**DECISION SUPPORT SYSTEM FOR FISH SEED SELECTION USING THE WEIGHT SUM MODEL (WSM) METHOD**

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**Abstract:** *Decision Support Systems (DSS) have become essential tools across various domains, including the realm of selecting fish fry. Choosing the right fish fry is a pivotal step in achieving a successful aquaculture endeavor. In this context, the Weight Sum Model (WSM) method emerges as an effective approach for decision-making. This research aims to develop a Decision Support System for fish fry selection using the Weight Sum Model (WSM) methodology, facilitating a systematic evaluation of pertinent criteria for optimal fry selection. The initial phase of this study involved the identification of key criteria to be evaluated during the fish fry selection process. Each fish fry is assessed based on these criteria, using appropriate scales of measurement. Within the WSM framework, the assigned values ​​for each criterion are multiplied by their respective weights, afterward summed up for each fish fry under consideration. The fish fry with the highest cumulative score is deemed the most suitable choice, aligned with the predetermined evaluation criteria. This Decision Support System serves to aid aqua culturists and fish farmers in making well-informed decisions grounded in data-driven insights. By assisting in the selection of fish fry that aligns with specific requirements, the system contributes to enhancing the decision-making process within the aquaculture industry. This Decision Support System serves to aid aqua culturists and fish farmers in making well-informed decisions grounded in data-driven insights. By assisting in the selection of fish fry that aligns with specific requirements, the system contributes to enhancing the decision-making process within the aquaculture industry. This Decision Support System serves to aid aqua culturists and fish farmers in making well-informed decisions grounded in data-driven insights. By assisting in the selection of fish fry that aligns with specific requirements, the system contributes to enhancing the decision-making process within the aquaculture industry.*

**Keywords:** *Decision Support Systems, Fish Seeds, Criteria, Weight Sum Model (WSM), Fish Cultivation*.

**Abstract:** Sistem pendukung keputusan (SPK) telah menjadi alat penting dalam berbagai bidang, termasuk dalam pemilihan bibit ikan. Memilih bibit ikan yang tepat merupakan langkah krusial dalam budidaya ikan yang sukses. Dalam konteks ini, metode Weight Sum Model (WSM) dapat digunakan sebagai pendekatan dalam pengambilan keputusan. Penelitian ini bertujuan untuk mengembangkan Sistem Pendukung Keputusan untuk pemilihan bibit ikan menggunakan metode Weight Sum Model (WSM). Metode ini memungkinkan penilaian yang sistematis terhadap berbagai kriteria yang relevan dalam memilih bibit ikan. Langkah pertama dalam penelitian ini adalah mengidentifikasi kriteria-kriteria yang akan dievaluasi dalam pemilihan bibit ikan. Setiap bibit ikan dinilai berdasarkan setiap kriteria menggunakan skala yang sesuai. Dalam metode WSM, nilai-nilai diberikan pada setiap kriteria akan dikalikan dengan bobot kriteria terkait, dan hasilnya dijumlahkan untuk setiap bibit ikan. Bibit ikan yang memiliki jumlah tertinggi akan dianggap sebagai pilihan terbaik berdasarkan evaluasi kriteria yang telah ditentukan. Sistem Pendukung Keputusan ini dapat membantu para petani budidaya ikan dalam mengambil keputusan yang lebih informatif dan berdasarkan data dalam memilih bibit ikan yang sesuai dengan kebutuhan.

**Kata kunci:** Sistem Pendukung Keputusan, Bibit Ikan, Kriteria, Weight Sum Model (WSM), Budidaya Ikan.

**INTRODUCTION**

In an increasingly advanced era like today, technology is progressing very rapidly. Especially in the field of information systems which is in line with the increasing need for information that is fast, accurate, well integrated and structured[1]. The application of information technology is widely used in processing power into accurate information. The development of information systems is very helpful in everyday life so that it can facilitate the delivery and receipt of information because each information system has a role to provide information to the user by processing existing data so as to produce detailed and accurate information.[2].

