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SELECTION OF FEED SUPPLIER IN SEA FISH CULTIVATION USING ANALYTICAL HIERARCHY PROCESS (AHP) METHOD

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Abstract— The problem that often occurs in the cultivation of seawater fish is the lack of efficiency in determining the right supplier, usually the fish culture simply selects the supplier, namely by contacting the supplier asking for the help of sea fish needed and the price according to the order or not. If appropriate, the company issues a purchase order. Receiving results is not optimal because it does not consider other considerations such as quality, price, service, delivery time, and guarantee. This study aims to overcome these problems and make it easier for farmers to select appropriate suppliers of marine fish feed. Analytical Hierarchy Process (AHP) method used as a support in this study for the analysis of suppliers of data obtained from Batam Aquaculture Fisheries Center (BPBL) Batam with contributions in the form of Quality, Price, Service, Delivery, Delivery, and Guarantee. The stages of this method are determining the value of pairs, making the value of the criteria, Calculating the Eigen Value of the Principle, Calculating the Eigen Value of the Principle of the final value in making decisions. From the evaluation of the 5 supplier data, the results obtained rank rankings of each supplier with Supplier_003 as rank 1 with a value of 4.25 and Supplier_002 as rank 2 with value. 3.99 is accepted as a decision of Supplier_003 as the selected supplier and Supplier_002 Reserve supplier, while other suppliers are not selected. With these results, the decision support system using the AHP method can be applied as a supplier of fish suppliers at the Batam Aquaculture Fisheries Center (BPBL).

Keywords: Decision Support System, Analytical Hierarchy Process (AHP), Sea Fish Feed, Aquaculture.

Abstract— *Permasalahan yang sering terjadi di pembudidayaan ikan air laut adalah kurang efisiennya dalam menentukan supplier yang benar-benar tepat, biasanya pihak budidaya ikan memilih supplier dengan cara sederhana, yaitu dengan menghubungi supplier apakah mempunyai pakan ikan laut yang dibutuhkan dan harga sesuai dengan order atau tidak. Bila sesuai perusahaan mengeluarkan purchase order. Sehingga hasilnya tidak optimal dikarenakan tidak mempertimbangkan kriteria lainnya seperti: kualitas, harga, pelayanan, waktu pengiriman dan jaminan. Penelitian ini memiliki tujuan untuk mengatasi permasalahan tersebut serta mempermudah para pembudidaya melakukan pemilihan supplier pakan ikan laut yang tepat. Metode Analytical Hierarchy Process (AHP) digunakan sebagai pendukung dalam penelitian ini untuk analisis terhadap data supplier yang didapatkan dari Balai Perikanan Budidaya Laut (BPBL) Batam dengan kriteria penilaian berupa Kualitas, Harga, Pelayanan, Waktu Pengiriman dan Jaminan. Tahapan dari metode ini yaitu menetapkan matrik perbandingan berpasangan, membuat matrik nilai kriteria, Menghitung Principle Eigen Value, Menghitung Principle Eigen Value nilai akhir dalam pengambilan keputusan. Dari pengujian terhadap 5 data supplier mendapatkan hasil berupa rangking nilai pada masing-masing supplier dengan Supplier_003 sebagai rangking 1 dengan nilai 4,25 dan Supplier_002 sebagai rangking 2 dengan nilai. 3,99 Sehingga didapatkan keputusan Supplier_003 sebagai supplier terpilih dan Supplier_002 supplier Cadangan, sedangkan supplier lainnya tidak terpilih. Dengan hasil tersebut sistem pendukung keputusan dengan menggunakan metode AHP dapat diterapkan sebagai pemilihan supplier pakan ikan pada Balai Perikanan Budidaya Laut (BPBL).*

Kata Kunci*: Sistem Pendukung Keputusan, Analytical Hierarchy Process (AHP), Pakan Ikan laut, Budidaya.*

INTRODUCTION

The development of computational methods is currently widely used in all fields of human life. One development of the computational method is a decision support system. Decision support systems can be utilized as an easy way to make the right decisions despite complex problems.

A computer technology from the beginning was created until now has undergone developments, so that, it can improve its efficiency and effectiveness in facilitating human activity, as well as computer devices in the processing of data or information can be done comprehensively in carrying out its duties. The development of information technology has enabled decision making with the development of software as well as the ability to assemble and combine several techniques in decision making from a variety of alternatives solutions [1].

