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RESEARCH

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Organic Waste Management Behavior Through Cultivating Black Soldier Fly (BSF)

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Abstract

Waste is our common problem because it is generated every day and throughout the year. People's behavior in throwing rubbish in any place and not caring about the environment can house an unpleasant atmosphere, especially the type of organic waste that causes an unpleasant odor. The aim is to find out the behavior of managing organic waste as feed in cultivating Black Soldier Flies (BSF) in RT 32 Bengkuring. The Qualitative research method with an action research (AR) approach. The research results show that the first stage, here is no organic waste management by residents in RT 32. Second stage, he implementation of socialization and training on BSF/maggot fly cultivation was welcomed by community shops, the government, and local residents. Third phase, most of the mothers were amused or disgusted to see maggots during training because they are shaped like caterpillars, so it is difficult to feed them organic waste. Besides that, it is difficult to get permission from the owners of houses or residential land that has not been used for a long time because their whereabouts are unknown to the owner. In conclusion, the knowledge of residents, community shops, and the local government increased after socialization and practice on how to manage organic waste through cultivating BSF flies. Behavior is low because not all residents dare to see, let alone touch and feed maggots.

Keywords: Organic Waste, Management Behavior, Black Soldier Fly.

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1. INTRODUCTION

Waste is a common issue that we face as it is generated every day and throughout the year. The World Bank, in a September 2019 report, provided data on global waste production. The international financial institution claimed that in 2016, there were 2.01 billion tons of waste accumulated worldwide. Meanwhile, in Indonesia, it was 26 million tons per year (Fitriyah, & Nisa, 2023), making intensive waste management essential, especially for organic waste originating from kitchens, which easily decomposes (Adhikari, et al., 2024; Yulianto, Hasibuan, & Sugiarto, 2023).

Household waste remains a national problem due to its potential to cause air and soil pollution and aesthetic disturbances. Therefore, comprehensive and integrated management is needed from upstream to downstream to benefit health, the environment, and have economic value. One solution for organic waste processing is through Black Soldier Fly (BSF) cultivation (In, et al., 2023), or known as maggot, as BSF/maggot is a type of fly that can consume organic waste, especially from kitchens (Sari, et al., 2022).

In a national seminar on community service and empowerment, training was conducted for members of the waste concern forum in Indramayu district. The participants understood environmental issues and were able to reduce organic waste by 3 kg/day for each BSF enclosure (Ginanti, & Kusuma, 2020). Additionally, waste processing in the form of residual maggots can be used to produce preserved maggots, compost, and other economically valuable products, (Kalidas, Cr M, & Goodsell, ; Susanto, et al., 2022). BSF/maggot cultivation is one method that can be used to reduce organic waste volume. Moreover, BSF/maggots can be sold or used as animal feed, such as for chickens or fish, cultivated by the community (Ananda, Karunasena, & Pearson, 2023), thereby increasing residents' income.

In 2021, the Ministry of Environment and Forestry (KLHK) recorded waste piles in East Kalimantan totaling 733.4 thousand tons/year. Samarinda city was noted as the largest waste-producing city in East Kalimantan, with 212.3 thousand tons/year. The composition was 40% inorganic waste and 60% organic waste. According to the SNI M-36-1991-2003, the waste produced per person per day was 0.7 kg. With a population of 391 people in RT 32 Bengkuring in 2022, the organic waste produced by the residents of Bengkuring RT 32 was 164 kg/day and 1,149.54 kg/week. This shows the importance of intensive and sustainable waste management, so that it can reduce the volume of waste.

Based on initial observations conducted in RT 32 Bengkuring, residents are not consistent in managing organic waste, it has been proven that leftover food waste is thrown into the ditch in front of the house or put in plastic bags, then there are residents who hang it on the fence in front of the house or put in uncovered rubbish bins, so that the rubbish is scattered by cats, rats, and other vectors before the waste carrier comes to pick it up, causing an unpleasant odor. Most residents also utilized their yards for catfish cultivation using tarpaulin ponds or buckets. The catfish produced were sold to groups of women forming joint businesses (kubu) Amanah 32 to be processed into snacks such as fish sticks, frownies, amplings, and others. Therefore, it is highly relevant to process organic waste into maggot feed, which can subsequently be used as catfish feed. Besides being a solution to reduce organic waste, it can also improve the nutritional quality, especially the protein content, of the catfish cultivated by residents (Andari, Ginting, & Nurdiana, 2021). The research aims to understand the behavior of organic waste management as maggot/BSF feed in RT.32 Bengkuring housing.