Fish seeds refer to individual fish that are used as an initial or initial stage in fish cultivation. Fish seeds can come from artificial sorting and hatching or from natural catches. Selection of good fish seeds is very important in aquaculture activities, because the right seeds will affect the growth, health and productivity of the fish being cultivated. However, the process of selecting fingerlings can be complicated because many factors must be considered, such as fish species, environmental conditions, source of seeds, and quality of seeds.[3].

The number of factors that must be considered in determining the selection of fish seeds requires a scientific approach to a decision support system. This system was built to make it easier for fishermen to make decisions by utilizing data, models and analytical methods. Providing appropriate and timely information to decision makers in order to make better and more informed decisions[4].

In this research, the Weight Sum Model (WSM) is used as an approach in decision making. WSM is a popular method in Decision Support Systems (DSS) because it is relatively simple and easy to understand[5]. This method combines and assigns weight to each relevant factor in the selection of fish seeds, then adds up these weights to obtain a final value that describes the degree of suitability of each alternative fish seed.[6].

A decision support system is an interactive information system that provides information, modeling, and data manipulation that is used to assist decision making in semi-structured and unstructured situations where no one is sure how they should make a decision.[7].

The decision support system is part of a computer-based information system including the knowledge system used to support decision making[8].The decision support system (Decision Support System) only helps in making decisions in dealing with quite complex problems and is a second opinion in decision making, and does not mean replacing the manager's duties.[9].

The aim of the research to be carried out is to develop a computer system that can help fishery business owners or fish farmers in choosing fish seeds that best suit their needs.[10]. This system will analyze various factors relevant to selecting fish seeds, such as water quality, temperature, type of feed, and the quality of the fish seeds themselves. By using the WSM method, the system will provide recommendations about the most optimal fish seeds based on the weight assigned to each factor.

It is hoped that this research can help improve efficiency and effectiveness in selecting fish seeds, so that the results of fish farming can be improved. In addition, this decision support system can also reduce the level of uncertainty and risk in decision making, because it is based on a more detailed and objective analysis.

**METHODS**

In this research, researchers used the WSM method. The WSM method is a very popular method and is widely applied to help decision makers in making decisions. Method (WSM) is one of the simplest and easiest to understand implementation methods[11]. The WSM method is a general model that is used for different applications such as robotics, processors and others, this method is often used in single-dimensional problems.[12]. The flowchart of this research can be seen in Figure 1.



Figure 1. Research Flow Diagram

The research diagram above illustrates the steps that will be carried out in SPK research on fish seed selection using the Weight Sum Model (WSM) Method.

1. The initial stage involved a needs and criteria analysis, during which the relevant criteria for fingerling selection were determined. Then, the SPK design was carried out using the WSM method, which involved model development and the formulation of criteria weights.
2. Furthermore, data collection was carried out using various data collection techniques, such as questionnaires, interviews, or field observations. The collected data is analyzed to obtain the information needed in developing the SPK.
3. After that, the SPK is implemented, and the evaluation and validation stage is carried out to test the system performance and ensure the accuracy and effectiveness of the recommendations produced.
4. Finally, an analysis of the results and recommendations is carried out, where the data that has been analyzed is used to produce recommendations for selecting appropriate fish seeds based on the weight of the criteria that have been determined.

The following is a flowchart of the Weighted Sum Model (WSM) method as follows:



Figure 2. WSM Method Flowchart

**RESULTS AND DISCUSSION**

The Weighted Sum Model method is a very general method, and is widely applied to help decision makers in making decisions. WSM is one of the simplest and easiest to understand methods of implementation. Is part of the MCDM (Multi-Criteria Decision Making) method in evaluating the value of each alternative.

Ajwsm – score(1)

Information:

 N: number of criteria

WA: weight of each criterion

aij : matrix value x

The process of analyzing data is where the data is in the form of criteria used as an assessment of the selection of superior seeds in seawater fish ponds. The method used to analyze this data is to apply the weighted product method to produce information in the form of rankings against the criteria for the data managed earlier.

