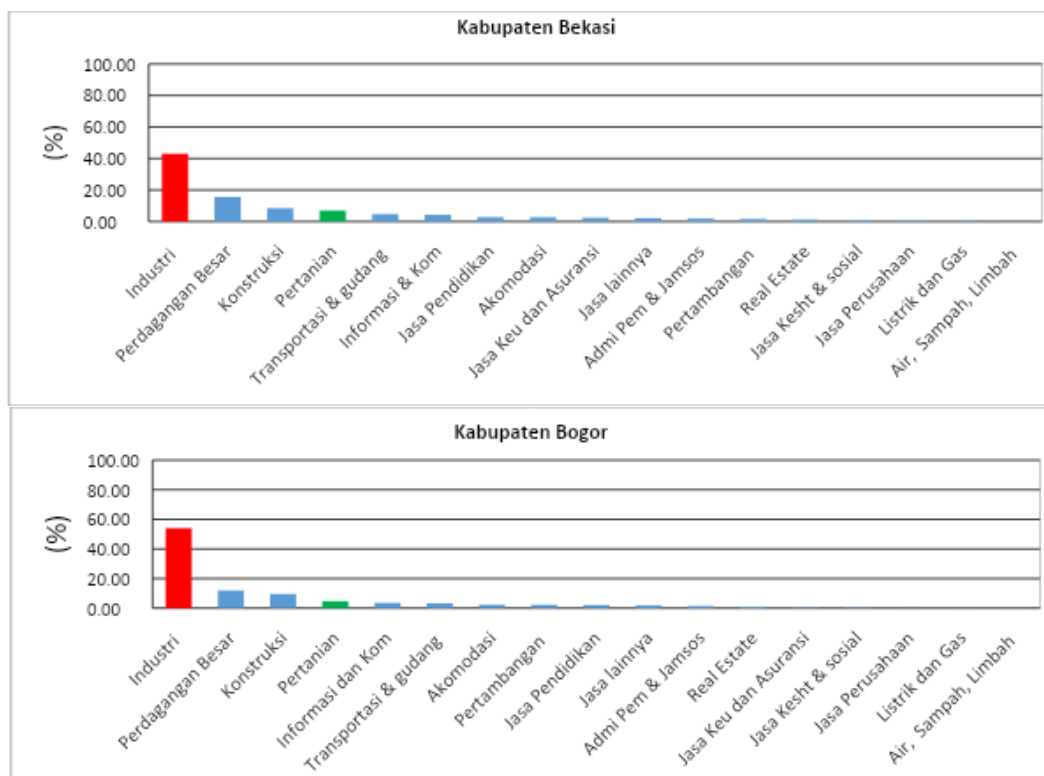


Figure 2. Population density by district in West Java in 2018

Further in terms of the percentage contribution of Gross Domestic Product in 2019 by sector (Figure 2) shows that in Bekasi Regency and Bogor Regency the

dominant sector contribution is the industrial sector, while in Sukabumi Regency and Bogor Regency The dominant Tasikmalaya sector is the agricultural sector.



