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LINKAGES, POTENTIAL AND SPATIAL EFFICIENCY OF RICE PRODUCTION IN EAST JAVA

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Abstract

East Java has a big role in supplying agricultural products at national level. However, the region is in need to push regional planning and development implementing sectoral and spatial approach. This study analyses the linkage of rice production to other sectors. An Input-Output (IO) model is applied together with Location Quotient test, to measure the degree of relative specialization of the region. DEA approach is implemented to analyze the performance of spatial efficiency.IO results indicate that the largest backward linkage contribution comes from the rice sector itself, followed by fertilizer and pesticide sector, and agriculture-hunting services. The largest forward linkage contributors are rice sector itself, food products and beverages. Spatially there are 28 areas that serve the market for rice. Nine areas were found to be under efficient production, with inputs in the form of land and the number of farmers employed. Policy implications related to the findings of Input-Output approach are related to the affordability and accessibility to inputs, the development of farmers on input use (education and information), as well as the price stabilization of rice and its derivatives. Whereas, related to the spatial aspect, soft infrastructure plays an important role in strengthening internal capacity of farmers and instructors. Hard structure shows the need to restore irrigation systems, and facilitates the use of better seeds and fertilizers.

Keywords: Agriculture Policy, Regional Economics, IO Model, LQ, DEA

Introduction

Background

The concept of regional planning is not limited to the development of a local plan, or particular activities within the region, but it looks at the region in a wider range, as an economic entity where a variety of elements interact with each other (Kuncoro, 2012). The purpose of development planning is to increase the gross domestic product, to expand employment, to decrease income and welfare disparity, among others. The existence of differences among regions, naturally and/or artificially created, offers an opportunity for regional growth and development (Jhingan, 2012).

One of the common rural economic policies focuses on the development of agribusiness and food supply. Development plans often consist on giving industry the necessary support to improve food production facilities, expand downstream agribusiness, helping them to improve production process, foster marketing activities, among others (Nugroho and Rokhmin, 2012). Policies that have direct influence on rural economic activities are policies related to food supply, housing and clothing, which are associated to productivity and income growth. In a more micro perspective, policies oriented to benefit from regional potential represent a good and effective choice for regions.

Agricultural sector plays a special role in local market development, assuming that local market will mature as community revenues increase. The role of productivity in

stimulating agricultural improvements, and then revenues, is therefore essential for the sector. Although Indonesia is well integrated into the global food supply, the reality is that food policies in the country are often left behind. The truth is that the performance of actors from within food industry is often times incompatible with the abundance of resources and the local wisdom, putting Indonesia in a difficult situation to succeed in agribusiness. Moreover, the conversion of land and farms into another kind of uses puts pressure on the sector. Land conversion to other uses is estimated to be at the rate of 100 hectares per year (Kuncoro, 2009).

Agricultural sector contribution to GNP during the last 10 years shows a static position at the level of 14 percent to 15 percent of total GNP. At sub-sector level, the contribution of crops to GNP shows a reduction from 7,48 percent in 2000 to 6,62 percent in 2014 (Appendix 1). Geographically, East Java has a relative smaller amount of land than other provinces in Indonesia within Papua, Sumatra and Kalimantan. Nevertheless, East Java has better available resources and more advance agro-technology that can be used to improve plantations. East Java revealed higher comparative advantage in agriculture versus other provinces. The advantages are revealed in several agricultural products that enjoy of national reputation.

East Java has an important role in food supply at national level. Out of 8.502 villages in East Java, 5.059 of them are rice producers. In fact, the 5.059 villages have rice as their main source of income. In 2012, East Java rice production contributed with 17.66 percent of food national production (Table 1.1).

Table 1. Contribution of East Java to Rice Production in 2012

No	Items	2012
1	Paddy production in dry-mile rice (ton)	12,198,707
2	Equivalent of rice product (ton)	7,929,159
3	Population (people)	37,781,599
4	Consumption in a year (ton)	3,447,949
5	Harvest area of the nation (percent)	14.69
6	Production, share of the nation (percent)	17.66

Source: Soekarwo, 2015

Research Problems

The development of an area planning should include a more sectoral and spatial approach (Tarigan, 2010). This implies that the development of an agricultural planning, particularly on rice as sub-sector, must be reviewed under a sectoral and spatial view in order to determine the basic sectors. According to Eriyanto (1998), the logic of production problem solving is the ability to relate phenomena associated to labor, targets and product.

At the center of rice production in Indonesia, there are some problems in structural areas related to agriculture productivity. The problems are shown in the decline of agricultural land due to increased urbanization, the small size of arable land per farmer, the diminishing quality in land, poor infrastructure (such as irrigation systems), lack of electricity in rural areas, a low absorptive technological capability, and low investment in research and innovation (Bank of Indonesia, 2004).

The apparent success in agriculture sector in East Java is contrary to the challenges experienced within the sector. One factor is that the vigorous development of enterprises within secondary and tertiary sectors, oftentimes because of programs promoted by the government, absorbs resources -including land- from primary sector. As a result, less

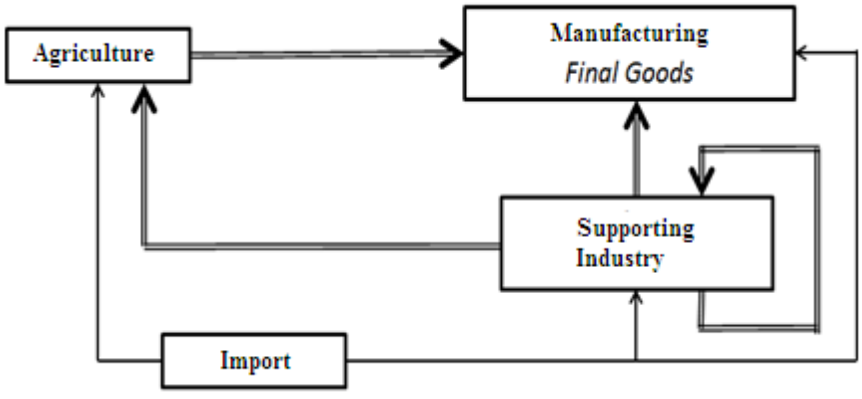
resource is being allocated in agriculture, causing a constant decline in agricultural land from year to year(BPS Jatim, 2013).

Linkage and efficiency of the rice sector becomes an important issue of research on agriculture in Indonesia and Asia. Research shows the stability of rice prices is associated with many commodities in Java (Idris, H.M., 2002), and the shift in focus towards the development of agribusiness and mechanization means an increase in productivity and efficiency in Indonesia (OECD, 2012). Brazdik (2006) focus on the efficiency of the rice sector in West Java, Indonesia, while a recent study in Vietnam (Minh, NK, & Long, GT, 2009), and Myanmar (Tun, Y., and Kang, H., 2015), identify factors that can increase the efficiency of rice production. However, it shows the important issue of relevance and efficiency of the rice sector.

