



CONSUMER PREFERENCES ON FOOD INGREDIENTS AND ANALYSIS OF REGIONAL GROUPING USING HIERARCHICAL CLUSTERING AGGLOMERATIVE METHOD OF FOOD CROP AGRICULTURAL COMMODITY PRODUCTS IN SEMARANG

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ABSTRACT

The purpose of this research is to determine the consumer preferences towards the food ingredients, such as rice, chili, onion, and garlic. The data collection is conducted by using the questionnaire for 55 respondents. The results of this research show that most respondents are not concerned about which regions that produce the rice, onion,

garlic, and chili. Most respondents have knowledge of the food producers of each region. They prefer Pandan Wangi, IR, and Rojolele rice and they prefer to buy rice in the stalls, traditional markets, and rice distributor shop. After that a cluster analysis is conducted to determine the regional grouping of the rice and other food crop producers in Semarang city. It uses a hierarchical clustering method with agglomerative type, which aims to interpret the cluster analysis results of the districts in Semarang based on their similarity as the largest producer of rice and other food crops. The research results show that in the year of 2012 - 2014, Cluster 1 is the largest producer of rice and other crops in Semarang. From the analysis, it can be concluded that Semarang city needs to bring in the supplies of rice, onion, garlic, and chili from other regions.

Key words: Agriculture Economics, Consumer preferences, Food Ingredients, Cluster, Hierarchical Clustering Method.

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1. INTRODUCTION

One of the priorities in the National Medium Term Development Plan (RPJMN) of the year 2010-2014 is the National Food Security, which focuses on increasing the food availability, stabilizing the food distribution, accelerating the food diversification, and controlling the fresh food safety in accordance with the characteristics of each region. The development of food security is conducted through various efforts in order to increase the economic growth and to reduce the poverty as the embodiment of the social, culture, and economic independence development.

A prosperous independence, in which there are the food sovereignty based on the community agribusiness, is one way of change of the governmental vision in the Working Cabinet. The food sovereignty based on community agribusiness becomes a chore that requires the participation of the government, stakeholders, farmers, and community. Based on the Law No. 18 of 2012 on Food, food sovereignty is a part of food security. Food security, according to the Law No. 18 of 2012 on Food, is "a condition of food fulfillment for the country to individuals, which is reflected in the availability of adequate food, both in quantity and quality, safe, diverse, nutritious, equitable and affordable and does not conflict with religion, beliefs, and culture, to be able to live healthy, actively, and productively in a sustainable manner ". Food security can be achieved through the realization of food sovereignty, food resilience, and food safety (Astawan, 2015).

The three pillars of food security according to the Law No. 18 of 2012 on Food are as follows: availability, accessibility both physically and economically, and stability that should be available and accessible at any time and any place (Bulog, 2014). The land functions are different so that it requires different ways and plants to be utilized. It needs to create groupings because of the diversity of potential food crop agricultural production in each district in Semarang; it needs to create groupings to know which district that has a high agricultural production so that it can help to optimize the government programs in the field of food crops.

The policy direction to achieve the food security in Semarang is developing a food security system based on the diversity of food resources, institutional and local culture. In this case, one of the objectives of food security improvement program is to increase the diversity of

production, the availability and consumption of people's food. The pattern is in accordance with the regional autonomy policy that authorizes the region in the development of food (Food Security Guidance Bureau, 2002).

The cluster system is conducted to see the diversification of food production generated by the districts in Semarang, so that the pattern of people's consumption of food ingredients can be seen. The development of food consumption patterns requires the mastery of knowledge, ability, and skill in choosing the types of food ingredients, adjusted to the habitual patterns of the local communities (Witoto, 2004).

With various issues existing, the theme of food resilience and security has become a strategic issue for the researchers. Viewing the importance of diversification of potential agricultural production in maintaining the stability of food supply and price, this research will develop a cluster model to promote stability of food supply and price.

2. REVIEW OF PREVIOUS RESEARCH

According to Hair, et al. (2006), a cluster analysis is a technique of grouping to group the objects based on the characteristics possessed by the object. Cluster analysis groups the most similar objects into the same group, so that the characteristics of the object in a cluster is homogeneous whereas the characteristics of the object among the other clusters is heterogeneous. Meanwhile, according to Simamora (2005: 201), cluster analysis is a statistical analysis technique that intends to place groups of objects into two groups or more based on the similarities of the objects on the basis of various characteristics.

