P-ISSN: 2407-5434
E-ISSN: 2407-7321

Available online at http://journal.ipb.ac.id/index.php/ijbe
DOI number: 10.17358/IJBE.2.3.151

CLUSTER OF INDONESIA *KABUPATEN-KOTA* POTENTIAL IN DEVELOPING FOOD CROP AND HORTICULTURE COMMODITIES

Imam Wahyudi[*)1], Nunung Nuryartono[**)], and Amzul Rifin[***)]

[*)] Statistic Bogor
Layungsari Road III, No. 13, Bogor 16161
[**)] Department of Economics, Faculty of Economics and Management, Bogor Agricultural University
Kamper Road, Wing 4 Level 5, Campus of IPB Darmaga Bogor 16680
[***)] Department of Agribusiness, Faculty of Economics and Management, Bogor Agricultural University
Kamper Road,Wing 4 Level 5, Campus of IPB Darmaga Bogor 16680

ABSTRACT

Identification of potential areas in an agricultural sector is needed in order to meet the national food needs, among others, by carrying out mapping the potential areas through clustering the Kabupaten-Kota in Indonesia, especially on imported agricultural commodities of food crops and horticultures. The use of cluster analysis with top-down clustering method (K-means) produces the best cluster. Of 268 regencies-cities, there are 7 clusters, namely Cluster 1 consisting of 154 regencies, Cluster 2 consisting of 2 regencies, Cluster 3 consisting of only1 regency, Cluster 4 consisting of 8 regencies, Cluster 5 consisting of 24 regencies, Cluster 6 consisting of 75 regencies, and Cluster 7 consisting of 4 regencies. Each cluster has its own dominant commodity characteristics. The results of typology klassen on constructed clusters show that food crop and horticulture commodities have grown well and fast. Out of 13 commodities, there are 7 major commodities: Cluster 1: rice and corns; Clusters 2, 3 and 7: cassava; Cluster 4: corns, cassavas and chilly; Cluster 5: apples; Cluster 6: corns, shallots, and garlic. Six other commodities do not grow well, namely sorghum, potatoes, soybeans, peanuts, oranges, and grapes. The potential lack of an area is due to the plants' low productivity, which is mainly because of plant pests, highly operational cost, climates and natural disasters.

Keywords: imports, food crops, horticulture, cluster, and leading sector.

ABSTRAK

Identifikasi potensi wilayah disektor pertanian diperlukan dalam rangka memenuhi kebutuhan pangan nasional, diantaranya dengan melakukan pemetaan potensi wilayah melalui pengelompokan (cluster) wilayah Kabupaten Kota di Indonesia, terutama pada komoditas pertanian tanaman pangan dan holtikultura yang diimpor. Penggunaan analisis cluster dengan metode top-down clustering (K-means) didapat klaster terbaik, dengan obyek sebanyak 268 Kabupaten Kota, dihasilkan 7 klaster, yaitu Klaster 1 sebanyak 154 Kabupaten, Klaster 2 sebanyak 2 Kabupaten, Klaster 3 sebanyak 1 Kabupaten, Klaster 4 sebanyak 8 Kabupaten, Klaster 5 sebanyak 24 Kabupaten, Klaster 6 sebanyak 75 Kabupaten serta klaster 7 sebanyak 4 Kabupaten. Setiap klaster memiliki karakteristik dominan komoditasnya. Hasil typology klassen pada klaster yang terbentuk menunjukan pertumbuhan komoditas tanaman pangan dan holtikultura pada tingkat maju dan tumbuh cepat dari 13 komoditas ada 7 komoditas yaitu pada klaster 1; padi dan jagung, klaster 2,3 dan 7; komoditas ubi kayu, klaster 4; jagung, ubi kayu dan cabe, klaster 5; apel, klaster 6; jagung, bawang merah dan bawang putih. Sementara 6 komoditas relatif tertinggal pertumbuhannya yakni; sorghum, kentang, kedelai, kacang tanah, jeruk dan anggur. Kurang potensinya suatu wilayah sebagai akibat rendahnya produktivitas tanaman yang utamanya disebabkan serangan hama tanaman, tingginya biaya operasional, iklim dan bencana alam.

Kata kunci: impor, tanaman pangan, holikultura, klaster, sektor unggulan

[1] Corresponding author:
Email: imamw@bps.go.id

P-ISSN: 2407-5434
E-ISSN: 2407-7321
Available online at http://journal.ipb.ac.id/index.php/ijbe
DOI number: 10.17358/IJBE.2.3.151

INTRODUCTION

Indonesia is an agrarian country that makes agricultural sector an important role in the national economy. This can be seen from its contribution to PDB in 2014 which reached 14.43% (BPS, 2014). Besides contributing to fulfilling the national food needs, agricultural sector is also the country's devisa when there is a production surplus. Therefore, this sector must become a major priority.

Statistics Central Bureau (SCB) in 2014 recorded that import of food crop had increased by 346.10% for the last ten years. Therefore, only 30% of Indonesian agricultural food crops that spread in the market, most of which came from sub-sector of food crops and horticultures. Although the trade balance (export-import) in the agricultural sector had a surplus in 2014, i.e. US$ 15.16 billion and in 2013 US$ 17.92 billion, this was because of contribution from plantation commodities, which is US$ 26.94 billion in 2014 and US$ 29.48 billion in 2013. Meanwhile, the main food supporting sectors in Indonesia in 2014 underwent a trade balance deficit: food crops US$ -7.45 billion, horticulture US$ -1.12 billion and animal farming US$ - 3.2 billion. The high food commodity deficit is due to import dependency according to the percentage: beef (25%), soybeans (70%), corns (10%), peanuts (15%), garlic (95%), milk (90%), sugar (30%), and wheat (100%). The data showed that food import dependency besides the big population number is also as a result of the declined size of harvesting land, except rice which increased by 4.08% for the last five years, corns -7.09%, soybeans -6.93%, peanuts -19.56% and cassavas -15.22% (BPS, 2014). Meanwhile, land opening reform is not yet optimal, intensification program for improving technology-use is not yet evenly carried out by farmers all over Indonesia, so that to meet in-country food needs, not to mention other export commodities than plantation sector, agricultural sector still needs hard work to reach.

Inevitable agricultural import is due to the government policy that put farmers only as objects. Future efforts must focus on small farmers, i.e. to protect them from international food trade that is not beneficial to them. Food import dependency is a result of in-country agricultural productivity that keeps decreasing. A decreasing number of farmers and low productivity did not keep up with Indonesian population growth rate, which reached more than 252 billion persons in 2014. Demand has increased, while local farmers' production has decreased. Therefore, the shortage of food provision must be imported. One of the examples is soybeans, which according to SCB, used to be self-reliance in 1992, and in 2014 they were only produced as much as 954 thousand tons, while the needs for them reached 2.5 million tons. Data in 2014 from SCB also showed that, from the import point of view, wheat/ meslin commodities gave significant contribution, namely it reached US$ 2.51 billion, fresh soybeans US$ 3.36 billion and corns US$ 854.04 billion. This variety of import and export caused the trade balance of wheat/meslin commodity underwent a deficit during January-December 2014 as much as US$ -2.47 billion, while soybeans is the biggest import commodity in the sub-sector food crops, namely US$ -3.32 billion. Surplus of food crop commodity trade balance in January-December 2014 was only reached by cassavas as much as 8.33 million. In the sub-sector horticulture, on the other hand, the highest deficit in the trade balance was garlic as much as US$ 361.54 million, and then followed by apples US$ 201.93 million, oranges US$ 201.36 million, grapes US$ 158,38 million and potatoes US$ 76.72 million.

