

THE IMPACT OF AGRICULTURAL SECTOR GROWTH IN WEST JAVA ON THE INTER-PROVINCIAL ECONOMY

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(Received: March 22, 2022; Accepted: September 20, 2022)

ABSTRACT

The agricultural sector is the third-largest contributor to West Java's gross regional domestic product (GRDP), yet its growth tended to decrease in the last five years. Accordingly, this research sought to analyze the impact of agricultural growth on the economy of West Java and other regions, and analyze intra-regional and inter-regional linkages of West Java's agricultural sector. The method used in this study was a multi-regional input-output model. Interregional Input-Output tables of Indonesia for 34 provinces in 2016 were used for the analysis. The effect of West Java's agricultural sector growth has a slight intra-regional effect on regional output growth and a finite spillover effect in several provinces within Java Island. The agricultural sector in West Java has weak backward and forward intra-regional linkages, which means that the agricultural sector is less able to push the growth of the upstream and downstream sectors. The agricultural sector in West Java only has a strong forward linkage with the manufacturing sector in DKI Jakarta.

Key words: intraregional effect, intra and interregional linkages, multi-regional input-output, spillover effect

INTRODUCTION

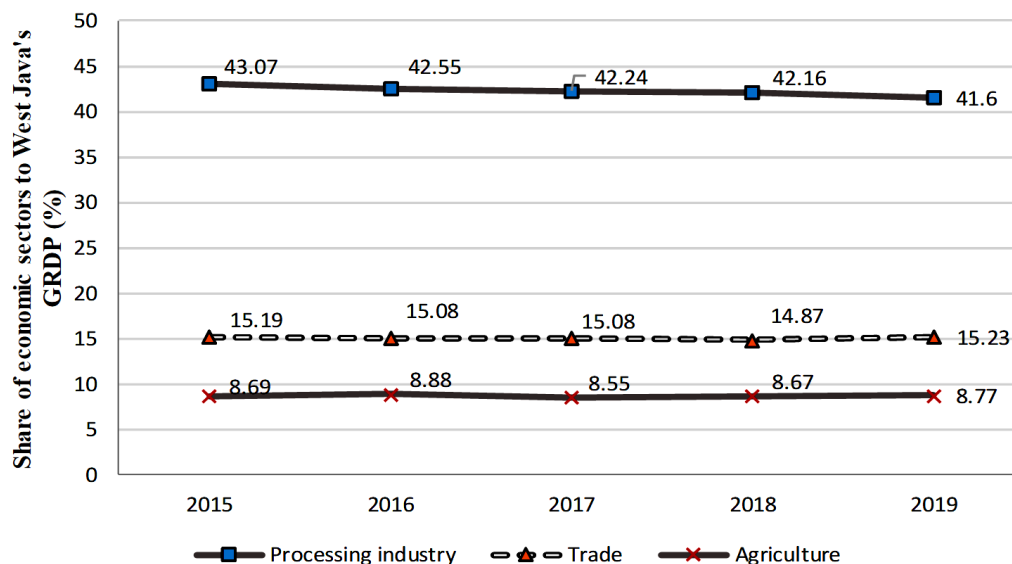
The agricultural sector is strategic in supporting the acceleration of economic development in Indonesia since its contribution to the national gross domestic product (GDP) is the third-largest contributor after the manufacturing and the trade sector during the 2016-2019 period (Statistics Indonesia 2021a). The role of the agricultural sector is indeed inseparable from the performance of regional economic development in 34 provinces in Indonesia, especially for provinces that put agriculture as a basis sector in economic development, such as West Java Province (Sulistiyowati et al. 2021). The share of West Java's agricultural sector to Indonesia's GDP reaches 7.9 percent over the same period (Statistics Indonesia 2021a).

