EXPERIMENTAL STUDY AND PROPOSAL OF A HOUSEHOLD ORGANIC WASTE TREATMENT MODEL USING VERMICOMPOSTING

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Abstract - This study investigates vermicomposting as a sustainable solution for household organic waste management in rapidly urbanising areas like Da Nang. A three-tier pilot system utilising earthworms efficiently decomposed kitchen waste into nutrient-rich vermicompost, achieving significant volume reduction within 21 days, particularly with pre-sorted, high-moisture food waste. Findings indicate that a 1:3 earthworm-to-waste ratio in a rotational two-unit system enables continuous processing. While optimised for vermicompost production, the model's efficacy for earthworm biomass generation may be limited by high oil, salt, or spice content in feedstock like leftover cooked dishes. Source separation, prioritising high-moisture, low-salt organic matter (e.g., vegetable scraps, plain rice), is recommended for optimal earthworm digestion. The resulting vermicompost is a valuable organic fertiliser for agriculture and gardening, offering dual environmental and agricultural benefits. The study concludes that household-level vermicomposting is a practical, eco-friendly approach to organic waste management with the potential to reduce landfill burden and promote urban sustainability.

Key words - Vermicomposting; Household Organic Waste; Waste Sepration; Waste Management; Three-tier bin

1. Introduction

The escalating pace of societal advancement, coupled with accelerating demographic expansion, particularly within urbanised and metropolitan regions, has precipitated a commensurate and substantial increase in the generation of municipal solid waste (MSW). In 2019, Vietnam generated approximately 64,658 metric tonnes of MSW per day, with urban centres accounting for 55% of this volume, of which organic waste made up between 50.2% and 68.9% [1]. In Da Nang City, the per capita MSW generation was 1.1 kg/day, totaling over 373,000 tonnes in 2020, with organic waste comprising 68.47% [2]. Despite the high organic content, inadequate segregation and treatment have strained existing waste management systems and contributed to environmental and public health risks. In response, the 2020 Law on Environmental Protection and Decree No. 45/2022/NĐ-CP mandate the classification of household waste and proper use of waste packaging, with monetary penalties for non-compliance starting January 1, 2025. These regulations aim to promote resource recovery, particularly from biodegradable waste, which can be recycled into high-quality compost. However, in practice, most household waste remains unsegregated and is sent directly to landfills, undermining the effectiveness of current policies. This underscores the urgent need for sustainable, decentralized solutions like vermicomposting, which can transform kitchen waste into valuable organic fertilizer while aligning with legal requirements [3].

Over the past few decades, vermicomposting has garnered significant global interest owing to its simplicity, efficiency, and environmental advantages. This biological process exhibits versatility in its feedstock, capable of utilising a wide array of waste materials, including animal, agricultural, industrial, and municipal sources [3]. It is recognised as a practical and effective technology for the management of both organic and agricultural waste streams. Vermicomposting involves the non-thermophilic biodegradation of organic matter facilitated by the synergistic action of earthworms and microorganisms. Notably, this process typically exhibits a faster rate of decomposition compared to conventional composting, which relies solely on microorganisms – primarily bacteria and fungi – as the earthworm digestive system accelerates the breakdown of organic material. The resultant vermicompost is a valuable resource, abundant in plant growth-promoting substances, beneficial microorganisms, and agents that can suppress harmful insects. Its application enhances soil structure and stimulates plant development [4]. In contrast, a notable drawback of conventional composting can be the generation of odours and the attraction of pests, particularly under low-oxygen (anaerobic) conditions, where the decomposition of dairy products or oily residues can release unpleasant smells. These odours not only create an uncongenial composting environment but can also attract various undesirable pests such as ants, flies, rodents, and stray animals, raising both sanitary and ecological concerns. However, a key limitation associated with the widespread application of vermicomposting technology is the challenge of maintaining a consistent and sufficiently large-scale supply of organic waste to sustain substantial earthworm populations [4]. Consequently, household-scale vermicomposting is often considered a viable alternative in situations where space and waste volumes are constrained [5]. This technology has been extensively researched and implemented for the treatment of organic household waste, particularly kitchen scraps. The waste undergoes decomposition through microbial activity and earthworm digestion, yielding vermicompost rich in essential plant nutrients and beneficial microorganisms that contribute to soil improvement. Among the earthworm species studied, *Eisenia fetida* is commonly employed in contemporary vermicomposting systems and has demonstrated its capacity to process organic materials with high moisture content, such as urban sewage sludge and livestock waste [6]. Additionally, *Eudrilus eugeniae* is also regarded as a fast-growing worm species with significant potential for treating organic waste and producing protein-rich feed for livestock [7]. *Perionyx excavatus*, in particular, has shown remarkable efficiency in converting organic waste under low-investment conditions, rendering it a feasible option for decentralised waste treatment systems [8]. These earthworm species primarily consume partially decomposed organic matter, transforming it into high-quality vermicompost.

