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Economic Empowerment through the Production of Fish Pellet, Organic Fertilizers from Maggots, and Catfish Nuggets from Budikdamber in Kronggahan Hamlet, Gamping, Sleman

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Abstract Sleman Regency produces the biggest waste pile, approximately 701.95 tons/day, higher than the other districts in Yogyakarta Province (The Ministry of Environment and Forestry, 2020). National data show that unmanaged waste is 12.4% per year. This unmanaged waste has the potential to cause significant environmental and health problems. Efforts to minimize organic waste have been carried out by Kronggahan residents by utilizing waste bioconversion technology with black soldier fly (BSF) technology to produce maggot and kasgot. Maggot could be used for feeding fish and kasgot could be used for plant fertilizers. Kronggahan Hamlet has also developed several activities such as the, the development of aquaponics and budikdamber (budidaya ikan dalam ember-farming fish in buckets) where the feeding of catfish use maggot's product. Harvested catfish and spinach from aquaponics and budikdamber can be processed into nuggets and could be added value for food security in Kronggahan Hamlet. This technology reduce organic waste by ± 70% by converted it into alternative fish feed that has economic value and high nutritional content. The purpose of this community empowerment activity was to increase community knowledge about maggot and maggot product proccessing from organic waste, foster knowledge in maintaining and improving health to prevent non communicable diseases. Hopefully, stakeholder can adopt policies in processing organic waste into maggot, the public can apply organic waste treatment and play a role in reducing the organic waste produced. The methods of implementing this program encompassed knowledge sharing, coordination and consolidation, preparation of educational media, and training packages that were integrated with other productive economic activities facilitated by Academic Hospital UGM's community empowerment team in collaboration with Kronggahan Hamlet residents. Hopefully this program will be able to be publicized more broadly and can be duplicated in other regions.

1. INTRODUCTION

Waste processing efforts are still a problem that has not been resolved properly in Sleman. The largest waste generation generated by Sleman Regency, which was recorded at 701.95 tons/day, higher than the other districts in Yogyakarta Province (The Ministry of Environment and Forestry, 2020). National data shows that not all waste

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generated can be managed and unmanaged waste is 12.4% per year. This unmanaged waste has the potential to cause significant environmental and health problems. More than 50% of the waste in Indonesia is organic waste which is usually perishable and must be diverted from the source immediately before it causes odour problems and other environmental problems (Damanhuri, 2010). The type of organic waste includes food waste. Percentage of waste in 2020 consist of 30.4% in the form of food waste, 17.3%, of wood branches and leaves, 11.1% of paper/cardboard, and 16.6% of plastic (The Ministry of Environment and Forestry, 2020).

This effort simultaneously supports the achievement of one of the global goals contained in the Sustainable Development Goals or in English known as the Sustainable Development Goals (SDGs), namely goal XI. Make cities and human settlements inclusive, safe, resilient and sustainable. In the Presidential Regulation of the Republic of Indonesia Number 59 of 2017 concerning the Implementation of Achieving the Sustainable Development Goals, the global goal for this global goal is by 2030 reducing the adverse per capita urban environmental impact, including by paying special attention to air quality, including handling municipal waste (Pemerintah Indonesia, 2017).

This shows that food waste has not been properly managed and processed into something useful products as well as reducing the generation of organic waste. The Final Waste Disposal Site (TPST) in Piyungan is currently full because it has exceeded capacity. However, the conditions are still forced so that hundreds of tons of waste every day go to the TPA. The waste disposed of at the Piyungan landfill is dominated by food waste, vegetables, fruits and other (organic) waste, i.e. 55% an anorganic waste wes recorded at 45% (Adminwarta, 2022). Based on Law Number 25 of 2004 concerning the National Development Planning System (SPPN), especially in the environmental field, efforts should be made to improve the quality of people's behaviour towards ecological balance (Pemerintah Indonesia, 2004). By protecting and preserving the environment, the community will benefit from the continuity and balance of the ecosystem needed. One aspect of environmental balance that is of concern is the problem of waste management in each region (Kiran et al., 2014).

