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Analysis of Supply Chain Coordination of Soybean in East Java, Indonesia

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Abstract
Local soybean has not been able to compete than the import of soybean, both in terms of price and quality. To improve the competitiveness required training cooperation among participants of supply chain from farmers to agro-industry based on soybean. This mutual cooperation can be achieved if there is coordination system and to determine the extent of the coordination system has been applied, it is necessary to research the level of coordination in supply chain. The problem of the research is how the level of coordination in supply chain of soybean coordinated and uncoordinated, whether the variables that differentiate both of soybean supply chain, then how to coordinate the variables relationship in the forms of discriminant function. The research method includes factor analysis, cluster analysis and discriminant analysis. The result shows that a significant difference between the level of coordination in soybean supply chain, where the average discriminant score of soybean supply chain coordinated greater than the soybean supply chain which not coordinated. Then the variables that make the performance of both different soybean supply chain is Logistics Synchronization (SL), Alignment of Incentive (PI) and Collective Learning (PK) with discriminant model: zScore = -7.017 + 1.871SL + 1.994PI + 3.153PK. The government needs to improve the training of coordination system, thus the supply chain into a union that the members are interrelated and interdependent, where every member of supply chain has the responsibility against the overall supply chain performance.
Keywords: supply chain, coordination system, logistics synchronization, alignment of incentives, collective learning

1. Introduction

Indonesia has experienced a deficit in the soybean production for years as the impact of soybean production soybean production not able to keep the domestic soybean consumption which continues to increase. Based on the data from FAO (2012), this condition occurred since 1975 in which Indonesian soybean consumption at that time amounted to 0.61 million tons, whereas production was only 0.59 million tons or about 97% of the national soybean consumption, thus resulting in production deficit of 0.02 million tons. This continued in subsequent years until in 2009 the need reached 1.97 million tons, while production is only 0.97 million tons or about 49% of the national soybean demand or production deficit of about 1 million tons. The production deficit has been met by imported soybean. Thus to fulfill the national soybean demand, local soybean contribution decreases and its role was replaced by imported soybean.

This matter has led to dependence on imported soybeans (Secretariat of Republic of Indonesia, 2009). In addition, conditions of imported soybean prices are often cheaper even make farmers are not motivated to grow local soybean, thus in the end the local soybean supply decreases (Ministry of Agriculture, 2012). In addition to the price issue, there are other problems that the low quality of local soybean compared with imported soybeans. The low quality of local soybean is caused by technical factors both treatments occur at on farm level as less optimal use of production inputs or during post-harvest handling. Therefore, local soybean has not been able to compete than soybean imports, both in terms of price and quality of products.

Cases rise in soybean prices in 2008 is a valuable experience, where in 2008 there was a very significant increase in prices as the result of the increase in international prices and many economists consider that the high price increase will last long. According to Saragih (2008), it should be able to motivate farmers to increase production, but in reality the national soybean production does not increase even continue to decline. These conditions should be anticipated so that the supply chain actors can work together in mutually beneficial. In this case the traders and consumers in particular tempeh and tofu agro-industry need to proactively develop cooperation with soybean farmers. This mutual cooperation can be achieved if there is a system of coordination between local soybean supply chain actors. With a system of this kind of coordination is expected to motivate farmers to grow soybeans because the market was already guaranteed continuously, as well as agro-industry will get a continuous supply of soybeans as well with the price and quality that can compete. Bear responsibility of the supply chain is to coordinate the activities of production, input marketing, output marketing, and create a harmonious relationship between the actors.

With the efforts to improve the coordination are expected that supply chain members of soybeans increasingly

coordinated as a mutual entity. Thus the problem researched is how the level of coordination in soybean supply chain coordinated and the soybean supply chain that are not coordinated. In addition, it also researched about what factors that makes the difference in coordination level of both supply chains and how it relates of these factors in the form of the discriminant function. The goal is to determine the level of coordination in supply chain, which is expected to reveal a system of coordination in the supply chain for soybeans that unknown its performance. The end result can be used as a basis for consideration for soybean development in Indonesia.
Research on the mode of coordination in the soybean supply chain has not received attention. Therefore, this research intends to fill the gap in the area. This research is conducted in East Java Province, Indonesia on the basis that this province is a province that has the greatest contribution to the Indonesian soybean production. According to the Statistics Indonesia (2011), East Java soybean production contributes to the national soybean production since 1993 up to now has always been above 29% every year. With these conditions, the contribution of East Java towards the needs of the national soybean is still the largest compared to 33 other provinces.

