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A Decision Support System To Determine The Best Natural Feed For Fish Cultivation Using Topsis Method

Abdul Malik[1], Ester Frescila Simbolon[2], Lukman[3], and Tiara Adinda[4]

Sistem Informasi Kelautan, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Isola, Kec. Sukasari, Kota Bandung, Jawa Barat 40154

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ABSTRACT

Natural feed in the cultivation of carp (Cyprinus carpio) is a very important effort to do so that the cultured fish can breed quickly and of course in good health. Sometimes carp cultivators are confused about deciding which natural feed is good. This study aims to select the best natural carp feed using a Decision Support System (DSS) with the TOPSIS method. This method uses an alternative approach to the ideal solution called preference value. In this study using several criteria, namely C1: Protein; C2 : Fat; C3 : Carbohydrates; C4 : Feed Prices; C5: Yes. From the calculations performed using the TOPSIS method, the highest preference level with a value of 1 is A1. The results of the Decision Making System with the TOPSIS method from natural selection of carp that can be used by farmers, namely earthworms.

Corresponding Author:

Abdul Malik
Sistem Informasi Kelautan
Universitas Pendidikan Indonesia
Jl. Dr. Setiabudi No. 229, Isola, Kec. Sukasari,
Kota Bandung, Jawa Barat
E-mail: abdulmalik@upi.edu

1. Introduction

The need for fish as a source of protein can be done by catching fish in public waters or carrying out aquaculture activities. According to Law Number 45 of 2009, fisheries are all activities related to the utilization and management of fish resources and their environment, including pre-production, production, processing, and marketing carried out in a fishery business system. The aquaculture industry makes a significant contribution to economic growth, income generation, and community welfare, as well as providing employment.

Cultivation of carp (Cyprinus carpio) is a fishery business that is developing along with the increasing food needs of the community (Mantau, 2004). Carp is well-known as a type of consumption fish that has a number of freshwater fishery commodities with a promising future (Amri, 2002). This is because carp is easy to cultivate, grows quickly, and the flesh is delicious to eat, making it easy to market. In the process of cultivation there are various factors that can affect its growth, one of which is feed.

To produce quality fish seeds, we must pay attention to the provision and provision of high quality, high protein, and cost-effective feed during the goldfish cultivation process. Because later the need for nutrients can affect the growth of the goldfish itself. According to Afrianto and Liviawati (2005), the nutritional needs of each type of fish are not the same as each other and are influenced by various variables, including the type of fish, size, habitat, and season.

Carbohydrates, fats and proteins provide energy for feed. With increasing fish size, the proportion of energy consumed also increases. Due to the scarcity of feed and the high cost of artificial feed, farmers must be able to provide other options such as natural feed. Based on this, it is hoped that this research can be used to find optimal natural food for carp. To then help solve existing problems and provide solutions to reduce production costs in carp cultivation.

2. Method

2.1 Data Collection Method

Data collection methods are an important part of ensuring the scientific validity of a study, and this method is also needed to obtain results that are consistent with the research objectives. Data for this study were collected by reading literature, books, articles, journals, and other origins related to the subject under study to gather reliable information.

2.2 TOPSIS (Technique for Order Preference by Similarity to Ideal Solution)

TOPSIS method (*Technique for Order Preference by Similarity to Ideal Solution*) is a step in the decision-making system that allows decision-making to run quickly and accurately, from the results of the desired criteria or at least very close to the desired criteria. According to Ifo (2018), TOPSIS is a multi-criteria decision-making method developed by Yoon and Hwang in 1981 with the main premise that the alternative chosen is closest to the positive ideal solution and furthest from the negative ideal solution. In general, the stages of the TOPSIS method are as follows:

1. Creating a normalized decision matrix with the equation:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}}$$

Where rij is the matrix resulting from the normalization of the basic matrix of the problem, with i = 1, 2, 3, …m, and j = 1, 2, 3, …n. While Xij is the basic matrix which will be normalized later. For each I denotes the rows of the matrix and for each j denotes the columns of each matrix.

2. Create a weighted normalized decision matrix with the equation

$$y_{ij} = w_i r_{ij}$$

Where yij is the weighted rating matrix, wi is the weight of the rating to i and rij is the matrix normalized in the second step. For i = 1,2, …, m, and j = 1, 2, …, n. In this case, the rating weight must be determined based on the number of decision variables that are being completed.

3. Determine the positive ideal solution matrix and the negative ideal solution matrix with the equation

$$A^+ = (y_1^+, y_2^+, \ldots, y_n^+)\ A^- = (y_1^-, y_2^-, \ldots, y_n^-)$$

Under the condition

$$y_j^+ = \begin{cases} \max_i y_{ij} & ;\ \text{jika j adalah atribut keuntungan} \\ \min_i y_{ij} & ;\ \text{jika j adalah atribut biaya} \end{cases}$$

$$y_j^- = \begin{cases} \min_i y_{ij} & ;\ \text{jika j adalah atribut keuntungan} \\ \max_i y_{ij} & ;\ \text{jika j adalah atribut biaya} \end{cases}$$

4. Calculates the distance between the weighted values of each alternative

To determine the distance between the weighted value of each alternative to the positive ideal solution, the following equation is used:

$$D_i^+ = \sqrt{\sum_{j=0}^{n} \left(y_i^+ - y_{ij}\right)^2}$$

To determine the distance between the weighted value of each alternative to the negative ideal solution, the following equation is used:

$$D_i^+ = \sqrt{\sum_{j`=1}^{n} \left(y_{ij} - y_i^-\right)^2}$$

5. Calculating preference values for each alternative

$$\mathrm{V_i} = \frac{\mathrm{D_i^-}}{\mathrm{D_i^-} + \mathrm{D_i^+}} ;$$

The largest Vi value indicates that the alternative Ai is selected.

