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Usability Assessment of Kitchen Waste for Organic Liquid Fertilizer from Bangladesh

Jakiya Hossain Moon[1,2], Pijush Kanti Jhan[1†*], Md. Atiqur Rahman Bhuiyan[1†], Mehede Hassan Rubel[1] and Md. Mahfuzur Rahman[3]

[1]Department of Agriculture, Noakhali Science and Technology University, Noakhali-3814, Bangladesh; [2]Department of Biochemistry and Molecular Biology, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh; [3]Department of Agronomy, Patuakhali Science and Technology University, Patuakhali-8602, Bangladesh.

† The authors contributed equally.

***Corresponding author:** Pijush Kanti Jhan; E-mail: pijush.ag@nstu.edu.bd

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ABSTRACT

Improper disposal of kitchen waste produces unwanted microorganisms and breeds mosquitoes and flies, making the environment unhealthy. As organic matter, kitchen waste can serve as biofertilizer. This experiment was carried out to assess the feasibility of making liquid fertilizer from kitchen waste. The work aimed to manage kitchen waste to minimize its pollution and promote organic farming by converting it into liquid fertilizer to contribute to sustainable agriculture. The Randomized Complete Block Design (RCBD) was followed for this research. Kitchen wastes like vegetable peels, fruit peels, eggshells, fish and meat bones, used tea leaves, food waste, etc., were collected and fermented to get the liquid extracts. Essential plant nutrient analysis showed that it contained significant amounts of N (25000ppm), P (12.7 ppm), K (2.7ppm), S (0.05ppm), Mg (30.24ppm), Zn (5.8ppm), Cu (0.7ppm), Mn (0.7ppm), Fe (25ppm), and B (0.5ppm) encouraging the use of such liquid extract as liquid fertilizer. Making liquid fertilizer will encourage organic farming, minimize the hazard created by the wrong disposal of kitchen waste, achieve sustainable agriculture by lessening the use of synthetic fertilizer, and provide economical elements in farm technology.

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Introduction

Kitchen waste comprises leftovers from cooking, vegetables, fruit peeling, fish scales, tea liquor, eggshells, etc. Where proper management options are not present, these substances create nasty odor, polluting the environment and causing many health issues (Paritosh et al., 2017). This kind of garbage produces mosquitoes, breeds various microorganisms, attracts flies, and creates an unhealthy environment (Sarwar, 2015). Kitchen waste is also responsible for the contamination of groundwater (Igboama et al., 2022). With global economic development and population growth, hotels, restaurants, families, canteens, and businesses in particular are producing more and more food waste. In both developed and developing countries, kitchen waste is a problem (Zhang et al., 2014). Around 25,000 tons of solid waste are produced daily in Bangladesh's urban regions, and by 2025, this is expected to rise to 47,000 tons daily (Ahmed, 2019). Local municipalities have struggled to deal with these massive amounts of solid waste. Data on waste collection effectiveness in different urban areas lies between 37 and 77%, with an average of 55% (Ahmed, 2019). The existing waste disposal without sorting and throwing it in open areas, and into drains causes an unhealthy environment, leading to human infections, environmental pollution, and waterlogging (Islam, 2016; Islam, 2018; Parvin and Begum, 2018; Masud et al., 2023). In 2020, Statistics show that Sub-Saharan Africa and Western Asian countries produce the highest amount of household food waste annually. Western Asian countries produce an average of 110 kilograms of food waste per person each year. So, managing kitchen waste should be a matter of concern (Rushton and L., 2003). In recent years, climate change, sustainability, and the reduction of kitchen waste have been some of the most challenging topics for academics, scientists, politicians, and society worldwide (Wang et al., 2019; Kapsdorferová et al., 2021). Currently, there are many technologies like anaerobic digestion, composting, incineration, and landfilling to convert kitchen waste into useful matter (Shekdar, 2008; Prepilková et al., 2023). Composting kitchen waste is a very easy and quick process (Maindargikar et al., 2022). Different forms of fertilizers are produced, such as soil conditioners, composts, soluble bio-waste composts, degraded crops, and mineral and liquid organic fertilizers (Du et al., 2018). Agricultural uses include the production of animal feed and organic fertilizer by composting (Wang et al., 2019; Yong et al., 2021). Composting is an aerobic bio-degradation process carried out under controlled conditions to transform organic waste, resulting in a stable and sanitized organic treatment, commonly known as compost (Aguilar-Paredes et al., 2023). Kitchen waste as organic fertilizers is nutritious and most of them are great sources of organic carbon. These are not only a carbon source but also an excellent nutrient source. This huge nutrient source is inexpensive or otherwise unused organic waste can be utilized for recycling as valuable resources (Chatterjee et al., 2017). Therefore, composting promotes nutrient cycling; composting is an efficient and economical way of treating waste before land application; the output is a healthy humus-like material; elimination of air emissions and reduced demands on land in a closed system (García et al., 1993; Kulcu, 2004; Halloran et al., 2014; Dronia et al., 2024).