The data that describe in spatial analysis identifies the areas in which rice production in East Java are potentially efficient. Considering the background and the problems already identified, this study looks at the following research questions: (1) How strong is the relationship (linkage) of the rice sector towards the other productive sectors in East Java, (2) How efficient is the production of rice in East Java, and (3) What is the potential offered by the rice sector. This study analyzes relationships and linkages of rice production towards other sectors, the efficiency in the production of rice from a spatial perspective, and proposes the implementation of some policies for the further development of rice sector in East Java.

Literature Review

In general, the role of agriculture is central for many countries as many citizens depend directly or indirectly from it to cover basic living needs. Among other things, the role is critical for the following reasons: (1) it represents the main source and largest food supply, (2) its performance impacts industry as it stimulates tertiary and secondary sectors and supports its expansion, (3) it provides additional revenues from agricultural exports, (4) it increases rural revenues, and (5) it helps increasing prosperity in rural areas (Jhingan, 2012). Aside from this, agricultural products are important as they differ from other kind of products in (1) land plays an important role as the main factor of production, (2) they are highly dependent on climate, and (3) it is a sector responsible for food production, essential good for living. While many industrial products have some kind of substitutes, food cannot be easily replaced. Therefore, agriculture is considered to be an important sector (Perkins et.al, 2001).



Source: Tambunan, 2003

Figure 1. The Linkage between Agriculture and Manufacturing

Looking at agriculture as economic linkage among sectors, it plays the following functions: (1) as investment source to non-agricultural sectors through the surplus income

generated in agriculture and absorbed in other sectors, (2) as source of raw materials for other sectors, especially in agro industry and trade, (3) as market for other economic sectors (Tambunan, 2003). The linkage between agricultural and processing industry (manufacturing) should follow what describe on figure 1. The linkages showed a strong bond between both sectors that can decrease the dependence of import or even eliminate it.

According to Ellis (1992), a policy that relates agricultural inputs and outputs consist of seven aspects: (a) *output policy*, including price and marketing policy, (b) *input policy*; related to price and input distribution systems, (c) *credit policy*, pertaining to capital and input purchasing, (d) *mechanical policy*, concerning with fix capital on agricultural such as machine and agricultural equipment, (e) *land reformation* in regard to redistribution and land legal status, (f) *research policy* related to agricultural system research and new technology dissemination, (g) *irrigation policy* related to water supply as an input variable. The main inputs in agricultural products, especially for farmers on developing countries, are the use of new seeds, fertilizers and irrigation.

In particular, there are three main inputs in agricultural policy; (1) *input prices*: related to the level of input price and government awareness in influencing prices that a farmer should pay for purchasing fertilizer and seeds, (2) *input delivery*; concerning input delivery systems and government awareness in managing distribution systems until it reaches all farmers, (3) *advice to farmers*: the available information for farmers about type, amount and combination of available inputs. As seeds, fertilizers and irrigation are inputs bound to each other, and as the proper combination of them allows reaching higher productivity levels, education in input use becomes then critical to improve productivity.

According to Soekartawi (2002), in order to improve productivity, government should develop a policy that stimulates production in a form of (1) *price policy*, such as price determination on market to stimulate farmers to focus on right crops, (2) *non price policies*, such as set KUD near to a central location or farmers residences. The availability of inputs does not guarantee that productivity will increase, but the most important point is to allow higher levels of efficiency. Technical efficiency, will be achieve only if farmers are able to allocate factors of productions into those areas with higher productivity and efficiency.

A research conducted by the Bank of Indonesia in 2014 concludes that the increase in agricultural productivity mostly depends on the results of intermediation as well as in the farmers' adoption capability of innovation and development. The strengthening of soft infrastructure includes (1) the improvement of farmers' internal capacity, (2) intensify agricultural institutions, (3) counseling institutions, (4) university intervention, and (5) government commitment. Those aspects can complete the hard structure such as the improvement of facilities and infrastructure like irrigation systems, village roads, and electricity, among others.

A number of studies use Input-Output (IO) approach to solve different problems associated with the effective use of inputs, the identification of strategic sectors, analysis of market structures, etc. Dwiastuti et.al, (2008) applied IO methodology to identify and determine the main agricultural sectors in Indonesia. Sahara and Resosudarmo (1998) analyses the role of processing industrial sector on the economy of DKI Jakarta. Amir and Riphat (2005) evaluate the policy development in East Java. Rondhi (2009) analyzes economic behavior and market structure in order to determine the main sectors in East Java. Suharjo and Santoso (2014) focus on forward and backward linkages within economic sector in East Java.

Several studies apply LQ approach in order to determine which commodities within agriculture are revealed as more competitive. Handayana (2003) applied a spatial analysis to compare different provinces in Indonesia. Arifien (2012) analyzes horticultural products in

West Java using LQ. Kurniawan (2014) uses it to determine the most competitive pulses commodities in Nganjuk regency in East Java. Some other studies that apply DEA approach are those of Santosa and Khariza (2009) using it to examine the efficiency of rice business sector in West Java, and Suripto (2010) who applies DEA to analyze productivity on agricultural crops in Kebumen Regency using land area and the number of farmers as inputs, whereas rice production as well as and non-rice production as output.

Methodology

Input Output Approach

Input-output (IO) approach is a comprehensive framework capable to carry out area (regional) analysis, describing various inter-relationships between sectors and among sectors, attached to other economic components (Nugroho and Dahuri, 2012). As a quantitative method, the I-O table provides an overall description on: a) economic structure of the region/nation including output and value added on each sector; b) transactions of intermediary inputs on goods and service among production sectors; c) relation of goods and services, both locally supplied or imported from other provinces or nations; d) demand structure of goods and services by all economic sectors, including demand for consumption, investment and exported goods and services.

The relationship of economic sectors is presented in the form of backward linkages, relating the input usage mechanism, while the forward linkages relates to output usage mechanism. The backward linkage is the ability of a sector to stimulate the growth of output of another sector through a link of input demand, while the forward linkage is the increase of economic output level caused by an increase in the output of another sector through output demand links.

Total backward linkages involve direct and indirect effects as shown below (Nazara, 2005):

$$B(d+i)_j = \sum_{i=1}^{n} a_{ij} \quad (1)$$

The specification indicates that the □(□ + □)□isthe total backward linkage, a_{ij}matrix elements of Leontief inversed line-i row-j, and *n is* number of sectors (110 sectors stated in this study).

