

# Detected The Sex Of Fish That Is Good For Cultivation Using Fuzzy

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## Abstract

Fish is a type of vertebrate animal that is poikilothermic (cold-blooded), has distinctive features on its spine, gills and fins and depends on water as a medium for life. Fish have the ability in the water to move by using fins to maintain the balance of their body so that it does not depend on the current or movement of water caused by the wind direction using the FMADM (fuzzy multi attribute decision making) method. The purpose of this study is to get the problem to be solved, namely making a decision support model using the FMADM (fuzzy multi attribute decision making) method with the help of image processing in determining the sex of fish to increase fish farming yields. The preferred alternative in the selection of fish sex is that the 4th alternative has the highest value as the best prospective fish brood with a weighting point of 0.57. Then the investigation is carried out using image processing which is processed using photoshop so that it can be calcified into three image criteria of the physical shape of the sex, and from the number of spines located on the fins of the fish.

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## I. INTRODUCTION

Aquaculture is broadly speaking fish (including other seafood) obtained by cultivation (raising, raising/breeding and harvesting). Aquaculture is the cultivation of aquatic organisms, including fish, mollusks, exchange rates and aquatic plants. This cultivation includes several forms of activities in the maintenance process to increase production, such as regular stocking, feeding/feeding, protection from predators and others. (Food and Agriculture Organization of the United Nations, 1988) . Fish farming is an activity to maintain, raise, and/or breed fish and harvest the produce in a controlled environment, including activities that use vessels to load, transport, store, cool, handle, process, and/or preserve them. (Law of the Republic of Indonesia Number 31 of 2004).

Fish is a type of vertebrate animal that is poikilothermic (cold-blooded), has distinctive features on its spine, gills and fins and depends on water as a medium for life. Fish have the ability in the water to move by using fins to maintain the balance of their body so that it does not depend on the current or movement of the water caused by the direction of the wind.

Of all vertebrates, about 50,000 types of animals, fish make up the largest group among other vertebrates having the largest type or species around 25,988 types consisting of 483 families and 57 orders. These types of fish are mostly scattered in marine waters, namely about 58% (13,630 types) and 42% (9870 types) of all types of fish. The greater number of fish species in marine waters, it is understandable because almost 70% of the earth's surface is composed of seawater and only about 1% is freshwater.

To determine the sex of fish as (*Source: Research Nofri Rahmad Fadli*) [12][13], seeds increase cultivation yields in meeting the consumption of the Indonesian people. Fish sex selection using image processing using FMADM (Fuzzy Multi Attribute Decision Making) weighting has the aim of creating a new model to see the sex of the fish to be farmed. It is hoped that this model can trigger fish farmers to increase fish farming yields.

By using image processing with the FMADM (Fuzzy Multi Attribute Decision Making) method, it can make it easier for fish farmers to determine the sex of fish.

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## Problem Formulation

Based on the background above, the problem that will be solved is to create a decision support model using the FMADM (fuzzy multi attribute decision making) method with the help of image processing in determining the sex of fish to increase fish farming yields.

## Limitations of the issue

In this study, it is necessary to set boundaries to match what was planned in advance, so that the research objectives are achieved. The limitations of the problems that will be discussed in this study are:

- a. The sample data used in this study was obtained from fish farmers in the pringsewu district area.
- b. The method of data collection was obtained using a sample of the fish that was determined, namely the tilapia jaer.

