



Utilization of Tofu Industrial Liquid Waste as Organic Fertilizer to Support the Alley Garden Project Development

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Abstract

Tofu is a food that people are fond of and is recognized as healthy, nutritious and cheap cuisine. The tofu industry has been growing rapidly in Indonesia in the form of household scale businesses or MSME (Micro, Small and Medium Enterprises). On the other hand, tofu industry also has a negative impact to the environment due to its waste. The waste of tofu industry has high level of BOD and COD so that it becomes organic pollutant for groundwater and creates an unpleasant odor. Tofu components that potentially become liquid waste are the organic compounds such as protein (40-60)%, carbohydrates (25-50)%, and 10% fat. The largest component of tofu liquid waste is protein, which is 226.06 mg/L to 434.78 mg/L. This nutrient content allows tofu liquid waste to be processed into liquid organic fertilizer through a simple fermentation process. In this community service project, short training on processing tofu industrial liquid waste into liquid organic fertilizer has been conducted in Sumurrejo are, Semarang. To utilize this organic fertilizer for plant growing, an alley garden was also established in the village.

Keywords: Tofu liquid waste, organic fertilizer, community service, alley garden, fermentation

INTRODUCTION

The community service activity in this study involved the entrepreneur community of tofu industry in Semarang. Tofu is a food that people are fond of and is recognized as healthy, nutritious and cheap cuisine. In line with these conditions, tofu industry has been growing rapidly in Indonesia in the form of household scale businesses or MSME (Micro, Small and Medium Enterprises). In Semarang, small tofu industry centers are found in various areas such as Bandungan, Jomblang, Ambarawa, Sumurrejo, and so on. The development of

tofu industry provides positive impact such as the development of production centers in food sector and meeting people's needs for food products. On the other hand, the existence of the tofu industry also has a negative impact due to the waste resulted that causes environmental pollution problems. The tofu industrial waste in Semarang is produced from several process stages which has an average value of Biological Oxygen Demand (BOD), total Chemical Oxygen Demand (COD), and Total Suspended Solid (TSS) of 3,500 mg/L, 7,300 mg/L, 5,600 mg/L, and 500 mg/L respectively (Romli, 2009).

These high levels of BOD and COD indicate that tofu industrial liquid waste can become the organic pollutants for groundwater (Patty, 2018). Mostly, the liquid waste produced by the tofu industry is a thick liquid that is separated from the clumps which is called "whey".

Tofu industrial liquid waste contains suspended or dissolved solids which undergoes physical, chemical and biological changes and will produce toxic substances or create a medium for germs growth. The waste will turn into blackish brown color and stink. This stinky smell will cause respiratory problems. If this waste is discharged into the river, it will bring about pollution and will cause itching, diarrhea, and nausea when the river water is utilized (Muhajir, 2013).

On the other hand, tofu liquid waste has nutrients that can be utilized. However, so far, people have not recognized the economic potential of tofu industrial liquid waste as raw material for environmentally friendly liquid organic fertilizer. They are also not familiar with the method on how to process tofu industrial liquid waste into liquid organic fertilizer, and do not have knowledge about how to apply liquid organic fertilizer to plants. As a result, the waste is simply thrown into the places and disturbs environmental health, soil and water quality, and becomes the source of unpleasant odors.

Therefore, to overcome the problem of high volume of tofu industrial liquid waste, it is necessary to carry out community service activity that aims to increase added value for tofu industrial liquid waste by processing it into liquid organic fertilizer and apply the fertilizer for fertilizing plant in Alley Garden. A training on how to process tofu industrial liquid waste into environmentally friendly liquid organic fertilizer is very beneficial for people in Indonesia, especially people in the tofu industrial center area such as in Sumur Jurang sub-village, Sumurrejo village, Gunungpati District, Semarang.

With a proper management, a large production of tofu liquid waste can be converted into large liquid fertilizer. However, the next problems are the marketing, its utilization and the development of its sale value (Association of Indonesian Fertilizer Producers/*Asosiasi Produsen Pupuk Indonesia*, 2018). Therefore, the concept of small scale alley garden is interesting to develop. The development of alley garden can adopt a similar concept with the one developed in Makassar (Anggun et al.,

2018). The concept starts with the arrangement of plants in small pots along the yard of each house located in alleys.

Based on the current situation, the potential raw materials to make liquid organic fertilizer in Semarang is the liquid waste of the tofu industry. Therefore, a community service was conducted in Tofu MSME in Sumurrejo, Semarang which aimed at training the skill to process tofu industrial liquid waste into liquid organic fertilizer, as well as to apply the liquid organic fertilizer in the alley garden. In addition to having a positive impact on environmental cleanliness, this activity was also useful for empowering people to become economically independent and have an entrepreneurial spirit by having innovative skills in making environmentally friendly liquid organic fertilizer from tofu industrial liquid waste. It also supported the realization of green environment through the development of alley garden in Semarang.