Improvement and development strategy as well as agricultural sector efficiency in one area can be carried out if the government knows its region potential. In this case, the commodity potential of an agricultural sector in one region can be identified by looking at its region's similar potential. Identification of an area that has a food crop and horticulture development potential becomes very important in the sustainable context. This can help the policy makers to determine their agricultural development policy. Especially in terms of food crops and horticultures, they need to be more concentrated. Therefore, it is necessary to carry out a research where mapping of regional potential is carried out using cluster, especially in *Kabupaten-Kota* in Indonesia, so that in the future Indonesia will be self-reliance in their imported agricultural commodities, especially food crops and horticultures. The objective of the research was: 1) to describe export-import and potential of Indonesian imported food crops and horticultures; 2) to analyze clusters of *Kabupaten-Kota* in Indonesia based on product values of imported commodities i.e. food crops and horticultures in Indonesia; 3) to obtain information on productivity of the constructed clusters and the obstacles in producing imported food

P-ISSN: 2407-5434
E-ISSN: 2407-7321
Available online at http://journal.ipb.ac.id/index.php/ijbe
DOI number: 10.17358/IJBE.2.3.151

crop and horticulture commodities; and 4) to analyze the sustainability (basic sectors) of potential food crop and horticulture commodities as well as the growth structure in the constructed clusters.

A number of researches related with this study are as follow Tsurayya and Kartika (2015) identified supply chains, analyzed the institutions, formulated strategies for competitiveness enhancement, designed competitiveness enhancement model, and determined the main strategies in competitiveness enhancement of chili pepper commodities in Garut Regency. The main strategies cover an increase in the number of productions; market expansion; and partnership strengthening and development.

According to Prishardoyo (2008), in reference to the results of location quotient analysis, the potential sectors which are perceived to be reliable in a period of 2000–2005 were agriculture, electricity, gas and drinking water, building, finance, company rent and service. The regional linkage analysis (Gravity) in a period of 2000–2004, showed that Kudus Regency had an interaction value in average of 1,491,862.31, while Jepara Regency had the least interaction with a value of 1,491,862.31.

Wicaksono (2011) highlighted most of the primary districts in Purworejo regency in which the agriculture sectors are the basic sector and subsector. Bruno and Bener districts have the most basic subsectors, while the plantation crops are the basic subsectors in most districts in Purworejo regency. There are small parts of Purworejo regency with a decreasing level of agriculture sector and subsectors. Purworejo district has the most decreasing specialized sectors and subsectors, while the subsector of plantation crops have the most reposition and are not expected to become basic subsector at the future.

Riyadi (2007) has conducted a research in one of the corn crop production centers in Grobogan regency, which is in Wirosari district by utilizing cross section data to describe situations in particular time. Regression and production function proposed by Cobb-Douglas were used to analyze the data in which the calculation applying the equation of multiple linear regression. The estimated results showed that the factors which significantly influenced corn production were land areas, labors, seeds, fertilizers, and pests.

The scope of the research covers as many as 505 *Kabupaten-Kota* areas in Indonesia that have imported potential food crop and horticulture that will be clustered according to their potential regions and characteristics of their dominant commodities in the constructed clusters.

METHODS

The data sources used were production value and productivity of imported agricultural food crop and horticulture commodities and national export-import data from SCB. The sources that were used were product value and productivity of food crop and horticulture commodities as well as national export-import data. Data came from SCB and the Ministry of Agriculture with data series from 2010–2013 and supporting data from 2014 and the results of interviewing the resource persons from the Department of Agriculture (2014).

The variables used were product value of food crop and horticulture commodities that had trade balance deficit. The commodities are as follows: wheat/sorghum (X1), rice (X2), soybeans (X3), corns (X4), cassavas (X5), peanuts (X6),potatoes (X7), shallots (X8), garlic (X9), chilies (X10), oranges (X11), grapes (X12) and apples (X13).

In order to reach the objectives, the following steps were conducted to do the analyses:

1. Carrying out selection on 505 potential regencies-cities in Indonesia, by measuring the rate of product values for each variable that was used, using 2010-2013 data. During the selection stage, the regencies-cities in Indonesia that had potential below the average product value were eliminated.
2. Carrying out statistical description to analyze the commodity potential.
3. Obtaining the best clusters based on standard deviation within the smallest clusters and standard deviation among the biggest clusters, using top-down clustering method (k-means).
4. Analyzing the results of constructed clusters.
5. Carrying out analyses of Klassen Typology on the constructed clusters by dividing them into four groups, namely commodities whose growth is progressive and fast, commodities whose growth is progressive but slow, commodities that develop fast, and commodities that are relatively left-behind.

P-ISSN: 2407-5434
E-ISSN: 2407-7321
Available online at http://journal.ipb.ac.id/index.php/ijbe
DOI number: 10.17358/IJBE.2.3.151

Johnson and Winchern (2007) argue that the technique of Cluster Analysis does not require assumptions regarding the number of clusters or group structures. There are two methods commonly utilized to conduct data classification i.e. hierarchical and non-hierarchical clustering. Hierarchical clustering is a technique of data classification in which the number of cluster is unknown, while non-hierarchical clustering sets goal to classify objects into clusters (k<n). The number of clusters can be determined upfront or as a part of classification process.

The use of cluster analysis in agriculture sector needs to be well organized systematically to predict and increase plant production. There is a high complexity in predicting the best plant because of an unavailability of appropriate knowledge. A discovery of plant knowledge influences the quality of prediction. In data mining, classification is perceived to be an important step and serves useful information. Such classifications cover k-Means, expectation-maximization, and hierarchical micro clustering (Utkarsha et al. 2014).

The research substance was aimed to answer the research questions using a clustering method to classify the potential areas and sustainability of those commodities, by identifying agricultural imported commodities of food crop and horticulture; in other words by looking at the production of the commodities and then clustering them. The results of the cluster will show the sustainability of their superior potential and the structure of the commodity growth using Klassen typology. The framework can be seen in Figure 1.

