Jurnal Ilmu Pertanian Indonesia (JIPI), Juli 2022
ISSN 0853-4217
EISSN 2443-3462

Vol. 27 (3) 332–340
http://journal.ipb.ac.id/index.php/JIPI
DOI: 10.18343/jipi.27.3.332

The Spatial Effect of Agricultural Sector Growth in West Java: A Spatial Approach to Panel Data

(Pengaruh Spasial Pertumbuhan Sektor Pertanian di Jawa Barat: Pendekatan Spasial Data Panel)

Adi Hadianto[1]*, Harianto[2], Bonar Marulitua Sinaga[1], Bagus Sartono[3]

(Diterima Januari 2022/Disetujui Mei 2022)

ABSTRACT

The agricultural sector is strategic and the third-largest contributor to the GRDP of West Java Province, but its growth has slowed during the 2016–2019 period. The slow growth rate can be caused by the determinants of the growth of the agricultural sector itself and is very likely to be affected by the spatial interaction between regions in the province. Therefore, this study aims to analyze the spatial effect between regions on the growth of the agricultural sector in West Java and identify the factors that influence the growth of the agricultural sector within the province by using spatial analysis of panel data. The results reveal that the appropriate model is a fixed effect spatial error model, which shows an effect of spatial interaction between regions on the growth of the agricultural sector in West Java Province. The factors that affect the growth of the agricultural sector are agricultural credit, agricultural road infrastructure, and diversification of economic activities.

***Keywords*: agricultural sector growth, spatial autoregressive, spatial error model, spatial panel data**

ABSTRAK

Sektor pertanian merupakan sektor strategis dan kontributor terbesar ketiga dalam PDRB Provinsi Jawa Barat, tetapi pertumbuhannya melambat selama periode 2016–2019. Lambatnya laju pertumbuhan tersebut dapat disebabkan oleh faktor-faktor penentu pertumbuhan sektor pertanian itu sendiri dan sangat mungkin dipengaruhi oleh interaksi spasial antarwilayah di Jawa Barat. Penelitian ini bertujuan menganalisis pengaruh spasial antarwilayah pada pertumbuhan sektor pertanian di Jawa Barat, dan mengidentifikasi faktor-faktor yang memengaruhi pertumbuhan sektor pertanian di provinsi tersebut dengan menggunakan analisis spasial data panel. Dari hasil analisis diperoleh model yang sesuai adalah *fixed effect spatial error model* yang menunjukkan ada pengaruh interaksi spasial antarwilayah *pada* pertumbuhan sektor pertanian di Jawa Barat dan faktor-faktor yang memengaruhi pertumbuhan sektor pertanian adalah kredit pertanian, infrastruktur jalan pertanian, dan diversifikasi aktivitas ekonomi.

Kata kunci: pertumbuhan sektor pertanian, regresi spasial data panel, *spatial autoregressive*, *spatial error mode*l

INTRODUCTION

The agricultural sector has a strategic role in economic development in West Java and is a *leading sector* in the regional economy (Bank Indonesia 2020, Sulistyowati *et al.* 2021). During the 2015–2019 period, the share of the agricultural sector's GRDP to West Java's GRDP was an average of 8.71%, the third-largest after the processing industry and trade. Even during the 2020 COVID-19 pandemic that shook the national economy, including West Java, the share of the agricultural sector's GRDP to West Java's GRDP increased to 9.20% (BPS West Java 2021). After that, however, the growth of the agricultural sector in West Java experienced a slowdown in growth. BPS West Java (2021) noted that in 2015–2019 the average GRDP growth rate of the agricultural sector was 2.48%, the smallest after the mining and the electricity & gas sectors.

The low growth rate of the agricultural sector is caused by factors that determine the growth of the agricultural sector itself. Theoretically, capital and labor are the main production factors that source economic growth (Mankiw 2000). Furthermore, the growth theory of Harrod-Domar Model, Neo-Classical Model, and Sollow Growth Model state the importance of capital accumulation in encouraging economic growth, labor, and technology factors (Basu 2000). The accumulation of capital in the agricultural sector can be in the form of infrastructure, and business financing credit is an essential factor in the growth of the agricultural sector.

[1] Department of Resources and Environmental Economics, Faculty of Economics and Management, IPB University, Campus IPB Darmaga, Bogor 16680
[2] Department of Agribusiness, Faculty of Economics and Management, IPB University, Campus IPB Darmaga, Bogor 16680
[3] Department of Statistics, Faculty of Mathematics and Natural Sciences, IPB University, Campus IPB Darmaga, Bogor 16680
* Coressponden Author:
Email: adihadianto@apps.ipb.ac.id

Therefore, the distribution of business credit and investment can be a driving factor for West Java's economic sector's growth (Bank Indonesia 2020). Furthermore, the provision of infrastructure can improve regional connectivity and help increase agricultural productivity and is one of the essential factors in accelerating the region's growth (Belaid 2003). Infrastructure can also increase accessibility so that economic activities grow and become more efficient in terms of time and cost (Edeme *et al*. 2020). In addition, the diversification of economic activity in West Java certainly impacts the growth of the agricultural sector.

