The Efficiency of Garlic Supply Chain Actors Measured using Data Envelopment Analysis (DEA) Method in Karanganyar, Indonesia

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Abstract

One of the obstacles to the development of agribusiness is related to supply chain management. The availability of supply is the most important factor in influencing supply chain performance. Without a stable and routine supply, supply chain performance will be disrupted. Karanganyar Regency is one of the production centers of horticultural commodities, particularly garlic. This study aimed to analyze the efficiency of each garlic supply chain actor in Karanganyar Regency. The research was conducted from March to April 2019. The efficiency of each supply chain actor in this study was measured using Data Envelopment Analysis (DEA) method. Performance measurement was done through the DEA approach and the performance attributes were input and output variables. The respondents observed were 50 farmers and 13 supply chain actors working in institutions. The samples of farmers were taken using purposive sampling technique, while the samples of supply chain actors were obtained using snowball sampling. The results have shown that the most efficient supply chain actors were retailers with an efficiency value of 1 (100%), while inefficient supply chain actors were farmers with an average efficiency value of 0.709. From a total of 50 Decision Making Unit (DMU) of total farmers, 13 DMU (26%) were efficient, while 37 DMU (74%) were inefficient and further need improvements, like using certified seeds and suitable fertilizer recommendations, as well as reducing external labor during the process of maintenance, harvesting and post-harvest. Farmers are expected to have the desire to learn from referral farmers.

Keywords: garlic production; optimization; performance

INTRODUCTION

Garlic *(Allium sativum L.)* is one of the seasonal plants and is the most popular spice in the world (Haciseferoğullari et al., 2005; Wu et al., 2015; Petropoulos et al., 2018). Garlic has a distinctive aroma and texture (Benkeblia, 2004). The current centers of garlic production in Indonesia include West Nusa Tenggara, Central Java, West Java, Special Region of Yogyakarta, West Sumatra and East Java. The main garlic producing regions in Central Java Province comprise Cilacap, Purbalingga, Wonosobo, Magelang, Karanganyar, Semarang, Temanggung, Kendal, Batang, Tegal and Brebes Regencies (Appendix 1).

A fundamental aspect of agribusiness of horticultural products is linked to supply chain management. Supply chain is correlated with the flow and transformation of goods and services, starting from the stage of providing raw materials

until the distribution of the final product to consumers (Furqon, 2014). Supply chain management is the unity of the initial actors developing in the distribution network with internal activities and supply data, so that it greatly affects the performance of a sustainable supply chain organization (Bastas and Liyanage, 2018). It is an integrated approach, started with the planning and controlling of materials, logistics, services and flows of information from suppliers to producers or to the end-consumers (Fantazy et al., 2010).

The research on supply chain performance conducted by Sari et al. (2014), in Losarang Sub-district, Indramayu Regency, analyzed the efficiency of catfish supply chain performance. The results of the study have shown that the performance of farmers belonging to the dealer partner of farmer's groups was not efficient, while the supply chain performance of farmers, companies and dealers was fairly efficient.

Supply chain management includes a range of approaches and practices to effectively integrate suppliers, producers, distributors and customers to improve the long-term performance of each company and the overall supply chain in a cohesive and high-performance business model (Chopra and Meindl, 2001). Successful implementation of supply chain management is expected to advance relations between upstream and downstream suppliers and thus increasing customer satis-faction and company performance (Ibrahim and Hamid, 2012).

The level or quality of the garlic that varies as well as the cost of varying garlic supply chain activities is a very influential factor on the level of income which in turn will affect the sustainability of the garlic supply chain in Karanganyar Regency. The amount of costs that must be paid by each supply chain actor will have an effect on the level of income which in turn will affect the level of efficiency of each actor in the garlic supply chain.

Cost variations incurred by each farmer to meet his/her farm, including the costs of purchasing seeds, fertilizers, pesticides and labor can affect production and income, which in turn puts effect on farmers' efficiency. At the level of the collectors, the costs, consisting of the expenses for buying garlic, loading and unloading garlic, drying garlic and transportation costs will vary based on the distance of location, quality and time of buying or selling garlic to the next supply chain.

Supply availability is the most important factor in influencing the performance of the garlic supply chain, because without a stable and routine supply, the performance of the garlic supply chain will be disrupted. Product quality is a factor affecting the supply chain performance, since product quality is closely related to the level of demand for garlic consumers. The performance of the garlic supply chain in Karanganyar Regency is strongly influenced by the efficiency of the performance of each garlic supply chain actor at each supply chain level. Performance measurement in the supply chain is focused on the actors involved in it (Sigala, 2008). Garlic supply chain performance can be seen through the efficiency level of each supply chain Decision Making Unit (DMU).