## II. RELATED WORKS/LITERATURE REVIEW

### Decision Support System

SPK is a computer-based system that helps in the decision-making process. SPK as a computer-based information system that is adaptive, interactive, flexible, which is specifically developed to support the solution of unstructured management problems to improve the quality of decision making. Thus, a definition of SPK can be drawn, which is a computer-based system that is adaptive, flexible, and interactive that is used to solve unstructured problems so as to increase the value of decisions made. (in The Journal of Muhamad Muslihudin SENATKOM 2015) [4]

### FMADM

FMADM is a method used to find optimal alternatives from a number of alternatives with certain criteria. The essence of FMADM is to determine the weight value for each attribute, then proceed with a ranking process that will select the alternatives that have been given. There are basically 3 approaches to finding the value of attribute weights, namely the approach of looking for attribute values, namely the subjective approach, the objective approach and the integration approach between the subjective and the objective. Each approach has its drawbacks and weaknesses. In the subjective approach, the value of weights is determined based on the subjectivity of the decision makers, so that several factors in the process of formulating alternative biases are determined freely. Meanwhile, in the objective approach, the weight value is calculated mathematically so as to ignore the subjectivity of the decision maker. (Sri Kusumadewi, 2006). [5] There are several methods that can be used to solve the FMADM problem, including (Sri Kusumadewi,2006):[5]

- a. Simple Additive Weighting method (SAW)
- b. Weight Product (WP)
- c. ELECTRE
- d. Tehnique For Order Preference by Similarity to Ideal Solution (TOPSIS)
- e. Analytic Hierarchy Process (AHP).

### Tilapia morphology

Tilapia is a type of freshwater consumption fish. This fish was introduced from Africa in 1969, and is now a popular pet fish in freshwater ponds and in several reservoirs in Indonesia (Wikipedia II, 2009). The scientific name of tilapia is *Oreochromis niloticus*, and in English it is known as Nile Tilapia. Pets of medium size, the total length (muzzle to the tip of the tail) reaches about 30 cm. Dorsal (dorsal) fin with 16-17 spines (sharp) and 11-15 fingers (soft spines); and anal (anal) fin with 3 spines and 8-11 fingers (Wikipedia II, 2009). [13][14]

The morphology of tilapia is that it has a flattened body shape in the bertikal direction (compress) with a rectangular profile towards the posterior anero. The position of the mouth is located at the tip of the nose (terminal) and can be cured. On the caudal fin are clearly visible vertical stripes and on the dorsal fin the line is visible leaning towards its location. A distinctive feature of tilapia is the black vertical stripes on the caudal, dorsal and anal fins. On the caudal fin (tail) with a shape makes there is a reddish color and can be used as an indication of the maturity of the gonads. On the jaws there are blackish patches. Tilapia scales are of the ctenoid type. Tilapia is also characterized by hard dorsal fingers, as well as its part. With the position of the anal fin behind the pectoral (abdormal) fin. [13][14][15]

Tilapia has perfect cranium cartilage bones, a stinging organ and an otik capsule combined into one. Ostracodermi exoskeleton has similarities with dentin on the skin. Elasmobranchii which is a hard coat like enamel on vertebrate teeth. Under the layer are several layers of sponge bones and below them are solid bones. The palato-quadrat bone and the Meckel cartilage are cartilages that will form the upper jaw and lower jaw.

### Image Processing Concept

Image processing can be interpreted as a process carried out on an image so as to produce another image that is more in line with our wishes [1]. The following illustration of the digital image processing process can be seen in [16][18] The following figure:

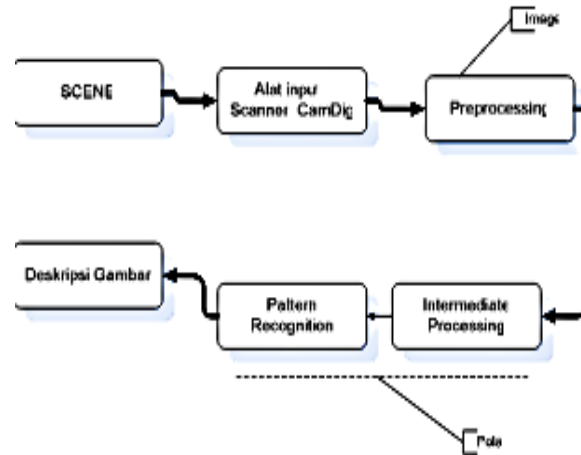


Fig. 1 Digital image process

### Definition of Image Processing

Image = image = image Imagery, according to Webster's dictionary, is *a representation, resemblance, or imitation of an object or object* e.g. :