Forward linkages include direct and indirect effects:

$$F(d+i)_i = \sum_{j=1}^{n} a_{ij} \quad (2)$$

Where $F(d+i)_i$ *is* total forward linkage, a_{ij} corresponds to the matrix elements of Leontief inversed line-i row-j, and *n is* number of sectors.

The value of total forward and backward linkages shows the relation among all economic sectors (110 sectors) in East Java. Based on the total value of the linkages, is possible to known the composition of the sectors, as well as its linkages (forward and backward) with other sectors. The mapping of sectors and products represents the basis for policy development in East Java.

The detail of agricultural input sector is simpler than industrial ones. The inputs used for the model are mainly seeds, fertilizer, livestock feed, pesticide and fuel for agricultural machine. The amount of seeds consumption is estimated from regional sampling survey in different agricultural areas, the livestock feed consumption is estimated from the number of livestock, fuel consumption is estimated based on the stock of agricultural machines available in farms and the use of pesticides and fertilizers is estimated based on their domestic production and net imports (PBB, 1988).

Location Quotient

Location Quotient test is applied to measure the specialization degree in each area analyzed. The index for comparison uses the largest area as reference versus the analyzed area (Nugroho and Dahuri, 2012). According to Tarigan (2005), LQ may be apply to measure comparative advantage and can be implemented into sectors that have been well establish and growing for relatively long periods of time. In the other hand, the method cannot be applied for new established or newly evolving sectors since the total production does not show the real capacity in the area.

LQ technique determines the capacity of a region to export and the degree of independency of a sector. The economic activities in LQ analysis consist of:

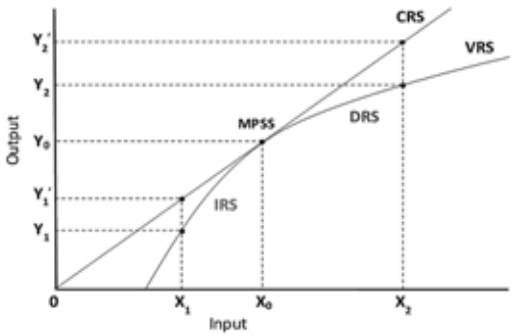
a. Economic activities that serve the internal market (within the same area) or outside the related area. This industry is known as a basic industry.
b. Sectoral activities that that serve a market in particular area (local). This is known as non basic or local industry.

The logic of LQ is based in basic economic theory in which the main definition is that the particular industry produces goods and services both for internal and external market. The LQ technique measures the concentration of an economic activity (industry) in a particular area by comparing the role it plays in that region versus the role played by the same industry at regional and/or national level (Widodo, 2006).

The existence of inflows of revenue from outside areas cause increments in consumption (C) and investment (I). As a consequence, income tends to increase and job creations starts to rise. The increase of income does not only foster the demand on the basic industry, but it also increases the demand on non basic industries (local). The increasing demand also stimulates improvements in investment. These are some reasons why developing basic industries will lead improvements in many economic sectors.

Data Envelopment Analysis Approach

DEA is based in linear programming. It is often applied to measures the relative performance in organization units where the existence of several inputs and outputs makes it difficult to be compared. The criteria of efficiency are function of weighted values of virtual inputs and output. The measure of efficiency, the decision making unit, is based on a mathematical solving approach.



Source : Smart, 2014

Figure 2. CRS, VRS, IRS, DRS Production Function

DEA CCR is known as Constant Return to Scale (CRS) where inputs and output values are considered constant, the additional output and input values are treated similarly. In other hand, DEA BBC is known as Variable Returns to Scale (VRS) in which the increases of inputs and output are not treated proportionally. The increasing proportions of inputs and output can follow either the increasing or decreasing returns to scale. CRS, VRS, IRS, DRS production functions are graphically described in figure 2. DEA modes implemented in this study is VRS which has an orientation on output maximization.

Variables and Data

This study uses data from an Input-Output (IO) table of 2010. The table covers a total of 110 sectors for the province of East Java, Indonesia, published by the Statistics Bureau of Indonesia (BPS). Data on food plantations and crops by sub-sector was obtained from BPS at provincial (East Java), regency and city level. The number of farmers was collected from statistical data of agricultural human resources and farmers institutions in 2013, published by the ministry of agriculture.

The input variables applied are: number of farmers and land area for harvesting rice, while the output variable is rice production by each regency and city within the East Java province. The number of farmers describe the labor used in producing rice. Researchers use the harvested area instead of paddy land area. The harvested area is assumed to have involved the use of other essential inputs such as seeds, fertilizers, and pesticides. The combination of a number of farmers and harvested area became a major component of rice production.

LQ calculation using a value-added food crops and instead use the value-added rice, due to the availability of data each regency. Efficiency spatially describe the efficient use of inputs and outputs to the calculation method of DEA. DMU uses data from each regency or city in 2012.The calculation of the basic sector and non bases on LQ analysis, and spatial efficiency of DEA method, will produce a combination of the four areas of each regency and the city, to do further analysis.

Conceptual Framework

The relationship between rice sector and another productive sectors is analyzed using Input-Output approach. It is important to mentioned that the relation between agricultural sector and another sectors may be indirect, when for example, agriculture provides its output in form of raw materials for a specific industry, then that industry provides semi-finished products to be used by the next industry. By analyzing the total value chain, its possible to obtain the total impact created within the production sector. That total value is used to determine the composition and shape of the sector, with both total forward and backward linkages. The composition of the sector, becomes the basis for the development of production policy for both industry or rice sector in East Java.

The development plan for a specific area should combine both a sectoral and spatial approach. This implies that the plans developed for sub-sectors of food production, need to be reviewed and should considered both sectoral and spatial aspects (Tarigan, 2010). According to Tambunan (2003), the ability to increase agricultural production is influenced by both external factors such as climate, as well as by several internal factors in which people takes part in it. The precise and optimal combination of those factors can determine both the level of land productivity and of human resources.

In line with the purposes of this study, the research framework focuses on the relation of rice productions on other sectors, as well as in the spatial aspects needed to determine the basic sector and efficiency of rice production. The results of the analysis provide information

to advice policy makers for a review on development plans for rice production in East Java. The conceptual framework is shown in the figure of 3.

