

Development of environmentally friendly urban agricultural system through household waste utilization training in Jombang Indonesia

Anggi Indah Yuliana ^{a,1,*}, Mucharomah Sartika Ami ^{b,2}, Tholib Hariono ^{c,3}

^a Fakultas Pertanian, Universitas KH. A. Wahab Hasbullah, Jombang, Indonesia

^b Fakultas Ilmu Pendidikan, Universitas KH. A. Wahab Hasbullah, Jombang, Indonesia

^c Fakultas Teknologi Informasi, Universitas KH. A. Wahab Hasbullah, Jombang, Indonesia

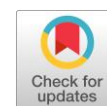
¹ anggiyk@unwaha.ac.id; ² msartika@unwaha.ac.id; ³ hariono@unwaha.ac.id

* Corresponding Author

Received 2020-10-17; accepted 2021-04-21; published 2021-04-24

ABSTRACT

The development of residential areas in Jombang Regency has the potential to increase global warming, so it needs urban greening in the area. The green of the environment can be done through the development of an environmentally friendly urban agricultural system with the application of 3R (Reduce, Reuse, Recycle) waste management. Utilization of domestic waste must be supported by the skills of residents, so this requires adequate training activities. This training aimed to (1) increased the knowledge and skills of the residents in processed domestic waste into compost and liquid organic fertilizer; (2) increased the knowledge and skills of residents in processed inorganic waste as a plant's pot; and (3) increased the spirit of citizens to lived clean and healthy. This community service activity was carried out on 24 to 26 July 2020 with partner residents of the Bahrul Ulum Menara Asri, Jombang Regency. Evaluation of the results of the training showed that 76 percent of residents understood how to processed waste into compost, liquid organic fertilizer and planting pots; 86 percent of participants stated that the instructor's performance was very good; 88 percent of residents admitted that this training was useful improving their skills in processed domestic waste; and as many as 86 percent of the participants planned to carry out waste processing practices in their homes.



KEYWORDS

Domestic waste
Urban agriculture
Training



This is an open-access article under the [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license

1. Introduction

The population has grown rapidly in recent years. In 2019, the population in Jombang reached 1,376,987 people, which increased from 1,258,618 in 2018 [1]. The rapid population growth encourages the development of new residential areas in Jombang, one of which is Bahrul Ulum Menara Asri Jombang Housing. The development of residential areas with high levels of building density causes the ground level will reflect more sunlight, thus causing the surface air temperature to be higher, and will ultimately decrease the carrying capacity of the environment [2]. In addition, the development of new residential areas in rice fields leads to a decrease in the amount of vegetation that serves as a barrier to solar radiation as well as absorbing carbon dioxide. Environmental greening activities are one of the efforts in reducing the risk of environmental damage due to global warming, by increasing vegetation to absorb carbon dioxide. Nevertheless, greening activities in densely populated residential areas are constrained by the lack of land that can be utilized. Almost every house or residence does not have a yard or open space to plant. Therefore, to green in dense settlements with limited land, efforts are needed to overcome them by utilizing existing resources. One alternative that can be done is to develop an urban agricultural system in densely populated areas. Urban agriculture is an agricultural activity conducted in or around urban areas, namely areas that have main activities outside the agricultural sector, with the arrangement of regional

functions as a place of settlement, social services, concentration and distribution of government services, as well as economic activities [3]. The concept of urban agriculture can be integrated with a waste management system with the principle of 3R (Reduce, Reuse & Recycle), so that an environmentally friendly urban farming system can be formed. Therefore, the application of urban agricultural systems in addition to being a means of greening the environment also contributes to the reduction of waste (Reduce), through the utilization of kitchen waste into compost and liquid organic fertilizer (Recycle). The use of inorganic waste such as refillable cooking oil wraps, plastic bottles, paint cans, or used pipes into pots/containers of plants is the application of Reuse, as well as being a farming solution in a narrow land. Planting materials can also be taken from the rest of the vegetables that can be grown (Regrow) such as chili seeds, leek root pieces, celery leaf root pieces, and spices such as ginger and turmeric. Urban agriculture is one of the effective ways to preserve the environment while supporting people's food security.

The use of household waste as a means of urban agricultural activities must be supported by the skills and high spirit of the community, especially housewives as consumers of vegetables for daily cooking needs. Therefore, the community service team from KH University. A. Wahab Hasbullah held a training on the utilization of household waste as a means of urban agricultural activities for residents of Bahrul Ulum Menara Asri Jombang Housing. The objectives of this community service activity include: (1) improving the knowledge and skills of citizens in processing kitchen waste into compost and liquid organic fertilizer; (2) improving the knowledge and skills of citizens in processing inorganic waste in the form of used bottles/containers as plant containers; and (3) foster the spirit of citizens to live clean and healthy.