The agricultural sector is one of the leading sectors in the West Java economy, especially its contribution to the gross regional domestic product (GRDP) (Nugrahadi et al. 2010; Bank Indonesia 2020; Sulistiyowati et al. 2021). The share of the agricultural sector to West Java's GRDP during 2015-2019 is the third-largest after the processing industry and trade sector (Statistics of Jawa Barat Province 2021). The share of the agricultural sector to West Java's GRDP during 2015-2019, on average, was about 8.72 percent (Fig. 1). In addition, the agricultural sector also absorbs a reasonably large workforce, which is around 40 percent (Statistics of Jawa Barat Province 2021). However, in the same period, the GRDP growth of the agricultural sector in West Java tends to decline. Based on Klassen's typology, this condition indicates a developed but depressed sector, where it has a considerable contribution to the economy but faces some challenges to grow (Widianingsih et al. 2015). The average GRDP growth rate of the agricultural sector was 2.48 percent, from 2015-2019, the third-lowest after the mining sector and the electricity and gas sector (Statistics of Jawa Barat Province 2021). This condition has direct implications for the economy of West Java, especially for regional output growth.

In an open economic system, the growth and development of an area will impact other areas around it, thus the growth that occurs in the agricultural sector in West Java will impact the economy of West Java itself (intraregional multiplier) and the economy of other regions around West Java (spillover effect), and vice versa. This research expected that there are linkages between the agricultural sector and other economic sectors in

West Java and with economic sectors outside West Java. There are interrelationships between economic sectors and regions in an economic system (Isard et al. 1998; Miller and Blair 2009). The existence of economic linkages between regions was also stated by Hoover (1985), Fujita et al. (1999), and McCann (2001).

However, the question is how significant the impact of the growth of West Java agricultural sector is on the economy of West Java itself and outside West Java, and which economic sectors inside and outside West Java have strong linkage with the agricultural sector in West Java. Thus, this study sought to analyze the impact of the growth of the West Java agricultural sector on the economy of West Java and outside West Java, and analyze the linkages of the different sectors using the Multi-Regional Input- Outputs (MRIO).



Source: Statistics of Jawa Barat Province (2021)

Fig. 1. Share of economic sectors to West Java's GRDP in the period of 2015-2019

METHODOLOGY

Data types and sources. The data used in this study is secondary data in Indonesian Inter-Regional Input-Output (IRIO) table data as a database. The IRIO table used is the Indonesian IRIO Table of Domestic Transactions Based on Producer Prices by 34 Provinces and 17 Economic Sectors in 2016 sourced from Statistics Indonesia (2021b).

MRIO Indonesia table structure. The Indonesian MRIO table in this study is based on data from the Indonesian IRIO Table of Domestic Transactions Based on Producer Prices by 34 Provinces and 17 Business Fields in 2016 (Statistics Indonesia 2021b). The Indonesian MRIO table in this study is classified into 17 economic sectors consisting of a matrix of intra-regional and inter-regional transactions in 34 provinces in Indonesia. Intra-regional is a transaction of trade in goods and services between sectors of the economy within the same province, while inter-regional is a transaction of trade in goods and services between sectors of the economy between provinces.

Intra-regional and inter-regional analysis of output multiplier. Intra-regional and inter-regional output multiplier in this study is used to analyze the impact of West Java's agricultural sector growth on the economy of West Java and outside West Java which is written as follows:

$$O_j^{LL} = \sum_{i=1}^n \hat{b}_{ij}^{LL} \quad (1)$$

$$O_j^{ML} = \sum_{i=1}^n \hat{b}_{ij}^{ML} \quad (2)$$

where:

- O_j^{LL} = Intra-regional output multiplier (intra-regional effect) sector j in province L against province L
- O_j^{ML} = Inter-regional output multiplier (spillover effect) sector j in province L against province M
- j = agricultural sector

- L = West Java Province
M = Provinces Other Than West Java
 \widehat{b}_{ij} = Leontief inverse matrix element MRIO

Interregional multiplier output shows the amount of change in the value of output in the province of M due to changes in final demand in sector j in province L. Inter-regional output multipliers show the magnitude of the spillover effect (Isard et al. 1998). At the same time, the intra-regional output multiplier shows the amount of change in the province of L's output value due to changes in final demand in sector j in province L. The output multiplier value is the sum of the columns in the Leontief inverse matrix, both intra-regional and inter-regional sum of the columns in the Leontief inverse matrix, both intra-regional and inter-regional.