The Partners involved in these activities was the entrepreneurial community of small tofu industrial centers in Sumurrejo, Gunungpati, Semarang. In addition, the volume of tofu industrial liquid waste in this MSME area was identified and it was found that the liquid waste was resulted in huge amount and cause problems to the environment. However, there was a lack of knowledge about the negative impact of tofu industrial liquid waste, the economic potential of this waste as a raw material for fertilizer organic liquid, and the prospective implementation of liquid organic fertilizers in alley garden. Furthermore, the community did not have the skill in processing tofu industrial liquid waste into liquid organic fertilizer. They did not know how to implement liquid organic fertilizer in alley garden due to the limited knowledge and skill. Besides, they did not have entrepreneurial insight about liquid organic fertilizer production. These problems caused the inadequate use of the large volume of tofu industrial liquid waste in Semarang. The improper management of liquid waste has negatively impacted the environmental health, soil quality and groundwater, and caused a strong bad odor. According to this situation, there was a need to apply an innovative through community service for the people in tofu industrial area in Semarang which prioritize on:

1. Providing knowledge regarding the economic potential of tofu industrial liquid waste

2. Skill training for the community on how to process tofu industrial liquid waste into liquid organic fertilizer

3. Providing skills regarding the application of liquid organic fertilizers to plants in the alley garden

In general, Semarang people were cooperative and willing to learn new useful things and participate in trainings that empower the community's economy. Based on this background, the mutually agreed priority problems to be resolved through this community service activity laid in the aspect of organic fertilizer production from tofu liquid waste and its application on alley garden.

METHOD

The solutions for the partners' problems (tofu industry entrepreneurs) were carried out through training and mentoring activities. The trainings and assistances to partners was prioritized to: 1) provide information on the composition and economic potential of tofu industrial liquid waste by converting it into liquid organic fertilizer; 2) introduce the implementation of science and technology and technical skills training for the processing of tofu industrial liquid waste-based liquid organic fertilizer; 3) skills training and mentoring for the application of liquid organic fertilizer in alley garden.

RESULTS AND DISCUSSION

The community service activities on the use of tofu industrial liquid waste as raw material of liquid organic fertilizer was carried out at tofu MSMEs in Sumurrejo Village, Gunungpati District, Semarang. Sumurrejo area is one of the tofu MSMEs centers in Semarang which has 7 tofus MSMEs, such Pak Muhzidin Tofu MSME, Pak Yahman Tofu MSME, etc.

The activity began by surveying the condition and volume of tofu waste in the MSMEs, and was followed by coordinating with tofu entrepreneurs and local area (RT/RW) managers, conducting practices of making organic fertilizer product using tofu liquid waste in the laboratory, providing presentations and materials on producing organic fertilizers from tofu waste, designing and building alley garden, applying fertilizers to alley garden, and monitoring the activities.

The survey on the condition and volume of tofu liquid waste was carried out especially in the RT 003/RW 001 and RT 006/RW 001 of Sumurrejo Village on June 26, 2019. There were tofu MSMEs belonged to Mr. Yahman and Mr. Muhammad Nur. The MSMEs were nearby to the cattle breeding center, rice fields and rivers. They produced a large volume of liquid waste per day which was fully discharged into the river. This polluted the river and decreased the quality of the river water which disturbed the biota and ecosystem in the river due to the high level of COD and BOD in tofu liquid waste. In RT 003 area, all tofu liquid waste was not used and was only discharged into the river behind the the MSME buildings (Figure 1).



Figure 1. The condition of Mr. Yahman's MSME

As for RT 006 area, there were 3 tofu MSMEs, one among them belonged to Mr. Muhzidin. The waste in RT 006 area had become a prioritization by the Semarang City Environment Agency (Dinas Lingkungan Hidup) through the development of a biogas installation. With this biogas installation, the odor generated by the tofu liquid waste was expected to be reduced. However, the installation was not functioning optimally at the moment due to a leak and the low heat generated so that it cannot be used as an energy source in the furnace used in the tofu making process. As a result, some tofu liquid waste was still disposed into the environment and became polluter (Figure 2). This was a common phenomenon occurred in the traditional tofu industries (Rahmadi and Handajani, 2014). Therefore, an easy way to manage the tofu liquid waste in RT 006 was necessary, which was by processing it into liquid fertilizer.



Figure 2. The Condition of Tofu Liquid Waste in Tofu MSME in RT 006, Sumurrejo

To ensure the community service activities run well, coordination was carried out with tofu entrepreneurs on August 7, 2019. A coordination meeting was conducted between the Community Service Team and one tofu MSME owner in the RT 006 area, namely Mr. Muhzidin (Figure 3). The coordination was about the plan for trainings on the skill of making organic fertilizers by the utilization of tofu waste produced by the MSME and making alley garden. Both the team and the MSME owner agreed that the activities would be carried out on August 14, 2019 at Mr. Muhzidin's residence and invited other MSME owners in Sumurrejo area. The alley garden location was planned to be built either in Mr. Muhzidin's yard or in a vacant lot next to the RT 006 MSME.