Some of the criteria and sub-criteria that influence the determination of freshwater fish farming are as follows: grouper, red snapper, milkfish, tuna and gourami. Alternative Data Alternative data is very important data in decision support systems. The following is a list of alternatives to choose from. Alternatives and criteria can be seen in the following table:

Table 1. List of Alternatives

|  |  |  |  |
| --- | --- | --- | --- |
| **No** | **Alternative** | **Sub Criteria** | **Information** |
| 1 | Growth Rate | C1 | Daily Growth Rate |
|  |  | C2 | Total length |
|  |  | C3 | Standard Length |
|  |  | C4 | Morphological Changes |
|  |  | C5 | Feed Conversion Factor |
|  |  | C6 | Survival Rate |
| 2 | Nutrient content | C1 | Protein Content |
|  |  | C2 | Fat Content |
|  |  | C3 | Vitamin content |
|  |  | C4 | Water Content |
|  |  | C5 | Micronutrient Content |
| 3 | Fish Prices | C1 | Seed Quality |
|  |  | C2 | Types and species |
|  |  | C3 | Seeding rate |
|  |  | C4 | Health and certification |
|  |  | C5 | Environmental Suitability |
| 4 | Fish Harvesting Period | C1 | Weight |
|  |  | C2 | Quality |
|  |  | C3 | Maturity Level |
|  |  | C4 | Population density level |
|  |  | C5 | Growth rate |
|  |  | C6 | Feed efficiency |
|  |  | C7 | Water quality |
|  |  | C8 | Market Demand |
| 5 | Fish Health | C1 | Survival rate |
|  |  | C2 | Physical appearance |
|  |  | C3 | Growth rate |
|  |  | C4 | Dietary habit |
|  |  | C5 | General health level |
|  |  | C6 | stress level |
|  |  | C7 | Water cleanliness |
|  |  | C8 | Symptoms of Disease |
|  |  | C9 | Pool Cleanliness |
|  |  | C10 | Vaccination or medication |
| 6 | Easy Seeds to Get | C1 | Market availability |
|  |  | C2 | Purchase accessibility |
|  |  | C3 | Affordable prices |
|  |  | C4 | Seed Quality |
|  |  | C5 | Seed size and age |
|  |  | C6 | Guarantee and after-sales service |
|  |  | C7 | Stock availability throughout the year |
|  |  | C8 | Type of payment |

To carry out a calculation analysis of each alternative and the criteria given, a weighting scale is needed for each criterion, the following scale is used:

Table 2. Weighting Scale

|  |  |  |
| --- | --- | --- |
| **Criteria** | **Scale** | **Weight** |
| **Growth Rate** | Very good | 5 |
|  | Good | 4 |
|  | Pretty good | 3 |
|  | Not good | 2 |
|  | Very Not Good | 1 |
| **Nutrient content** | Very good | 5 |
|  | Good | 4 |
|  | Pretty good | 3 |
|  | Not good | 2 |
|  | Very Not Good | 1 |
| **Fish Prices** | 0 - 1000 | 1 |
|  | 1050 - 2000 | 2 |
|  | 2050 - 3000 | 3 |
|  | 3050 - 4000 | 4 |
|  | 4050 - 5000 | 5 |
| **Harvest Time** | 0 – 4 Months | 5 |
|  | 5 – 9 Months | 4 |
|  | 10 – 13 Months | 3 |
|  | 14 – 17 Months | 2 |
|  | 20 – 23 Months | 1 |
| **Fish Health** | Very good | 5 |
|  | Good | 4 |
|  | Pretty good | 3 |
|  | Not good | 2 |
|  | Very Not Good | 1 |
| **Seeds are easy to get** | Very easy | 5 |
|  | Easy | 4 |
|  | Quite easy | 3 |
|  | Less Easy | 2 |
|  | Not easy | 1 |