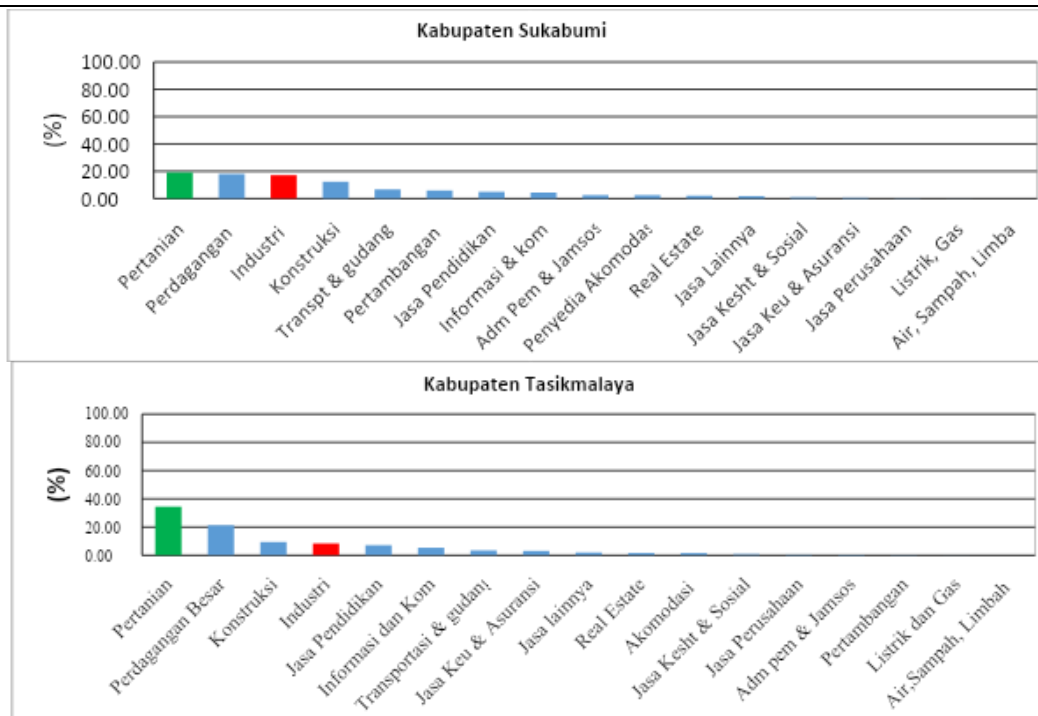


Figure 3. Percentage of contribution by sector in 2019 GRDP at research locations

Technical analysis of data to answer the research objectives using spatial overlay analysis, quantitative calculations and multiple linear regression.

Answering the objective of analyzing the factors of space allocation and road access affecting the location of economic activities (industrial and housing) through the conversion mechanism of paddy fields, using multiple linear regression.

Multiple linear regression analysis was performed on each economic activity, namely industry and housing. Multiple regression analysis of the location of industrial activities was carried out in all sub-districts at the research location where the conversion of paddy fields into industrial activities occurred in the 2013-2018 period. The consideration is that industrial activity is an investment activity, wherever it is placed, pay attention to ease of access (roads) and KKPR, because easy access can minimize costs and according to

regulations, KKPR is a condition for legalizing assets (land certificates) and land is a means of sustaining industrial activities. In the same way, multiple regression analysis of the placement of housing activity locations was also carried out in all sub-districts at the research location where the conversion of paddy fields into housing for the 2013-2018 period was carried out. The consideration is that housing development activities are investment activities, wherever they are placed, they pay attention to ease of access and KKPR, because KKPR is a condition for legalizing assets (land certificates) to be built housing units for marketing needs.

Conversion of paddy fields into industrial activities for the period 2013-2018 (Y_i) and conversion of paddy fields into residential activities for the period 2013-2018 (Y_p) are dependent factors and the space allocation and road access factors are independent factors (X), where

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$Y_i = f(X)$ and $Y_p = f(X)$. Variable (X) is translated into 5 (five) variables, namely X1, X2, X3 are road access factors and variables

X4 and X5 are space allocation factors as presented in Table 2.

Table 2. Details of Road Access Factors and Spatial Designations Affecting the Location of Economic Activities Through the Mechanism of Rice Field Conversion

Factor	Variable	Code	Description*)
1. Road Access	X1	0 -1DJ	Rice field area 2013 at 0-1 km from the road (ha)
	X2	1-3 DJ	2013 rice field area at 1-3 km from the road (ha)
	X3	> 3 DJ	2013 rice field area at >3 km from the road (ha)
2. Space	X4	PPI	2013 rice field area at PR-PPI (ha)
	X5	NPPI	2013 rice field area at PR-NPPI (ha)

obtained from the processing/analysis of spatial *overlay* and quantitative calculati space allocation and road access factors were obtained from the results spatial data analysis *overlay* and quantitative