Decision support system functions to assist a person in making decisions [2]. The system must be Interactive Information System that is interactive, flexible, easy to adjust [3] There have been many applications of decision support systems such as Decision Support Systems for selecting freshwater fish culture with AF-TOPSIS [4], Decision Support System for Selection of the Best Catfish Seedlings Using the MOORA (Multi-Objective Optimization based on Ratio Analysis) and WASPAS (*Weight Aggregated Sum Product Assessment*) Method [5], Development of a Supplier Selection Decision Support System Using the TOPSIS Method in Furniture Companies [6] and there is also research for the Selection of Outstanding Teachers [7] and much more research on other decision support systems. In this research, the AHP method will be used.

AHP is designed to arrive at a scale of various alternative sets rationally explaining the perception of people who are closely related to a particular problem with the procedure [8]. The AHP work principle is a complex problem that is not structured will be simplified to the problem. Then the level of importance to the variable will be given a numerical value relative to other variables. From these considerations, synthesis is carried out as the determination of variables that have high priority and play a role as affecting the results of the system [9]. Research on AHP has also been carried out for the selection of the Windows operating system [10], for the acceptance of computer laboratory assistants [11]. AHP method in decision support systems can also be applied to supplier selection for suppliers of marine fish feed.

Batam is a rich island, which has a sea of abundant fish [12]. In the waters of Batam, there are various types of sea fish that have high values can be easily found. Because demand from local and export markets is still high [13]. The current high price of fish feed is because feed ingredients made are almost 30% imported from foreign countries while the demand for raw materials is increasing in line with the increase in fish farming activities. A solution to reduce the percentage of feed costs can have a positive impact. But it is not only the cost issue that affects the supply of fish food, but there are also various other criteria such as the timeliness of fish food supply, fish feed insurance, and the quality of the fish feed. So that the marine fish culture must be able to choose the right supplier to get a fish feed at a low price but of good quality.

The problem that often occurs in the cultivation of seawater fish is the lack of efficiency in determining the right supplier because no research has been done in connection with the selection of suppliers in marine fish feed. For supplier selection, research has only been done for egg suppliers [14], construction material suppliers [15], sports shoes supplier [16]. Previously, the fish farmers simply chose the supplier, namely by contacting the supplier whether they had the required sea fish feed and the price according to the order or not. If appropriate, the company issues a purchase order. So the results are not optimal because the supplier selection process is less efficient where no one knows for certain how decisions should be made in a semitructured or unstructured situation [16]. Another problem is the difficulty to get the needs of fish feed at competitive prices but quality because it influences the decision process [17]. The decision support system using the AHP method is expected to be the best solution in the selection of suppliers for marine fish farming.

This study aims to overcome the problem of less than the maximum of the farmers to choose the right supplier of marine fish feed and facilitate the farmers to choose the right supplier of sea fish feed based on quality, price, service, delivery time and guarantee criteria.

MATERIALS AND METHODS

So that the steps taken by the author in this design do not deviate from the subject and are more easily understood, then the sequence of steps will be made systematically so that it can be used as a clear and easy guide to solving existing problems. The sequence of steps to be made in this study can be seen in Figure 1.

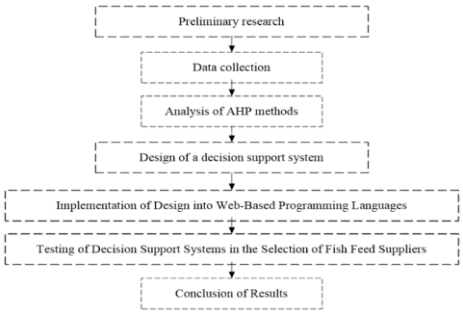

Figure 1. Framework

Accredited Rank 3 (Sinta 3) based on the Decree of the Dirjen Penguatan RisBang Kemenristekdikti
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This research phase consists of preliminary research, data collection, design, implementation, and testing which will be explained below.

a. Preliminary Research

From research first is to analyze the object to be processed. Learn how the object can solve the problem, environmental factors, and the impact of the object. Preliminary research can provide preliminary evidence that the problems we will examine in the field exist.