3. Result and Discussion

This section will explain how to compare the consistency of the evaluation and the comparison of the consistency of the best natural feed to the criteria evaluated using the TOPSIS approach with totality. The TOPSIS approach can be used by aquaculture farmers as a decision support tool to choose the best natural feed from a number of identified natural feeds. The following are the results of calculations carried out by the author using the TOPSIS method:

1. Determine the criteria that will be taken into consideration
   Of course, many factors must be considered when making an assessment and must be linked to the problem at hand. The TOPSIS approach was used to select the best natural feed based on the following criteria:
   a. C1 : Protein
   b. C2 : Fat
   c. C3 : Carbohydrates
   d. C4 : Feed Price
   e. C5 : Availability
   And the alternatives chosen as consideration in determining the best natural feed are as follows:
   a. A1 : Earthworm
   b. A2 : Silk Worm
   c. A3 : Kroto
2. Develop preference weights for each criterion
   After determining the evaluation criteria, the preference weight value of each criterion is determined based on the relative relevance of each criterion.
   a. 1 = Very Low
   b. 2 = Low
   c. 3 = Enough
   d. 4 = Important
   e. 5 = Very Important
   From the statement above, it can be said that the preference value ranges from 1 to 5, if a criterion has a high preference value, the criteria will also be more important in making decisions in a problem. The preference value of each criterion is determined as follows:
   a. C1 : Protein = 5
   b. C2 : Fat = 4
   c. C3 : Carbohydrates = 4
   d. C4 : Feed Price = 3
   e. C5 : Availability = 2
   W = (5, 4, 4, 3, 2)

TABLE 1
DETERMINING CRITERIA

Criteria Code	Criteria	Attribute	Weight
C1	Protein	Benefits	5
C2	Fat	Benefits	4
C3	Carbohydrate	Benefits	4
C4	Feed Price	Cost	3
C5	Availability	Benefits	2

Form a decision matrix based on the preference value of each criterion against all alternatives:

TABLE 2
DETERMINING THE VALUE OF EACH ALTERNATIVE

Alternative	Criteria				
	C1	C2	C3	C4	C5
A1	76	45	17	60	5
A2	57	13.3	5	98	4
A3	24.1	42.2	4.3	310	4

After determining the value of each alternative, the next step is to normalize the value of the decision matrix, the value (R) is obtained as follows:

TABLE 3
NORMALIZED MATRIX

Divider	98.00923	63.10887	18.23431	330.61155	7.54983
Alternative	Criteria				
	C1	C2	C3	C4	C5
A1	0.77544	0.71305	0.93231	0.18148	0.66227
A2	0.58158	0.21075	0.27421	0.29642	0.52981
A3	0.24590	0.66869	0.23582	0.93766	0.52981

After obtaining a normalized matrix, then create a weighted normalized matrix (Y):

TABLE 4
WEIGHTED NORMALIZED MATRIX

Alternative	Criteria				
	C1	C2	C3	C4	C5
A1	3.87719	2.85221	3.72923	0.54445	1.32453
A2	2.90789	0.84299	1.09683	0.88926	1.05963
A3	1.22948	2.67474	0.94328	2.81297	1.05963

Determine the positive ideal matrix A+ and the negative ideal matrix A-

TABLE 5
POSITIVE AND NEGATIVE IDEAL MATRIX

	C1	C2	C3	C4	C5
	Benefits	Benefits	Benefits	Cost	Benefits
Positive	3.87719	2.85221	3.72923	0.54445	1.32453
Negative	1.22948	0.84299	0.94328	2.81297	1.05963

Determine the distance between the value of each alternative with the positive ideal solution matrix and the negative ideal solution matrix:

TABLE 6
THE DISTANCE BETWEEN THE VALUE OF EACH ALTERNATIVE TO THE POSITIVE AND NEGATIVE IDEAL SOLUTION

D+	A1	0.00000	D-	A1	4.90156
	A2	3.47781		A2	2.55760
	A3	4.47435		A3	1.83176

Determine the preference value for each alternative:

TABLE 7
PREFERENCE VALUE

Alternative	Preference	Rank
A1	1	1
A2	0.42377	2
A3	0.29047	3

From the manual calculations that have been carried out and have yielded results, it can be seen that alternative A1 has the largest value with a value of 1, greater than alternative A2 with a value of 0.42377 and alternative A3 with a value of 0.29047. then it can be concluded that alternative A1 (Earthworm) will be chosen because it best fits the criteria of the farmer.

4. Conclusion

From the results of research through the results of the calculation of the Decision Making System using the TOPSIS method, this system is very useful and makes it easier for carp farming farmers. The results of manual calculations that have been carried out, there is an alternative that gets the largest result, which is worth 1 which indicates that natural feed is suitable for use and in accordance with the criteria that farmers want for carp feed, namely Earthworm (Alternative A1).

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