

solution to determine the best raw material suppliers for the company. Therefore, the MSME is urged to apply the supplier selection method, using the Multi Objective Optimization on the Basis of Ratio Analysis (MOORA) method.

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The type of research used is quantitative and qualitative research. Qualitative research uses data regarding supplier selection that includes a weighting assessment of the best supplier criteria. Quantitative analysis is obtained from filling out questionnaires by related parties

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The analysis process has built a goal and two levels. There are six main criteria which classified as level 1, and each criterion has its own sub criteria as level 2. Table 2 shows the five original criteria and sub criteria from of the research model which being analyze with pair-wise comparison method using data from respondents.

Table 2 Criteria and sub criteria of the research model

Criteria	Sub criteria
Price	Raw material price
	Discounted price
	Payment
Quality	Specification
	Freshness
	Size
Delivery	Lead time
	Geographic area
	Quantity
Service	Responsibility
	Behaviour
	Service contact
Flexibility	Responsiveness
	Custom quantity order
	Delivery time

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1. Interview
2. Questionnaire
3. Literature Study

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2.4.1 Data Processing Method Using AHP

1. Define problems and determine solutions to existing problems by compiling a hierarchical structure starting from general goals and criteria and making sorted sub criteria and alternative choices.

2. Create a pairwise comparison matrix that describes the relative contribution to each goal or criterion at the level above
3. Normalize the data by dividing the value of each element in the matrix and the total value of each column.
4. Calculate the priority value of the vector obtained from the number of each row
5. Calculating the weights obtained from (prioritas vektor)/(n matriks)
6. Determine the eigenvalue by multiplying the weight obtained from normalization with the total, the first matrix (the total result is called max
7. After calculating max, then look for the consistency index or consistency index (CI) as follows:

$$CI = \frac{\lambda - n}{n - 1} \quad (1)$$

Whereas:

CI = Consistency index

max = eigenvalues

n = number of resulting matrices

8. The consistency ratio (CR) is obtained by comparing the consistency index (CI) with the value of the random index number (RI) as follows:

$$CR = \frac{CI}{RI} \quad (2)$$

Whereas:

CI = Consistency index

RI = Random index

9. Hierarchy consistency test with CR <0.1

2.4.2 Data Processing Method Using MOORA

1. Decision Matrix
This decision matrix is in the form of data that has been taken during data collection which made in the form of a matrix
2. Matrix normalization
Matrix normalization is the calculation of the value of each criterion and each alternative supplier of raw material for fish crackers

$$X = [X_{11} X_{12} X_{1n} X_{21} X_{22} X_{2n} X_{m1} X_{m2} X_{mn}] \quad (3)$$

3. Normalization of weighted matrix
Weighted matrix normalization is a calculation based on matrix normalization multiplied by the weights in the data collection.

$$X_{ij} = X_{ij} / \sqrt{\sum_{i=1}^m X_{ij}^2} \quad (4)$$

Whereas:

X_{ij} = alternative matrix j on criterion i

i = 1, 2, 3, ..., n is thesequence number of attributes or criteria

j = 1, 2, 3, ..., m is an alternative sequence number

X_{ij} = alternative normalization matrix j on criterion i

4. Multi-objective optimization, the normalized size is added in the case of maximization for favourable attributes and reduced in minimization (for

unfavourable attributes) or, in other words reducing the maximum and minimum values in each row for ranking in each row.

$$y_i = \sum_{i=1}^g w_j x_{ij} - \sum_{i=g+1}^n w_j x_{ij} \quad (5)$$

Whereas:

$i = 1, 2, \dots, g$ is the criteria/attribute with maximized status

$i = g+1, g+2, \dots, n$ are criteria/attributes with minimized status

W_j = criterion weight

X_{ij} = normalized matrix value

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A consistency test is a way to find out whether the results of filling out the questionnaire in pairwise comparisons have a value that can be said to be consistent or not. Decision making is carried out under the following conditions:

CR < 0.10 = Consistent

CR > 0.10 = Inconsistent

Calculating CI (consistency index) with eigenvalue λ_{max} matrix / n matrix minus one so that the result is 0.03. RI is adjusted to the RI table, which is 0.58 because it uses the order matrix (3) and then calculates the CR (consistency ratio) resulting from the CI/RI, which is 0.05, not more than 0.10 so it is consistent.

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3.2.2 Matrix Normalization Calculation on Criteria
Matrix normalization is calculating the value of each criterion from each supplier. The following is the calculation of each supplier. Normalization of Price criteria matrix for Martono suppliers

$$X_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}$$

$$X_{ij} = \frac{Rp \ 53.000}{\sqrt{[53.000^2 + 62.000^2 + 55.000^2 + 65.000^2]}}$$

$$= \frac{53.000}{117.910,98}$$

$$= 0,45$$

The result of the calculation of the normalization of the price criteria matrix on the supplier Martono is 0.45.

3.2.3 Calculation of Weighted Matrix Normalization on Criteria

#"
[0,45 0,44 0,44 0,53 0,54 0,53 0,55 0,55 0,53 0,54 0,47 0,44 0,44 0,40 0,36 0,55 0,55 0,55 0,53 0,54]!