Kronggahan Hamlet has been making efforts to minimize organic waste by utilizing waste bioconversion technology with black soldier fly (BSF) that produces maggot and kasgot. BSF larvae are an innovative strategy and a sustainable method for managing organic waste that can reduce the burden on landfill waste (Nguyen, 2015). Maggot can be used as an alternative fish feed that has economic value and high nutritional content for fish and livestock, and kasgot can be used as plant fertilizer (Fahmi, 2015). To optimizing maggot's product and kasgot, we conducted Aquaponic system and Budikdamber as supporting concept for food security in Dusun Kronggahan, Trihanggo, Gamping, Sleman. The fishery group and farmer groups used maggot for fish feeding and kasgot for plant fertilizer. It is hoped that it will become a supporting alternative for Kronggahan residents to provide food for their families. It can be duplicated or become a pilot area in terms of organic waste management based on community trust. It can be used as an option in increasing food security during a pandemic.

Aquaponics is a sustainable method of food production combining aquaculture (aquatic animals) and hydroponic (cultivating plant in water), which is an alternative to growing plants and fish in one place. In this system, fish waste acts as natural fertilizer for plants, and then plants take up those nutrients and return clean water to the fish. A wide variety of plants could be grown using aquponic. A few plants that have grown successfully in aquaponics are; eggplants (purple), tomatoes, chillies, melons etc. aquatic animals that can be farmed in aquaponics are catfish, nila, gurameh, etc. In Kronggahan Hamlet, we used catfish for aquaculture and water spinach for the plants. The yields from aquaponics in this hamlet were catfish and water spinach. We developed catfish from the yield into food product such as catfish nuggets. Both of the product have a socio-economic impact to the farmers.

Aquaponics is a sustainable food production approach that uses 90% less water compared to aquaculture and agriculture, due to the minimal water loss represented by evaporation and transpiration from plants (Diodenha, 2011). Its strengths are represented by the fact that this activity eliminates the use of chemicals or pharmaceuticals which allows to produce more food with less resources, reduces negative impacts of Agriculture and Aquaculture on the environment (Organic and chemical pollutions), and according to some scientific publications aquaponics increases productivity compared to Hydroponics supporting food security. Furthermore, this activity fights against soil degradation, allowing environment conservation and restoration, which indirectly preserve Biodiversity (Rharrhour et al., 2022).

The issue of food security is very important as well as prone to problems in disaster situations, including disease outbreaks such as the COVID-19 pandemic (FAO, 2020). Food security indicates the availability of access to food sources so that they can meet basic needs (Rosales & Mercado, 2020). The condition of the COVID-19 pandemic has resulted in the exacerbated availability of food access to food being exacerbated by the worsening of the pandemic itself and the restrictions on population movement that followed. This is also in accordance with (Burgui, 2020), which states that an outbreak of a disease that occurs in the world will increase the number of people experiencing hunger and malnutrition (LIPI, 2020).

The COVID-19 pandemic occurred at 2020 in the world had caused many problems especially in socio-economic. People in the Kronggahan Hamlet had the impact too. House hold member with variety job such as informal workers and freelance experiencing of income decline. Hospital Academic of Gadjah Mada University (RSA UGM) where the location nearest with Kronggahan

Hamlet have responsibility to carry out this issue. From this issue, we choose educational and empowerment program to increase family's revenue by Aquaponic and using technology BSF, hopefully can minimalizing expenses for food.

2. METHOD

In 2019 in Dusun Kronggahan, we successfully carried out the community training program in processing and utilizing household organic wastes. In this program, we educated Dusun Kronggahan residents to treat household wastes using the Black Soldier Fly (BSF) system to produce maggot for fish feed and other purposes. This program involved policymakers in Tribanggo Village, namely the Village Head and his staff, representatives of the Dukuh in Trihanggo, productive groups in the community, including KWT (Women Farmers Group) Kronggahan, fisheries groups, and agricultural groups. The stages in this program consisted of the following.

a. Preparation tools and materials for BSF through bioconversion process
b. BSF Technology Installation
c. raining for community how to bioconversion organic waste in to maggot larvae.