On the other hand, the development of the agricultural sector in West Java represents the existing agricultural conditions in districts/cities in West Java. Thus, the growth of the agricultural sector in West Java is very likely to be affected by the spatial interaction between regencies/cities in West Java. Tobler (1970) stated that *"everything is related to everything else, but near things are more related than distant things."* According to Miller and Blair (2009), an economic system has interrelationships between economic sectors and regions. Based on this description, this study aims to analyze the spatial effect between regions on the growth of the agricultural sector in West Java and identify the factors that influence the growth of the agricultural sector in this province by using spatial analysis of panel data.

MATERIALS AND METHOD

Data

The data used in this study was secondary data in the form of panel data consisting of *time series data from* 2016 to 2019 and cross-sections in 27 districts and cities in West Java (Figure 1). The variables observed were data on the growth rate of the agricultural sector, data on bank lending to the agricultural sector, data on the number of workers in the agricultural sector, data on the length of farming roads, and data on the ratio of GRDP of the agricultural sector to regional GRDP. The data was obtained from the Central Statistics Agency, Bank Indonesia, and the Geospatial Information Agency.

Panel Data Spatial Regression Analysis

Selection of the Best Panel Data Regression Model

This stage was carried out to determine the best panel data model. In the spatial panel data model**,** the Random Effects Model (REM) was tested against the Fixed Effects Model (FEM) using Hausman's specification test (Baltagi 2005). Parameters were estimated using Generalized Least Square (GLS). The hypothesis tested was H0: correlation $(x_{it}, \varepsilon_{it})$ = 0; the suitable model is REM. This test statistic has a chi-squared $\chi 2$ distribution with *K* degrees of freedom (the number of explanatory variables in the model, excluding the constant term) (Elhorst 2010). Therefore, the test statistic could be written as follows.

$$x^2{}_{hit} = \hat{q}[var(\hat{q})]^{-1}\hat{q} \quad (1)$$

The symbol $\hat{q}$ denotes the random-fixed, the vector coefficient of explanatory variables in the REM, and the β fixed denotes the vector coefficient of explanatory variables in the FEM. If the value of $\chi 2 > \chi 2$ (k,α) or *P-value* < α, the hypothesis H_0 is rejected, and the random effects models must be rejected in favor of the fixed-effects model.

Selection of *Spatial Weights Matrix*

Spatial weights matrix*, W*, describes the relationship between regions, in this case, the 27

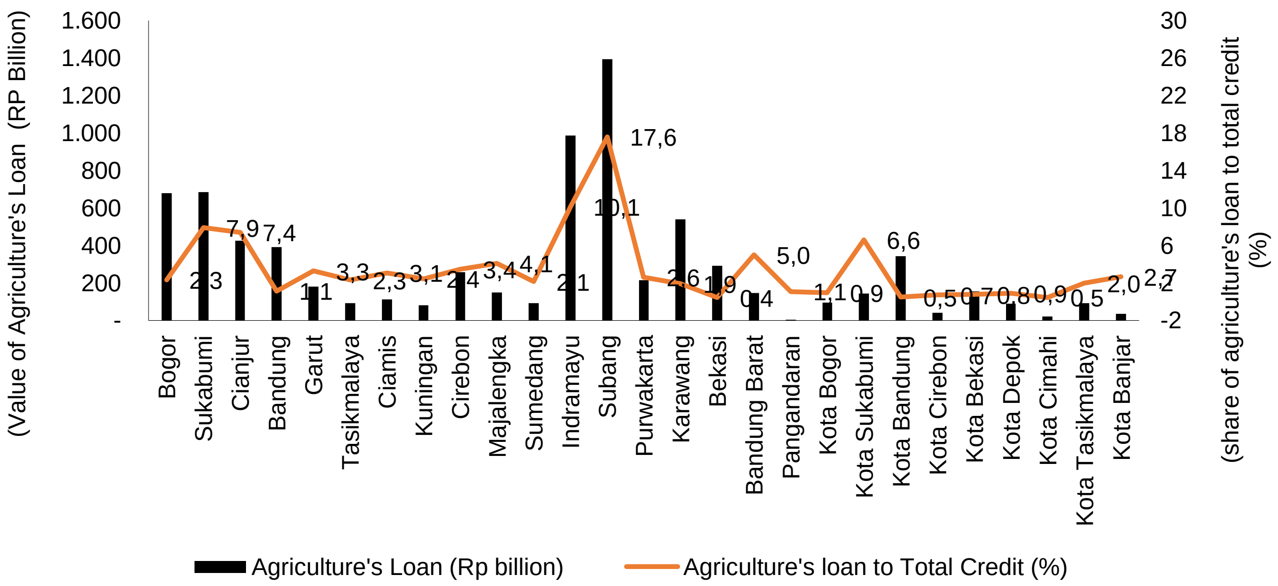


Figure 1 Total and percentage of agricultural sector loans to total loans by commercial banks in 27 regencies and cities in West Java for the 2016–2019 period.

districts and cities in West Java. The spatial weighting matrix uses a contiguity approach (Lu *et al.* 2014). The concept of contiguity shows the relative position with other locations, whether directly adjacent or not. In this study that analyzes the spatial relationship between regions in 27 districts and cities in West Java, the weighting used *queen contiguity* based on the characteristics of 27 districts/cities, written as follows:

$$W_{ij} = \begin{cases} 1, if\ i\ next\ to\ j \\ 0, \quad j\ others \end{cases} \quad (2)$$

W might be row normalized such that the elements of each column sum to one.

