EUROPEAN ACADEMIC RESEARCH
Vol. XI, Issue 6/ September 2023

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Evaluation of Supplier Performance using AHP (Analytical Hierarchy Process): A case study in UMKM BERKAH in Sidomulio Hamlet, Bekiung Village, Kuala District, Langkat Regency

ARI SANJAYA
Researcher and Student in Agribusiness, University of Medan Area
Dr. Ir. ZULHERI NOER, MP
Researcher and Lecturer in Agronomy, University of Medan Area
SRI ARIANI SAFITRI, SP., M.SI
Researcher and Lecturer in Agribusiness Management, University of Medan Area

Abstract

The industrial sector acts as a leading sector, meaning that industrial development will encourage and increase the development of other sectors such as the agricultural sector. For example, the rapid growth of the industrial sector will encourage the growth of the agricultural sector. The agricultural sector industry, namely agro-industry, plays an important role in regional development activities, both in terms of equitable development and economic growth. This is supported by agricultural natural resources that are able to produce many processed products. To be able to operate a good, efficient and effective supply chain system, it is necessary to measure supply chain performance. Supply chain performance is the meeting point between consumers and related parties which has been qualified with the relevance of attributes on performance indicators that occur from time to time. This measurement aims to evaluate the activities carried out by supply chain members using the AHP (Analytical Hierarchy Process) method.

Keywords: Supply Chain, Corn Chips, Entrepreneurs

INTRODUCTION

The industrial sector is one of the sectors that has an important role in national economic development. The industrial sector makes a considerable contribution to national income, besides that the industrial sector is a sector that absorbs labor and creates added value to the various products that have been produced. The industrial sector is one of the strategies that must be pursued in achieving the process of economic development in order to achieve a high level of income per capita (Tambunan, 2001).

Food processing industry activities in North Sumatra Province are a leading sector that contributes greatly to the absorption of the largest number of workers in North Sumatra Province, namely 105,362 workers in 2018. The contribution of the food processing sector increased in 2019, amounting to 107,241 workers (BPS North Sumatra Province, 2019).

Kuala sub-district has the second largest production of 23 sub-districts in Langkat Regency which is 9,897.00 tons, after Sei Bingai sub-district with a production of 36,822.98 tons (BPS Langkat Regency, 2021). When viewed from these data, the

Kuala sub-district has the potential to develop processed food industries with the main raw material of corn such as processed corn chips which have been produced by BERKAH UMKM in Sidomulio Hamlet, Bekiung Village, Kuala Sub-district, Langkat Regency.

To be able to operate a good, efficient and effective supply chain system, it is necessary to measure supply chain performance. Supply chain performance is the meeting point between consumers and related parties where it has been qualified with the relevance of attributes on performance indicators that occur over time (Christien et al., 2006).

The AHP (Analytical Hierarchy Process) method used in measuring supply chain performance in general has covered all components of supply chain actors from suppliers to consumers. This measurement aims to evaluate the activities carried out by members of the supply chain.

CONCEPT IDEA

Analytical Hierarchy Process (AHP) is defined as a method that can support a decision by describing a problem with factors and criteria into a hierarchy. To measure the Analytical Hierarchy Process (AHP), the following steps can be used (Munthafa, 2017):

1. Define a problem and determine the solution to be used.
2. Create a hierarchical structure that has the main objectives presented in Figure 1.

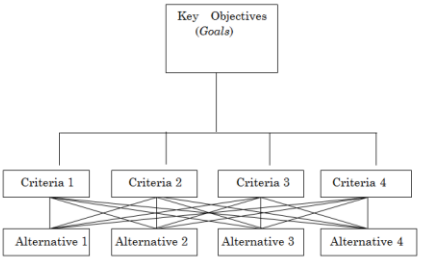

Figure 1. AHP Hierarchical Structure

3. Create a pairwise comparison matrix that affects each element against the criteria presented in table 1.

Table 1. Pairwise Comparison Matrix

	Criteria – 1	Criteria – 2	Criteria – 3	Criteria – n
Criteria – 1	K11	K12	K13	K1n
Criteria – 2	K21	K22	K23	K2n
Criteria – 3	K31	K32	K33	K3n
Criteria – n	Kn1	Kn2	Kn3	K4n

Source: Marsono, 2014

4. Define the total number of raters as n x [(n-1)/2], where n is the number of elements being compared to get the size of the table used. The values to be used in the pairwise comparison matrix table can be measured by the scale found in Table 2.

