Use of Household Waste for Organik Fertilizer Using The "Ember Tumpuk" Method

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Abstract. Waste is a very serious problem that can damage the environment and also become a social, economic and cultural problem. The purpose of this study was to determine the level of knowledge about the use of organic household waste for making Organic Fertilizer and to determine the level of skills of partners about making liquid organic fertilizer (POC) with the "ember tumpuk" method. The respondents of this study were PKK RW 03 Jetis Tarubasan Karanganom Klaten women who are members of the RESIKan Waste Bank in the area. The methods used were lectures, discussions, demonstrations, and practices. The activity began with 1). Educating and socializing technology and utilization of household waste, 2). Demonstration and practice of how to make liquid organic fertilizer with the "ember tumpuk" method. The analysis technique used is descriptive analysis and to test the success of this activity with non-parametric analysis before and after Mc Nemar. The statistically tested results showed a significant increase in knowledge about the utilization of household waste by 55.39% and a significant increase in skills about making liquid organic fertilizer with the "ember tumpuk" method by 63.25%. The success of this activity is supported by the very high participation and motivation of the respondents, besides that assistance is needed for the sustainability of this activity.

1 Introduction

Waste is an invaluable or worthless object that is around the community environment. In Indonesia we can see waste everywhere and it is now a big problem that can damage the environment. Waste is a very serious problem and is also a social, economic [1], and cultural problem and is not harmless, although it is not harmful, it needs proper handling so as not to cause new problems [2]. Almost all countries experience obstacles and challenges in managing waste [3]. This happens because the processing of TPA (landfills) in an area is still lacking land so that people throw a lot of garbage in the river. So that cleanliness and marine ecosystems will be damaged [4].

Efforts made in overcoming environmental problems, especially waste, must start from the individual, start small and start from now on by habituation in the family and transmitted to the community so that changes occur. In general, in households, waste management has not been done optimally. It is still mixed disposal for various kinds of waste. Household

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waste needs to be separated which is categorized as organic waste can be composted while anargonic household waste can be recycled again and can be used as economically valuable materials [5]. Organic waste that is easily decomposed and inorganic waste such as plastic, aluminum foil, glass, cans that are difficult to decompose or even cannot rot are thrown away together. In fact, waste can still be recycled for further utilization, so it is not impossible that it will be able to increase income for households and reduce the surrounding environmental problems, so there needs to be a paradigm shift regarding waste needs to be done sustainably [6].

In waste management, there must be a change in the way people view waste. Waste should not be considered as a dirty item or waste item, but waste is an item that can be utilized. In order to implement the Management of Household Waste and Waste Similar to Household Waste according to Government Regulation No. 81 of 2012, processing and utilizing waste must be a real step in managing waste. Recent regulations in Poland and the European Union to support the circular economy require fertilizers containing valuable plant nutrients from organic waste or recycled materials [7].

The 3R concept (Reduce, Reuse and Recycle) is a new method in waste management. Where the 3Rs are reducing everything that causes waste (reduce), reusing waste that can still be reused (reuse) and reprocessing / recycling waste into new useful goods or products (recycle)[8]. The implementation of the 3R system or reuse, reduce, and recycle is one of the waste management solutions in addition to processing waste into compost or utilizing waste as a source of electricity [9].

Organic materials from organic waste have not been maximally utilized by the community. Whereas organic materials from organic waste have great potential to be reused into useful goods and can have considerable economic value. Actually in rural areas, organic waste is widely used by residents, such as tofu waste can be used as organic waste [10], food scraps can become liquid organic fertilizer [11]. Usually they dispose of organic waste on plantation or agricultural land to be used as natural fertilizer. But generally they have not processed the organic waste effectively and continuously. If organic waste is only spread on agricultural land without any prior processing, the nutrients in the waste cannot be absorbed optimally by plants. Therefore, there is a need for proper management efforts so that organic waste can become something that produces, is useful and has economic value [12]. Organic waste can be processed into organic fertilizer, biogas, charcoal briquettes, fish / farm animal feed, handicrafts, is an alternative to the utilization of organic waste into a product with high economic value and beneficial value.