In our experiment, we prepared liquid fertilizer from kitchen waste and validated the nutrient status. As we know, Liquid organic fertilizers are more advantageous to plant growth than other fertilizers since they are administered directly to the single root zone in the irrigation system. Besides that, they are quickly absorbed by plants and require less per plot, and the degradation process is relatively straightforward (More et al., 2016). The nutrient status of liquid fertilizer varies on the types of kitchen waste used (Tampio et al., 2016) and it was studied in many countries before (Khadidja and Aman, 2022). The types of kitchen waste are related to food habits and it varies from country to country. In the case of Bangladesh or the Indian sub-continent, there is no research found where the nutrient status was studied from liquid fertilizer prepared from kitchen waste. The result will indicate the eligibility of Bangladeshi kitchen wastes for liquid fertilizer. Gaining the goal of sustainable agriculture through eco-friendly and budget-friendly elements, liquid organic fertilizer from kitchen waste can be one of the best options. This eco-friendly and cost-effective liquid fertilizer from kitchen waste will be a good source of organic fertilizer providing nitrogen, phosphorus, potassium, and lots of micro, macro, and trace elements as more use of agrochemical or inorganic fertilizer pollute soil, hamper the health of soil microorganisms, reduce soil fertility, effects soils physical, chemical and biological properties and eventually reduces crop production. Liquid organic fertilizer contributes to soil's physical and biological properties. It improves soil structure, texture, and cation exchange capacity as well as keeps soil temperature optimum. Continuous application of liquid organic fertilizer will improve the soil organic matter and high levels of nutrients in the soil.

Materials and Methods

Kitchen waste

Various kitchen waste such as vegetable peels, fruit peels, eggshells, fish and meat bones, used tea leaves, food waste, etc., has been collected from different kitchens. After collection, all waste products were mixed perfectly to use in liquid fertilizer production.

Liquid fertilizer extraction

Five plastic buckets, each with a capacity of 25 liters, were used for the composting process. Approximately five kilograms of mixed organic waste were added to each bucket at regular intervals. The buckets were placed in a shaded area, where the daily average temperature ranged between 24°C and 32°C. To facilitate the composting process, 2.5 liters of water were added to each bucket. The mixture was allowed to decompose over a period of five weeks. At the end of this period, the liquid accumulated at the bottom of each bucket was collected by filtration and subsequently stored in a refrigerator for further analysis.

Data collection

During the preparation of the fertilizer, the mixture was stirred regularly using a wooden stick to ensure homogeneity. The fermentation process took place in a shaded area beneath a banyan tree located near the university dormitory, where the average relative humidity ranged between 78–80%. To promote effective fermentation, the buckets containing the mixture were often covered with lids. Visible signs of fermentation began to appear after approximately one week, marked by a gradual change in the liquid’s color from pale brown to dark brown.

Initial physical characteristics of the fertilizer were recorded at the Laboratory of Agriculture, Noakhali Science and Technology University, Noakhali, Bangladesh. Subsequently, samples were sent to the Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratory in Dhaka, Bangladesh for nutrient analysis. The assessment focused on five macronutrients—Nitrogen (N), Phosphorus (P), Potassium (K), Sulfur (S), and Magnesium (Mg)—and five micronutrients—Zinc (Zn), Copper (Cu), Manganese (Mn), Iron (Fe), and Boron (B). All nutrient concentrations were quantified in parts per million (PPM).

Data analysis

Analysis of variance (ANOVA) was performed using SPSS. The significance of means was analyzed with at least significant differences (LSD) between replication means at $P = 0.05$.