Analysis of intra-regional and inter-regional linkages. Analysis of intra-regional and inter regional linkages, both forward and backward, is used to analyze the linkages of the West Java agricultural sector with other economic sectors in West Java and outside West Java. Intra-regional linkages, both backward and forwards, are written as in equations (3) and (4), while interregional linkages, both backward and forwards, are written as in equations (5) and (6). According to Isard et al. (1998) and Miller and Blair (2009), if the value of backward and forward linkages is more significant than one, then the sector has strong linkages and can encourage the growth of its upstream, downstream sectors.

$$BL_j^{LL} = \frac{n \sum_{i=1}^n \widehat{b}_{ij}^{LL}}{\sum_{i=1}^n \sum_{j=1}^n \widehat{b}_{ij}^{LL}} \quad (3)$$

$$FL_i^{LL} = \frac{n \sum_{j=1}^n \widehat{b}_{ij}^{LL}}{\sum_{i=1}^n \sum_{j=1}^n \widehat{b}_{ij}^{LL}} \quad (4)$$

$$BL_j^{ML} = \frac{n \sum_{i=1}^n \widehat{b}_{ij}^{ML}}{\sum_{i=1}^n \sum_{j=1}^n \widehat{b}_{ij}^{ML}} \quad (5)$$

$$FL_i^{ML} = \frac{n \sum_{j=1}^n \widehat{b}_{ij}^{ML}}{\sum_{i=1}^n \sum_{j=1}^n \widehat{b}_{ij}^{ML}} \quad (6)$$

where:

- BL_j^{LL} = Backward linkage of sector j in area L with sector other economies in the L
 FL_i^{LL} = forward linkage of the sector I in area L to sector other economies in the L
 BL_j^{ML} = Backward linkage of sector j in area L with sector other economies in the M
 FL_i^{ML} = forward linkage of the sector I in area L to sector other economies in the M
j = agricultural sector in backward linkage
i = agricultural sector in forward linkages
L = West Java Province
M = Provinces Other Than West Java
 \widehat{b}_{ij} = Leontief inverse matrix element MRIO

RESULTS AND DISCUSSION

Impact of West Java's agricultural sector growth on the economy of West Java and outside West Java. The slowdown in growth in the agricultural sector in West Java, both directly and indirectly, will impact the economy in West Java itself (intra-regional) and the economy outside West Java (inter-regional). The analysis shows that the impact of agricultural sector growth on the economy in West Java itself can be seen based on the intra-regional output multiplier or often called the intra-regional effect, which is presented in Table 1.

The value of the intra-regional effect for the agricultural sector in West Java is 1.15. This value indicates that if there is growth in the agricultural sector due to an increase in final demand of 1 million rupiahs, it will increase the total output in all sectors of the West Java economy to IDR 1.15 million or 1.15 times. However, the value of the intra-regional effect for the agricultural sector is the smallest after the real estate sector compared to all other economic sectors in West Java. The intraregional effects of the growth of the agricultural sector are mostly felt only by the manufacturing sector and the agricultural sector itself (Statistics Indonesia 2021b). Notably, the value of the intra-regional effect shows that the growth that occurs in the agricultural sector has a negligible impact on increasing output in all sectors of the West Java economy compared to other economic sectors. Based on the output demand structure, the low value of the intra-regional effect of the agricultural sector was caused by agricultural output

characteristics. A large part of agricultural output is fresh products and consumed directly in the form of final demand without being reprocessed by other sectors. Agricultural output in form of intermediate input share about 53,8 percent and only 35% percent of this amount is used by the manufacturing sector as raw materials (Statistics Indonesia 2021b).

