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Analysis of The Core Industry Determination of Cassava-Based Industrial Clusters Development in Jember Regency

Emi Kurniawati*, Yani Subaktilah
Department of Agricultural Technology, Politeknik Negeri Jember, Mastrip Street PO BOX 164 Sumbersari
*Correspondence: emi_kurniawati@polije.ac.id

Abstract. *The cassava-based industry is an industry that processes cassava into various processed products. Development of cassava-based industry in Jember Regency can be carried out through a cluster approach. The cluster approach is a geographic concentration of interrelated and collaborating companies, involving suppliers of goods, service providers, core industries, related industries, and institutions. This research aims to determine the potential core industry of cassava-based industrial cluster development in Jember Regency. Analysis of the core industry of cassava-based industrial cluster development in Jember Regency was carried out using the AHP (Analytical Hierarchy Process) method. The research stages start from analysis, hierarchical structure, and AHP method to obtain core industry priorities. The research results show that the type of cassava-based industry that has the highest alternative weight is the tape industry with a weight of 0.415. The tape industry is the core industry with the most potential because in terms of 6 criteria, namely: the number of industries, market reach, production capacity, raw material potential, government policy, and access to investor funding, the tape industry has the highest weight. Based on this, the tape industry was chosen to be the core industry of cassava-based industrial cluster development in Jember Regency.*

Keywords: *Analytical Hierarchy Process, Cassava-based, Cluster, Core industry*

INTRODUCTION

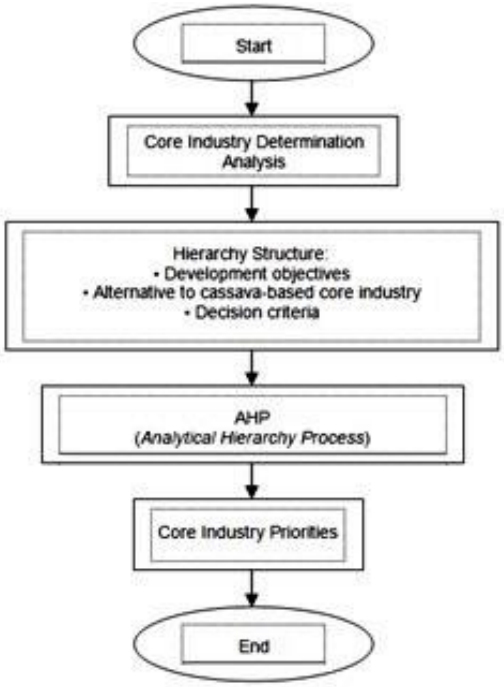
One of the agricultural commodities with adequate availability is cassava. Cassava has the potential to be used as food raw material and industrial products with high economic value through agro-industry. The cassava-based industry is an industry that processes cassava into various processed products. Most cassava-based industries are carried out on a small and medium enterprise (SME) scale (Kurniawati *et al.*, 2019). Jember Regency is one of the areas in East Java that has the potential for developing a cassava-based industry. Industrial development that can be carried out by cassava-based industry players in Jember Regency is through a cluster approach. The cluster approach is a geographic concentration between companies that are interrelated and working together, involving suppliers of goods, service providers, core industry, related industry, and several institutions that specifically function as supporting and complementary. According to Dewanti *et al.* (2017)) the industrial cluster approach in regional economic development can be used as an effective tool for regional economic development policies and integrated technology policies.

Determining the core industry in an industrial cluster has been carried out in research by Lolowang (2012) and Tarigan (2008). In both studies, there are several criteria used to determine the core industry, namely (1) raw material potential, (2) agro-industry distribution, (3) production capacity, (4) market reach, (5) human resource potential, and (6)) knowledge and technology capabilities. The core industry is the industry that is used as the entry point for the study, it can be an industrial center. It is hoped that the core industry in an industrial cluster will gain many benefits from being in the cluster because of the cluster's advantages such as collective efficiency and efficiency in transaction costs. This research aims to determine the potential core industry for developing cassava-based industrial clusters in Jember Regency. Determining the core industry can be analyzed using the AHP (Analytical Hierarchy Process) method. The AHP method allows testing consistency in assessments, namely by checking and reducing inconsistencies in opinions or assessments (Aziz *et al.*, 2016).