Industrial Activities

$$Y_i = j + k_1 X_1 + k_2 X_2 + k_3 X_3 + k_4 X_4 + k_5 X_5$$

Y_i = prediction of conversion of paddy fields to industry;

j = constant; k_1, k_2, \dots, k_5 = regression coefficient value;

X_1, X_2, X_3, X_4, X_5 = independent variable

Housing Activities

$$Y_p = m + n_1 X_1 + n_2 X_2 + n_3 X_3 + n_4 X_4 + n_5 X_5$$

where :

Y_p = prediction of conversion of paddy fields to housing;

m = constant; n_1, n_2, \dots, n_5 = regression coefficient value;

X_1, X_2, X_3, X_4, X_5 = independent variables

Answering the objective of determining

calculations. wheremultiple linear regression model is as follows:

the priority scale for re-arrangement/revision of the spatial designation of paddy fields in terms of potential conversion of paddy fields, using multi-criteria evaluation techniques.

Spatial-based multi-criteria analysis utilizes tools insoftware Geographic Information System (GIS)The results of the analysis are in the form of a map of the potential for rice field conversion in 2018 at each research location, using 4 criteria (space allocation; road access; population density and rice field prices). The weighting of the 4 (four) criteria is based on the results of multiple linear regression on 4 (four) factors affecting the conversion of paddy fields, where the space allocation factor is relatively dominant in influencing the conversion of paddy fields, followed by road access, population density and land

prices. The weighting of space allocation factors (40%), road access (30%), population density (20%) and land prices (10%) in influencing the potential for rice field conversion (Table 2.4). As for the weighting of the 3 (three) types of road access, namely arterial, collector and toll roads based on the physical condition and function of the road, where the arterial road is a public road that serves to serve the main transportation for long-distance travel with a speed of > 60 km/hour and a width of > 60 km/hour. road body > 8 m, while collector roads are roads that are used to serve vehicles with medium travel distances, speeds > 40 km/hour and road width > 7 m, while toll roads are public roads that are part of the road network

system and as national roads that users are required to pay and ease of access is determined by the exit/entrance of the toll road, so based on this the weighting of arterial roads is (0.5), collector roads (0.3) and toll roads (0.2) in influencing the potential conversion land. Calculation of the area and spatial distribution of potential conversion of paddy fields using the equal intervals (three classes), namely the classification of "high, medium and low".

The potential for rice field conversion is classified as "low" if the total score on the unit or polygon of paddy fields is less than 1.78 and "medium" if the total score is between 1.78 to 2.74 and the classification is "high" if the total score is more of 2.74.

Table 3 . Matrix of Criteria, Weighting, Scoring for Determining Potential Conversion of Paddy Fields

Criteria (Weight)	Classification (weight)	Sub Criteria	Level of ease of conversion	Score	Total
Space allocation Score (40%)	up land	PPI	High	4	1.60
	Extensive agriculture	PLK	Medium	3	1, 20
	Intensive farming	PLB	Low	2	0.80
	Protective function	L	Very low	1	0.40
Road access (30%)	Arteries (Weight 0.5)	0-1	High	6	0.90
		1-3 DJ		4	0.60
		> 3 DJ		2	0.30
	Collector (Weight 0.3)	0-1	Medium	6	0.54
		1-3 DJ		4	0.36
		> 3 DJ		2	0.18
	Toll (Weight 0.2)	0-1 DJ	Low	6	0.36
		1-3 DJ		4	0.24
		> 3 DJ		2	0.12
very dense	> 8500 people/km ²	6000-8499	4	0.80	

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Population density (20%)	Dense	people/km ²	Medium	3	0.60
	Medium	1500-5999 inhabitants/km ²	Low	2	0.40
	Low	< 1500 people/km ²	Very low	1	0.20
Land price (10%)	Low price	< Rp. 50,000 per m ²	High	4	0.40
	Medium price	Rp. 50.000 -150.000 per m ²	Medium	3	0.30
	High price	Rp. 151,000-450,000 per m ²	Low	2	0.20
	Very high price	> Rp. 450,000 per m ²	Very low	1	0.10
Highest total score 3.70					
Lowest total score 0.82					

industrial activities and housing.

