EXPERT JURNAL MANAJEMEN SISTEM INFORMASI DAN TEKNOLOGI

Fish Marketing Decision Support System at Belawan Fishing Port with AHP and PROMETHEE Method

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ABSTRACT – This study aims to develop a fish marketing decision support system at Belawan Fishing Port to assist fish warehouses or markets in determining the vessels with the best fish marketing performance. Once the results are obtained, port authorities can evaluate vessels with low marketing results to improve their marketing strategies in the future. The methods used in this study are the Analytical Hierarchy Process (AHP) and PROMETHEE, which are applied to evaluate and rank marketing alternatives based on multiple criteria such as market demand, price, sales volume, sales targets, and sales turnover. The integration of these two methods allows for a more structured and objective decision-making process. The results of the study show that the application of the AHP and PROMETHEE methods can effectively assist in determining optimal marketing decisions by comprehensively considering the factors that influence fish marketing performance. This system also increases the accuracy of decision making by up to 90% compared to conventional methods that rely solely on experience. Overall, the developed system is expected to improve the efficiency of fish marketing and support the welfare of fishermen in Belawan Fishing Port.

Keywords: Decision Support System; AHP; Marketing; PROMETHEE.

ABSTRAK – Studi ini bertujuan untuk mengembangkan sistem pendukung keputusan pemasaran ikan di Pelabuhan Perikanan Belawan untuk membantu gudang atau pasar ikan dalam menentukan kapal dengan kinerja pemasaran ikan terbaik. Setelah hasilnya diperoleh, otoritas pelabuhan dapat mengevaluasi kapal dengan hasil pemasaran rendah untuk meningkatkan strategi pemasaran mereka di masa mendatang. Metode yang digunakan dalam studi ini adalah Analytical Hierarchy Process (AHP) dan PROMETHEE, yang diterapkan untuk mengevaluasi dan memberi peringkat alternatif pemasaran berdasarkan beberapa kriteria seperti permintaan pasar, harga, volume penjualan, target penjualan, dan omset penjualan. Integrasi kedua metode ini memungkinkan proses pengambilan keputusan yang lebih terstruktur dan objektif. Hasil studi menunjukkan bahwa penerapan metode AHP dan PROMETHEE dapat secara efektif membantu dalam menentukan keputusan pemasaran yang optimal dengan mempertimbangkan secara komprehensif faktor-faktor yang memengaruhi kinerja pemasaran ikan. Sistem ini juga meningkatkan akurasi pengambilan keputusan hingga 90% dibandingkan dengan metode konvensional yang hanya mengandalkan pengalaman. Secara keseluruhan, sistem yang dikembangkan diharapkan dapat meningkatkan efisiensi pemasaran ikan dan mendukung kesejahteraan nelayan di Pelabuhan Perikanan Belawan.

Kata Kunci: AHP; PROMETHEE; Pemasaran; Sistem Pendukung Keputusan.

1. INTRODUCTION

Indonesia is a maritime country, which means the marine sector plays an important role in the overall national economy. The country is surrounded by oceans that are rich in natural resources, making it one of the countries with the largest marine potential in the world. Being a maritime country, Indonesia is blessed with abundant natural resources and coupled with a very strategic geographical position. Geographically, Indonesia is located in the tropics with high rainfall [1]. This condition creates a fertile aquatic ecosystem and supports the life of various types of fish. Abundant rain also brings nutrients to the waters, increasing biological productivity and providing ideal habitats for fish.

Fish is one of the fishery commodities that is highly favored by the people of Indonesia. Fish is an animal food source that has various advantages because it is acceptable to all religions and does not require special slaughter methods. However, fish is perishable so it needs careful, good, and correct and fast handling so that the quality of fish can be maintained as long as possible so that it does not rot / damage in the process of marketing fish [2],[1]. Belawan Fishing Port, as one of the main infrastructures in the North Sumatra region, plays an important role in supporting fish distribution and marketing. Marketing is a strategy to serve the market or market segment targeted by an entrepreneur. Therefore, the marketing strategy is a combination of the marketing mix that will be applied by entrepreneurs to serve their market. Marketing objectives aim for the company to objectively know the internal and external conditions of the company [2].

Belawan Fishing Port is the center of fish landing, so it is the right location to carry out quality development of ship catches. The potential implementation of fish marketing at Belawan Fishing Port requires the support of complete and accurate data collection so that it can be inventoried and managed properly using information technology. The main challenge in today's fish marketing system is the complexity of decision making involving various dynamic variables[3]. Price fluctuations, supply uncertainty, market demand, and logistics infrastructure conditions are critical factors that affect the effectiveness of the fisheries supply chain. The utilization of Decision Support System (DSS) aims to help the port. Utilization of the Decision Support System (DSS) aims to assist the Fishing Port in determining the vessels or fishermen with the best fish marketing as a priority and providing evaluations and awards carried out by the warehouse every 1 semester. With the amount of data that must be calculated and calculations that are still manual, it is possible to make mistakes in choosing the best marketing. To avoid errors in the calculation, a computerized decision support system is needed so that the Fishing Port is not wrong in choosing the best marketing. So far, in sending the data, each admin on each boat will make daily reports and monthly reports in hardcopy [4].