METHOD

The materials used in this research are primary data. The primary data in this research are the results of a questionnaire filled in by experts who are directly involved in the development of cassava-based industrial clusters. The experts involved consist of

lecturers, researchers, industry practitioners, and government officials. The primary data used is the results of the AHP (Analytical Hierarchy Process) hierarchical structure value for determining the core industry. The tools used in this research are laptops and laptop software. Analytical data processing for determining the core industry for developing cassava-based industrial clusters using Microsoft Excel software.



Source: processed data

Figure 1
Research Stage

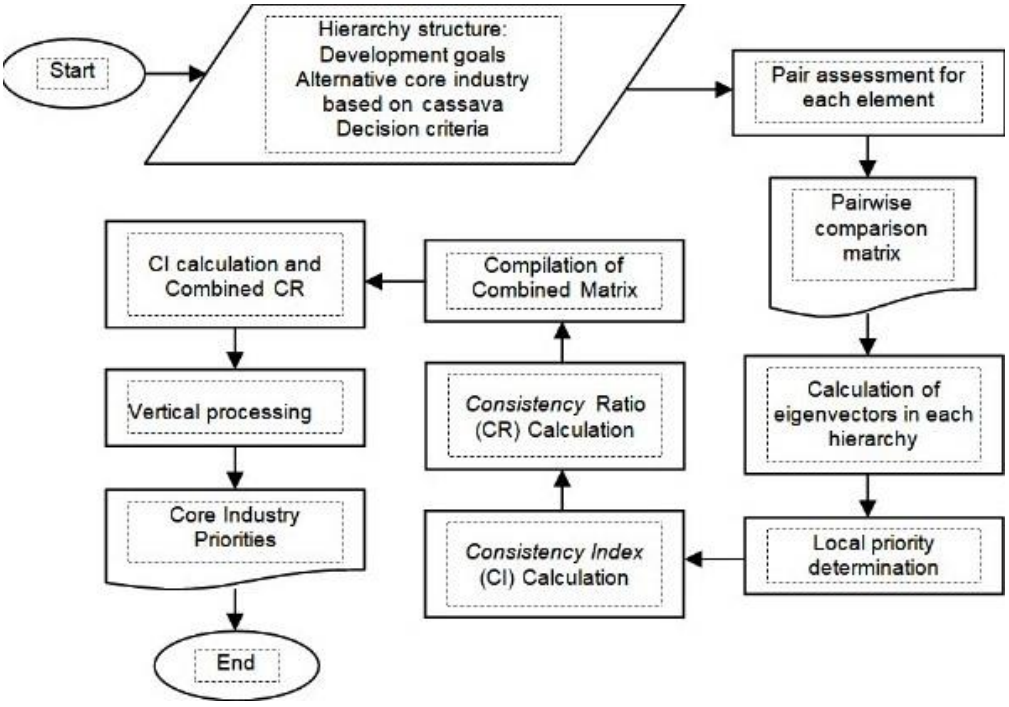


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Figure 2
Flow Diagram of The Model For Determining Core Industries Based on Cassava

This research is a type of qualitative research with a descriptive design using the AHP (Analytical Hierarchy Process) method. The data collection method was carried out by giving questionnaires to 3 experts. The questionnaire functions as instrumentation to obtain primary data in determining priority core industries for developing cassava-based industrial clusters in Jember Regency. Based on the research objective to be achieved, namely determining the core industry for developing cassava-based industrial clusters in Jember Regency, this research was carried out in several stages. The research stages start from analysis, hierarchical structure, and AHP method to obtain core industry priorities. The research stages of the analysis of determining the core industry for the development of a cassava-based industrial cluster can be seen in Figure 1.