Table 2. Pairwise Comparison Rating Scale

Importance intensity	Description
1	Both elements are equally important
3	One element is slightly more important than the other
5	One element is more important than another
7	One element is more important than the other
9	One element is absolutely essential to the other
2,4,6,8	Values between two adjacent consideration values
Opposite	If activity i gets one number compared to activity j, then j has the opposite value compared to i.

Source: Marsono, 2014

5. Calculate eigenvalues and test for consistency, if inconsistent then data collection is repeated.
6. Repeating steps 3, 4 and 5 for all hierarchy levels
7. Calculating the eigenvector value of each pairwise comparison matrix sum for prioritizing the lowest hierarchy level elements to achieve the goal.
8. The calculation is done by summing the values of each column concerned to obtain the normalization of the matrix and summing the values of each row and dividing them by the number of elements to obtain the average value.
9. If A is a pairwise comparison matrix, then the vector of weights formed is as follows:

$$(A)(wT) = (n)(wT)$$

can be approached by :
1. Normalize each column j in matrix A, such that:

$$\sum_i a\,(i,j) = 1$$

Call it A:
2. A Calculate the average value for each row i in A

$$w_i = \frac{1}{n}\sum_i a(i, j)$$

where wi is the i-th destination of the weight vector.
10. Checking the consistency of the hierarchy, for example, A is a pairwise comparison matrix and w is a weight vector, the consistency of the weight vector w can be tested as follows:

Suppose A is a pairwise comparison matrix and w is the weight vector, then the consistency of the weight vector w can be tested as follows:

(1) Calculate: (A)(wT)

$$t = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{\text{element to} - i \text{ at (A) } (w^T)}{\text{element to} - i \text{ at } w^T}\right)$$

(2) Calculate the consistency index:

$$CI = \frac{t-n}{n-1}$$

(3) The random index RIn is the average value of randomly selected CIs in A and is given as :

N	2	3	4	5	6	7	…
RI_n	0	0,58	0,90	1,12	1,24	1,32	…

(4) Calculate the consistency ratio :

$$CR = \frac{CI}{RI_n}$$

With criteria:

a. If the value of CR = 0, then the value of the hierarchy is sufficiently said to be consistent

b. If the value of CR < 0,1 then the value of the hierarchy is said to be fairly consistent.

c. If the value of CR > 0,1 then the hierarchy value is said to be inconsistent.

ANALYSIS

Performance assessment is carried out on the agro-industry of corn chips UMKM Berkah which produces corn into processed corn chips with assessment criteria, namely: planning, processing, delivery and consumers.

The alternative performance assessment to be taken is 20 people consisting of farmers, corn chips entrepreneurs, corn chips traders, and consumers in Kuala District, Langkat Regency with a list of respondents: farmers (Suppliers) 1, farmers 2, farmers 3, farmers 4, farmers 5, corn chips entrepreneurs UMKM Berkah 1, traders 1, traders 2, traders 3, traders 4, traders 5, consumers 1, consumers 2, consumers 3, consumers 4, consumers 5, consumers 6, consumers 7, consumers 8, consumers 9, consumers 10, and consumers 11.

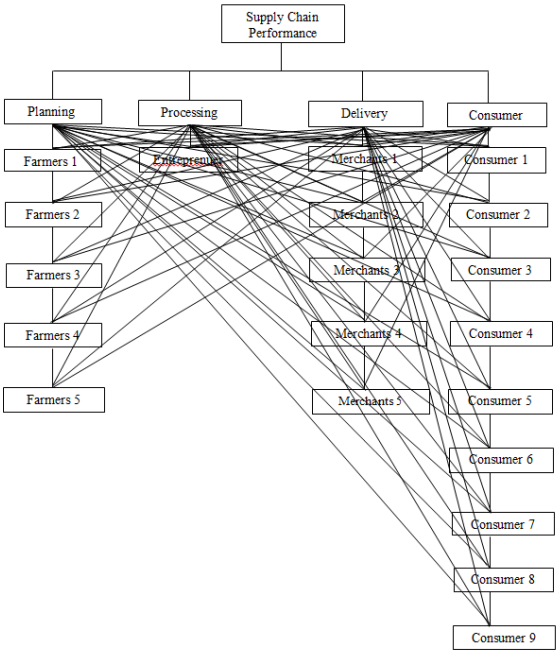

Figure 2. Hierarchical structure of corn agro-industry as raw material for corn crackers

The criteria in this research are planning, processing, delivery and consumers while the alternatives are farmers, Blessing MSME entrepreneurs, traders, and consumers. Criteria and alternatives have a correlation with each other in this study. This is because supply chain performance greatly affects the supply chain flow in the corn chips agro-industry, so that the supply chain performance starting from farmers - Blessing MSME entrepreneurs - traders - consumers is coordinated and integrated.