Normalization of the Martono supplier weighted matrix

$$y_i = \sum_{i=1}^g w_j x_{ij} - \sum_{i=g+1}^n w_j x_{ij}$$

$$y_i = (X_{12}(max) * W + W + X_{14}(max) * W + X_{15}(max) * W) - (X_{11}(min) * W + X_{13}(max) * W)$$

$$y_i = ((0.44x0.42) + (0.53x0.11) + (0.54x0.13) - (0.45x0.42) + (0.44x0.11))$$

$$y_i = (0.10 + 0.06 + 0.07) - (0.19 + 0.05)$$

$$y_i = 0.23 - 0.24$$

$$= 0.01$$

The result of the normalization of the weighted matrix on the Martono supplier is 0.01

Table 3. Recap of the calculation results of the weighted matrix normalization for each supplier

N:DD6'B;	H#[7:7! ! O\:#6/%*!NB;-K]6B['M'6/%P	H'.7:7 ! !O9:'KB*! CB6'-B;%F	^! ! OH#[!!! H'.P!	R#.<!
H#;/,., !	_Q04	_Q08	_Q !	(!
N'&,! H#<7:; !	_Q0?	_Q0'	T_Q_0	0!
C\$#;7#!	_Q(a	_Q08	T_Q_#	8!
HB6#/'! HB<#;	_Q0?	_Q0a	T_Q_4	4!

3.2.3 Ranking of Suppliers on Criteria

This ranking will determine which supplier will be selected for Bu Musidah's fish cracker SMEs. Here are the results of the supplier rankings:

Table 4. Ranks of Each Supplier

N:DD6'B;	R#.<!
H#;/,., !	(!
N'&,!H#<7:; !	0!
C\$#;7#!	8!
HB6#/'!HB<#;	4!

The table results are the ranking of each supplier obtained from the weighting calculation using the AHP method and the MOORA method. These results were obtained on the supplier Martono with rank 1; the selection was based on data collection through questionnaires and data processing using AHP and MOORA. The AHP method makes the results of pairwise comparisons and calculates the weight value used for the MOORA method; the AHP method also criteria and subcriteria. The criteria include price, quality, delivery, service and flexibility. In the criteria there are subcriteria, namely the cost of raw materials for each supplier, discounts, payment methods, fish specifications, fish freshness level, fish size, timeliness of delivery, geographical location, the accuracy of delivery numbers, supplier responsibilities, supplier behaviour, ease of contact, time order response, ease of adding and subtracting orders and flexibility of delivery time. From each criterion and subcriteria, data were collected directly from the MSME owners, and the results were obtained for data processing using the AHP and MOORA methods. These results were obtained at the Martono supplier with rank 1 and the result the

Sido Makmur supplier are expected to make Bu Musidah Fish Crackers SMEs able to cooperate well through the selection of the best suppliers from the four other suppliers in the selection of raw material suppliers for sea cucumbers.

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This research uses the Analytical Hierarchy Process (AHP) method criteria and subcriteria. That generated from the study of the literature and adjust the problems found in the research object. The criteria are price, quality of delivery, service and flexibility. In the criteria there are subcriteria. The price criterion has subcriteria such as price of raw materials for each supplier, discounts, payment methods. For quality criterion, the sub criteria are fish specifications, fish freshness level, fish size. The delivery criterion has the subcriteria such as, timeliness of delivery, geographical location, and the accuracy of the number of deliveries. For service criterion, the subcriteria are the responsibility of the supplier, the behaviour of the supplier. For flexibility criterion, the subcriteria are ease of contact, order response time, ease of adding and subtracting orders and flexibility of delivery time.

Decision making using the MOORA (Multi Objective Optimization on The Basis of Ratio Analysis) method is carried out to determine the ranking of each supplier that will be selected later. The calculation of the MOORA method was carried out using a questionnaire related to price, quality, delivery, service and flexibility criteria. Data processing using MOORA goes through stages, namely the results of the questionnaire are entered into the formation of a decision matrix, calculating the normalization of the matrix and the normalization of the weighted matrix and determining the maximum and minimum for each criterion so that a ranking can be carried out on each supplier. Ranking of each supplier obtained from the calculation of weighting using the AHP method and the MOORA method. These results were obtained and concluded that the supplier Martono is the most appropriate raw material suppliers for the Bu Musidah's Fish Cracker Producer.