The data obtained is primary data, then the data is processed using the AHP (Analytical Hierarchy Process) method. The AHP method is a multi-criteria decision-making method supported by a methodology that has been recognized and accepted as a priority which in theory can provide different answers to decision-making problems and provide a ranking of alternative solutions (Taherdoost, 2017). The flow diagram for the analysis of determining the core industry for the development of cassava-based industrial clusters in Jember Regency using the AHP method is presented in Figure 2.

The procedure for using the AHP method to determine cassava-based core industries is as follows: (1) define the problem and determine the solution for determining the cassava-based core industry; (2) create a hierarchical structure that includes general objectives, criteria, and alternative cassava-based core industries that you want to rank; and (3) form a pairwise comparison matrix that describes the relative contribution or influence of each element towards each goal or criterion at the level above it, then make a comparison based on the choice or judgment of the decision maker by assessing the levels of importance of one element compared to other elements.

Table 1
Pairwise Comparison Scale Assessment Criteria

Level of Importance	Definition
1	Equally important
3	A little more important
5	Obviously more important
7	It's clearly more important
9	Definitely/absolutely more important
2, 4, 6, 8	When in doubt between two adjacent values Kindness scores the level of
1 / (1-9)	importance on a scale of 1-9

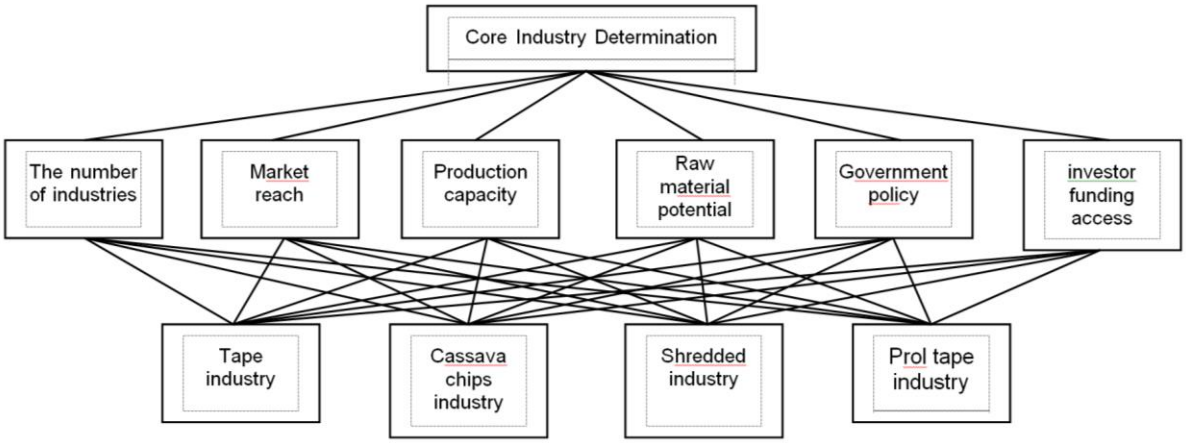
Source: Kumar and Pant (2022)

1. Calculate the eigenvector value of each pairwise comparison matrix. The eigenvector value is the weight of each element. This step is to synthesize choices in determining the priorities of elements at the lowest hierarchical level until goal achievement.
2. Test the consistency of the hierarchy, if it does not meet the CR (Consistency Ratio) < 0.100 then the assessment must be repeated.
3. Determine priority criteria and alternatives for cassava-based core industries through ranking.

RESULTS

Hierarchy Structure

The hierarchy structure for determining the core industry in the cassava-based industrial cluster can be seen in Figure 3. The hierarchical structure consists of decision objectives, criteria, and selected alternatives.



Source: processed data

Figure 3
Hierarchical Structure For Determining Core Industries Based On Cassava

The first level in the process hierarchy is the decision objective. Determining the core industry is the first level which aims to determine the core industry in the cassava-based industrial cluster. The second level is the criteria that are considered in selecting alternatives. In Figure 3 there are 6 criteria, namely the number of industries, market reach, production capacity, raw material potential, government policy, and investor funding access. The third level is the existing alternatives. In Figure 3 there are 4 alternative core industries, namely the tape industry, cassava chips industry, shredded industry, and prol tape industry. The importance of criteria in a process hierarchy can be used to determine core industries. The same thing has been done by Din & Yunusova (2016), there are criteria used in agro-industrial projects, namely financial, social, and risk criteria, then these criteria are used to improve agro-industrial projects so that they contribute to the success of their evaluation.

