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# Determination of Feed Fish Price Based on Feed Formulation with Local Raw Materials using Fuzzy Logic Implementation

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**Abstract**
Fish feed is essential on fish farming. Cost of feed fish is the biggest cost component in fish farming is almost 70% of the total costs. Costs for fish farming could reduced if the feed is made byself by the availability of local raw materials in the surrounding environment. To determine the approximate price of artificial fish feed by feed formulation, the required complex calculations of combinations of various types and prices of raw materials locally available. Therefore, we need a method to facilitate the determination of the price of the fish feed. In this study, the use of fuzzy logic methods known to use natural language facilitates pricing based fish feed formulation.

**Keywords:** Price of fish feed, fish feed formulations, raw materials locally, fuzzy logic, natural language

## Introduction

Aquaculture development in Indonesia has been done through the development of pilot minapolitan. A total of 3,600 employer groups will be intensified coaching aquaculture through the Rural Business Development Program Mina Aquaculture. However, in the development of aquaculture are experiencing problems, especially in the supply of fish feed. Intensive fish farming requires high feed costs. As it is known that the activity of intensive fish farming, feed cost component ranks the highest, reaching 70% of the total cost of production [1]. The existence of high feed costs caused profits to decline fish farmers. Even [2] in the magazine edition Gempur 7 April 2013 stated that nearly 80% of the costs incurred for business development carp feeding itself. One of the factors the high price of fish feed due to the inability of farmers and local produce fish feed itself [3]. Therefore, it is necessary to make efficient use of feed but still watching the feed quality, because after that the function of food for fish as a source of energy is required in the physiological processes in the body of the fish [4].

One effort to make efficient use of the feed is to make fish feed itself with raw materials that are easily available and cheap. But in making the feed, the fish farmers are still experiencing difficulties, especially in the early stages of making the feed is formula feed preparation in order to produce quality feed and cheap price. This is because the raw materials of many kinds of feed used. Each of these raw materials have different prices. Whereas information on the feed raw materials are very limited among fish farmers. Local ingredients that can be used for the manufacture of fish food processing waste eg shrimp, crabs, and crabs are processed into chitosan for tiger shrimp feed additives [5], khitin for additional feed of prawns [6], which proved to be the chicken feather meal can be used substitution for fish feed ingredients tawes [7], and carp [8]. Meanwhile, the calculation of feed raw material prices has been done by [9] using an expert system. Results of this research should be developed further with a method that feed prices more informative information in accordance with the feed formulations based on local raw materials or in other words using natural language. The method used in this research is fuzzy logic.

Fuzzy logic associated with the type of uncertainty that has become human nature. This technique, using the mathematical theory of fuzzy sets to simulate normal human reasoning process by allowing the computer to behave a little more careful and logical than that required by conventional computer methods [10]. Fuzzy logic can be useful because it is an effective and accurate way to describe the human perception of the issue of decision-making [11]. The main

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reason the use of fuzzy logic in this study is based on a natural language such as that delivered by [12].

The underlying concepts of fuzzy logic depicted in Figure 1 below [11].
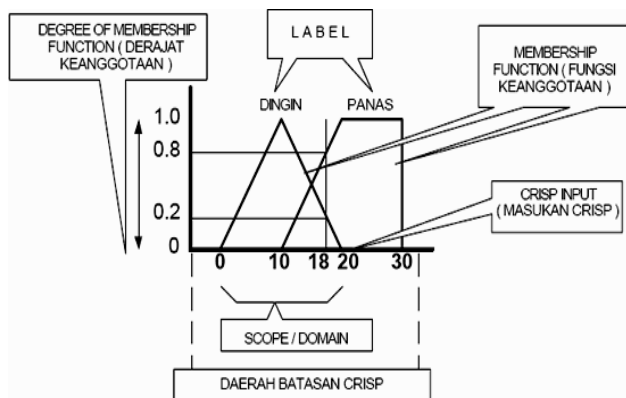


**Fig 1:** The concepts that support the fuzzy logic

## Description
- The degree of membership is the degree to which the crisp values compatible with the membership function (from 0 to 1), also referred to as the membership level, the value of truth, or input fuzzy)
- The label is a descriptive name that is used to identify a function-membership)
- Membership function is to define the fuzzy set with crisp memetakkan input from domain to degrees of membership.
- Input is crisp and firm specific input
- Domain is the width of the membership function. Range of concepts, usually numbers, where the membership functions dipetakkan. Here the domain of fuzzy sets (membership function) is from 0 to 20 degrees and the scope is 20 degrees.
- Regional crisp boundary is the entire range of possible values can be applied to the system variables.

