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Mentoring in Maggot Cultivation as Cheap Catfish Feed, at the Karang Taruna Padukuhan Bulu, Semanu, Gunungkidul, Yogyakarta

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Abstract

Karang Taruna in Padukuhan Bulu, Semanu, Gunungkidul Regency, Special Region of Yogyakarta, has been cultivating catfish since 2018. The problem is that the cost of feed was getting higher so farmers' income was getting lower. This community service aims to introduce and provide mentoring for maggot cultivation for cheap catfish feed so that it can bring benefit to the catfish farming business. From observation and problem identification by the community service team, a program was arranged to produce cheap feed with maggot ingredients, so that the catfish farm can operate more economically and the farmers' incomes can be increased. The activity was carried out for four months, starting from the preparation of making maggot lair cages, maintaining maggot from eggs, and using it as maggot cages. The target is to provide cheaper catfish feed as a substitute for factory-made commercial feed. The results obtained were that Karang Taruna members managed to get catfish feed made from maggots, at a cheaper cost. Besides that, the level of catfish production increased (an increase in income of Rp. 366,000 per pond per period). Hopefully, this activity can be followed up by the local government and the welfare of the younger generation can be improved on an ongoing basis.

***Keywords**: catfish cultivation, cheap feed, maggot, youth organization*

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Introduction

The COVID-19 pandemic has had a negative impact on the economy in both urban and rural areas (Pramono *et al*., 2022). Karang Taruna Padukuhan Bulu is an active and productive youth organization in Padukuhan Bulu, Sesa Candireja, Subdistrict of Semanu, Gunungkidul Regency, Special Region of Yogyakarta. Padukuhan Bulu is located 12 km from Kapanuwon Semanu, 24 km from Gunungkidul City. This area is a mountainous area with rocky land, but there has been a water source since 2000 from PDAM (PAM), a water utility company. Although water is not so abundant, especially during the dry season, Karang Taruna Padukuhan Bulu can cultivate catfish to increase income. Semanu District is one of the 18 sub-districts in Gunungkidul with 85% of its population (about 8200) living as food crop farmers (BPS, 2021).

Agricultural activities carried out by the Karang Taruna Padukuhan Bulu are called Sasana Muda Karya (Samuka). Samuka has 26 members, the majority of whom have an education level equivalent to junior and senior high school, of whom some are still actively attending school. Karang Taruna in Padukuhan Bulu utilizes water from PAM to support its agricultural business, by raising catfish, which has been cultivated since the beginning of 2018. However, in the catfish business run by groups and members, the profit level is still low, about IDR 200,000,- to IDR 500,000,- once harvested, for 3 months, with a population of 1000 seeds with a capital of IDR 12,000,000,- each period..

Problem identification had been carried out by members and administrators of Karang Taruna, with a companion team from the Universitas Sarjanawiyata Tamansiswa (UST), Akademi Peternakan Brahmaputra (APB), and Universitas Kristen Duta Wacana (UKDW) Yogyakarta, involving 10 students for a duration of 3 meeting sessions. From the identification of the problem, the team selected applicable business with a small risk, i.e. catfish farming.

Catfish farming is currently growing rapidly in Indonesia because it is quite economically profitable and easy for farmers to implement. The protein content in catfish reaches 18% (Apriyana, 2014) so it is beneficial for consumption by children to adults. The farming

process is also easy, it only requires a pond for cultivation, and it has short harvest period so the farmers get a lot of benefits. The weakness in catfish farming is the high cost of feed, so an alternative is needed to reduce feeding costs with maggot cultivation as a feeding source.

Maggot is an organism derived from the black soldier fly and is known as a decomposer because it consumes organic materials (Silmina *et al*., 2010). The requirements for feed ingredients that can be used as an alternative for catfish farming are not harmful to fish, easy to obtain, contain sufficient nutrients for fish, and do not compete with human needs.

The problem faced in catfish farming is the high cost of feed. To reduce feed costs, the maggot is used as the source of feed. Maggots were chosen because they can be easily cultivated, have good nutritional value for fish feed because they contain high protein (32-52.5%) and the price is relatively stable, about Rp. 7,000,- per kg (Yunianta *et al*., 2021). By using maggots, the cost of feed can be reduced by as much as IDR 1,200 per kg (11%). In addition, it can increase the crude protein content of 3% of the finished feed, from 30% to 33%. With this in mind, it is expected that maggots will improve the quality of feed, productivity, and profits of the catfish business run by Karang Taruna.