b. Data collection

As for matters relating to conducting data collection on this research methodology are as follows:

1. Research time
   This research was conducted from 2019 until 2020.
2. Place of Research
   The place of the research that the author did was at the Batam Batam Aquaculture Fisheries Cente (BPBL)
3. Research methods
   Matters relating to this research method are as follows:

a. Field Research
   In a study to produce optimal data, it is necessary to conduct field research, where this field research conducts data collection directly at the Batam Aquaculture Fisheries Center (BPBL) Batam.
b. Library Research
   Collecting data through library research by reading books and other references that are related to issues related to the discussion in this study, then comparing it with data that has been obtained in the field of research.
c. Laboratory research
   Laboratory research is concerned with the hardware and software used in research. The hardware (hardware) used in this study, namely: Laptops with Intel Core i5 Processor specifications. 4 GB DDR3 Memory. 610 GB hard disk. 16 GB flash disk. Inkjet Printer. While the software (software) used in this study, namely: Windows 8.1 Operating System, Rational Rose 2002 Professional, Portable Mowes, Macromedia Dreamweaver, Mozilla Firefox Version 33.2.

c Analysis of AHP methods

The analysis stage is one of the important stages in this research, because at this stage identification will be made of the problems that exist in Batam Aquaculture Fisheries Center (BPBL) Batam in the selection of suppliers of marine fish feed, as well as analyzing the data obtained, where the data in the form of criteria used as an assessment of the feasibility of prospective suppliers. The method used in analyzing this data is to apply the AHP method to produce information in the form of ranking the data criteria that were managed earlier, as well as the steps needed for the desired design to the expected analysis.

RESULTS AND DISCUSSION

Based on the research conducted by the author, following the application of the Analytical Hierarchy Process (AHP) method which is used as a systematic research method which consists of assessment procedures based on criteria. The steps in the method of AHP:

1. Determine a pairwise comparison matrix, create a criterion value matrix. The criteria determined as a basis for evaluating supplier selection in this study are:

a. Quality = K1

The quality of feed provided by fish feed suppliers must be the best because the food eaten by fish is one of the factors in fish growth. Good quality is one way to maintain trust. The weights for each value on quality are as follows: very good with a weight of 5, good with a weight of 4, enough with a weight of 3 bad with a weight of 2 and very poor with a weight of 1.

b. Price = K2

Competitive prices without ignoring the quality of the products provided by fish feed suppliers are one of the criteria that needs to be considered because it relates to the costs incurred by the fish farmers, the more minimal costs incurred the better but with a low price must be followed by the quality of the product the good one. Weights for each value on the price are as follows: very cheap with a weight of 5, cheap with a weight of 4, enough with a weight of 3 is expensive with a weight of 2 and very expensive with a weight of 1.

b. Service = K3

Good service provided by suppliers is one of the factors that will make consumers interested in always making these suppliers as providers of fish feed. the weights for each value in the service are as follows: very good with a weight of 5, good with a weight of 4, enough with a weight of 3, bad with weight and very bad with a weight of 1.

c. Delivery time = K4

Delivery time is one of the criteria used, the faster the delivery time, the better the supplier. weights for each value at the time of delivery are as follows: very fast with a weight of 5, fast with a

weight of 4, enough with a weight of 3, slow with a weight of 2 and very slow with a weight of 1.

d. Guarantee = K5

The purpose of the guarantee is a guarantee during the delivery and quality of fish feed. the weights for each value on the guarantee are as follows: There are weights of 5 and None with weights of 1.

The hierarchical structure to be used in the AHP process is as shown in Figure 2.

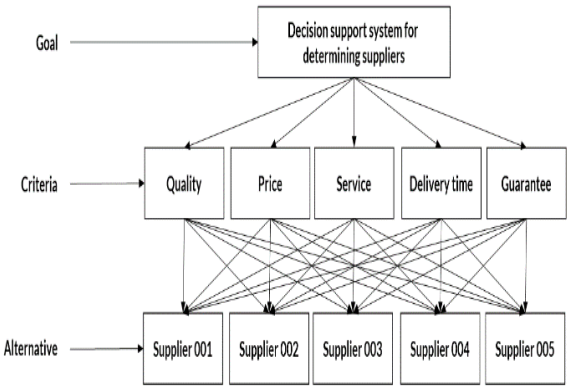

Figure 2. AHP hierarchy

In the stages of determining the priority criteria, the first step is to make a pair comparison matrix, which is to compare elements in pairs according to the given criteria. As Table 1 below.