Table 3. Criteria Weight (Quisoner questions and answers with initial weight)

|  |  |  |
| --- | --- | --- |
| **Criteria Code** | **Criterion Name** | **Weight** |
| **K1** | Growth Rate | **5** |
| **K2** | Nutrient content | **3** |
| **K3** | Prices of Fish Seeds | **4** |
| **K4** | Harvest Time | **4** |
| **K5** | Fish Health | **5** |
| **K6** | Seeds are easy to get | **5** |

Table 4. Fish Seed Data Conversion

|  |  |
| --- | --- |
| **Alternative Code** | **Criteria** |
| **Growth Rate** | **Nutrient content** | **Prices of Fish Seeds** | **Harvest Time** | **Fish Health** | **Easy to Get Seeds** |
| BI1 | 4 | 4 | 4 | 4 | 5 | 4 |
| BI2 | 4 | 4 | 5 | 4 | 5 | 4 |
| BI3 | 5 | 5 | 4 | 5 | 5 | 5 |
| BI4 | 5 | 4 | 3 | 5 | 5 | 5 |
| BI5 | 4 | 4 | 4 | 5 | 4 | 3 |

Based on the initial weight table that has been determined for each criterion, the decision maker gives the weight

preferences are w = [5 3 4 4 5 5] where W= (W1,W2,W3,W4,W5). Correction of Weight Value Correction of the initial weight value will be corrected by:

Growth Rate(2)

Fixed Weight for Growth Rate Value:



Weight Improvement for Nutritional Content Value:



Weight Improvement for Fish Seed Price Value:



Improvement of the weight of the harvest period value



Fish Health Weight Improvement



Fish Health Weight Improvement



From the weighting process above, the final weights are obtained as follows:

Table 5 . Change in Weight Value

|  |  |  |
| --- | --- | --- |
| **Criteria Code** | **Criterion Name** | **Weight** |
| **K1** | Growth Rate | 0.192 |
| **K2** | Nutrient content | 0.115 |
| **K3** | Fish Prices | 0.153 |
| **K4** | Harvest Time | 0.153 |
| **K5** | Fish Health | 0.192 |
| **K6** | Seeds are easy to get | 0.192 |
|  | **Amount** | 1 |

Calculate the WSM-Score value with the formula:

Ajwsm – score

BI1=(0.192\*4)+(0.115\*4)+(0.153\*4)+(0.153\*4)+(0.192\*4)+(0.192\*5)= 8.224

BI2 = (0.192 \* 4) + (0.115\*4)+(0.153 \* 5)+(0.153 \* 4) + (0.192\*5)+(0.192 \*5) = 9.416

BI3 = (0.192 \* 5) + (0.115\*5)+(0.153 \* 4)+(0.153 \* 5) + (0.192\*5)+(0.192 \*5) = 9.8

BI4 = (0.192 \*5) + (0.115\* 4)+(0.153 \* 3)+(0.153 \* 5) + (0.192\*50.192 \* 5) = 9.416

BI5 = (0.192 \* 4) + (0.115\*4)+(0.153 \* 4)+(0.153 \* 5) + (0.192\*4)+(0.192 \*3) = 7.224

From the results of calculations carried out based on the Weighted Sum Model (WSM) method, the values ​​of the following alternatives are obtained:

Table 6. Ranking Based on Preference Value.

|  |  |  |  |
| --- | --- | --- | --- |
| **Alternative Code** | **Alternative** | **Preference Value** | **Information** |
| BI3 | Milkfish | 9,8 | Rank 1 |
| BI4 | Tuna | 9,416 | Rank 2 |
| BI2 | Red Snapper | 8,416 | Rank 3 |
| BI1 | grouper | 8,224 | Rank 4 |
| B14 | Gourami | 7,224 | Rank 5 |

From the table above, data is obtained that the B13 (Milkfish) sample is the type of fish seed that has the largest WSM index value, namely 9.8, which ranks first, so that in research using the WSM method, it can be used as material in making decisions about cultivating fish seeds.