The approach to the target community was carried out by placing the target community as the subject and not the object of this community service activity. For this reason, Karang Taruna was involved in activities, planning processes and was the main actor in the implementation of maggot cultivation training activities. Discussions are held every Sunday, and the construction of maggot lair was carried out every afternoon for 3 weeks.

Methods

The method of mentoring activities was carried out using various approaches, ranging from counseling, visitation to more advanced maggot farmer group, as well as making demonstration plots of maggot lairs and bioponds. This catfish farming business uses 3 ponds made of steel-framed plastic sheeting, 2 m in diameter, which contains about 1,000 catfish breeds. Meanwhile, water is obtained from PDAM (PAM). Cultivation is carried out for 3 months (until harvest).

The method of implementing this community service activity includes several stages, which are coordination, observation, and cultivation. The coordination stage was carried out with the village government, then the observation stage was carried out to find out the problems of catfish cages and land for maggot cultivation, with the results of the coordination stage then maggot and catfish cultivation were carried out. The activity is divided into several stages including:

1. Planning and determining activities
2. Extension of maggot cultivation as catfish feed.
3. A visit to an advanced maggot breeder, in Ngaglik, Sleman Yogyakarta
4. Repair of catfish cages and their cultivation
5. Cultivation of Maggot as catfish feed

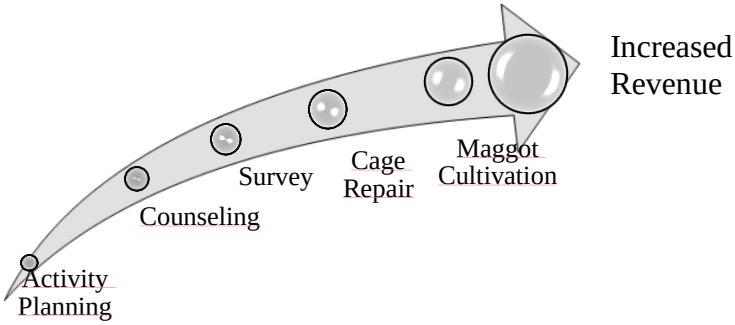

Fig. 1. Steps of activities

Results and Discussions

Each stage does need to be evaluated so that confidence arises that everything that has been decided is correct, and can safely move on to the next stage. Community service activities consist of several stages including:

1. Planning and determining activities
2. Extension of maggot cultivation as catfish feed.
3. A visit to an advanced maggot breeder, in Ngaglik, Sleman Yogyakarta
4. Repair of catfish cages and their cultivation
5. Cultivation of Maggot as catfish feed

The results of activities and evaluations during the mentoring of Karang Taruna Padukuhan Bulu are as follows:

A. Planning and Determination of Activities

An activity plan was formed that was ready to be carried out with a financing plan covered by the MBKM Bina Desa program and assistance from the village administrators. The activity plan was carried out using a participatory method to look for the root of the problem, the cause of the catfish farming business that had been running so far but had not been profitable. In implementing the working plan, the catfish farmers were accompanied by the Karang Taruna, the head of Dusun, and the head of Desa. There was also a companion from the university. The root of the problem found; the cost of feeding is too expensive. The solution offered was to procure cheaper yet higher-quality catfish feed.

B. Cultivation Counseling

Counseling on the cultivation of maggot as catfish feed was carried out in 4 separate meeting sessions. Counselors from the community service team (UST, APB, and UKDW) worked together with an average of 22 participants from Karang Taruna, supported by 4 UST students and 6 UKDW students. Counseling was held at the Bulu Padukuhan Hall, Candirejo Village, every Saturday afternoon. After counseling from the resource persons, a comparative study was continued by visiting a group of advanced catfish farmers that already use maggots as feed, in Nylumprit Padukuhan, Ngaglik District, Sleman Regency.

The catfish farming business is growing rapidly in Indonesia because it is quite economically profitable and easy to implement. However, catfish farming often has obstacles, especially the aspect of expensive feed, which already mentioned, that catfish feed can reach 70% of the total cost of cultivation (Yunianta *et al*., 2021). Therefore, farmers need to be introduced to alternative feed efforts to reduce costs without reducing their nutritional value.

Maggot besides being easy to cultivate also contains nutrients, especially crude protein up to 40-50%. Based on the above requirements, black soldier fly larvae (maggot) can be used as alternative feed to replace pellets or finished feed from factories and commercial feed. Maggot or black fly or black soldier fly (BSF) is a typical spoilage organism because it consumes organic materials to grow (Silmina *et al*., 2010). The phases in the BSF life cycle are larvae, prepupae, pupae, and adult insects (Fahmi *et al*., 2009). The life cycle of BSF depends on the feed medium and environmental conditions in which it lives. The life cycle lasts from 40 days to 43 days. The BSF life cycle is shown in Figure 2.