Figure 3. Coordination activity with Tofu entrepreneurs

Tofu waste was processed into liquid fertilizers through a fermentation process

with the help of EM4 for plants. Fermentation was applicable on tofu liquid waste because it contained good nutrients (protein, carbohydrate fat) that served as the medium for the growth of soil fertility microbes. To increase the nutrients that support the fermentation process, coconut water was added. These materials of liquid organic fertilizer were tofu liquid waste, coconut water, refined lemongrass, and crushed curcuma (Figure 4). All the ingredients were mixed with EM4 and dissolved in 70% alcohol solvent (Figure 5). Apart from being a solvent, alcohol also functioned as antiseptic. The mixture was then fermented anaerobically for 10 days and was ready to be used as an organic fertilizer. The product was then analyzed to determine the level of organic N, P, C and the C/N ratio, which were the quality standards for fertilizer.

Aside from being a fertilizer, the fermented tofu liquid waste combined with lemongrass and curcuma functioned as a biopesticides. Biopesticides are organic compounds and antagonistic microbes that inhibit or kill plant pests and diseases (Schuman and Gleora, 2012). Natural compounds in biopesticides that could kill insects, weeds, or plant pests, among others are flavonoids, citronellals and saponins which are found in many essential oils. The natural ingredients containing a lot of flavonoids, citronellal, or saponins that are sources of essential oils which belongs to spices group such as ginger and lemongrass (Rukmana, 2004).

The training activity was carried out on August 14, 2019 at Mr. Muhzidin's house. It was attended by several tofu UMKM entrepreneurs and their employees (Figure 6). This activity was intended to provide them with the knowledge on the economic potential of tofu industrial liquid waste and the skill on how to turn tofu liquid waste into economically valuable products which were fertilizers. There were 15 participants attended the activity. The training included a discussion about the problem of liquid waste in tofu MSMEs, presentations and video screenings on how to make fertilizers from tofu waste, and simple practices (Figure 7). Participants were very enthusiastic during the training and stated that they would practice on making fertilizer and applying it to plants. In addition, MSME entrepreneurs also planned to share the acquired knowledge and skills to the local youth groups so that the activities can be developed into youth entrepreneurial activities which would provide positive impacts for the

local economy.



Figure 5. The Process of Making the Organic Fertilizer from Tofu Liquid Waste

The next stage of this activity was the construction of alley garden in the yard of one of the MSME owners's house (Pak Muhzidin) and the application of organic fertilizers to the plants. The types of crops to be planted in the alley garden were vegetables so that it could also fulfill the vegetables need of the families and increase the economical aspect of the family by selling them. A coordination meeting about the design of alley garden and land measurement was conducted on August 17, 2019 (Figure 8). The preparation of land, plants and the building process of the making of alley garden were carried out on August 21, 2019. The handover and inauguration of the alley garden were held on the first week of September 9, 2019 (Figure 9).

CONCLUSION

Based on the results, it can be concluded that the knowledge of tofu MSME entrepreneurs about the negative environmental impact of tofu liquid waste as well as the economic potential of it had increased. Moreover, the community were then skilled in making organic fertilizers and from tofu liquid waste. The community also obtained economic benefits from the alley garden built through the harvested vegetables and they were also able to directly apply the organic fertilizer from tofu liquid waste to improve the plants growing in the alley garden.

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REFERENCES

- Anggun, P., Salim, M., and Rasyid, R. 2018. Partisipasi Masyarakat dalam Program Lorong Garden (Longgar) di Kota Makassar. *Wiratani*, Vol 1 (1), 139-148.
- Asosiasi Produsen Pupuk Indonesia. 2018. *Supply and Demand 2007-2018*.
- Muhajir, M.S. 2013. Penurunan Limbah Cair BOD dan COD pada Industri Tahu Menggunakan Tanaman *Cattail (Typha Angustifolia)* dengan Sistem *Constructed Wetland*. Skripsi ditujukan pada Jurusan Kimia, FMIPA, Universitas Negeri Semarang, Semarang.
- Patty, I. S. 2018. Oksigen Terlarut dan Apparent Oxygen Utilization di Perairan Selat Lembeh, Sulawesi Utara. *Jurnal Ilmiah Platax*, Vol. 6 (1), 54-60.
- Rahmani, F. and Handajani, M. 2014. Efisiensi Penyisihan Organik Limbah Cair Industri Tahu dengan Aliran Horizontal Subsurface pada *Constructed Wetland* Menggunakan *Typha angustifolia*. *Jurnal Teknik Lingkungan*, Vol. 20 (1), 78-87.
- Romli. 2009. Beban Pencemaran Limbah Cair Industri Tahu. *Jurnal* Vol. 10, No.2. Bogor: Fakultas Teknologi Pertanian IPB.
- Rukmana, R. 2004. *Temu-Temuan*. Jakarta: Kanisius.
- Schumann, G.L. and Gleora J.D. Arcy. 2012. *Hungry Planet, Stories of Plant*. The American Phytopathological Society, St. Paul Minnesota, USA.