2. Method

This community service activity is located in Bahrul Ulum Menara Asri Jombang Housing, with partners namely residents of Bahrul Ulum Menara Asri Jombang, RW 09 Sambongdukuh Village, Jombang. The implementation of the service activities began on July 24-26, 2020. Forms of community service activities in the form of demonstrations and training on the utilization of household waste into compost, liquid organic fertilizer, and planting containers. The implementation of this devotional activity brought a speaker, namely one of the lecturers at the University of KH. A. Wahab Hasbullah. The implementation of this activity was also assisted by two lecturers and three students to coordinate participants (citizens) in the training activities. The method used in this activity is training. This training activity is an effort to improve the knowledge and skills of citizens in recycling kitchen waste into a source of nutrients needed by plants (fertilizer), as well as providing direct experience to residents in reusing organic waste such as used plastic bottles/containers and used pipes development into pots/plant containers. Tools, materials, and how household waste utilization works are as follows:

2.1. Household-scale compost making by *takakura* method

The main characteristic of the *takakura* composting method is to maximize the natural degradation process, from organic waste to fine compost [4]. This method is carried out using a perforated basket which is then coated with cardboard. Tools and materials used include perforated wastebaskets, husk pillows, porous black cloth, cardboard, and finished compost as compost. How to make compost with the *takakura* method, among others:

- Prepare a perforated basket, then coated with cardboard. The selection of perforated baskets aims to make the aerobic process run well. The functions of cardboard are: limiting insect disturbances, regulating moisture, and porous so that it can absorb and dispose of air and water.
- Put the chaff pillow under and on top of the basket. The function of a husk pillow is as a place of microbeads that will accelerate the decay of organic waste, absorb water and the smell of garbage, and facilitate the control of waste moisture that will become compost due to the dry nature of husks.

- On the husk pillow, the basket is filled with compost media so up to 1/3 part, then on it is given a new compost material in the form of household organic waste until the basket is almost full. Compost in the basket serves as an activator/yeast for new waste.
- Cover the compost layer with the husk pillow again, then cover again with a porous black cloth. The cloth cover is placed on the husk cushion so that the fly can not lay eggs in the basket, as well as preventing the metamorphosis (change) from maggots to flies, since flies can not get out and die in the basket.
- Cover the upper basket as ballast so as not to be disturbed by predators (cats/dogs). Select the perforated lid so that air can come in and out.

2.2. Making liquid organic fertilizer using kitchen waste

Liquid organic fertilizer is a fertilizer that is made naturally through the fermentation process, resulting in a solution due to the decay of plant waste, as well as animal or human excrement [5]. The selection of liquid organic fertilizer (POC) as an alternative in the effort to fertilize plants on narrow land is because the nutrients contained in liquid fertilizer have been decomposed so that it is easily absorbed by plants [6]. POC raw materials can be a variety of organic materials tailored to local conditions. One example of POC that can be made from ingredients that are easy to find is POC from stale rice. Tools and materials used, among others plastic containers, plastic bottles/buckets, stale rice, and granulated sugar. Here's how to make POC from stale rice:

- Put stale rice first in a place that is not exposed to direct sunlight and let it stand for about two days until overgrown with orange mushrooms.
- Then, put 5 tbsp granulated sugar and 1 liter of water in a container or bucket and stir until completely dissolved.
- After that, put the moldy rice in a container and stir until well mixed.
- Next, close the container tightly and let it stand for a few days until it smells like the smell of tape.
- Filter POC so that it is separate from the pulp, POC is ready to use.

2.3. Making planting containers from inorganic waste

Planting containers simply means a place to plant, where plants and planting media are placed [7]. The use of planting containers is generally adjusted to the type of plants, planting media, and planting techniques. Verticulture planting techniques become the main choice in urban agriculture in narrow land, so that the planting containers used are also adapted to the needs of verticulture [8]. How to plant on a verticulture system can use a multilevel shelf, hang, or arrange containers in such a way that plants are arranged vertically [9]. The verticulture cultivation system is suitable to be applied to limited land, especially in densely populated urban areas. Materials used in verticulture techniques can come from used bottles as well as used pipes, which are arranged vertically. The steps of making verticulture containers made of used pipes are as follows:

- Make planting hole marks with markers/pencils on pipes with holes 7 cm in diameter and the distance between holes 10-15 cm.
- Cutting the planting hole marks using a hacksaw.
- Burn planting holes that have been sawed before with a flame torch gun or other heaters.
- Form a planting hole, on the previously heated part, with a glass bottle, then wiped using gauze that has been moistened.
- Put verticulture pots on prepared containers.