Lagrange Multiplier Test

To test for spatial interaction effects in a cross-sectional setting we used the Lagrange Multiplier (LM) test (Anselin 1988). The hypothesis tested was H_0: δ, ρ = 0 denotes no spatial interaction effects for SAR and SEM. Therefore, the statistics LM test was written as follows.

$$LM_\delta = \frac{[e(I_T \otimes W)Y/\hat{\sigma}^2]^2}{J} \quad (3)$$

$$LM_\rho = \frac{[e(I_T \otimes W)e/\hat{\sigma}^2]^2}{T \times T_W}$$

Where the symbol ⊗ denotes the Kronecker product, I_T denotes the identity matrix, and its subscript is the order of this matrix. E denotes the residual vector of a pooled regression model without any spatial or time-specific effects or of a panel data model with spatial and or time-period fixed effects, and denotes mean square error, *W* denotes spatial weight matrix after normalized, and "*tr*" denotes the trace of a matrix. Finally, *J* and T_W are defined by

$$a_1 = (I_T \otimes W)X\hat{\beta} \quad (4)$$

$$a_2 = I_{NT} - X(X'X)^{-1}X'$$

$$J = \frac{1}{\hat{\sigma}^2}[(a'_1 a_2 a_1) + TT_W\hat{\sigma}^2] \quad (5)$$

$$T_W = \mathrm{tr}(WW+W'W)$$

If the p-value < α or LM test > $\chi^2_{(q)}$ with q=1, q denotes the number of spatial parameters, the hypothesis H_0 is rejected, and the spatial random effects are significant (Elhorst 2010). The selection between Spatial Auto-Regressive (SAR) and Spatial Error Model (SEM) can also be seen from goodness-of-fit measures such as Akaike Information Criterion (AIC).

Estimation Parameters of Spatial Panel Data Model

According to the LM test, the spatial panel data model for the growth of the agricultural sector that would be selected was the *Spatial Auto-Regressive* or *Spatial Error Model. The Spatial Panel Data Model estimates parameters* using the Maximum Likelihood (ML) estimator. According to Elhorst (2010), if the spatial dependence among the observations is reflected in the spatial lag, the models used are the Fix Effect Spatial Autoregressive Model and the Random Effect Spatial Autoregressive Model. Error term, the models used are Fix Effect Spatial Error Model and Random Effect Spatial Error Model. SAR model for the agricultural growth sector can be written as follows:

$$y_{it} = \delta \sum_{j=1}^{N} W_{ij}\, y_{jt} + \beta_i x1_{it} + \beta_i x2_{it} + \beta_i x3_{it} + \beta_i x4_{it} + \mu_i + \varepsilon_{it} \quad (6)$$

Where *i* is an index for the cross-sectional dimension (district), with *i* is 1,…27, and *t* is an index for the periods, with *t* = 2016,…,2019. Y_{it}i s an agricultural sector growth in districts and cities, is a spatial autoregressive coefficient, w is an element of a normalized spatial weights matrix, *x*1 is a working capital loan for the agriculture sector, *x*2 is several workers in the agricultural sector, *x*3 is an agricultural road, *x*4 is a ratio of GRDP of the agricultural sector to the total GRDP of each district/city which is a proxy for diversification of economic activity, β is an independent variable coefficient. Meanwhile, ε_{it} is an independently and identically distributed error term for *i* and *t* with zero mean and variance σ2, while μi denotes a spatial specific effect.

The SEM model for the agricultural growth sector was written as equations (7), (8), and (9).

$$y_{it} = \beta_i x1_{it} + \beta_i x2_{it} + \beta_i x3_{it} + \beta_i x4_{it} + \mu_i + \emptyset_{it} \quad (7)$$

$$\emptyset_{it} = \rho \sum_{j=1}^{N} W_{ij}\, \emptyset_{it} + \varepsilon_{it}\mathrm{n} \quad (8)$$

$$y_{it} = \rho \sum_{j=1}^{N} W_{ij}\, \emptyset_{it} + \beta_i x1_{it} + \beta_i x2_{it} + \beta_i x3_{it} + \beta_i x4_{it} + \mu_i + \varepsilon_{it}\mathrm{n} \quad (9)$$

Where $\emptyset_{it}$ reflects the spatially autocorrelated error term and is called the spatial autocorrelation coefficient.

RESULTS AND DISCUSSION

Spatial Panel Data Analysis

The initial step in the panel data spatial regression analysis is to choose the appropriate model, whether the Random Effects Model *(REM)* or the Fixed Effects Model (FEM). The results of the Hausman test show that the panel data model that is more suitable to be used is FEM. The p-value of 2.2e-16 is smaller than the significance level of = 0,05. Hausman test results are presented in Table 1.

Another consideration in selecting models between REM and FEM was selecting cross-sectional data samples, whether done randomly or not. If N (*cross-sectional data*) is more significant than T (times-series data) and it is believed that each cross-sectional data unit selected in the study was taken at random, REM is used and vice versa (Diputra *et al.* 2012). In this study, the number of T was four, and the number of N was 27, which were taken not randomly, namely the number of all districts and cities in West Java Province during the

2016–2019 period. Thus, the selection of FEM becomes more convincing.

