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Design of Grouping Packaging Palm Cooking Oil Distribution at Traditional Market in Jakarta with Fuzzy Clustering

Teja Primawati Utami[1*] Syamsul Ma'arif[2] Yandra Arkeman[2] Liesbetini Hartoto[2]
1.Ministry of Trade of Indonesia, Jakarta, Indonesia
2.Agro Industrial Department, Bogor Agricultural University, Bogor, Indonesia
* E-mail of the corresponding author: teja.p.utami@gmail.com

Abstract
Referring to the Indonesian National Standard 7709 numbers in 2012 that palm cookingoil should be fortified with vitamin A, so that the distribution process required packaging to protect Vitamin A.packaging palm cooking oil is purposed to protect and to make it hygiene. Packaged cooking oil was distributed from the factory to the traditional market directly. In accordance with Regulation of the Minister of Industry of the Republic of Indonesia Number 87 of 2013 on the application of ISO palm olein is mandatory and Trade Minister Regulation number 80 of 2013 on compulsory packaging cooking oil, we need a mechanism to bulk cooking oil distribution. Simple packaging in the traditional market of producers to effective and efficient consumer. The purpose of this paper is to design a system of distribution of cooking oil from producers to consumers in traditional markets by creating a central cluster automatically determined its distribution central. Design models created using fuzzy clustering method. The results of this study is there are 15 clusters of traditional markets in Jakarta with each of the distribution centers.
Keywords: Fuzzy clustering, packaging cooking palm oil, traditional market, distribution center

1. Introduction

In the world today, only in Indonesia and in Bangladesh people still consume bulky palm cooking oil, so in Southeast Asia only in Indonesia are still consuming bulky palm cooking oil. Palm cooking oil consumed by the Indonesian rainfall reached 4,444 million tons per year, or 73.65% of total bulky palm cooking oil[1]. Cooking oil that has been consumed by the people of Indonesia are very susceptible to adulteration and hygiene is not maintained. Therefore, the government as a policy holder who assigned to protect consumers in accordance with Law No. 8 of 2009 on Consumer Protection, has sought to make the Indonesian National Standard (SNI) 2012 7709 number of palm oil. The policy followed by the Ministry of Industry through PERMENPERIN number 87 of 2013 on the application of ISO palm olein is mandatory and Trade Minister Regulation number 80 of 2013 on compulsory packaging cooking oil.

Policy to require cooking oil In cooking oil conversion to simple packaging needs to be followed up with the management of the distribution from producers to consumers in the traditional market. Therefore a logistics system is needed to reduce shipping costs and keep stock for price stability. The movement of goods from producers to consumers is referred to as the distribution market (Tilokavichai 2012). In the distribution market, represents the ultimate consumer final destination track. The ability to deliver the goods in accordance with customer orders a service, and is called if integrated logistics services between production and distribution. Component logistics services include (1) the number of factories, (2), zero, one or many levels of distribution with central distribution, (3) the consumer, (4) suppliers of raw materials or component support, (5) product rotation in the central distribution and flow in and out of vehicles, and the last(6) transportation channels that link all of the above components (Goetschalckx 2002).

Indonesia is an archipelago that has contained many traditional markets as a purchase transaction. Traditional markets are very scattered throughout Indonesia an effective mechanism and efficient distribution to be able to lower costs and stabilize prices. Good distribution mechanism is through the establishment of a central distribution, making it easy to control stock and price. Optimization determination of the distribution centers of each region can be done by clustering. The process of clustering with fuzzy clustering provides better clustering results (Hamzah 2001). In this paper the traditional market that will be made clustering are traditional markets in Jakarta.