The combination of methods that can be used to analyze marketing strategies is to use the Analytic Hierarchy Process (AHP) and Preference Ranking Organization Methods for Enrichment Evaluations (PROMETHEE) methods [5],[6],[7],[8]. Decision Support System (DSS) can be used to assist decision makers in utilizing certain data and models to solve various semi-structured and unstructured problems [9],[10],[11]. The integration of AHP and PROMETHEE methods in this research is designed to address the complexity of fish marketing decision making comprehensively [12]. AHP (Analytical Hierarchy Process) is used to determine the relative importance of marketing criteria through hierarchical analysis and pairwise comparisons, while PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluations) is utilized to evaluate and rank marketing alternatives based on predetermined criteria weights [13],[14],[15]. By utilizing the latest computing technology and decision analysis methodologies, this research is expected to make a significant contribution in improving the performance of the fish marketing system at the Belawan Fishing Port [16].

Previous research that became the author's reference in conducting this research includes research conducted by Br.Hombing, Sonya Yolanda (2017) in selecting the quality of fish to be exported abroad using the Topsis and AHP methods. The next research is a discussion of a decision support system by combining AHP and Promethee methods in selecting watermelons that are worth selling based on the results of alternative weighting calculations using the AHP method, weighting is carried out on a scale of 1-9 according to AHP provisions carried out by [1]. Further research conducted by Ahmad Raynaldi et al (2023), concluded that the system built by applying AHP and PROMETHEE methods can function effectively in decision support systems, and provide convenience in choosing the best alternative [17]. Further research conducted by Reni Lestari & Raissa Amanda Putri (2023) decision support system to determine the type of facial treatment using AHP and SAW methods with CR 0.0038 which shows that the pairwise comparison matrix value is consistent [18].

In previous research, the difference between the current research written by the author is that it has different objects and problems. In this study the authors solve problems in fish marketing and get alternative weight values from the AHP method, and produce the highest ranking value from the Promethee method. This research aims to develop a decision support system that can assist ports in optimizing fish marketing. This system will give priority to fishermen with the best marketing and provide operational costs or boat maintenance and quality fishing gear and provide solutions to fishermen with the lowest scores at the Belawan Fishing Port. By using the AHP and PROMETHEE methods, the system also prevents oversupply of fish in the market and ensures a balanced distribution of fish, thus improving the overall marketing process.

2. METHODS

2.1 Stages of Research

In this research, there are stages that will be applied to ensure that the research process is structured and systematic. In this study, the authors used quantitative methods by examining the relationship between variables. And the system development method carried out is the Waterfall method, which shows that research begins with data collection, then system analysis, system design, program creation, testing and analysis of program results, and the last stage is program implementation or deployment [19].

DOI http://dx.doi.org/10.36448/expert.v15i2.4576
e-ISSN 2745-7265 p-ISSN 2088-5555 EXPERT Vol. 15 No. 2
Dec 31, 2025 – Hal. 174

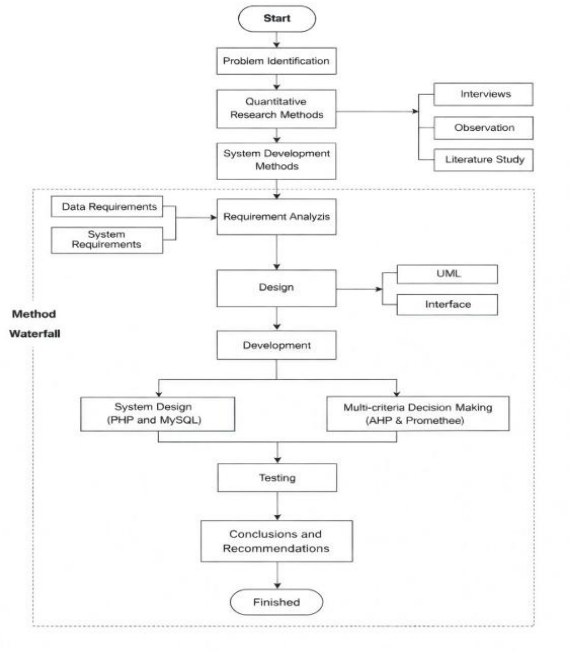

Figure 1. Research Stages

In Figure 1 above is a picture of the research stages that will be used in this study [20].