2. RESEARCH METHOD

The research method used is qualitative with the Action Research (AR) approach, which aims to facilitate analysis of reinforcing and supporting factors in the formation of organic waste management behavior as BSF/maggot feed in Bengkuring RT 32. Secondary data is from

sub-districts and RTs, while primary data was obtained by interviews in-depth observation and documentation to 4 informants, namely 3 residents and 1 RT head who carried out three stages, namely in the first stage, diagnostic action, namely initial communication about the behavior of the RT 32 community in managing organic waste as BSF/maggot feed. In the second stage of taking action, (research participants) carried out outreach and training on maggot cultivation so that the organic waste produced by residents could be fed to maggots and the maggots themselves could be fed to catfish which residents have been cultivating for a long time. Stage 3, evaluation action, namely evaluating the results of counseling and training carried out through in-depth interviews, observation and documentation. Next, the data is processed and analyzed qualitatively and interpreted, after the data is saturated, conclusions are drawn.

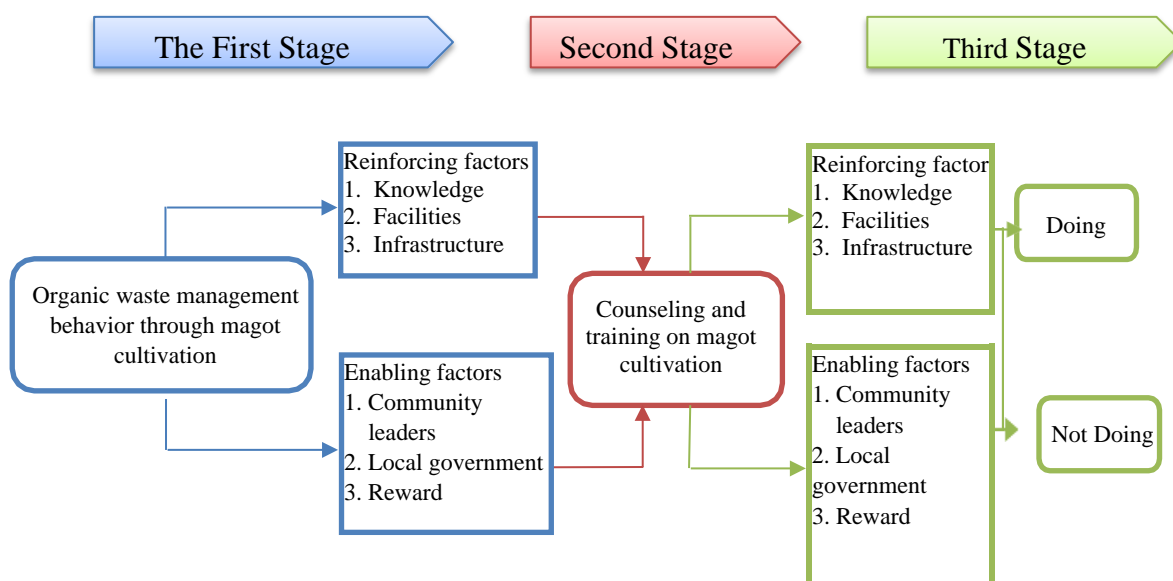


Figure 1. Interview and Observation Organic Waste Management Behavior Through Cultivating Black Soldier Fly (BSF)

3. RESULTS AND DISCUSSION

The first stage, namely *diagnosing action*, based on the results of observation and documentation of characteristics to four informants as follows.

Table 1. Informant Characteristics

No.	Informant Code	Age	Education	Occupation	Gender
1	W.A.S.X	46 year	S1	Private Institution/Residency Head	Man
2	W.A.A.X	23 year	SMA	Teacher/resident	Women
3	W.A.G.X	18 year	SMA	Student/resident	Women
4	W.A.I.X	53 year	S1	Self-employed/resident	Women
5.	W.A.H.S	58 year	S1	Head of Sempaja Timur Village	Women

The results of in-depth interviews with community stores, RT.32 has won the first prize in the *Kampung Sampah Nilai* (salai) competition at the Samarinda City level, and the results of observations also prove that residents are proactive in managing inorganic waste, either by recycling plastic waste or selling it directly to the Amanah 32 Waste Bank. Meanwhile, organic waste from food scraps and vegetable lunches has not been recycled or processed, because they do not know how to manage it, forever food scraps are immediately thrown away so that they do not rot. as follows excerpts from interviews with informants;

Excerpt 1

"I don't know, can organic waste be processed with maggot cultivation? Here, we can only make compost for the organic waste." (W.B.S.3)

Excerpt 2

I don't know, because I've never heard of maggot, what is it, I'm curious" (W.B.I.3).