## Materials and Methods
Methods of research carried out through the following stages:
a. Acquisition of knowledge.
At this stage, taking knowledge of the types of local feed and its raw material price and the price of finished feed. This knowledge is obtained from books, journals, internet, field surveys, as well as information from sources.
b. Specify the input and output system
Input in this system is a combination of local feed ingredients to be used in feed production, while output prices forecast system in the form of artificial feed for every kg of feed. The concept of natural language used in the form of fuzzy logic low category information, is being, or is expensive when compared with the price of finished feed on the market.
c. Build and fuzzy set membership function for the price of feed.
d. Build a system using Turbo C ++ programming language

## Results and Discussion
### A. Research Knowledge
Knowledge of the types of local feed and its raw materials

costs presented in Table 1, while the prices of manufactured feed for current conditions are assumed to IDR 6,000/kg. Determination of the combination of feed raw materials as the basis for preparing the feed formulation has been presented in [9].

**Table 1:** List of Local Feed Raw Material Prices

| No. | Bahan pakan | harga/kg (Rp) |
|---|---|---|
| 1 | Fish meal | 15000 |
| 2 | Rebon meal | 9000 |
| 3 | Head shrimp meal | 6000 |
| 4 | Chicken meal | 3500 |
| 5 | Tepung Kepompong Ulat Sutra | 3500 |
| 6 | Waste of cod liver oil | 4000 |
| 7 | Blood meal | 3500 |
| 8 | Fish Silase | 5500 |
| 9 | Bone meal | 4000 |
| 10 | Bekicot meal | 3000 |
| 11 | Cacing Tanah meal | 8000 |
| 12 | Egg | 18000 |
| 13 | Milk | 8000 |
| 14 | Rice bran | 2500 |
| 15 | Corn meal | 6000 |
| 16 | Wheat flour | 8000 |
| 17 | Soybean meal | 7500 |
| 18 | Waste of tofu meal | 2000 |
| 19 | Tepung Bungkil Kacang Tanah | 3500 |
| 20 | Bungkil Kelapa | 3500 |
| 21 | Biji Kapuk/Randu | 3500 |
| 22 | Biji Kapas | 3500 |
| 23 | Tepung Daun Turi | 2000 |
| 24 | Tepung Daun Lamtoro | 2000 |
| 25 | Tepung Daun Ketela Pohon | 2000 |
| 26 | Isi Perut Besar Hewan Memamah biak | 3500 |

### B. Fuzzy Membership Function and Feed Prices
Fuzzy sets and membership functions of the feed material prices built on the concept presented in Figure 1. The curve of fuzzy sets feed rates of materials formed using triangular curve and the shoulder curve as shown in Figure 2.
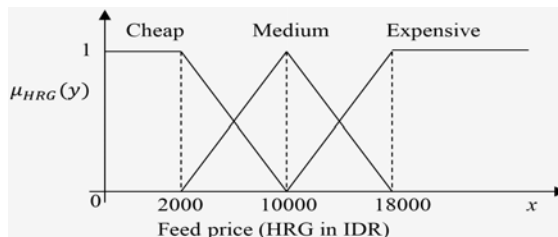
**Fig 2:** The Fuzzy curve of feed material prices

Degree of membership worth 0-1 are denoted with μ_HRG based on input prices. Label or the set consists of three kinds of low, medium, and high. The membership function in the form of a function that maps the equation between local and regional input degrees of membership as presented in equation 1 - 3. Crisp input is input feed prices in dollars. Domain of value for any set price, namely: Cheap (0-10,000), Medium (2,000-18,000), and Expensive (10,000 - ~). Crisp boundary area is the range of values of feed raw material prices, namely Rp 0 - Rp 18,000, -

$$\mu_{HRG\_Murah}(x) = \begin{cases} 1, & 0 \le x < 2000 \\ \frac{10000-x}{10000-2000}, & 2000 \le x < 10000 \\ 0, & 10000 \le x \end{cases} \quad \text{.................... (1)}$$

$$\mu_{HRG\_sedang}(x) = \begin{cases} 1, & x = 10000 \\ \frac{x-2000}{10000-1000}, & 2000 \le x < 10000 \\ \frac{18000-x}{18000-10000}, & 10000 < x < 18000 \\ 0, & x < 2000 \text{ atau } 18000 \le x \end{cases} \quad \text{.................... (2)}$$

$$\mu_{HRG\_Mahal}(x) = \begin{cases} 0, & x < 10000 \\ \frac{x-10000}{18000-10000}, & 10000 \le x < 18000 \\ 1, & 18000 \le x \end{cases} \quad \text{.................... (3)}$$