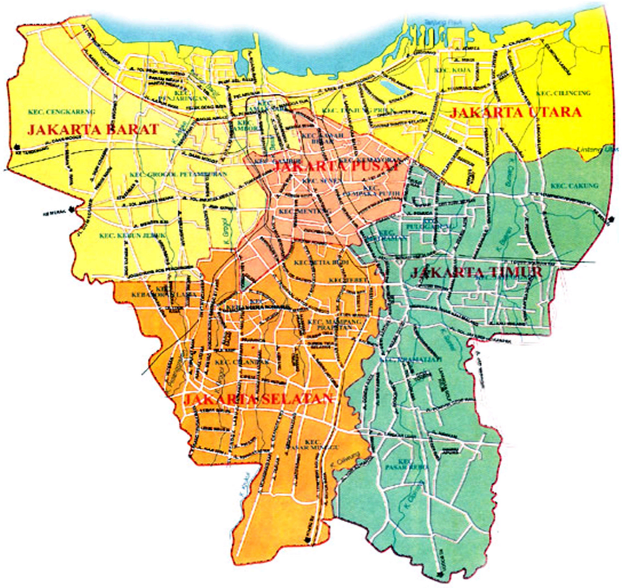

Figure 1. Map of Jakarta City

Figure 1 present the map of Jakarta City. Jakarta is the capital city of Indonesia with 5 province consisting of North Jakarta, South Jakarta, West Jakarta, East Jakarta and Central Jakarta. Each province show with different color.

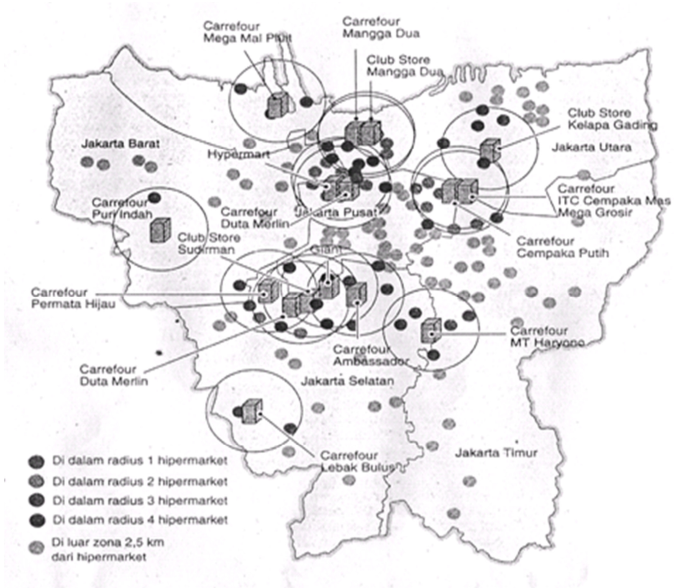

Figure 2.Traditional Markets Mapping in Jakarta

Figure 2 show the mpping of traditional markets in Jakarta. Each province in Jakarta city has an traditional markets managed by PD Pasar Jaya. The traditional markets totaled 153 traditional markets. The price of cooking oil in the traditional markets have disparity or difference due to the availability of bulk cooking in each market is not guaranteed. Thus the need for a mechanism to be able to maintain the availability of cooking oil so the price can be stable and uniform. This study seeks to address the problem.

Traditional markets clustering process is done by determining the center of the cluster which processed by using fuzzy clustering. Mapping the market are cluster made by considering the shortest distance so hopefully get a homogeneous cluster. Clustering process with Fuzzy clustering method generates better cluster compared to hard clustering. The fundamental difference between the hard clustering or conventional method with fuzzy clustering method in fuzzy clustering is possible to produce many clusters that have different degrees or different members. Thus clustering with fuzzy clustering can approach the real condition.

Clustering has long been used to determine a unique position in the distribution area. This became the basis of the fundamental characteristics of algorithmic data analysis at regional grouping. Almost since the invention of fuzzy sets, rules and potential information clustering already known and appreciated by many parties.(Sato 2006)

In recent years has undergone a metamorphosis clustering large enough. Metamorphosis of exclusively data and then convert that data into a vehicle that has substantially the data center coupled with the incorporation of a domain that produce the next generation of science and collaboration clustering. Fuzzy clustering is used to identify the center of each cluster directly.

2. Method

Fuzzy clustering is one method that can capture the uncertainty of real data and it is known that fuzzy clustering can obtain strong results compared to the conventional method of hard clustering (Kannan 2010). Referring to the general suppression of data analysis problems, this is a solution that is capable of analyzing a number of complex data, so that the role of fuzzy clustering is shown.

