The effect of feed management technology (life and pellet feed) on the maintenance of mutiara catfish (Clarias sp.) in freshwater cultivation

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Abstract. Catfish is currently the flagship commodity to increase economic value in Indonesia. Catfish farming is very profitable because good broodstock maintenance will produce quality tillers. A good catfish broodstock should have a feed management system, thereby improving the quality of mains. The purpose is to learn about feed management technology (life and pellet feed) on the maintenance of Mutiara catfish (Clarias sp.). The method is with a descriptive method with immediate data retrieval and secondary data. Life feed is observed by taking water samples and then observed using a microscope. Feed that is found using a microscope is Spirulina sp. and Chlorella sp. Feed management on the maintenance of the broodstock of the Mutiara catfish (Clarias sp.) is by feeding one time a day at a dose of 1.5 kg, the feed used is pellets PL 1 size 2 mm which has 33% protein and 5% fat, FCR which can be 2.43, absolute growth 15.42 kg, SGR 0.147 %, GR 2.4 gram/day, and SR 100%. Fish enlargement is a business activity maintenance fish up to the size of consumption. The feed is the largest component on the business of catfish enlargement.

1. Introduction
Catfish broodstock is one of the fish from Indonesian waters that have been successfully cultivated, and Mutiara catfish (Clarias sp.) has several advantages, namely having a complete cultivation performance which includes growth, feed efficiency, size uniformity and tolerance to disease [1]. Catfish broodstock cultivation is generally carried out to prepare spawning which in good broodstock maintenance will produce seeds of good quality and quantity. Catfish broodstock should be maintained separately between male and female broodstock. The aims to facilitate the management, control, and so that spawning does not occur outside the will [2].

Catfish broodstock must be selected to get a quality broodstock, selection of quality broodstock is to observe the morphological characteristics of the female genital orifice are round or oval and red in colour, enlarged abdomen, and relatively slow movement while the male genital tapers towards the tail, slender abdomen, and at the tip of the genitals reddish [3,4,5]. Good maintenance the broodstock of catfish (Clarias sp.) is concerned with feed management because it is included in the main factor of the success of a culture. Catfish broodstock generally requires a protein content of 35-40% to achieve optimal growth [6], in addition to other nutritional content needed by catfish are 20-30%.
carbohydrates, 4-18% fat, vitamin 0.25-0.40%, and minerals 1% [7,8,9].

Feed management is a critical aspect in aquaculture, while some things that need to be considered in feed management include feed quality, type of feed, and frequency of feeding. Good feed quality is food that has a size according to the fish's mouth opening, easy to digest so that it can increase fish growth. The feed must have an aroma that can stimulate the fish's appetite. The feed given must be food that has nutrients that are suitable to the needs of the fish and liked by the fish so that it can improve feed efficiency so that no food is wasted in the water so that there is no pollution because if the aquatic environment is low, it will be able to inhibit growth [10].

The frequency of good feeding in cultivation is generally three times a day. The feed given must be by the needs of fish and should not be excessive so that nothing is wasted into the waters. Aquaculture activities such as aquaculture have impacts on the environment, especially in the field of feed management. Feed waste can cause pollution in the waters if the feed is excessively stretched because most of the feed given is excreted into metabolic waste that contains much ammonia so it can cause the environment to become toxic [11]. Therefore it is necessary to have adequate feed management that is able to reduce production costs but still quality and can provide a good influence on the growth and survival of Mutiara catfish (Clarias sp.). The purpose is to gain knowledge in feeding management for the broodstock catfish (Clarias sp.).