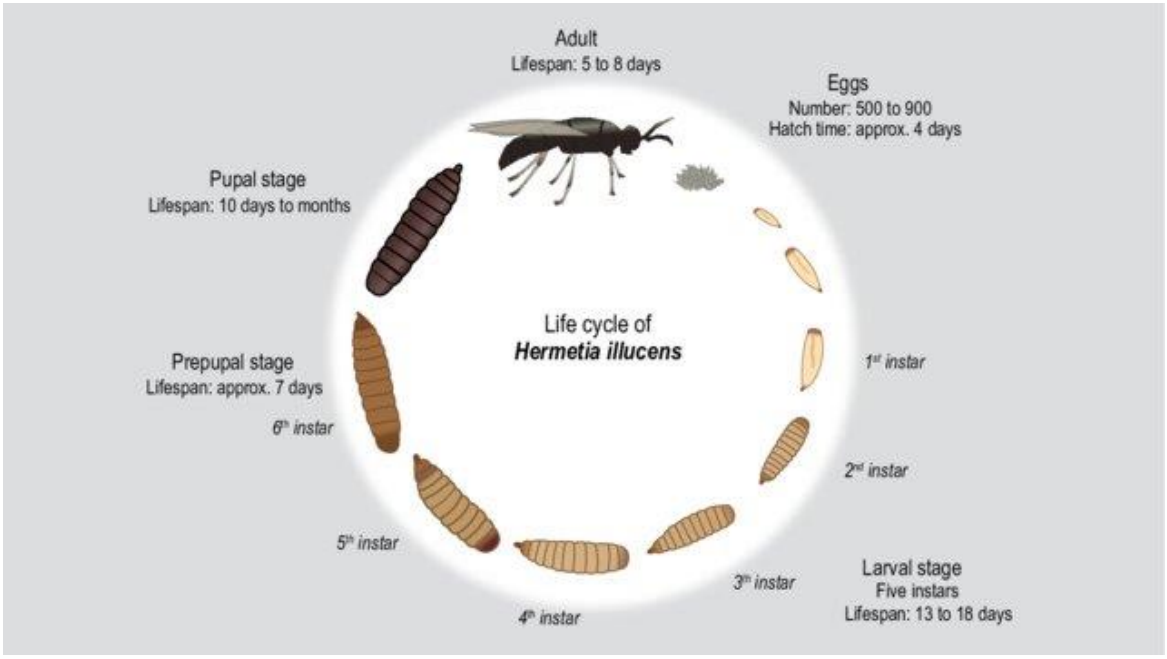

Fig. 2. Life cycle of BSF (Lievens et al., 2021)

Figure 2 shows the development time of BSF in each stage of its metamorphosis seen in days. Adult BSF flies lay their eggs near food sources. Maggot has 5 instars in its development and can grow up to 20 mm (Figure 3), pupae migrate to a more humid place to then grow into adult flies.

Fig. 3. Development of BSF (Makhrojan, 2018)

Diener, Zurburgg, and Tockne (Lalander *et al*., 2019) have mentioned several advantages of maggot or BSF. Maggot has a chewy texture and the ability to produce natural enzymes that can increase the digestibility of fish to feed. Maggot is a source of protein which is an alternative feed for fish and other livestock. The content of maggot protein is around 41-42%, 31-35% ether extract, 14-15% ash, calcium, and phosphorus 0.60% to 63%. Research conducted by Sheppard (Sheppard & Newton, 2000) and Sobgesan (Sobgesan *et al*., 2006)

shows that the protein content of maggots is quite high. The nutritional content of maggots is shown in Table 1. Meanwhile, according to Astuti (Harlystiarini *et al*., 2019) and Newton (Čičková *et al*., 2015), the nutritional content of maggots that are maintained in palm oil waste and organic waste, shows that the difference in media affects the nutritional content of maggots. generated. From the existing nutritional content, it is feasible for the maggot to be used as feed ingredients, especially fish feed, which on average contains more than 30% crude protein. Next, the difference of nutritional content of larvae and prepupa maggot was describe of Table 2. The crude protein of prepupa maggot higher than larvae maggot it was 52.34%, as we know that fish feed must have 30% crude protein so the farmer can give larvae (40.00) or prepupa maggot (52.34) for feed.