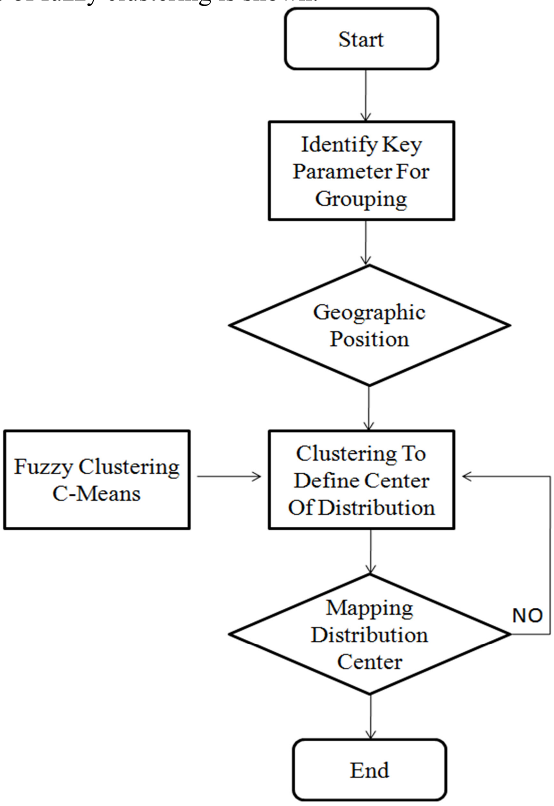

Figure 3. Research Method

Figure 3 show The frame work of this research method. In this methodology, there is calculated depending on whether they use fuzzy membership functions or density functions. The data in this study was obtained from the Ministry of Trade and PD Pasar Jaya. Fuzzy clustering analysis in this study using Matlab application software.

Center of distribution of traditional market in Jakarta is defined by fuzzy clustering. we use MATHLAB to create the clustering. Fuzzy clustering with c-means is used for data analysis. The algorithm of fuzzy c-means (FCM) by (Kusumadewi 2004) are below :

1. Input data to be in the cluster is a matrix of n x m (n = number of data sample, m – attribute for each data). X_{ij} = sample data to i (i = 1,2,…,n), attribute to-j (j=1,2,…,m).
   Umber of cluster (c) = 15
   Square (w) = 2
   Maximum iteration (maxIter) = 100
   Error (ƺ) = 10^{-5}
   First objective function (P_0) = 0
   First iteration (t) = 1
2. Random number (μ_{ik}) generated,
   i = 1,2,…,n; k = 1,2,…,c; with sequence below.

$$Q_j \sum_{k-1}^{c} \mu_{ik} \quad (1)$$

j = 1,2,…,m, which are,

$$\mu_{ik} = \frac{\mu_{ik}}{Q_j} \tag{2}$$

3. Center of cluster to-k ; V_{kj} with k = 1,2,…,c; and j = 1,2,…,m

$$V_{kj} = \frac{\sum_{i=1}^{n}\left(\left(\mu_{ik}\right)^{w} * X_{ij}\right)}{\sum_{i=1}^{n}\left(\mu_{ik}\right)^{w}} \tag{3}$$

4. Objective fungsion at iteration to-t, P_t :

$$P_t = \sum_{i-1}^{n}\sum_{k=1}^{c}\left(\left[\sum_{j-1}^{m}\left(X_{ij} - V_{kj}\right)^{2}\right]\left(\mu_{ik}\right)^{w}\right) \tag{4}$$

5. Partition matrix change

$$\mu_{ik} = \frac{\left[\sum_{j=1}^{m}\left(X_{ij} - V_{kj}\right)^{2}\right]^{\frac{-1}{w-1}}}{\sum_{k=1}^{c}\left[\sum_{j=1}^{m}\left(X_{ij} - V_{kj}\right)^{2}\right]^{\frac{-1}{w-1}}} \tag{5}$$

i = 1,2,…,n ; and k = 1,2,…,c

6. Finish iteration
If :$(|P_t - P_{t-1}| < \varepsilon)$ or (t$> MaxIter$) so iteration is stopping.;
If not t = t+1, looping go to 3.

3. Discussion

Fuzzy c-means algorithm (FCM) is one of the most widely used method in fuzzy clustering. Data clustering is the process of dividing the data elements into classes or groups so that the characteristics in the same class made as closely as possible, and characteristic in different classes are created as different as possible. Depending on the nature and purpose of data clustering is used, consideration of the similarity of data can be used to put the data or the area into a same class, where the size of the degree of similarity determines how the cluster is formed. Some examples of parameters that can be used in clustering the distance, connectivity, and intensity (Kannan 2010).

Fuzzy clustering method of this paper is the method of Fuzzy C-Means (FCM) were adopted from (Yang 2012) and other authors (Klawonn 1999), (Agboizebeta 2012). Typically, the membership function is defined by a function of distance, so that the degree of membership proximities revealed entity cluster centers. By choosing a suitable distance function By choosing a suitable distance function (Bataineh 2011) deferent cluster shapes can be identified. However, this approach usually fails to explicitly explain how clustering fuzzy structure associated with the data from which the data are derived.