2. Literature Review

A supply chain is a network of organizations that distribute output and distribute it from the manufacturer to the end customer, while supply chain management (SCM) is the coordination and control of all activities in a supply chain with the primary objective of maximizing value for the consumer. If the customer wants a product at a cheap price, then the supply chain is focused on producing products with high volume and standardized. If the demand is focused on innovative and customized products then the supply chain is build to facilitate the flexible products and have a maximum adaptation (Anindita, 2010). Supply chain is a unit of customers and suppliers who work together for the common interest (Azambuja & O'Brien, 2009). Both of the above opinion indicates that the mode of coordination is very important role in the supply chain operations and coordination aspect are the main key to success the supply chain
In the context of the supply chain, Malone and Crowston (1994) suggested that the coordination can be seen as an act of combining correctly (to connect, to harmonize, to adjust, to align) a number of objects (action, goal, decision, information, knowledge, funds) for achievement the goal of chain. Gittell (2011), suggests that coordination should be understood as a relational process, which involves a shared understanding of the work and the context in which the work was conducted. Relational coordination is a mutually reinforcing process of interaction between communication and connection made for the purpose of task integration. The research is based on the coordination mode proposed by Simatupang et al. (2002) who has compiled a taxonomy of coordination consisting of four different modes, namely logistics synchronization, information sharing, incentive alignment, and collective learning.
Several other researches show several models of supply chain coordination that combined with actual issues, such as internal and external integration model (Gimenez, 2006), quality management system (Van Plaggenhoef, 2007), the contract system (Arshinder et al., 2008), and electronic data interchange (Hill and Scudder, 2002). The results of research on the mode of coordination so far indicate that: (1) research is generally conducted in coordination in the organization interface functions such as production, procurement, inventory and distribution as well coordination have not seen in buyer-supplier relationships in the supply chain, (2) most of the research conducted for the scope of the manufacturing industry , and (3) research applied on agricultural commodities in the aggregate and not specifically discuss the one commodity. The advantages of this research is to apply taxonomic mode of coordination that comes from various sources of literature to analyze the coordination level of supply chain coordination levels of soybean and analyze supply chain actor with score approach.

3. Research Methods

The approach used in this study is quantitative approach. Sampling of farmers is conducted with multistage cluster sampling, namely the sampling process which conducted in two steps or more sampling (Nafiu et al., 2013). This method is selected because of the size of the population is unknown with certainty and its presence in a wide geographical spread, so it is not possible to made a sample framework.
The population in this research are soybean farmers in East Java. The first step is selecting the regencies as the first cluster, namely Banyuwangi and Jombang Regencies. Banyuwangi Regency chosen with consideration that district with the largest soybean production in East Java (Department of Agriculture of East Java Province, 2012). Whereas, Jombang Regency purposively selected is based on the great potential in the soybean development. The second step is selecting each of the 2 districts of each Regency as the second cluster based on the largest soybean production, namely Purwoharjo District and Tegaldlimo District in Banyuwangi Regency (Regional Development Planning Board of Banyuwangi Regency, 2010) and Sumobito District and Kesamben District in Jombang Regency (Statistics Jombang Regency, 2010). The third step is selecting sample of each 2 villages of every district as the third cluster on the basis of the largest soybean production, namely Glagahagung Village and Sumberasri Village (Purwoharjo District), Tegaldlimo Village and Kedungasri Village (Tegaldlimo District), Palrejo Village and Jogoloyo Village (Sumobito District), and Kedungbetik Village and Pojokkulon Village

(Kesamben District). The final step is sampling from each selected village using stratified random sampling technique, based on the acreage strata, which medium area (0.2 ha - 0.5 ha) and large area (0.5 ha - 1 ha) (Roosgandha and Darwis, 2000).

Analysis method used includes factor analysis, cluster analysis and discriminant analysis. In order to develop the scale, respondents is asked to rate on 5-point of likert scale on the level of coordination in the interface of farmer-trader-processor and confirmatory factor analysis are used to ensure the reliability of the developed scale. Malhotra (2007) suggested that the analysis factor does not distinguish between the independent variables and the dependent variable in which all variables have been researched and there is an interdependent relationship. Factor model of these variables are standardized as follows:

$$X_i = A_{i1}F_1 + A_{i2}F_2 + A_{i3}F_3 + ... + A_{im}F_m + V_iU_i \quad \text{.....(1)}$$

where:

X_i = standard variable i
A_{ij} = coefficient of standard multiple regression of variable i on the general factor j
F = general factor
V_i = standardized regression coefficient of variable i on specific factors i
U_i = specific factor of the variable i
m = number of general factors

Whereas, cluster analysis is used to determine the coordination step of supply chain actors, in this research the desired cluster is 2 clusters, namely clusters relations uncoordinated and coordinated clusters. To determine the condition of the average of a variable in a cluster, can be used the following general formula:

$$X = \mu + Z.\sigma \quad \text{..... ....(2)}$$

where:

X : average sample (variables in the cluster)
μ : average population
Z : the value of standardization
σ : standard deviation

Thus it can be seen beyond the average value of each variable in each cluster.