RESULTS AND DISCUSSION

A. Analysis Of Space Allocation Factors And Road Access Affect The Location of Economic Activities (Industrial And Housing)

Conversion of agricultural land into built-up land is a common mechanism in regional economic development activities. Conversion of agricultural land, especially paddy fields into built-up land, namely industrial and residential activities is permanent ([Arisoy & Ozturk, 2014](#)). According to ([Grežo et al., 2020](#)) the placement of industrial activities is based on the principle of minimizing transportation costs, labor wages and the strength of agglomeration, while ([Hausman, 2017](#)) the choice of residence is influenced by accessibility or ease of reaching the location or center of economic growth in the vicinity. In other words, the cost of transportation (road access) is an important factor in the placement of

Spatial planning is a form of spatial structure and pattern of space utilization as a place of life that includes land space in a territorial unit. According to ([Haaland & van Den Bosch, 2015](#)) the urgency of spatial planning arises as a result of the growing awareness of the importance of public intervention (collective action) in developing spatial patterns and spatial structures in accordance with common goals. The regulation on the implementation of spatial planning (PP No. 15/2010 jo. PP No. 21/2021) mandates that the use of space should refer to the spatial designation pattern based on the spatial plan (RTR). After the issuance of Law no. 11 of 2020 concerning Job Creation (UUCK) introduced the term suitability

of space utilization activities (KKPR) based on the RTR (formerly Location Permit), where KKPR approval for industrial and residential activities can

be approved if the activity is located on land with the function of allotment of space for industrial trade settlements (PPI).

Table 4. Regression Analysis Of Road Access Factors And Space Designation Affect The Location Of Economic Activities (Industrial And Housing)

Factors	Variable	Code	of Industrial		Activities Residential Activities	
			Coefficient	P-value	Access	Road
X1	0-1	DJ	0.227	0.407	0.550	0.109
	X2	1-3	-	-	-	-
		DJ	-	-	-	-
X3	> 3 DJs	-	-	-0.179	0.451	
Space Designation	X4	PPI	0.031	0.001*	0.036	0.009
	X5	NPPI	-0.077	0.743	2.575	0.002

Note :

- = excluded from the analysis process because there is high multicollinearity;

* = Significant P-value < 0.05 and ** = Significant P-value < 0.10

R-square : Industrial Activities (75.63%); Housing Activities (76.37%).

Regression analysis of space designation factors and road access affecting the location of industrial activities through the rice field conversion mechanism (Table 3.1) shows that the X4 space allocation factor (PPI) is significantly positively correlated, while the X5 space allocation factor (NPPI) is not significantly negatively correlated, while road access factor X1 (0-1 DJ) is not significant positively correlated to affect the location of industrial activities. This indicates that the location of industrial activities is more influenced by the space allocation

factor (PPI) than the access road (0-1 DJ), where the X4 space allocation factor (PPI) has a significant correlation. The placement of industrial activity locations is directly proportional to the area of paddy fields with the PPI space designation, meaning that the wider the paddy fields are in the PPI space designation, the higher the chance of placing industrial activities on paddy fields.

NPPI Regression analysis of space allotment factors and road access factors mechanism paddy field conversion (Table 3.1)) space allocation factors significantly positively affect the

placement of housing activity locations. The X5 variable coefficient (NPPI) is quite large, namely 2.575, which indicates that the correlation between the location of housing activities and the spatial allocation of the NPPI is quite strong. This condition illustrates that the location of housing activities is relatively less concerned with the suitability of space utilization activities (KKPR), while in terms of road access factors, the X1 variable (0-1 DJ) is not significantly positively correlated, the X3 variable (> 3 DJ) is not significantly negatively correlated. This condition indicates that the housing location tends to be in paddy fields 0-1 km from the road rather than in paddy fields >3 from the road.