Table 1. Comparison of Criteria

Criteria	K1	K2	K3	K4	K5
K1	1,000				
K2		1,000			
K3			1,000		
K4				1,000	
K5					1,000

From Table 1 above it will be converted into a matrix, and given a diagonal 1, because the results of the comparison between the value of the criteria themselves, As Table 2 below.

Table 2. Pairwise Comparison Matrix Matrix

Criteria	K1	K2	K3	K4	K5
K1	1,00	3,00	2,00	2,00	3,00
K2		1,00	2,00	2,00	2,00
K3			1,00	2,00	3,00
K4				1,00	2,00
K5					1,00

Determine the ranking of criteria in the form of priority vectors (also called normalized vectors). Fill in the Pairwise Comparison matrix values as shown in Table 3 below.

Table 3. Fill in the Pairwise Comparison Matrix Value

Criteria	K1	K2	K3	K4	K5
K1	1,00	3,00	2,00	2,00	3,00
K2	0,33	1,00	2,00	2,00	2,00
K3	0,50	0,50	1,00	2,00	3,00
K4	0,50	0,50	0,50	1,00	2,00
K5	0,33	0,50	0,33	0,50	1,00

In the value below the diagonal obtained from the division of the value of the pairwise comparison matrix so that the values obtained by the Pairwise Comparison Matrix, then do the summation as table 4 below.

Table 4. Content Value Pairwise Comparison Matrix

Criteria	K1	K2	K3	K4	K5
K1	1,00	3,00	2,00	2,00	3,00
K2	0,33	1,00	2,00	2,00	2,00
K3	0,50	0,50	1,00	2,00	3,00
K4	0,50	0,50	0,50	1,00	2,00
K5	0,33	0,50	0,33	0,50	1,00
Total	2,67	5,50	5,83	7,50	11,00

Normalize the Matrix by dividing the contents of each column value divided by the number of column values, and Calculate the Normalized Vector Eigen by adding up each row then divide by the number of criteria. As Table 5 below.

Table 5. Matrix of Finding Vector Eigen

Criteria	K1	K2	K3	K4	K5	Total	EV
K1	0,38	0,55	0,34	0,27	0,27	1,80	0,36
K2	0,13	0,18	0,34	0,27	0,18	1,10	0,22
K3	0,19	0,09	0,17	0,27	0,27	0,99	0,20
K4	0,19	0,09	0,09	0,13	0,18	0,68	0,14
K5	0,13	0,09	0,06	0,07	0,09	0,43	0,09

Furthermore, normalization will be performed where the matrix value is obtained from the results of the multiplication of Table 3 with the Vector Eigenvalue as shown in Table 6 below.

Table 6. Normalization Matrix

Criteria	K1	K2	K3	K4	K5
K1	0,361	1,082	0,721	0,721	1,082
K2	0,073	0,220	0,439	0,439	0,439
K3	0,099	0,099	0,198	0,396	0,594
K4	0,068	0,068	0,068	0,136	0,272
K5	0,029	0,043	0,029	0,043	0,086

Next, Make a table to calculate the consistency ratio as Table 7 below.

Table 7. Calculation of Consistency Ratio

Criteria	Normalization	EV	Results
K1	3,966	0,36	4,326
K2	1,611	0,22	1,830
K3	1,385	0,20	1,583
K4	0,611	0,14	0,747
K5	0,230	0,09	0,316
Total			8,803
λ max (total /n)			1,761

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Criteria	Normalization	EV	Results
CI ((λ max-n)/n-1)			-0,810
CR (CI/IR)			-0,723

The contents of the column from Table 7 are taken from the previous table, where for normalization is taken from table 6, for the EV column is taken from the Priority column in Table 5, while the Column Results obtained from the normalization column are added to the EV column. Furthermore, the CR value will be sought to determine whether the consistency of the calculation is acceptable or not, with the following conditions:

a. total (sum of results): 8,803
b. n (number of criteria): 5
c. λ max (total /n): 1,761
d. CI ((λ max-n)/n-1): -0,810
e. CR (CI/IR): -0,723

Because CR <0.1, the consistency ratio from the calculation is acceptable. Furthermore, data processing will be carried out obtained from a field study at the Batam Aquaculture Fisheries Center (BPBL) Batam, the data displayed in this study is only in the form of codes. As Table 8 below.