Planting containers in urban agricultural systems, in addition to using a verticulture method, can also use a simple pot/polybag method by utilizing used bottles, cooking oil plastic, or used cans. Used goods that will be used as planting containers are perforated at the bottom first. The purpose of making holes is as drainage channel pots so that the added water does not flood the planting media and interferes with the aeration of the root area of plants.

3. Results and Discussion

Community service activities in the form of demonstrations and training on the utilization of household waste as a means of urban agricultural activities and waste processing in Housing Bahrul Ulum Menara Asri Jombang were attended by about 28 participants. Most of them were housewives. This activity took place in the courtyard of As-Salam Mosque, Bahrul Ulum Menara Asri Jombang Housing complex, from July 24 to 26, 2020. This devotion program is one of the efforts to minimize the amount of waste in the neighborhood of Bahrul Ulum Menara Asri Jombang Housing, to realize a clean and healthy residential area. The devotional activity began with a demonstration and training on making household-scale compost with the *takakura* method on the first day. The main purpose of this activity is to introduce compost as a planting medium, as well as introduce how to make compost by utilizing kitchen waste. The expected exterior of this activity is that residents can recycle kitchen waste into compost so that it will reduce the volume of kitchen waste that will be disposed of in a landfill. In addition, residents can use compost as a mixture of planting media in urban farming systems. The selection of *takakura* as a composting method is due to the raw materials that are easily found by residents (Figure 1).



Fig. 1. (a) *Takakura* Compost Tools and Materials; (b) The process of making *takakura* compost from kitchen waste.

Further training is focused on the use of kitchen waste as raw materials for liquid organic fertilizer. This activity aims to provide experience to residents in making fertilizer independently with kitchen waste raw materials. In this training, residents are invited to use stale rice as a raw material of liquid organic fertilizer, as well as sugar as a substrate for the development of microorganisms (Figure 2). Stale rice is placed in an open house and left for 2-3 days so that an orange mushroom will appear. Furthermore, stale rice that has been moldy is put in a container/plastic bottle and then given sugar as a substrate. The container containing the mixture of ingredients was given water and then stirred well. The fertilizer solution was closed tightly and silenced for 4-7 days to ferment. During fermentation time, checking is done by opening the container to remove the gas accumulated during the fermentation process, so that there is no explosion. Liquid organic fertilizer solution is ready to be used when it has a fermentation scent such as tape. Liquid organic fertilizer produced by citizens can be used as a source of plant nutrition in their urban agriculture. The use of liquid organic fertilizer made from stale rice with a concentration of 10% can increase the yield of mustard [10]. In addition, liquefied organic fertilizer of stale rice can also be used as an activator in the manufacture of compost. The results showed that the addition of *lindi* and stale rice solution as activators can accelerate composting and improve compost quality, compared to control without the addition of activators [11].

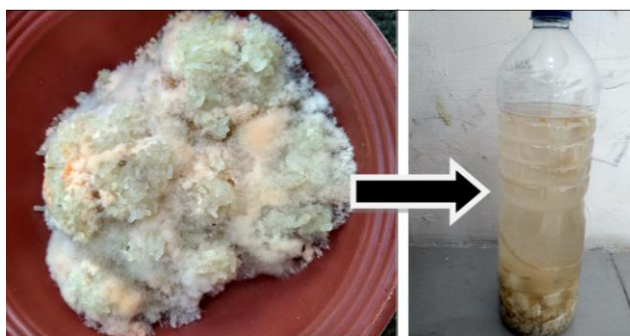


Fig. 2. Making POC from stale rice

The last series in the training of household waste utilization is to make planting containers. Planting containers serve as a place to grow crops cultivated in urban agricultural systems. In this devotional activity, residents are invited to make use of inorganic waste in the form of bottles and pipes used in plant pots. To maximize the use of narrow land in residential areas, residents were introduced to the use of verticulture pots made from used pipes. The remaining pipes of household construction/renovation are given planting holes that will be where plants grow and develop. The use of a verticulture system is expected to increase the production of crops of citizens because in one pot verticulture can be cultivated 10 - 28 plants, depending on the type of plant and the distance of planting holes (Figure 3).