The next steps that need to be conducted is to see the difference variables in the cluster formed. In this case it can be seen from the value of F and the probability value (sig) of each variable, with the formula:

$$F = \frac{MS - Between}{MS - Within} \quad \text{.....(3)}$$

Where is in the ANOVA table, MS-Between shown by the Square Means in column clusters, whereas MS-Within shown by Means Square in error column. The larger the value of F and (sig> 0.05), the greater the difference variables in the cluster formed.

Furthermore, to determine the actors number of each formed cluster can be seen in the output table of Number of Cases in each Cluster. In this case, each supply chain actors will be known its existence in each cluster which shown in a particular column in the display of data view.

Now, to validate the results of cluster analysis, thus used discriminant analysis. Malhotra (2007) suggested that discriminant analysis model is an equation that shows a linear combination of various independent variables, namely:

$$D = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + ... + b_kX_k \quad \text{.....(4)}$$

where:

D = discriminant score
b = coefficient of discrimination or weight
X = predictor or independent variable

Estimation is conducted towards b coefficient, so that the value of D in each group is considerable different. It happens when the ratio of between-group sum of squares toward within-group sum of square to achieve maximum discriminant scores. Based on this D value, the membership within group of soybean supply chain actors is predicted.

4. Results and Discussions

The first step is to test the classical assumption, whereby the coordination analysis of supply chain conducted twice a classic assumption test, which is when the test of supply chain data coordination (the number of respondents 135 people) and the time of factor analysis (with 219 respondents). This is conducted considering both of them have data group from different respondent group.

Testing of the first classical assumption namely at the time of the data test of supply chain coordination, including normality test, multicollinearity test and heteroscedasticity test. Normality test based on the linear regression with the independent variables consist of variables Logistics Synchronization, Information Sharing, Incentive Alignment, Collective Learning, and Supply Chain, as well as Prices Class variable as the dependent variable. Computing linear regression gives the figure of R Square of 0.837 which shows that 83.7 % Prices Class variable can be explained by the Supply Chain variable, Information Sharing, Collective Learning, Logistics Synchronization and Alignment Incentives, while the remaining (16.3 %) is explained by other causes. From the ANOVA test or F test, obtained the F value of 132.891 with a significance level of 0.000 (much smaller than 0.05), thus the regression model can be used to predict the Prices Class. In other words, Logistics Synchronization, Information Sharing, Incentive of Alignment, Collective Learning, and Supply Chain jointly affect the Prices Class.

Similarly, the t-test shows that all the independent variables significantly affect the dependent variable (all Sig values is far below 0.05). Ratio value of skewness and kurtosis ratio of all variables are between the values of -2 and 2 so it can be concluded that the data of all variables are normally distributed. Computation result of multicollinearity test indicates that between the independent variables does not occur multicollinearity problem because the value of Variance Inflation Factor (VIF) of the variables is less than 5. Heteroscedasticity test is conducted by the Glejser test which regressing between independent variables with absolute value of its residual. Based on the table of output coefficients it appears that the value of the significance of all variables > 0.05 thus in this case we can conclude that there is no problem of heteroscedasticity.

4.1. Confirmatory Factor Analysis

The computation of validity test produces the value of the Kaiser Meyer Olkin about measure of sampling adequacy (KMO MSA) of 0.684 with a significance of 0.000. the number of 0.684 which greater than 0.5 is a good enough. Probability number for 0.000 is well below the 0.05 that showing all the variables have a high correlation in the correlation matrix. Based on Bartlett's test of sphericity test obtained the chi-square value of 1065 with 351 degrees of freedom and it is significant at 0.000, this means that the matrix is a correlation matrix and not the identity matrix so that it can be used a factor analysis.

Output of total variance explained suggests that the validity test has been successfully extracted into 4 components and produce 16 pieces of valid items. Even the output of component matrix further clarifies the position of the sixteen items of the statement (see Table 1).