On hard clustering, the data were divided into different groups, where each data element belonging to one particular cluster. While on Fuzzy clustering (also called soft clustering), data elements can belong to more than one cluster, and associated with each element is a set of membership level. It shows the strength of the relationship between data elements and specific clusters. Fuzzy clustering is a process to put this membership level, and then use the degree of membership to define data elements into one or more clusters.

3.1 Parameter Identification of Determinants of Cluster

Clustering of traditional markets in Jakarta was built with four parameters are combined. The parameter is the position of latitude, longitude, the amount of cooking oil traders in traditional markets and the accessibility of the 153 traditional markets. The first stage to form a cluster analysis is to determine the point object traditional markets in a group called a cluster, then the point of traditional markets in the cluster have the same relative membership degree compared to other traditional markets point to another cluster.

Clustering is a main task of explorative data mining, and a common technique for statistical data analysis used in many fields, including machine learning, pattern recognition, image analysis, information retrieval, and bio informatics. Cluster analysis itself is not a particular algorithm, but the equations that are used are resolved. It can be calculated by various algorithms which differ significantly in terms of determining the parameters depending on the cluster and efficient way to determine the cluster Popular notion cluster is a group with close distance between cluster members, dense regions of the data space, interval or certain statistical distribution. Thus clustering can be formulated as a multi-objective optimization problem.

Clustering algorithms and parameters appropriate settings (including values as a function of distance to use, the threshold density or number of clusters expected) depends on the individual data sets and objective results. Clustering analysis is not an automatic process, but an iterative process of knowledge discovery or interactive multi-objective optimization that involves trial and error. It will often be necessary to modify preprocessing and parameters to achieve the results desired properties.

3.2 Clustering To Determine The Distribution Centers

Cluster centers are represented by vectors, which may not necessarily be a member of a cluster of data. When the number of clusters is fixed to k, k-means algorithm provides a formal definition as clustering optimization problem: finding the center of the cluster and assign the object to the nearest cluster center, so that the squared distance of the cluster can be minimized.

Optimization problem itself is known as a hard non-probabilistic, and thus a common approach is simply to find an approximate solution. A non-probabilistic methods are very famous is Lloyd's algorithm, in fact often referred to as "k-means algorithm". But it was only find a local optimum, and usually run several different random initialization times. Variations such as k-means generally choose the best optimization of several iterations of data, but also limits the concentration of members of the data set (k-medoids), choose the median (k-median clustering), randomly selecting initial center (K-means ++) or allows testing of fuzzy cluster (Nock 2006).

Most k-means-type algorithms require the number of clusters - k- to be specified in advance, which is considered to be one of the biggest drawbacks of these algorithms. Furthermore, the algorithms prefer clusters of approximately similar size, as they will always assign an object to the nearest centroid. This often leads to incorrectly cut borders in between of clusters (which is not surprising, as the algorithm optimized cluster centers, not cluster borders). K-means has a number of interesting theoretical properties. On the one hand, the method to partition the data space into a structure known as Voronoi13 diagram. On the other hand, is conceptually similar to the classification of nearest neighbor points between clusters. In addition, it can be seen as a variation of a model-based classification, and Lloyd algorithm as a variation of the expectation maximization algorithm.

There is a great interest in clustering techniques due to the vast amount of data generated in every field including business, health sciences, engineering and aerospace. It is essential to extract useful information from the data. Clustering techniques are widely used in pattern recognition and related applications. This research monograph presents the clusters for traditional market in Jakarta, which these have each distribution center.

Clustering of numerical data forms the basis of many classification and system modeling algorithms. The purpose of clustering is to identify natural groupings of data from a large data set to produce a concise representation of a system's behavior.

Fuzzy Logic Toolbox tools allow to find clusters in input-output training data (Bottani 2006). It can use the cluster information to generate a Sugeno-type fuzzy inference system that best models the data behavior using a minimum number of rules (Aryanezhad 2011). The rules partition themselves according to the fuzzy qualities associated with each of the data clusters.