The classic example of hierarchical agglomerative cluster is taxonomic species. Hierarchy with agglomerative approach is also known as a bottom-up approach that starts with placing every object in each group. The next step is to combine / cluster from the small to the larger (Tiwari in Han and Kamber, 2011). Megala and Hemalatha (2011) conducted a research to determine whether the mining data technique can be used to analyze the patterns of land. This research aimed to determine whether the mining data technique can be used to assist in the grouping method to determine the pattern of the land profile at various research sites in the whole Tamil Nadu, India. Another research conducted by Malik, et.al (2011) used a hierarchical agglomerative cluster method with a combination of GIS, RS, and the new grouping of spatial data algorithm of 3DCCOM to assess the rural demographic development strategies in Sonapat, Haryana, India. The study was conducted in a rural district in the Indian State to indicate the rural integration with the spatial and non-spatial data in GIS environment using the clustering hierarchy.

Reiff, et al. (2016) conducted a research using the hierarchical agglomerative cluster analysis, which analyzes the differences of agricultural performance in the countries of the European Union in 2010-2013. The research result is the significant difference in the performance of the agricultural sector between the old members and the new members that joined the EU after 2004. Another research was also conducted by Ukpatu, et. al (2015) by using a hierarchical agglomerative cluster analysis to evaluate the water quality of the mangrove in Okoro River Estuary, Southeastern Nigeria. Cluster analysis is conducted by using the quadratic method for measuring the Euclidean distance that shows the different parameter distribution.

Carraresi and Banterle (2015) evaluated the performance of the EU countries at the sectoral level in the intra-EU market in 1995 to 2011 by comparing the food and agricultural industries and also by assessing the effect of the EU expansion and the economic crisis and the competitiveness of the countries.

Spicka (2013) explored the agricultural income differences between the old members (EU-15) and the new members of the European Union (EU-12) before and after the expansion of the

European Union in 2001-2011. The structure and economic features in the European Union are identified by the cluster analysis. The author concludes that the ranking of the EU-27 countries changed after the expansion.

Szabo and Grznar (2015) analyzed the ranking of the European Union countries in the long term from the average amount of their agricultural output per unit area into seven segments. The analysis showed a strong relationship between the fixed production and the variable assets, the number of livestock, and the government support that has been given.

Latruffe (2010) reviewed the competitiveness, productivity, and efficiency in the agricultural sector. The author explains the concepts and terminology of the research area and provides a critical assessment by conducting the approach and viewing the indicators to measure the competitiveness, productivity, and efficiency in the agricultural sector.

Svoboda et al. (2015) compared the agricultural subsidies in the member countries of the European Union from 2004 to 2012 based on the database of the Agriculture Accounting Data Network. The authors concluded that there has been a slight increase in the operating subsidies. With the assistance of the cluster analysis, the member countries are divided into groups according to the operational subsidies, total production, and costs.

3. RESEARCH METHODOLOGY: PREFERENCE OF CONSUMERS AND HIERARCHICAL AGGLOMERATIVE CLUSTERING

The research was conducted in Semarang with the types of primary and secondary data from the Agriculture Department of Semarang during the year of 2012-2014. The first analysis conducted is to determine the consumer preferences in the food ingredients by sampling using the purposive sampling technique, which is the election of members of the sample based on the objectives and specific consideration of the researcher. The advantages of sampling by the purposive sampling is that the researchers can reach the goal. Meanwhile, the weakness is not necessarily the representative of the whole existing variations (Lawrence, 2006). The questionnaire contains about the tendency of Semarang people in consuming rice, onion, garlic, and chili from 55 respondents. The respondents in the questionnaire are from the merchants, housewives, university students, and private employees.

The next analysis is using the cluster analysis, which steps are collecting the secondary data, the data on rice and other food crop production in the year of 2012-2014 from the Department of Agriculture of Semarang and determining the number of clusters in accordance with the research purposes. Using the secondary data from the Department of Agriculture of Semarang, the researcher believes that the data is the representative of the existing population. The data does not need to be standardized because each variable used has the same unit of measurement that is tons. The clustering process is conducted using the hierarchical clustering with the agglomerative type. The location of the occupied clusters have been known by interpreting the results of cluster analysis in the existing districts. The last is making a diagram of the data used for the analysis of clusters in accordance with the needs of research, then interpreting it descriptively.