The next stage is to estimate the parameters of the panel data spatial model, whether there is a spatial interaction between districts and cities using the Lagrange Multiplier (LM) test. The results of the LM test show that *the p-value* of 2.338e-12 is smaller than the significance level of α=0.05, meaning that there are spatial effects or cross-sectional dependence between districts and cities in West Java. The results of the LM test for cross-sectional dependence can be seen in Table 2. According to the LM test, P-value < also shows that hypothesis. H 0 is rejected, and the spatial random effects are significant (Elhorst 2010). The goodness-of-fit measure using AIC for SEM of 76.10 is smaller than SAR of 77.67.

West Java Agricultural Sector Growth Model

Based on the results of statistical tests on the spatial model of panel data above, the model chosen is the fixed effect-spatial error model (SEM-FEM). The parameter estimates for the selected model are written in Table 3. Variables of spatial autocorrelation (ρ), $x1$ is a working capital loan for the agriculture sector, $x3$ is an agricultural road, and $x4$ is diversification of economic activity, have a significant effect on the model. On the other hand, the variable $x2$ is the number of workers in the agricultural sector is not significant.

The fixed effect-spatial error model for the growth of the West Java agricultural sector in 27 districts and cities during the 2016-2019 period is written in equations (10) and (11).

$$y_{it} = 0.011x1_{it} + 0.014x3_{it} + 0.778x4_{it} + \mu_i + \emptyset_{it} \quad (10)$$
$$\emptyset_{it} = 0.948\sum_{j=1}^{N} W_{ij}\,\emptyset_{it} + \varepsilon_{it} \quad (11)$$

Table 1 The Results of Hausman's specification test

Indicators	Value
df	4,00
chisq	104,96
p-value	2,2e-16
alpha	0,05

Table 2 LM test for cross-sectional dependence in panels data

Indicators	Value
df	351,00
chisq	566,52
p-value	2.338e-12
alpha	0,05

Spatial Effect on Agricultural Sector Growth

The slowing growth of the agricultural sector in West Java indicates the decreasing role of the agricultural sector in driving economic growth in West Java. BPS West Java (2021) noted that during 2015–2019 the average GRDP growth rate of the agricultural sector was 2,48%, the smallest after the mining sector and the electricity & gas sector (BPS West Java 2021). Based on Klassen's typology, the current condition of the agricultural sector in West Java is *a developed but depressed sector,* which illustrates that the agricultural sector has a significant contribution to the regional GRDP share, but its growth rate is slowing (Widianingsih *et al.* 2015).

The results of the LM test for cross-sectional dependence (Table 2) show that there is a spatial effect between districts and cities on the growth of the agricultural sector in West Java. The slowdown in the growth of the agricultural sector in this province is primarily determined by the performance of the development of the agricultural sector in districts and cities in West Java. It can be said that the growth that occurs is very likely to be afrfected by the spatial interaction between districts/cities in West Java. According to Tobler's law in geography, everything is related to one another, but something closer will be more influential than something far away (Anselin 1988). In spatial relations, often observations in one location (*space*) depend on observations at other adjacent locations (*neighboring*) (Djuraidah & Wigena 2012).

Factors Affecting Agricultural Sector Growth

Apart from being caused by spatial interactions, the growth of the agricultural sector in West Java is also caused by factors that determine the growth of the agricultural sector itself. The results (Table 3) show that *agricultural credit* has a significant effect on the growth of the agricultural sector in West Java. The role of agricultural business financing in the form of agricultural credit distribution is crucial, especially in overcoming the problem of limited farm capital and output growth (Cothern 2002; Ashari 2009; Hung; Sial *et al.* 2011). The availability of business capital is an incentive for farmers to increase agricultural production, which has implications for increasing output and growing the agricultural sector (Florence & Nathan 2020).

The realization of credit disbursement for the agricultural sector by banks in West Java during the 2016–2019 period was an average of Rp7,72 trillion per

Table 3 Estimation of spatial panel data model

Variables	Coefficient	p-Value
x1 (agricultural credit)	0.011	6.408e-05*
x2 (agricultural worker)	-0.012	0.05708
x3 (agricultural road)	0.014	0.01699*
x4 (economic diversification)	0.778	< 2.2e-16*
ρ (spatial autocorrelation)	0.948	< 2.2e-16*

Description: * significant, α=0.05

year, with the most significant number of credit distributions occurring in the Subang and Indramayu districts of Rp1,39 trillion and Rp0,89 trillion, respectively, per year (Bank Indonesia 2021). The two regions are centers of food production in West Java and even nationally. However, the proportion of credit disbursement to the agricultural sector is much smaller than that of credit disbursed to other sectors. The proportion of loans disbursed to the agricultural sector to the total lending to all economic sectors during 2016–2019 was an average of 2,07%. This condition is one of the factors causing the growth of the agricultural sector in West Java to slow down.