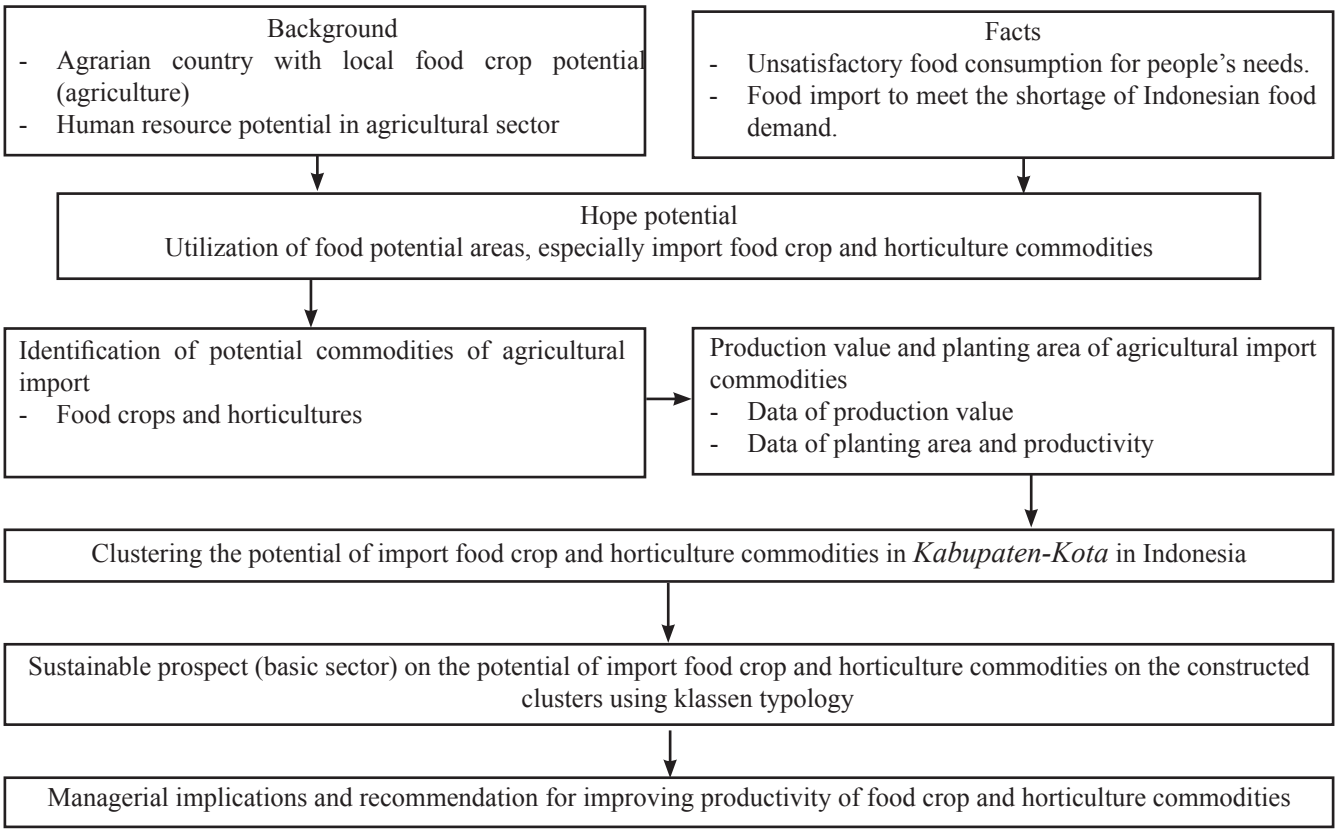

Figure 1. The framework

P-ISSN: 2407-5434
E-ISSN: 2407-7321
Available online at http://journal.ipb.ac.id/index.php/ijbe
DOI number: 10.17358/IJBE.2.3.151

RESULTS

Potential of Imported Food Crop and Horticulture Production in Indonesia

Development of product value of food crop and horticulture commodities in Indonesia from 2011 to 2014 showed that there was a quite substantial increase from 2011 to 2013, although in 2014 there was a slight decrease, especially in rice, corns and cassavas. In the meantime horticultural plants from 2011 to 2014 increased from year to year, except apples in 2014 decreased slightly. Wheat/sorghum had a production of 4,315 tons/year. Wheat/sorghum potential production as basic materials for wheat flour was still lower than in-country needs. The areas that produced wheat/sorghum were Lamongan Regency, Sumenep Regency, Pasuruan Regency, Sampang, Regency, Gunung Kidul Regency, Bantul Regency, Bangkalan Regency, Probolinggo Regency, Pacitan Regency, and Malang Regency.

Rice production in Indonesia in 2014 was 70.83 million tons and if it were converted into ready-eaten rice it would become 38 million tons. Almost all *Kabupaten-Kota* areas produced rice, only a few in the urban areas that had no rice production. This shows that rice is potential to be grown all over Indonesia. The following is product value of food crop and horticulture in Indonesia, which is presented in Table 1.

Soybean crops as the raw materials for soybean cakes and tofu had a great potential in some areas in Indonesia. It was noted that this commodity reached 954 tons. This potential commodity was found in East Java, Central Java, NTB, West Java, South Sulawesi, and many other more. Corns and cassavas had production up to 18.36 million tons and 23.46 million tons in 2014. Corns also had a potential in almost all areas in Indonesia. Meanwhile, cassavas were found in Lampung Province.

Some areas in Indonesia can be cultivated with horticultures, such as potatoes, shallots, chilies, and oranges. Garlic, a commodity that is the most potential, can be found in Lombok Timur Regency, Solok Regency, and Bima Regency. The data above show there are potential food crops and horticultures in Indoneisa; however, this potential cannot adequately fulfill in-country needs so that it must be imported. This potential needs to be traced in the areas of *Kabupaten-Kota* in Indonesia so that the potential areas that can contribute to national food can be identified. By carrying out trace study of potential areas using cluster analysis approach, it is expected that the potential constructed clusters can be identified.

Using production data from 2010 to 2013, from 505 regencies-cities in Indonesia, 268 regencies-cities had a production above the average rate of regencies-cities in Indonesia (which are to be made into clusters) for each of the 13 commodities that become the object of the research.

Table 1. Production of imported food crops and horticultures in Indonesia in 2011–2014 (Ton)

Commodities	2011	2012	2013	2014
Food crops				
Sorghum, Meslin	3.888	4.093	4.308	4.315
Rice	65.756.900	69.056.100	71.279.700	70.831.800
Soybeans	851.300	843.200	780.000	954.000
Corns	17.643.250	19.387.022	18.511.853	18.364.430
Cassavas	24.044.00	24.177.400	23.936.900	23.458.100
Peanuts	691.289	712.857	701.680	638.258
Horticultures				
Potatoes	955.488	1.094.240	1.124.282	1.316.016
Shallots	893.124	964.221	1.010.773	1.227.839
Garlic	14.749	17.638	15.766	16.902
Chilies	1.483.079	1.656.615	1.726.381	1.846.202
Oranges	1.721.880	1.498.396	1.548.401	1.791.107
Grapes	n.a	10.160	9.425	11.153
Apples	n.a	247.384	255.331	242.916

Source: Statistics Central Bureau, Indonesian Statistics 2014

P-ISSN: 2407-5434
E-ISSN: 2407-7321
Available online at http://journal.ipb.ac.id/index.php/ijbe
DOI number: 10.17358/IJBE.2.3.151

Almost all provincial areas in Indonesia had a representative of potential imported food crop and horticulture commodities. There were only three provinces whose commodities had an average below regencies-cities in Indonesia, namely Province of DKI Jakarta, Maluku Utara and Papua Barat. In terms of percentage, the province that has the most potential regencies-cities are Central Java, East Java, West Java, Lampung, South Sulawesi, NTB, Bali, Central Sulawesi, Gorontalo, and Banten. This potential gives a picture that Indonesia has potential food crops and horticultures that are relatively equal, and they need to be mapped to see on which areas potential commodities need to be developed so that they can give contribution, and thus import-reliance can be reduced. Therefore, these 268 regencies-cities will be made into clusters based on the food crop and horticulture potential.