4. RESULTS

4.1. Analysis of Consumer Preference

Table 1 Rice, Onion, Garlic, and Chili are Staple Food Ingredients

The consumers tend to agree that the staple food consists of rice, onion, garlic, and chili (51 respondents / 45.5%), while the others reply neutral (2 respondents / 3.6%) and disagree (2 respondents / 3.6%)

Table 2 Consumer Tendency of Original Region of Staple Food Ingredients

The consumers tend to agree that the main food can be obtained from Semarang (26 respondents / 47.3%), while the others reply neutral (11 respondents / 20%) and disagree (18 respondents / 32.7%). The consumers also tend to agree that the main food can be obtained from outside Semarang (25 respondents / 45.5%), while the others reply neutral (16 respondents / 29.1%) and disagree (14 respondents / 25.4%)

Table 3 Tendency of Cheaper Food Price outside Semarang

The consumers tend to agree that the main food prices outside Semarang are cheaper (18 respondents / 32.7%), while the others reply neutral (23 respondents / 41.8%) and disagree (14 respondents / 25.4%)

Table 4 Tendency of More Qualified Food Quality outside Semarang

The consumers tend to agree that the quality of the main food outside Semarang is more qualified (14 respondents / 25.4%), while the others reply neutral (31 respondents / 56.4%) and disagree (10 respondents / 18.2%)

Table 5 Tendency of Staple Food Ingredients of Semarang Being Imported from outside Semarang

The consumers tend to agree that the main food in Semarang is always imported from outside Semarang (32 respondents / 58.2%), while the others reply neutral (12 respondents / 21.8%) and disagree (11 respondents / 20%)

Table 6 Knowledge of Rice Producer Region

The consumers tend to agree that the largest producers of rice are from Cilacap, Sragen, Grobogan, Brebes, and Demak (32 respondents / 58.2%), while the others reply neutral (12 respondents / 21.8%) and disagree (11 respondents / 20%)

Table 7 Knowledge of Onion Producer Region

The consumers tend to agree that the biggest onion producer is Brebes (37 respondents / 67.3%), while the others reply neutral (11 respondents / 20%) and disagree (7 respondents / 12.7%)

Table 8 Knowledge of Garlic Producer Region

The consumers tend to agree that the largest garlic producers are Purbalingga and Banjarnegara (21 respondents / 38.2%), while the others reply neutral (22 respondents / 40%) and disagree (12 respondents / 21.8%)

Table 9 Knowledge of Chili Producer Region

The consumers tend to agree that the largest chili producer is Blora (24 respondents / 43.7%), while the others reply neutral (20 respondents / 36.4%) and disagree (11 respondents / 20%)

Question 1: The main reason for the consumers to consume rice, onion, garlic, and chili produced in Semarang

About 56% or 31 respondents tend to consume the local staple food ingredients because it is easy to get them.

Question 2: The main reason for the consumers to consume rice, onion, garlic, and chili produced outside Semarang

About 45% or 18 respondents tend to consume the staple food ingredients from outside Semarang because they have better quality than the local products

Question 3: Varieties of rice that the consumers want

About 28% or 17 respondents tend to choose the varieties of rice those are Pandan Wangi, IR, and Rojolele. As for the other categories, some consumers choose the varieties of rice those are Mawar, Mentik Wangi, and organic rice.

Question 4: Time period of rice purchase

About 72% or 40 respondents tend to buy rice once a month.

Question 5: Time period of purchase of onion, garlic, and chili

About 30% or 16 respondents tend to buy onion, garlic, and chili once a month.

Question 6: The consumers buy rice

About 31% or by 25 respondents tend to buy rice in the stalls, traditional markets, and rice distributor shop.

Question 7: The consumer complaints against the rice consumed

About 33% or 31 respondents tend to complain of the price of rice that is not appropriate in quality and not durable.