- ✓ your photo represents an entity of yourself in front of the camera
- ✓ X-ray photos of the thorax represent the state of the inside of a person's body
- ✓ the data in a BMP file represents what it describes

Imagery, from a mathematical point of view, is *a continuous (continued) function of the light intensity in a 2-dimensional plane*. Visible imagery is light reflected from an object. The light source illuminates the object, the object reflects back part of the light beam and the reflected light is captured by optical devices, such as the human eye, cameras, scanners, satellite sensors, etc., and then recorded.

Imagery as the output of a data recording system can be:

- ✓ optics in the form of photos
- ✓ analog in the form of a video signal such as an image on a television monitor
- ✓ digital that can be directly stored on magnetic storage media

Image Processing / Image Processing is the process of improving the quality of images so that they are easily interpreted by humans or computers. Image processing techniques by transforming images into other images, for example: image compression. Image processing is the initial process (preprocessing) of computer vision. Furthermore, the results of image processing will be continued in the pattern recognition process is the next stage or analysis of image processing. Automatic grouping of numerical and symbolic data (including images) by a computer so that an object in the image can be recognized and interpreted [1].

### III. METHODS

#### Simple Additive Weighting Method (SAW)

The *Simple Additive Weighting Method (SAW)* in the Journal of Muhamad Muslihudin (*SENATKOM 2015*) is one of the methods of solving MADM (Multiple Attribute Decision Making) problems. The Simple Additive Weighting (SAW) method is often also known as the weighted summation method. The basic concept of the SAW method is to find the weighted summation of the performance rating on each alternative dri of all attributes (fishburn, 1976). The SAW method requires the process of normalizing the decision matrix (x) to a scale that can be compared with all existing alternative ratings.[4][3]. Given the equation as follows:

$$r_{ij} \left\{ \begin{array}{l} \frac{x_{ij}}{\text{Max } x_{ij}} \\ \frac{\text{Min } x_{ij}}{x_{ij}} \end{array} \right.$$

Where:

$r_{ij}$  = normalized performance rating

Max  $X_{ij}$  = minimum value of each row and column

Min  $X_{ij}$  = minimum value of each row and column

$X_{ij}$  = rows and columns of the matrix

Where  $r_{ij}$  is the neuralized performance branch of the alternative  $A_i$  on the  $C_j$  attribute;  $i = 1, 2, \dots, m$  and  $j = 1, 2, \dots, n$

The preference value for each alternative ( $V_i$ ) is given as :

$$V_i = \sum_{j=1}^n W_j r_{ij}$$

$V_i$  = preference value

$W_j$  = rating weight

$r_{ij}$  = normalized performance rating

The greater value of  $V_i$  indicates that alternative  $A_i$  is more elected.

Rare completion of Simple Additive Weighting (SAW):

1. Determining the criteria that will be used as a reference in decision making, namely  $C_i$ .
2. Specifies the match rating of each alternative on each criterion.
3. Make a decision matrix based on criteria ( $C_i$ ), then normalize the matrix based on equations adjusted to the type of attribute (attribute of elasticity or attribute of cost) so that a normalized matrix of  $R$  is obtained.
4. The final result is obtained from the calculation result, namely the summation of the normalized matrix multiplication  $R$  with the weight vector so that the largest value is obtained which is chosen as the best alternative ( $A_i$ ) as a solution. (*In the Journal of Ida Widianingrum UM Diponegoro 2013*) [3][4]

#### IV. RESULTS

##### Weight Criteria

In this research method there are weights and criteria needed to determine the sex of the fish. The criteria are:

$C_1$ =Body Size

$C_2$ =Color

$C_3$ =Behavior

$C_4$ =Head Size

$C_5$ =Fin Size

From each of these weights, a variable is made. Where from a variable will be changed into a fuzzy number. Below is the fuzzy number of the weight.