1. Problem Identification
   In this study, the authors sought to observe and understand the problems that exist in the Belawan Fishing Port. Problems were found in this study, namely in the selection of large quantities of fish that are worth selling to the market.
2. Data Collection
   One of the important aspects in conducting research is data collection techniques, because it can make it easier for writers when conducting research. With the right technique, the author can obtain accurate and relevant data, and can reduce errors when processing data[1]. In data collection techniques, the authors conducted interviews to obtain clear information related to the problems in this study. Furthermore, the authors made observations to obtain complete data. Finally, the authors conducted a literature study by looking for journals, books, and other references that were relevant to the problem at hand.
3. Requirement Analyziz
   At this stage, a requirement analysis will be carried out. In this research, requirement analysis includes data requirements, functional requirements, and non-functional requirements. Data requirements include the criteria that will be used, while functional requirements define the functions that must exist in the system being developed. Non-functional requirements focus on the tools needed to build the system, including hardware and software.
4. Design
   At this stage, the system design is carried out in accordance with the results of data collection and analysis that has been carried out. The design starts from making diagrams, namely, use case diagrams, activity diagrams, sequence diagrams, and class diagrams as well as making interface designs [21].
5. Development
   At this stage, a system design will be carried out using PHP and MySQL, and the application of the AHP method and the Promethee method with AHP used to determine the relative weight of the criteria that have been identified, while Promethee is used to assess and rank design alternatives based on these criteria. Inputs include requirements data and design criteria. Output in the form of prioritized needs and selected designs that will be used in the Development stage.
6. Testing
   At this stage of system testing aims to find out the possibility of errors in the system that has been made. besides that this test can be done to find the suitability of the system with users.

2.2 Steps of AHP and PROMETHEE

The following are the steps in performing the AHP and PROMETHEE methods**:**

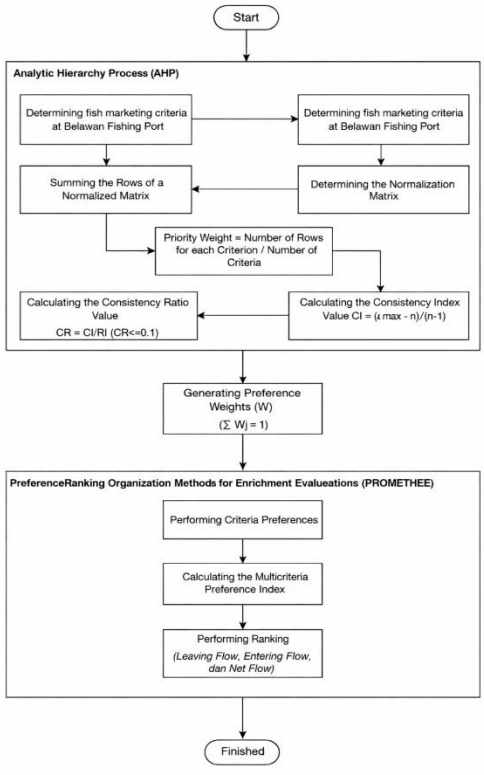

Figure 2. The following are the steps in performing the AHP and PROMETHEE methods

2.2.1 AHP Method (Analytical Hierarchy Process)

The Analytical Hierarchy Process (AHP) method was developed in the early 1970s by Thomas L. Saaty, a mathematician from the University of Pittsburg. AHP is basically designed to rationally capture the perceptions of people who are very closely related to a particular problem through a procedure designed to arrive at a scale of preferences among various sets of alternatives [21],[22],[23]. This decision support model will decompose complex multifactor or multi-criteria problems into a hierarchy [24]. This hierarchy defines as a representation of a complex problem in a multi-level structure, where the first level is the goal, followed by the level of factors, criteria, sub-criteria, and so on until reaching the last level of alternatives [25]. The following is the procedure for solving the AHP method [26]:

1. Develop a hierarchy of the problem at hand. Define the problem and determine the desired solution, then compile a hierarchy of these problems [27].
2. Criteria and Alternative Assessment. Assessment of criteria and alternatives is carried out through pairwise comparisons using a scale that has been determined by the AHP method [28]. Comparisons are made by considering elements, where the determination of the element is determined by the decision maker's policy.
3. Calculating priority and consistency of weighting.
4. Calculate the Consistency Index (CI) with the formula [9]:
   CI = ($\lambda\ max$ - n)/ (n-1)
5. Where n = number of elements
6. Calculate the Consistency Ratio CR = CI/RC
7. Where CR = Consistency Ratio CI = Consistency Index
   IR = Index Random Consistency

2.2.2 PROMETHEE Method (Preference Ranking Organization Methods for Enrichment Evaluations)

Weighting will be used as input to the PROMETHEE method is the result of calculations that have been carried out in the AHP method [29]. These two methods include types of methods for decision making related to problem solving with multiple criteria categories [27]. PROMETHEE is one of several methods of determining the order or priority in multi-criteria analysis [30],[31],[32]. The PROMETHEE method is able to accommodate quantitative and qualitative selection criteria [33],[34]. The main problems faced are simplicity, clarity, and stability. The steps in compiling the Promethee method are as follows [35]:

1. Determining alternatives
2. Determining criteria
3. Determining Criteria Weight Values
4. Calculating the difference between alternatives with the following formula:

$$H(d) = \begin{cases} 0 \ if \ d \leq 0 \\ 1 \ if \ d > 0 \end{cases}$$

5. Calculating Multicriteria Preference Index
6. Calculating Entering Flow Value
7. Calculating Leaving Flow Value
8. Calculating Net Flow Value

2.2.3 Research Criteria and Alternatives

The determination of criteria in this study is based on the results of interviews with the Belawann Fishing Port. In this study, 5 criteria were used in determining fish marketing, namely market demand, selling price, sales volume, sales target, and sales turnover.