Calculation Between Criteria

The criteria for determining core industries are the number of industries, market reach, industrial capacity, material potential, government policy, and access to investor funding. Data for weighting criteria in determining the core industry was obtained from a questionnaire distributed to 3 experts. Criteria weighting is done by calculating the geometric mean and obtaining one priority weight in the comparison matrix. Setiawan *et al*. (2021) explain that the AHP method only requires one answer for the comparison matrix. The criteria weight values are influential in considering priorities for determining core industries in cassava-based industrial clusters. This is similar to research conducted by Suryaningrat & Fianeka (2017), that in determining priorities for the Rice Milling Unit (RMU) scale, it is necessary to pay attention to priority weights based on the main criteria (economic, social, technological, equipment and machine design, and area potential). The comparison matrix between criteria and its normalization can be seen in Table 2 and Table 3. Next, calculate the assessment weights for pairwise comparisons between criteria.

Table 2
Pairwise Comparison Between Criteria

	K1	K2	K3	K4	K5	K6
K1	1.00	0.24	1.26	0.32	1.14	1.49
K2	4.22	1.00	2.47	1.00	2.15	3.48
K3	0.79	0.41	1.00	0.55	1.49	1.82
K4	3.11	1.00	1.82	1.00	2.15	4.22
K5	0.87	0.46	0.67	0.46	1.00	1.26
K6	0.67	0.29	0.55	0.24	0.79	1.00

Information: K1 = the number of industries; K2 = market reach; K3 = production capacity; K4 = raw material potential; K5 = government policy; and K6 = investor funding access
Source: processed data

Table 3
Matrix Normalization

	K1	K2	K3	K4	K5	K6	Total	Weight
K1	*0.09	0.07	0.16	0.09	0.13	0.11	0.66	0.110
K2	0.40	0.29	0.32	0.28	0.25	0.26	1.80	0.299
K3	0.07	0.12	0.13	0.15	0.17	0.14	0.78	0.131
K4	0.29	0.29	0.23	0.28	0.25	0.32	1.66	0.277
K5	0.08	0.14	0.09	0.13	0.11	0.09	0.64	0.107
K6	0.06	0.08	0.07	0.07	0.09	0.08	0.45	0.075

Source: processed data

Calculation:

$$* = \frac{criteria\ comparison\ value}{total\ values\ per\ column} = \frac{1}{10.66} = 0.09$$

The calculation of the Consistency Ratio or CR value for comparison between criteria is as follows.

$$Lamda\ Max\ (\lambda) = \overline{Eigen} = 6.11$$

$$Consistency\ Index\ (CI) = \frac{Lamda\ Max\ -\ n}{n\ -\ 1} = \frac{6.11\ -\ 6}{5} = 0.02$$

$$Random\ Index\ (RI) = 1.24$$

$$CR = \frac{CI}{RI} = \frac{0.02}{1.24} = 0.017$$

The Consistency Ratio or CR value in the comparison between criteria is 0.017 so the CR value is consistent and acceptable because the CR value is ≤ 0.1. The pairwise comparison value is considered consistent if the Consistency Ratio or CR value is ≤ 0.1. If the CR value is > 0.1 then the pairwise comparison value is declared inconsistent and needs to be revised for the assessment (Aritonang *et al.*, 2020).