In 2020 waste management activities were organized again with the concept of Rumah Maggot (Maggot House) as a support for community food security during the COVID-19 Pandemic. The improvement of activities not only aimed at managing domestic waste, but also at utilizing bioconversion of domestic waste, namely maggot as feed fish and livestock and kasgot as an organic fertilizer that will be redeveloped in the fields of agriculture and fisheries, namely the Aquaponic cultivation system that could be implemented by the community at the household level.

The stages of activities in the community service program in 2020 are as follow.

a. Presentation of Community Service Program, namely Rumah Maggot for supporting food security during the pandemic period in Dusun Kronggahan Trihanggo, Sleman
b. Coordination and consolidation with teams and policy stakeholders for program strengthening
c. Pre-training, the preparation of educational media and training modules
d. Maggot home training
e. Evaluation monitoring
f. Dissemination and follow up plan

In the third year in 2021, the next program that was developed was to diversify processed products from maggot into fish pellet products, fertilizers and various processed budikdamber (cultivation of fish in buckets). This was also a forum for the development of productive economic activities in the community, especially during the COVID-19 Pandemic Period. It was carried out in the closest area to the UGM RSA, namely in Kronggahan I and II Padukuhan.

The stages of activities in this community service program are as follow.

a. Presentation of the Community Service Program, namely Productive Economic Empowerment through the Development of Maggot into Fish Pellet Products, Organic Fertilizers, and processed Budikdamber Products in Padukuhan Kronggahan, Gamping Sleman.

   The presentation of the community service program aimed to inform policymakers in Tribanggo Village, namely the Village Head and his staff, representatives of the Dukuh in Trihanggo, productive groups in the community, including KWT (Women Farmers Group) Kronggahan, fisheries groups, and agricultural groups to explain the background, objectives, and implementation plans as well as the targets to be achieved from the program.
b. Coordination and consolidation with the team and stakeholders as well as the community to strengthen the program
c. Pre-training, namely the preparation of educational media and training curricula
d. Training packages in the context of empowering health independence and community economic independence

   The recommendation for this training program was a group of women farmers in Kronggahan Elementary School and representatives of Gapoktan (association of farmer groups) in Kronggahan Padukahan. The selection of targets was carried out by Mr Dukuh Kronggahan who has a deeper understanding regarding the competence of the KWT women who will represent them to participate in the training.
e. Program Evaluation Monitoring
f. Dissemination and Follow-Up Plans

3. RESULT AND DISCUSSION

The result of community service in 2019 and 2020, namely the BSF bioconversion waste management system and the Development of Rumah Maggot as a support for community food security during the COVID-19 Pandemic, has been successfully implemented in Kronggahan Hamlet. This could be achieved because of the strong solidarity that was led by Dukuh Kronggahan head and was supported by the fisheries, and agriculture group. And KWT (Women's Farmer Group). The improvement of activities not only aimed at managing domestic waste, but also at utilizing bioconversion of domestic waste, namely maggot as feed fish and livestock and kasgot as an organic fertilizer that would be redeveloped in the fields of agriculture and fisheries, namely the Aquaponic cultivation system that can be implemented by the community at the household level.

3.1 Program presentation

The presentation of the community service program was carried out on September 2, 2021. This presentation was attended by the Village Head and his staff, Hamlet representatives in Trihanggo, productive groups in the community including KWT (Women Farmers Group) Kronggahan, Fisheries groups, groups agriculture as well as the Sleman Regency Agriculture Service. In this forum we explained the background, goals, and implementation plans as well as the targets to be achieved from having a maggot education house which has been programmed in the 2021 UGM Community Service activity implementation plan as well as synergizing activities with programs owned by other relevant agencies, for example, Sleman District's Agriculture Office.