1. Creating a pairwise comparison matrix with the results obtained from respondents, namely processing to planning is worth 5, delivery to planning is worth 3, consumer to planning is worth 2, delivery to processing is worth 1/3, consumer to processing is worth 1/4 and consumer to delivery is worth 1/3. After getting the value, the next step is to enter each value according to the place presented in Table 3.

Table 3. Pairwise Comparison Matrix

Criteria	Planning	Processing	Delivery	Consumer
Planning	1	1/5	1/3	½
Processing	5	1	3	4
Delivery	3	1/3	1	3
Consumer	2	¼	1/3	1
Total	11	1,78	4,66	8,5

2. Define a pairwise comparison that will obtain a total of n x [(n-1)/2] raters, where n is the number of elements being compared.
The number of weights of the pairwise comparison rating scale is 9.

$$[(n-1)/2] = [(9-1)/2] = 8/2 = 4$$

Using a 4x4 matrix.

3. Calculate the eigenvalue by testing its consistency. If the value is inconsistent, then the data collection is repeated. To calculate the normalization eigenvector, you must add up the matrix of each criterion. To calculate the first criteria matrix can be seen in table 4.

Table 4. Search for Eigen Vectors Normalizing Planning Criteria

Criteria	Planning	Processing	Delivery	Consumer	Total
Planning	1	1	0,99	1	3,99
Planning	0,2	0,2	0,1089	0,125	0,6339
Planning	0,33	0,6	0,33	0,165	1,425
Planning	0,5	0,8	0,99	0,5	2,79
			Line 1		8,8389

Based on Table 4, the matrix sum result for planning criteria is 8.8389. The next step is to add up the matrix values of the processing criteria presented in Table 5.

Table 5. Search for Eigen Vectors Normalizing Processing Criteria

Criteria	Planning	Processing	Delivery	Consumer	Total
Processing	5	5	9	8	27
Processing	5	0,2	0,99	1	7,19
Processing	15	0,99	1	1,32	18,31
Processing	20	2	3	3	28
		Line 2			80,5

Based on Table 5, the matrix summation result for processing criteria is 80.5. The next step is to sum up the matrix values for the delivery criteria presented in Table 6.

Table 6. Search for Eigen Vectors Normalizing Delivery Criteria

Criteria	Planning	Processing	Delivery	Consumer	Total
Delivery	3	1,65	3	6	13,65
Delivery	0,99	0,2	1	0,75	2,94
Delivery	3	0,99	0,33	0,99	5,31
Delivery	9	0,165	4	3	16,165
		Line 3			38,065

Based on Table 6, the result of the matrix summation for the delivery criteria is 38.065. The next step is to sum up the consumer criteria matrix values presented in Table 7.

Table 7. Search for Eigen Vector Normalization of Consumer Criteria

Criteria	Planning	Processing	Delivery	Consumer	Total
Consumer	2	1,25	0,99	2	6,24
Consumer	0,4	0,25	0,1089	0,25	1,0089
Consumer	0,66	0,75	0,33	0,33	2,07
Consumer	1	1	0,99	0,5	3,49
		Line 4			12,8089

Based on Table 7, the result of the matrix summation for the delivery criteria is 12.8089.

4. Calculating the eigenvector in each pairwise comparison matrix which is the weight of each element for prioritizing elements starting from the lowest hierarchy to achieve the objectives presented in Table 8.

Table 8. Calculating the Eigen Vector of Each Matrix

Criteria	Planning	Processing	Delivery	Consumer	Total	EVN
Planning	3,99	0,6339	1,425	2,79	8,8389	0,063
Processing	27	7,19	18,31	28	80,5	0,574
Delivery	13,65	2,94	5,31	16,165	38,065	0,271
Consumer	6,24	1,0089	2,07	3,49	12,8089	0,091
		Overall			140,2128	

Based on Table 8, the normalized eigenvector value of each criterion is obtained, in the planning criteria obtained a value of 0.063, the processing criteria obtained a value of 0.574, the shipping criteria obtained a value of 0.271 and the consumer criteria obtained a value of 0.091.