Table 1. Intra-regional effect of West Java economic sector

No	Sector	Intra-regional effect
1	Electricity and gas supply	1.92
2	Processing industry	1.46
3	Construction	1.45
4	Transportation and warehousing	1.44
5	Provision of accommodation and drinks	1.41
6	Health services and social activities	1.37
7	Company services	1.36
8	Water supply, waste management, waste	1.35
9	Government administration, defense, and social	1.33
10	Information and communication	1.29
11	Other services	1.27
12	Wholesale and retail trade; motorcycle car repair	1.25
13	Education services	1.24
14	Mining and excavation	1.20
15	Financial services and insurance	1.18
16	Agriculture	1.15
17	Real estate	1.12

Source: Statistics Indonesia 2021b (processed)

The growth in the agricultural sector in West Java impacted the growth of other areas around West Java in the form of a spillover effect. The sum of the intra-regional effects and spillover effects becomes the total effect or the overall impact nationally. Table 2 shows that the total effect of the West Java agricultural sector is 1.26, which mean that if there is growth in the West Java agricultural sector due to an increase in final demand as much as IDR 1 million, it will increase the total output in all sectors of the West Java economy by IDR 1.15 million and have a spillover effect. In the form of an increase in output to other provinces by IDR 0.11 million or a national impact of IDR 1.26 million.

Table 2. Total effect of West Java's agricultural sector

No.	Effect	Mark
1	Intra-regional effect	1.15
2	Spillover effect	0.11
3	Total effect	1.26

Source: Statistics Indonesia 2021b (processed)

Economic development in a region does not only have an impact on the region itself but also has a spillover effect on the surrounding area. Economic development in one sector will have an impact on the region itself and the surrounding area. However, the development of the agricultural sector also will have an impact on the economy in the region and the surrounding area (Zhang et al. 2015; Wang et al. 2020). Moreover, there is a spillover effect of the development of the agricultural sector in Sulawesi on the economic sector in Kalimantan (Arman et al. 2016). Meanwhile, the construction of agricultural roads has a direct effect on agricultural output solely and also a spillover effect on the surrounding area (Tong et al. 2013)

The spillover effect in this study shows that if there is a growth in the agricultural sector in West Java due to an increase in final demand, then to produce output from the agricultural sector in West Java, goods and services are needed from other provinces so that it has an impact on increasing output in these other provinces. The magnitude of the spillover effect due to the growth of the agricultural sector in West Java is presented in Table 3. analysis results show that the most significant spillover effect is in DKI Jakarta, continued at Banten and East Java. The main economic sectors most affected by the spillover in the three provinces are the manufacturing, agricultural, financial services, and transportation and storage industry. The manufacturing industry sub-sector that receive the largest

spillover effect are chemical industries, pharmaceutical industries, and traditional medicine industries where the outputs are the main inputs for agriculture sector such as fertilizers, concentrate feed, pesticides, and other inputs.

Table 3. Spillover effect of West Java agricultural sector growth.

No.	Province	Spillover effect	Economic sector most affected
1	East Java	0.034	Processing industry and agriculture
2	DKI Jakarta	0.017	Processing industry and financial services
3	Banten	0.012	Processing and transportation and warehousing Industry

Source: Statistics Indonesia 2021b (processed)

Linkage of West Java's agricultural sector with other economic sectors. Based on various studies, the development of an economic sector in a region has linkages with other economic sectors in the region as well as outside the region using the Multi-Regional Input-Output approach. There is a strong relationship between the growth of the agricultural sector and the growth of the non-agricultural sector in developing countries (Imai et al. 2016). Specifically, there is a spatial relationship between agriculture-based areas and manufacturing-based areas (Okomoto and Ihara 2016).

West Java's agricultural sector has trade links with other economic sectors in West Java (intra-regional linkages) and economic sectors outside West Java (inter-regional linkages). The agricultural sector in West Java has an intra-regional linkages value of less than one (<1), both forward linkages and backward linkages (Table 4). If the forward linkage index (<1) then the sector has a weak linkage in encouraging the growth of its downstream sector, while if the backward linkage index (<1), then the sector has a weak linkage in attracting growth in its upstream sector (Cella 1984; Clements and Rossi 1991).

Table 4. Intra-regional backward and forward linkages economic sector in West Java.