Fig. 3. Training on making planting containers. (a) Training on making verticulture pots from PVC pipes; (b) Trainees make hanging planting containers from used plastic bottles

In addition to using a verticulture pot system, residents are also invited to make plant pots from plastic waste such as bottles and cooking oil wraps. This technique is very easy to adopt because residents only need to make drainage holes at the bottom of the pot, although the number of plants that can be cultivated is limited. The development of planting containers based on the utilization of household inorganic waste is one of the efforts to provide planting facilities in densely populated residential areas. This is done to support environmental greening in urban areas. The whole series of community service activities is an effort to improve the skills of residents in Bahrul Ulum Menara Asri Housing in utilizing household waste as a means of urban agriculture. Processing waste as compost, liquid organic fertilizer, as well as pot and verticulture planting containers is very easy to do by the community independently, does not require a large cost, but strongly supports efforts to maintain environmental cleanliness. The participants responded positively to this activity (Figure 4).

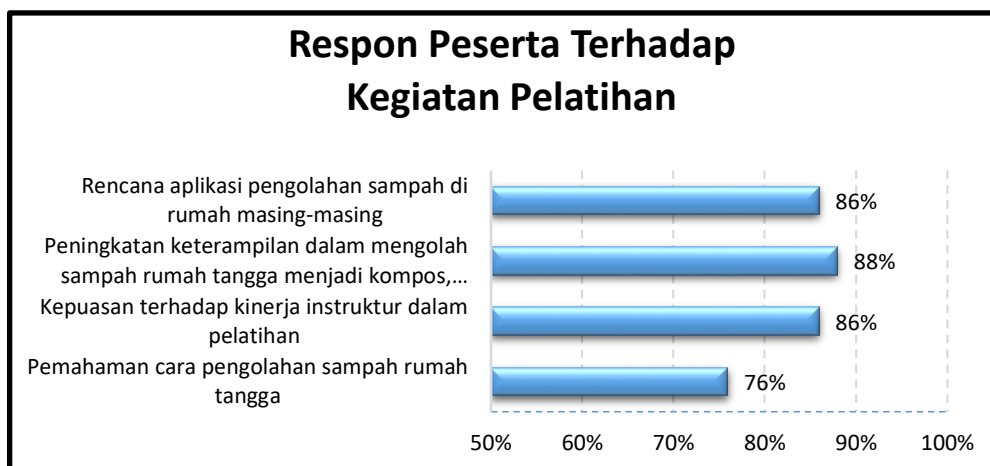


Fig. 4. Graph of the response of participants of the training on the utilization of household waste as a means of urban agriculture.

Based on the results of the processing of questionnaire data about the response of the trainees, as many as 76% of participants understood how to make compost with the *takakura* method, how to make liquid organic fertilizer, and how to make verticulture planting containers and plant pots. Reviewed in terms of training instructors, 86% of participants stated that the instructor's performance has been very good in providing learning and training. Residents also responded positively to this activity. A total of 88% of residents claimed that this training is useful in improving their skills in processing household waste as compost, liquid organic fertilizer, as well as pot and verticulture planting containers. As many as 86% of participants plan to practice waste processing in their own homes. The impact of this activity is the increasing enthusiasm and awareness of citizens in maintaining the health of their neighborhood. There is awareness-raising of active participation, indirectly fostering the habit of the community to want to manage household waste, starting from their residence [12].

4. Conclusion

Training on the utilization of household waste, as an effort to develop an environmentally friendly urban agricultural system, for residents of Bahrul Ulum Menara Asri Housing is well carried out. Participants have additional knowledge and skills. This can be seen from the good response of participants, namely 76% of participants understand how to process waste into urban agricultural facilities, namely compost, liquid organic fertilizer, and pots/planting containers; 86% of participants stated that the instructor's performance has been very good in providing learning and training; 88% of residents claimed that this training is useful in improving their skills in processing household waste into compost, liquid organic fertilizer, as well as pot and verticulture planting containers, and as many as 86% of participants plan to practice waste processing in their own homes. Ongoing mentoring is needed to increase the benefits of the training.

Acknowledgment

Praise be to Allah SWT who always gives grace and guidance to us so that community service activities are completed on time. Thank you, researchers conveyed to the Ministry of Research and Technology, The National Research and Innovation Agency of the Republic of Indonesia, the Institute of Research and Community Service of Universitas K.H.A. Wahab Hasbullah, as well as residents of RW 09 Perumahan Bahrul Ulum Menara Asri, have supported this community service activity. Thank you also to the family of the research team who always supports morally, as well as to all parties who help and support the implementation of this activity.