1. Very low (SR) =0.2
2. Low (R) = 0.4
3. Simply (C)= 0.6
4. Height (T)=0.8
5. Very high (ST)=1

For this reason, the criteria have their own results and weights. The following can be seen in the tables about each criterion and its weight.

TABLE 1  
 BODY SIZE CRITERIA

Body Size	Value
Normal Flattened	0,8
Long Flattened	0,4
Elliptical	0,2

TABLE 2  
 COLOR CRITERIA

Fish Color	Value
Red Black	1
Silver Rage	0,8
Plain Silver	0,6

TABLE 3  
 BEHAVIOR

Fish Behavior	Value
Aggressive, Makes Attacks, Lively	0,8
Silent Waiting	0,6

TABLE 4  
 HEAD SIZE CRITERIA

Head Size	Value
Flat Lonjon	0,8
Round Oblong	0,4
Flat	0,2

TABLE 5  
 FIN SIZE

Fin	Value
3 Fin Spines	1
2 Fin Spines	0,8
1 Fin Thorn	0,2

TABLE 6  
 WEIGHT OF VETOR EACH CRITERION

Criterion	Weight
C1	0,25
C2	0,30
C3	0,15
C4	0,10
C5	0,20

Alternative:

A1= Fish 1

A2= Fish 2

A3= Fish 3

A4= Fish 4

A5= Fish 5

TABLE 7  
 ALTERNATIVE WEIGHTING OF EACH CRITERION

Fish as a Sample	Criterion				
	C1	C2	C3	C4	C5
A1	0,6	0,6	0,8	1	0,6
A2	1	0,2	0,6	0,6	0,6
A3	0,8	0,6	0,2	0,2	0,2
A4	0,2	0,2	0,8	0,6	1
A5	0,6	0,8	1	0,8	0,6

**Normalization for each matrix**

Benefit criteria (C1,C2,C3,C4,C5,C6,C7,C8,C9)  $R_{ij} = (X_{ij}/\max \{X_{ij}\})$

From column C1 the maximum value is '1', then each row of column C1 is divided by the maximum value of column C1

$$\begin{aligned} R1.1 &= 0.6/1 = 0.6 \\ R2.1 &= 1/1 = 1 \\ R3.1 &= 0.8/1 = 0.8 \\ R4.1 &= 0.2/1 = 0.2 \\ R5.1 &= 0.6/1 = 0.6 \end{aligned}$$

From column C2 the maximum value is '1', then each row of column C2 is divided by the maximum value of column C2

$$\begin{aligned} R1.2 &= 0.6/1 = 0.6 \\ R2.2 &= 1/1 = 1 \\ R3.2 &= 0.6/1 = 0.6 \\ R4.2 &= 0.2/1 = 0.2 \\ R5.2 &= 0.8/1 = 0.8 \end{aligned}$$

From column C3 the maximum value is '1', then each row of column C3 is divided by the maximum value of column C3

$$\begin{aligned} R1.3 &= 0.8/1 = 0.8 \\ R2.3 &= 0.6/1 = 0.6 \\ R3.3 &= 0.2/1 = 0.2 \\ R4.3 &= 0.8/1 = 0.8 \\ R5.3 &= 1/1 = 1 \end{aligned}$$

From column C4 the maximum value is '1', then each row of column C4 is divided by the maximum value of column C4

$$\begin{aligned} R1.4 &= 1/1 = 1 \\ R2.4 &= 0.6/1 = 0.6 \\ R3.4 &= 0.2/1 = 0.2 \\ R4.4 &= 0.6/1 = 0.6 \\ R5.4 &= 0.8/1 = 0.8 \end{aligned}$$

From column C5 the maximum value is '1', then each row of column C5 is divided by the maximum value of column C5

$$\begin{aligned} R1.5 &= 0.6/1 = 0.6 \\ R2.5 &= 0.6/1 = 0.6 \\ R3.5 &= 1/1 = 1 \\ R4.5 &= 0.6/1 = 0.6 \\ R5.5 &= 0.6/1 = 0.6 \end{aligned}$$