**CONCLUSION**

Validation of the weight sum model (WSM) method can provide more accurate selection results in drawing conclusions about the effectiveness of the WSM model in selecting fish fry. The application of the WSM method can contribute to increasing productivity in aquaculture businesses. The WSM method shows that the WSM-based decision support system is successful in increasing fish seed selection.

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**BIBLIOGRAPHY**

[1 M. Zulpan Batubara, M. Irwan, and P. Nasution, "Online Information System for Social Fund Management at the North Sumatra Orphanage," *J. Technol. And Sis. inf. Business-JTEKSIS*, vol. 5, no. 3, p. 164, 2023, [Online]. Available: http://jurnal.unidha.ac.id/index.php/jteksishttps://doi.org/10.47233/jteksis.v5i3.819.

[2]L. Hernando, "Financial Information System Design in Savings and Loans Cooperative Units," *J. Technol. And Sis. Inf. Business*, vol. 2, no. 1, pp. 22–32, 2020, doi: 10.47233/jteksis.v2i1.84.

[3]S. Hudaidah, Q. Hasani, and MW Yusup, *Community Empowerment Through Development of Catfish Cultivation*. 2017.

[4] Ramadina Pertiwi, Natalia Silalahi, and Fince Tinus Waruwu, "Decision Support System in Determining the Best Workshop Head Using the AHP and WSM Methods," *Bull. Comput. sci. Res.*, vol. 2, no. 1, pp. 1–5, 2021, doi: 10.47065/bulletincsr.v2i1.122.

[5]S. Supiyandi *et al.*, "Implementation of the Weighted Sum Model Method in Determining Used Car Selection," SENASHTEK Pros. Monday. Nas. Sauce. Humanities and Technology., pp. 106–111, 2022.

[6]R. Zulkarnain and T. Susilowati, "Decision Support System for Selecting Quality Catfish Seeds Using the Saw Method (Simple Additive Weighting) in Wates Village," *Department of Information Systems, STMIK Pringsewulampung*, vol. 5, no. 1, pp. 434–441, 2017.

[7] WP Sari, A. Setiawan, and MI Saepulhaq, "Implementation of the Weighted Sum Model Method in Decision Support Systems Using the Rational Unified Process (Rup)," *Narrative J. Nas. Research, App. and Tech. inform.*, vol. 2, no. 1, pp. 50–54, 2020, doi: 10.53580/naratif.v2i1.83.

[8]A. Ramadhan and S. Supatman, "Decision Support System for Supplier Selection at PT. Avo Innovation Technology With the Simple Addivite Weighting (SAW) Method," *J. Technol. And Sis. Inf. Business*, vol. 4, no. 2, pp. 256–267, 2022, doi: 10.47233/jteksis.v4i1.484.

[9]L. Hernando, “Client Server-Based Decision Support System for Accepting New Employees,” *JURTEKSI (Journal of Information Technology and Systems)*, vol. 6, no. 3, pp. 239–246, 2020, [Online]. Available: https://jurnal.stmikroyal.ac.id/index.php/jurteksi/article/download/671/412.

[10] Ade Suhara, "Cultivation Techniques for Raising and Selecting Patin Fish Seeds (Case Study on the Large Land of Mekar Mulya Village, Teluk Jambe Barat District, Karawang Regency)," *J. Buana Pengabdi.*, vol. 1, no. 2, pp. 1–8, 2019, doi: 10.36805/jurnalbuanapengabdian.v1i2.1066.

[11]R. Irwansyah and Mesran, "Decision Support System for Selecting the Best Vocational School Students in Medan City Using the Weighted Sum Model Method," *J.Inf. syst. Res.*, vol. 3, no. 3, pp. 155–158, 2022, doi: 10.47065/josh.v3i3.1432.

[12]J. Fredricka and L. Elfianty, "Decision Support System for Vocational School Selection with the Weighted Product and Weighted Sum Model Methods," *J.Tek. inform. Unika St. Thomas*, vol. 05, no. 02, pp. 186–192, 2020, [Online]. Available: http://download.garuda.kemdikbud.go.id/article.php?article=2582107%5C&val=24271%5C&title=Vocational School Selection Decision Support System using the Weighted Product Method and Weighted SUM Model.