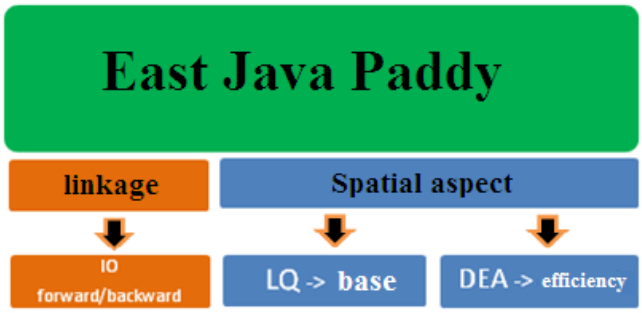


Figure 3.Conceptual Framework

Results and Analysis

East Java Rice Production

The majority of people in East Java are economically dependent on agriculture. The sector, is the third largest contributor to provincial GDP, after trade sector and manufacturing. Agriculture still represents a pillar for regional economic development, due to its important contribution to GDP and the support it offers to other sectors, providing raw materials. According to the Village Potential Statistics in East Java (BPS, 2014), a total of 7.245 or equivalent to 85,22 percent of total villages within East Java, depends on incomes from agriculture sector. Out of the 7.245 villages, 5.059 depend mainly in rice production, while 1.151 rely on horticulture crops. As comparison, manufacturing industry (factories, handicraft, and so on) represents the main income for only 519 villages (6,10 percent of villages) in the province.

Utilizing 2012 data, rice production in East Java reached 12.198.707 ton, with a total extension of harvest land of 1.975.719 ha. The total number of farmers working at rice production was of 2.566.164. If each regency is examined according to three main criteria (harvest land size, number of farmers, and rice production), there are four regencies always present in the ranking of top five regencies (Jember, Lamongan, Bojonegoro, and Ngawi, see Appendix 2).

The Linkage of Rice Sector with 110 IO Sector Approach

To analyze how the rice sector (Sector 1) links with other sectors, the Backward Linkage (BL) and Forward Linkage (FL) are employed. The backward linkage looks at the connections through raw materials with other sectors, based on the data located in the columns in the IO table (raw materials or intermediary goods). The forward linkage looks at the connections with other sectors through finished goods. The domestic transactions of finished goods are located in the rows of the IO table.

Backward Linkage

The backward linkage is computed using the 2010 IO table. After computed for the coefficient matrix (matrix A) and the inverse matrix (I - A)-1, it is possible to obtained the backward linkage index. The BL score for the rice sector is 1.303, representing the ranking position 66th in backward connection (Appendix 3a). This score indicates that the increase in

one unit of output in the rice sector will increase total input demand in 1.303 units. The largest contribution to the BL score (1.303) of rice sector comes from the rice sector itself that contributes with 1.120 (points), representing 85,98 percent of the total backward linkage for rice sector. Fertilizer and Pesticide represent 4,66 percent, Agriculture Services and Hunting 1,71 percent, Retail Trades except of Motor Vehicles and Motorcycles 1.31 percent, and Crude Petroleum and Natural Gas 0.93 percent (Table 2). The rest, 105 sectors, represent the remaining 4.41 percent of the total BL to rice.

Table 2. The Big Five Contributor of BL Rice Sector

Code	Description	BL Contribution	percent
1	Paddy	1.120	85.98
61	Fertilizer and pesticide	0.061	4.66
28	Agricultural services and hunting	0.022	1.71
87	Retail trade except motorvehicle and motorcycle	0.017	1.31
34	Crude petroleum and natural gas	0.012	0.93
	Other sectors	0.071	5.41
	Forward linkage score of paddy	1.303	100

Source: I-O 2010, data processed by the author.

Forward Linkage

The total forward linkage in the Rice sector represents the eleventh position in the ranking of sensitivity among all sectors, scoring a total of 2.153 (Appendix 2b). It means that the increase in output of rice in one unit will stimulate the total economic growth in 2.153 units. The increase comes through rice output that is being used as input for other sectors. If the FL from rice is analyzed at more detail, the largest five contributors to the sector FL's index comes the sector itself (*Padi* as a plant) -52,98 percent-, rice semi processed (*Beras*) represents 35,92 percent, Food Products and Beverages contributes with 3,20 percent, Health and Social Work Services (1.89 percent), and finally Chicken industry (1.09 percent). The remaining 5.86 percent is distributed among 105 sectors (Table 3).

Table 3. The FiveMain Contributors to BL Rice Sector

Code	Description	FL Contribution	percent
1	Paddy	1.12	52
43	Rice	0.773	35.9
98	Food products and beverages	0.069	3.2
108	Health and social work services	0.041	1.89
23	chicken	0.024	1.09
	Other sectors	0.126	5.86
	Forward linkage score of paddy	2.153	100

Source: IO 2010, data processed by the author

Spatial location of rice basis Areas

All scores of LQ (2012) at regency and city level are calculated based on value added as well as by its contribution to provincial GDP (Appendix 2). Two zone classifications are distinguished, those that are Basis Zone (Base), and the Non Basis one (Table 4.3). The results show there are 28 zones that are able to serve its own rice market and/or other zones in East Java (Base of rice sector), whereas the other ten zones show no capacity to serve its own

market or other ones (Non Base rice areas). All zones categorized as cities, except for Batu city, are included as Non Base regions. All regencies are categorized as basis regions, except for Gresik and Sidoarjo regencies that were found as Non Base areas.

Table 4. Base and Non Base areas in Rice Sector by Regencies/Cities

Regencies/Cities	Result
21. Ngawi	Base
24. Lamongan	Base
27. Sampang	Base
11. Bondowoso	Base
02. Ponorogo	Base
26. Bangkalan	Base
19. Madiun	Base
10. Banyuwangi	Base
01. Pacitan	Base
20. Magetan	Base
03. Trenggalek	Base
28. Pamekasan	Base
18. Nganjuk	Base
09. Jember	Base
29. Sumenep	Base
05. Blitar	Base
23. Tuban	Base
13. Probolinggo	Base
08. Lumajang	Base
22. Bojonegoro	Base
17. Jombang	Base
07. Malang	Base
79. Batu city	Base
12. Situbondo	Base
14. Pasuruan	Base
06. Kediri	Base
16. Mojokerto	Base
04. Tulungagung	Base
72. Blitar City	Non Base
25. Gresik	Non Base
74. Probolinggo City	Non Base
77. Madiun City	Non Base
75. Pasuruan City	Non Base
76. Mojokerto City	Non Base
15. Sidoarjo	Non Base
73. Malang City	Non Base
71. Kediri City	Non Base
78. Surabaya City	Non Base

Source: BPS, data processed by the author

IV.4. Spatial Analysis of Efficiency in Rice Production

To determine the efficiency of rice production areas, DEA efficiency approach is implemented. The goal is to maximize rice (*pady)* production output (ton) using as inputs the zone area (ha) and the number of farmers (people). The results indicate that nine zones are efficient; Batu City, Mojokerto City, Pasuruan City, Jember, Gresik, Pamekasan, Madiun, Tuban, dan Lamongan. Out of the nine zones, only Jember and Lamongan are consider as efficient in rice production output and part of the ranking of the big five categories, such as in

Appendix 2. It means those two zones are able to combine arable area with the number of farmers, reaching production efficiency through the right use of inputs.