From the description above, it is shown that the spatial allocation factor (PPI) is significantly positively correlated to affect the location of industrial activities and housing activities, while the road access factor does not significantly affect the location of industrial activities and housing activities. This indicates that the location of industrial activities and housing activities is relatively influenced by space allocation factors or the suitability of space utilization activities (KKPR) compared to road access factors.

The suitability of space utilization activities (KKPR) based on RTR is a factor that is considered in the placement of industrial activity locations and housing activities for business actors, this is because the

suitability of industrial activities and housing activities with space allocation is a condition for asset legalization (land certificates). According to ([Molinaro & Malloy](#), 2016) that land acquisition for industrial activities, housing and land certificates for business actors must be in accordance with the spatial designation, where land parcels are for business purposes, it must first be ensured that the KKPR is fulfilled. According to ([Wieland & Thornton](#), 2014) that land certificates can encourage an increase in asset value, due to the more open transaction process for land assets. In other words, land certificates can increase land value (economic rent) and land certificates for business activities require KKPR approval.

B. Recommendations for revision of the pattern of paddy field space designation.

The existence of paddy fields in Indonesia is not only necessary to support food self-sufficiency, but also to balance the sustainability of the production system and the environment as well as maintain the heritage of cultural values from generation to generation. Indonesia, through the Ministry of Agriculture, is targeting food (rice) self-sufficiency in 2045, so that the existence of paddy fields as an important means of production is maintained. Rice fields in Java, including West Java Province, are the main suppliers of food (rice) in Indonesia. For reasons of regional economic development, a lot of

agricultural land (rice fields) in rural areas with industrialization and high urbanization has resulted in the conversion of paddy fields for various sectoral purposes. The conversion of paddy fields is dynamic due to the transformation of the regional economic structure. Spatial analysis shows that most of the conversion of paddy fields in the 2013-2018 period at the study site turned into built-up land (housing and industry) reaching 1,692 ha (57.57%). Conversion of paddy fields mostly occurs in rice fields in an area of 0-3 km from the road with the function of allotment of space for industrial trade settlements (PPI).

The results of quantitative analysis, assuming an average rice need of 92.9 kg per capita per year and the calculation of dry milled grain production (GKG) an average of 4.5 tons per ha, an average rice yield of 65%, and a cropping pattern of 2 times rice in a year, with the number and rate of population growth in each district of the research location (attached), and the existence of existing paddy fields with the conversion rate of paddy fields in each research location as well as the data on rice field conversion during the period 2013-2018, an overview is

obtained. the position of the demand for paddy fields versus the availability of paddy fields at each research location to achieve food (rice) self-sufficiency, as presented in Figure 1.

Bekasi Regency is a highly industrialized and urbanized rural area, the availability of paddy fields until 2025 indicates food self-sufficiency can be achieved, but after 2025 the availability of paddy fields is lower than the need for paddy fields, with a larger difference. While in Bogor Regency as a rural area with high industrialization and urbanization, from 2010 the availability of paddy fields is lower than the demand for paddy fields and the difference is getting bigger, this condition illustrates that in Bogor Regency it is very difficult to achieve food self-sufficiency. Meanwhile, Sukabumi and Tasikmalaya Regencies are rural areas with low industrialization and low urbanization, showing the same pattern, namely the availability of paddy fields is greater than the demand for paddy fields and the availability of paddy fields tends to decrease with the difference between the availability of paddy fields and the needs of paddy fields getting smaller.