Tabel 1. Output of Component Matrix

	Component [a]			
	1	2	3	4
Item 01	.808	-.155	-.246	.039
Item 02	.799	-.128	-.333	-.057
Item 03	.440	-.256	.252	.197
Item 04	.314	.123	.299	-.213
Item 05	.796	-.117	-.357	-.049
Item 06	.801	-.044	-.381	-.092
Item 07	.517	-.042	.353	.219
Item 08	.254	.847	-.003	-.010
Item 10	.177	.852	-.026	-.061
Item 11	.324	.835	.042	-.110
Item 12	-.325	.148	-.357	-.081
Item 14	.390	-.186	.404	-.029
Item 18	.405	-.021	.476	-.447
Item 20	.278	.219	.530	.429
Item 24	.368	-.132	-.010	.557
Item 26	-.194	.345	-.252	.593

Extraction Method: Principal Component Analysis; a. 4 components extracted.

The output of case processing summary and reliability statistics indicate that the case processed in the reliability test is totaled 135 respondents, so that there is no case issued with the value of Cronbach's Alpha (reliability coefficient) = 0.662. Cronbach's Alpha value = 0.662 (> 0.60) indicates that the result of measurement data of questionnaire has a good reliability level, or in other words the data results of the questionnaire can be trusted.

4.2. Cluster Analysis

The output of final cluster centers associated with the previous data standardization process and refers to the z-score has the following provisions:

- A negative (-) means that the data is under average total.
- A positive (+) means that the data is above the average total.

The results of data processing by cluster analysis, based on the output table of final cluster centers, can be summed up as follows:

- Cluster-1
  In this cluster-1 contains the actors of supply chain that have coordination system that lower than average population researched. This can be seen from the negative value (-) contained in the output of final cluster centers for all variables. Thus, it can be presumed that the cluster-1 is a grouping of supply chain actors that not coordinated.
- Cluster-2
  Whereas, the characteristics of supply chain actors grouped in cluster-2 are the supply chain actors who in the position of the above average population researched. So it can be assumed that the cluster-2 is a grouping of actors coordinated supply chain.

Based on the qcl_1 value, so that the composition of supply chain member can be broken down further by coordinating groups as in Table 2.

Table 2. The Composition of Supply Chain Actors Based on Coordination Group

Supply Chain	**Coordination Group**	**Total**	
		Person	**%**
Local Soybean	Not coordinated	109	63%
	Coordinated	64	37%
Imported Soybean	Not coordinated	3	7%
	Coordinated	43	93%
Total		**219**	

Table 2 shows that 63% of local soybean supply chain palyers including uncoordinated group and 93% of imported soybean supply chain actors including coordinated groups, thus it can be said that the local soybean supply chain is not coordinated supply chain and supply chain of imported soybeans is supply chain coordinated. Supply chain coordinated is supply chain that has a high degree of coordination, otherwise uncoordinated supply chain is supply chain with a low level of coordination. High and low level of coordination is determined by the high and low values of variables logistics synchronization, information sharing, incentive alignment, and collective learning.

4.3. Discriminant Analysis of Two Factors

For the purpose of discriminant analysis, the sample is divided into 2 parts, namely the sample for estimation and validation purposes. Based on Table 2 obtained 112 local and import supply chain actors that are not coordinated and 107 local and import supply chain actors are coordinated. For estimation purposes, the samples is used 56 local and import supply chain actors that are not coordinated and 54 local and import supply chain actors are coordinated.

Based on the column of Sig in the output table of tests of equality of group means can be seen that the three variables (Logistics Synchronization, Incentive Alignment and Collective Learning) turns tend to be different, while the Information Sharing variable tends to equal with Sig number > 0.05 (0.098). Thus, whether coordinated or not, the actors of supply chain is affected by those three variables.

Discriminant analysis has assumed that:

- Variance of independent variables should be the same for each group. If so, should the variance of respondents that coordinated equal to the variance of the respondents that not coordinated.
- The variance between the independent variables also should be the same. If so, should the variance of Logistics Synchronization equal to the variance of Sharing Information, and so on.

Both the above definition, it can be concluded that it should the group covariance matrices are relatively the same, which is tested by Box's M with the following provisions:

- Hypothesis
  Ho: group covariance matrices are relatively the same.
  H1: group covariance matrices are significantly different.
- The decision on the basis of significance (see figure Sig.)
  If the Sig. > 0.05 means that Ho is accepted.
  If the Sig. < 0.05 means that Ho is rejected.

