Regionalization of Agricultural Based Leading Sectors and Food Security in Indonesia

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Abstract. Indonesia is the largest archipelago in the world with total land area is around 190 million hectares (ha), of which about 28.94 percent or some 55 million ha are agricultural land. As the world’s fourth most populous country, Indonesia’s total population is estimated to increase from about 245 million in 2013 to 288 million in 2050. This study aims to analyze the leading sectors of each province in Indonesia by Location Quotient (LQ) method and distribution of food security level in every province in Indonesia based on rice production balance. This research uses Gross Domestic Product (GDP) of Indonesia and Gross Domestic Regional Product of each of the provinces in all sectors during 2010-2014 obtained through the Indonesian Central Bureau of Statistics. The determination of the leading sectors of each province is based on the Location Quotient (LQ) which is the comparative method of the role of an economic sector in a province to the magnitude of the economic sector's role nationally. The food security index determined by the food security calculation that done by the ministry of Agriculture Indonesia especially the Food Security Agency of Indonesia based on the assumption of the resident who can fulfill more than 90 percent of Recommended Dietary Allowance (RDA) is food secure category. Leading sectors in Indonesia is varies between one province to other province. Leading sectors obtained from Location Quotient (LQ) formula shows that although it is said to be an agrarian country, the LQ results indicate that not all provinces in Indonesia have the leading sector in agriculture. Leading sector in agricultural is only found in 20 provinces out of 33 provinces in Indonesia (exclude North Kalimantan). Most provinces with agricultural based have experienced economic structuring towards secondary and tertiary sectors. Provinces with the highest LQ scores in agriculture, forestry and fisheries are found only in North Sumatra, Lampung, West Kalimantan, Central Sulawesi and West Sulawesi. Provinces with LQ> 1 score for the agricultural sector indicate that the province has a high level of agricultural production so that it becomes a comparative advantage for regional development. Agriculture, forestry and fishery sector still dominates in some parts of Indonesia, especially Sumatra, Sulawesi, Maluku, Nusa Tenggara and part of Kalimantan Island but not as major economic contributor. While most provinces in Java, Bali and Papua do not have an economic advantage in the agricultural sector. Food Security Index of Indonesia mainly classified as the moderate level except for North Maluku, Papua, and West Papua in low level and Bali and West Nusa Tenggara (NTB) in high level. Factors influencing differences in food security are based on availability and affordability factors. Availability factor reflects the resilience of an area in terms of food availability, while affordability factor reflects the ease of obtaining food.

Keywords: Agriculture, Leading Sectors, Food Security, Location Quotients (LQ), Indonesia
1. Introduction
Indonesia is the largest archipelago in the world with total land area is around 190 million hectares, of which about 28.94 percent or some 55 million hectares are agricultural land [1]. As the world’s fourth most populous country, Indonesia’s total population is estimated to increase from about 245 million in 2013 to 288 million in 2050 [2]. High number of population coupled with high demand on rice commodity as main food consumption of Indonesian people up to 139 kg per capita higher than Malaysia and Thailand which was only 65 to 70 kg per capita per year [3]. The instability of food prices since 2008 has led to a renewed emphasis on food security. Crisis was particularly significant for Indonesia’s poor, who on average spend about two-thirds of their income on food, especially rice. In spite of a decline of its share of GDP over the last 50 years, agriculture still accounted for 14% of GDP in 2014 [1].

Indonesian rice production grew rapidly between 1977 and 1982, self-sufficiency achieved in 1984 but it was short-lived. Growth declined gradually from about 1985 and stabilizing at a low rate in the late 1990s, even after the reformation era [4]. The government has always issued a policy of national rice management. The rice policy in Indonesia was radically changed after the reformation movements and began to import rice from neighboring countries because national production is not sufficient enough for domestic demands on rice consumption [3]. Indonesia nowadays became a net importer of several grains, horticulture and livestock produce. Nevertheless, many say that Indonesia is still classified into agrarian countries because of high food production and the leading sectors of the economy are mostly in the primary agricultural sector.

Development of agriculture sector in Indonesia can be done with the initial stage of comparative analysis of agricultural leading sectors both from demand and supply sectors by comparing value of Gross Domestic Regional Product (GDP) of each economic sector in a region. Development of agricultural based on leading sector determination is a strategic step towards regional development based on the concept of efficiency and comparative and competitive advantage facing the global trade. Determination of leading sectors can help to see direction of development of a region in Indonesia to differentiate the region, whether it still depends on economic in the agricultural based sector or non-agricultural based sector. This study aims to analyze the leading sectors of each province in Indonesia by Location Quotient (LQ) method and distribution of food security level in every province in Indonesia based on rice production balance. Through appropriate agriculture planning it can support national food security and see the prospects of national agricultural potential in the future in order to maintain food self-sufficiency.