Calculation Between Alternatives

Table 4
Pairwise Comparison Between Alternatives in Terms of The Number of Industries Criteria

K1	A1	A2	A3	A4
A1	1.00	1.36	2.32	2.32
A2	0.74	1.00	1.91	1.91
A3	0.43	0.52	1.00	0.91
A4	0.43	0.52	1.10	1.00

Information:
K1 = the number of industries; A1 = tape industry; A2 = cassava chips industry; A3 = shredded industry; and A4 = prol tape industry
Source: processed data

Table 5
Matrix Normalization

K1	A1	A2	A3	A4	Total	Weight
A1	0.38	0.40	0.37	0.38	1.53	0.382
A2	0.28	0.29	0.30	0.31	1.19	0.298
A3	0.17	0.15	0.16	0.15	0.63	0.156
A4	0.17	0.15	0.17	0.16	0.66	0.164

Source: processed data

Table 6
Pairwise Comparison Between Alternatives in Terms of Market Reach Criteria

K2	A1	A2	A3	A4
A1	1.00	2.62	2.62	3.11
A2	0.38	1.00	3.11	3.68
A3	0.38	0.32	1.00	1.26
A4	0.32	0.27	0.79	1.00

Information: K2 = market reach
Source: processed data

Table 7
Matrix Normalization

K2	A1	A2	A3	A4	Total	Weight
A1	0.48	0.62	0.35	0.34	1.79	0.448
A2	0.18	0.24	0.41	0.41	1.24	0.310
A3	0.18	0.08	0.13	0.14	0.53	0.133
A4	0.15	0.06	0.11	0.11	0.43	0.109

Source: processed data

Table 8
Pairwise Comparison Between Alternatives in Terms of Production Capacity Criteria

K3	A1	A2	A3	A4
A1	1.00	1.71	1.65	1.00
A2	0.58	1.00	1.82	2.71
A3	0.61	0.55	1.00	1.26
A4	1.00	0.37	0.79	1.00

Information: K3 = production capacity
Source: processed data

Table 9
Matrix Normalization

K3	A1	A2	A3	A4	Total	Weight
A1	0.31	0.47	0.31	0.17	1.27	0.316
A2	0.18	0.28	0.35	0.45	1.26	0.315
A3	0.19	0.15	0.19	0.21	0.74	0.186
A4	0.31	0.10	0.15	0.17	0.73	0.183

Source: processed data

Table 10
Pairwise Comparison Between Alternatives in Terms of Raw Material Potential Criteria

K4	A1	A2	A3	A4
A1	1.00	1.44	3.68	3.68
A2	0.69	1.00	3.68	3.11
A3	0.27	0.27	1.00	0.46
A4	0.27	0.32	2.15	1.00

Information: K4 = raw material potential
Source: processed data

Table 11
Matrix Normalization

K4	A1	A2	A3	A4	Total	Weight
A1	0.45	0.48	0.35	0.45	1.72	0.430
A2	0.31	0.33	0.35	0.38	1.37	0.341
A3	0.12	0.09	0.10	0.06	0.36	0.091
A4	0.12	0.11	0.20	0.12	0.55	0.138

Source: processed data

Table 12
Pairwise Comparison Between Alternatives in Terms of Government Policy Criteria

K5	A1	A2	A3	A4
A1	1.00	1.44	3.11	3.56
A2	0.69	1.00	3.11	3.11
A3	0.32	0.32	1.00	1.71
A4	0.28	0.32	0.58	1.00

Information: K5 = government policy
Source: processed data

Table 13
Matrix Normalization

K5	A1	A2	A3	A4	Total	Weight
A1	0.44	0.47	0.40	0.38	1.68	0.420
A2	0.30	0.32	0.40	0.33	1.36	0.339
A3	0.14	0.10	0.13	0.18	0.56	0.139
A4	0.12	0.10	0.07	0.11	0.41	0.102

Source: processed data

Table 14
Pairwise Comparison Between Alternatives in Terms of Investor Funding Access Criteria

K6	A1	A2	A3	A4
A1	1.00	1.44	3.11	3.98
A2	0.69	1.00	1.82	3.11
A3	0.32	0.55	1.00	2.47
A4	0.25	0.32	0.41	1.00

Information: K6 = investor funding access
Source: processed data

Table 15
Matrix Normalization

K6	A1	A2	A3	A4	Total	Weight
A1	0.44	0.44	0.49	0.38	1.74	0.436
A2	0.31	0.30	0.29	0.29	1.19	0.297
A3	0.14	0.17	0.16	0.23	0.70	0.175
A4	0.11	0.10	0.06	0.09	0.37	0.092