Results

Physical properties

A total of 5 L of liquid was collected from each 5kg waste bucket by filtering and kept in bottles for storage. The liquid was initially observed to be a pale brown color, which gradually turned into a deep, dark brown color. Initially, it smelled very stinky, and the intensity increased over time. The pH value was 6.2 ± 0.9. Small moving organisms, micro life, were observed when the waste began to degrade, and these gradually increased with the degradation of the waste. It can be hypothesized that the presence of small organisms in the sample may include single or multiple strains of microorganisms such as algae, bacteria, and fungi (Nosheen, Ajmal, & Song, 2021, p. 1868). Among the bacterial populations, strains belonging to genera such as Pseudomonas, Staphylococcus, and Bacillus are likely to be present. Given that the fertilizer used was enriched with a high nitrogen content, it is also reasonable to predict the presence of nitrogen-fixing bacteria commonly associated with such environments.

Macro and micronutrient status

The amount of the nutrients was measured in PPM (Table 1). Among the nutrients, the highest amount observed for Nitrogen (N) was 25000 ± 70.71 ppm, followed by 30.24 ± 2.45 ppm for Magnesium (Mg) and 25 ± 2.23 ppm for Iron (Fe). Then, 12.7 ± 1.59 ppm for Phosphorus (P) was recorded, and 5.8 ± 1.07 ppm for Zinc (Zn). At the same time, the amount of Potassium (K) was 2.7 ± 0.73 ppm and 0.7 ± 0.37 ppm for both Copper (Cu) and Manganese (Mn). An amount of 0.5 ± 0.14 ppm of Boron (B) and the lowest amount of Sulfur (S) 0.05 ± 0.09 ppm, resulted from the liquid extracts.

Table 1. The macro and micro-nutrient composition of liquid fertilizer extracted from kitchen waste. The values are expressed in ppm as Mean ± Standard error of three replicates. The values are expressed in ppm.

Types	Nutrients	Mean ± SE (PPM)
Macro-nutrient	N	25000 ± 70.71
	P	12.7 ± 1.59
	K	12.7 ± 1.59
	S	12.7 ± 1.59
	Mg	30.24 ± 2.45
Micro-nutrient	Zn	5.8 ± 1.07
	Cu	0.7 ± 0.37
	Mn	0.7 ± 0.37
	Fe	25 ± 2.23
	B	0.5 ± 0.14

Discussion

This higher nitrogen concentration supports vigorous leaf and stem development, contributing to overall plant strength and growth (Febrian and Masjud, 2021). In addition to nitrogen, potassium and phosphorus are essential macronutrients that play critical roles in plant development. Magnesium is also vital, as it forms the central element of the chlorophyll molecule, directly impacting photosynthesis. Moreover, the presence of high levels of iron enhances enzymatic activity involved in both photosynthesis and respiration (Nasution et al., 2024). However, the lower concentrations of copper and sulfur suggest variability in the raw materials used for fertilizer production. Enhancing the formula with organic waste materials rich in copper and sulfur could naturally improve these nutrient levels.

The results indicated the nutrient elements in liquid fertilizer with significant differences (*p=<0.005*) in the values of nutrients in ppm. This result reveals that liquid fertilizer from kitchen waste is rich in nutrients such as macro (N, P, K, S, and Mg) and Micro (Zn, Cu, Mn, Fe, and B) (Table 1), especially rich in higher nitrogen content. The results reveal that the liquid fertilizer from the anaerobic process is a great source of organic fertilizer.

The high nitrogen content in the fertilizer can be attributed to the use of protein-rich materials such as fish skin and green kitchen waste, including coriander and vegetable peels. These organic wastes break down into nitrogenous compounds during decomposition. Unlike many other nutrients, nitrogen compounds particularly in the forms of ammonium (NH_4^+) and nitrate (NO_3^-) are highly water-soluble, allowing them to accumulate rapidly in liquid fertilizers. During fermentation or anaerobic digestion, microbial activity intensifies nitrogen mineralization, converting organic nitrogen into forms readily available for plant uptake. In contrast, other essential elements are present at relatively lower levels, likely due to the naturally low mineral content in the original waste materials and the limited solubility and bioavailability of these nutrients in the final product.

Table 2. A comparison of the macro and micro-nutrients observed in this study and the range of different organic fertilizers compiled from various published articles (Chatterjee et al., 2017; Unnisa, 2015; Skrzypczak et al., 2023; Prativa and Bhattarai, 2012; Theunissen et al., 2010; Ewulo et al., 2008; Ewulo et al., 2007). The values are expressed in ppm.