No.	Sector	Backward Linkages	Forward Linkages
1	Agriculture	0.86	0.97
2	Mining and excavation	0.90	0.99
3	Processing industry	1.09	2.29
4	Electricity and gas supply	1.43	1.34
5	Water supply, waste management, waste	1.01	0.75
6	Construction	1.08	0.86
7	Wholesale and retail trade; car repair, motorcycle	0.93	1.17
8	Transportation and warehousing	1.07	1.02
9	Provision of accommodation and drinks	1.05	0.78
10	Information and communication	0.96	0.97
11	Financial services and insurance	0.88	0.97
12	Real estate	0.84	0.80
13	Company services	1.02	0.99
14	Government administration, defense, and social	0.99	0.75
15	Education services	0.92	0.78
16	Health services and social activities	1.02	0.76
17	Other services	0.95	0.80

Source: Statistics Indonesia 2021b (processed)

The weak linkages of the agricultural sector in encouraging the growth of the upstream and downstream sectors are caused by the absence or small transactions of trade in goods and services between the agricultural sector and other economic sectors throughout the West Java region. The backward linkage of the agricultural sector in West Java is mostly (about 67 percent) with the agriculture sector itself and the processing industry, especially the chemical and pharmaceutical industries, as producers of fertilizers and pesticides (Statistics Indonesia 2021c). Meanwhile, the future linkages of the agricultural sector in West Java are mostly (about 65 percent) with the food accommodation provider sector and the processing industry, especially the food and beverage industry as a processed industry based on agricultural products (Statistics Indonesia 2021c).

Trade transactions in the agricultural sector with its upstream sector show that the output from the upstream is used as input by the agricultural sector. On the other hand, the agricultural sector's output is used as input by the downstream sector. Trade linkages between the agricultural and other economic sectors in West Java are described in Table 5 based on the flow of goods and services between sectors. The backward linkage is from using inputs from an economic sector by the agricultural sector. In comparison, the forward linkage is from inputs from the agricultural sector by an economic sector.

Table 5. Composition of input and output use of agricultural sector with other economic sectors in West Java (in percent)

No.	Sector	Input use of agricultural sector	Output of agricultural sector used by other sector
1	Agriculture	0.38	0.10
2	Mining and excavation	0.00	0.00
3	Processing industry	0.29	0.65
4	Electricity and gas supply	0.00	0.00
5	Water supply, waste management, waste	0.00	0.00
6	Construction	0.07	0.00
7	Wholesale and retail trade; car repair, motorcycle	0.14	0.00
8	Transportation and warehousing	0.03	0.00
9	Provision of accommodation and drinks	0.00	0.21
10	Information and communication	0.00	0.00
11	Financial services and insurance	0.03	0.00
12	Real estate	0.00	0.00
13	Company services	0.02	0.00
14	Government administration, defense, and social	0.00	0.00
15	Education services	0.00	0.01
16	Health services and social activities	0.00	0.01
17	Other services	0.02	0.01

Source: Statistics Indonesia 2021b (processed)

Inter-regional linkages describe inter-sector linkages between regions described by trade transactions between economic sectors in one region and other regions. These linkages also describe how the role of an economic sector in a region towards the output growth of the economic sector in other regions. This section discusses how the agricultural sector in West Java relates to the economic sector in other regions, especially with the provinces that have the most significant spillover effect from the growth of the agricultural sector in West Java, namely DKI Jakarta Banten and East Java.

The inter-regional backward linkages of the agricultural sector in West Java with its upstream sector in three regions, namely DKI Jakarta, Banten, and East Java, have weak linkages or linkage index of less than one ($BL < 1$) (Table 6). When compared with intra-regional linkages (Table 4), the agricultural sector in West Java, both intra-regionally and inter-regionally, is equally less able to encourage the growth of the upstream sector (downstream). The agricultural sector of West Java cannot attract the growth of its input supply sector both in West Java and in the provinces around West Java. This result is consistent with the small value of the spillover effect from the West Java agricultural sector. However, West Java's agricultural sector has strong inter-regional forward linkages with $FL > 1$ only with DKI Jakarta Province. That number means that the agricultural sector of West Java can encourage the growth of the downstream sector in the surrounding area but is limited to the province of DKI Jakarta. The future linkage of the West Java agricultural sector with DKI Jakarta can be seen from the number of intermediate inputs used by the West Java agricultural sector by the economic sector in DKI Jakarta.

