Utilization of organic waste as raw material of fish feed production for African catfish *Clarias gariepinus*

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**Abstract.** Utilization of organic waste as raw material for fish feed can save the cost of fish feed production. This study aimed to utilize organic waste as raw materials for making fish feed. The study was conducted at the Polytechnic Indonesia Venezuela during four months (November 2014 - February 2015). This research comprised 5 treatments with 3 replications, namely: P1 (commercial feeding), P2 (feeding with 5% organic waste formulation), P3 (feeding with 25% organic waste formulation), P4 (feeding with 50% organic waste formulation) and P5 (feeding with 75% organic waste formulation). *Clarias gariepinus* was fish species used during the observation with size 2 g/tail. Fish are cultivated in soil ponds (2x2 m\(^2\)) with density 500 fishes/pond for 3 months. Parameters measured were growth and survival rate. The results showed that the best growth rate obtained at treatment P2 (114.2 g) and the highest survival percentage was on treatment P1 and P2 (> 60%). Conclusion, the addition of the proportion of organic waste as much as 5% in making fish feed with protein 34.19% produces the best growth.

1. Introduction
Lambung Village is one of the tourist villages located in the city of Banda Aceh, which is visited by tourists both local and non-local. There are many activities done by visitors in this village would be give not only positive impact but also negative impact. One of the negative impacts was increasing organic/ inorganic wastes from visitor's activities. Based on observations, the most organic waste found were corn cobs (corn waste) and vegetable/food waste.

The Lambung Village Community has a program to utilize organic waste in order to reduce environmental pollution. So far, utilization of organic waste has been carried out only for making compost. However, it is expected that there will be a variety of products from the organic waste processing as raw material i.e. fish feed could be used by fish farmers in Lambung Village. Mo et al., [1] mentioned that food waste is suitable as a raw material for aquaculture feed. The use of organic waste as feed raw materials will save the production costs of fish feed and it can reduce the overcome organic waste for environmental management. Kusumanto and Hidayat [2] stated that one of the weaknesses in the preparation of fish feed is un-optimized the potential of local ingredients. The saving of fish feed production costs can be done by providing the composition of organic waste as the main ingredient. The maximum utilization of organic waste can provide significant results because the nutritional content and nutrients in organic waste are still very potential to be utilized. Furthermore, Martin et al. [3] also said that the utilization of organic waste as raw material for feed formulation is an attractive alternative that deserves greater attention. In addition, to reduce the environmental effects associated with animal feed production, the use of vegetable by-products for feed formulations will maximize resource efficiency, help feed producers in providing more sustainable raw materials and reduce dependence on current raw materials.

2. Materials and Methods
2.1 Time and location
The study was conducted at the Polytechnic Indonesia Venezuela, Aceh, Indonesia started from November 2014 to February 2015.

2.2 Raw materials of fish feed
The fish sample in this study was catfish (*Clarias gaperianus*) which was stocked in a soil pond (2 x 2 m²). Totally 500 fishes/pond with a weight of 0.2 g/head. The raw materials used during the study for feed fish presented at Table 1.

| No | Kind of raw material     | Feed composition (1000 g) |
|----|--------------------------|--------------------------|
|    |                          | 5% | 25% | 50% | 75% |
| 1  | Soy flour                | 180| 90  | 100 | 30  |
| 2  | Organic waste           | 50 | 250 | 500 | 75  |
| 3  | Bran                     | 50 | 50  | 50  | 20  |
| 4  | Shrimp flour             | 260| 210 | 80  | 50  |
| 5  | Fermentation fish        | 10 | 210 | 80  | 50  |
| 6  | Fish meal                | 270| 20  | 20  | 2   |
| 7  | Tapioca flour            | 20 | 50  | 50  | 20  |
| 8  | Corn cob                 | 50 | 50  | 50  | 20  |
| 9  | *Leucaena* sp. flour     | 50 | 50  | 50  | 20  |
| 10 | *Gliricidae seplum* flour| 50 | 10  | 10  | 10  |
| 11 | Premix                   | 10 | 10  | 10  | 10  |