Table 5. Production Efficiency Based on Spatial Approach

	Name	Score	Scale
79	Batu city	100	constant
76	Mojokerto city	100	constant
75	Pasuruan city	100	constant
09	Jember	100	constant
25	Gresik	100	constant
28	Pamekasan	100	constant
19	Madiun	100	constant
23	Tuban	100	constant
24	lamongan	100	constant

Source: BPS, data processed by the author (Appendix5)

The Graphic Combination and Policy Implication

A graphic combination of the areas considered as basis (Appendix 4) and those areas under Efficiency criteria of rice production (Appendix 5) it is exhibited in a four quadrant figure. The four quadrants represent (1) Zone consider as Base and under Efficiency criteria (2) Non-Base, but under Efficiency, (3) Base, but Non Efficiency, and (4) Non-Base, and Non Efficiency.

The results obtained both by means of calculations of efficiency, or graphically, show that out of the 28 zones consider as rice sector bases, only six of them are considered as efficient. Those zones are Lamongan, Madiun, Jember, Tuban, Pamekasan, and Batu City. Whereas out of the ten non-basis zones there are three that show efficiency. As Figure 4.1.indicates, seven zones are considered as non-basis and non-efficient (left bottom side of the quadrant). Those areas (cities) are Blitar, Probolinggo, Madiun, Sidoarjo, Malang, Kediri, and Surabaya.

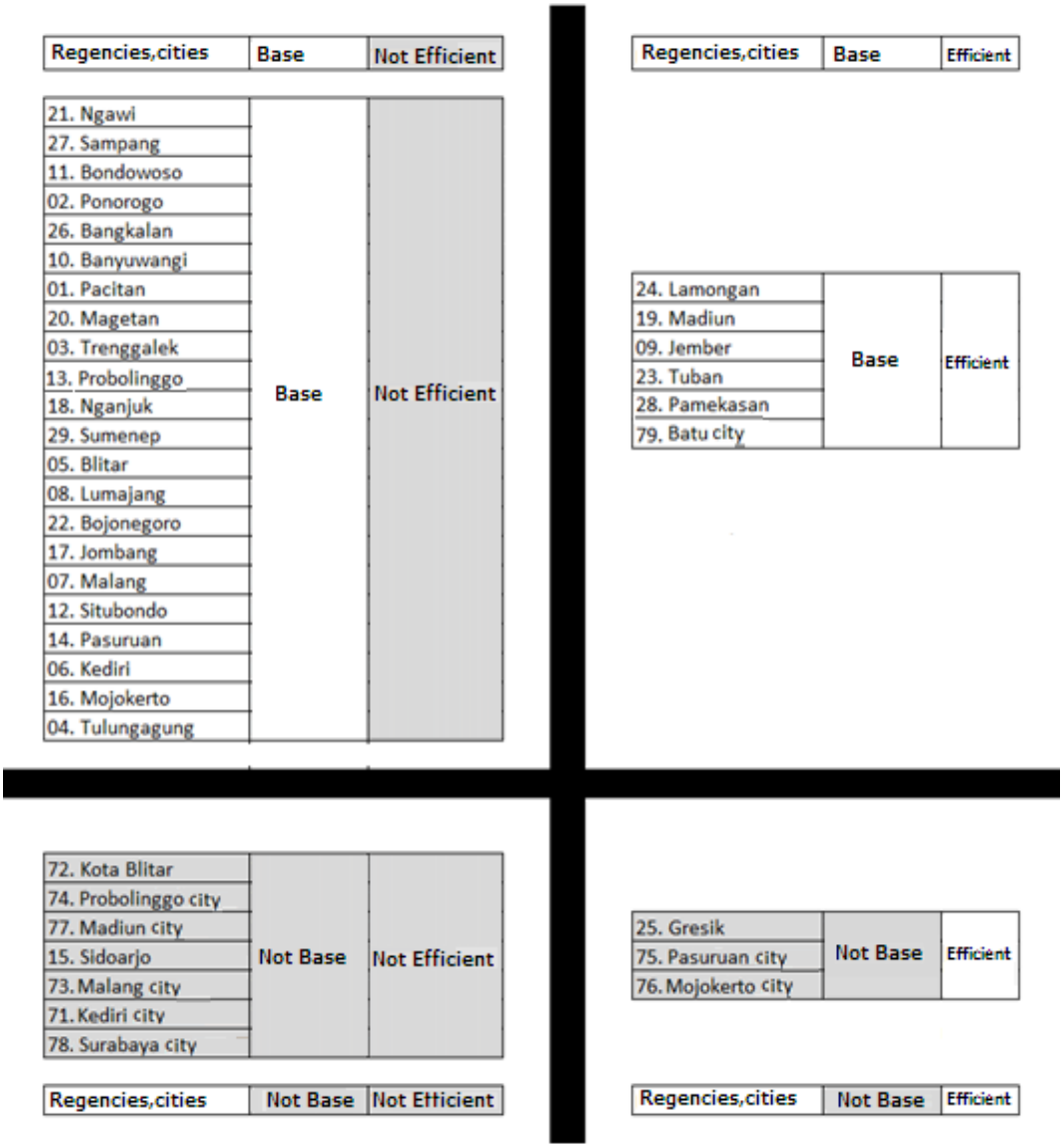


Figure 4. Topology Base and TheEfficiency of Rice Production

Some of the findings identify important inputs with policy implication in the rice productive sector. The three main contributors to the backward linkages are: the rice sector itself, fertilizers and pesticides, as well as agricultural services. If it is related with input policy dimension from Ellis (1992) the three main elements are: (1) input price level of seeds, fertilizer and pesticides, as well as agriculture equipment must be affordable (price) for farmers, (2) an efficient and proper distribution network that assures that seeds as well as good quality fertilizer will reach all farmers, (3) availability of information and training to farmers about seeds, fertilizers and new agriculture equipment technology. The instruments to carry out the policy could be the subsidies for seed and fertilizers, a wider credit allocation, supporting services for farmers in production facilities, and facilitating the spread and absorption of agriculture technology.

The main contribution to increase forward linkages within rice productive sector, are the rice sector itself, then rice (*beras*), as well as food products and beverages. The main policy implication is related to keep the stability of rice prices since it directly affects its main three boosters of forward linkages: farmers (who are also households and rice consumers),

the rice sector itself (*beras*), and food products and beverages. The stability of prices will decrease uncertainty for farmer, will stabilize staple food prices and assures that food and beverage services will have access to supplies with an affordable price.