2. Material and methods

2.1. Preparation
The method used is to measure water quality such as temperature, pH, DO, turbidity and ammonium, which are measured twice a day, at 08.00 AM and 3.00 PM GMT +7. The broodstock of Mutiara catfish is the main result of maintenance for two years which is treated starting from the preparation of the pool by using a concrete pool and cleaned first, then do the drying and calcification can be done to increase the pH so that it can grow plankton after that good seeding can be carried out in the morning when the temperature is low. Maintenance is carried out properly, including maintaining water quality and feeding well. Maintaining the broodstock will be prepared for spawning fish so that before spawning, selection of the broodstock is ready to spawn, and preparation of spawning ponds by installing “kakaban”, then spawning is done naturally by pairing the female broodstock with the male broodstock in a pool with a ratio of 1:1, after 24 hours a fish egg will be seen and 1-2 days can be seen hatching eggs. Other parameters include absolute growth, growth rate, specific growth rate, FCR, and SR.

2.2. Absolute growth
Total growth is the result of the subtraction of the final biomass and early biomass. The absolute growth can generally be identification in feeding. The formula can calculate the absolute growth or weight increase according to [12]:

\[
W_m = W_t - W_o
\]

Note:
Wm = absolute Growth (kg)
Wt = Final biomass (kg)
Wo = Initial biomass (kg)

2.3. Specific growth rate (SGR)
The specific growth rate of a cultivar can show specific growth daily and is calculated by the formula according to [13]:

\[
SGR = \frac{\ln W_t - \ln W_0}{t - t_0}
\]
Note:

SGR = Specific Growth Rate (%)  
Wt = Final biomass (kg)  
Wo = Initial biomass (kg)  
t = Maintenance time

2.4. Growth of Siamese catfish broodstock
Daily growth rate can be calculated by reducing the final weight rating with the initial weight rating divided by maintenance time, as the formula is calculated according to [14]:

\[ GR = \frac{W_t - W_o}{t} \]

Note:

GR = growth rate (gram/day)  
Wt = Final biomass (kg)  
Wo = Initial biomass (kg)  
t = Maintenance time

2.5. Food conversion ratio (FCR)
FCR is a comparison between the weight of the feed that has been given with the total weight produced during sampling; the calculation formula FCR is [15]:

\[ FCR = \frac{F}{(W_t + d) - W_0} \]

Note:

F: Total weight of feed during maintenance  
Wt: the weight of final fish maintenance biomass  
Wo: the weight of initial fish maintenance biomass  
d: Number of dead fish

2.6. Survival rate
Survival is a comparative rate of the amount of fish living from the beginning and the amount of fish surviving at the end. Generally, the survival rate can be calculated using the formula [16]:

\[ SR = \frac{N_0 - N_t}{N_0} \times 100\% \]

Note:

SR = Survival rate (%)  
Nt = number of fish at the end of the research  
No = number of early fish of research

3. Result and discussion
3.1. Feeding management
Feed management on the maintenance of broodstock Mutiara catfish (Clarias sp.) several things need to be noticed among them are a type of feed, feeding technique, frequency of feeding, feed content. Type of feed used for the maintenance of the broodstock of Mutiara catfish (Clarias sp.) is using artificial feed with the type of feed pellets. The type of feed given is MS Prima Feed LP 1 production
from PT Matahari Sakti which is a premium grade catfish feed used to support and optimize the cultivation of catfish with balanced nutrient content, so it is hoped that using the feed can optimize catfish organization well.

The technique of feeding on the broodstock of Mutiara catfish (*Clarias* sp.) is to use buckets for each pool with a feed weight worth 1.5 kg equivalent to 1% for male ponds and 0.5% for female pools. The feeding is done once a day the amount of pellet 1.5 kg. Feeding on the broodstock of the fish is different from feeding on the seed because in the seeds require more intense frequency with a different feed with the broodstock because on the seed, it is because on the seed more need energy for the maintenance, development, and refinement of the organs, but because the hull is smaller so that the frequency of delivery is more [17].