[1 M. Zulpan Batubara, M. Irwan, and P. Nasution, "Online Information System for Social Fund Management at the North Sumatra Orphanage," *J. Technol. And Sis. inf. Business-JTEKSIS*, vol. 5, no. 3, p. 164, 2023, [Online]. Available: http://jurnal.unidha.ac.id/index.php/jteksishttps://doi.org/10.47233/jteksis.v5i3.819.

[2]L. Hernando, "Financial Information System Design in Savings and Loans Cooperative Units," *J. Technol. And Sis. Inf. Business*, vol. 2, no. 1, pp. 22–32, 2020, doi: 10.47233/jteksis.v2i1.84.

[3]S. Hudaidah, Q. Hasani, and MW Yusup, *Community Empowerment Through Development of Catfish Cultivation*. 2017.

[4] Ramadina Pertiwi, Natalia Silalahi, and Fince Tinus Waruwu, "Decision Support System in Determining the Best Workshop Head Using the AHP and WSM Methods," *Bull. Comput. sci. Res.*, vol. 2, no. 1, pp. 1–5, 2021, doi: 10.47065/bulletincsr.v2i1.122.

[5]S. Supiyandi *et al.*, "Implementation of the Weighted Sum Model Method in Determining Used Car Selection," SENASHTEK Pros. Monday. Nas. Sauce. Humanities and Technology., pp. 106–111, 2022.

[6]R. Zulkarnain and T. Susilowati, "Decision Support System for Selecting Quality Catfish Seeds Using the Saw Method (Simple Additive Weighting) in Wates Village," *Department of Information Systems, STMIK Pringsewulampung*, vol. 5, no. 1, pp. 434–441, 2017.

[7] WP Sari, A. Setiawan, and MI Saepulhaq, "Implementation of the Weighted Sum Model Method in Decision Support Systems Using the Rational Unified Process (Rup)," *Narrative J. Nas. Research, App. and Tech. inform.*, vol. 2, no. 1, pp. 50–54, 2020, doi: 10.53580/naratif.v2i1.83.

[8]A. Ramadhan and S. Supatman, "Decision Support System for Supplier Selection at PT. Avo Innovation Technology With the Simple Addivite Weighting (SAW) Method," *J. Technol. And Sis. Inf. Business*, vol. 4, no. 2, pp. 256–267, 2022, doi: 10.47233/jteksis.v4i1.484.

[9]L. Hernando, “Client Server-Based Decision Support System for Accepting New Employees,” *JURTEKSI (Journal of Information Technology and Systems)*, vol. 6, no. 3, pp. 239–246, 2020, [Online]. Available: https://jurnal.stmikroyal.ac.id/index.php/jurteksi/article/download/671/412.

[10] Ade Suhara, "Cultivation Techniques for Raising and Selecting Patin Fish Seeds (Case Study on the Large Land of Mekar Mulya Village, Teluk Jambe Barat District, Karawang Regency)," *J. Buana Pengabdi.*, vol. 1, no. 2, pp. 1–8, 2019, doi: 10.36805/jurnalbuanapengabdian.v1i2.1066.

[11]R. Irwansyah and Mesran, "Decision Support System for Selecting the Best Vocational School Students in Medan City Using the Weighted Sum Model Method," *J.Inf. syst. Res.*, vol. 3, no. 3, pp. 155–158, 2022, doi: 10.47065/josh.v3i3.1432.

[12]J. Fredricka and L. Elfianty, "Decision Support System for Vocational School Selection with the Weighted Product and Weighted Sum Model Methods," *J.Tek. inform. Unika St. Thomas*, vol. 05, no. 02, pp. 186–192, 2020, [Online]. Available: http://download.garuda.kemdikbud.go.id/article.php?article=2582107%5C&val=24271%5C&title=Vocational School Selection Decision Support System using the Weighted Product Method and Weighted SUM Model.