Quasi-random two-dimensional data is used to illustrate how FCM clustering works[19]. To load the data set and plot it, type the following commands:

```
load sheet1.dat
plot(sheet1 (:,1), sheet1 (:,2),'o')
```

Next, invoke the command-line function fcm to find two clusters in this data set until the objective function is no longer decreasing much at all

```
[center,U,objFcn] = fcm(sheet1sheet1,15);
```

Here, the variable center contains the coordinates of the fifteen cluster centers, U contains the membership grades for each of the data points, and objFcn contains a history of the objective function across the iterations.The fcm function is an iteration loop built on top of the following routines:

- initfcm — initializes the problem
- distfcm — performs Euclidean distance calculation
- stepfcm — performs one iteration of clustering

This command returns the result in Table 1.

Table 1. Result of Iteration Process

ITERATION	FCN	ITERATION	FCN
Iteration count = 1	obj. fcn = 0.041209	Iteration count = 15	obj. fcn = 0.019307
Iteration count = 2	obj. fcn = 0.030768	Iteration count = 16	obj. fcn = 0.019042
Iteration count = 3	obj. fcn = 0.030263	Iteration count = 17	obj. fcn = 0.018754
Iteration count = 4	obj. fcn = 0.029399	Iteration count = 18	obj. fcn = 0.018506
Iteration count = 5	obj. fcn = 0.027972	Iteration count = 19	obj. fcn = 0.018407
Iteration count = 6	obj. fcn = 0.026048	Iteration count = 20	obj. fcn = 0.018366
Iteration count = 7	obj. fcn = 0.024263	Iteration count = 21	obj. fcn = 0.018337
Iteration count = 8	obj. fcn = 0.022998	Iteration count = 22	obj. fcn = 0.018313
Iteration count = 9	obj. fcn = 0.021964	Iteration count = 23	obj. fcn = 0.018292
Iteration count = 10	obj. fcn = 0.021105	Iteration count = 24	obj. fcn = 0.018275
Iteration count = 11	obj. fcn = 0.020507	Iteration count = 25	obj. fcn = 0.018262
Iteration count = 12	obj. fcn = 0.020139	Iteration count = 26	obj. fcn = 0.018251
Iteration count = 13	obj. fcn = 0.019853	Iteration count = 27	obj. fcn = 0.018242
Iteration count = 14	obj. fcn = 0.019580		

To view the progress of the clustering and show the iteration figure, we have plot the objective function by typing the following commands:

```
figure
plot(objFcn)
title('Objective Function Values')
xlabel('Iteration Count')
ylabel('Objective Function Value')
```

Figure of convergence level is presented on Figure 4.

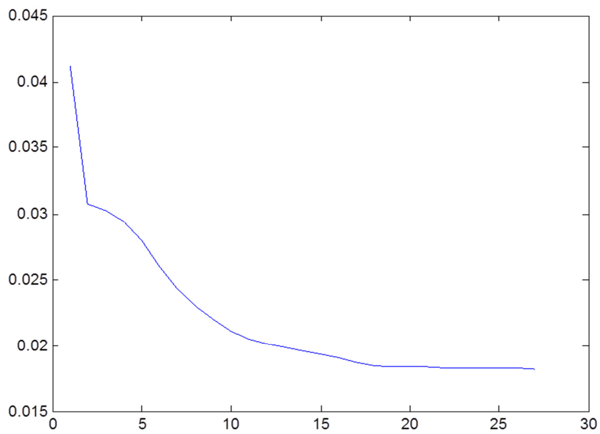

Figure 4. Convergence iteration level

3.3 Mapping Distribution Center by Fuzzy Clustering

Finally, plotting the fifteen cluster centers found by the fcm function using the following code:

```
maxU = max(U);
index1 = find(U(1, :) == maxU);
index2 = find(U(2, :) == maxU);
figure
line(fcmdata(index1, 1), fcmdata(index1, 2), 'linestyle',...
'none','marker', 'o','color','g');
line(fcmdata(index2,1),fcmdata(index2,2),'linestyle',...
'none','marker', 'x','color','r');
hold on
plot(center(1,1),center(1,2),'ko','markersize',15,'LineWidth',2)
plot(center(2,1),center(2,2),'kx','markersize',15,'LineWidth',2)
```

Center coordinate geographic of each cluster is presented on Tabel 2.

Table 2. Result of Iteration Process

LATITUDE	LONGITUDE
6,166857107	106,5257554
6,117264127	106,5397226
6,097970909	106,5185177
6,113407044	106,4485211
6,132045031	106,5232911
6,084219788	106,4826314
6,198297649	106,5389418
6,177211515	106,5031623
6,11282601	106,5040352
6,147559819	106,477369
6,09005159	106,4984854
6,111806182	106,483161
6,075793481	106,5700858
6,151378553	106,5046289
6,085014952	106,4341617

These are 15 cluster traditional market in Jakarta was defined. All of them will present on figure 5, 6, 7, 8, 9 and 10. Every cluster have one center called distribution center.