The method used to measure the efficiency is Data Envelopment Analysis (DEA). According to (Thakkar et al., 2009), DEA is a method for optimizing mathematical programs that measure the efficiency of a DMU technique and compare it relatively to other DMUs. DEA analyzing technique is specifically designed to measure the relative efficiency of a DMU in conditions of many inputs and outputs.

DEA formulates DMU as a fractional linear program to find a solution, if the model is transformed into a linear program with weight values from input and output. Liang et al. (2006) have stated that DEA only uses three input variables, namely labor, operational costs and shipping costs, as well as two output variables, namely total sales and total profits.

O'Keeffe and Fearne (2002) have determined two elements as input variables, including depreciation of quality and utilization of labor and four output variables, comprising price management, promotion, price perception and profit. Batt (2009) have mentioned that supply chain efficiency ultimately depends on the efficiency of each chain actor and the relationships that are built between the members of the supply chain.

Sustainable agricultural productions provide environmental, economic and social benefits. In fact, the short supply chain other than reducing costs, which are cut down by decreasing the number of intermediaries that take the product from the producer to the consumer, creates a positive environmental externalities and above all, promotes the garlic in local areas. This work highlights the central role taken on by the implementation of new forms of marketing

in the short supply chain and its importance in influencing the concept of sustainable development in the agricultural supply chain (De Fazio, 2016).

This research needs to be conducted to find out the supply data, supply chain flow and actors involved in the garlic supply chain in Karanganyar Regency. The purpose of this study was to analyze the efficiency of each garlic supply chain actor in Karanganyar Regency.

MATERIALS AND METHOD

Method

This study was carried out purposively in Karanganyar Regency, especially in four garlic producing sub-districts, including Tawangmangu, Jenawi, Ngargoyoso and Jatiyoso. Karanganyar Regency is located at an average altitude of 511 meters above sea level and has a tropical climate with temperatures of 22-31°C. The total area of Karanganyar Regency is 77,379 ha, which consists of paddy fields (23,107 ha), non-rice farming fields (29,795 ha) and non-agricultural lands (24,477 ha).

Data of supply were obtained from farmers and supply chain institutions, including village level collectors, sub-district level collectors, sub-district level traders and retailers. The study was conducted from March to April 2019.

Research design

The samples of farmers were taken using the purposive sampling method. According to Sugiyono (2014), purposive sampling is a technique of determining samples with certain considerations. The criteria used are farmers who belong to farmer groups, farmers who grow garlic for consumption and farmers with farm experience of at least two years. The total samples of respondents were 50 farmers in four sub-districts.

The samples of supply chain institutions were obtained using the snowball sampling method. The sampling technique begins with several people, then extends based on the relationships with the respondents (Sadler et al., 2010; Nurdiani, 2014; Lee and Spratling, 2019). The criteria used are supply chain institutions that buy and sell consumable garlic and have a minimum of two years trading experience. A total of 13 supply chain institutions in four sub-districts were taken as the samples of respondents.

The data used in the study were primary and secondary data. Primary data were the data obtained directly from respondents through interviews using questionnaires. Secondary data were supporting data collected from relevant agencies related to the research.

Characteristics of respondents

The respondents involved in this study were farmers and supply chain institutions. The observed characteristics of farmers cover the aspects of age (Table 1), duration of farming experience (Table 2) and recent education (Table 3).

Table 1. Distribution of efficiency based on farmer's age and gender

No.	Age group	Population			Percentage (%)
		Male	Female	Total	
1.	$20 \leq x < 30$	1	-	1	2
2.	$30 \leq x < 40$	5	4	9	18
3.	$40 \leq x < 50$	23	2	25	50
4.	$50 \leq x < 60$	8	-	8	16
5.	≥ 60	7	-	7	14
	Total	44	6	50	100

Table 2. Distribution of efficiency based on length of farming experience

No.	Length of farming experience	Total	Percentage (%)
1.	≤ 10	25	50
2.	$10 \leq x < 20$	9	18
3.	$20 \leq x < 30$	12	24
4.	$30 \leq x < 40$	4	8
	Total	50	100

Table 3. Distribution of efficiency based on farmer education level

No.	Educational attainment	Total	Percentage (%)
1.	Elementary school	13	26
2.	Junior high school	23	46
3.	Senior high school	12	24
4.	University	2	4
	Total	50	100

The characteristics of supply chain institutions include the aspects of age (Table 4), duration of trading experience (Table 5) and recent education (Table 6).