Feed-in the cultivation business is a critical element because the feed can affect the activity and growth of fish so feed that is given must meet the standards of nutrients and have a complete nutrient composition of protein including proteins, fats, carbohydrates, vitamins and minerals [18,19]. Protein in feed is one of the macronutrients needed by the broodstock. This is because protein can help in the reproductive process [20,21]. Protein in the feed takes a high concentration, and it is useful because it will give maximum results on the formation of vitellogenin which plays a role in the reproductive process [22]. Fats, vitamins and minerals include supporting nutrients required by the broodstock as it can affect the vitellogenesis, which is instrumental in the reproductive process [23]. Carbohydrates in feed have a role as an energy source where the most rapid and most effortless source of energy in its distribution is from carbohydrates. Adequate carbohydrates in the feed can prevent the use of protein as a Sumer energy, which is carbohydrate in the feed it will lead to the energy source of the protein and cause the protein cannot maximize the primary function as a substance builders [24]. Good feed nutrition is the one that suits the needs of fish so that the nutrition can maximize its function and usefulness, as well as the required value in protein content of 35-40% [6], carbohydrate 20-30%, fat 4-18%, vitamin 0.25-0.40%, and mineral 1% [7]. The feed given to the catfish contains nutrients such as the following:

| Table 1. The nutritional content of MS Prima Feed |
|-----------------------------------------------|
| Code  | Packaging (bag) | Size Feed (mm) | Protein (min) | Fat (min) | Fiber (max) | Ash (max) | Water content (max) |
|-------|-----------------|----------------|---------------|-----------|-------------|-----------|---------------------|
| LP 1  | 30 Kg           | 1.9 - 2.3      | 33%           | 5%        | 4%          | 12%       | 10%                 |
| LP 2  | 30 Kg           | 2.6 - 3.0      | 31 - 33%      | 5%        | 4%          | 12%       | 10%                 |
| LP 3  | 30 Kg           | 3.2 - 4.0      | 31 - 33%      | 5%        | 4%          | 12%       | 10%                 |
| LP 4  | 30 Kg           | 4.0 - 4.8      | 31 - 33%      | 5%        | 4%          | 12%       | 10%                 |
| LP 5  | 30 Kg           | 5.0 - 6.0      | 31 - 33%      | 5%        | 4%          | 12%       | 10%                 |
| LP 6  | 30 Kg           | 6.5 - 7.5      | 31 - 33%      | 5%        | 4%          | 12%       | 10%                 |

Source: https://mataharisakti.com/products/prima-feed-lp

Nutrients contained in the artificial feed is seen that has a high protein content. Protein in fish feed can be used as an energy source in fish that are carnivorous, but it can also be used as a builder so that fish can repair damaged tissue and also reproduce [25]. Fat has a relatively low content, and this is because of the influence of the quality of the feed ingredients used and the manufacturing process. Fat can function as an energy source and also for the growth and defence of the fish's body and can help the absorption of dissolved vitamins and protect vital organs of fish [26]. The fibre in the feed material reservoirs is closely related to fish digestibility, which the higher the fibre, the more difficult the food to be digested by fish [27]. Ash in a feed cannot be consumed, and ashes are usually carried out by burning or composting so that it can be ash [25].

The fish feed should contain ash content of <12% so that the nutrients in the artificial feed are already good as fish feed, while the effect of ash is able to affect the digestibility and growth of fish. Water is a content that needs to be considered because if it is too high in water content, it is not good
for fish feed because it can cause the feed to decay faster. Good water content is <14% so that the nutritional content of the artificial feed is good [25].

Life feed in the maintenance of catfish broodstock is not given because for the use of life feed is generally used when catfish in the larval stage is given tubifex worms, but based on observations using a microscope seen the presence of plankton that can act as life feeds namely chlorella sp and spirulina sp. Microscopic-sized life feed has a good impact on fish because it has a natural content and is different from artificial feed which has been mixed with several ingredients [28, 29, 30].