TABLE 8  
 NORMALIZED FACTORS TABLE

C1	C2	C3	C4	C5
0,6	0,6	0,75	1	0,6
1	1	0,25	0,6	0,6
0,8	0,6	1	1	1
0,2	0,2	0,75	0,6	0,6
0,6	0,8	1	0,8	0,6

Displayed in a matrix

$$X = \begin{Bmatrix} 0,6 & 0,6 & 0,8 & 1 & 0,6 \\ 1 & 1 & 0,6 & 0,6 & 0,6 \\ 0,8 & 0,6 & 1 & 1 & 1 \\ 0,2 & 0,2 & 0,8 & 0,6 & 0,6 \\ 0,6 & 0,8 & 1 & 0,8 & 0,6 \end{Bmatrix}$$

**Calculation**

By multiplying each column of the table by the weight of the declared criteria. With the equation :

$$V_i = \sum_{j=1}^n W_j r_{ij}$$

$$\begin{aligned} V1 &= (0.1 \times 0.6) + (0.2 \times 0.6) + (0.3 \times 0.8) \\ &\quad + (0.4 \times 1) + (0.5 \times 0.6) \\ &= 0.06 + 0.12 + 0.24 + 0.4 + 0.3 \\ &= 0.49 \end{aligned}$$

$$\begin{aligned} V2 &= (0.1 \times 1) + (0.2 \times 1) + (0.3 \times 0.6) \\ &\quad + (0.4 \times 0.6) + (0.5 \times 0.6) \\ &= 0.1 + 0.2 + 0.18 + 0.24 + 0.3 \\ &= 0.48 \end{aligned}$$

$$\begin{aligned} V3 &= (0.1 \times 0.8) + (0.2 \times 0.6) + (0.3 \times 1) \\ &\quad + (0.4 \times 1) + (0.5 \times 1) \\ &= 0.08 + 0.12 + 0.3 + 0.4 + 0.5 \\ &= 0.32 \end{aligned}$$

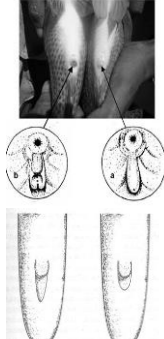
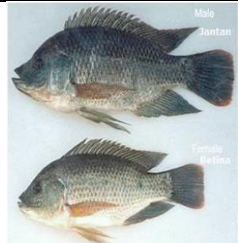
$$\begin{aligned} V4 &= (0.1 \times 0.2) + (0.2 \times 0.2) + (0.3 \times 0.8) \\ &\quad + (0.4 \times 0.6) + (0.5 \times 0.6) \\ &= 0.02 + 0.04 + 0.24 + 0.24 + 0.3 \\ &= 0.57 \end{aligned}$$


$$\begin{aligned} V5 &= (0.1 \times 0.6) + (0.2 \times 0.8) + (0.3 \times 1) \\ &\quad + (0.4 \times 0.8) + (0.5 \times 0.6) \\ &= 0.06 + 0.16 + 0.3 + 0.24 + 0.3 \\ &= 0.52 \end{aligned}$$

**Implementation of Image Processing**

Based on the results of the weighting above physical assessment based on gender criterion:

TABLE 9  
 IMAGE PROCESSING RESULT

No	Image Results	Processing	Information
1			The results of the image processing of fish A show the male type, and B the female type
2			Image processing results based on the physical shape and color of the upper fish

		species show that male fish have a larger shape and fish
3		Image Processing results of fin type.

## V. CONCLUSIONS

From the results of the calculation of alternatives that are selected in the selection of fish sex, the 4th alternative has the highest value as the best prospective fish broodstock with a weighting point of 0.57. Then the investigation is carried out using image processing which is processed using photoshop so that it can be calcified into three image creteria of the physical shape of the sex, and from the number of spines located on the fins of the fish.

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