Table 4. Distribution of efficiency based on age of supply chain institutions

No.	Age group	Population			Percentage (%)
		Male	Female	Total	
1.	20 ≤ x < 30	-	-	-	-
2.	30 ≤ x < 40	-	-	-	-
3.	40 ≤ x < 50	1	1	2	15.4
4.	50 ≤ x < 60	4	7	11	84.6
	Total	5	8	13	100.0

Table 5. Distribution of efficiency based on the length of trading experience

No.	Length of trading experience	Total	Percentage (%)
1.	≤ 10	11	84.6
2.	10 ≤ x < 20	2	15.4
3.	20 ≤ x < 30	-	-
4.	30 ≤ x < 40	-	-
	Total	13	100.0

Table 6. Distribution of efficiency based on educational level of supply chain institution

No.	Educational attainment	Total	Percentage (%)
1.	Elementary school	-	-
2.	Junior high school	6	46.2
3.	Senior high school	7	53.8
4.	University	-	-
	Total	13	100.0

DEA

DEA is a non-parametric approach based on linear programming assisted by DEAP 2.1 software. In this study, the assumption used was a constant return to scale which was first developed by Charnes et al. (1978) or commonly referred to as the CCR model as follows:

$$Max\ E_m = \frac{\sum_{j=1}^{J} v_{jm} y_{jm}}{\sum_{i=1}^{I} u_{im} x_{im}}$$

with the provision of

$$0 \leq \frac{\sum_{j=1}^{J} v_{jm} y_{jm}}{\sum_{i=1}^{I} u_{im} x_{im}} \leq 1; \quad n = 1, 2, \dots, N$$

$$v_{jm}, u_{im} \geq 0; \quad i = 1, 2, \dots I; \quad j = 1, 2, \dots, J$$

Explanation:
E_m = The m-th DMU efficiency
y_{jm} = J-th output for m-th DMU
v_{jm} = The amount of output weight
x_{im} = The I-th input for m-th DMU
u_{im} = The amount of input weight.

The DMU is part of the DEA. Performance measurement in this study was carried out to compare the performance of one supply chain actor (DMU) with another DMU, so that the supply chains requiring improvements to measure supply chain performance could be determined. Each performance attribute had a performance indicator that was useful for identifying the performance efficiency of a supply chain. In measuring performance through the DEA approach, performance attributes included input and output variables. Input variables at the farm level were seed costs, input costs, labor costs (non-family), while the output variable were production and total income. Input variables at the supply chain level were product purchase costs, loading and unloading costs and transportation costs, while the output variable were production and total income.

RESULTS AND DISCUSSION

Indo Calculations that done using DEAP Version 2.1 software to determine the efficiency of the garlic supply chain used input variables, namely seeds, production facilities and wages of external labor, while the output variable was the production and income at the farm level. At the level of supply chain institutions the input variables used were the purchase of garlic, loading and unloading of the product, as well as drying stage and transportation, while the output variables used were the production and income.

The results of the study show that it is necessary to reduce the input of each garlic supply chain actor in Karanganyar Regency. Baltacioglu et al. (2007) have stated that companies can benefit from reduced costs, increased revenue, increased customer satisfaction and increased shipping and product or service quality. Supply chain management operations consist of procedures and functions that are effectively integrated with suppliers of producers, distributors and customers to improve the performance of supply chains (Chopra and Meindl, 2007). Effective performance measurement does not only affect activities throughout the chain, but also evaluates the performance made by members of the supply chain (Zhang et al., 2009). Overall, efficiency of supply chain management can affect business performance (Peng wong and Yew wong, 2011; Tippayawong et al., 2016).

Based on the measurement of performance using the DEA method, the supply chain actors who must increase the most efficiency are farmers. The farmers had an average efficiency of 0.709. Of the 50 farmers' DMU, 13 DMUs (26%) were efficient, while the remaining 37 DMUs (74%) need to make improvements to achieve efficiency (Table 7). Sub-district collectors are some of the actors in the garlic supply chain in Karanganyar Regency who need to increase efficiency, after farmers. The average value of efficiency was 0.962 for traders of sub-district level collectors. A total of 4 DMU collectors at the sub-district level had 2 DMUs (50%), which were efficient, while the other 2 DMUs (50%) need to make improvements to reach efficiency. The performance of each supply chain actor who needs to improve the efficiency of the garlic supply chain in Karanganyar Regency is as follows.