2. Methods
2.1. Location Quotient
Research uses Gross Domestic Product (GDP) of Indonesia and Gross Domestic Regional Product of each of the provinces in all sectors during 2010-2014 obtained through the Indonesian Central Bureau of Statistics. The determination of the leading sectors of each province is based on the Location Quotient (LQ) method, which is the comparative method of the role of an economic sector in a province to the magnitude of the economic sector’s role nationally. Through the LQ method, it can be done a relative specialization of a sector or economic sub-sector of each province. The calculation of LQ is based on the formula (1):

\[
LQ = \frac{xi/GDRB}{Xi/GDB} \ldots (1)
\]

where:
xi = Value added sector i in a province
GDRB = Gross Domestic Regional Bruto in a province
Xi = Value added sector i in national level
PNB = Gross Domestic Bruto Indonesia
If LQ > 1, then the role of sector i in a region more prominent or more specialize so that classified into leading sector. If LQ < 1, then the role of sector in a region is smaller or does not specialize in producing the sector so that it is classified into non-leading sector. While if LQ = 1, then the role of the sector both in the region and national level are equal in degree in producing the sector. LQ> 1 can also be used as an indication that the area is experiencing a surplus of products in the sector and is able to export to other areas.

2.2. Food Security

Food security index determined by the food security calculation that done by the ministry of Agriculture Indonesia especially the Food Security Agency of Indonesia. Data was averaged from 2010-2014 food security data. In this paper, the data provided the food security index of food security based on the assumption of the resident who can fulfill more than 90% of number of enough nutrition (RDA) is food secure category. Recommended Dietary Allowance (RDA) is the average of healthy nutrition need taken from a population and RDA standard in Indonesia is about 2150 Kilo-Calories [2]. The data used is the presentage of number of people who can meet the needs of Nutritional Needs more than 90 percent compared with the total population in the province as the basis data for the classification. Data was classified into three classes: high, moderate, and low based on the standard deviation as shown in equation (2) below:

$$
\sigma = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n}} \ldots (2)
$$

where

- \(\sigma\) = deviation standard
- \(\bar{x}\) = the average of food security
- \(x_i\) = the food security of province data
- \(n\) = number of province.

Classification based on standard deviation is good to observed range data from the mean. Data for this classification must have the normal distribution. While the disadvantage is did not showed the actual value of data on map and the high ranged data can skew the mean [5]. The high food secure category is the number that more than the average number plus the standard deviation \{ > (\bar{x} + \sigma)\}. The low class identified by the data less than the average number minus the standard deviation \{ > (\bar{x} - \sigma)\}. Then the moderate value is the range between those limit. The data is normal distributed so that why the standard deviation dis not work as well as the limit of the classes. The presentage of food secure is similar one of another. This is why the class showed the data almost moderate as the absolute data.

3. Result and Discussion

3.1. Location Quotient and Leading Sectors

Location Quotient (LQ) development indicators are used as a benchmark to assess the success of provincial development in Indonesia through leading economic sectors. Growth of an economic sector that occurs in a region creates impacts not only on economic growth within a region, but also another regions that have economic linkages with the region. LQ macro approach resulted in the determination of the main sectors (primary sector) as the main trigger factor of economic growth in every province in Indonesia. Analysis of economic development that is applied is using the basic economic theory which assumes that demand for input only increases through the expansion of demand for output produced by base and non-base sectors [6]. Increased revenue only occurs if the base sector as exports commodities increases. Based on this statement, regional exports are the determinants of economic development. Basic economic analysis using the LQ Index compares relatively the same sector capabilities over a larger area in one region.
Based on the pre-selected sectoral LQ study it is found that there is considerable variation in the highest LQ scores in each province in Indonesia (Fig 3.1). Each province has its own distinctive sector which shows the level of specialization and regionalization of economic development is good enough and the sector is tradable sectors (can be traded between provinces). Main leading sectors of each province have a proportional share greater than the average of other regions for these sectors. There are ten types of leading economic sectors in each province, both primary, secondary and tertiary economies, namely;

a. Primary: Agriculture, forestry and fishing, and mining and excavation
b. Secondary: Water supply and waste processing, electricity supply and gas, and processing industry
c. Tertiary: Civil administration and social security, health service and social activities, accommodation, food, and drink, business services, and other services.