Types	Nutrients	Observed nutrient content in Mean ± SE (PPM)	The range of nutrients (PPM)
Macro-nutrient	N	25000 ± 70.71	11500 - 22000
	P	12.7 ± 1.59	115 - 7000
	K	12.7 ± 1.59	126 - 8000
	S	12.7 ± 1.59	1.9 – 5.5
	Mg	30.24 ± 2.45	20 - 2000
Micro-nutrient	Zn	5.8 ± 1.07	1.3 – 48.1
	Cu	0.7 ± 0.37	0.4 - 5
	Mn	0.7 ± 0.37	1.8 – 96.5
	Fe	25 ± 2.23	15.4 - 2134
	B	0.5 ± 0.14	11500 - 22000

A comparison was made between the observed and the range of nutrients found in different articles (Table 2). The nitrogen content was 25000 ± 70.71ppm, which is significant to other findings. In different studies, the nitrogen range was found 11500 to 22000 ppm (Unnisa, 2015; Siddiqui et al., 2021; Skrzypczak et al., 2023) indicating that the liquid fertilizer was very nitrogen-rich. Another macronutrient phosphorus content was 12.7 ± 1.59 ppm. The slow-release mechanism of liquid organic nitrogen can improve nutrient uptake efficiency and increase yield with positive soil health properties. (Karkee and Bishwokarma, 2023). The controlled release of organic fertilizer minimizes the risk of leaching and volatilization. While synthetic nitrogen fertilizers can offer immediate nutrient availability and higher short-term crop yields, but their environmental costs, including greenhouse gas emissions and nutrient leaching, are considerable (Liu et al., 2021). However, the content of phosphorus was low if we consider the range observed in various articles 115 – 7000 ppm (Unnisa, 2015; Skrzypczak et al., 2023; Prativa and Bhattarai, 2012; Theunissen et al., 2010; Ewulo et al., 2008). The banana peels and vegetable scarps used in this fertilizer are a good source of phosphorus. During decomposition, microorganisms break down organic phosphorus, but the rate at which this occurs can be slow. Moreover, phosphorus in organic matter may be present in forms that require microbial action for mineralization into plant-available forms (García-Berumen et al., 2025, p. 100326). If the microbial population is not optimized or if decomposition conditions (like moisture, temperature, and aeration) are not ideal, the phosphorus content in the liquid fertilizer could be low (Greff et al., 2022). The potassium recorded 2.7 ± 0.73 ppm in the liquid fertilizers. In comparing with the range of 126 – 8000 ppm observed in different studies (Unnisa, 2015; Skrzypczak et al., 2023; Prativa and Bhattarai, 2012; Theunissen et al., 2010; Ewulo et al., 2008) it seemed that the liquid fertilizer could not be a good source of potassium. But some points should be considered, the ingredients which provide potassium were not high enough in concentration to significantly impact the overall potassium content of this liquid fertilizer. Such as fish skin, orange peels used to make this fertilizer may contribute some potassium, but they are not high enough in concentration to significantly impact the overall potassium content. Additionally, as organic matter decomposes, microorganisms break down complex compounds, mineralizing potassium into plant-available forms (Rawal et al., 2022). However, this process is slow, which explains the lower initial potassium levels. Over time, mineralization will contribute to soil potassium, but the immediate availability in the liquid fertilizer remains limited. Besides the environment, composition or fermentation process may also be contributory factors for this lower level (Greff et al., 2022). The sulfur content was 0.05 ± 0.09 ppm and the range of sulfur was found 1.9 – 5.5 ppm indicating it not to be a good source (Chatterjee et al., 2017). The Sulphur content can be improved by focusing on the ingredients of fertilizer, duration of fermentation and filtering process. However, the magnesium showed a quantity of 30.24 ± 2.45 ppm that falls within the range of magnesium 20 – 2000 ppm observed in different literatures (Chatterjee et al., 2017). Therefore, this fertilizer will enhance the plant's overall growth, improve crop quality, increase chlorophyll content, stimulate biochemical activity, strengthen its defense mechanisms, and bolster resilience against environmental stressors (Xu et al., 2022). This Zinc plays a vital role metabolically for plant growth and development. It is an essential trace element which effect plant physiological functions, structural development, facilitation of protein synthesis and gene expression, even in enzyme structure and production (Mousavi et al., 2013). The zinc content was 5.8 ± 1.07 ppm in our study. In different studies, the range of zinc observed was 1.3 – 48.1 ppm (Skrzypczak et al. 2023 Prativa and Bhattarai, 2012; Theunissen et al., 2010) indicating this liquid fertilizer can be a good source of zinc. The copper content was 0.7 ± 0.37 ppm and the range of copper observed was 0.4 – 5 ppm (Skrzypczak et al., 2023; Prativa and Bhattarai, 2012; Theunissen et al., 2010). The manganese content was 0.7 ± 0.37 ppm. Whereas, in different studies, the range of manganese was observed from 1.8 to 96.5 ppm (Skrzypczak et al.2023; Prativa and Bhattarai, 2012; Theunissen et al., 2010). The reason for lower manganese content may be due to plant-based sources, alkaline condition, and microbial activity. The iron was found 25 ± 2.23 ppm and the range of iron observed was 15.5 – 2134 ppm (Skrzypczak et al.2023; Prativa and Bhattarai, 2012; Theunissen et al., 2010). This liquid fertilizer can be a rich source of iron which will enhance plants protein content and root length, even it will reduce the heave metal uptake. It will improve the overall crop quality (Zhang, Li, & Wang, 2023). The content of boron was recorded at 0.5 ± 0.14 ppm. Contrary, the range of boron observed was 0.02 – 0.06 ppm (Chatterjee et al., 2017). The higher amount of boron can contribute to plant growth particularly in plant height and leaf number (Che Nordin et al., 2022). We observed the quantities of phosphorus, potassium, and sulfur were lower than the range found in different research (Chatterjee et al., 2017; Unnisa, 2015; Ewulo et al., 2007). However, nitrogen, copper, zinc and iron content were highest among all other related studies (Chatterjee et al., 2017; Unnisa, 2015; Skrzypczak et al., 2023; Prativa and Bhattarai., 2012; Theunissen et al., 2010; Ewulo et al., 2007).