The activity was carried out online, bearing in mind that when the knowledge sharing activity took place, the Level IV Restrictions on Community Activities (PPKM) were still in force in the Special Region of Yogyakarta Province. Those present at the knowledge sharing session were the RSA UGM team (4 people), the Main Director of UGM RSA, PIAT UGM (2 people), the Head of Trihanggo Village, KWT representatives (2 people), the Head of Kronggahan Hamlet, Fisheries Group (1 person), a livestock group (1 person) and an Agricultural Extension Officer in the Trihanggo Region as a representative from the Sleman District Agriculture Office. The knowledge sharing session also involved the PKRS RSA UGM team to strengthen and maintain the continuity of the UGM community service program which could be continued after the community service program was completed. Through this session, it was hoped that policymakers and the public could fully support the implementation of Productive Economic Empowerment activities through the Development of Maggot into Fish Pellet Products, Organic Fertilizers, and Processed Budikdamber Products in Kronggahan Elementary School, Gamping Sleman.

The agenda for this knowledge sharing session activity consisted of a remark by the Head of Kronggahan Hamlet, a remark by the Head of Trihanggo Village who represented stakeholders then remarks from the Sleman District Agriculture Service and from the Main Director of RSA UGM, followed by program presentations by the representatives of the UGM community service team, and finalized with discussions related to program implementation. This session activity was closed with a joint commitment to support and implement community service programs, so that they could be successful in accordance with the expected goals.

3.2 Coordination and consolidation with the team and stakeholders as well as the community to strengthen the program

The hearing session for the community service program to the Trihanggo village government and the Kronggahan Hamlet, in particular, was carried out intensively in 2019 regarding the waste management program using the BSF method. The program was successful according to the expected target. Strengthening the program network was also carried out in groups of productive economic activity groups in the community, the Women Farmers Group (Kelompok Wanita Tani/ KWT), the fisheries group, and the animal breeders' group. In addition to conducting hearings and communication with policymakers and productive groups or communities in the community, activities that are also important were the Community Service Team's routine coordination activities consisting of the UGM RSA team and the UGM PlAT team. Prior to implementing the program, the team had conducted discussions several times both in person via an online platform considering the conditions of the COVID-1 Pandemic.

3.3 Pre-training, preparation of educational media, and training

We prepared several materials to support community teaching activities. The educational media used this time was a pocketbook containing some materials such as Community Economic Empowerment through Development Bioconversion Result Products Waste and Budikdamber Become Product Superior Economic Value, Practice Maggot Making Becomes Maggot Pellets, Nutrition in Catfish As Source of Important Macro and Micronutrients For Increase Immunity The Body in a Pandemic Period. The pocketbook was compiled, printed, and distributed to all training participants.

3.4 Training

The training was held for 2 days, on 29 and 30 October 2021 in Kronggahan Hamlet. This training program's targets were representatives of productive economic groups including cadres, KWT (women's farmer groups), fisheries groups, livestock groups, agricultural groups, and hamlet representatives from Kronggahan Hamlet, Bedog, Trini, and Ngawen.

To assess the level of knowledge of participants before the training program was implemented, each participant was asked to take a pre-test, and after the training was completed the participants was requested to take a post-test to discover out the increase in their knowledge related to the material that had been delivered during the training program. The training was carried out for 2 days, the first day in the form of providing material by presenting three resource persons and the second day in the form of providing material by another three resource persons including the practice of making catfish nuggets and maggot pellets.

The discussion program was guided by a moderator chosen by the UGM Community Service Team. In this training program, the participants received educational materials to increase their knowledge and practical materials to improve their skills. The second day continued with the provision of material and practice. The first practice was related to the manufacture of maggot pellets where the participants practiced processing fresh maggot into pellets. These could enrich nutrition and could be widely used as livestock or fish feed. The next practice was making catfish nuggets from the catfish harvested from

Budikdamber. By processing catfish into catfish nuggets, more and more varied processed sources of animal protein for family needs can be produced.

Educational training for community empowerment in Kronggahan hamlet was held in 2021. Discovering whether the training was successfully was done by assessing each participant using a questioner. The results are shown in Table 1.