**Table 1** Experimental feed formulation using in the study

Feed protein (%)

|                          | 32.19 | 27.46 | 18.68 | 14.31 |

2.3 Experimental Design
The research method used experimental methods. The experimental design used was completely randomized design (CRD) non factorial with 5 treatments and 3 replications, namely:
P1 = commercial feeding
P2 = feeding with organic waste formulation 5%
P3 = feeding with organic waste formulation 25%
P4 = feeding with organic waste formulation 50%
P5 = feeding with organic waste formulation 75%

2.4 Data analysis

2.4.1 Growth rate
The absolute growth was calculated according Effendi [4]:

\[
W = W_t - W_o
\]

Where:

- \( W \) = growth (gram)
- \( W_t \) = weight biomass at the end of the study (gram)
- \( W_o \) = weight biomass at the start of the study (gram)
2.4.2 Survival rate
Survival rate of fish was calculated based on Muchlisin et al. [5]:
\[ SR = \frac{(N_0 - N_t)}{N_0} \times 100 \]
Where: SR= survival rate (%), Nt= number of fish death during at study, N0= number of fish at the start of study

3. Results and Discussion
3.1 Fish growth
Fish growth is the result of the difference between intake energy and energy out, and the intake energy is obtained from the food consumed. The amount of energy consumed by fish is influenced by the availability of energy in the feed, the physical condition of the fish and the condition of the water (temperature and dissolved oxygen). Fish growth is very dependent on the energy available in the feed and energy expenditure. Energy requirements for maintenance must be fulfilled first, and if excess, the excess will be used for growth. This means that if the energy in feed is limited, the energy is only used for metabolism and not for growth. According to Anggreani and Rahmiati [6] that the high and low optimum protein content in feed is influenced by adequate fat and carbohydrates. Without carbohydrates and fats that are enough fish depend on energy mostly from feed protein, which will be used as a source of energy to digest food and metabolic processes.

Fish growth rate is one of the important factors to know the success in aquaculture activities. The growth of catfish feed with organic waste - formulations of 5, 25, 50 and 75% for twelve weeks can be seen in Figure 1.

![Figure 1. Growth chart of catfish fed by different type of feed](image)

Based on the Duncan’s test, the treatment of 5% organic waste-feed was not significantly different with the treatment of 25% organic waste-feed, but it was significantly different with those 50% and 75% organic waste-feed treatments. The growth rate of fish feed commercial feed at the beginning - was better than feeding-formulated by utilizing 5% of organic waste where the second protein content of this feed is >30%. In the early days, the maintenance of fish fed commercial food was better to utilize the feed given optimally because the feed size - given was appropriate with the opening of fish's mouth. Then the growth of fish feed fish by utilizing 5% organic waste was able to rival the growth of fish fed commercial feed and even experienced a significant increase in the week of 9th-12th week. The present study showed that fish are better able to use commercial feed at the beginning of maintenance,
which is 0 to 6th week. At the 1st week to the 6th week the feed utilizing organic waste was not printed in the form of pellets because there was no small size feed printing machine that can be adjusted to the size of the fish mouth opening. Therefore it is dealt with by making feed in the form of lumps to fit the opening of the fish's mouth. The Weakness of feed in the lumps form when was given to fish in water, it will be easily broken (dissolved in water). So that sometimes before being eaten by fish, the nutrient content of the feed has been dissolved in water. Adequacy of nutrition is very important to avoid signs of deficiency, maintain adequate animal performance and maintain animal health. Feed with important nutrients (protein, amino acids, essential fatty acids, vitamins and minerals) is not adequate will be cause malnutrition and susceptibility to disease [7]. However, after the six week maintenance, in this size fish feeding using organic waste can already be optimally utilized by fish because it has been printed in the form of pellets so that it is not easily dissolved in water.