Household organic waste can be processed into quality organic fertilizer which can be used as a nutrient supply to increase plant productivity [13]. Organic waste if left unattended, it will cause environmental pollution and health problems for people who live around the waste. Organic waste that accumulates, then decomposes so that it produces an unpleasant aroma. This will invite animals such as flies, mosquitoes, rats and cockroaches, where these animals are disease vectors [Shitophyta 14 dkk]. Waste from household waste has potential if processed into fertilizer. Household waste such as vegetables contains a lot of liquid, so it will decompose faster. Making this fertilizer will reduce waste in the environment, but will add nutrients to the soil.

Feeding household waste such as vegetable scraps directly to plants is not recommended because raw household waste can reduce soil nutrients. This is because the waste is utilized by microbes causing the microbial population to be higher. When the microbial population is higher, nutrients from the soil will be taken by microbes for their growth, resulting in competition between microbes and plants for nutrients in the soil. Based on this, a simple form of organic waste processing is needed so that it can benefit the community, for example, it is used for plants around the house, so that this can reduce the amount of existing waste. One way of processing organic waste in a simple way is making liquid organic fertilizer

(POC). Processing organic waste into POC is in principle to reuse. This will cause the environment to be clean while making waste have economic value. Giving POC can fertilize red spinach plants [15]. The use of POC is expected to reduce the use of chemical fertilizers, because the use of chemical fertilizers, especially long-term use, can cause damage to soil and the environment.

Household waste treatment is important, considering that every day, households produce waste. The type of organic waste that can be processed using the "ember tumpuk" technique is vegetable kitchen waste. Uncooked waste such as vegetable scraps, banana peels and fruits. In addition, waste that has been cooked and juicy such as leftover rice, boiled cassava and others.

"Ember tumpuk" technique discovered by Nasih Widya Wiyono, UGM Agriculture Lecturer, has the advantage of decomposing household waste more effectively and efficiently because it uses the help of Black Soldier Fly (BSF) larvae [16]. Processing household waste using the "ember tumpuk" produces three outputs at once, namely compost, liquid organic fertilizer (POC) and maggot. It takes about two months to see the results of waste treatment using the "ember tumpuk" technique. The POC from processing household waste using the "ember tumpuk" must first be dried in the sun for about two days. This is to kill bad bacteria that can potentially damage plants. Stacked bucket research has been carried out on food waste from restaurants in Sleman district, Yogyakarta, Indonesia [17].

The community in the Jetis RW03 Tarubasan Karanganom Klaten hamlet, especially mothers who are members of the Waste Bank, have sorted non-organic waste such as bottles, cardboard, paper, plastic and others. Meanwhile, no one has initiated organic waste management, even though there is often a buildup of garbage in residents' homes which causes health effects and is one of the causes of environmental pollution. This study was conducted to activate community participation, with independent organic waste management into liquid organic fertilizer (POC) with the "ember tumpuk" method which will produce liquid organic fertilizer, compost and maggot. This study aims to determine the level of knowledge about the utilization of household waste and determine the level of skills regarding the manufacture of liquid organic fertilizer (POC) with the "ember tumpuk" method.

2 Methodology

This research was conducted in Jetis Tarubasan Karanganom Klaten with the consideration that in this area there is a Waste Bank that has been sorting samapah since 2020. Respondents were 39 of the PKK RW 03 Jetis Tarubasan Karanganom Klaten women who were members of the RESIK-an Waste Bank in the area. The method used to determine the level of knowledge with lectures followed by discussions about the utilization of household waste. Meanwhile, to determine the level of skills with demonstrations, and practice on how to make liquid organic fertilizer with the "bucket pile" method. Indicators of knowledge and skills as in table 1.