Figure 3.1. Province regionalization based on highest LQ value

Main variation of leading sectors in each province shows that most of the provinces are no longer dominated by agriculture based sector as the main leading sector with the highest LQ value. During 2010-2014 there was no significant change in the main leading sector (highest LQ), except West Kalimantan province, which experienced the highest change of LQ value from water supply and processing in to agriculture, forestry and fishing starting in 2013 and Central Kalimantan from agriculture, forestry and fishing into mining and excavation began in 2011. Most provinces have experienced economic structuring towards secondary and tertiary sectors. Provinces with the highest LQ scores in agriculture, forestry, and fisheries are found only in North Sumatra, Lampung, West Kalimantan, Central Sulawesi and West Sulawesi. Those provinces even dominated by primary sector in plantation and forest not agriculture products, among others; oil palm, nutmeg, and forest wood.

Existence of major leading sectors in agriculture, forestry, and fishery in some provinces has a challenge of economic development because the primary sector tends to develop more slowly than the secondary and tertiary sectors. Primary agricultural sector has low demand flexibility of income. This is indicated by the relative survival of agricultural sector growth performance in times of crisis, but as the economic situation improves and people's income increases demand for agricultural commodities does
not increase with the same proportion. Unlike the case with the demand for manufactured products, which is very flexible to increase income.

Agricultural sector holds an important role in maintaining national food security. Provinces with LQ > 1 score for the agricultural sector indicate that the province has a high level of agricultural production so that it becomes a comparative advantage for regional development. Although it is said to be an agrarian country, the LQ results indicate that not all provinces in Indonesia have the leading sector in agriculture (Fig 3.2). Leading sector in agricultural is only found in 20 provinces out of 33 provinces in Indonesia (exclude North Kalimantan). This shows that agriculture, forestry and fishery sector still dominates in some parts of Indonesia, especially Sumatra, Sulawesi, Maluku, Nusa Tenggara and part of Kalimantan Island. Palm oil, maize, nutmeg, spices and timber commodities are main products in several provinces in areas with leading sector in agriculture and forestry.

Figure 3.2. Province regionalization based on agriculture LQ Value as leading sector

Islands of Papua and Bali are areas in Indonesia that are not developed through agricultural products. Provinces of Papua and West Papua are economically supported by mining and excavation activities such as gold, aluminum and copper mining. Other provinces that have GDRB focus on mining and excavation include; West Sumatra with coal mines, East Kalimantan with petroleum and natural gas mines, South Kalimantan with diamond mines, and Bangka Belitung with tin mines. The non-oil and gas processing industry sector can grow by absorbing new labor force and absorbing labor that accumulate in other sectors such as agriculture, trade and services that are less productive. Bali Province with LQ value of agriculture under the number 1 indicates that the agricultural sector is not a leading sector because the leading sector of the economy is focused on providing services, especially in the field of tourism.

Java Island dominated 42.49 percent (3.4 million hectares) of total rice field area in Indonesia [7]. Although the area of Java's rice fields is the largest compared to other islands in Indonesia, but most provinces in Java do not have an economic advantage in the agricultural sector. Only Central Java province has an agricultural GDRB value with LQ > 1, commodities developed especially rice and horticulture. Other provinces in Java focus on secondary and tertiary economic sectors. Together with
Central Java, the province of Banten, West Java and East Java focuses on industrial development that absorbed a lot of labor. DI Yogyakarta focuses on accommodation economic development especially business types and student settlement as well food and drink, while DKI Jakarta as the capital city focuses on the leading sectors of business services. Condition of most provinces in Indonesia that still have agriculture sector shows that dependence on agrarian economy is still quite high in Indonesia, although not in all provinces of agriculture sector has the highest LQ value.

3.2. Food Security

Food security is the ability of physical and economical to access the sufficient, safe and nutritious food to meet the needs and food preference for doing the active and healthy life [8]. Food security was broken down by four pillars which are availability, accessibility, utilization and stability. The food security is well correlated with the nutrition secure as the condition when the nutritionally of food meet the diet and used for the maintained growth, recover from the sickness, pregnancy, lactation, and other physical work [8]. The food security calculated in this study was used the food security based on the nutrition needs. The food secure used in this study was followed the Indonesian Agency of Food Security that the food secure is fulfilled more than 90 percent of nutritional needs (RDA), the vulnerable food security is classified as 71-89.9 percent nutritional needs fulfilled, and the very vulnerable food security is classified as less than 70 percent nutritional needs fulfilled. High class has the food security which is more than 56.35 percent of the population meet the nutritional needs more than 90 percent, low class is less than 42.20 percent of people that meet the nutritional needs more than 90 percent, while the 42.20-56.36 percent population is classified as moderate food security.