Under spatial analysis, a number of areas are identified as Base for rice sector, however, 22 areas of them are in fact considered under non-efficiency criteria. This suggest that the first priority in policy making, in line with a research conducted by the Bank of Indonesia (BI), is to support farmers to adopt the wide research and innovation done and proposed for agriculture sector. It also needs to strengthen soft infrastructure that can help to increase internal capacity. As proposed by Soekartawi, a counseling institution is essential to support the farmer to properly allocate production factors. In the other hand, the hereafter priority in policy making for areas considered as non-basis but that enjoy of efficiency criteria, is to support and complement the hard structure aspects of the sector, especially improvement (restoration) of irrigation facilities, in providing seed and better fertilizers for farmers.

Conclusion and Suggestions

Conclusion

1. The backward linkage of the rice sector is able to boost three main sectors; the rice sector itself, fertilizer and pesticide sector, as well as agricultural services and hunting. The forward linkage in rice sector fosters three main sectors; the rice sector itself, rice sector (*beras*), and food products and beverages.
2. The results show that out of 28 basis areas of rice sector, only six zones are considered as efficient (Lamongan, Madiun, Jember, Tuban, Pamekasan, and Batu City). Whereas, out of the 10 Non-base areas, 3 of them are in efficient category (Gresik, Pasuruan City and, Mojokerto City).
3. Policy implications related to the findings of input-output approach are: the affordability of input prices, the importance of an efficient system of input distribution, the facilitation of information, education and training programs to farmers related to input use, as well as the stability of rice prices and its derivatives. Related to the findings based on spatial approach, it is important to strengthen soft infrastructure in order to increase internal capacity of farmers and instructors. In the other hand, related to hard structure, it is essential to restore irrigation systems, allocate better seed and fertilizers for farmers.

Suggestions

For future research, multiplier computations for IO analysis could be added for a more comprehensive analysis. Efficiency calculation can include some other indicators like land area, or other inputs of production. Future studies can also extend the analysis coverage to other sectors and other food crops, like corn, soybean, and nuts.

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APPENDIX

1. Gross Domestic Product by Industrial Origin at Current Prices in 2004, 2010, 2014

Billions of IDR

Industrial Origin	2004	%	2010	%	2014	%
1. Agriculture, Forestry and Fishery	329.124,6	14,34	984.470,5	15,29	1.446.722,3	14,33
a. Food Crops	*165.558,2*	*7,21*	*482.377,1*	*7,48*	*668.337.7*	*6,62*
b. Plantation crops	49.630,9	2,16	136.048,5	2,11	192.921,5	1,91
c. Livestock	40.534,7	1,77	119.371,7	1,85	184.246,5	1,83
d. Forestry	20.290,0	0,88	48.289,8	0,75	60.872,8	0,60
e. Fishery	53.010,8	2,31	199.383,4	3,09	340.343,8	3,37
2. Mining and Quarrying	205.252,0	8,94	719.710,1	11,16	1.058.750,2	10,49
3. Manufacturing	644.342,6	28,07	1.599.073,1	24,80	2.394.004,9	23,71
4. Electricity, Gas, and Water Supply	23.730,3	1,03	49.119,0	0,76	81.131,0	0,80
5. Construction	151.247,6	6,59	660.890,5	10,25	1.014.540,8	10,05
6. Trade, Hotel and Restaurant	368.555,9	16,05	882.487,2	13,69	1.472.559,7	14,60
7. Transport and Communication	142.292,0	6,20	423.172,2	6,56	745.648,2	7,39
8. Financial and Business Services	194.410,9	8,47	466.563,8	7,24	771.961,5	7,65
9. Other Services Activities	236.870,3	10,32	660.365,5	10,24	1.108.610,3	10,98
GROSS DOMESTIC PRODUCTS	2.295.826,2	100,00	6.466.851,9	100,00	10.094.928,9	100,00

Source: BPS

10. Harvest Land Size, Farmer Amount and Rice Production in 2012

Regencies , cities	Harvest Land (ha)	Farmers (Persons)	Productions (Ton)
01 Pacitan	35,202	60,305	172,688
02 Ponorogo	63,338	86,582	406,678
03 Trenggalek	27,401	63,502	167,222
04 Tulungagung	47,107	64,986	299,755
05 Blitar	49,684	102,239	303,332
06 Kediri	51,233	94,756	306,175
07 Malang	59,901	90,329	416,607
08 Lumajang	74,772	79,025	408,635
09 Jember	158,568	209,084	968,505
10 Banyuwangi	118,186	119,380	732,262
11 Bondowoso	58,989	80,476	317,439
12 Situbondo	44,057	63,961	266,005
13 Probolinggo	55,454	58,460	302,572
14 Pasuruan	88,943	82,786	571,510
15 Sidoarjo	31,022	24,141	203,573
16 Mojokerto	48,365	56,527	306,881
17 Jombang	70,774	62,137	462,628
18 Nganjuk	80,169	108,803	507,670
19 Madiun	73,138	69,828	499,679
20 Magetan	43,928	58,139	288,756
21 Ngawi	116,261	122,710	708,694
22 Bojonegoro	133,834	168,532	808,112
23 Tuban	82,303	134,626	576,738
24 Lamongan	143,149	124,946	856,890
25 Gresik	59,203	45,518	386,435
26 Bangkalan	46,155	68,774	259,861
27 Sampang	43,150	68,010	245,536
28 Pamekasan	25,343	57,445	178,801
29 Sumenep	29,188	117,239	160,365
71 Kediri	1,564	3,218	9,770
72 Blitar	1,762	2,315	10,899
73 Malang city	1,969	3,799	12,563
74 Probolinggo city	2,277	3,569	13,178
75 Pasuruan city	2,598	1,117	19,830
76 Mojokerto city	1,058	951	6,674
77 Madiun city	2,444	1,753	17,135
78 Surabaya city	2,305	3,313	13,776
79 Batu city	925	2,883	4,878
Total	**1,975,719**	**2,566,164**	**12,198,707**

Note: Grey line color is the big five in each aspect.
Source: East Java BPS (2013), and Ministry of Agriculture (2013)