Table 1. Maggot nutrient content

Nutrition	Palm Waste	Organic Waste
Dry ingredient (%)	95,15	91,72
Crude protein (%)	43,22	31,57
Ether extract (%)	29,51	37,49
Crude fiber (%)	12,27	6,24
Ash (%)	4,85	10,47

Source: (Harlystiarini *et al*., 2019)(Newton *et al*., 2005)

Table 2. Nutritional Value of Prepupa Maggot Larvae

Nutrition	Larvae	Prepupa
Dry ingredient (%)	92,58	94,41
Crude protein (%)	40,00	52,34
Ether extract (%)	2,39	36,92
Crude fiber (%)	10,59	11,17
Ash (%)	15,70	4,24

Source: (Harlystiarini *et al*., 2019)

C. Field Visit

The field visits have provided a complete picture of maggot farming to support better and cheaper catfish farming. The visit was carried out by 12 participants at the Rumah Maggot Ngaglik, Sleman. During this visit, there was a cooperation agreement between the Karang Taruna and the Rumah Maggot breeders. Especially while the Karang Taruna could not produce maggot eggs by themselves, they would be supplied with eggs from the Rumah Maggot, for Rp. 5.000,- per gram. Each purchase of more than 50 grams would be sent to

Gunung Kidul with free shipping, via online transaction. Besides, Rumah Maggot is willing to accept the yield of maggot production by Karang Taruna at a price according to the market, in the form of larvae currently, the price reaches Rp. 8.000,- per kg, delivered to Rumah Maggot Sleman.

D. Catfish Pond Repair and Maintenance

There are 3 catfish ponds made of plastic tarpaulin belonging to the Karang Taruna group, with a capacity of 1,000 fish in each pond. The cages were cleaned by spraying with disinfectant, allowed to dry for one week, and prepared with water at a height of 1 meter for 1 week. Catfish seeds were obtained from catfish farmers in Kapanewon Semanu, who are expected to have adapted to the environment there. Seedlings are put in a pond with a size of 7-9 cm and maintained for 3 months. The following is the calculation of catfish business income (income over feed cost, Kristanti & Andalas, 2017) using maggots, in each pond in Padukuhan Bulu, Candirejo, Semanu.

1. Feed cost savings per kg

   The factory (commercial) feed required for the maintenance of each pond (1,000 fish) is 100 kg, at IDR 12,000 per kg, thus the cost of feed until harvest time is IDR 1,200,000. While factory feed mixed with maggot (30%), the price of feed per pond is Rp. 1.050.000,- or there is a saving (Rp. 1.200.000,- substracted by Rp. 1.050.000,-) which is Rp. 150.000,- per pool.

   It is based on the calculation that:

   a. Commercial feed (factory) 70% x 100 kg x Rp 12,000,- = Rp 840,000,-
   b. Maggot 30% x 100 kg x Rp 7,000,- = Rp 210,000,-
   c. The total feed mix costs = IDR 1,050,000, thus there is a savings of IDR 150,000 per pond per period.

2. Catfish harvest

   Harvest yields with factory feed that have been practiced so far produce an average of 95 kg of catfish, while with the mixed feed of maggot, it becomes 107 kg, at harvest time. So there is additional income (107-95) kg x Rp. 18.000,- = Rp. 216.000,- per harvest period.

3. The profit rate of utilizing maggot mixed with factory feed

   The level of profit on the use of maggot as a substitute for factory-produced catfish feed has 2 components, that is from the cost reduction and the difference in revenue from catfish sales so that a profit of IDR 150,000 + IDR 216,000 = IDR 366,000 per period is

obtained.

4. Net Present Value (NPV)

   NPV determines the difference between the present value of the cash inflows and outflows that will occur over a number of future periods. The NPV of this business is positive, which indicates that an investment is expected to generate more revenue than it would cost. There will be a return on the investment.

5. B/C ratio

   In agriculture, the B/C ratio is calculated as gross income divided by cultivation costs. This business's B/C ratios are larger than 1. This shows that the project is efficient.

In addition to fast-growing fish, it turns out that using maggot as catfish feed can reduce mortality during maintenance by 3-5% compared to the previous average mortality which reached approximately 10% of the population of stocked seedlings. The reason is, feed with 30% maggot has a protein content higher than factory feed, besides that maggot fat contains a lot of medium chains of saturated fatty acids such as lauric which is important in maintaining a healthy body, because these fatty acids are known as anti-bacterial substances (Sheppard & Newton, 2000). From this shift, Karang Taruna gets an economic benefit of Rp. 366.000,- per period. From the results of this community service program, the activities of Karang Taruna Dusun Bulu can generate economic benefits. Likewise, some good, creative and innovative assistance to Karang Taruna provides added economic value (Natalia *et al*., 2022).