5. Calculating the consistency ratio value:
Suppose A is said to be a pairwise comparison matrix and w is said to be a weight vector, then the consistency of the weight vector w can be tested as follows:

a). Calculate : $(A)(w^T)$

$$t = \frac{1}{n}\sum_{i=1}^{n} \frac{\text{element to} - \text{i at } (A)\ (w^T)}{\text{element to} - \text{i at } w^T}$$

$$t = \frac{11\ (0{,}063039) + 1{,}78\ (0{,}574127) + 4{,}66\ (0{,}271480) + 7{,}5\ (0{,}091353)}{1{,}000000}$$

$$t = \frac{0{,}69343098 + 1{,}0219466403 + 1{,}2650977646 + 0{,}776502931}{1{,}000000}$$

$$t = \frac{3{,}7569783115}{1{,}000000}$$

$$t = 3{,}756$$

b). Calculating the consistency index value:

$$CI = \frac{t - n}{n - 1}$$

$$CI = \frac{3{,}756 - 4}{4 - 1}$$

CI = - 0, 081

c). The random index RIn can be interpreted as the average value of randomly selected CIs in A and given the following values:

N	2	3	4	5	6	7	…
RI_n	0	0,58	0,90	1,12	1,24	1,32	…

d). Calculating the ratio value:

$$CR = \frac{CI}{RI_n}$$

$$CR = -\frac{0{,}081}{0{,}90}$$

$$CR = -0{,}09$$

With criteria:

a. If the value of CR = 0, then the value of the hierarchy is sufficiently said to be consistent

b. If the value of CR < 0,1 then the value of the hierarchy is said to be fairly consistent.

c. If the value of CR > 0,1 then the hierarchy value is said to be inconsistent.

Based on the description above, the consistency ratio of the criteria is -0.09, meaning that the performance of the corn agroindustry business as a raw material for corn chips is quite consistent. It can be seen based on the relationship between criteria and alternatives that are interrelated, then the consistency of values on criteria and alternatives is tested using a comparison matrix scheme and normalization eigen search. So that the CR value is <0.1 with the explanation that the hierarchy is quite consistent.

So it can be concluded that the supply chain of corn as raw material for corn chips agro-industry that has been running in this research location is farmers (suppliers) - corn chips entrepreneurs - corn chips traders - consumers and it is known

that the performance of the supply chain in this study has been running well. However, the highest weight value of criteria in this study is in the criteria of processing, delivery, consumers and planning where in this study there is a problem because the actual structure mechanism begins with planning, processing, delivery and consumers. However, in this study respondents prioritized processing, shipping, and consumers first compared to planning because when the researchers conducted research at the location of the corn chips agro-industry of UMKM Berkah the business was already running.

CONCLUSION

The performance of the corn supply chain as a raw material for the Berkah UMKM corn chips agro-industry in the research area is known that the CR value = -0.09 with a consistency ratio value of CR <0.1, so the hierarchical value is said to be quite consistent.

ADVICE

1. To Berkah UMKM corn chips entrepreneurs to be able to increase partnership cooperation with UMKM or grocery stores to expand the marketing area of processed corn chips products so as to increase the production capacity of Berkah UMKM.
2. As for farmers as suppliers of raw materials for corn chips in order to provide good quality raw materials, namely by providing pipil corn that has large and dry seeds so that during the production process it produces wide corn chips and has a crunchy texture.
3. Berkah UMKM can utilize digital marketing in marketing corn chips products such as Facebook, Instagram, and other market places.