Table 1. indicator level of knowledge and skills

Variable	Indicator
Knowledge	Knowledge of waste management
	Knowledge of organic waste
	Knowledge of Organic fertilizer
	Knowledge of the "ember tumpuk" method
	Knowledge of the benefits of organic fertilizer

Skills	Waste management skills
	Skills to make organic fertilizer “ember tumpuk”
	Skills to utilize organic fertilizer

This success was evaluated using pre and post-tests, as has been done in research on Effectiveness of the educational interventions on improvement of the performance [18]. Then a non-parametric analysis of Mc Nemar's test [19] was carried out . With the following formula

Table 2. Display of observation data

			After/Post-test	
			Response Category	
			(-)	+
Before/ Pre-test	Response Category	+	A	B
		((-)	C	D

$$X^2_{count} = \frac{(|A-D|-1)^2}{A+D} \qquad (1)$$

Description:

X^2_{count}= Chi Square Count
A and D = Number of respondents who have changed from - to + and vice versa

Decision Making:

If sig ≤ α then there is an increase in knowledge / skills before and after counseling / training

If sig > α then there is no increase in knowledge / skills before and after counseling / training

3 Result and Discussion

Research on the utilization of household waste for the manufacture of liquid organic fertilizer with the “ember tumpuk” method was conducted on 39 respondents of PKK mothers who were members of the waste bank in the Jetis RW 05 Tarubasan Karangnom Klaten area. There are 2 objectives to be achieved in this study, namely, to determine the level of knowledge of household waste and the level of skills regarding the manufacture of liquid organic fertilizer with the “bucket pile” method.

3.1 “Ember Tumpuk” Technique

“Ember tumpuk” is a fertilizer processing tool made by putting together 2 buckets arranged in stages. The “ember tumpuk” is used to process waste with the help of Hi larvae (Hermetia illucens) on a household scale. Hermetia illucens is also known as BSF (Black Soldier Fly). Hi larvae can help the aerobic composting process and accelerate the decomposition of

organic waste in the piling reactor. The "ember tumpuk" reactor also allows a separate flow of leachate and solid materials to produce liquid fertilizer.

A device called a bucket stack (Ember Tumpuk) is used to combine two buckets that are stacked one on top of the other. With the aid of BSF larvae, organic waste in the form of leftover fruits and vegetables or other domestic garbage is treated in stacked buckets. In the stacked bucket reactor, BSF larvae aid in the aerobic composting process and hasten the breakdown of organic waste. In order to create liquid fertilizer, the leachate flow can also be separated from the solid material using a stacked bucket reactor [20]

"Ember Tumpuk" method uses simple equipment and is cheap to obtain. This technology is very easy to apply at home. "Ember tumpuk" is able to process organic waste into environmentally friendly organic fertilizer. Processing household waste using the "ember tumpuk" produces three outputs at once, namely compost, liquid organic fertilizer (POC) and maggots. With the "ember tumpuk", everyone can make cheap organic fertilizer and support agricultural land that is starting to lose its fertility.

3.2 Respondents' Knowledge Level

The indicators used to measure the level of knowledge about the utilization of household waste consist of knowledge about waste management, knowledge about organic waste, knowledge about organic fertilizers, knowledge about the "ember tumpuk" method and knowledge about the benefits of organic fertilizers. The following are the results of pre and post tests conducted lectures and discussions on the utilization of household waste.

Table 3. the level of knowledge of respondents before and after receiving a lecture on the utilization of household waste

Indicator	Percentage (%)		Improvement	Mc Nemar Test
	Before	After	(%)	Significant (%)
Knowledge of waste management	41.00	100.00	59	1
Knowledge about organic waste	25.64	89.74	.64.1	1
Knowledge of Organic fertilizers	51.28	89.74	38.46	1
Knowledge of the "ember tumpuk" method	-	100.00	100	1
Knowledge about the benefits of organic fertilizer	84.61	100.00	15.39	5
Average increase in knowledge			**55.39**	

Based on Table 1 and Figure 1, before the counseling on the utilization of household waste, the lowest level of knowledge of respondents was knowledge of "bucket piles", it is very understandable that respondents do not know at all about the "bucket piles" method, because for respondents this is a new technology that has just been obtained. The level of knowledge of respondents before counseling was about the benefits of household waste, namely knowledge of the benefits of organic fertilizer, which was 84.61%. This was due to the fact that most of the respondents were members of a waste bank and were often involved in waste management activities.