Table 2 presents the highest average production of food crops and horticultures in *Kabupaten-Kota* in Indonesia for during 2010–2013. Some commodities, such as sorghum although producing only 1,944.55 tons per year showed that the commodity potential in Lamongan Regency East Java. Sorghum is actually a kind of plant, which produces wheat flour. This plant still cannot be fully grown in tropical climate like Indonesia. Sorghum, in fact, produces seeds, and its flour can be processed to make bread and noodles. Besides, this plant can also produce roomie, and its other parts can also be made into cattle feed. The government is trying to develop sorghum business in order to reduce sorghum import.

Indramayu Regency has the highest rice production in Indonesia, that is 1.397 million tons per year, the highest soybean is produced in Banyuwangi Regency 54.89 million tons per year, corns in Grobogan Regency 572.14 tons per year, cassavas in Lampung Tengah Regency 3.20 tons per year, and peanuts in Gunung Kidul Regency 55.19 tons per year. Kerinci Regency in Jambi Province has potential potato commodity, and its production is 180.59 thousand tons per year. Shallot production center is located in Brebes Regency, and its averaged production for the last four years has been 310.78 thousand tons per year. Lombok Timur Regency in Nusa Tenggara Barat has as a matter of fact a garlic potential production, amounting to 4,779.75 tons per year. Garut Regency in south of Jawa Barat has a chilly potential production, namely 85.75 thousand tons per year. Karo Regency in Sumatera Utara has a potential production of Siam oranges, i.e. 362.16 tons per year. The biggest production of apples is produced in Pasuruan Regency, namely 95.08 thousand tons per year, while Kota Batu Malang is the second biggest apple production. Buleleng Regency in Bali Province has a grape production of 1,779.5 tons per year. The highest potential *Kabupaten-Kota* producing the thirteen commodities shows the progress of food crop and horticulture sector in their regions.

Table 2. The highest average production of food crop and horticulture commodities in *Kabupaten-Kota* in Indonesia 2010–2013

Variables	Name of commodities	Highest production (Ton)	Productivity (ton/Ha)	Name of *Kabupaten-Kota*
X1	Wheat/Sorghum	1,944.55	3.23	Lamongan
X2	Rice	1,396,508.25	5.97	Indramayu
X3	Soybeans	54,888.75	1.60	Banyuwangi
X4	Corns	572,142.25	5.63	Grobogan
X5	Cassavas	3,202,632.25	25.33	Lampung Tengah
X6	Peanuts	55,189.63	1.05	Gunung Kidul
X7	Potatoes	180,591.50	18.30	Kerinci
X8	Shallots	310,780.50	11.75	Brebes
X9	Garlics	4,779.75	7.80	Lombok Timur
X10	Chilies	85,751.50	1.90	Garut
X11	Siam Oranges	362,159.75	20.21	Karo
X12	Apples	95,083.00	57.44	Pasuruan, Batu
X13	Grapes	2,280.00	49.27	Buleleng

Source: Statistics Central Bureau, Region in Numbers 2010–2013, processed

P-ISSN: 2407-5434
E-ISSN: 2407-7321
Available online at http://journal.ipb.ac.id/index.php/ijbe
DOI number: 10.17358/IJBE.2.3.151

The Top-down Clustering (K-means) of *Kabupaten-Kota* cluster in Indonesia based on import commodity production of food crops and horticultures

Increasing the agricultural sector in one region can be carried out if the government knows the potential of the region well. To find out easily the agricultural sector potential commodities in groups can be identified using clustering, that is by looking at the region's similar characteristics with others' in groups. One of the cluster methods that are used is top-down clustering (K-means) (Johnson RA, Wichern DW, 2007). The K-means method with k=2 is a classification method that separates objects into several determined clusters and then moves the objects into clusters until their typical characteristics can be met. There are two assumptions to be fulfilled before conducting the cluster analysis i.e. representative sample population and an absence of multi-collinearity (Hair et al. 2006)

Before doing the cluster analysis, there are two assumptions that must be fulfilled, namely sampling that expresses population and no multicolinerity (Vincent, 1992). The correlation results show the correlation value among variables below 0.5 so that there is no multicolinerity. To find out whether the samples obtained can represent the whole population, Kaiser-Meyer-Olkin (KMO) value is used. KMO value is obtained with the help of software SPSS 13.0 for Windows. If KMO value is less than 0.5, it shows that the samples taken cannot represent the existing population. The results of this research test show that KMO value is 0.611 so that the number of samples can be met, since the KMO value is more than 0.5.

As many as 268 regencies-cities will be determined by the constructed clusters by finding the number of the best clusters, namely by looking at the smallest value of Sw(internal homogeneity) and the optimum value or the smallest Sw/Sb value (Bunkers WJ, Miller JR, DeGaetano AT, 1996). The results of eight-time group simulations showed there were seven constructed clusters, namely the smallest value, i.e. Sw as many as 62,229.90 and Sw/Sb value as much as 0.57. This makes seven clusters which are considered as the best classification in k-mean method. Table 3 presents the results of simulation determining Sw and Sb values.

The results of the number of clusters formed from 13 variables of import commodities of food crops and horticultures with 268 regencies-cities that have potential of product value above the *Kabupaten-Kota* average in Indonesia) can be seen in Table 4 with the following description:

1. Cluster 1 consisting of 154 regencies; cluster 1 has characteristics or similarity to rice, corns, cassava, potatoes, and Siam oranges.
2. Cluster 2 consisting of 2 regencies, namely Lampung Timur and Wonogiri; its dominant characteristics are rice, corns, cassavas, and peanuts.
3. Cluster 3 is something different; it consists of only one regency, that is Lampung Tengah Regency. This regency has cassava commodity with the highest production in Indonesia, i.e. it reaches 3.2. millions per year. Besides, it also has other potential, that is corns and rice.
4. Cluster 4 consisting of 8 regencies. These regencies are Simalungun, Pati, Ponorogo, Malang, Lampung Selatan, Garut, Grobogan and Tuban. This cluster has dominant commodity characteristics, namely rice, corns, cassavas, soybeans, peanuts, potatoes, peanuts, potatoes, chilies, oranges, shallot, garlic and apples.
5. Cluster 5 consisting of 24 regencies with dominant characteristics as follows; rice, soybeans, shallots, sorghum, oranges and apples.
6. Cluster 6 consisting of 75 regencies with dominant characteristics as follows: rice, shallots, garlic and corns.
7. Cluster 7 consisting of 4 regencies, that is Tulang Bawang, Lampung Utara, Tulang Bawang Barat, and Gunung Kidul. This area has dominant characteristics for the following commodities: rice, cassavas, soybeans, and peanuts.