The nutrient contents of compost are substantially influenced by the use of different organic wastes and methods of composting (Wolka and Melaku, 2015; Jahan et al., 2022). For example, compost prepared by mixing cow dung with paddy straw showed higher total organic matter, and C/N ratio, but higher phosphorus, nitrogen, zinc, and manganese for composts enriched with nitrogen or phosphorus (Hussain et al., 2014) On the other hand, the compost enrichment with urea, phosphate, zinc, iron, copper, and manganese at various stages of composting in chaffed cotton stalks and farm wastes reduced the C/N ratio, and lignin but increased other nutrients (Chari et al., 2013). The compost produced from poultry litter showed higher phosphorus, potassium, calcium, and magnesium compared to fresh manure (Faridullah et al., 2014). After complete decomposition, the household waste compost can also contain a significant proportion of plant nutrients and soil properties amending constituents (Mrabet et al., 2012). However, in every study, essential plant nutrients were evident including this one. Additionally, agriculturalists and environmentalists have an increasing interest in converting solid waste to compost, contributing to soil fertility and crop productivity (Ewulo et al., 2007; Rajaie et al., 2016). Organic food waste as a liquid fertilizer is also expected to meet the demand for sustainable waste management (Cheng et al., 2022). From our research, the observed compost capacity and overall nutritional status suggest that kitchen waste should be converted into liquid fertilizer for Bangladesh. This study not only evaluates the nutrient profile of a homemade liquid organic fertilizer but also underscores its potential role in sustainable waste management in Bangladesh. By using commonly discarded materials such as banana peels, vegetable scraps, fish skin, and orange peels, the fertilizer formulation promotes the recycling of organic kitchen and market waste—an urgent need in urban and peri-urban areas across Bangladesh, where organic waste makes up a large portion of municipal solid waste (Ahmed, 2019). The nutrient analysis reveals that despite relatively low levels of phosphorus, potassium, and sulfur, the fertilizer contains high concentrations of nitrogen, iron, zinc, and boron, which are essential for crop productivity and soil health. It can provide low-cost biofertilizer, which will contribute to smallholder farmers. Moreover, the controlled-release nature of nutrients from organic sources minimizes nutrient leaching and environmental contamination, unlike conventional synthetic fertilizers. These findings align with global efforts toward a circular economy, emphasizing waste valorization, reduced reliance on chemical inputs, and the promotion of eco-friendly agricultural practices. Therefore, the study contributes meaningfully to both local and international sustainable development goals by offering a replicable, low-tech solution for converting organic waste into a nutrient-rich agricultural input.