Table 1 Criteria

Code	Criteria
1	Market Demand
2	Selling Price
3	Sales Volume
4	Sales Target
5	Sales Turnover

Based on these 5 criteria, each criterion has parameters. These parameters are obtained from observations and interviews which aim to assess each alternative criterion that will be used in the Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) method. While the table below is the types of fishing boats that do fish marketing at the Belawan Fishing Port, the data obtained will be used as alternative data. Observations and interviews were conducted at the fishing port. The data obtained can be seen in the following table:

Table 2 Alternative

Code	Alternative
1	KM Tenggiri
2	KM Arta Prima
3	KM Prima Karya
4	KM Tetap Jaya
5	KM Camar Laut
6	KM Jaya Bersama
7	KM KBS
8	KM Bintang Laut
9	KM Samudra Biru
10	KM Indah Permai
11	KM Karya Laut
12	KM Makmur Jaya
13	KM Pinari Jaya

3. RESULTS AND DISCUSSION

At this stage, data processing is carried out to calculate and determine the priority of fish marketing at the Belawan Fishing Port. This process uses a Decision Support System (DSS) by applying the AHP (Analytical Hierarchy Process) and

PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation) methods. The following are the stages and calculation results of the AHP and PROMETHEE methods.

3.1 AHP Method (Analytical Hierarchy Process)

At this stage, before carrying out the calculation process, the criteria used in decision making to determine the ranking are first determined. The criteria used at the fishing port in determining priorities based on rankings are as follows:

a. The comparison value table in the AHP method

Criteria	C1	C2	C3	C4	C5	Priority Weight
C1	0,373	0,283	0,483	0,490	0,304	0,386
C2	0,373	0,283	0,161	0,294	0,217	0,265
C3	0,124	0,283	0,161	0,098	0,217	0,176
C4	0,074	0,094	0,161	0,098	0,217	0,128
C5	0,053	0,056	0,032	0,019	0,043	0,040

provides a comparison scale between 1 to 9 in accordance with the theory developed by Saaty.

b. Giving weight to the criteria is done based on information obtained from the results of research at the Belawan Fishing Port.

Table 3 Criteria Weight

Code	Criteria	Weight
1	Market Demand	1
2	Selling Price	1
3	Sales Volume	3
4	Sales Target	5
5	Sales Turnover	7

The table 3 above shows the criteria and weights that have been determined based on the research results.

c. Comparison between criteria according to the initial weighting with calculations as in the table below:

Table 4 Comparison Between Criteria

Criteria	C1	C2	C3	C4	C5
C1	1	1	3	5	7
C2	1	1	1	3	5
C3	0,333	1	1	1	5
C4	0,2	0,333	1	1	5
C5	0,143	0,2	0,2	0,2	1
Amount	**2,676**	**3,533**	**6,2**	**10,2**	**23**

Weighting is done first, then calculated in accordance with AHP provisions to determine the comparison between criteria.

Inter-Criteria Comparison Formula:
Cx = Cn / Cm

C1,C1:
C1=1,C1=1
Cx = C1/C1
Cx = 1 / 1
Cx = 1
C1,C2:
C1=1,C2=1
Cx=C1/C2
Cx = 1 / 1
Cx = 1
etc… all criteria data.

d. Next, normalization of the criteria matrix is carried out with calculations to obtain the value (C1, C1), by taking the value of the comparison table between criteria. This normalization aims to arrange the relative weight of each criterion based on the comparison matrix that has been made.

Table 5 Normalization and Priority Weighting

The normalization matrix is obtained by summing the value of each column in the comparison matrix, then dividing each value in the column by the total column concerned. This process produces a normalization matrix that is used to calculate the priority weight of the criteria in the AHP method.