The low disbursement of bank credit to the agricultural sector was mainly due to the prudent banking sector to avoid the risk of bad loans. According to Azis and Wicaksono (2016); Panekenan *et al.* (2017); Herliana *et al.* (2018), the low disbursement of bank credit to the agricultural sector is caused by too high *prudentiality* by implementing banks in lending and the experience or perception of banks facing non-performing loans when

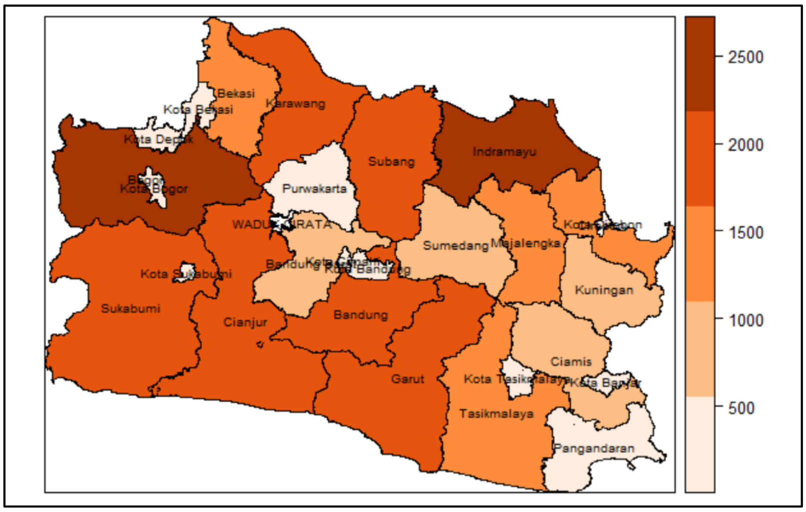
In agricultural sector development, credit has a dual function capital assistance to agricultural businesses and as an effective policy instrument in supporting government programs such as food self-sufficiency policies. Credit is a form of financing that is *enabling* or empowering, where financing is not only limited to encouraging the development of agricultural businesses but must be viewed as a national economic policy strategy. For this reason, it is necessary to support government policies, both central and local governments of West Java, through interest subsidies for agricultural loans and appropriate distribution schemes so that the agricultural sector continues to grow and does not experience a growth slowdown.

Another factor that affects the growth of the agricultural sector in West Java is the availability of agricultural infrastructure. In this study, is the length of farming roads in 27 districts and cities in West Java. The parameter estimation results for the selected model (Table 3) show that the longer the length of the farm road, the higher the GRDP growth in the agricultural sector in West Java. Farm roads referred to in this study are village roads that are directly co nnected to or around agricultural areas. Agricultural roads can improve farming efficiency and connectivity between production center locations and markets (Shamdasani 2021). Infrastructure such as roads positively impacts agricultural sector output (Winoto & Siregar 2005; Edeme *et al.* 2020).

Spatially, the length of farming roads in 27 districts and cities in West Java varies, as shown in Figure 2. The most significant farming roads are available in Indramayu and Bogor Regencies, which are centers of agricultural production and have the most significant area relative to other areas. However, in general, the availability of long farming roads is in the northern coastal areas of Java Island (such as Indramayu, Subang, and Karawang Regencies) and southern coastal areas (such as Sukabumi, Cianjur, and Garut districts). The length of roads in both areas is 1700–2700 km. These are areas of agricultural products such as food, horticulture, plantations, and livestock. Meanwhile, all industrial and service-based urban areas, namely Bogor City, Bekasi City, Depok City, Sukabumi City, Bandung City, Cimahi City, Tasikmalaya City, and Banjar City, have short farm roads.

The role of farm roads is crucial to facilitate the mobility of agricultural tools and machines, transport facilities to agricultural land, and transport agricultural products from production sites to storage, processing sites, or markets. Agricultural roads are an essential element as infrastructure facilities in agricultural development in developing the agricultural sector and improving the welfare of farmers in West Java.

It is realized that the development of farm road infrastructure requires substantial costs. At the same time, the fiscal capacity of the government, especially



Data source: Badan Informasi Geospasial 2021
Figure 2 Map of the farming roads length in 27 regencies and cities in West Java (in km).

local governments, is limited. Hence, the development of farming road infrastructure needs to be carried out on a priority scale in the allocation of the provincial and district and city budgets. The existence of village autonomy also opens up vast opportunities for regions, especially in production centers, to prioritize village funds in supporting the development of farming infrastructure in various production center locations in the province.

Another thing that needs to be considered in the development of farm road infrastructure is the negative effect of increasing access to farming locations, namely the potential for converting agricultural land to non-agricultural land due to increasing land prices. Road infrastructure development has an impacts on the conversion of agricultural land (Effendi and Asmara 2011; Kusumaastuti *et al.* 2018). For this reason, the policy of establishing Sustainable Food Agricultural Land (LP2B) by local governments needs to be maintained.