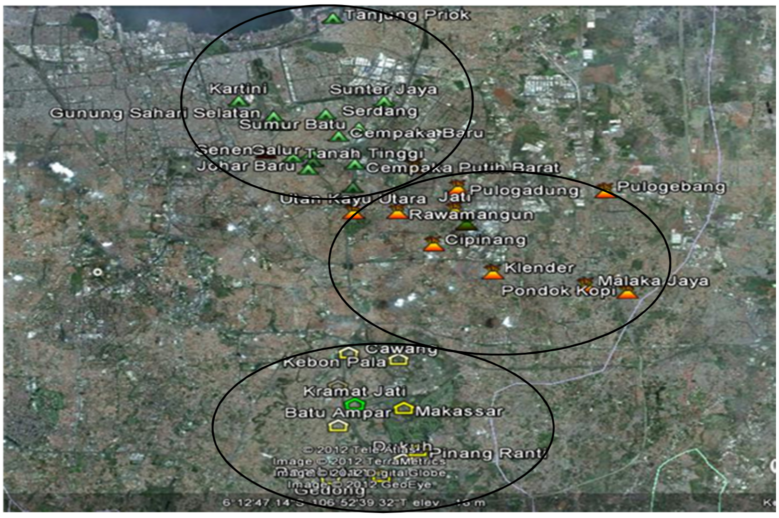

Figure 5. Cluster 1, 2 and 3

Figure 5 represents the cluster 1, 2 and 3. Members of the traditional markets in cluster 1 are: Cawang, BatuAmpar, Cililitan, Dukuh, Gedong, Kebon Pala, KramatJati, Makassar, Pinangranti, and Rambutan. Distribution centers in Cluster 1 is the traditional market Kramat Jati. Furthermore, members of the traditional markets in cluster 2 is: Cipinang, Jati, Jatinegara Kaum, Kayu Putih, Klender, Malaka Jaya, Pondok kopi, Pulogadung, Pulogebang, Rawamangun and Utan Kayu Utara. Distribution centers in cluster 2 is Jatinegara the traditional market. While members of the traditionalmarketsincluster3is: Tanjungpriok, Tanah tinggi, Sunterjaya, Sumurbatu, Senen, Rawasari, Kemayoran, Kartini, Kampungraya, Joharbaru, Gunung Sahari selatan, Galur, Cempaka baru, Cempaka putih barat and serdang. Distribution centers in cluster 3 is Senen traditional market

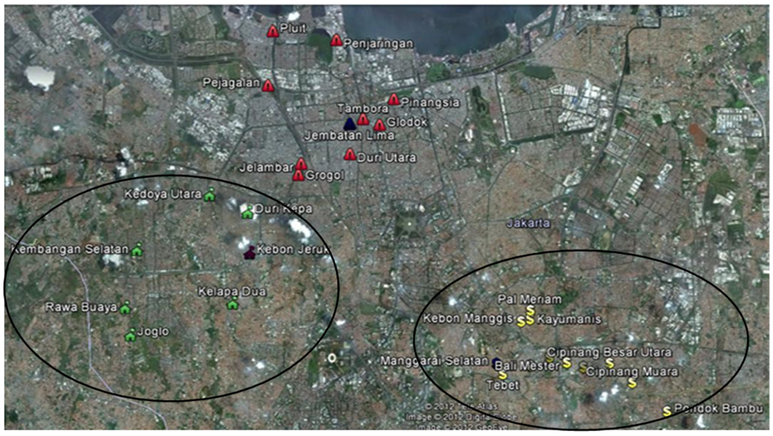

Figure 6. Cluster 4, 5 and 6

Figure 6 present the cluster 4, 5 and 6. Member of traditional market of cluster 4 are : Rawa buaya, Merayu selatan, Kembangan selatan, Kedoya utara, Kebon jeruk, Duri kelapa, Joglo, Kelapa dua. The distribution center of cluster 4 is Kebon jeruk traditional market. Then member of traditional market of cluster 5 are : Bali mester, Bukit duri, Cipinang besar utara, Cipinang muara, Kampung melayu, Kayu manis, Kebon manggis, Manggarai selatan, Pal meriam, Pondok bamboo, Rawabuaya and Tebet. The distribution center of cluster 5 is Manggarai selatan traditional market. Furthermore member of traditional market of cluster 6 are :Tambora, Pluit, Pinangsia, Penjaringan, Pejagalan, Jembatan lima, Jelambar, Grogol, Glodok, Duriutara. The distribution center of cluster 6 is Glodok traditional market.