This research seeks to ascertain the decomposition rate of earthworms across various categories of household kitchen waste. Based on these findings, it proposes a three-tier vermicomposting bin system for household-scale implementation, thereby aiming to enhance the effectiveness of waste classification at the source, diminish the volume of organic waste requiring collection and transportation to centralised landfill sites, and concurrently mitigate pollution issues arising from the decomposition process during waste storage, transfer, and treatment.

2. Materials and methods

2.1. Scope of study

Figure 1. *Study area: Hoa Khanh Bac, Lien Chieu, Da Nang*

The remit of this study encompasses an investigation into household kitchen waste management within the Hoa Khanh Bac ward, Lien Chieu district, Da Nang city, Vietnam. Kitchen waste, predominantly organic in nature, was gathered from 60 households located in the vicinity of The University of Danang - University of Science and Technology (UD-DUT) campus. For the purposes of this research, organic kitchen waste was categorised into three discrete types:

Rice, defined as uneaten cooked rice without any admixture of other ingredients or the addition of flavourings.

Scraps, comprising unavoidable organic residues generated during culinary activities, such as fruit and vegetable peelings, cores, and trimmings.

Food waste, encompassing prepared meals that were not fully consumed, typically contain a significant amount of ingredients such as oils, salts, and chilli.

A continuous waste generation survey was conducted over a ten-day period. Investigators visited each target household on a daily basis, providing separate, labelled bags for each of the three organic waste categories and collecting the segregated waste. The collected samples were weighed on-site prior to transportation to a laboratory at the UD-DUT campus for utilisation as input materials in an experimental pilot study. In this study, kitchen waste was introduced in unprocessed form to reflect household reality, with particle sizes ranging from <3 cm (rice and leftovers) to 5 cm (vegetable trimmings). Compared to livestock manure, which is more homogeneous and microbially balanced, kitchen waste presents greater variability in structure and nutrient content, influencing moisture dynamics and decomposition uniformity. These differences highlight the importance of substrate composition and pre-treatment strategies in future model optimisation.

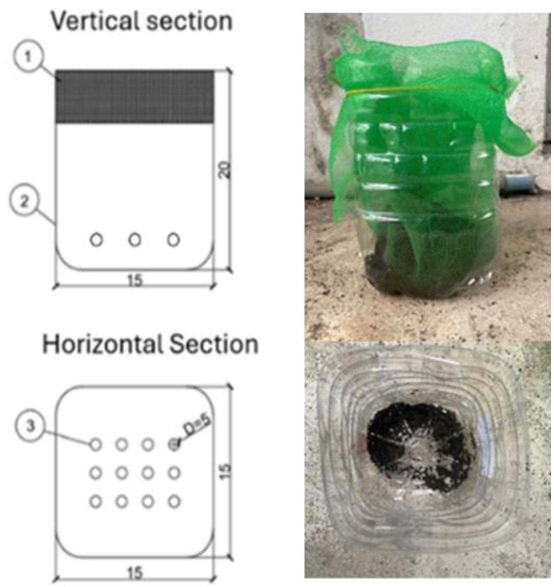
2.2. Earthworms

Earthworms play a crucial role in the natural decomposition and cycling of organic materials. They also enhance the availability of nutrients for plants and contribute to proper soil aeration and moisture content. Their actions significantly impact ecosystem processes, particularly the water, carbon, and nutrient cycles. The selection of *Perionyx excavatus* for this study is supported by findings from researchers such as Suthar [9], who have demonstrated the species' strong ability to efficiently break down organic matter. Moreover, the approach of mixing different types of organic inputs is consistent with the work of Gunadi and Edwards [10], who observed that a varied diet of organic substrates optimises earthworm growth and reproduction. While *Perionyx excavatus* is a commonly used species in vermicomposting systems, in practical settings, organic matter processing is unlikely to be carried out by a single species, even if only one is introduced. This species tends to live in the upper soil layers, where organic matter is most concentrated, facilitating habitat maintenance and the breakdown of surface-applied organic materials. They are also known for their rapid processing rates, tolerance of high densities, and greater resistance to temperature changes. An individual earthworm can consume several times its own body weight in organic matter each day.