Table 3. S_w and S_b values for classification using top-down clustering (K-means) methods

Simulation on the number of clusters	S_w	S_b	S_w/S_b
2	199,076.70	237,395.89	0.84
3	107,862.94	187,778.16	0.57
4	87,716.78	145,197.31	0.60
5	86,223.28	133,110.64	0.65
6	74,295.00	119,401.11	0.62
7	65,229.90	114,707.55	0.57
8	86,706.44	104,256.30	0.83

P-ISSN: 2407-5434
E-ISSN: 2407-7321
Available online at http://journal.ipb.ac.id/index.php/ijbe
DOI number: 10.17358/IJBE.2.3.151

The map on Figure 2 shows the thematic map that describes the map of regencies-cities in Indonesia according to constructed clusters. It can be seen that in white is the area of *Kabupaten-Kota* with production value for all variables below the average, while the constructed clusters (1 to 7) have color other than white.

Table 5 presents the highest productivity average of food crops and horticultures on the constructed clusters. The productivity value in each cluster can become the target to be reached by regencies and cities. By looking at the average product per cluster, in which every cluster member in increasing production can always refer to at least the highest productivity, Therefore, regencies that previously have not reached the target can identify agricultural problems from pre-harvest to post-harvest.

It is like what happens to Tabanan Regency that has the highest rice production in cluster 1with rice production of 222.59 thousand tons and productivity of 5.45 tons per hectare, while the highest rice productivity of all the clusters is in Indramayu Regency (5.97 tons per hectare). This productivity value can become a regional reference for every *Kabupaten-Kota* in this cluster (cluster 1). It is expected that it avail productivity between 5.45 and 5.97 tons per year. With this target the *Kabupaten-Kota* under this scheme can be encouraged to increase their productivity at least 5.45 tons per hectare and reach 5.97 tons per hectare.

The highest Soybean productivity happens in cluster 5, namely Regency with productivity of 1.6 tons per hectare (production of 54.89 tons per year). This is a regency that the highest productivity of all clusters. All the regencies-cities are expected to have productivity at least the same as productivity of each cluster or to target 1.6 tons per hectare per year.

The highest corn productivity happens in cluster 5, namely Jember Regency with a productivity of 6.70 tons per hectare (production of 391,894.50 tons/year). Jember Regency has the highest productivity of corns of all clusters. All regencies-cities are expected to have productivity at least the same with productivity in each cluster or to target 6.70 tons per hectare per year. Productivities of other commodities like cassavas, peanuts, potatoes, shallots, garlic oranges, apples, and grapes can refer to that as can be seen in Table 5.

Klassen Typology on the constructed clusters

Klassen Typology analysis describe patterns and structures of production growth of food crop and horticulture commodities that can be divided into four parts, namely progress commodities with fast growth, progress commodity with slow growth, developed commodity with fast growth, and relatively left-behind commodity. This analysis is very dynamic since it very much depends on development of building activities in the related regency and city (Sjafrizal, 2008).

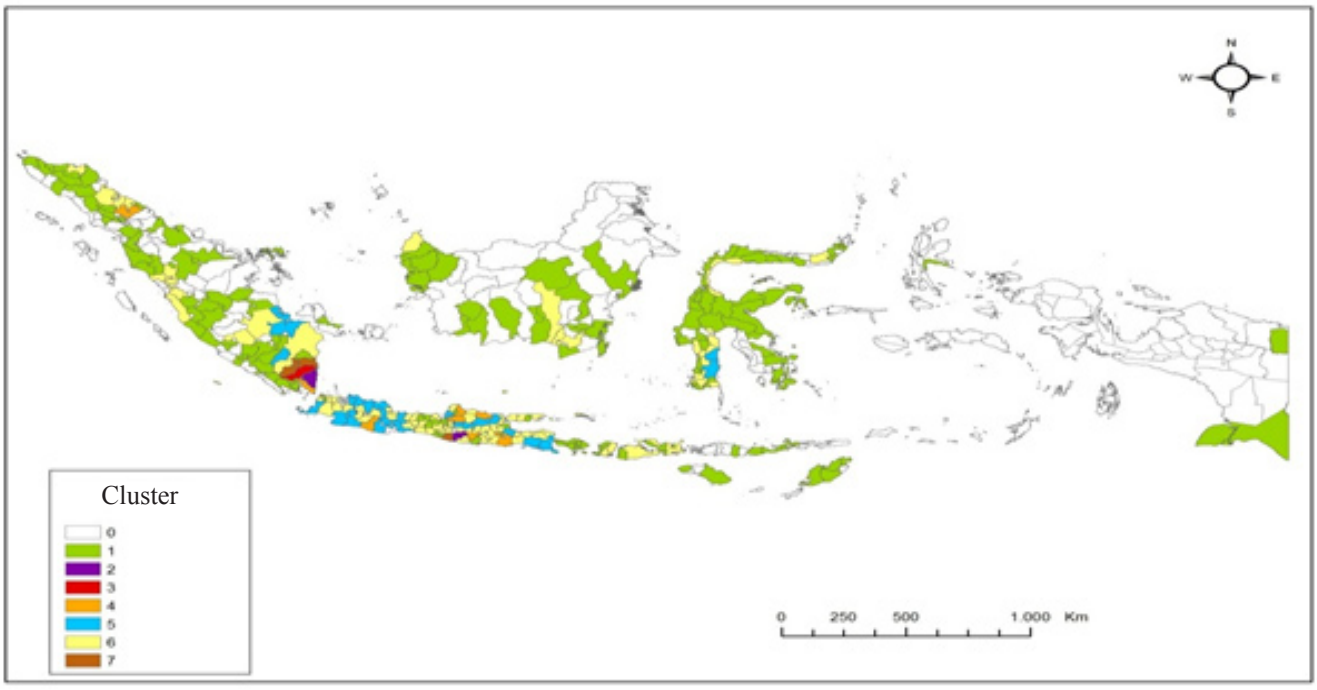

Figure 2. The thematic map of regencies-cities in Indonesia according to constructed clusters

P-ISSN: 2407-5434
E-ISSN: 2407-7321
Available online at http://journal.ipb.ac.id/index.php/ijbe
DOI number: 10.17358/IJBE.2.3.151

Table 4. Results of grouping *Kabupaten-Kota* in Indonesia based on the import commodity of food crops and horticultures, 2010-2013.