Farmer supply chain efficiency improvement

The results of the calculation of efficiency of garlic farmers DMU in Karanganyar Regency varied greatly from 0.299 to 1 with an average efficiency level of 0.709, indicating that many DMUs need to be evaluated regarding the garlic farming and the causes of inefficiency need to be investigated. Based on the results of analysis using the DEAP 2.1 software, it is still possible to increase the output by reducing the use of inputs by the DMU, so that an efficient point can be reached. 13 DMU farmers from a total of 50 DMU farmers had an efficiency score of 1 (100%) and they were peers for other farmers' DMUs. There were 11 DMUs, including P1, P8, P11, P34, P35, P40, P44, P45, P47, P49 and P50 (Table 7).

One DMU of inefficient farmers was DMU P2, which had an efficiency value of 0.725, so it is necessary to refer to efficient DMU farmers, some of which were DMU P8, P1 and P40 to obtain efficient DMU (Table 8). The results of calculations with DEAP 2.1 software show that in DMU P2 with an efficiency value of 0.725 (72.5%), there is the potential to increase the output (income) from IDR 1,113,254.000 to IDR 1,123,944.920 by reducing the number of inputs before finally DMU P2 is at an efficient point such as P8, P1 and P40 (as a reference set). DMU P8 contributes 4.8%, DMU P1 contributes 2.8% and DMU P40 contributes as much as 7% in increasing output and decreasing input DMU P2. It can be concluded that DMU P2 is recommended to choose DMU P8, P1 and P40 as the benchmarks.

Peers farmers, farmers P8, P1 and P40, have met particular characteristics, including having an average age of 40-60 years included in the productive age category with an average level of education in junior high school and having an average experience of 15 years in farming so they already have experience in farming garlic. The productive age population is the population in the age ranging between 15 and 64 years. This age population is considered capable of producing goods and services in the production process (Sukmaningrum and Imron, 2017).

The age of farmers can influence their physical ability to carry out agricultural practices related to the establishment of agricultural businesses, movements to new goals and the intensity of production (Burton, 2006). Wongnaa and Awunyo-vitor (2017) conducted a research in Ghana with the respondents aged between 20 and 75 years old in the Guinea Savannah zone. Age can affect workers' productivity for various reasons (Lovász and Rigó, 2013). Some of reasons are the farmers are more experienced, they are able to produce optimal garlic production and they have the willingness to learn and find information related to garlic farming.

Table 7. Efficiency values and peers that become references to each DMU of farmers in Karanganyar

DMU	Efficiency values	Peers			
P1	1.000	P1			
P2	0.725	P8	P1	P40	
P3	0.511	P8	P34	P45	
P4	0.652	P1	P8	P11	
P5	0.548	P34	P8	P45	
P6	1.000	P49			
P7	0.637	P1	P8	P11	
P8	1.000	P8			
P9	0.997	P40	P8	P1	
P10	0.741	P1	P40	P8	P11
P11	1.000	P11			
P12	0.799	P8	P47	P40	P11
P13	0.794	P8	P11	P1	P40
P14	0.641	P34	P8	P45	
P15	0.546	P1	P11	P40	
P16	0.471	P8	P40	P45	
P17	0.489	P34	P8	P45	
P18	0.783	P40	P1	P11	
P19	0.652	P34	P8	P45	
P20	1.000	P20			
P21	0.299	P1	P8	P40	
P22	0.305	P1	P8	P40	
P23	0.338	P8	P34	P45	
P24	0.357	P8	P34	P45	
P25	0.342	P8	P34	P45	
P26	0.306	P8	P34	P45	
P27	0.800	P8	P45		
P28	0.373	P34	P8	P45	
P29	0.657	P47	P11		
P30	0.444	P1	P11	P40	
P31	0.459	P40	P8	P1	
P32	0.675	P11	P47		
P33	0.545	P34	P8	P45	
P34	1.000	P34			
P35	1.000	P35			
P36	0.947	P45	P34	P8	
P37	0.885	P8	P34	P45	
P38	0.919	P8	P34	P45	
P39	0.685	P34	P45		
P40	1.000	P40			
P41	0.721	P34	P45		
P42	0.552	P8	P40	P1	
P43	0.598	P40	P8	P45	
P44	1.000	P44			
P45	1.000	P45			
P46	0.693	P40	P45	P47	
P47	1.000	P47			
P48	0.569	P34	P45	P47	
P49	1.000	P49			
P50	1.000	P8			