6. Factors that affect the growth of catfish

Catfish is one of the aquaculture commodities that has various advantages, including fast growth and high adaptability to the environment (Sitio *et al*., 2017). Market demand for catfish is increasing, so it will have an impact on its production which is always increasing (Jailani *et al*., 2020). The growth and productivity of catfish are influenced by the quality of water, feed, and the environment. Fish, which are aquatic organisms, are faced with environmental stressors such as water quality (Armando *et al*., 2017). Although fish can tolerate changes in water quality, in most fish species, temperatures above optimum can result in increased metabolic rate and energy begins to be diverted from growth to high metabolic rates so that growth rates decrease. Decreased water quality can cause stress to fish, even if the decrease in water quality has exceeded the tolerance limit, it will result in death.

Changes in temperature in the cultivation environment can affect fish life and even cause stress (Jailani *et al*., 2020). High temperatures can cause oxygen to decrease and reduce fish appetite. Although fish can acclimatize to relatively high temperatures, to a certain degree, an increase in temperature can cause fish death. Temperature affects growth, feeding speed, metamorphosis time, behavior, swimming speed, absorption, gastric emptying rate, and metabolism. Each fish species has an optimum temperature, which is the temperature range where growth can reach optimum. Temperatures outside this range will continuously cause stress and even death (Jailani *et al*., 2020).

Fish growth is influenced by internal and external factors. Internal factors include heredity, gender, and age (Karimah *et al*., 2018). External factors are controllable factors consisting of water and feed quality factors. Feed is one of the important factors in aquaculture activities, 60-80% of production costs in intensive aquaculture activities come from feed costs. In addition, the percentage of feeding also affects its growth, the higher the protein content in the feed the more it encourages the growth rate of fish. Maggot can be used as a source of protein for catfish feed because maggot contains a lot of crude protein up to 52%. In this program, the catfish feed used contains 32% crude protein, higher than the commercial feed commonly used, which is 30%. The amount of feeding is the frequency of the amount of feed given in a day. The amount of feeding depends on the size of the fish's body. The right amount of fish feed can maximize the use of feed by fish so that it is expected to achieve maximum growth, reduce operational costs and reduce the impact of declining quality. During the catfish cultivation by Karang Taurna, each pond from start to harvest requires 100 kg of feed per pond.

7. Nutritional content of catfish

Catfish is one of the fish that has been widely cultivated by fish farmers. The protein content of catfish reaches 18.7%. Catfish heads contain protein, fat, calcium salts, and phosphates which have not been used optimally (Apriyana, 2014). Catfish can be grouped into medium protein foods with low fat. Catfish also contain carotene, vitamin A, phosphorus, calcium, iron, vitamin B1, vitamin B6, vitamin B12, and it is rich in amino acids (Asriani *et al*., 2019). The nutritional component content of catfish is easily digested and absorbed by the human body; children, adults, and the elderly (Rohimah *et al*., 2013). Catfish has benefits for helping growth and development in children, the content of essential amino acids is very useful for

bone growth, helps absorb calcium and maintains nitrogen balance in the body, and maintains children's body mass so that they are not too fatty (Rosa *et al*., 2007).

E. Maggot Cultivation

Karang Taruna Padukuhan Bulu managed to build 3 plots of maggot or biopond cages (Figure 4), as well as 1 plot of maggot breeding lair, made of wood and HDPE plastic mesh with a size of 1.5 m x 2 m with a height of 2 meters and a roof made of asbestos and fiberglass, while the maggot enlargement cage (biopond) is made with a size of 1m x 2 m with 20 cm deep. The practice of maggot cultivation begins with 7-day-old baby maggots that are put in a biopond cage and kept for 12-21 days. As a medium or maggot feed, household waste and chicken egg waste from the chicken factory in Kapenewon Semanu are used, which are taken free of charge. The results of cultivating maggots with 5 grams of maggot eggs, after being hatched and raised into larvae, produced 20 kg of maggot larvae. with a maintenance period of 12 days in a biopond (Figure 5). Maggot is directly given to catfish ponds as animal feed, with a ratio of 30% maggot and 70% commercial feed.

Fig. 4. BSF Cage made of HDPE plastic mesh

Fig. 5. Results of the maggot cultivation for catfish feed by Karang Taruna Bulu

Conclusion

As the result of community service in the form of mentoring maggot cultivation for catfish feed by the university team, Karang Taruna gains experience in the practice of maggot cultivation for catfish feed, while generating higher profits, providing cheap feed costs, and increasing catfish yield. The supporting factor for this success is the high spirit to try new things from Karang Taruna members. Another supporting factor for success is that regional leaders (the head of Dusun and the head of Desa) play an active role in supporting this program.

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