Cluster	Count of *Kabupaten-Kota* cluster	Name of *Kabupaten-Kota*
1	154	Aceh Tenggara, Aceh Timur, Aceh Tengah, Aceh Besar, Pidie, Bireuen, Gayolues, Naganraya, Bener Meriah, Pidie Jaya, Mandailing Natal, Tapanuli Selatan, Tapanuli Utara, Labuhan Batu, Dairi, Karo, Pakpak Bharat, Samosir, Batubara, Pasaman, Solok Selatan, Pasaman Barat, Siak, Kampar, Rokan hilir, Pekan baru, Kerinci, Merangin, Muaro Jambi,Tanjung Jabung Barat, Tebo, Bungo, Ogan Komering Ulu, Muara Enim, Lahat, Ogan Komering Ulu Selatan, Ogan Ilir, Pagar Alam, Bengkulu Selatan, Rejang Lebong, Bengkulu Utara, Mukomuko, Kepahiang, Lampung Barat, Tanggamus, Pesawaran, Pringsewu, Mesuji, Bangka Tengah, Bintan, Batam, Wonosobo, Kudus, Semarang, Temanggung, Batang, Pekalongan, Tegal, Kulonprogo, Bantul, Sidoarjo, Pamekasan, Pasuruan, Batu, Cilegon, Serang, Jembrana, Tabanan, Badung, Gianyar, Klungkung, Bangli, Karangasem, Buleleng, Lombok Barat, Dompu, Sumbawa Barat, Lombok Utara, Bima, Sumba Timur, Kupang, Timor Tengah Selatan, Timor Tengah Utara, Belu, Flores Timur, Sikka, Ende, Ngada, Sumba Barat Daya, Bengkayang, Landak, Pontianak, Sanggau, Kubu Raya, Pontianak, Singkawang, Kotawaringin Barat, Kota Waringin Timur, Barito Utara, Sukamara, Lamandau, Pulang Pisau, Murung Raya, Palangkaraya, Tanah Laut, Kota Baru, Hulu Sungai Selatan, Hulu Sungai Tengah, Tabalong, Kutai Kartanegara, Balikpapan, Minahasa, Minahasa Selatan, Minahasa Utara, Minahasa Tenggara, Bolaang Mongondow Timur, Tomohon, Banggai Kepulauan, Banggai, Morowali, Poso, Donggala, Toli-Toli, Buol, Tojo Una-Una, Sigi, Kota Palu, Bantaeng, Jeneponto, Takalar, Sinjai, Pangkep, Barru, Enrekang, Tana Toraja, Luwu Utara, Luwu Timur, Buton, Muna, Konawe, Konawe Selatan, Boalemo, Gorontalo, Pohuwato, Bone Bolango, Gorontalo Utara, Majene, Polewali Mandar, mamuju, Mamuju Utara, Halmahera Tengah, Merauke, Keerom
2	2	Lampung Timur, Wonogiri
3	1	Lampung Tengah
4	8	Simalungun, Pati, Ponorogo, Malang, Lampung Selatan, Garut, Grobogan dan Tuban
5	24	Banyu Asin, Ogan Komering Ulu Timur, Sukabumi, Cianjur, Tasikmalaya, Ciamis, Majalengka, Indramayu, Subang, Bekasi, Karawang, Cilacap, Sragen, Demak, Brebes, Jember, Banyuwangi, Pasuruan, Ngawi, Bojonegoro, Lamongan, Pandeglang, Bone dan Wajo
6	75	Serdang Bedagai, Way Kanan, Banjarnegara, Pacitan, Aceh Utara, Deli Serdang, Langkat, Pesisir Selatan, Solok, Tanah Datar, Padang Pariaman, Agam, Lima Puluh Kota, Ogan Komering Ilir, Musi Rawas, Musi Banyuasin, Bogor, Bandung, Kuningan, Cirebon, Sumedang, Purwakarta, Bandung Barat, Banyumas, Purbalingga, Kebumen, Purworejo, Magelang, Boyolali, Klaten, Sukoharjo, Karanganyar, Blora, Rembang, Jepara, Kendal, Pemalang, Tegal, Sleman, Tulungagung, Blitar, Kediri, Lumajang, Bondowoso, Situbondo, Probolinggo, Mojokerto, Jombang, Nganjuk, Madiun, Magetan, Gresik, Bangkalan, Sampang, Sumenep, Lebak, Tangerang, Serang, Lombok Tengah, Lombok Timur, Sumbawa, Bima, Sambas, Kapuas, Banjar, Barito Kuala, Bolaang Mongondow, Parigi Moutong, Bulukumba, Gowa, Maros, Soppeng, Sindenreng Rappang, Pinrang dan Luwu
7	4	Tulang Bawang, Lampung Utara, Tulang Bawang Barat, dan Gunung Kidul

P-ISSN: 2407-5434
E-ISSN: 2407-7321
Available online at http://journal.ipb.ac.id/index.php/ijbe
DOI number: 10.17358/IJBE.2.3.151

Table 5. Summary of the highest productivities in the constructed clusters from import commodities of food crops and horticultures in *Kabupaten-Kota* in Indonesia, 2010-2013 (ton/ha).

Variable	Cluster							The highest	National
	1	2	3	4	5	6	7		
$X_{1(wheat)}$	3.23	-	-	2.70	3.23	2.80	3.23	3.23	3.04
$X_{2(rice)}$	5.45	5.07	4.97	5.83	5.97	4.30	4.80	5.97	5,05
$X_{3(soybeans)}$	1.50	1.33	1.23	1.98	1.60	1.45	1.10	1.98	1.38
$X_{4(corns)}$	5.83	4.98	5.03	5.50	6.70	2.60	3.65	6.70	4.63
$X_{5(cassavas)}$	23.89	25.58	25.33	35.15	22.25	19.98	25.90	35.15	21.08
$X_{6(peanuts)}$	1.53	1.33	1.30	1.68	1.30	1.13	1.10	1.68	1.25
$X_{7(potatoes)}$	18.30	13.10	-	18.80	17.48	19.72	-	19.72	16.13
$X_{8(shallots)}$	10.37	4.50	-	11.10	11.75	11.58	3.80	11.75	9.75
$X_{9(garlic)}$	6.40	3.40	-	5.63	7.20	7.80	1.0	7.80	5.24
$X_{10(chilies)}$	1.10	1.65	1.7	1.9	1.5	1.20	1.40	1.90	1.49
$X_{11(siam\ oranges)}$	20.21	15.10	19.81	15.04	16.84	18.60	19.02	20.21	18.10
$X_{12(apples)}$	55.17	-	-	57.16	57.44	53.25	-	57.44	55.76
$X_{13(grapes)}$	49.27	-	-	-	-	-	-	49.27	-

Source: Statistics Central Bureau, Region in number 2010-2013, processed

Table 5 shows the results of agricultural commodity classification that is based on growth rate measurement and contribution of food crops and horticultures in the constructed clusters with the same commodities in all clusters. Based on the Klassen Typology analysis it can be found out the structure of each commodity's growth on the constructed clusters during the four-year period of observation (2010–2013).

Based on the Klassen Typology analysis, those belonging to the category of developed with fast growth are the ones that have the highest contribution in all clusters and their growth rate is also the highest in all clusters. In this category cluster 1 produces rice and corn commodities, cluster 2 produces cassavas, cluster 3 also produces cassavas, cluster 4 produces cassavas and chilies, cluster 5 produces apples, cluster 6 produces shallots and garlic, and cluster 7 produces cassavas. Efforts need to be done to maintain this commodity productivity, and soil fertility also needs to be monitored.