Table 8. Potential for increasing output and reducing input in P2 DMU that is inefficient

Variable	Original value	Radial movement	Slack movement	Projected value
Average efficiency value = 0.725				
Production (Kg)	250	0	0	250
Income (IDR)	1,113,254	0	10,690.920	1,123,944.920
Seeds (IDR)	715,000	-196,315.128	0	518,684.872
Input (IDR)	466,100	-127,975.498	0	338,124.502
Outside employee (IDR)	460,000	-126,300.642	0	333,699.358

Peer	Lambda weight
P8	0.048
P1	0.028
P40	0.070

The lack of non-family workers in the studied area had an impact on some farmers who were no longer productive while still engaged in farming activities. Farmers' productivity can upsurge with increasing age, can reach a maximum level, then decline (Abdulai and Eberlin, 2001). Economic problems, lifestyles and career perspectives (Gale, 2003) and precarious employment are generally characterized by short-term contracts such as daily worker groups, homeworkers and part-time and temporary workers (Iwata, 2004) that are capable of underpinning young farmers who are reluctant to farm research area

Improvement of supply chain efficiency of collector traders at village level

The results of DMU efficiency calculation of the performance of garlic supply chain collectors at village level in Karanganyar Regency were worth 0.964 to 1 with an average efficiency level of 0.987. This indicates that almost all DMUs were efficient. Only two DMUs were inefficient and thus need to make improvements by decreasing inputs to reach an efficient point.

Three DMUs of traders at village level from a total of five DMUs had an efficiency value of one and three DMUs were peers for DMUs of other traders at village level, namely PD5, PD2 and PD4 (Table 9).

Table 9. Efficiency values and peers serving as the reference to each DMU of collector traders at village level in Karanganyar Regency

DMU	Efficiency value	Peers	
PD1	0.964	PD5	PD2
PD2	1.000	PD2	
PD3	0.969	PD5	PD4
PD4	1.000	PD4	
PD5	1.000	PD5	

One of the examples of village-level traders who were inefficient was PD3 with an efficiency value of 0.969, which needs to refer to DMU peers of PD5 and PD4 to obtain efficient DMU (Table 10).

Table 10. Potential output increase and input reduction in inefficient PD3 DMUs

Variable	Original value	Radial movement	Slack movement	Projected value
Average efficiency value = 0.969				
Production (Kg)	11,700	0	0	11,700
Income (IDR)	339,300,000	0	0	339,300.000
Garlic purchase (IDR)	187,200,000	-5,753,536.042	0	181,446,463.958
Loading/unloading and drying (IDR)	17,500,000	-537,857.269	-15,461,845.299	1,500,297.433
Transportation (IDR)	2,500,000	-76,836.753	0	2,423,163.247

Peer	Lambda weight
PD5	0.928
PD4	0.687

PD5 and PD4 were peers for village level collectors with the characteristics of having an average age of 50-60 years included in the productive age category with an average junior secondary education level and having an average experience of 7 years in trading garlic in village level.

Village level collectors are one of the suppliers in the supply chain business. Suppliers have an important role in customer perceptions of service and customer satisfaction (Cho et al., 2012). Supply chain management emphasizes the important role of buyer and supplier relations in supply chain management strategies (Tan, 2001), especially in the agricultural sector (Fischer et al., 2010).

Improvement of supply chain efficiency of merchant traders at sub-district level

The results of DMU efficiency calculation of the performance of garlic supply chain traders at the sub-district level in Karanganyar Regency were worth 0.882 to 1. Two DMUs of trader collectors at sub-district level were not efficient and thus, they need to make improvements by lowering inputs to reach an efficient point. Two

DMUs of sub-district collectors from a total of four DMUs had an efficiency score of one and two DMUs were peers for DMUs of other sub-district traders, namely PK1 and PK3 (Table 11).

Table 11. Efficiency values and peers serving as the reference to each DMU of sub-district level traders in Karanganyar Regency

DMU	Efficiency value	Peers	
PK1	1.000	PK1	
PK2	0.882	PK1	
PK3	1.000	PK3	
PK4	0.966	PK3	PK1

One example of sub-district traders with efficient performance was the PK4 with an efficiency score of 0.966, which needs to refer to PK3 and PK1 DMU peers, so that the DMU can become efficient (Table 12). Peers at the sub-district level, traders PK1 and PK3, had an average age of 60 years old included in the productive age category with an average high school education level and an average experience of 5 years in trading garlic at the sub-district level.