![The Classification of Food Security Index](image)

Food Security Index of Indonesia mainly classified as the moderate level (Figure 3.3). Mostly the data showed same classification in each year except for few province. Most food security class in the provinces are moderate level except for North Maluku, Papua, and West Papua in low level (< 32 percent people reach more than 90 percent nutritional needs as well for Bali, South Kalimantan and
West Nusa Tenggara (NTB) in high level (> 57 percent people reach more than 90 percent nutritional needs). Aceh classified into high level in 2010 while afterwards classified into moderate level. West Sumatra classified as high level in 2011 and 2012 while afterwards in moderate level. Banten classified as moderate level except for 2010 as low and high in 2013. East Nusa tenggara Timur (NTT) and Gorontalo classified as moderate but in 2014, NTT classified as low, while Gorontalo low in 2013. South Sulawesi, West Sulawesi, and Southeast Sulawesi, classified as moderate except high in 2010 for Southeast Sulawesi, 2011 for South Sulawesi, and 2013 in West Sulawesi. DI Yogyakarta have the most significance increase with low in 2010, moderate 2011-2012, and high in 2013-2014. While Maluku have fluctuative trend, in 2010 and 2013 classified as low and the other is moderate.

Regionalization of food security shows that mainly province in Indonesia classified as the moderate level near the average of Indonesia food security. Which means the half of population is secure and the other half is insecure. Factors influencing differences in food security are based on availability and affordability factors. Availability factor reflects the resilience of an area in terms of food availability, the provinces in Java as the center of rice agriculture Indonesia has a large degree of availability as well NTB, while Bali and South Kalimantan have low availability but have good access from the rice market in Java. High food availability in Bali, NTB and South Kalimantan is not only seen from the production side but also other supporting factors such as GDRB support, the population is not too large compared to Java and the level of consumption of good rice.

Affordability factor reflects the ease of obtaining food. In this factor, provinces in Java, Kalimantan and Bali have access to food because of the high per capita income from the industrial and service economies. Percentage of poor people in the provinces of Bali, NTB and South Kalimantan in 2014 ranges from 4.6 to 4.81 percent of the total population [2]. This value is lower than the percentage of poor people in provinces in Java Island as main rice production areas such as West Java, Central Java and East Java with a poverty percentage of 9.18 to 13.8 percent [2]. Even on the island of Kalimantan, province of South Kalimantan with the value of food security in high level has the lowest proportion of the poorest below the average province in Kalimantan which is 6.3 percent. High economic capacity and low proportion of poor people make the three provinces have access to food to be relatively higher compared to other provinces.

Provinces in Java Island generally has a good level of availability while for affordability is still below the province of Bali, NTB and partly in Kalimantan. The high availability of food crops and horticulture centers also supports the centralized infrastructure in Java, but has been well distributed to the surrounding central areas such as Bali and South Kalimantan. As for the lowest food security, the eastern part of Indonesia including Papua, West Papua and North Maluku is the lowest. For the availability factor in eastern Indonesia, rice commodities tend to be very rare due to difficulty of land use for agriculture. Only Merauke (low land areas) in Papua that have rice cultivation center with surplus over 70 ton in a year [9]. Main food commodities are filled with sago and tubers, while the affordability of people to buy food from other islands is low due to the lack of infrastructure, low economic structure and low purchasing power. The proportion of poor people still high in Papua (27.8 percent) and West Papua (26.26 percent) are also a factor of difficulty in fulfilling domestic food and even bring in products coming from other regions or borders. Based on this condition, the food production needs to be improved so that the food security level can be increased to facing global change.

4. Conclusion

Leading sectors in Indonesia is varies between one province to other province. Leading sectors obtained from Location Quotient (LQ) formula shows that although it is said to be an agrarian country, the LQ results indicate that not all provinces in Indonesia have the leading sector in agriculture. Leading sector in agricultural is only found in 20 provinces out of 33 provinces in Indonesia (exclude North Kalimantan). Most provinces with agricultural based have experienced economic structuring towards
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