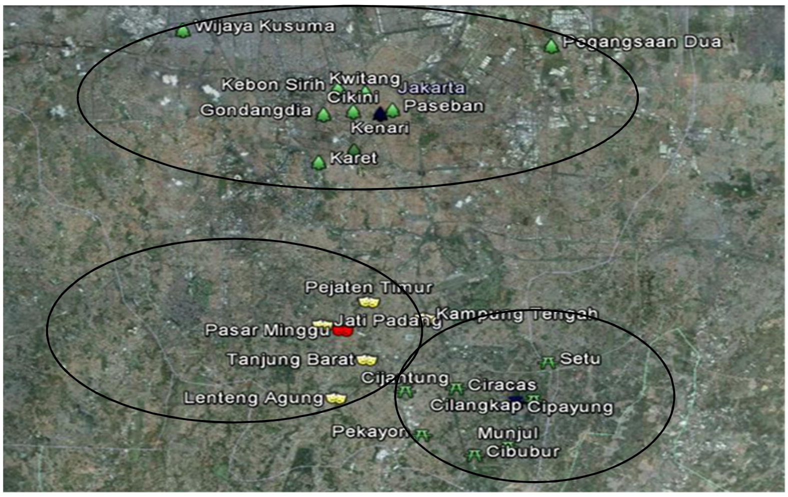

Figure 7. Cluster 7, 8 and 9

Figure 7 present the cluster 7, 8 and 9. Member of traditional market of cluster 4 are :Cibubur, Cijantung, Cilangkap, Cipayung, Ciracas, Munjul, Pekayon, and Setu. The distribution center of cluster 7 is Ciracas traditional market. Then member of traditional market of cluster 8 are : Jati padang, Kampung tengah, Lenteng Agung, Pasar minggu, Pejaten timur, Ragunan and Tanjung barat. The distribution center of cluster 8 is Pasar minggu traditional market. Furthermore member of traditional market of cluster 9 are :Wijaya kusuma, Pegangsaan dua, Manggis, Kwitang, Kenari, Kebon sirih, Karet, Gondangdia. Cikini and Paseban. The distribution center of cluster 9 is Kenari traditional market.

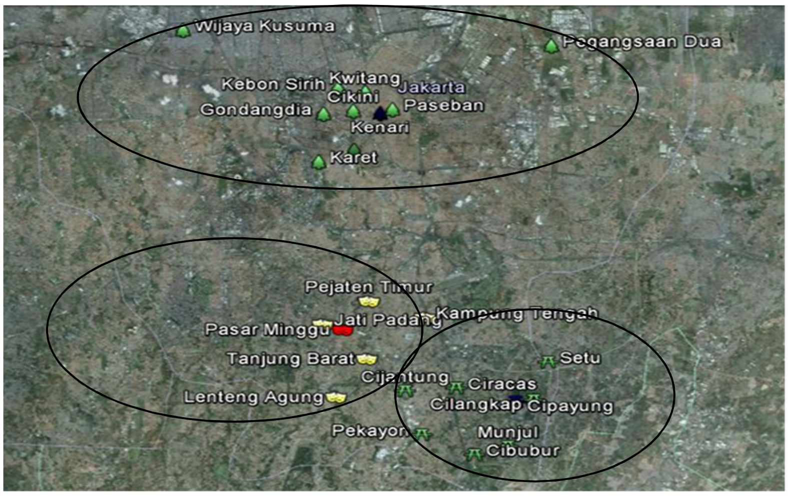

Figure 8. Cluster 10, 11 and 12

Figure 8 present the cluster 10, 11 and 12. Member of traditional market of cluster 10 are : Cipete Utara, Cipulir, Gandaria utara, Grogol selatan, Kebayoran lama selatan, Kramat pela, Lebak bulus, Melawai, Petukangan selatan, Pondok labu and Senayan. The distribution center of cluster 10 is Kramatpela traditional market. Then member of traditional market of cluster 11 are : Ancol, Gambir, Karang anyar, Kebon kelapa, Mangga besar, Mangga dua selatan, Pedemangan timur, Pasarbaru, Prtojo selatan and Taman sari. The distribution center of cluster 11 is Karang anyar traditional market. Furthermore member of traditional market of cluster 12 are : Bendungan hilir, Harapan mulia, Kampung bali, Karendang, Karet tengsin, Kebon kacang, Kebon melati, Kemanggisan, Kota bamboo selatan, Palmerah, Petamburan, Slipi, Tanjung duren utara and Tomang. The distribution center of cluster 12 is Petamburan traditional market.