Most respondents are not concerned about which regions that produce rice, onion, garlic, and chili. The more important thing is that the availability of rice, onion, garlic, and chili is sufficient for Semarang. However, most respondents know that the largest producers of rice are Sragen, Grobogan, Brebes, and Demak, the largest producer of onion is Brebes, the largest producers of garlic are Purbalingga and Banjarnegara, the largest producer of chili is Blora, so that the food distribution system in Semarang City should be in synergy with the regencies in Central Java. The rice types of Pandan Wangi, IR, and Rojolele are most favored by the respondents. They prefer to buy rice in the stalls, traditional markets, and rice distributor shop. From the analysis, it can be concluded that Semarang needs to bring in supplies of rice, onion, garlic, and chili from other regions.

4.2. District Grouping for Rice Paddy Production in Semarang

4.2.1. Result of District Grouping in Semarang Based on Rice Paddy Production

The result of district grouping in Semarang based on the rice paddy production using the hierarchical method is as follows: Cluster 1 consists of Mijen, Tembalang, Tugu, Ngaliyan districts; Cluster 2 consists of Gunung Pati district, and Cluster 3 consists of Banyumanik, Gajah Mungkur, South Semarang, Candisari, Pedurungan, Genuk, Gayamsari, East Semarang, North Semarang, Central Semarang, West Semarang.

Table 10 Weight Production of Rice Paddy in Semarang (tons)

	2012	2013	2014	Average
Cluster 1	23,288	21,654	23,614	22,852
Cluster 2	12,759	12,354	11,574	12,229
Cluster 3	2,969	3,270	3,316	3,185

Source: own estimation, 2017

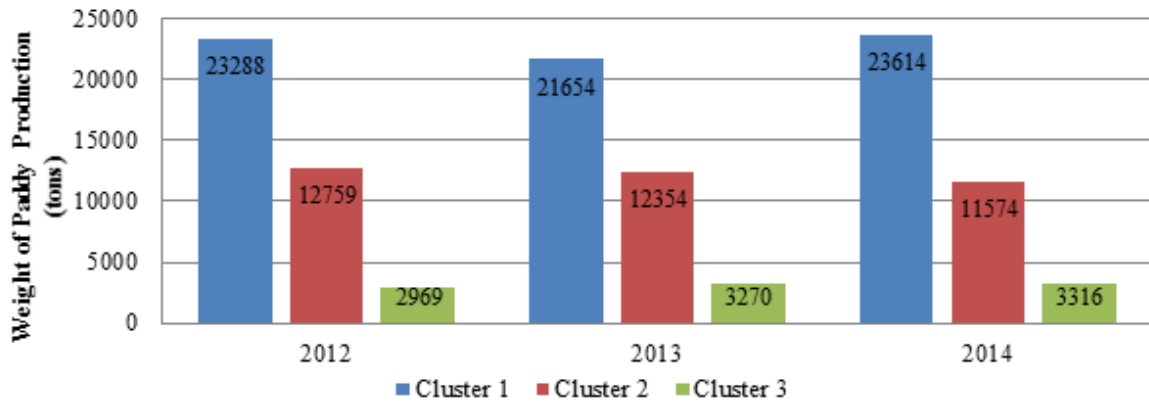


Figure 1 Diagram of Weight Stem of Rice Paddy Production in Semarang Based on Cluster

Source: own estimation, 2017

The largest producer of rice paddy in Semarang is in cluster 1 (Mijen, Tembalang, Tugu, and Ngaliyan districts) with the average rice paddy production weighing 22,852 tons annually. The lowest producer of rice paddy in Semarang is in cluster 3 (Banyumanik, Gajah Mungkur, South Semarang, Candisari, Pedurungan, Genuk, Gayamsari, East Semarang, North Semarang, Central Semarang, West Semarang) with the average rice production only weighing 3,185 tons annually. Cluster 2 (Gunung Pati district) ranks the second largest producer of rice paddy in Semarang after Cluster 1 with the average rice paddy production weighing 12,229 tons annually.