Conclusion

Due to the lack of proper waste management, many problems have been observed, and composting is one of the sustainable ways to resolve these problems. Additionally, liquid composting is a new alternative to solid composting with many advantages. From our research, we have observed the nutrient richness of liquid organic fertilizer made from available kitchen wastes, indicating their suitability for Bangladesh. This will also solve a part of the household and municipal waste problem.

Competing interests

The authors declare that they have no competing interests

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Authors’ Contributions

‘Pijush Kanti Jhan’ designed the study, ‘Jakiya Hossain Moon’ performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. ‘Md. Atiqur Rahman Bhuiyan’ and ‘Mehede Hassan Rubel’ managed the analyses of the study. ‘Md. Mahfuzur Rahman’ managed the literature searches and reviewed the manuscript. All authors read and approved the final manuscript.”

References

1. Aguilar-Paredes A, Valdés G, Araneda N, Valdebenito E, Hansen F, and Nuti M, 2023. Microbial community in the composting process and its positive impact on the soil biota in sustainable agriculture. Agronomy, 13(2): 542.
2. Ahmed N, 2019. When the garbage piles up. The Daily Star, 7. https://www.thedailystar.net/opinion/environment/news/when-the-garbage-piles-1810375
3. Chari KM, Ravi MV, Beladhadi, RV, Rao KN, and Raghu MS, 2013. Enrichment of Cotton Stalk-Based Compost and its Influence on Growth and Yield of Sunflower. Indian Journal of Dryland Agricultural Research and Development, 28(1): 58-62.
4. Chatterjee R, Gajjela S, and Thirumdasu RK, 2017. Recycling of organic wastes for sustainable soil health and crop growth. International Journal of Waste Resources, 7(3): 296-2.
5. Cheng KM, Tan JY, Wong SY, Koo AC, and Amir Sharji E, 2022. A review of future household waste management for sustainable environment in Malaysian cities. Sustainability, 14(11): 6517.
6. Dronia W, Kostecki J, Połomka J, and Jędrczak A, 2024. Bio-waste from urban and rural areas as a source of biogas and methane—A case study from Poland. Energies, 17(2): 317.
7. Du C, Abdullah JJ, Greetham D, Fu D, Yu M, Ren L, et al., 2018. Valorization of food waste into biofertiliser and its field application. Journal of Cleaner Production, 187: 273–284.
8. Ewulo BS, Hassan KO, and Ojeniyi SO, 2007. Comparative effect of cowdung manure on soil and leaf nutrient and yield of pepper.
9. Ewulo BS, Ojeniyi SO, and Akanni DA, 2008. Effect of poultry manure on selected soil physical and chemical properties, growth, yield and nutrient status of tomato. African Journal of Agricultural Research, 3(9): 612–616.
10. Faridullah F, Nisar Z, Alam A, Irshad M, and Sabir MA, 2014. Distribution and evaluating phosphorus, potassium, calcium and magnesium in the fresh and composted poultry litter.
11. Garcia C, Hernández T, Costa C, Ceccanti B, Masciandaro G, and Ciardi C, 1993. A study of biochemical parameters of composted and fresh municipal wastes. Bioresource Technology, 44(1): 17–23.
12. García-Berumen JA, Flores de la Torre JA, De los Santos-Villalobos S, Espinoza-Canales A, Echavarría-Cháirez FG, and Gutiérrez-Bañuelos H, 2025. Phosphorus dynamics and sustainable agriculture: The role of microbial solubilization and innovations in nutrient management. Current Research in Microbial Sciences, 8: 100326. https://doi.org/10.1016/j.crmicr.2024.100326
13. Golueke CG, 1973. Composting: A study of the process and its principles. Rodale Press.
14. Greff B, Szigeti J, Nagy Á, Lakatos E, and Varga L, 2022. Influence of microbial inoculants on co-composting of lignocellulosic crop residues with farm animal manure: A review. Journal of Environmental Management, 302: 114088. https://doi.org/10.1016/j.jenvman.2021.114088
15. Halloran A, Clement J, Kornum N, Bucatariu C, and Magid J, 2014. Addressing food waste reduction in Denmark. Food Policy, 49: 294–301.
16. Hussain SS, Ara T, Raina FA, Gani G, Hussain N, Hussain M, and Dar SR, 2015. Quality evaluation of different forms of compost and their effect in comparison with inorganic fertilizers on growth and yield attributes of wheat (Triticum aestivum L.). Journal of Agricultural Science, 7(1): 154.
17. Igboama WN, Hammed OS, Fatoba JO, Aroyehun MT, and Ehiabhili JC, 2022. Review article on impact of groundwater contamination due to dumpsites using geophysical and physiochemical methods. Applied Water Science, 12(6): 130.
18. Islam KN, 2016. Municipal solid waste to energy generation in Bangladesh: possible scenarios to generate renewable electricity in Dhaka and Chittagong city. Journal of Renewable Energy, 2016(1): 1712370.