Based on the data above, informants did not know what BSF or magot were, and all informants admitted that this was the first time they had heard the name magot. Based on the initial observation, the available infrastructure is limited. RT 32 is a residential neighborhood that is densely packed with buildings, but there is still public land such as a large langar yard, greening land and an empty house that has been uninhabited for a long time so that the house is not suitable for habitation and the owner gives permission to be used so that someone also cleans the land.

As for the means to support magot cultivation, residents are willing to prepare it if magot can be profitable and useful for them.

Table 2. Recapitulation The First Stage Organic Waste Management Behavior Through Maggot Before Intervention.

Reinforcing/Supporting Factors	Informant			
	W.A.S.X	W.A.A.X	W.A.G.X	W.A.I.X
Knowledge	Don't know	Don't know	Don't know	Don't know
Facilities	Ready to set up	Ready to set up	Ready to set up	Ready to set up
Infrastructure	Available	Limited	Limited	Limited

Based on the data above, the intervention activities to be carried out are socialization and training on BSF/maggot cultivation and the method of feeding from organic waste, especially food leftovers. The goal is to increase residents' knowledge about BSF/maggot cultivation and feeding from organic waste, specifically food leftovers, as well as the benefits of maggots.

Second stage is the implementation of the intervention, which involves conducting socialization and training on BSF/maggot cultivation and feeding from organic waste. Following meetings with residents and community leaders, it was agreed to hold the training on Tuesday, January 3, 2023, at the badminton court in the Al-Ittihad mosque yard, RT 32, from 9:00 to 11:00.

The topics covered during the training include: a. Understanding organic waste, methods of converting organic waste into maggot feed, b. Explanation of maggots, the process of maggot cultivation, and the equipment and infrastructure needed for maggot cultivation. Many enthusiastic participants attended the training, including residents from other RTs such as RT 30, 31, and 33, as well as the village head, the head of the community empowerment section

(KASI), and staff from East Sepaja sub-district. Third stage, evaluating action. All informants have a good understanding of how to manage organic waste, especially food leftovers, into maggot feed. They also have knowledge of how to cultivate maggots and use them as catfish feed, which economically helps reduce the purchase of expensive catfish feed. The following is an overview of the evaluation results conducted through observation and in-depth interviews.