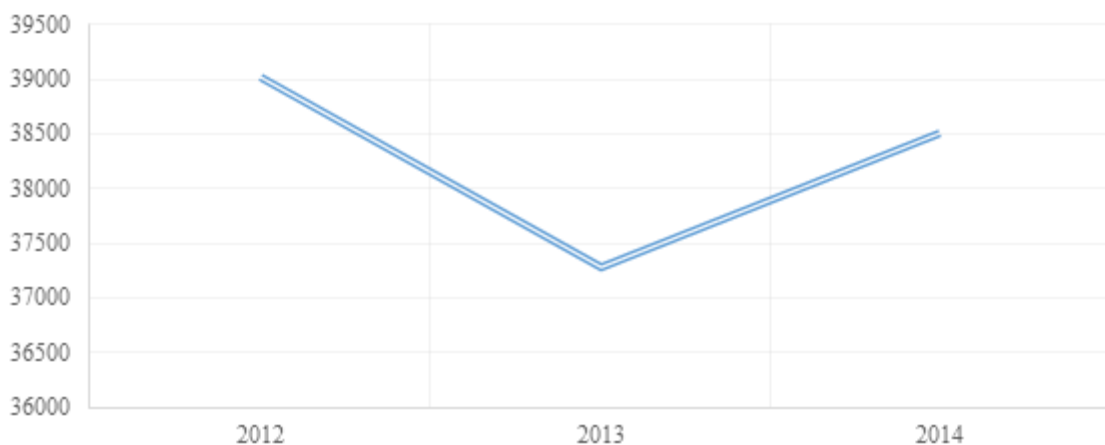


Figure 2. Line Diagram of Rice Paddy Production Weight in Semarang (tons)

Source: own estimation, 2017

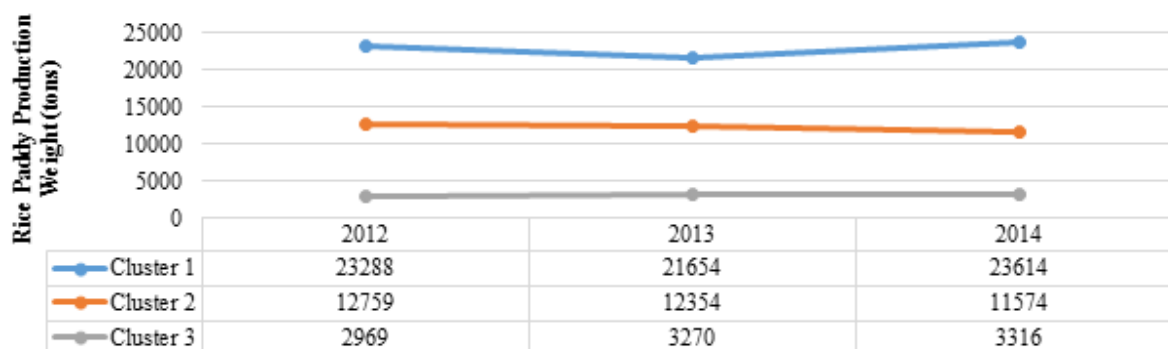


Figure 3 Line Diagram of Rice Paddy Production Weight in Semarang Based on Cluster

Source: own estimation, 2017

The rice paddy production in Semarang from 2012 to 2014 fluctuated, in which had decreased in 2013 amounted 4.45% and then increased again in 2014 amounted 3.29%. Based on the cluster, only cluster 3 that increased every year amounted 11.68% from 2012 to 2014. Cluster 2 always decreased with the rice paddy production in the last two years amounted 9.29% from 2012 to 2014.

4.2.2. Result of District Grouping in Semarang Based on Food Crop Production

The result of district grouping in Semarang based on the rice paddy production using the hierarchical method is as follows: in 2012 Cluster 1 consists of Mijen and Tugu districts, Cluster 2 consists of Gunung Pati, Banyumanik, Gajah Mungkur, South Semarang, Candisari, Tembalang, Pedurungan, Genuk, Gayamsari, East Semarang, Semarang Utara, Semarang Central, West Semarang, and Ngaliyan districts. In 2013 and 2014, Cluster 1 consists of Mijen, Gunung Pati, Banyumanik, Gajah Mungkur, South Semarang, Candisari, Tembalang, Pedurungan, Genuk, Gayamsari, East Semarang, North Semarang, Central Semarang, West Semarang, and Ngaliyan districts. Cluster 2 consists of Tugu district.