The agricultural sector in West Java has the most significant linkage with the accommodation and food and drink provider sector in DKI Jakarta. The total output of the West Java agricultural sector used as input by the accommodation and food and drink provider sector in DKI Jakarta is around Rp. 1.13 trillion or about 70.5 percent of the total output of the West Java agricultural sector, which is used as input by all economic sectors in DKI Jakarta. DKI Jakarta, as the capital city of Indonesia as well as the center of the service and trade economy, the accommodation and eating and drinking sectors such as hotels, restaurants, and food stalls providing small and medium scale food, is growing and is urgently needed to meet the consumption demands of the people who live and work in DKI Jakarta.

Table 6. Inter-regional forward and backward linkages West Java agricultural sector

No	Inter-Regional Linkages	DKI Jakarta	Banten	East Java
1	Forward linkages	1.03	0.99	0.71
2	Backward linkages	0.40	0.55	0.71

Source: Statistics Indonesia 2021b (processed)

On the whole, trade linkages between areas of the agricultural sector of West Java, both forward and backward linkages, are still weak in attracting growth in the upstream sector and still limited in encouraging growth in the downstream sector. The only exception is the province of DKI Jakarta. Weak inter-regional linkages in the agricultural sector of West Java is caused by the small proportion of total input and output of the agricultural sector traded between regions, which is only 9.24 percent, the remaining 88.6 percent of input-output of the agricultural sector of West Java is traded within the province of West Java itself (Statistics Indonesia 2021b). Trade transactions between the output areas of the West Java agricultural sector are primarily concentrated in several provinces on the island of Java, namely DKI Jakarta, Banten, Central Java, and East Java, with a total trade proportion of 78.54 percent (Statistics Indonesia 2021b).

Table 7. Trade between regions for West Java agricultural sector output

No	Province	Percentage of Total Trade
1	East Java	2.49
2	Central Java	2.40
3	Banten	2.19
4	DKI Jakarta	1.84
Total		9.24

Source: Statistics Indonesia 2021b (processed)

CONCLUSIONS AND RECOMMENDATIONS

The growth of the agricultural sector in West Java has a small intra-regional effect and a limited spillover effect. The intra-regional effects of the growth of the agricultural sector in West Java were felt mainly by the manufacturing industry sector and the agricultural sector itself in West Java. In contrast, the spillover effect is limited to only a few provinces around West Java, namely DKI Jakarta, Banten, and East Java. West Java's agricultural sector has weak intra-regional linkages with the upstream (backward) and downstream (forward) sectors. Agricultural sector in West Java only has a strong forward linkage with the manufacturing sector in DKI Jakarta. For this reason, the development of the agricultural sector in West Java is directed at increasing productivity to encourage growth in the upstream and downstream sectors and increasing added value to spur growth in the agricultural sector. In addition, the provision of agricultural infrastructure is essential to support the smooth distribution and trade with provinces that have strong links to the agricultural sector of West Java.

ACKNOWLEDGEMENT

This research is part of a dissertation archived at the Agricultural Economics Study Program, Department of Resource and Environmental Economics, Faculty of Economics and Management, IPB University, Indonesia.

REFERENCES CITED

- Arman., S. Hadi., N.A. Achsani. and A. Fauzi. 2016. The impact of the economic linkages of the islands of Sulawesi, East Java, and Kalimantan Timur on the regional economy (in Indonesian, English summary). *Jurnal Ekonomi dan Kebijakan Publik*. 7 (1): 97 - 109.
- Bank Indonesia. 2020. Economic report of West Java Province, May 2020 (in Indonesian, English summary). Bank Indonesia, West Java Province, Bandung. Rep. May 2020. 113 p.
- Cella, G. 1984. The input-output measurement of interindustry linkages. *Oxford Bulletin of Economics and Statistics*. 46 (1):1-6.
- Clements, B.J. and J.W. Rossi. 1991. Interindustry linkages and economic development: the case of Brazil considered. *The Developing Economies*. 29 (2): 166-187.