Figure 2. *Earthworm*

2.3. Experimental setup

The experimental design was structured to assess the rate of decomposition of various household kitchen waste types via vermicomposting over three distinct time intervals: 7, 14, and 21 days. A total of eight vermicomposting setups were developed and each was conducted in triplicate, yielding 24 experimental units. Each unit comprised a 5-litre plastic container (dimensions: 15 × 15 × 20 cm) (Figure 3) fitted with 12 drainage apertures at the base and 12 ventilation apertures on the sides (5 mm in diameter), these being covered with a plastic mesh featuring 0.5 mm openings to prevent the escape of soil and earthworms. Each container was labelled with comprehensive details, including the model number, the specific type of organic waste, the initial mass of waste, the quantity and weight of earthworms introduced, and the duration of the composting period.



(a) (b)

Figure 3. *Experimental model: (a) in design; (b) in experiment*

Table 1. *Detail of organic waste distribution in pilots*

Pilot	Remark
M1	Rice (150g) + Worm (50g)
M2	Scraps (150g) + Worm (50g)
M3	Rice (75g) + Scarps (75g) + Worm (50g)
M4	Rice (75g) + Food waste (75g) + Worm (50g)
M5	Scraps (75g) + Food waste (75g) + Worm (50g)
M6	Food waste (150g) + Worm (50g)
M7	Mixed (150g) + Worm (50g)
M8	Mixed (150g) without worm

Within each experimental unit, 600 g of soil was introduced to serve as the earthworm habitat. Subsequently, 150 g of the designated organic waste type was added according to the specific model and thoroughly incorporated into the existing substrate. Each vermicomposting unit was inoculated with 50 grams of Perionyx excavatus, equivalent to approximately 73–80 individuals, establishing a worm-to-waste ratio of 1:3 by weight. This ratio was found to be effective for both organic matter decomposition and worm survival under household-scale conditions. Earthworm growth was monitored through changes in total biomass and average body length. The experimental pilots were designated M1 to M8, maintaining consistent waste and worm parameters across the replicates, differing solely in the composting duration assigned to each model, as detailed in Table 1.

2.4. Analytical procedure

To quantify the rate of organic waste decomposition, the mass reduction was calculated using the subsequent formula:

$$\%_{Decomposition} = \frac{(M_0 - M_1)}{M_0} \times 100\% \quad (1)$$

Where:

M_0: Initial Organic Waste Mass, represents the mass of organic waste on the first day (150 g).

M_1: Final Organic Waste Mass, represents the mass of organic waste after 7, 14, or 21 days (in grams).

$\%_{Decomposition}$: Decomposition Rate, represents the percentage of organic waste decomposed after the completion of the vermicomposting process.

To evaluate the earthworms' growth response within each model, the investigation focused on monitoring two key indicators: earthworm length and biomass, both prior to and upon completion of the experimental period. These parameters provide a clear reflection of the earthworms' growth in relation to each specific type of organic waste. Before the commencement of the experiment, the earthworms in each model were measured for length using an electronic caliper and weighed using a high-precision analytical balance. Following the designated experimental periods (7, 14, and 21 days), this measurement procedure was repeated to ascertain the changes in size and mass. The comparison of pre- and post-experiment values enabled an assessment of the suitability of each organic waste type as a food source, thereby facilitating the selection of the optimal organic composition to promote the most efficacious vermicomposting process. To determine the percentage increase in earthworm biomass, the following formula was employed:

$$\%\ \text{increase} = \frac{(g_1 - g_0)}{g_0} \times 100\% \quad (2)$$

Where:

g_0: Initial Worm Mass represents the mass of the earthworms at the beginning of the experiment (in grams);

g_1: Final Worm Mass represents the mass of the earthworms at the end of the experimental period (in grams);

% increase : Percentage Increase in Worm Biomass represents the proportional increase in the earthworms' total mass over the duration of the experiment.

The decomposition rate of earthworms for each specific type of organic waste, alongside the recorded daily mass of household kitchen waste generation, served as the foundational data for calculating the operational parameters of the proposed three-tier household-scale vermicomposting model. These parameters encompass the requisite number of earthworms needed to effectively process the kitchen waste and the appropriate input waste quantity to ensure optimal processing efficiency within each layer of the model.