Table 11 Food Crop Production Weight in Semarang

Number of Food Crop Production in Semarang (ton)						
	2012		2013		2014	
	cluster 1	cluster 2	cluster 1	cluster 2	cluster 1	cluster 2
Corn	2763	912	1570	1162	2137	1563
Peanuts	414	193	299	175	628	361
Green beans	129	148	18	117	8	239
Cassava	9837	5589	7097	2221	5025	1050
Sweet potato	220	0	209	81	84	0
Total	13363	6713	9193	3756	7882	3213

Source: own estimation, 2017

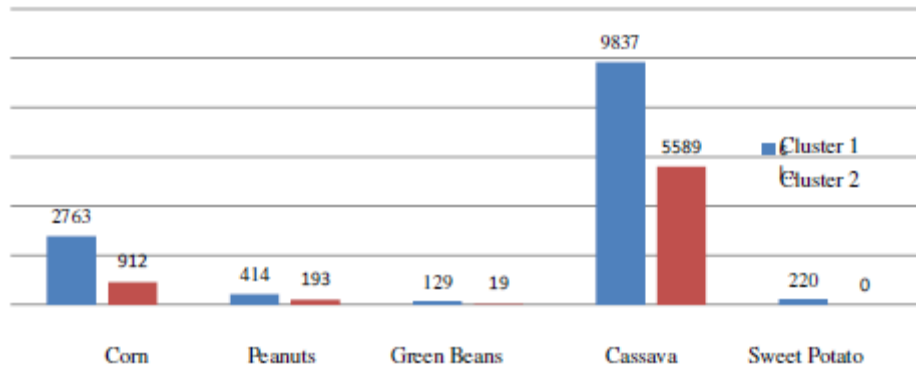


Figure 4. Bar Diagram of Food Crop Production Weight in Semarang in 2012

Source: own estimation

In 2012, the corn, peanuts, cassava, sweet potato are most produced by Cluster 1 (Mijen and Tugu districts). While the green beans are most produced by Cluster 2 (Gunung Pati, Banyumanik, Gajah Mungkur, South Semarang, Candisari, Tembalang, Pedurungan, Genuk, Gayamsari, East Semarang, North Semarang, Central Semarang, West Semarang, and Ngaliyan districts). In 2012 Cluster 2 did not produce sweet potatoes because the districts in the cluster have no land to produce the food crop. In 2012, cassava became the most widely food crop produced by Semarang.