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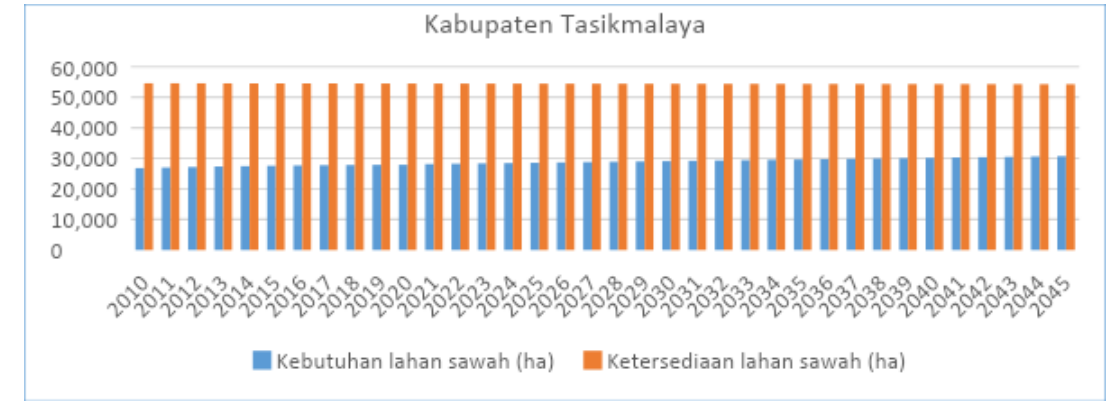
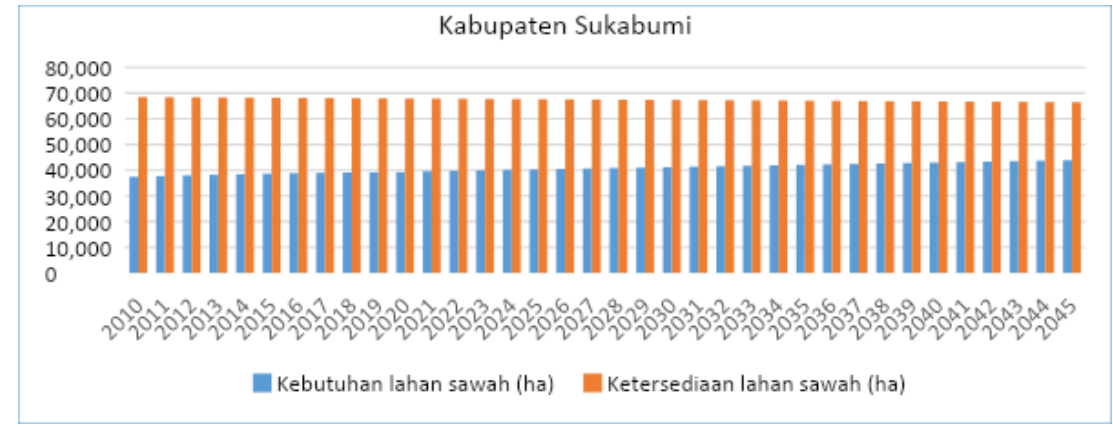
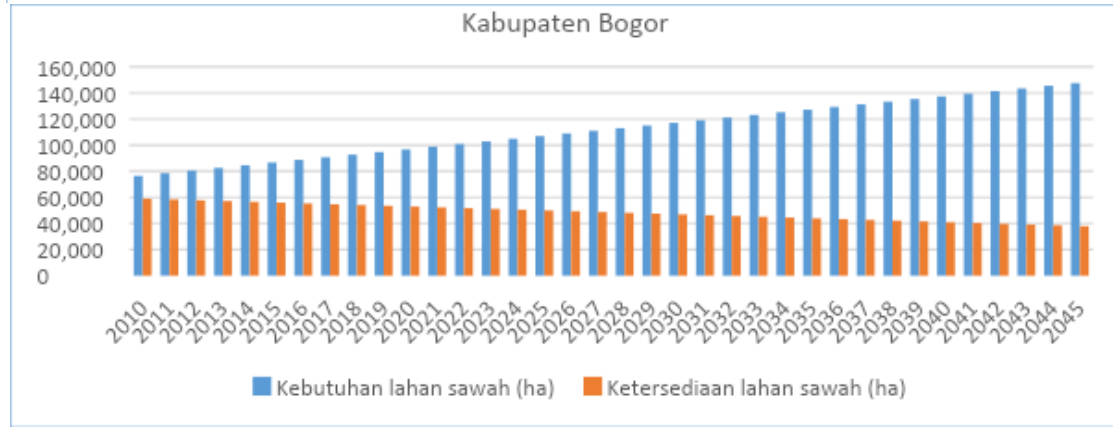
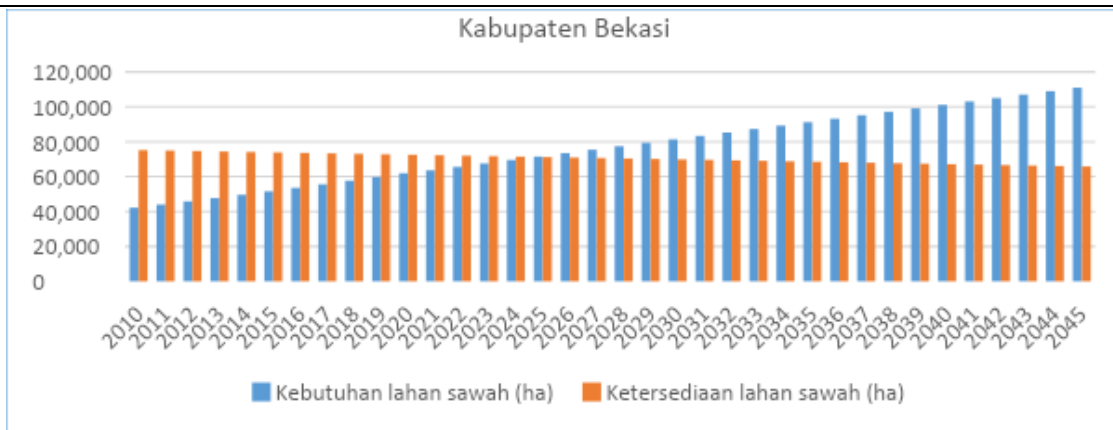