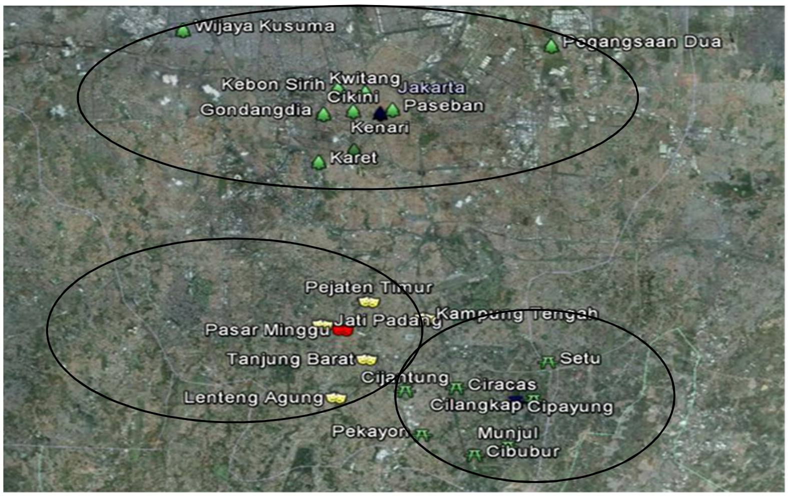

Figure 9.Cluster 13, 14 and 15

Figure 9 represents the clusters 13, 14 and 15. Members of the traditional markets in cluster 13: :Cakung timur, Cilincing, Kelapa gading timur, Marunda, Rorotan, Semper timur and Tugu utara,.Distribution centers in cluster 13 is the traditional market Cilincing. Furthermore, members of the traditional markets in cluster 14 are: Cikoko, Durentiga, Kalibata, Mampang prapat, Pancoran, Pelamampang, Rawabadak and Tegalparang. distribution centers in the cluster 14 is a traditional market Durentiga. While the members of the traditional markets in cluster 15 are: Cengkareng timur, Duri kosambi, Kalideres, Kamal, Kamarmuara, Kapuk, Pondok pinang, Selong and Tegalalur. distribution centers in the cluster 15 is a traditional market Kalideres.

3. Conclusion

The existence of traditional markets is very important to support the economy of the people of Indonesia, especially in Jakarta. Everyday they go to traditional market to buy many things for basic need consumption especially for palm cooking oil in bulky. Cooking oil that were not packaged or bulk form, it's time packed with simple packaging that can reach the public pleh medium. This is because the cooking oil is felt quite dangerous because it is not hygienic and prone to adulteration, for example with cooking oil. Thus the government's policy to require manufacturers to package bulk oil with simpler packaging Regulation of the Minister of Trade is set at number 2 in 2009.

The series of studies in this paper subsystem localized on cooking oil distribution mechanism is simple packaging especially in Jakarta. Good distribution mechanism can ensure the availability of supply in any traditional market, so it can be established simple packaging cooking oil prices. The mechanisms discussed in this paper with the determination of cluster solutions and distribution centers so simple packaged cooking oil distribution can be arranged well in 153 traditional markets in Jakarta. Traditional markets are divided into 15 clusters with each distribution center. Distribution centers are intended as a first link between the manufacturer of points with other traditional markets in channeling simple packaging cooking oil.

This traditional market cluster mapping using fuzzy-clustering method assisted with Matlab application as a data processing tool. Convergence of iterations on the processing of this data is the 27th iteration. At iteration is obtained respectively optimum distribution centers closest distance, the greater the capacity of trade and good protective accessibility between distribution centers and points of other traditional markets in each cluster.

Further advice of this research is the need for scheduling mechanism and determination of the distribution channels to distribute the simple bottled cooking oil from distribution centers to points of traditional markets that are members of a cluster. This is taking into account the type of fleet, fleet capacity and demand in the market points and also the production capacity of producers to meet the public demand, which is expected in the market price can be guaranteed stable and community health and economic stability.

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