>"="*"1" . \$

b(cQ JQ! RBX#B*! JQ! 1#.A*! #.&! dQ! E#-#22X%*! ed'.<'.A!
2:DD6'B;! &B-B6,D7B./! /,! 2:DD6'B;! 2BA7B./#/,!
'2'.A! I! B2/! 1,;2/! HB/\$,&*e! @! [DB;! /! N%2/B72! 13/! \$!
UDD6'K#/,2*! -,6Q\$*! ,Q! 04*! DDQ! aT(08*!
0_ (=FQ

b0cQ NQ! d:/\$;#*! fQ! g,-'&#.*! CQ! f#..#.*! NQ! fQ!
H#.A6#*! #.&! "Q! 9Q! g#;A*! eU.! '/BA;/#B&!
L;#7B3;<! L,;! 2:2/#.#M6B! 2:DD6'B;! 2B6BK',.1#.&!
B-#6:#/,,'! 2:DD6%! K\$#.2*e! J,;:#6!,L! K6B#.B;!
D,;&:K',*! -,6Q\$%!*! DDQ!(?T?`a`*! 0_(hFQ

b4cQ fQ! +,2\$#&! #.&! UQ! U3#2/\$*! eN:DD6'B;! i:#6'/%!
&B-B6,D7B./Y! U;! B-'B3!,L! 6'/B;/;B! #.&'.&:2/%!
D;#K'/KB2*e! 5./B;#/,#6! J,;:#6!,L! 9,;&:K',!
RB2B#;K\$*! 86(*!,Q! 0*! DDQ! 88`n*! 0_ (=FQ

b8cQ UQ! +#;.*! JQ! J#%#;#7*! #.&! UQ! C#2*! eN;/#BA'K!
D;K\$#2'.A! D#;'K'D#/'*! 2:DD6'B;! 2B6BK',.*!
2:DD6'B;! B-#6:#/,,'! #.&! D;K\$#2'.A!
DB;L;#7.KB*e! 5./B;#/,#6! F,;:#6!,L!
D,;&:K',*! B2B#;K\$*! -,6Q\$*! ,Q! 0_*! DDQ! ?0?4
?0h`*0_ (=FQ

b=cQ fQ! g,-'&#.*! NQ! R#FB.&#.*! JQ! N#;<2*! #.&! 9Q!
H,;:AB2#.*! eH:6/! K;/B;#! &BK'2',! 7#<'.A!
#DD;#K\$B2;! A;BB! 2:DD6'B;! B-#6:#/,,'! #.&!
2B6BK',.Y! #! 6'/B;#;/;B;! B-'B3*e! J,;:#6!,L! K6B#.B;!
D,;&:K',*! -,6Q\$*! *! DDQ! ?4*! 0_ (=FQ

b?cQ 9Q! f#;#.&B! #.&! NQ! "\$#<#M,;/%*! eUDD6'K#/,,'! L!
7:6/ T,MFBK'-'B! D/'7X#/,,'! /\$B! I#2B! ,L!
#.#6%2'2! OHWWRUP! 7B/\$,&! L,;! #62!
2B6BK',.*e! H#B;#62! j! CB2'A.*! -(6QDDQ! 4T
408*0_ (0FQ

bhcQ NQ! N:/#;.*! HQ! HB2;#.*! NQ! N:D:'%#/,,'! ^Q!
^:6#.#*! #.&! UQ! CB3*! e57D6B7B./#/,,'! ,L!
H:6/ TWMFBK'-'B! WD/'7X#/,,'! /\$B! I#2B! ,L!
R#/,! U.#6%2'2! OHWWRUP! !57D,,'.A! N:DD,;!
L,;! CBK'2',,'! N#6B2! d,K#/,,'! CB/B;7' #/,,'.*e!
'! J,;:#6!,L! 9\$%2'K2Y!',.LB;B.KB! I#B;B2*(aP!
-,6Q\$*! *! ,Q!(Y! 5W9! 9:M6'2\$'.A*! DQ! _ (0_aQ!

b`cQ kQ! HQ! HQ! N;BA#;.*! HQ! RQ! E#7D:M,6,*! @Q! 9Q! NQ!
9#;#D#/*! @Q! 5Q! H#6#;.*! #.&! CQ! NQ! >:#A#6:.A*!
eCBK'2',.2:DD,;/2%2/B7! L,;! 2B6BK',,\$/B\$!
'2'.A! HWRU! 7B/\$,&*e! '! 5W9! ',.LB;B.KB!
NB;'B2Y! H#B;#62! NK'B.KB! #.&! @.A'.BB;.A*!
0_0(P! -,6Q\$%***! ,Q!(Y! 5W9! 9:M6'2\$'.A*! DQ!
_ (0_00Q!

bacQ NQ! >Q! I%,&! #.&! CQ!]:K\$2:2K\$*! eU!
M'M6',7B;/M#2B&! 2;-B%!,! U>9! #.&! EW9N5N!
/BK\$.! i:B2*e! @! [DB;! /! 2%2/B72! 13/! 3#SD6'K#/,,'2*!
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b(_cQ CQ! HQ! G/#7#*! HQ! NQ! U2,;L*! #.&! 5Q! U7#66%.&#*!
e5./BA;#/,,'! ,L! U>9THWWRU! #6A,;/\$7! '!
A;BB.! 2:DD6'B;! 2B6BK',,'! /\$B! 5.&,B2#.! /B/'6B!
'.&:2/%*e! '! J,;:#6!,L! 9\$%2'K2Y!',.LB;B.KB!
NB;'B20_0(P! -,6Q\$)((*! ,Q!(Y! 5W9! 9:M6'2\$'.A*!
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