Relatively-developed but slow commodities are the ones whose contribution to production value in each constructed cluster is higher than its contribution to all clusters, but its growth rate is lower compared to its growth rate in all clusters. These commodities are basically decreased during initial observation, but at the final observation the growth rate increased compared to previous years. According to Klassen Typology analysis commodities belonging to this category are potatoes, chilies, oranges and apples in cluster 1, corn in cluster 2, soybeans, peanuts, potatoes and apples in cluster 4, rice, soybeans, shallots and sorghum in cluster 5, rice, peanuts, and sorghum in cluster 6, and cassavas in cluster 7. These can be seen in Table 6.

Basically these commodities give bigger contribution to the region's food capacity and can be exported to other regions, but their growth rate is low in its cluster compared to all clusters. Efforts that need to be carried out for these developed, but slow growth commodities are by increasing the growth rate existing in each constructed cluster against the growth rate in all clusters. These efforts are as follows:

1. Carrying out evaluation each year on the improving programs of agricultural sector that have been conducted, finding out their weaknesses, for example improving program of food crops, extension on disease prevention whether it has been effective or not. In the following years it is expected to improve compared to the previous years.
2. Agricultural technology innovation from year to year to help increase production, for using agricultural machineries such as milling machine and drying machine, improving farmers' knowledge in absorbing farming knowledge, for example nowadays organic plants in agricultural sector have become a menu searched by most people. For this reason, farmers must be able to try to carry it out or at least reduce the use of organic fertilizers.

P-ISSN: 2407-5434
E-ISSN: 2407-7321
Available online at http://journal.ipb.ac.id/index.php/ijbe
DOI number: 10.17358/IJBE.2.3.151

Table 6. Typology of growth on import commodities of food crops and horticultures according to Klassen Typology from each constructed cluster

Cluster	Developed with fast growth commodities	Developed with slow growth commodities	Fast developed commodities	Relatively left-behind commodities
1	Rice and corns	Potatoes, chilies, oranges, and apples	Soybeans and cassavas	Sorghum, peanuts, shallots, garlic, and grapes
2	Cassavas	Corns	Rice, potatoes, shallots, chilies, and oranges	Sorghum, soybeans, peanuts, shallots, garlic and grapes
3	Cassavas	-	Rice and chilies	Sorghum, corns, soybeans, peanuts, potatoes, shallots, garlic, oranges, apples, and grapes
4	Corns, cassavas and chilies	Soybeans, peanuts, potatoes and apples	Shallots and oranges	Sorghum, rice, garlic and grapes
5	Apples	Sorghum, rice, soybeans and shallots	Corns, potatoes, garlic, chilies and oranges	Cassavas, peanuts and grapes
6	Corns, shallots and garlic	Sorghum, rice and peanuts	Cassavas, chilies, oranges and apples	Soybeans and grapes
7	Cassavas	Peanuts	Chilies and rice	Sorghum, soybeans, corns, shallots, garlic, oranges, apples and grapes

Commodities would be considered fast-developed when they have better developing prospect, but have lower contribution. Basically those commodities have bigger growth rate in each cluster compared to all the clusters; however, they give lower contribution to each cluster, compared to all clusters. Contribution is very much influenced by product value competition among commodities in the agricultural sector. Based on Klassen Typology analysis fast-developed commodities include soybeans and cassavas in cluster 1; rice, potatoes shallots, chilies and oranges in cluster 2; rice and chilies in cluster 3; shallots and oranges in cluster 4; corns, potatoes, garlic, chilies ad oranges in cluster 5; cassavas, potatoes, chilies and apples in cluster 6; and chilies and rice in cluster 7.

The effort that needs to be carried out on these fast-developed commodities is increasing cluster contribution in regency level to all clusters, as follows:

1. Using superior seeds for agricultural commodities until these agricultural commodities can compete with better quality.
2. On the agricultural commodity marketing system, the government must do their best to enable farmers to sell their products fast so that there won't be any heap of production. For example, establishing agribusiness market.

Relatively left-behind commodities are those whose growth and contribution to product is still lack compared to all groups, so that the contribution of regency cluster is smaller than the contribution of all clusters and the growth rate regency is smaller than the average of all clusters. The role of the government and related institutions must be more dominant on the relatively left-behind commodities, whether it is an extension to increase farmers' knowledge or new technology. The relatively left-behind commodities consist of sub-sector of food crops, namely peanuts, shallots, garlic, sorghum, and grapes in cluster 1; sorghum, soybeans, garlic, apples, and grapes in cluster 2; sorghum, corns, soybeans, peanuts, potatoes, shallots, garlic, oranges and apples in cluster3; sorghum, rice, garlic and grapes in cluster 4; cassavas, peanuts and grapes in cluster 5; soybeans and grapes in cluster 6, and sorghum, soybeans, potatoes, shallots, garlic, oranges apples and grapes in cluster 7.

Obstacles of Food Crop and Horticulture Business

The major obstacle that are faced by household farming business of rice according to the survey of Rice Household Business (RHB) and Household Second-crops Business Survey (HSBS) 2014 that was carried out by Statistics Bureau Center, 32.4 percent farmers of hybrid rice said that pest attack/plant-disturbing organisms are the major obstacle of in business.

P-ISSN: 2407-5434
E-ISSN: 2407-7321
Available online at http://journal.ipb.ac.id/index.php/ijbe
DOI number: 10.17358/IJBE.2.3.151

Likewise, 30.9 percent of non-hybrid rice farmers admitted that pest attack/plant-disturbing organisms also are the major obstacle. Other obstacles whose percentage is quite significant are high production cost that is incomparable to the increase of production price and also climate change. These problems also become the major obstacles for hybrid corns and composite corns business, beside pest attack. Pest attack is indeed something that makes farmers restless, not to mention soybean cultivation farmers. Of the obstacles faced, pest attack/plant-disturbing organisms are the major ones. There were 32.7% soybean farmers who said this. The next obstacle was the increase of high production cost that was relatively higher than the increase of production price (Table 7).

The results of survey on Horticulture Business Household (HBH) 2014 that was carried out by Statistics Central Bureau, showed that majority farmers that grew shallots, red chilies and small chilies did not get many problems with their business in terms of drought, labor, marketing, and others. However, there were some that had problems with production cost increase that was lower than production price and pest attack/ plant disturbing organisms. The percentage of farmers that had problems with production cost increase and pest attack/ plant disturbing organisms was bigger than the percentage of those who did not.

The problem of production price increase of horticultures was lower than production cost increase, especially in shallots farmers and red chilies farmers because these commodities are some of the strategic plants that are very much influenced by price condition. On the other hand, the problem due to pest attack or plant disturbing organisms often happens to farming business. This certainly was very disadvantageous to farmers in terms of production or during harvest due to lower quality of the harvest or even harvest failure. Table 8 presents problems in horticulture farming business.

Managerial Implications

The Table 9 presented below shows the result of information source and efforts to be performed in reference to Klassen analysis results, along with a number of researches and surveys on rice plant crops and horticulture conducted by Central Bureau of Statistics (BPS).