19. Islam KN, 2018. Municipal solid waste to energy generation: An approach for enhancing climate co-benefits in the urban areas of Bangladesh. Renewable and Sustainable Energy Reviews, 81: 2472–2486.
20. Jahan S, Ujjaman S, Rahman S, Sarker BC, Hossain Z, and Kamal M, 2022. Physicochemical properties and nutrient contents of compost as influenced by organic wastes and methods of composting. Journal of the Indian Society of Soil Science, 70(1): 106–112.
21. Liu B, Wang X, Chadwick D, and Chen X, 2021. Combined applications of organic and synthetic nitrogen fertilizers for improving crop yield and reducing reactive nitrogen losses from China's vegetable systems: A meta-analysis. Environmental Pollution, 269: 116143. https://doi.org/10.1016/j.envpol.2020.116143
22. Karkee SS, and Bishwokarma S, 2023. Comparative analysis of the effectiveness of organic and inorganic nitrogen sources on potato yield and soil fertility. Journal of Agriculture and Environment, 24(1): 51–57. https://doi.org/10.3126/aej.v24i01.58077
23. Kapsdorferová Z, Jacková S, and Švikruhová P, 2021. The state and the share of rural women on the agricultural entrepreneurship activities in the Slovak Republic. Slovak Journal of Food Sciences, 15.
24. Khadidja B, and Aman B, 2022. Valorization essay of green kitchen waste into liquid fertilizer. Plant Archives, 22(2).
25. Kulcu R, and Yaldiz O, 2004. Determination of aeration rate and kinetics of composting some agricultural wastes. Bioresource Technology, 93(1): 49–57.
26. Maindargikar M, Shete R, Nikam V, and Vaidya V, 2022. Studies on preparation of organic compost and biofertilizers from kitchen waste. International Journal of Novel Research in Life Sciences, 9(4): 33–38.
27. Masud MH, Ananno AA, Hossain MS, Chowdhury SA, and Dabnichki P, 2023. Anaerobic co-digestion of liquid dairy manure with food waste: A sustainable source of green energy. Manure Technology and Sustainable Development, 1–32.
28. More A, Srinivasan A, Liao PH, and Lo KV, 2017. Microwave enhanced oxidation treatment of organic fertilizers. Journal of the Science of Food and Agriculture, 97(10): 3233–3239.
29. Mousavi SR, Galavi M, and Rezaei M, 2013. Zinc (Zn) importance for crop production – A review. International Journal of Agronomy and Plant Production, 4(1): 64–68.
30. Mrabet L, Belghyti D, Loukili A, and Attarassi B, 2012. Effect of household waste compost on the productivity of maize and lettuce. Agricultural Science Research Journals, 2(8): 462–469.
31. Nasution Z, Adam DH, Rizal K, and Triyanto Y, 2024. The effect of liquid organic fertilizer made from eggshells and sugarcane bagasse on the growth of cayenne pepper. Jurnal Ekonomi, 13(3): 83–92.
32. Nosheen S, Ajmal I, and Song Y, 2021. Microbes as biofertilizers, a potential approach for sustainable crop production. Sustainability, 13(4): 1868. https://doi.org/10.3390/su13041868
33. Parvin M, and Begum A, 2018. Organic solid waste management and the urban poor in Dhaka city. International Journal of Waste Resources, 8(320): 2.
34. Paritosh K, Kushwaha SK, Yadav M, Pareek N, Chawade A, and Vivekanand V, 2017. Food waste to energy: an overview of sustainable approaches for food waste management and nutrient recycling. BioMed Research International, 2017(1): 2370927.
35. Prativa KC, and Bhattarai BP, 2011. Effect of integrated nutrient management on the growth, yield and soil nutrient status in tomato. Nepal Journal of Science and Technology, 12: 23–28.
36. Prepilková V, Poništ J, Schwarz M, and Samešová D, 2023. Challenges and opportunities for kitchen waste treatment—a review. Environmental Reviews, 31(4): 632–642.
37. Rajaie M, and Tavakoly AR, 2016. Effects of municipal waste compost and nitrogen fertilizer on growth and mineral composition of tomato. International Journal of Recycling of Organic Waste in Agriculture, 5: 339–347.