Table 12. Potential increased output and reduced input in inefficient PK3 DMUs

Variable	Original value	Radial movement	Slack movement	Projected value
Average efficiency value = 0,966				
Production (Kg)	9,150	0	0	9,150
Income (IDR)	263,350,000	0	2,000,000.000	265,350,000.000
Garlic purchase (IDR)	155,550,000	-5,231,375.623	0	150,318,624.377
Loading/unloading and drying (IDR)	950,000	-31,949.899	-91,880.508	826,169.593
Transportation (IDR)	1,500,000	-5,0447.209	0	1,449,552.791
Peer		Lambda weight		
PK3		0.871		
PK1		0.095		

Trader collectors at regency level have an important role in establishing efficient supply chain management in Karanganyar Regency because the contribution of traders at the sub-district level is intermediaries from consumers outside the Karanganyar Regency area. Regency level traders cannot be analyzed because there is only one trader exists in the studied area.

Improved retail supply chain efficiency

The result of DMU efficiency calculation at the retail level of the garlic supply chain performance in Karanganyar Regency was 1,

meaning that the supply chain actors were efficient. Efficiency refers to how well resources are used (Lai et al., 2002). The speed of delivery and quality of garlic is one of the important indicators in supply chain efficiency (Persson and Olhager, 2002; Rong et al., 2011). Retailers in the studied area bought garlic directly from farmers without going through collectors and sold the garlic directly to the nearest market.

One of the advantages of supply chain management is being able to compete in the supply chain business (Rahimnia and Moghadasian, 2010; Lee et al., 2011; Skandrani

et al., 2011; Kazemzadeh et al., 2012; Zhang and Huo, 2013), as well as being able to manage the relationship between buyers and suppliers, not only from the purchasing function, so that supply chain businesses between actors can run long-term (Chakraborty et al., 2014).

CONCLUSIONS

The results presented in the previous chapter have shown that the most efficient actors were retailers with an average efficiency value of 1. The most inefficient actors were farmers with an average efficiency value of 0.709. 13 DMUs from 50 DMUs were efficient, while the remaining 37 DMUs need to make improvements to achieve efficient point. Improvements at the farm level to increase output values can be done by reducing inputs, using certified seeds and suitable fertilizer recommendations and reducing external labor during the process of maintenance, harvest and post-harvest. Farmers are expected to have the desire to learn from referral farmers. Improvements in village and sub-district level traders are reductions in inputs, i.e. reducing the number of garlic purchases from previous actors. It is intended that the price of garlic at the level of end consumers is not too high. Further research is needed regarding the performance of the garlic supply chain at the level of end consumers.

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Appendix 1. Harvest area and garlic production by regency / city of Central Java Province in 2018

No.	Regency/City	Harvest area (ha)	Production (ton)
1.	Cilacap Regency	10	27.8
2.	Banyumas Regency	0	0.0
3.	Purbalingga Regency	2	0.3
4.	Banjarnegara Regency	0	0.0
5.	Kebumen Regency	0	0.0
6.	Purworejo Regency	0	0.0
7.	Wonosobo Regency	3	226.9
8.	Magelang Regency	335	2,052.5
9.	Boyolali Regency	0	0.0
10.	Klaten Regency	0	0.0
11.	Sukoharjo Regency	0	0.0
12.	Wonogiri Regency	0	0.0
13.	Karanganyar Regency	206	1,677.9
14.	Sragen Regency	0	0.0
15.	Grobogan Regency	0	0.0
16.	Blora Regency	0	0.0
17.	Rembang Regency	0	0.0
18.	Pati Regency	0	0.0
19.	Kudus Regency	0	0.0
20.	Jepara Regency	0	0.0
21.	Demak Regency	0	0.0
22.	Semarang Regency	1	4.0
23.	Temanggung Regency	1,748	13,779.1
24.	Kendal Regency	3	14.5
25.	Batang Regency	4	6.6
26.	Pekalongan Regency	0	0.0
27.	Pemalang Regency	0	0.0
28.	Tegal Regency	211	1.663.8
29.	Brebes Regency	15	93.8
1.	Magelang City	0	0.0
2.	Surakarta City	0	0.0
3.	Salatiga City	0	0.0
4.	Semarang City	0	0.0
5.	Pekalongan City	0	0.0
6.	Tegal City	0	0.0
	Total	2,573	19,547.2

Source: BPS-Statistics of Jawa Tengah Province, 2020