11. The Ranking of pull factor (Backward linkage) and push factor (Forward linkage) to The Whole Sector (110 sectors)

a. Backward linkage

Ranking	code	BL Score	Ranking	code	BL Score
1	42	2.0770	56	11	1.3535
2	48	2.0638	57	52	1.3517
3	37	1.9661	58	90	1.3505
4	43	1.9641	59	92	1.3425
5	39	1.8487	60	59	1.3389
6	44	1.8360	61	58	1.3341
7	55	1.8300	62	101	1.3257
8	45	1.8183	63	89	1.3190
9	102	1.8161	64	86	1.3048
10	51	1.8040	65	8	1.3039
11	41	1.7844	66	1	1.3028
12	38	1.7804	67	54	1.2998
13	47	1.7785	68	97	1.2968
14	70	1.7516	69	20	1.2953
15	108	1.7460	70	109	1.2903
16	84	1.7208	71	69	1.2803
17	98	1.7009	72	7	1.2791
18	85	1.6892	73	32	1.2791
19	71	1.6735	74	21	1.2713
20	60	1.6588	75	107	1.2586
21	103	1.6318	76	95	1.2585
22	94	1.6222	77	62	1.2573
23	27	1.6068	78	110	1.2525
24	26	1.5866	79	3	1.2521
25	67	1.5628	80	9	1.2493
26	56	1.5621	81	78	1.2449
27	57	1.5551	82	82	1.2399
28	33	1.5455	83	2	1.2399
29	100	1.5403	84	73	1.2346
30	22	1.5370	85	14	1.2317
31	77	1.5351	86	50	1.2306
32	64	1.5155	87	6	1.2280
33	91	1.5067	88	46	1.2247
34	49	1.4854	89	10	1.2215
35	106	1.4846	90	4	1.2152
36	24	1.4815	91	36	1.2134
37	63	1.4759	92	19	1.2131
38	23	1.4699	93	12	1.2010
39	25	1.4616	94	17	1.1944
40	93	1.4478	95	34	1.1943
41	83	1.4288	96	16	1.1880
42	65	1.4269	97	87	1.1801
43	40	1.4268	98	99	1.1799
44	53	1.4227	99	88	1.1705
45	61	1.4196	100	18	1.1680
46	76	1.4180	101	15	1.1568
47	105	1.4060	102	29	1.1551
48	79	1.3964	103	30	1.1471
49	66	1.3810	104	5	1.1391
50	75	1.3759	105	28	1.1241
51	104	1.3726	106	96	1.1204
52	81	1.3701	107	35	1.1164
53	74	1.3681	108	13	1.1134
54	68	1.3670	109	31	1.1044
55	80	1.3580	110	72	1.0265

b. Forward linkage

Ranking	code	FL Score	Ranking	code	FL Score
1	87	6.6318	56	27	1.1887
2	34	2.9903	57	11	1.1865
3	88	2.9446	58	18	1.1842
4	91	2.8300	59	107	1.1834
5	100	2.5303	60	7	1.1817
6	105	2.5149	61	106	1.1639
7	61	2.4092	62	67	1.1540
8	48	2.3368	63	97	1.1463
9	99	2.2583	64	4	1.1371
10	57	2.1689	65	74	1.1353
11	1	2.1530	66	109	1.1324
12	86	2.1165	67	80	1.1245
13	36	2.0764	68	73	1.1156
14	104	1.9363	69	29	1.0940
15	70	1.9251	70	62	1.0927
16	95	1.8653	71	3	1.0909
17	2	1.8398	72	110	1.0909
18	44	1.7721	73	72	1.0795
19	85	1.7412	74	96	1.0749
20	102	1.7101	75	39	1.0731
21	41	1.6497	76	108	1.0675
22	71	1.6317	77	40	1.0631
23	37	1.6307	78	9	1.0594
24	12	1.5888	79	76	1.0590
25	6	1.5504	80	5	1.0588
26	42	1.5471	81	89	1.0587
27	23	1.5437	82	93	1.0536
28	46	1.5264	83	83	1.0515
29	20	1.5159	84	16	1.0435
30	79	1.5073	85	77	1.0406
31	98	1.5067	86	14	1.0369
32	66	1.4274	87	51	1.0326
33	33	1.4085	88	26	1.0308
34	94	1.3972	89	49	1.0279
35	59	1.3830	90	30	1.0277
36	58	1.3699	91	13	1.0262
37	92	1.3666	92	54	1.0253
38	69	1.3457	93	84	1.0249
39	63	1.3397	94	35	1.0242
40	22	1.3307	95	82	1.0241
41	28	1.3041	96	17	1.0239
42	64	1.3037	97	103	1.0238
43	55	1.2862	98	45	1.0199
44	101	1.2833	99	31	1.0192
45	47	1.2808	100	10	1.0171
46	65	1.2788	101	21	1.0160
47	43	1.2494	102	75	1.0152
48	90	1.2426	103	38	1.0147
49	25	1.2371	104	78	1.0109
50	32	1.2295	105	24	1.0109
51	52	1.2254	106	50	1.0083
52	8	1.2166	107	56	1.0076
53	81	1.2117	108	68	1.0034
54	60	1.1992	109	53	1.0032
55	19	1.1975	110	15	1.0015

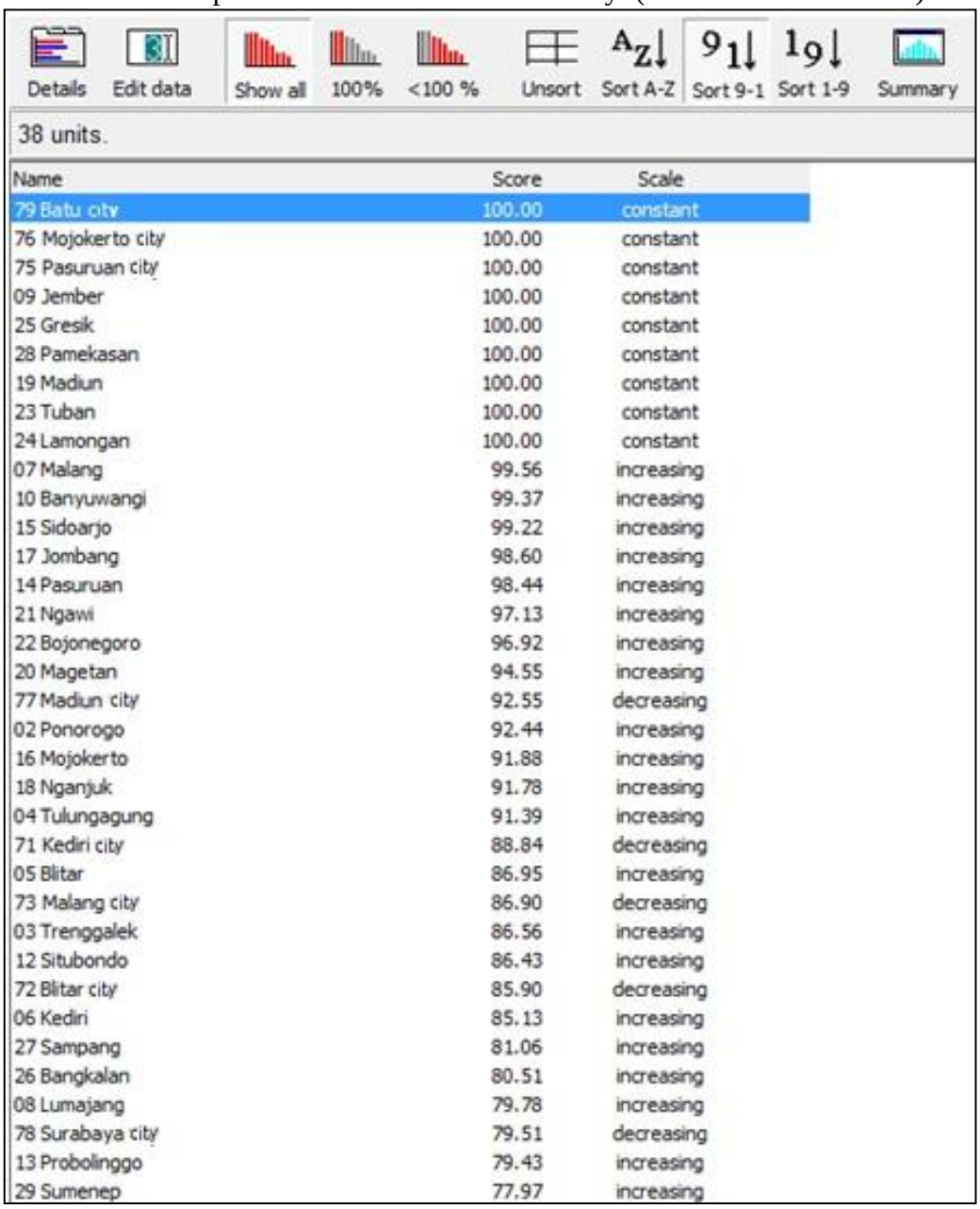
Source: IO table, data processed by the author