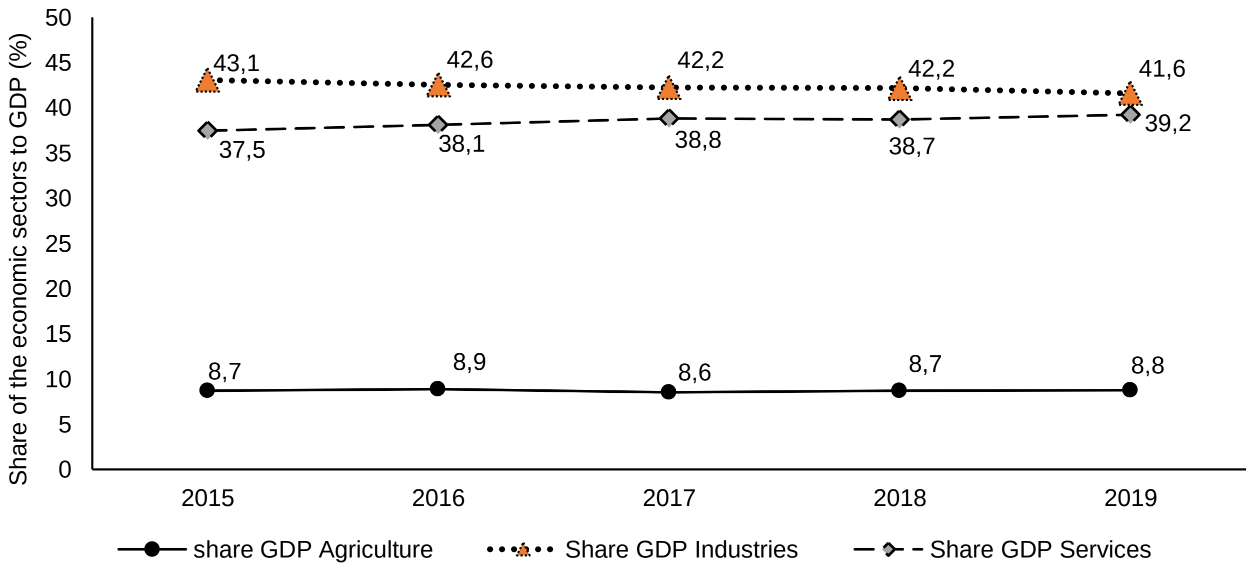
In addition to agricultural credit and farming roads, another factor that influences the growth of the agricultural sector in West Java is the diversification of economic activity in 27 districts and cities. In this study, the diversification of economic activity was measured based on the share of agricultural GRDP to total GRDP in each region. The higher the share of agricultural GRDP to total GRDP, or in other words, the lower the GRDP share of the industrial and service sectors to total GRDP, the growth of the agricultural sector is increasing, or vice versa.

According to the United Nations Economic and Social Commission for Asia and Pacific (UN ESCAP 2014), economic diversification shows the increasing number and diversity of outputs produced and further processed by a region. This diversification means that the more significant the role of the industrial and service sectors in the economy in a region, the greater the number and types of processed and traded products that are represented in the value of GRDP of the industrial and service sectors to total GRDP.

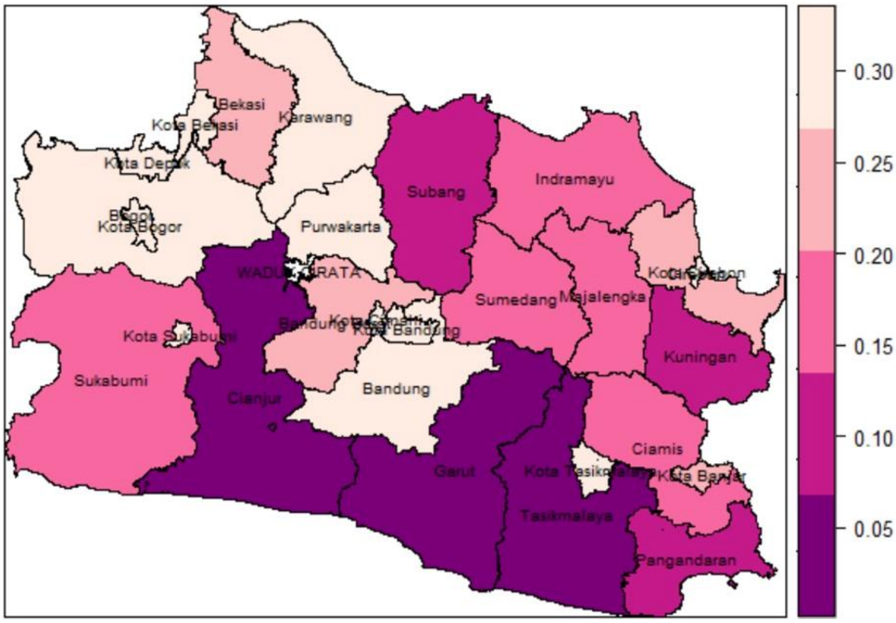
Economic diversification can positively impact income or vice versa, depending on the diversification conditions (Susilowati 2017). In the context of the growth of the agricultural sector, the diversification of West Java's economic activity, whether it has a positive or negative impact on the growth of the agricultural sector, depends on the concentration of economic activity that occurs whether or not it has a relationship with the agricultural sector.

The model estimation results show that the value of the coefficient of the variable economic diversification is positive and significant. It can be interpreted that the higher the share of agricultural GRDP to total GRDP, or in other words, the lower the share of GRDP in the industrial and service sectors to total GRDP, the growth of the agricultural sector will increase. Thus, the less developed the service sector and industry in West Java, the growth of the agricultural sector will increase. However, the facts show that the industrial and service sectors are multiplying in West Java, as indicated by the large share of the industrial and service sector GRDP to the total GRDP of West Java (BPS West Java 2021). This fact shows that the industrial and service sectors developing in West Java are not yet based on agriculture or *backward linkages* of the industrial and service sectors to the agricultural sector are low. The industrial and service sectors developing in West Java cannot attract growth in the agricultural sector (Nugrahadi *et al.* 2010). This condition is one of the factors causing the growth of the agricultural sector in the province to slow down (Figure 3).