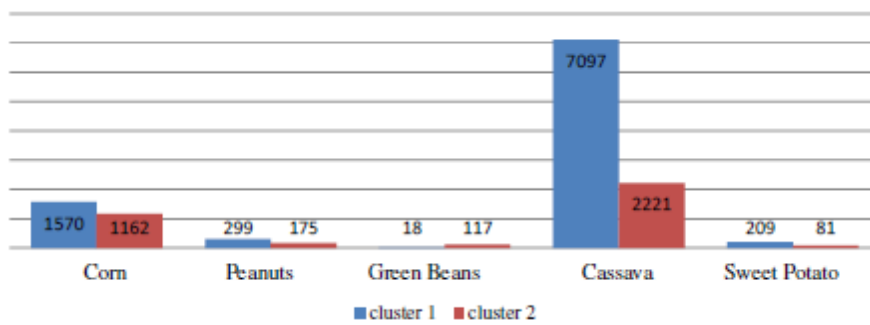


Figure 5 Bar Diagram of Food Crop Production Weight in Semarang in 2013

Source: own estimation, 2017

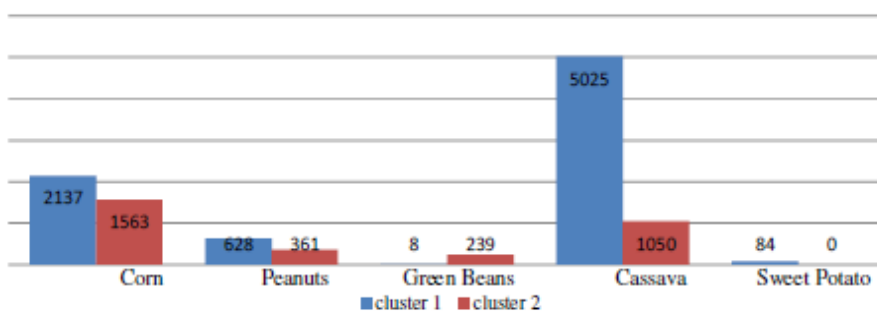


Figure 6 Bar Diagram of Food Crop Production Weight in Semarang in 2014

Source: own estimation, 2017

In 2013 and 2014 the corn, peanuts, cassava, sweet potato are most produced by Cluster 1 (Mijen, Gunung Pati, Banyumanik, Gajah Mungkur, South Semarang, Candisari, Tembalang, Pedurungan, Genuk, Gayamsari, East Semarang, North Semarang, Central Semarang, West

Semarang, and Ngaliyan districts). While the green beans are most produced by Cluster 2 (Tugu district). In 2014 Cluster 2 did not produce the sweet potatoes because the districts in the cluster have no land to produce the food crop. In the last two years, cassava has become the most widely food crop produced by Semarang.

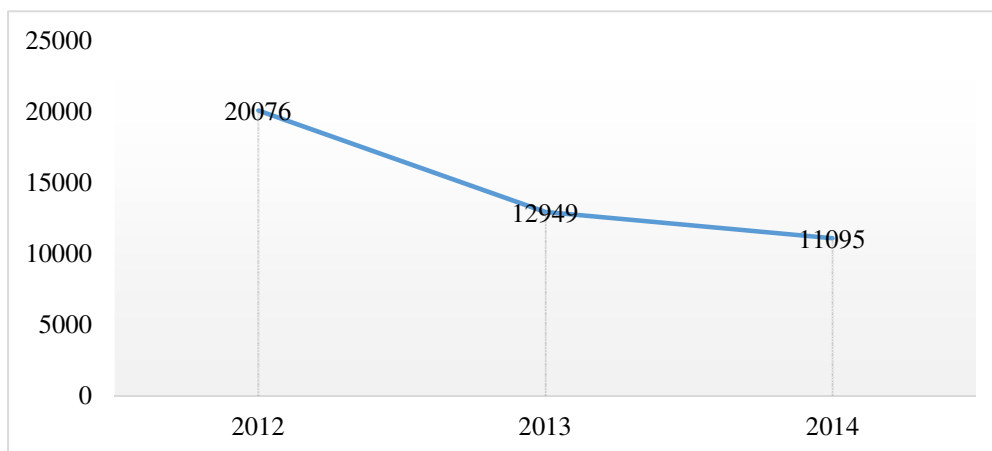


Figure 7. Line Diagram of Food Crop Production Weight in Semarang

Source: own estimation, 2017

From the line diagram above, it can be concluded that the food crop production in Semarang has decreased over the last two years (44.74%) due to the lack of area for the harvest. In particular, Tugu district is the largest producer of corn, peanuts, and green beans and Mijen district is the largest producer of cassava and sweet potato in Semarang.

5. CONCLUSIONS

Most respondents in preference to the food ingredients of rice, onion, garlic, and chili are not concerned about which region is the largest producer, provided that the availability of rice, onion, garlic, and chili in Semarang is sufficient. The respondents prefer to shop in the stalls and traditional markets; besides, they prefer the rice, onion, garlic, and chili from other areas because the quality is better.

The results of district grouping in Semarang from 2012 to 2014 based on the rice paddy production show that in general in the districts in Semarang can be grouped into three clusters. In 2012-2014, the largest producer of paddy rice in Semarang is in cluster 1 (Mijen, Tembalang, Tugu, and Ngaliyan districts). Nevertheless, Semarang needs a supply of rice from other regions because the production of rice in Semarang is insufficient to fulfill the needs of people in Semarang

The results of district grouping in Semarang based on the food crop production in 2012 is as follows: in 2012, the corn, peanuts, cassava, and sweet potato are most produced by Cluster 1 (Mijen and Tugu districts), whereas in 2013 and 2014, they are most produced by Cluster 1 (Mijen, Gunung Pati, Banyumanik, Gajah Mungkur, South Semarang, Candisari, Tembalang, Pedurungan, Genuk, Gayamsari, East Semarang, North Semarang, Central Semarang, West Semarang, and Ngaliyan districts).

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