Membership functions used to categorize the total price of feed materials which have been prepared formulation. This category includes the price of feed is cheap, moderate and expensive feed prices are based on information obtained from field surveys. For example obtained total price of feed ingredients Rp 5,000, -, then according to the diagram included in the low and moderate curves. With equations 1 and 2, can be determined categories, namely:

$$\mu_{HRG\_Murah}(5000) = \frac{10000-5000}{8000} = \frac{5000}{8000} = 0.625$$

or 62.5% is included in the low category (according to equation 1).
Meanwhile, according to equation 2, is obtained:

$$\mu_{HRG\_Sedang}(5000) = \frac{5000-2000}{8000} = \frac{3000}{8000} = 0.375$$

or 37.5%, including in the medium category. From both these categories, are fuzzy means that the price of feed ingredients needed to make the feed formulation is classified in the low category with a percentage of 62.5%.

**C. System Implementation**
Results of fuzzy system implementation is shown in Figure 3. The system call database containing feed raw materials and the price for each kilogram of feed to be displayed so that the user can select the type of feed raw materials desired. The system will provide information about the estimated price of the raw material feed for every kilogram using fuzzy logic membership functions based feed ingredients and according to equation 1 - 3. In addition, the system also provides information about its comparison with the market price of fish feed, assuming the price of fish feed The market is Rp 6,000 (Figure 4).

**Fig 3:** Option combinations of feed ingredients



**Fig 4:** The results of the implementation of fuzzy logic in determining the price of feed

Based on Figure 4 above, the system provides information on the price of feed produced from three combinations of raw materials used for the formulation of fish. This can be explained as follows:

1. The combination of the raw materials used in the manufacture of feed are:
   - chicken or duck eggs (at a price of IDR 18,000/kg or IDR 18/g).
   - Bran (at a price of IDR 2,500/kg or IDR 2.5/g).
   - Flour tofu (with a price of IDR 2,000/kg or IDR 2/g)

Based on the method of determining the feed formulation according Suwarsito and Mustafidah (2014a and 2014b) using computational algebraic methods, in the manufacture of 100 grams of feed needed 17.396111 grams (rounded to 17.4 grams) egg chicken / duck, 68.368 grams (rounded up to 68.37 g) bran, and 14.01 grams of flour tofu. Thus, the price of feed ingredients each raw material are:
   - Eggs chicken/duck: 17.396 x IDR 18 gr/gr = IDR 313.128 (rounded up to IDR 313.13)
   - Bran: 68.37 x IDR 2.5 gr / gr = IDR 170.92
   - Flour tofu: 14.01 gr x IDR 2/g = IDR 28.02

Thus the total price of the raw material (after experiencing rounding) to make feed 100 g is IDR 512.065 or IDR 5120.65 to make 1 kg of feed.

2. The calculation of the value of the membership price of

feed.

Membership value feed prices IDR 5120.65 for each fuzzy set prices are as follows:

− Cheap Price ("HRG_Murah") Set:

$$\mu_{HRG\_Murah}(5120.65) = \frac{10000 - 3120.63}{8000} = \frac{3120.63}{8000} = 0.6099$$

− Medium Price ("HRG_Sedang") Set:

$$\mu_{HRG\_Sedang}(5120.65) = \frac{5120.65 - 2000}{8000} = \frac{3120.65}{8000} = 0.3901$$

− Expensive Price ("HRG_Mahal") Set:

$$\mu_{HRG\_Mahal}(5,120.65) = 0$$

Based on the calculation of the price of membership value, then the price of IDR 5,120.65 included in the set low by 0.6099, or 60.99%, or included in the set was at 0.3901 or 39.01%. Because a value price has more than two grades of membership in the set, then using the properties of fuzzy OR operator obtained the maximum value of the two fuzzy membership value [11]. Thus obtained fuzzy membership value for the price of IDR 5,120.65 is included in the set low. However, because the membership is not worth an absolute value (= 1), so that fuzzy (in the context of natural language) can be described as "tendencies" or "somewhat". Therefore the membership value 60.99% is said to be "somewhat low". Furthermore, the price of feed ingredients Rp 5,120.65 when compared to the market price of finished feed is IDR 6,000 / kg, cheaper IDR 6,000 – IDR 5,120.65 = Rp 879.35 atau

$$\frac{879.35}{6000} \times 100\% = 14.6558333\% \approx 14.66\%$$
.

## Conclusions
The conclusion of this study is that fuzzy logic method can be used to determine the price of fish feed raw material locally. Moreover, using this method, users get the price calculation of feed ingredients needed are more informative, as well as get information about the comparison with the market price of finished feed. Thus, users can consider the results of this comparison to decide whether to make their own food or buy food made in the factory.

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