38. Rawal N, Pande KR, Shrestha R, and Vista SP, 2022. Phosphorus and potassium mineralization as affected by phosphorus levels and soil types under laboratory condition. Agrosystems, Geosciences & Environment, 5(1). https://doi.org/10.1002/agg2.20229
39. Rushton L, 2003. Health hazards and waste management. British Medical Bulletin, 68(1): 183–197.
40. Sarwar M, 2015. Insect vectors involving in mechanical transmission of human pathogens for serious diseases. International Journal of Bioinformatics and Biomedical Engineering, 1(3): 300–306.
41. Shekdar AV, 2009. Sustainable solid waste management: An integrated approach for Asian countries. Waste Management, 29(4): 1438–1448.
42. Siddiqui Z, Hagare D, Jayasena V, Swick R, Rahman MM, Boyle N, and Ghodrat M, 2021. Recycling of food waste to produce chicken feed and liquid fertiliser. Waste Management, 131: 386–393.
43. Skrzypczak D, Trzaska K, Mikula K, Gil F, Izydorczyk G, Mironiuk M, et al., 2023. Conversion of anaerobic digestates from biogas plants: Laboratory fertilizer formulation, scale-up and demonstration of applicative properties on plants. Renewable Energy, 203: 506–517.
44. Statista, 2024. Annual household food waste produced in selected countries worldwide as of 2020. https://www.statista.com/statistics/1219939/global-food-waste-per-capita-by-region/
45. Symonds M, 2021. Faculty Opinions recommendation of Food waste index report 2021. Faculty Opinions-Post-Publication Peer Review of the Biomedical Literature. https://doi.org/10.3410/f.739716609.793583719
46. Tampio E, Marttinen S, and Rintala J, 2016. Liquid fertilizer products from anaerobic digestion of food waste: mass, nutrient and energy balance of four digestate liquid treatment systems. Journal of Cleaner Production, 125: 22–32.
47. Theunissen J, Ndakidemi PA, and Laubscher CP, 2010. Potential of vermicompost produced from plant waste on the growth and nutrient status in vegetable production. International Journal of the Physical Sciences, 5(13): 1964–1973.
48. Unnisa SA, 2015. Liquid fertilizer from food waste—a sustainable approach. International Research Journal of Environment Sciences, 4(8): 22–25.
49. Wang H, Xu J, and Sheng L, 2019. Study on the comprehensive utilization of city kitchen waste as a resource in China. Energy, 173: 263–277.
50. Wolka K, and Melaku B, 2015. Exploring selected plant nutrient in compost prepared from food waste and cattle manure and its effect on soil properties and maize yield at Wondo Genet, Ethiopia. Environmental Systems Research, 4: 1–7.
51. Xu J, Tian Y, Ma Q, Zhang X, Wang L, Wang S, and Xu X, 2022. The power of magnesium: Unlocking the potential for increased yield, quality, and stress tolerance of horticultural crops. Frontiers in Plant Science, 13: 972930. https://doi.org/10.3389/fpls.2022.972930
52. Yong ZJ, Bashir MJ, and Hassan MS, 2021. Biogas and biofertilizer production from organic fraction municipal solid waste for sustainable circular economy and environmental protection in Malaysia. Science of the Total Environment, 776: 145961.
53. Zhang J, Lü F, Shao L, and He P, 2014. The use of biochar-amended composting to improve the humification and degradation of sewage sludge. Bioresource Technology, 168: 252–258.