The study monitored three primary indicators: (i) percentage of organic matter mass loss, (ii) percentage increase in worm biomass, and (iii) mean body length of earthworms. These were selected based on their relevance to decomposition efficiency and biological performance, and are well-supported by prior vermicomposting studies. Sampling occurred at 7-day intervals (days 0, 7, 14, and 21), with each treatment replicated three times. Data were processed using Microsoft Excel 365 to calculate means, standard deviations, and comparative growth rates. These parameters are not only biologically meaningful but also feasible for households to monitor in simplified versions of the model.

3. Results and discussion

3.1. Household kitchen waste generation

The collected kitchen waste predominantly comprised biodegradable organic matter derived from the daily activities of the participating households. This waste stream primarily originated from food preparation within the kitchen environment and from the households' daily meals. The quantity of organic waste generated daily was collected, sorted into separate containers, and subsequently utilised as input material for the experimental models. The total amount of organic waste collected from 60 households over the ten-day survey period is detailed in Table 2.

The data presented in the table elucidates the daily organic waste composition generated by the participating households. On average, the quantity of kitchen waste collected per household each day was 632 ± 52 grams, with the largest proportion comprising *scraps* at 344 ± 40 grams, followed by *food waste* at 187±25 grams and *rice* at 100±15 grams. Kitchen waste generally constitutes a significant fraction of household solid waste both in Vietnam as a whole and specifically within Da Nang. According to statistics from the Da Nang City Statistical Office (2019), the city encompasses 295,418 households across over 2,250 surveyed residential areas [11]. With a mean generation rate of 632 ± 52 grams per household per day, this equates to an estimated 187 tonnes of kitchen waste generated citywide on a daily basis. The effective implementation of waste segregation at the point of generation holds the potential to substantially alleviate the burden on the city's Khanh Son landfill.

Table 2. *Household kitchen waste generation*

Composition	Generation rate (g/hh.day)		
	n	**Mean± SE**	**95% CI**
Food waste	600	187 ± 25	137 – 238
Rice	600	100 ± 15	70 – 131
Scraps	600	344 ± 40	265 – 423
Total	600	632 ± 52	529 – 735

3.2. Decomposition rate

The experimental results revealed a modest reduction in organic waste mass during the first seven days, reflecting the rapid degradation of readily degradable components. After day 8, the rate of mass loss progressively declined, indicating that most labile organic compounds had been metabolized. By day 21, the substrate mass had reached a near-stable state, suggesting that the vermicompost had attained biological maturity with minimal further decomposition. This stabilization phase is characteristic of composting systems transitioning into humification, where the remaining organic matter becomes more chemically complex and resistant to microbial breakdown. A comparison between the treatment employing earthworms (Model 7) and the control treatment without earthworms (Model 8) revealed a statistically significant difference. Specifically, the organic waste mass in Model 7 decreased by 42 g per 150 g of initial input, whereas in Model 8, the reduction was 34 g per 150 g. Paired sample t-test analysis confirmed the statistical significance of this difference ($t = 11.04$, $p < 0.001$). These findings underscore the potential applicability of the vermicomposting method for the treatment of household organic waste, demonstrating enhanced efficiency compared to conventional composting techniques.