High

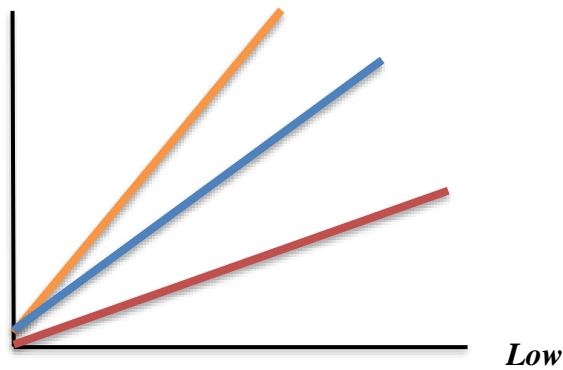





Figure 2. Reinforcing Factors

-  Knowledge
-  Facilities
-  Infrastructure

High

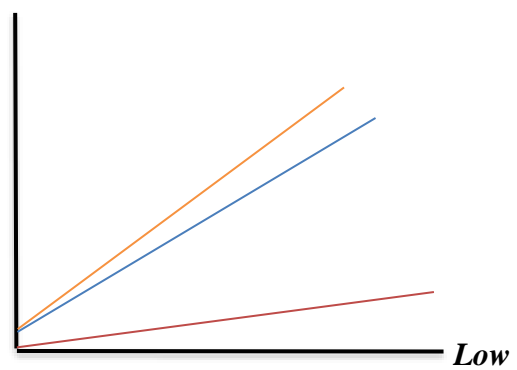





Figure 3. Enabling factors

-  Figure Community
-  Government
-  Reward

Based on the curve chart above, it depicts the conditions of reinforcing factors (knowledge, facilities, and infrastructure). Residents' knowledge, as indicated by the X1 data collection, initially ranged from not knowing what BSF/maggots were, how to feed maggots from organic waste such as food leftovers, to understanding how maggots become catfish feed and their benefits. The results showed that all residents now know and understand the socialization outcomes regarding the processing of organic waste, especially food leftovers, into maggot feed, and the use of maggots as catfish feed. As for facilities, only the head of RT 32 and one community store owner are willing to provide the necessary facilities for maggot cultivation, while two other informants are not yet ready.

Similarly, regarding infrastructure, only the head of RT 32 is prepared and has infrastructure, while the other three informants are still contemplating and find it difficult to obtain infrastructure. This is because the RT 32 area is densely populated and has minimal household yards. However, there is still hope that four long-uninhabited houses can be utilized, and if managed properly, they can prevent becoming breeding grounds for weeds and other rodents.

The condition of supporting factors (community stores, local government, rewards), especially rewards, is relatively weak. This is because the village office has never provided rewards to RTs in its working area, but it will be considered in the future. As per the interview results:

Excerpt 3

"We have never provided rewards to RT, whether it's for any form of success, for example, if an RT wins in a village competition throughout Samarinda, whether it's prizes, rewards, and others from DLH or the sub-district, but we will consider it in the future (W.A.H.S)."

Meanwhile, the role of community stores including the head of RT is quite supportive of any residents interested in maggot cultivation, with one of the aims being to assist in the absorption of organic waste, especially household food leftovers. Their support takes the form of preparing land for use by adult BSF, as adult BSF requires a relatively large area for breeding, such as preparing a cage in the form of a net for adult BSF to live in and go through the mating/egg-bearing phase. If maggots are in the egg, larva, and pupa stages, they can still be placed in containers that do not require a large space. If not permanent, they can be placed in a basin, while for a permanent solution, a cemented area of 1x1 meter or more can be constructed, adjusted according to the weight/quantity of BSF eggs, as evidenced by the following observation and documentation;



Figure 4. Feeding the maggot.



Figure 5. BSF drum net

Local government support from both the kelurahan and DLH Kecamatan is quite good, because support will be given if the community is ready to do it, and a system is established and agreed upon that will support the continuation of BSF/maggot cultivation without any losses. In fact, the kelurahan is ready to help through probabaya funds if the RT requests any materials needed for BSF/maggot cultivation. As the following interview excerpt shows;

Excerpt 4

"Please, Mr. RT, accommodate your citizens and gather who are interested in BSF/maggot cultivation and the need for facilities, then submit a request through the probabaya fund, then we will facilitate and prepare any suggestions needed". W.A.H.S

As a result of the evaluation, all informants were quite well informed on how to manage organic waste, especially food waste into maggot feed. Likewise, the knowledge of how to cultivate maggot to become catfish feed is economically very helpful in reducing the purchase of expensive catfish feed. The following is a recapitulation of the evaluation results;

Table 3. Recapitulation Second Stage Organic Waste Management Behavior through Maggot Cultivation After Intervention

Reinforcing/supporting factors	Informant			
	W.A.S.X	W.A.A.X	W.A.G.X	W.A.I.X
Knowledge	Knowing well	Knowing well	Knowing well	Knowing well
Facilities	Ready to Set Up	Limited	Limited	Ready to Set Up
Infrastructure	Available	Limited	Available	Limited

DISCUSSION

Garbage has two different sides. First, if it is not properly managed, it poses a risk to the human health that settles around it, especially organic garbage that has an unpleasant smell that can invite many vectors, such as flies, rats, cockroaches, and other rodents. These vectors are an intermediary in infecting humans with diseases such as diarrhea, typhus, sputum, chickenpox, and many other diseases.

So household garbage must be handled seriously, significantly and continuously. To do so needs the support and policy of the local government, the head of RT and the community store so that the citizens are committed in Together to the management of the waste especially organic waste that comes from households.