12. LQ Calculation of Food Crops by Regencies/ Cities

Regencies / Cities	Value Added of Food Crops	GDRP	A/B = C	LQ [C/(D/E]	Result
21. Ngawi	1,005,067.12	3,537,199.53	0.28	3.78	Base
24. Lamongan	1,947,493.49	7,098,168.75	0.27	3.65	Base
27. Sampang	881,507.14	3,271,497.39	0.27	3.58	Base
11. Bondowoso	949,746.53	3,557,683.76	0.27	3.55	Base
02. Ponorogo	967,388.93	3,768,417.45	0.26	3.41	Base
26. Bangkalan	950,962.19	3,891,566.84	0.24	3.25	Base
19. Madiun	827,467.45	3,478,780.54	0.24	3.16	Base
10. Banyuwangi	2,892,812.55	12,638,531.69	0.23	3.04	Base
01. Pacitan	397,303.43	1,762,562.97	0.23	3.00	Base
20. Magetan	826,464.42	3,694,611.37	0.22	2.97	Base
03. Trenggalek	730,814.79	3,480,534.54	0.21	2.79	Base
28. Pamekasan	512,381.76	2,453,150.29	0.21	2.78	Base
18. Nganjuk	1,191,309.35	6,008,052.22	0.20	2.64	Base
09. Jember	2,450,382.90	12,359,522.18	0.20	2.64	Base
29. Sumenep	1,169,246.52	5,937,681.10	0.20	2.62	Base
05. Blitar	1,259,519.25	6,468,467.19	0.19	2.59	Base
23. Tuban	1,841,024.02	9,650,283.17	0.19	2.54	Base
13. Probolinggo	1,441,325.68	7,642,065.55	0.19	2.51	Base
08. Lumajang	1,233,105.06	7,203,528.54	0.17	2.28	Base
22. Bojonegoro	1,605,596.21	9,379,581.33	0.17	2.28	Base
17. Jombang	1,208,160.82	7,230,304.36	0.17	2.22	Base
07. Malang	2,797,804.11	16,786,415.78	0.17	2.22	Base
79. Batu city	274,180.08	1,674,982.52	0.16	2.18	Base
12. Situbondo	636,405.96	3,989,292.96	0.16	2.12	Base
14. Pasuruan	1,187,082.99	7,793,273.21	0.15	2.03	Base
06. Kediri	1,200,808.18	8,673,840.51	0.14	1.84	Base
16. Mojokerto	973,183.94	9,066,494.89	0.11	1.43	Base
04. Tulungagung	925,818.10	8,941,209.47	0.10	1.38	Base
72. Blitar city	36,671.07	1,122,463.45	0.03	0.43	Non Base
25. Gresik	580,265.08	19,424,161.63	0.03	0.40	Non Base
74. Probolinggo city	35,817.90	2,303,403.94	0.02	0.21	Non Base
77. Madiun city	30,765.48	2,443,200.18	0.01	0.17	Non Base
75. Pasuruan city	14,561.57	1,264,355.98	0.01	0.15	Non Base
76. Mojokerto city	12,820.77	1,400,641.09	0.01	0.12	Non Base
15. Sidoarjo	220,498.40	29,958,884.64	0.01	0.10	Non Base
73. Malang city	18,600.06	16,176,980.57	0.00	0.02	Non Base
71. Kediri city	9,174.92	25,490,225.57	0.00	0.00	Non Base
78. Surabaya city	9,039.28	101,671,633.57	0.00	0.00	Non Base
VA Food Crops of East Java Prov.	(D)	29,602,961.48	D/E		
Gross Reg. Domestic Products of East Java Prov.	(E)	393,662,847.40	0.08		

Source: LQ calculations, data processed by the author

13. Calculation Output of Rice Production Efficiency (DEA Software Banxia)



Name	Score	Scale
79 Batu city	100.00	constant
76 Mojokerto city	100.00	constant
75 Pasuruan city	100.00	constant
09 Jember	100.00	constant
25 Gresik	100.00	constant
28 Pamekasan	100.00	constant
19 Madiun	100.00	constant
23 Tuban	100.00	constant
24 Lamongan	100.00	constant
07 Malang	99.56	increasing
10 Banyuwangi	99.37	increasing
15 Sidoarjo	99.22	increasing
17 Jombang	98.60	increasing
14 Pasuruan	98.44	increasing
21 Ngawi	97.13	increasing
22 Bojonegoro	96.92	increasing
20 Magetan	94.55	increasing
77 Madiun city	92.55	decreasing
02 Ponorogo	92.44	increasing
16 Mojokerto	91.88	increasing
18 Nganjuk	91.78	increasing
04 Tulungagung	91.39	increasing
71 Kediri city	88.84	decreasing
05 Blitar	86.95	increasing
73 Malang city	86.90	decreasing
03 Trenggalek	86.56	increasing
12 Situbondo	86.43	increasing
72 Blitar city	85.90	decreasing
06 Kediri	85.13	increasing
27 Sampang	81.06	increasing
26 Bangkalan	80.51	increasing
08 Lumajang	79.78	increasing
78 Surabaya city	79.51	decreasing
13 Probolinggo	79.43	increasing
29 Sumenep	77.97	increasing

Source: Data processed by the author