Supply chain actors that include the type of coordinated, has the average value of Logistics Synchronization of 2.15 whereas the actors including uncoordinated type, has a lower average value of Logistics Synchronization, namely 1.62. Both numbers are assessed differently (output table of group statistics).

The output results of the variables entered/removed presents a variable that can be entered anywhere in the discriminant equation.

- In the first step, the F value of Logistics Synchronization is the largest, reaching 51.466 so that at the first step, Logistics Synchronization variable is selected.
- In the second step, with the one variable that has been reduced, the F value of Collective Learning variable

is the second largest, reaching 42.731 so that in this second step, the Collective Learning variable is selected.

- In the third step, with the two variables that have been reduced, the F value of Incentives Alignment variable is the third largest, reaching 34.017 so that at this third step, the Incentive Alignment variable is selected.

All three of these variables must have a sig value under 0.05.

Thus, based on the four variables included, there are only three significant variables, or can be said Logistics Synchronization variable, Collective Learning, and Incentive Alignment affect the behavior of members of the supply chain for coordinated or not.

The output result of structure matrix describes the correlation between the independent variables with the discriminant function formed. Visible Logistics Synchronization variable is the most closely associated with the discriminant function, followed by variables of Collective Learning and Incentive Alignment. Now, Information Sharing variable is not included in the discriminant model.

Output result of canonical discriminant function coefficients has similar function to a multiple regression equation, which is in the discriminant analysis caled as discriminant function:

zScore= -7.017 + 1.871 SL + 1.994 PI + 3.153 PK

where: SL = Logistics Synchronization, PI = Incentive of Alignment and PK = Collective Learning.

The usefulness of this function is to determine whether a case (in this case is a supply chain actor) belongs to a group or belong to other groups.

In addition to the above function, the menu selection of fisher function coefficient on analysis process will also form a Fisher discriminant function. As well as the display of unstandardized (canonical), Fisher discriminant function in principle create such a regression equation based on code of division group (see Table 3).

Table 3. Coefficients of Fisher Discriminant Function

	Coordination Group	
	1	2
Logistics Synchronization	10.808	14.447
Incentive Alignment	17.832	21.711
Collective Learning	15.334	21.466
(Constant)	-20.044	-33.726

Supply chain actors in a coordinated category:

SCORE= -33.726 + 14.447 SL + 21.711 PI + 21.466 PK

Supply chain actors in uncoordinated category:

SCORE= -20.044 + 10.808 SL + 17.832 PI + 15.334 PK

The difference between coordinated and uncoordinated groups is:

(-33.726 + 14.447 SL + 21.711 PI + 21.466 PK) – (-20.044 + 10.808 SL + 17.832 PI + 15.334 PK)

or:

zScore= -13.682 + 3.639 SL + 3.879 PI + 6.132 PK

It appears that zScore from Fisher function is proportional to the previous unstandardized function:

zScore= -7.017 + 1.871 SL + 1.994 PI + 3.153 PK

Calculating scores on casewise statistics performed using unstandardized function. The Fisher function is exactly proportional to the unstandardized function; in this case by dividing each coefficient from Fisher function of 1.95 values will be obtained unstandardized zScore function.

5. Conclusion

There are significant differences between the coordination levels in supply chain soybean coordinated with soybean supply chain uncoordinated. This evidenced in the analysis of Wilk's lambda and functions at group centroids, where the average score of the discriminant soybean supply chain coordinated is greater than soybean supply chain uncoordinated (0.990> -0.955).

Variables that make the performance of soybean supply chain different are Logistics Synchronization, Incentive Alignment and Learning Collective. This can be seen in the initial analysis step, both on the part of variable in analysis and variable not in analysis.

Discriminant model or discriminant function in this research is:

zScore = -7.017 + 1.871 SL + 1.994 PI + 3.153 PK

Model (function) discriminant above has accuracy of classifying cases by 79%. Because the value is above 50%, then the accuracy of the model is considered quite high, and the above model can be used to classify a particular case. As an entity that is not separate, every actor needs to improve supply chain coordination activity that makes a coordinated supply chain, namely the supply chain implement the values of logistics synchronization, incentive alignment, and collective learning, in delivering soybeans from upstream to downstream. It is recommended to the Government through the relevant departments to conduct the training in a coordinate system in the extension activities or special events held to it, so that the supply chain into a union whose members are interrelated and

interdependent with each actor or member of the supply chain has responsibility for supply chain performance as a whole.

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