Table 1 . Test results

No	Participant Name	Pretest	Posttest
1	Septi Hermastuti	4	5
2	Yuliyanto	7	8
3	Harini	8	9
4	Tusrhatno	7	9
5	Sudaryanti	8	9
6	Suratmi	8	7
7	Etik Murwati	8	9
8	Nurati	5	7
9	Anjas Septiawan	5	6
	Rate	6.67	7.67

There was an increase in the participants' scores before the training (6.67) and after the training (7.67). In other words, the increase in the participants' knowledge was around 15%. It means that all of the participants experienced an increase in their knowledge of waste management.

1. Organoleptic test for catfish nuggets.
   Organoleptic test is a test based on sensing process and the purpose was to find difference between samples and the result was to conclude about consumer's preferences. Several factors which are important in organoleptic to be evaluated are aroma, flavour, texture, appearance, colour, and the general reception. In this study, we use several organoleptic test parameters that comprised colour, taste, aroma, and texture. The results of the organoleptic test are shown in Table 2.

Table 2 . Organoleptic assessment by panellists

Panellists	Colour	Flavour	Aroma	Texture
1	5	5	5	5
2	5	5	5	5
3	5	5	5	4
4	5	5	4	4
5	5	5	5	5
6	4	5	5	5
7	5	4	4	5
8	5	5	4	5
9	4	4	5	5
10	5	4	5	5
Rate	4.8	4.7	4.7	4.8

   The organoleptic test of catfish nuggets shows that their colour, flavour, aroma and texture were very close to consumers' preference.

2. Content Proximate Analysis

Content proximate tested on pellets created by the participants in the training were comprised of dry maggot pellets, wet maggot pellets, and waste catfish. Pellets from maggot material still had half of the protein from the pellets and half of the fat content from the maggots Table 3.

Maggot (Black soldier fly larvae) is an insect that can be used as an alternative source of feed because it contains several nutrients that fish need, such as relatively high protein content. Maggot larvae have a protein content of around 40% to 50%. With a relatively high source of nutrients, maggots can stimulate growth and organ formation, such as increasing weight so that it can increase the productivity of fish farming (Wardhana, 2016). Protein is an important component in the composition of fish feed as it plays a role in the growth process of body tissues or organs and actively involved in the body's metabolic processes. Table 3 shows that maggot larvae have protein components higher than wet maggot pellet and dry maggot pellet.

Table 3 . Nutritional component of maggot larvae

Component material	Ash (%)	Crude protein (%)	Crude fat (%)	Fiber coarse (%)
Waste catfish	32.18	41.47	18.7	0.86
Magot	3.81	31.80	44.66	5.63
Wet magot pellets	20.25	25.25	16.51	17.47
Dry magot pellets	22.23	20.44	16.49	16.36

3.5 Dissemination and follow-up plan

Dissemination and follow-up plans were carried out to re-explain the community service activity program that had been implemented, support the commitment from stakeholders, community leaders and productive economic groups. This was to support the implementation of productive economic empowerment activities through maggot processed products. This also supported the continuation of the maggot house development process as a supporter of educational tourism in Padukuhan Kronggahan and encouraged formal institutionalization in community organizations in Trihanggo Village. This institutionalization aimed to maintain the commitment of stakeholders and the community in maintaining and developing organic waste management through Maggot and its processed products as a vehicle for strengthening the Community's Food Security during the COVID pandemic. This dissemination was carried out on October 19, 2021 and was attended by the representatives of Padukuhan Kronggahan I and II, KWT, and Gapoktan representatives.

4. CONCLUSION

The implementing team has successfully carried out a series of community empowerment programs in Dukuh Kronggahan in the form of pre-training activities by preparing educational media and training curricula as well as mentoring. The people of Dukuh Kronggahan have obtained knowledge related to environment-based waste management, knowledge and skills regarding the production of maggot pellets and the production of various processed fish and vegetables from Budikdamber, and knowledge and skills regarding the packaging of pellet

products, cassava fertilizers, and processed healthy food to improve the economic value and marketing methods for finished products. This effort was aimed to prepare for the hamlet to become an independent community in food security. The target community's acceptance of this program would enable the program's sustainability in the future by focusing on enhancing their level of entrepreneurial skills.

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CONFLICT OF INTERESTS

The authors declare that there has been no conflict of interests during the community empowerment program and article publication process.

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