Next, calculate the priority weight with the formula:

BP = Total Normalized Rows / Number of Criteria

BP 1 = (0.373 + 0.283 + 0.483 + 0.490 + 0.304) / 5 = 0.386

BP 2 = (0.373 + 0.283 + 0.161 + 0.294 + 0.217) / 5 = 0,265

BP 3 = (0.124+ 0.283 + 0.161 + 0.098+ 0.217) / 5 = 0,176

BP 4 = (0.074 + 0.094 + 0.161 + 0.098 + 0.217) / 5 = 0,128

BP 5 = (0.053 + 0.056 + 0.032 + 0.019 + 0.043) / 5 = 0,040

e. Calculating the Consistency Index (CI) Value Calculating the Consistency Index value with several stages, namely:

Finding the value of λ max, done by adding up the results of multiplying the total value of each column of criteria with the average criteria from each row of criteria based on the normalized pairwise comparison matrix.

λ max = [(2.676*0.386) + (3.533*0.256) + (6.2*0.176) + (10.2*0.128) + (23*0.040)] = 5.255

Finding the Consistency Index value with the equation

DOI http://dx.doi.org/10.36448/expert.v15i2.4576
e-ISSN 2745-7265 p-ISSN 2088-5555 EXPERT Vol. 15 No. 2
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CI = (λ max - n)/ (n-1)

CI = 5.255 - 5 / (5-1) = 0.063

f. Calculating the Consistency Ratio (CR) Value

Based on Saaty's assessment, a matrix that has an order of 5 x 5 has a Random Consistency Index (IRC) value = 1.12 so that the Consistency Ratio (CR) can be calculated using the equation

CR = CI/RC

CR = 0.063 / 1.12 = 0.056

If the CR value is less than 0.1, it is considered consistent, while if it is more than that, it is considered inconsistent. Thus, the comparisons given for the criteria have met the expected level of consistency.

g. Next, determine the sub-criteria using AHP weights for alternative input and ranking using the PROMETHEE method.

Table 6 Sub Criteria

Main Criteria	Sub Criteria		Value
C1	Local and Specific		25
	Local		10
C2	SP Achievement > 105%		40
	SP Achievement 100% - 105%		30
	SP Achievement 95% - 100%		20
	SP Achievement 90% - 94%		15
	SP Achievement 85% - 89%		10
	SP Achievement 80% - 84%		5
	SP Achievement 75% - 79%		0
	SP Achievement <75%		-10
C3	>120.000	Increase of 13 – 15%	25
		Increase of 10 – 12%	20
		Increase of 7 – 9%	15
		Increase of 4 – 6%	10
		Increase of 1–3%	5
	100.000 – 120.000	Increase of 17–20%	25
		Increase of 13–16%	20
		Increase of 9–10%	15
		Increase of 7–8%	10
		Increase of 1–4%	5
	<100.000	Increase 25–30%	25
		Increase 19–24%	20
		Increase 13–18%	15
		Increase 7–13%	10
		Increase 1–6%	5
C4	Capacity and price		20
	Capacity or price		10
	None		0
C5	Turnover > 150%		40
	Turnover 120–150%		30
	Turnover 100–120%		25
	Turnover 95–99%		20
	Turnover 90–94%		15
	Turnover 85–89%		10
	Turnover 80–84%		5
	Turnover 75–79%		0
	Turnover <75%		-10

DOI http://dx.doi.org/10.36448/expert.v15i2.4576
e-ISSN 2745-7265 p-ISSN 2088-5555 EXPERT Vol. 15 No. 2
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3.2 PROMETHEE Method (Preference Ranking Method for Enrichment Evaluation)

At this stage, the weights of the alternatives are determined using Saaty's AHP table, where the initial data obtained is converted according to the table above. Next, ranking is carried out using the PROMETHEE method. Then, the assessment of each result is changed according to the specified conditions, based on the predetermined subcriteria weighting.

Table 7 Subcriteria Weighting

Code	C1	C2	C3	C4	C5
A1	25	10	5	10	15
A2	25	40	5	20	25
A3	25	30	10	20	25
A4	10	40	0	10	25
A5	25	5	5	10	10
A6	10	0	0	0	0
A7	25	40	5	20	30
A8	10	0	0	0	-10
A9	25	20	0	0	10
A10	25	10	0	10	10
A11	10	0	0	0	-10
A12	10	40	0	10	25
A13	10	30	0	10	20

The table 6 above shows the weighting of the subcriteria determined based on the results of the above research.

a. Calculate the preference value of each alternative according to criteria C1 – C5. Comparison formula:

d = Cn – Cm
if d ≤ 0 then 0
if d > 0 then 1

C1 (A1, A2): d= C1(A1) – C1(A2) = 25 – 25 = 0 ≤ 0 = 0

C2 (A1, A2): d= C2(A1) – C2(A2) = 10 – 40 = (-30) ≤ 0 = 0

C3 (A1, A2): d= C3(A1) – C3(A2) = 5 – 5 = 0 ≤ 0 = 0

C4 (A1, A2): d= C4(A1) – C4(A2) = 10 – 20 = (-10) ≤ 0 = 0

C5 (A1, A2): d= C5(A1) – C5(A2) = 15 – 25 = (-10) ≤ 0 = 0

It is consistent with the number of criteria and alternatives provided.