Source: processed data

Table 16
Final Assessment Results

Alternative	K1	K2	K3	K4	K5	K6	Total	Ranking
Priority Weight	0.110	0.299	0.131	0.277	0.107	0.075		
Tape Industry	0.38	0.45	0.32	0.43	0.42	0.44	0.415	1
Cassava Chips Industry	0.30	0.31	0.31	0.34	0.34	0.30	0.320	2
Shredded Industry	0.16	0.13	0.19	0.09	0.14	0.17	0.134	3
Prol Tape Industry	0.16	0.11	0.18	0.14	0.10	0.09	0.131	4

Source: processed data

The value obtained is the sum of each criteria weight from each core industry multiplied by the criteria priority weight. The value 0.415 is the highest value, where this value is the result of an assessment by 3 experts based on the criteria determined for the tape industry. Thus, the tape industry with a value of 0.415 is the best core industry among other core industries.

Criteria Priority Analysis

In Table 16 it can be seen that the order of criteria with the highest to lowest weight is market reach (0.299), raw material potential (0.277), industrial capacity (0.131), the number of industries (0.110), government policy (0.107), and access investor funding (0.075). The weight shows the level of importance of the criteria for determining the core industry. The higher the weight of a criterion, the greater the influence of the criterion on the goals to be achieved. Based on the results of the criteria weights, it can be seen that market reach has the highest weight. This shows that market reach is a factor that must be considered in determining the core industry in the cassava-based industrial cluster in Jember Regency. The market reach in question is the marketing of cassava-based products not only in Jember Regency, but also outside the region. According to Listanto *et*

al.(2023), the level of market concentration plays an important role in determining the strength of competition in an industrial cluster, where if the reach is wider, the competition tends to be stronger.

Core Industry Determination Analysis

In this research, the alternative is the cassava-based product industry which was selected and prioritized as the core industry for the development of the cassava-based industrial cluster in Jember Regency. Alternative cassava-based industries in determining the core industry based on the results of literature studies are (1) tape industry, (2) cassava chips industry, (3) shredded industry, and (4) prol tape industry. Alternative weightings are obtained by calculating the geometric average to obtain priority weights. The priority order for cassava-based industries can be seen in Table 17.

Table 17
Results of Core Industry Alternatives for the Development of Cassava-Based Industrial Clusters

Core Industry Alternatives	Weight	Priority
Tape Industry	0.415	1
Shredded Industry	0.134	3
Prol Tape Industry	0.131	4
Cassava Chips Industry	0.320	2

Source: processed data

Based on Table 17, it can be seen that the priority order from 1 to 4 is the tape industry, cassava chips industry, shredded industry, and prol tape industry. The tape industry is an alternative core industry that has the highest weight so it was chosen as the core industry in the development of the cassava-based industrial cluster in Jember Regency. This is because the tape industry in each of the 6 criteria, namely number of industries, market reach, production capacity, raw material potential, government policy, and access to investor funding has a high assessment weight compared to other core industry alternatives. If an alternative has the highest criteria assessment weight in large numbers compared to other alternatives, then that alternative can be designated as the preferred alternative. Simanjorang & Widharto (2023) in their research explained that the supplier PT Bona Hutaraja was the supplier in the first place, this was proven by the 3 criteria that PT Bona Hutaraja had the highest weight.

CONCLUSION

Determining the core industry for the development of a cassava-based industrial cluster in Jember Regency using the AHP (Analytical Hierarchy Process) method, it can be seen that the type of cassava-based industry that has the highest alternative weight is the tape industry with a weight of 0.415. The tape industry is the core industry with the most potential based on 6 criteria, namely: the number of industries, market reach, production capacity, raw material potential, government policy, and access to investor funding. In these 6 criteria, the tape industry has the highest weight score compared to other cassava-based core industries. So, based on the weight of these criteria and alternatives, the tape industry was chosen to be the core industry in developing a cassava-based industrial cluster in Jember Regency.

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