Figure 1. The Pattern of Demand for Paddy Fields Versus the Availability of Paddy Fields in the Research Location

Industrial and housing activities within the framework of investment can be approved by regulation to utilize land with the designation of industrial trade settlement space after obtaining approval from the KKPR (formerly a location permit). KKPR is a condition of asset legalization

(land certificate). Land certificates for industrial activities and housing activities in the form of Building Use Rights (HGB) certificates. HGB is a type of term land rights, where the first grant of land rights is granted for 30 years and can be extended for 20 years, and can be renewed for 30 years. In other words, business actors can utilize/use HGB land for industrial activities for up to 80 years, as long as the terms and conditions of the laws and regulations are complied with.

Meanwhile, for housing development activities, land rights (HGB-main) are issued for the first time for a period of 30 years, then land parcels are divided into housing units to be transferred to individuals through sale and purchase transactions. HGB housing units on behalf of individuals according to the legislation can be upgraded to Hak Milik (HM), which is land

rights with no time period. Thus, the existence of built-up land in the form of industrial activities and housing activities through the mechanism of rice field conversion, is legally protected and legally protected, meaning that it takes a long time to be re-functionalized into agricultural activities (rice fields).

In the context of optimizing the use of land resources in the agricultural sector, especially paddy fields where in its implementation there is a trade off between food fulfillment by controlling the conversion of paddy fields and increasing economic growth, labor absorption by encouraging investment in the manufacturing, trade, construction, housing sectors needs to be regulated. return or revise the pattern of land use for paddy fields through the revision of the RTR. According to Santosa et al (2014) protective policies (spatial designation patterns) are quite effective in being applied to areas with a high threat of conversion of paddy fields. The results of the spatial multi-criteria analysis with 4 (four) criteria obtained a map of the distribution pattern of potential conversion of paddy fields at the study site (Figure 2).