According to BPS (2021), about 35% of the total output of the agricultural sector in West Java is



Data source: BPS Provinsi Jawa Barat 2021.
Figure 3 Share of GRDP in agriculture, industry, and services sector to total GRDP in West Java in 2015–2019 (in %).



Data source: BPS Provinsi Jawa Barat, 2021
Figure 4 Diversification of economic activities in 27 regencies and cities in West Java.

reprocessed by the manufacturing sector to produce final goods. The rest is in the form of *fresh products* with low added value. Efforts are needed to increase the linkage of the agricultural sector with the industrial and service sectors as the downstream sector so that the development of the industrial and service sectors can attract the growth of the agricultural sector as the upstream sector, such as partnerships between actors in the agricultural sector and industry and service players, as well as encourage the development of the processed industry based on agriculture on the scale of micro, small and medium enterprises (MSMEs).

Figure 4 shows that the higher the diversification of economic activity leading to the industrial and service sectors, the higher scale value. On the other hand, economic activity based on the agricultural sector has a lower scale value. The analysis results show all industrial and service-based urban areas, namely Bogor City, Bekasi City, Depok City, Sukabumi City, Bandung City, Cimahi City, Tasikmalaya City, and Banjar City, have high scale values. In addition to the city area, seven regencies have industrial and service economic activity bases, namely Bogor Regency, Karawang Regency, Bekasi Regency, Purwakarta Regency, Bandung Regency, West Bandung Regency, and Cirebon Regency. The seven districts are locations for developing industrial estates in West Java.

CONCLUSIONS

The results of the spatial regression analysis of panel data obtained that the appropriate model is the *fixed effect spatial error model*, which shows an effect of spatial interaction between regions in 27 districts and cities on the growth of the agricultural sector in West Java. Factors that significantly affect the growth of the agricultural sector are agricultural credit, agricultural road infrastructure, and diversification of economic activity. These three factors need to be encouraged to overcome the slowdown in the growth of the agricultural sector in West Java.

The Regional Government of West Java Province, in collaboration with the bank and non-bank financing institutions, could prepare low-cost financing schemes for agricultural businesses by providing subsidies for agricultural loans. Furthermore, the development of farm road infrastructure should be prioritized in the local budget allocation (APBD) and optimizing village funds to prioritize village funds in supporting the development of farming infrastructure in various production center locations. In addition, the diversification of economic activity in West Java, which leads to the industrial and service sectors, needs to be linked to the agricultural sector to be able to attract growth in the agricultural sector through partnerships between actors in the agricultural sector and industry and service players, as well as encourage the development of agriculture-based processing industries on a large scale micro, small and medium enterprises (MSMEs).

REFERENCES

Anselin L. 1988. *Spatial Econometrics: Methods and Models*. Dordrecht: Academic Publishers. https://doi.org/10.1007/978-94-015-7799-1

Ashari. 2009. Optimalisasi kebijakan kredit program sektor pertanian di Indonesia. *Jurnal Analisis Kebijakan Pertanian*. 7 (1): 21–42.

Azis A, Wicaksono E. 2016. Analisis skema alternatif kredit program untuk usaha mikro, kecil, dan menengah. *Jurnal Ekonomi dan Kebijakan Publik*. 7(2): 143–157. https://doi.org/10.22212/jekp.v7i2.420

[BIG] Badan Informasi Geospasial. 2021. Peta Rupa Bumi Indonesia Tahun 2019. Bogor (ID): BIG.

[BPS Provinsi Jawa Barat] Badan Pusat Statistik Provinsi Jawa Barat. 2021. Produk Domestik Regional Bruto Atas Dasar Harga Berlaku (ADHB) dan Atas Dasar Harga Konstan (ADHK) Tahun 2008–2020. Bandung: BPS Provinsi Jawa Barat.

[BPS] Badan Pusat Statistik. 2021. Tabel Inter Regional Input-Output Indonesia Transaksi Domestik Atas Dasar Harga Produsen Menurut 34 Provinsi dan 52 Industri Tahun 2016. Jakarta: BPS.

Baltagi BH. 2008. Econometric Analysis of Panel Data. Third Edition. John Wiley & Sons, Ltd.

[BI] Bank Indonesia. 2020. Laporan Perekonomian Provinsi Jawa Barat Mei 2020. Bandung: BI.

[BI] Bank Indonesia. 2021. Posisi Pinjaman yang Diberikan Rupiah dan Valuta Asing Bank Umum dan BPR Per Dati II Menurut Sektor Ekonomi Berdasarkan Lokasi Proyek di Propinsi Jawa Barat. Jakarta: BI.

Basu K. 2000. *Analytical Development Economics: The Less Developed Economy Revisited*. Massachusetts: The MIT Press.