References

- [1] Badan Pusat Statistik Kabupaten Jombang, "Jumlah Penduduk Menurut Kecamatan dan Jenis Kelamin di Kabupaten Jombang," 2019. [Online]. Available at: jombangkab.bps.go.id.
- [2] J. Yang, Y. Wang, C. Xiu, X. Xiao, J. Xia, and C. Jin, "Optimizing local climate zones to mitigate urban heat island effect in human settlements," *J. Clean. Prod.*, vol. 275, p. 123767, 2020. doi: [10.1016/j.jclepro.2020.123767](https://doi.org/10.1016/j.jclepro.2020.123767)
- [3] S. L. G. Skar *et al.*, "Urban agriculture as a keystone contribution towards securing sustainable and healthy development for cities in the future," *Blue-Green Syst.*, vol. 2, no. 1, pp. 1–27, 2020. doi: [10.2166/bgs.2019.931](https://doi.org/10.2166/bgs.2019.931)
- [4] F. A. Nuzir, S. Hayashi, and K. Takakura, "Takakura composting method (TCM) as an appropriate environmental technology for urban waste management," *Int. J. Build. Urban, Inter. Landsc. Technol.*, vol. 13, pp. 67–82, 2019. Available at: [Google Scholar](#).
- [5] T. Phibunwatthanawong and N. Riddech, "Liquid organic fertilizer production for growing vegetables under hydroponic condition," *Int. J. Recycl. Org. Waste Agric.*, vol. 8, no. 4, pp. 369–380, 2019. doi: [10.1007/s40093-019-0257-7](https://doi.org/10.1007/s40093-019-0257-7)
- [6] M. Y. Alfarisy, A. Yassi, and K. Mustari, "Increasing Productivity and Biomass of Corn Plants Toward Grant Organic Fertilizer and Liquid Organic Fertilizer," *ENDLESS Int. J. Futur. Stud.*, vol. 4, no. 2, pp. 236–248, 2021. doi: [10.4712/ endless%20journal.v4i2.81](https://doi.org/10.4712/ endless%20journal.v4i2.81)
- [7] G. Wu, E. Sun, H. Huang, Z. Chang, and Y. Xu, "Preparation and properties of biodegradable planting containers made with straw and starch adhesive," *BioResources*, vol. 8, no. 4, pp. 5358–5368, 2013. doi: [10.15376/biores.8.4.5358-5368](https://doi.org/10.15376/biores.8.4.5358-5368)
- [8] S. Sitawati, A. Suryanto, and E. E. Nurlaelih, "Optimization of plant growth and yield through innovation of the verticultural materials and media," *Res. J. Life Sci.*, vol. 3, no. 1, pp. 55–64, 2016. doi: [10.21776/ub.rjls.2016.003.01.8](https://doi.org/10.21776/ub.rjls.2016.003.01.8)
- [9] D. R. D. Hastuti, R. Darma, D. Salman, S. Santosa, T. Martosenjoyo, and N. E. Dunga, "Gender preference on the quality of landscape aesthetic of urban agriculture," *J. Socioecon. Dev.*, vol. 4, no. 1, pp. 57–68, 2021. doi: [10.31328/jsed.v4i1.2164](https://doi.org/10.31328/jsed.v4i1.2164)
- [10] I. Mursalim, M. K. Mustami, and A. Ali, "Pengaruh penggunaan pupuk organik mikroorganisme lokal media nasi, batang pisang, dan ikan tongkol terhadap pertumbuhan tanaman sawi (brassica juncea)," *J. Biotek*, vol. 6, no. 1, p. 32, Jun. 2018, doi: [10.24252/jb.v6i1.5127](https://doi.org/10.24252/jb.v6i1.5127)
- [11] M. Nawir, M. S. Solle, and K. Mustari, "Utilization of Household Organic Waster (Leachate Water) as a Source of Liquid Organic Fertilizer with the Addition of Bio activators (Case Study: Congko Village, Marioriwawo District, Soppeng Regency).," *Adv. Environ. Biol.*, vol. 14, no. 2, pp. 18–25, 2020. Available at: [Google Scholar](#).
- [12] A. Ghazali, J. H. Tjakraatmadja, and E. Y. D. Pratiwi, "Resident-based learning model for sustainable resident participation in municipal solid waste management program," *Glob. J. Environ. Sci. Manag.*, vol. 7, no. 4, pp. 599–624, 2021. doi: [10.22034/GJESM.2021.04.08](https://doi.org/10.22034/GJESM.2021.04.08).