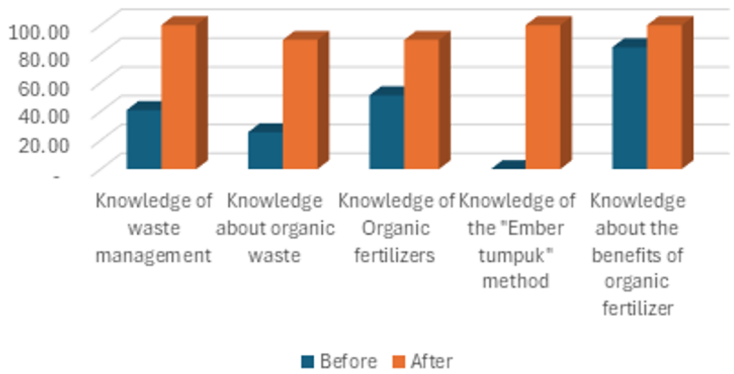

Fig. 1. Graph of respondents' knowledge level

The results of the analysis after counseling and discussion about the utilization of household waste, almost all indicators have a value of more than 80% and there are even 3 indicators that reach 100% of respondents who know about the utilization of household waste. This shows that this counseling activity succeeded in increasing the knowledge of respondents with an average increase in knowledge of 55.39%. While knowledge about organic fertilizers, has a small percentage increase because respondents already know about the benefits of organic fertilizers that can be used for soil fertility, this is supported by the results of research on organic fertilizers are generally considered an effective way to maintain soil fertility and plant growth [21].

Based on the results of Mc Nemar's non-parametric statistical analysis, the increase in knowledge before and after counseling on the utilization of household waste is significant at the 1% error rate except for the knowledge indicator on the benefits of organic fertilizer which is significant at the 5% error rate. This proves that the increase in knowledge, apart from being based on descriptive analysis that shows an increase, is reinforced by a significant statistical test. Good instructors and supported by soft skills owned by respondents will be able to increase the knowledge and skills of respondents [22].

3.2 Skill Level

The level of skills of respondents in making liquid organic fertilizer is seen from 3 indicators, namely skills in managing waste, skills in making organic fertilizer and skills in utilizing organic fertilizer. Analysis of the success of the training activities for making liquid organic fertilizer was carried out by filling out a questionnaire before and after the training.

Table 4. respondents' skill level before and after receiving training on making organic fertilizer using the "ember tumpuk" method

Indicator	Percentage (%)		Improve	Mc Nemar Test
	Before	After	(%)	significant (%)
Waste management skills	4.03	87.18	46.15	1
Skills in making organic fertilizer by "ember tumpuk"	0	100	100	1
Skills in using organic fertilizer	56.41	100	43.59	1
average increase in skills			63.25	

The results of the research before and after being given training on making liquid organic fertilizer with the "ember tumpuk" method, all indicators show an increase in skills, the highest increase in the skills of making liquid organic fertilizer with the "ember tumpuk" method, which is 100%. Initially, respondents did not know how to make liquid organic fertilizer, but after the training, this method is very easy to apply in everyday life. Other indicators have an increase of about 40%, this is because the waste management skills have been carried out by respondents who are active in the RESIKan waste bank activities in the Jetis Tarubasan Karangnom Klaten area. While the indicator of skills in managing waste, this training has already been carried out by the waste bank management. Respondents already know how to sort waste both to organic and organic waste. In addition, this sorting activity has been carried out regularly by the waste bank management. Scientific knowledge and innovation in training services are needed for agricultural development [23].

Overall, the average increase in skills in this study was 63.25%, which has been statistically tested at an error rate of 15. This shows the success of statistically significant technology transfer regarding the manufacture of liquid organic fertilizer with the "ember tumpuk" method. The existence of training or demonstration and practice carried out by respondents and supported by good counseling will be able to increase more effective learning [24].