Belaid H. 2003. Telecommunication Infrastructure and Economic Development, Simultaneous Approach: Case of Developing Countries. Paper The 5th IRSA International Conference, 18–19 Juli 2003, Bandung.

Diputra TF, Sadik K, Anggraini Y. 2012. Pemodelan data panel spasial dengan dimensi ruang dan waktu. *Indonesia Journal of Statistics*. 17(1): 6–14.

Djuraidah A, Wigena AH. 2012. Regresi spasial untuk menentukan faktor-faktor kemiskinan di Provinsi Jawa Timur. *Media Statistika*. 12 (1): 1–8.

Edeme RK, Nkalu NC, Idenyi JC, Arazu WO. 2020. Infrastructural Development, Sustainable Agricultural Output and Employment in ECOWAS Countries. *Sustainable Futures*. 2 (2020) 100010. https://doi.org/10.1016/j.sftr.2020.100010

Effendi PML, Asmara A. 2014. Dampak pembangunan infrastruktur jalan dan variabel ekonomi lain terhadap luas lahan sawah di koridor Jawa. *Jurnal Agribisnis Indonesia.* 2(1): 21–32. https://doi.org/10.29244/jai.2014.2.1.21-32

Elhorst JP. 2010. Spatial Panel Data Models. Fischer MM, Getis A, editor, *Handbook of Applied Spatial Analysis*. New York: Springer. https://doi.org/10.1007/978-3-642-03647-7_19

Florence N, Nathan S. 2020. The effect of commercial banks' agricultural credit on agricultural growth in Uganda. *African Journal of Economic Review*. 8(1): 162–175.

Herliana S, Sutardi A, Aina Q, Aliya QH, Lawiyah N. 2018. The constraints of agricultural credit and government policy strategy. MATEC Web of Conferences 215, 02008. https://doi.org/10.1051/matecconf/201821502008

Hung FS, Cothren R. 2002. Credit market development and economic growth**.** *Journal of Economics and Business*. 54: 219–237. https://doi.org/10.1016/S0148-6195(01)00063-7

Kusumaastuti AC, Kolopaking LM, Barus B. 2018. Faktor yang mempengaruhi alih fungsi lahan pertanian pangan di Kabupaten Pandeglang. *Jurnal Sosialogi Pedesaan*. 6(2): 131–136.

Lu B, Charlton M, Harris P, Fotheringham S. 2014. Geographically weighted regression with a non-Euclidean distance metric: a case study using hedonic house price data. *International Journal of Geographical Information Science*. 28 (4): 660–681. https://doi.org/10.1080/13658816.2013.865739

Mankiw NG. 2000. *Macroeconomics.* New York (US): Worth Publisher.

Miller RE, Blair PD. 2009. *Input-Output Analysis: Foundations and Extensions*. Second Edition. Cambridge University Press. https://doi.org/10.1017/CBO9780511626982

Nugrahadi EW, Tambunan M, Siregar H, Daryanto A. 2010. Analisis pola perubahan struktural dan sumber-sumber pertumbuhan dalam ekonomi Jawa Barat. *Forum Pascasarjana IPB*. 33 (2): 79–90.

Panekenan D, Rumagit GAJ, Pangemanan PA. 2017. Peran kredit perbankan pada sektor pertanian di Provinsi Sulawesi Utara. *Jurnal Agri-Sosio Ekonomi Unsrat*. 13(1): 183–194. https://doi.org/10.35791/agrsosek.13.1A.2017.15623

Shamdasani Y. 2021. Rural road infrastructure and agricultural production: evidence from India. *Journal of Development Economics* 152(2021): 102686. https://doi.org/10.1016/j.jdeveco.2021.102686

Sial MH, Awan MS, Waqas M. 2011. Role of institutional credit on agricultural production: a time series analysis of Pakistan. *International Journal of Economics and Finance*. 3(2): 126–132. https://doi.org/10.5539/ijef.v3n2p126

Sulistyowati L, Novitasari R, Trimo L. 2021. Structural Transformation of the West Java Economy and Its Agriculture. *IOP Conference Series: Earth and*

Environmental Science. 466(2020) 012005. https://doi.org/10.1088/1755-1315/466/1/012005

Susilowati, SH. 2017. Dinamika Diversifikasi sumber pendapatan rumahtangga perdesaan di berbagai agroekosistem. *Jurnal Agroekonomi*. 35(2): 105–126. https://doi.org/10.21082/jae.v35n2.2017. 105-126

Tobler WR. 1970. A computer movie simulating urban growth in the Detroit region. *Journal Economic Geography*. 46: 234–240. https://doi.org/10.2307/143141

[UN ESCAP] Economic and Social Commision for Asia and the Pacific. 2014. *Economic Diversification in Asian Landlocked Developing Countries: Prospects and Challenges*. Bangkok (TH): United Nation.

Widianingsih W, Suryantini A, Irham. 2015. Kontribusi sektor pertanian pada pertumbuhan ekonomi di Provinsi Jawa Barat. *Jurnal Agro Ekonomi*. 20(2): 2006–2018. https://doi.org/10.22146/agroekonomi.17272

Winoto J, Siregar H. 2008. Agricultural development in Indonesia: current problems, issues, and policies. *Jurnal Analisis Kebijakan Pertanian*. 6(1): 11–36.