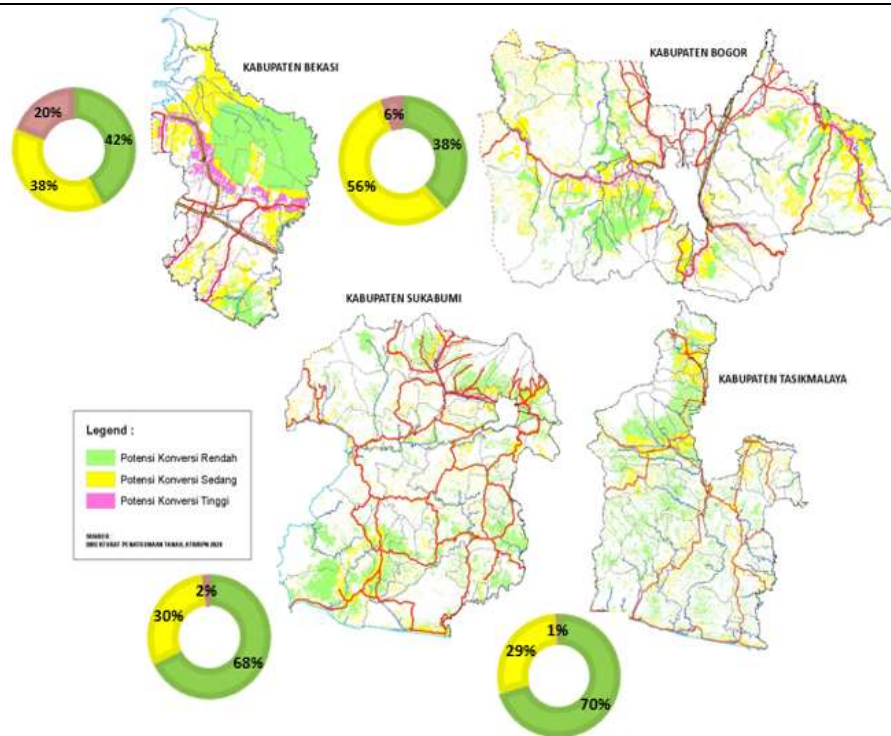


Figure 2. The distribution pattern of the potential conversion of paddy fields in the research location

The distribution pattern of potential conversion of paddy fields in industrialized and highly urbanized rural areas (Bekasi Regency and Bogor Regency) is classified as "high" spread along or along the road with a fairly large percentage. The potential for conversion of rice fields classified as "high" in Bekasi Regency reaches 14,612 ha (20%), while in Bogor Regency it reaches 3,250 ha (6%) of the total paddy field area in 2018. Meanwhile, in rural areas industrialization and urbanization are low, namely Sukabumi Regency and Regency Tasikmalaya, spatially the potential for rice field conversion is classified as "high" at only 2% and 1% of the total area of rice fields in 2018, and dominantly in the category of potential for conversion to rice fields as "low" which is 68% and 70%.

From the results of the spatial multicriteria analysis and quantitative

analysis of the availability of paddy fields versus the need for paddy fields, the proposed re-arrangement or revision of the spatial designation pattern of paddy fields through the revision of the RTR is prioritized in rural areas with high industrialization and urbanization, namely Bogor Regency and Bekasi Regency, prioritized on paddy fields that enter classification of potential conversion of paddy fields is "high", because in this area the opportunity for massive conversion of paddy fields is relatively high. Sukabumi Regency and Tasikmalaya Regency until 2045 are still relevant to achieve self-sufficiency in food (rice).

CONCLUSIONS

The placement of the location of

economic activities, both industrial activities and housing development activities in the context of investment, is more influenced by space allocation factors than road access factors. The industrial trade settlement space designation factor (PPI) is a significant factor that has a positive correlation with the placement of industrial and residential activity locations, while the road access factor does not significantly affect the location of industrial and residential activities. Recommendations for re-arrangement or revision of the pattern of rice field space designation through revision of RTR prioritized in rural areas with high industrialization and urbanization, prioritizing rice fields that are classified as "high" rice field conversion potential.

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