Spirulina sp is a microalga of the Cyanophyceae class, which is autotrophic in a bluish-green colour and has a twisted filament shape that resembles a spiral [31, 32, 33]. Life feeds such as spirulina sp can play a role in the prevention of diseases in fish so that it can be used as a substitute for antibiotics or other chemicals that are generally used in tackling diseases in cultured fish [34; 35]. Nutrient content contained in Spirulina sp, among others, contains high provitamin A, vitamin B₁₂ which can treat anaemia and protein content 60-70% of dry berries [36, 37].

Figure 1. Spirulina sp.

Chlorella sp is phytoplankton from the class of Chlorophyceae which is round or elliptical (ovoid) which has a green pigment (Chlorophyll) and is of high nutritional value and is easily digested and has bioactive compounds such as rubberinoids, phenol compounds, phenolic polysaccharides, and vitamins that can affect the regulation cell, immune, and as an antioxidant [38, 39, 40]. Life feed, such as Chlorella sp has benefits for cultivation to accelerate the growth of fish. This is because the nutrients needed are contained therein such as protein, fat, beta carotene and vitamins. Chlorella sp is a microalga that requires nutrients in the form of nitrogen and phosphate so that it can reproduce well in a high-nutrient environment and use it for its survival [41, 42].

Feed management in the maintenance of the broodstock Mutiara catfish (Clarias sp.) several things need to be considered include the type of feed, feeding techniques, frequency of feeding, feed content. Good feed nutrition is by the needs of fish so that the nutrition can maximize its function and use, as for the value needed in the protein content of 35-40% [6], carbohydrates 20-30%, fat 4-18%, vitamins 0.25-0.40%, and minerals 1% [7]. Life feed in the maintenance of the broodstock catfish based on observation using a microscope, namely Chlorella sp and Spirulina sp. Spirulina sp is a microalga of the Cyanophyceae class which is autotrophic in a bluish-green colour and has a twisted filament shape that resembles a spiral [31]. Life feed, such as Spirulina sp can play a role in the prevention of diseases in fish so that it can be used as a substitute for antibiotics. Chlorella sp is a type of phytoplankton from the class of Chlorophyceae which is round or elliptical (ovoid) which has green pigment (Chlorophyll) and high nutritional value and easily digested and has bioactive compounds such as rubberinoids, phenol compounds, phenolic polysaccharides, and vitamins that can affect the regulation cell, immune, and as an antioxidant [38].

Measurement of absolute growth obtained is 15.42 gram/day measurements are measured based on the weight of catfish that are maintained. Measurements are made by weighing using scales made on each fish sample which can then be known the average weight of catfish in the pond. High stocking densities will be able to increase production, but in general, at high stocking densities competition occurs both in the environment and feed. The growth rate obtained is 2.4 gram/day, it shows that every day the weight of fish increased by 2.4 gram per day [43]. The high growth rate in catfish is thought to
be due to genetic superiority and a fair selection process [44]. The growth of catfish can occur due to the presence of sufficient energy content in the feed which is used by fish for maintenance and activities of the body which with a lot of energy content can increase growth [27]. The specific growth rate obtained is 0.147% per day, this value indicates that growth through fish weight does not increase significantly and is relatively low, tends to slow growth, the results of SGR in catfish are around 1.54-1.63% and the lowest value is 1.54% [45], which is the accumulation of organic matter can cause a low SGR value.

3.2. Growth of Mutiara catfish (Clarias sp.) broodstock
The growth parameters observed were absolute growth, growth rate (GR), and specific growth rate (SGR). The absolute growth achieved was 15.42, and the GR obtained was 2.4 gram/day, while the calculation of the specific growth rate (SGR) obtained was 0.147% per day.

| Table 2. Data on maintaining Mutiara catfish (Clarias sp.) broodstock |
|---------------------------------------------------------------|
| Fish Sample | Initial | Final |
|-------------|---------|-------|
| 1           | 1.50    | 1.54  |
| 2           | 1.54    | 1.64  |
| 3           | 1.60    | 1.88  |
| 4           | 1.38    | 1.54  |
| 5           | 1.14    | 1.58  |
| 6           | 1.74    | 1.60  |
| 7           | 1.78    | 1.80  |
| 8           | 1.60    | 1.62  |
| 9           | 1.96    | 1.80  |
| 10          | 1.74    | 1.58  |
| total       | 15.98   | 16.58 |
| Average     | 1.598   | 1.658 |