Table 8. Supplier Data

NO	Supplier Code	K1	K2	K3	K4	K5
1	*Supplier*_001	Enough	Cheap	Enough	Slow	There is
2	*Supplier*_002	Well	Cheap	Well	Enough	There is
3	*Supplier*_003	Very good	Expensive	Very good	Fast	There is
4	*Supplier*_004	Well	Expensive	Well	Fast	There is
5	*Supplier*_005	Well	Cheap	Bad	Slow	There is

After the data is displayed along with the value of each criterion that exists on the supplier then we will do the conversion into numeric form following the weights specified in Step 'a'. The results of the conversion are shown in Table 9.

Table 9. Supplier Data Conversion Results

NO	Supplier Code	K1	K2	K3	K4	K5
1	*Supplier*_001	3	4	3	2	5
2	*Supplier*_002	4	4	4	3	5
3	*Supplier*_003	5	2	5	4	5
4	*Supplier*_004	4	2	4	4	5
5	*Supplier*_005	4	4	2	2	5

Furthermore, multiplication will be performed on each supplier value with EV values that have been obtained by the previous AHP calculation process, as in Table 10.

Table 10. Multiplication of Criteria with EV

No	Supplier Code	K1	K2	K3	K4	K5
1	*Supplier*_001	3*0,36	4*0,22	3*0,20	2*0,14	5*0,09
2	*Supplier*_002	4*0,36	4*0,22	4*0,20	3*0,14	5*0,09
3	*Supplier*_003	5*0,36	2*0,22	5*0,20	4*0,14	5*0,09
4	*Supplier*_004	4*0,36	2*0,22	4*0,20	4*0,14	5*0,09
5	*Supplier*_005	4*0,36	4*0,22	2*0,20	2*0,14	5*0,09

From Table 10. Then the final results are as shown in Table 11.

Table 11. Final Results

Supplier Code	K1	K2	K3	K4	K5	Total
*Supplier*_001	1,08	0,88	0,6	0,28	0,45	3,29
*Supplier*_002	1,44	0,88	0,8	0,42	0,45	3,99
*Supplier*_003	1,8	0,44	1	0,56	0,45	4,25
*Supplier*_004	1,44	0,44	0,8	0,56	0,45	3,69
*Supplier*_005	1,44	0,88	0,4	0,28	0,45	3,45

Then rank based on the final results table, as Table 12 below.

Table 12. Ranking

NO	Supplier Code	Total	Rank
1	*Supplier*_003	4,25	Rank 1
2	*Supplier*_002	3,99	Rank 2
3	*Supplier*_004	3,69	Rank 3
4	*Supplier*_005	3,45	Rank 4
5	*Supplier*_001	3,29	Rank 5

After ranking is determined, then a decision is obtained as in Table 13.

Table 13. Decision

NO	Supplier Code	Total	Decision
1	*Supplier*_003	4,25	Selected
2	*Supplier*_002	3,99	Reserve
3	*Supplier*_004	3,69	Not elected
4	*Supplier*_005	3,45	Not elected
5	*Supplier*_001	3,29	Not elected

From the results of the decision in table 12 obtained the results in the form of Supplier_003 with the decision selected as a supplier of fish feed at Batam Aquaculture Fisheries Center (BPBL) Batam with a value of 4.25 and also obtained the results of Supplier_002 with a Reserve decision with a value of 3.99 while other suppliers get a decision No Selected.

CONCLUSION

From the results of the research conducted, the following results were obtained: Decision Support System using the AHP method can be applied as a supplier of fish feed suppliers at the Batam Aquaculture Fisheries Center (BPBL) and the results obtained in this study in the form of Supplier_003 with the decision selected as a supplier of fish feed at Batam Aquaculture Fisheries Center (BPBL) Batam with a value of 4.25

and also obtained Supplier_002 results with a Reserve decision with a value of 3.99 while other suppliers get an Unselected decision.

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