Utilization of organic waste with a large porosity in the fish feed production will reduce the value of protein into feed -. Martin et al. [3] said that the utilization of vegetable waste as animal feed also has several weaknesses that can limit its feasibility. Fish feed formulation with 5, 25, 59, 75% of organic waste had protein content were 34.19%, 27.46%, 18.68%, 14.31%, respectively. The growth rate of fish fed with organic waste formulation of 25, 50 and 75% were low compared to fish fed with 5% organic waste formulation. This is probably because fish are less able to use digest sources of nutrients that are not proteins and protein requirements in large feeds. Catfish is omnivorous fish tend to be carnivores so that it is easier to use the source of nutrition in the form of protein from animal sources. Organic waste can be processed and it is good to be used for animal feed such as fishes, where in the first place organic waste is given special treatment and fermented, after that it is only used as a material for fish pellets [2]. Allameh et al. [8] in addition to fish size, different types of feed provide different digested energy values. Furthermore, Anggraeni [9]; Dewi et al. [10] mentioned that plant-based feed ingredients generally contain high coarse fiber which is difficult to digest and has a strong cell wall that is difficult to solve so that food derived from vegetable ingredients is usually less digested than animal ingredients. NRC (1983) in Dewi et al. [10] stated that the digestibility of fish to a food is influenced by several factors, i.e. chemical properties of water, water temperature, type of feed, size and age of fish, nutrient content of feed, frequency of feeding and the number and type of digestive enzymes in the digestive tract feed. The water quality parameters measured in this study were pH, temperature and dissolved oxygen. The value of those parameters were obtained 7, 28-30°C and 5.3 mg/l, respectively.

3.2 Survival rate
The result showed that the highest survival rate was fish given commercial food (64.1%), followed by fish feed with 5%, 25%, 50% and 75% of organic waste formulations which had value 61.1%, 60.1%, 56.7%, 54.4%, respectively (Figure 2). The highest of survival of fish is obtained from the treatment of fish given commercial feed because at this treatment the level cannibalism was low. Fish cannibalism is low because it uses floating feed types and sufficient nutrient content (high protein). Commercial fish feed used during the study was floating type feed and it will be easily eaten by fish before the feed reaches the pond bottom. The nutrient content of feed protein was > 30% also supports the nutritional adequacy needed by this omnivorous fish.

Furthermore, high survival rate in feed with 5% organic waste formulation, after that 25, 50 and 75%. During the observation, the survival rate of fish fed with low organic waste formulation lower than fish given commercial feed was due to the type of food that could be categorized as drowning food, so that when it was spread into the water it reached the bottom immediately. Actually, during the study it was anticipated through the provision of lift nets as a place to put food so that it did not fall directly to the bottom and mix with the soil. However, fish that will eat food in the net, the fish must swim into the net first and compete with other fish to get the food. Fish that move active will eat a lot of food, and if the food provided is not evenly distributed, then the fish in the pond is not nutritionally sufficient, causing the fish growth was not homogeneous. Fish growth is not homogeneous due to uneven distribution of feed, so fish that are well-fed will grow faster. Fish growth is not homogeneous
due to uneven distribution of feed, so fish that are well-fed will grow faster. According to Trisnawati et al. [11] mentioned that fish growth is influenced by energy from the food consumed. Digested feed will produce a supply of energy that can be used for the body's metabolism and the rest will be used for growth. Growth occurs when there is excess free energy after the available energy is used for body maintenance, basal metabolism, and activity. Arie [12] stated that the survival rate of fish can be influenced by biotic factors i.e. water quality, feed, competition, human handling and stocking density while abiotic factors are physical and chemical properties in waters.

![Figure 2. Survival rate of catfish during the observation](image)

4. Conclusion
The organic waste can be used as one of the raw material of the artificial feed. But, as high as organic composition in the formulation, as low the protein content of feed.

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