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Knowledge is very synonymous with behavior change, in line with the results of research conducted by CMaxwell-Smith et al, that there is a significant relationship between ability, opportunity and motivation with human action with a stage model approach to behavior change (Maxwell-Smith, et al., 2024). The knowledge of all informants at the initial stage, did not know what BSF was, after the intervention through socialization and training on BSF cultivation and how to feed from organic waste, especially food waste (Nguyen, et al., 2023). All informants understood well and the community store and local government were ready to support through policy, namely holding a competition during the celebration of Indonesia's independence day on August 17.

The results of research conducted by Krishna K et al, that to increase the knowledge of conducting more in-depth training, the activities carried out include making BSF fly cages, attractant media, maggot enlargement media, bioponds, preserved feed products from larvae, and product marketing strategies. The results achieved by participants understand environmental issues and are able to reduce organic waste by 3 kg / day for each participant's cage, make maggot preserved products, and waste processing by-products in the form of kasgot (used maggot) (Kalidas, Cr M, & Goodsell, ; Kim, et al., 2021).

After the intervention was given to informants, reactions showed that most were ready to do it and some, especially the mothers' group, were not ready to do it, because they felt disgusted and ticklish to see BSF larvae, let alone being fed and touched. In contrast to research conducted by L Moussaoui et al, which looked at the perceptions of recyclers of kitchen-sourced waste using government-funded small green bin facilities (PPV). The results showed

a significant relationship between sociodemographic characteristics and the behavior, knowledge and beliefs of sorting organic waste (Moussaoui, et al., 2022; Nguyen, et al., 2023).

The factor of inadequate availability of facilities and infrastructure is due to the fact that the bengkuring housing estate is a densely populated settlement, making it difficult to find land designated for maggot cages. BSF/maggot cultivation is one way of managing organic waste that is environmentally friendly (Rehman, et al., 2023). It efficiently consumes and decomposes a wide range of organic matter, turning it into nutrient-rich compost and high-protein larvae suitable for animal feed or other applications (Mulu, et al., 2023; Mutafela, 2015).

Here is the general life cycle and workings of BSF, starting with the life stages - egg, larva (grub), cocoon, and adult fly. The larval stage is when they consume organic waste. Collection system Organic waste, such as kitchen scraps or agricultural by-products, can be collected in containers suitable for the growth of BSF larvae (Gold, et al., 2018). These containers should allow for drainage, aeration, and protection from predators.

Optimal Conditions BSF larvae thrive in warm and humid environments. Ensure that the waste is moist but not too wet, as excessive moisture can lead to anaerobic conditions and create odors. Feeding the Larvae from Organic waste is put into a container, and the larvae are introduced. They will consume the waste, breaking it down through their digestive system (Rehman, et al., 2023; Reignier, Méchin, & Sarbu, 2021).

Harvesting Compost and Larvae After the feeding period, which varies depending on the conditions and type of waste, adult larvae move away from the food source to pupate (Sari, et al., 2023). Today, they can be harvested for various uses, such as animal feed or compost. Composting waste left in the container, which has been partially decomposed by the larvae, can be used as compost. It is nutrient-rich and beneficial for use in polybags/pots for vegetables or ornamental plants (Sarker, et al., 2024).

Managing the process, regular monitoring and maintenance of the BSF culture system is essential. Adjustments may be needed to optimize larval conditions and ensure efficient waste decomposition (Susanto, et al., 2022). because if it is not efficient, it will cause an unpleasant odor, while the bengkuring housing estate is a densely populated settlement. BSF fly farming for waste management requires attention to hygiene, proper organization and monitoring. It is an effective method that not only reduces organic waste but also produces valuable resources such as compost and protein-rich larvae.

4. CONCLUSION

Phase 1 (X01), many residents and community stores, and local governments do not know about organic waste management through BSF / maggot cultivation. local residents have not managed organic waste of food/kitchen waste, the results of kitchen waste are directly disposed of. As for facilities and infrastructure based on observations, there is still unused community land, so it can be utilized as maggot cage land. So that RT 32 is suitable if cultivating BSF / maggot flies. Stage 2 (X) The implementation of socialization and training activities on organic waste management through BSF/maggot cultivation went well and received a lively welcome from residents, RT 32 community stores and the local government. Stage 3 (X02) Residents, community stores of RT 32 and the local government have a good understanding of organic waste management through BSF/maggot cultivation. The local government is ready to support if residents are ready to carry out BSF/maggot cultivation, because it will absorb organic waste, especially food waste from household kitchens to the maximum, as well as economic value because maggot becomes catfish feed with high protein value.

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