Table 8 Comparison C

Alternative Code	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13
A1	0	0	0	1	1	1	0	1	1	1	1	1	1
A2	1	0	1	1	1	1	0	1	1	1	1	1	1
A3	1	1	0	1	1	1	1	1	1	1	1	1	1
A4	1	0	1	0	1	1	0	1	1	1	1	0	1
A5	0	0	0	1	0	1	0	1	1	1	1	1	1
A6	0	0	0	0	0	0	0	1	0	0	1	0	0
A7	1	1	1	1	1	1	0	1	1	1	1	1	1
A8	0	0	0	0	0	0	0	0	0	0	0	0	0
A9	1	0	0	1	1	1	0	1	0	1	1	1	1
A10	0	0	0	1	1	1	0	1	1	0	1	1	1
A11	0	0	0	0	0	0	0	0	0	0	0	0	0
A12	1	0	1	0	1	1	0	1	1	1	1	0	1
A13	1	0	0	0	1	1	0	1	1	1	1	0	0

The table 7 above shows the values obtained from comparing the alternatives and each criterion.

b. Calculate the multi-criteria preference index using the equation:

(A1,A2) = ((0*0,386) + (0*0,265) + (0*0,176) + (0*0,128) + (0*0,040)) = 0

(A1,A3) = ((0*0,386) + (0*0,265) + (0*0,176) + (0*0,128) + (0*0,040)) = 0

(A1,A4) = ((1*0,386) + (0*0,265) + (1*0,176) + (0*0,128) + (0*0,040)) = 0,562

(A1,A5) = ((0*0,386) + (1*0,265) + (0*0,176) + (0*0,128) + (1*0,040)) = 0.305

etc... up to all values of the multicriteria preference index calculation results. The final calculation results are presented in the following table.

DOI http://dx.doi.org/10.36448/expert.v15i2.4576
e-ISSN 2745-7265 p-ISSN 2088-5555 EXPERT Vol. 15 No. 2
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Table 9 Multicriteria Preference Index

Kode Alternatif	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	Jumlah
A1	0	0	0	0,562	0,305	0,995	0	0,995	0,344	0,216	0,995	0,562	0,562	5,536
A2	0,433	0	0,265	0,69	0,433	0,995	0	0,995	0,609	0,609	0,995	0,69	0,995	7,7
A3	0,609	0,176	0	0,69	0,609	0,996	0,176	0,995	0,609	0,609	0,995	0,69	0,73	7,884
A4	0,305	0	0,265	0	0,305	0,433	0	0,433	0,433	0,305	0,433	0	0,305	3,217
A5	0	0	0	0,562	0	0,995	0	0,995	0,304	0,176	0,995	0,562	0,562	5,151
A6	0	0	0	0	0	0	0	0,040	0	0	0,040	0	0	0,080
A7	0,433	0,04	0,305	0,73	0,433	0,995	0	0,995	0,609	0,609	0,995	0,73	0,995	7,869
A8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A9	0,265	0	0	0,386	0,265	0,691	0	0,691	0	0,265	0,691	0,386	0,386	4,026
A10	0	0	0	0,386	0,265	0,819	0	0,819	0,128	0	0,819	0,386	0,386	4,008
A11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A12	0,305	0	0,265	0	0,305	0,433	0	0,433	0,433	0,305	0,433	0	0,305	3,217
A13	0,305	0	0	0	0,305	0,433	0	0,433	0,433	0,305	0,433	0	0	2,647
Jumlah	2,655	0,216	1,1	4,006	3,225	7,785	0,176	7,824	3,902	3,399	7,824	4,006	5,226	

c. The PROMETHEE I calculation is performed to obtain the Leaving Flow and Entering Flow values.

Calculating Leaving Flow

Leaving Flow value for Alternative A1 = number of alternative rows / number of alternatives - 1 = 5.536 / 13-1 = 0.461

Leaving Flow value for Alternative A2 = number of alternative rows / number of alternatives - 1 = 7,7 / 13-1 = 0,642

Leaving Flow value for Alternative A3 = number of alternative rows / number of alternatives - 1 = 7,884 / 13-1 = 0.657

Leaving Flow value for Alternative A4 = number of alternative rows / number of alternatives - 1 = 3,217 / 13-1 = 0.286

etc... up to all values of the leaving flow calculation results for each alternative.

Calculating Entering Flow

Entering Flow value for Alternative A1 = number of alternative column/number of alternatives - 1 = 2,655 / 13-1 = 0.221

Entering Flow value for Alternative A2 = number of alternative column / number of alternatives - 1 = 0,216 / 13-1 = 0.018

Entering Flow value for Alternative A3 = number of alternative column / number of alternatives - 1 = 1,1 / 13-1 = 0.092

Entering Flow value for Alternative A4 = number of alternative column / number of alternatives - 1 = 4,006 / 13-1 = 0.334

etc... up to all values of the entering flow calculation results for each alternative.