Feed management is very closely related to FCR, and this is because the FCR calculation can also find out how the fish respond to the feed that has been given. The food conversion ratio in the maintenance of the broodstock catfish (Clarias sp.), which is 2.43 is calculated based on the FCR formula. The FCR value obtained after calculation during observation is 2.42 which is sufficient for catfish, good value for catfish FCR is generally around 1.4-2.6 [46] which is in low FCR conditions it can be interpreted that fish can utilize and absorb feed very well. The size of the FCR is influenced by several factors, including the quality and quantity of feed, species, and water quality [47]. Good feed must have nutritional content that can increase digestibility so that feed can be adequately digested, and nutrients can be fulfilled and can be used efficiently where high protein content increases growth [48]. The SR of a fish is closely related to feeding, and this is because if the survival rate of fish is low, then several factors affect, among others, food and water quality that can cause death in fish. The result of the calculation of survival rates on the broodstock Mutiara catfish (Clarias sp.) is 100% which indicates no dead fish.

3.3. Water quality parameters
Fish cultivation is closely related to water quality because with optimum water quality control by the needs of the fish will give the best effect to the fish being cultivated so that the fish will still live well. The observed water quality parameters include turbidity, temperature, DO, pH, and ammonium.

Observations obtained SR 100% results which during the maintenance the broodstock of Mutiara catfish (Clarias sp.) no fish died. Factors that can affect the survival rate of one of them is the age of the fish, which the increasing age of the fish eat endurance and adaptation to the environment is right it can increase the survival rate [48]. Water quality parameters observed during street vendors are turbidity, temperature, DO, pH and ammonium. Turbidity has an impact on aquaculture if the feed is
given too much and water changes are not carried out. It will cause the waters to become toxic, a good turbidity value of around 30-40 cm [49]. Temperature is the most influential parameter in which feeding with too low a temperature causes the lazy fish to eat. The optimal temperature is 23-30°C [50], at low DO in water caused by an abundance of organic matter where this situation shows algae blooming. It is caused by one of them is leftover food waste and fish faeces so that the optimum DO value is not less than 3 mg/L [51], it is related to the pH which the accumulation of waste mainly from fish faeces and leftover food can cause an increase in pH, and this causes the environment to become toxic to the optimum pH value is around 6-9 [49]. In comparison, ammonium is a compound due to low pH, which causes ionized ammonia, and the optimum value is not more than 2 mg/L [52].

| Parameter   | Average Measurement | Optimum |
|-------------|---------------------|---------|
| Turbidity   | 12.59 cm            | 30-40 cm|
| Temperature | 29.08°C             | 23-30°C |
| DO          | 2.3 mg/L            | > 3 mg/L|
| pH          | 7.6                 | 6-9     |
| Ammonium    | 0.03 mg/L           | <0.2 mg/L|

4. Conclusion
1. The average results of water quality parameters for 25 days are turbidity 17.85 cm, temperature 29.51°C, DO 4.23 mg/L, ammonium 0.005 mg/L, and pH 7.54. Feeding is carried out twice a day, at 08.00 AM and 15.00 PM GMT+7 with a feeding method of 3% of the biomass weight depending on the attainment of fish weight and several fish by spreading feed as much as 1.5 kg. The growth in the maintenance of catfish for 21 days is 9.52 gram/day and a specific growth rate of 0.147%. Catfish spawning uses a ratio of 10 males and three females.
2. The problem faced in the maintenance technique of Siamese catfish brooders is the ineffective management of feed which has an impact on the level of gonad maturity in catfish broodstock.

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