- Fujita, M., P. Krugman, and A.J. Venables. 1999. *The spatial economy*. The MIT Press. 380 p.
- Hoover E.M. and F. Giarratani. 1985. *An introduction to regional economics*. Alfred A. Knopf, Inc., New York. 292 p.
- Imai, K.S., W. Cheng, and R. Gaiha. 2016. Agricultural growth, poverty and inequality in developing countries. *Journal Development*. 58 (2-3): 230 - 236.
- Isard, W., I.J. Azis., M.P. Drennan., R.E. Miller., S. Saltzman. and E. Thorbecke. 1998. *Methods of interregional and regional analysis*. Ashgate Publishing. 463 p.
- McCann P. 2001. *Urban and regional economics*. Oxford University Press., New York. 289 p.
- Miller, R.E. and P.D. Blair. 2009. *Input-output analysis: foundations and extensions*. Second Edition. Cambridge University Press. 737 p.
- Nugrahadi, E.W., M. Tambunan., H. Siregar. and A. Daryanto. 2010. Analysis of structural change patterns and sources of growth in the West Java Economy. *Forum Pascasarjana*. 33(2): 79 - 90.
- Okamoto, N. and T. Ihara. 2005. Spatial structure and regional development in China, pp 201-209. In Okamoto, N and T. Ihara (eds). *Spatial structure and regional development in China: an interregional input-output approach*. Palgrave Macmillan., New York.
- Statistics Indonesia. 2021a. Gross domestic product at 2010 constant market prices and current prices by industrial origin year 2010-2020. Statistics Indonesia, Jakarta. <https://www.bps.go.id/subject/11/produk-domestik-bruto--lapangan-usaha-.html#subjekViewTab3>
- Statistics Indonesia. 2021b. Table of inter regional input-output Indonesia domestic transactions based on producer prices according to 34 provinces and 17 business fields in 2016. Statistics Indonesia, Jakarta. <https://www.bps.go.id/subject/105/input-output.html#subjekViewTab3>
- Statistics Indonesia. 2021c. Table of inter regional input-output Indonesia domestic transactions based on producer prices by 34 provinces and 52 industries in 2016. Statistics Indonesia, Jakarta. <https://www.bps.go.id/subject/105/input-output.html#subjekViewTab3>
- Statistics of Jawa Barat Province. 2021. Gross regional domestic product at current prices and at constant prices for 2008-2020. Statistics of Jawa Barat Province, Bandung.
- Sulistiyowati, L., R. Novitasari. and L. Trimo. 2021. Structural transformation of the West Java economy and its agriculture, pp. 1-10 in Proc. IOP Conference Series: Earth and Environmental Science. 466 (2020) 012005.
- Tong, T., T.H.E. Yu., S.H. Cho., K. Jensen., and D.D.L.T. Ugarte. 2013. Evaluating the spatial spillover effects of transportation infrastructure on agricultural output across the United States. *Journal of Transport Geography* 30 (2013) 47–55.
- Wang, Y., X. Li., Y. Sun., L. Zhang., Z. Qiao., Z. Zhang., H. Zheng., J. Meng., Y. Lu. and Y. Li. 2020. Linkage analysis of economic consumption, pollutant emissions and concentrations based on a city-level multi-regional input–output (MRIO) model and atmospheric transport. *Journal of Environmental Management* 270 (2020) 110819.
- Widianingsih, W., A. Suryantini. and Irham. 2015. The contribution of the agricultural sector to the economic growth in West Java Province (in Indonesian, English summary). *Jurnal Agro Ekonomi*. 26 (2): 206-218.
- Zhang, Y., H. Zheng., Z. Yang., M. Su., G. Liu. and Y. Li. 2015. Multi-regional input–output model and ecological network analysis for regional embodied energy accounting in China. *Energy Policy*. 86 (2015): 651–663.