Table 10 PROMETHEE II

Alternatif	Leaving Flow	Entering Flow
A1	0,461	0,221
A2	0,642	0,018
A3	0,657	0,092
A4	0,268	0,334
A5	0,429	0,269
A6	0,007	0,649
A7	0,656	0,015
A8	0	0,652
A9	0,336	0,325
A10	0,334	0,283
A11	0	0,652
A12	0,268	0,334
A13	0,221	0,436

The table 9 above shows the results of the Leaving Flow and Entering Flow values. The PROMETHEE calculation process is then carried out to obtain the Entering Flow value and determine the ranking based on the highest value.

Calculating Net Flow = Leaving Flow – Entering Flow

Net Flow value for Alternative A1 = LF - EF = 0.461 - 0.221 = 0.24

Net Flow value for Alternative A2 = LF - EF = 0.642 - 0.018 = 0.624

Net Flow value for Alternative A3 = LF - EF = 0.657 - 0.092 = 0.565

Net Flow value for Alternative A4 = LF - EF = 0.268 - 0.334 = -0,066

etc... up to all values of the Net Flow calculation results for each alternative.

DOI http://dx.doi.org/10.36448/expert.v15i2.4576
e-ISSN 2745-7265 p-ISSN 2088-5555 EXPERT Vol. 15 No. 2
Dec 31, 2025 – Hal. 180

To determine the highest ranking by calculating the highest net flow value, we obtain Ranking 1 with a value of 0. 641, which is A7. The final calculation from PROMETHEE to obtain the highest to lowest net flow values, which will then be ranked based on the highest net flow value of 0.641 (A7) and the lowest of -0.652 (A8 and A11).

Table 11 Alternative Net Flow Value After Ranking

Alternative	Market Code	Boat Name	Net Flow	Ranking
A7	710	KM KBS	0,641	1
A2	1670	KM Arta Prima	0,624	2
A3	8405	KM Prima Karya	0,565	3
A1	5115	KM Tenggiri	0,24	4
A5	1179	KM Camar Laut	0,161	5
A10	8054	KM Indah Permai	0,051	6
A9	1603	KM Samudera Biru	0,01	7
A4	5315	KM Tetap Jaya	-0,066	8
A12	1402	KM Makmur Jaya	-0,066	9
A13	2409	KM Pinari Jaya	-0,215	10
A6	2111	KM Jaya Bersama	-0,642	11
A8	2908	KM Bintang Laut	-0,652	12
A11	5441	KM Karya Laut	-0,652	13

3.3 Use case Diagram

In the use case diagram above, there are two actors, namely the administrator and the user. The administrator can log in, process alternative data, criteria, sub-criteria, and assessments. They can also view calculations, results, and user data. Meanwhile, users can only log in and open the assessment page to add and edit data.

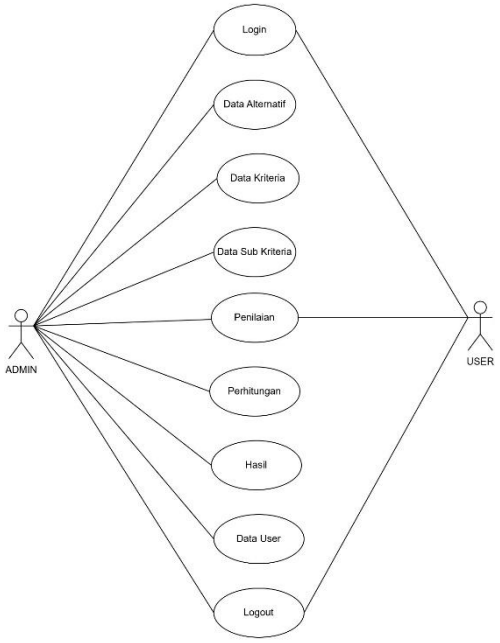

Figure 3 Use Case Diagram

3.4 Implementation

This home page is the login page that administrators and users see when they open the website. Administrators and users must enter their registered username and password. If they enter the wrong information, they will not be able to proceed to the next page. If the information is verified, administrators and users will be taken to the dashboard page. If not, a pop-up will appear stating that the username and password entered do not match or that the login has failed.

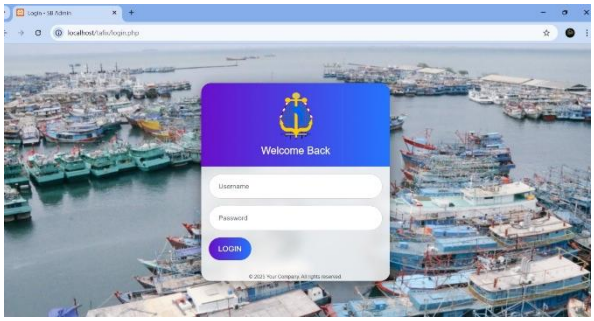

Figure 4 Page Login

The dashboard is the first page that administrators see after successfully logging in. It contains menus that can be selected to display the decision support system for the best fish marketing.