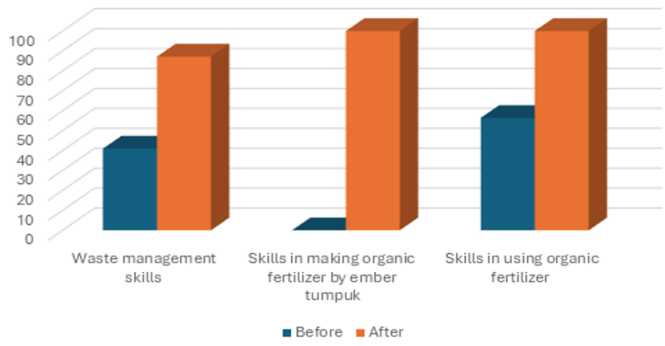

Fig. 2. Respondents' skill level before and after receiving training on making organic fertilizer using the "ember tumpuk" method

4 Conclusion

1. Counseling on the utilization of organic household waste can significantly increase knowledge by 55.39%.
2. Training on making liquid organic fertilizer can significantly improve skills by 63.25%.
3. To maintain the sustainability of the extension and training program, intensive mentoring is needed so that the program can be utilized effectively and efficiently.

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Reference

1. A. Seberini, SHS Web Conf. **74**, 03010 (2020)
2. D. K. Dewi, S. F. Yusuf, and U. Madya, in *Annu. Conf. Community Engagem. Peac. Transform.* (2022), pp. 605–609
3. M. S. Ayilara, O. S. Olanrewaju, O. O. Babalola, and O. Odeyemi, Sustain. **12**, 1 (2020)
4. Z. Ikhwan, R. H. Harahap, L. S. Andayani, and M. B. Mulya, Nveo.Org **8**, 5380 (2021)
5. Jumar, N. Fitriyah, and R. Kalalinggi, J. Adm. Reform **2**, 101 (2014)
6. D. Asteria and H. Heruman, J. Mns. Dan Lingkung. **23**, 136 (2016)
7. R. Pajura, A. Masłoń, and J. Czarnota, Energies **16**, (2023)
8. C. O. Ugwu, C. G. Ozoegwu, P. A. Ozor, N. Agwu, and C. Mbohwa, Fuel Commun. **9**, 100025 (2021)
9. P. A. Shentika, J. Ekon. Dan Ekon. Stud. Pembang. **8**, 92 (2016)
10. G. Yunitasari, H. Jayadi, and B. Suyanto, in *5th Int. Conf. Heal. Polytech. From Surabaya* (2022), pp. 95–103
11. S. A. Unnisa, Int. Res. J. Environ. Sci. Int. Sci. Congr. Assoc. **4**, 22 (2015)
12. Anonim, 186 (2012)
13. H. Setiawan and I. Lestari, Anfatama J. Pengabdi. Masy. **1**, 67 (2022)
14. L. M. Shitophyta, S. Amelia, and S. Jamilatun, Community Dev. J. J. Pengabdi. Masy. **2**, 136 (2021)
15. Salawati, F. Syadik, Tony, Masriani, S. Fatima, Nurmala, Y. Sasmita, N. Hikmah, Henrik, and S. Ende, J. Pengabdi. Masy. **4**, 149 (2021)
16. T. Hidayat, N. A. Utama, L. N. Aini, M. Fikri, A. Fadilla Rachma, S. Nurma, F. R. Bahar, N. Azizah, U. Hasanah, and D. Annisa, in *Proceeding Int. Conf. Technol. Community Environ. Dev. « Green Technol. Futur. 4.0 Community Environ. »* (2023), pp. 207–216
17. L. Rahayu, D. R. Kamardiani, and A. A. Nurusman, Proceeding Int. Conf. Technol. Community Environ. Dev. **1**, 580 (2023)
18. H. Hazrati, L. Vahedi, F. Shirzad, and R. Khanderoy, Russ. Open Med. J. **9**, 1 (2020)
19. S. Siegel, Z. Suyuti, and L. Simatupang, *Statistik Nonparametrik: Untuk Ilmu-Ilmu Sosial* (Gramedia Pustaka Utama, Jakarta, 1997)
20. Y. Mangera and N. Yuni Ekowati, J. Agron. Tanam. Trop. **4**, 206 (2022)
21. R. Ji, G. Dong, W. Shi, and J. Min, Sustain. **9**, 1 (2017)
22. H. Tamsan and Y. Yusriadi, Uncertain Supply Chain Manag. **10**, 625 (2022)
23. O. S. Alabi and A. Ajayi, Ife J. Agric. **33**, 10 (2021)
24. H. Kassem, Asian J. Agric. Extension, Econ. Sociol. **3**, 91 (2014)