REFERENCES

1. Aprilia, N., Affandi, M. I., & Kasymir, E. 2021. Analysis of Supply Chain and Value Added of Kelanting Agroindustry in Gantimulyo Village, Pekalongan District, East Lampung. Journal of Agribusiness Sciences, 9(1), 177-182.
2. BADRI, A. B. A. 2022. ANALYSIS OF SUPPLY CHAIN OF CORN AS A FARM FOOD MATERIAL (Case Study: Kecamatan Gunung Maligas, Kabupaten Simalungun) (Doctoral dissertation).
3. Bank Indonesia. 2012. PBI No 14/22/PBI/2012. accessed from www.bi.go.id on October 30, 2022.
4. Beamon BM. (1998). "Supply Chain Design and Analysis: Models and Methods". International Journal of Production Economics. 55(3), pp 281-294.
5. BPS. 2019. Number of Establishments and Workforce by Industry Classification in Micro and Small Industries. https://langkatkab.bps.go.id. (accessed October 5, 2022).
6. BPS. 2021. Maize Production by District. https://langkatkab.bps.go.id. (accessed September 28, 2022).
7. Chopra, S., and Meindl, P. 2004. Supply chain management: Strategy, planning, and operations. New Jersey - Prentice Hall.
8. CHRISTIEN, et al .2006. Quantifying the Agri Food Supply Chain. Netherlands: Spinger International Publisher Science.
9. Dewantara, R. S., Setiawan, B., & Anindita, R. 2013. SUPPLY CHAIN ANALYSIS OF CORN EMPING AGROINDUSTRY (Case Study on Corn Emping Agroindustry in Pandanwangi Village, Blimbing District, Malang City). Habitat, 24(2), 141-152.
10. Faqih, A., Rizkiani, D., & Budirokhman, D. 2019. Analysis of Corn Emping Agroindustry Business (Case in Ciomas Village, Sukahaji District, Majalengka Regency). Agrijati Scientific Journal of Agricultural Sciences, 29(3), 45-56.
11. Flippo, E.B. 2003. Personnel Management, Volume 1, Jakarta: Erlangga

12. Gunasekaran, A., & Ngai, E. W. (2009). Modeling and analysis of build-to-order supply chains. European Journal of Operational Research, 195(2), 319-334.
13. Hadiguna, R. P. (2016). Agro-industry Supply Chain Management.
14. Krisnamurthi, B., & Saragih, B. (2020). Year of development study: poverty reduction, agribusiness development and agricultural revitalization.
15. Kusnandar, F., Adawiyah, D. R., & Fitria, M. (2010). Accelerated Shelf-life Testing of Biscuits Using a Critical Moisture Content Approach. Journal of Food Technology and Industry, 21(2), 117-117.
16. Lockamy, A., & McCormack, K. 2004. The development of a supply chain management process maturity model using the concepts of business process orientation. Supply Chain Management: An International Journal.
17. Marsono. 2014. The Use of Analytical Hierarchy Process (AHP) Method in Research. Jambi University. 88 Pages.
18. Munthafa, A. E and H. Mubarok. 2017. Application of the Analytical Hierarchy Process Method in the Decision Support System for Determining Outstanding Students. Siliwangi Journal. Vol 3 No 2.
19. Pangestuti, M. D., Mukson, M., & Setiadi, A. 2019. Analysis of Marketing Supply Chain and Value Added of Grain in Undaan District, Kudus Regency. Journal of Agricultural Economics and Agribusiness, 3(4), 671-680.
20. Pujawan. I Nyoman. 2005. Supply Chain Management. Guma Widya, Surabaya
21. Qhoirunisa, A. 2014. Rice Supply Chain in Bogor Regency, West Java. Thesis. Bogor Agricultural University, Bogor.
22. Ramadhan, S., Anindita, R., & Suhartini, S. 2015. SUPPLY CHAIN MANAGEMENT PERFORMANCE OF CORN EMPING AGROINDUSTRY (Case in Pandanwangi Village, Blimbing District, Malang City). HABITAT, 25(3), 173-182.
23. Saaty, T. L. 2004. Decision making-the analytic hierarchy and network processes (AHP/ANP). Journal of systems science and systems engineering, 13, 1-35.
24. Sibuea, F. A., Sibuea, M. B., & Azwana, A. 2022. Supply Chain Analysis of Umkm Broom Lidi in Deli Serdang Regency. JASc (Journal of Agribusiness Sciences), 6(1).
25. Soekardijo. 1999. basic logic. Jakarta: Gramedia.
26. Suarni and I.U. Firmansyah. 2005. Effect of harvest age on the nutritional content of corn kernels of several varieties. Research results of Balitsereal Maros. Unpublished. 14 p.
27. Sugiono. 2008. Research Methods Qualitative, qualitative and R & D. Bandung. Afabeta. 334 pages.
28. Sugiyono. 2010. Educational Research Methods Quantitative, Qualitative, and R&D Approaches. Bandung. Alfabeta.
29. Tambunan, T.H. 2001. Indonesian Economy. Ghalia Publisher. Jakarta.
30. Tjitrosoepomo, G. (1991). Plant Taxonomy. Yogyakarta: Gadjah Mada University Press.