Figure 4 Page Login

On the alternative page, alternative data is displayed. On this page, administrators can also add (input), search, edit (update), and delete alternative data:

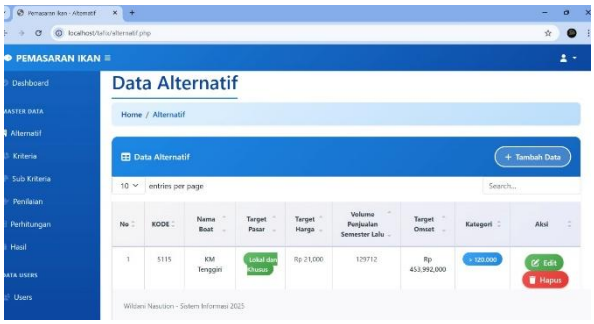

Figure 6 Page Alternative

On the criteria page, display the assessment criteria data along with the criteria weights. On this page, the admin can also add (input), search, edit (update), and delete criteria data:

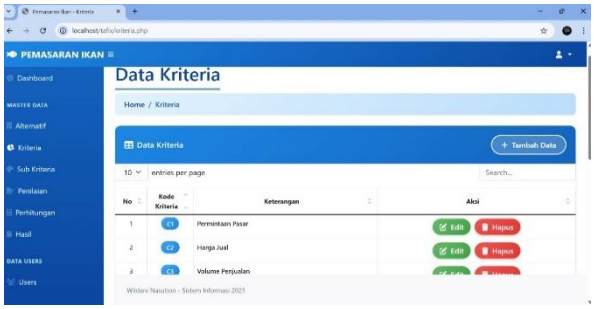

Figure 7 Page Criteria

On the criteria page, subcriteria data and their values are displayed. On this page, administrators can also add (input), search, edit (update), and delete subcriteria data:

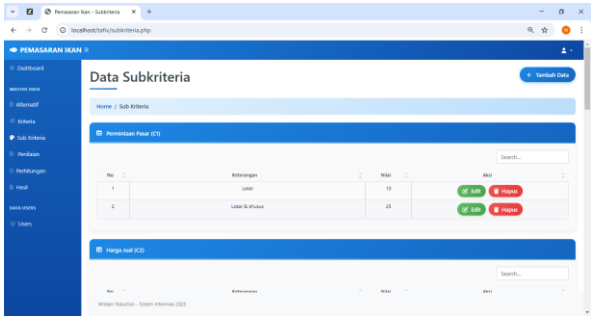

Figure 8 Page Sub Criteria

On the assessment page, the administrator can view and change each weighting value of the criteria used for further processing in the calculation menu.

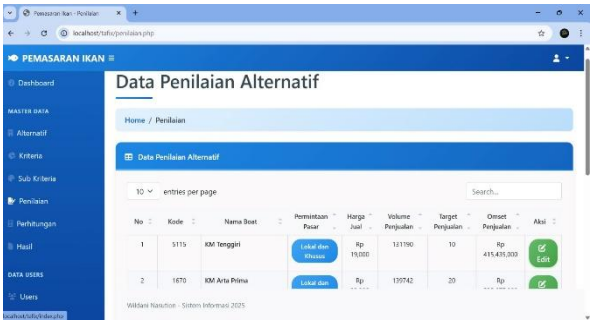

Figure 9 Page Alternative Assessment

The results page displays the rankings from the previous assessments. The report results can be printed in PDF format.

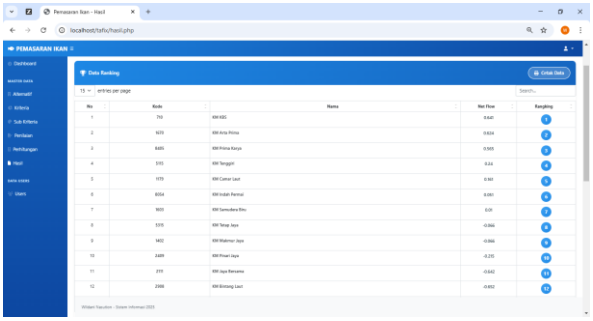

Figure 10 Page Ranking

4. CONCLUSION

Based on the results of the research conducted, it can be concluded that the system developed using the AHP and PROMETHEE methods is able to function effectively as a decision support system and provides convenience in determining the best fish marketing. This system can be utilized by the Belawan Fishing Port, particularly the Kurnia Laut Warehouse, to rank the best marketing as award recipients, and the results can be printed in PDF format. From the ranking process, the alternative with the highest score was KM KBS with a final score of 0.641. As for suggestions for future development, the current web-based system is expected to be implemented on the Android platform or other latest technologies. In addition, the system's simple appearance is expected to be refined and equipped with various additional features to make it more attractive and interactive.

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