Table 7. Percentage of farmers based on major obstacles face and commodities grown in 2014

Major obstacles	*Sawah*	*Ladang*	Corns	Soybeans
Business cost (more difficult loan, higher interest rate, etc.)	12.7	9.6	12.9	6.7
Increased production cost is higher than increased production price	28.1	28	29.9	28.9
Impacts of pest attack/plant disturbing organisms are relatively higher/ heavier	35.9	40.4	20.6	32.7
Impacts of climate change (drought, floods) and /or disasters are relatively bigger/heavier	10.3	9.9	25.6	15.4
To get labor is more difficult and wage is more costly	8.7	8.3	8	10.6
others	4.3	3.9	3	5.7

Source: Statistics Central Bureau. Survey on rice and second crops. 2014, processed

Table 8. Percentage of horticulture farming business households according to types of crops and problems/ difficulties of previous selected horticultures, 2014

Problems/business obstacles	Shallots		Red chilies		Small chilies	
	Yes	No	Yes	No	Yes	No
Agribusiness cost	47.46	52.54	45.56	54.44	45.78	54.22
Lower production cost increase than production price	79.24	20.76	73.1	26.9	67.53	32.47
Pest attack/plant disturbing organisms	83.19	16.81	75.71	24.29	56.16	43.84
Drought	33.37	66.63	24.83	75.17	23.05	76.95
Getting labor/ labor wage	54.42	45.58	31.03	68.97	33.43	66.57
Marketing harvest	21.36	78.64	8.97	91.03	7.76	92.24
Others	13.32	86.68	10.6	89.4	1.64	98.36

P-ISSN: 2407-5434
E-ISSN: 2407-7321
Available online at http://journal.ipb.ac.id/index.php/ijbe
DOI number: 10.17358/IJBE.2.3.151

Table 9. Policy implications of agricultural and horticultural import commodities according to Klassen Typology from each respective cluster

The result of Klassen Typology	Policy Implications
Advanced and fast-growing commodity	Maintaining this commodity and observing its productivity and soil fertility by conducting routine counseling, using superior seeds, improving the farming skills, and maintaining agricultural infrastructure and facilities.
Growing commodity	Using superior seeds to compete with excellent quality products. Excellent marketing system to assist farmers in selling their production fast, so that over stacked production shall not occur. For instance, an establishment of agribusiness market.
Advanced and slow-growing commodity	Conducting a program evaluation and seeking for difficulties in an agricultural improvement program, as well as the effectiveness of disease prevention counseling. Establishing agricultural technology innovations, e.g. the use of agricultural equipment, an increase in farmers' knowledge in grasping agricultural knowledge.Reducing the use of inorganic seeds.
Poor-growing commodity	Utilizing superior seeds for farmers to increase the product quality and quantity in each commodity. Supporting required infrastructure and facilities e.g. by providing more advanced and modern agricultural equipment. Assisting farmers to obtain fertilizers (fertilizer shortage). Not performing agricultural import commodities; including rice, corn, and soy which eventually may decrease prices of domestic agricultural commodities. Building partnership with other entrepreneurs or household industries which utilize agricultural commodities as raw materials to assist farmers in marketing their products.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Almost all *Kabupaten-Kota* areas in Indonesia have potential food crops, especially rice, except big cities. This potential shows that opportunity of each area to fulfill its own needs is bigger. If this potential is optimal zed, it can reduce dependency on import food crops. The result of cluster mapping has produced potential clusters that are expected to be able to supply other areas that are not or less potential.

Regencies-cities that have production potential above the average at least 1 out of 13 commodities as food crop and horticulture variables there are 268 regencies-cities. The results of constructed clusters show the potential characteristics based on mapped products of the commodities according to the groups. The results of constructed clusters using k-mean methods show there were a number of the best clusters, that is 7 clusters, which are as follows: cluster 1: 154 regencies; cluster 2 : 2 regencies; cluster 3 : 1 regency; cluster 4 : 8 regencies; cluster 5 24 regencies; cluster 6: 75 regencies; and cluster 7: 4 regencies. Each cluster has its own commodity dominant characteristics.

The progress potential of food crops and horticultures and the sustainability of the constructed clusters were obtained the typology klassen results that showed developed and fast growth, out of 13 commodities, seven commodities in cluster 1: rice; in cluster 2,3,4 and 7 cassavas; in clusters 1,4 and 6: corns; in cluster 4: chilies; in cluster 5: apples; in cluster 6: shallots and garlic. Six other commodities are relatively left-behind, namely sorghum, potatoes, soybeans, peanuts, oranges and grapes. One area's potential lack due to low productivity is the results of pest attack, highly operational cost, climate, and natural disasters.

Recommendations

To encourage improving food crop and horticulture productivities, the government policy related closely to agriculture and policy to increase production in agricultural sector needs to be carried out more intensively. Among others are policies on production, subsidy, agroindustry, and agribusiness development. These policies can be applied in each constructed cluster by considering the commodities' dominant characteristics and other aspects to improve productivities in each cluster.

REFERENCES

Badan Pusat Statistik. 2014. *Statistik Indonesia 2014.* Jakarta: Badan Pusat Statistik.

Bunkers WJ, Miller JR, DeGaetano AT. 1996. Definition of climate regions in the northern plains using an

Available online at http://journal.ipb.ac.id/index.php/ijbe
DOI number: 10.17358/IJBE.2.3.151

objective cluster modification technique. *Journal of Climate* 9(1):130–146.

Direktorat Jenderal Pengolahan dan Pemasaran Hasil Pertanian Kementerian Pertanian. 2014. *Statistik Ekspor Impor Komoditas Pertanian 2001–2013*. Jakarta: Direktorat Jenderal Pengolahan dan Pemasaran Hasil Pertanian Kementerian Pertanian.

Vincent G. 1992. *Teknik Analisis Dalam Penelitian Percobaan.Edisi 2*. Bandung: Torasito.

Hair J, Anderson R.E, Tatham R.L, Black W.C. 2006. *Multivariate Data Analysis, Sixth Edition*. UK: Prentice Hall International.

Johnson R.A, Wichern D.W. 2007. *Applied Multivariate Statistical Analysis, sixth edition*. USA:Pearson Education Inc.

Prishardoyo. 2008. Analisis tingkat pertumbuhan ekonomi dan potensi ekonomi terhadap produk domestik regional bruto Kabupaten Pati. *Journal of Economic and Policy* 1(1):1–9.

Riyadi. 2007. Analisis faktpr-faktor yang memengaruhi produksi jagung di Kecamatan Wirosari, Kabupaten Grobogan [tesis]. Semarang: Universitas Diponegoro.

Sjafrizal. 2008. *Ekonomi Regional, Teori dan Aplikasi*. Padang: Boduose Media.

Tsurayya S, Kartika L. 2015. Kelembagaan dan strategi peningkatan daya saing komoditas cabe Kabupaten Garut. *Jurnal Manajemen dan Agribisnis* 12(1): 1–13.

Utkarsha P, Narkedhe, Adhiya. 2014. Eavaluation of modified k-menas clustering algorithm in crop prediction. *International Journal of Advanced Computer Research* 4(3): 799–807.

Wicaksono. 2011. Analisis location quotient sektor dan subsektor pertanian pada kecamatan di Kabupaten Purworejo. *Mediagro* 7(2):11–18.