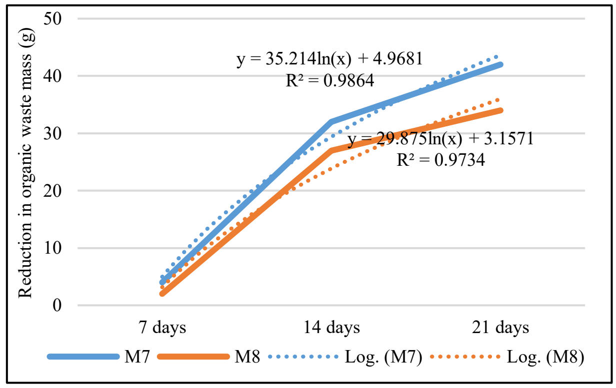


Figure 4. *Decomposition between with and without earthworm*

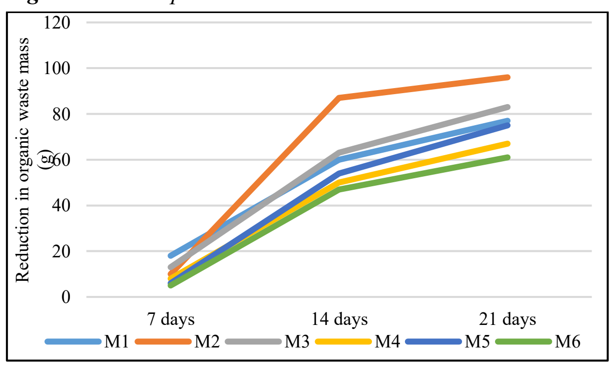


Figure 5. *Organic waste mass reduction over time*

During the monitoring period, the organic waste mass in all models exhibited a gradual decline over time. However, the efficacy of this reduction varied considerably across the different models. Notably, Model 2 (M2), employing the vermicomposting method, demonstrated the most pronounced degradation of organic waste in comparison to Models 1 (M1) through 6 (M6), which shows in Figure 5. When considering the various types of organic waste, *scraps* exhibited the most rapid decomposition, suggesting its high suitability as a feedstock for earthworms. Following this trend, the combination of *rice* and *scraps* in Model 3 (M3) also showed a swift reduction in organic matter. Conversely, *food waste* in Model 6 (M6) displayed the slowest rate of decomposition.

This disparity can be attributed to the differing compositions of the waste materials. Household food preparation waste (*scraps*) typically consists of vegetable trimmings and fruit peelings, while cooked rice remnants (*rice*) are often plain and devoid of significant food residues, seasonings, or oils. Both of these waste types generally possess a high moisture content and good biodegradability, rendering them favourable for vermicomposting. In contrast, leftover food (*food waste*) in central Vietnam frequently contains a significant proportion of spices, chilli, and oil, reflecting local culinary practices. These components are less amenable as feedstock for vermicomposting, potentially inhibiting earthworm activity. Nonetheless, with effective segregation at the source, leftover food and rice could potentially be repurposed as animal feed. Meanwhile, food preparation waste proves highly suitable for vermicomposting, yielding high-quality vermicompost beneficial for agriculture and plant growth.

3.3. Earthworms' growth

The Figure 6 presents graphically clearly illustrates that Model 2 (M2) exhibited the most significant earthworm growth, culminating in the highest worm biomass by the twenty-first day. This was followed by Model 3 (M3) and Model 1 (M1), which ranked second and third, respectively. These findings further corroborate that *scraps* constitutes the most suitable feedstock for earthworms, followed by a mixture of *rice* and *scraps*. Based on this evidence, these two organic waste types will be selected as the input materials for the three-tier vermicomposting model. The observed reduction in worm biomass in treatments with high proportions of cooked food waste may be attributed to inhibitory substances such as salt, oil, and spices. These compounds are known to interfere with gut microbial balance, induce osmotic stress, and lower palatability, thereby impeding growth and reproduction [9-10]. These findings reinforce the need for effective waste separation at the source and confirm that only certain organic waste fractions are suitable for household-scale vermicomposting.

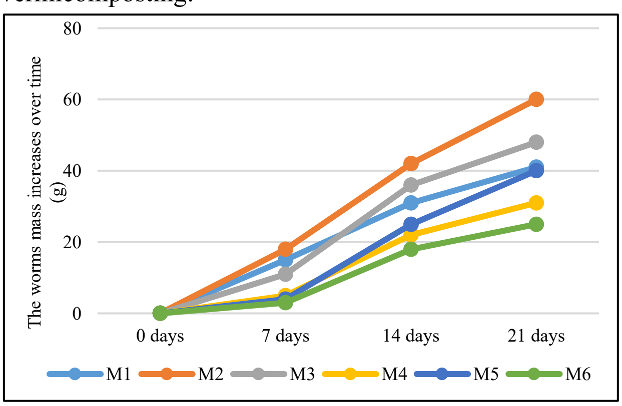


Figure 6. *The earthworms biomass increases over time*

The boxplot illustrates the temporal changes in earthworm length (mm) at four time points: 0, 7, 14, and 21 days. The results indicate a significant increase in earthworm length across these stages. Specifically, earthworm length was lowest at the commencement of the experiment (0 days), representing the baseline prior to development within the experimental conditions. After 7 days, a notable increase in length was observed, suggesting the earthworms' initial adaptation and development within the experimental environment. By day 14, earthworm length continued to increase, and the range of lengths also expanded, indicating stable and consistent growth. By the conclusion of the experimental period at 21 days, the earthworms reached their maximum length, demonstrating sustained growth and the favourable nature of the rearing environment throughout the study. These findings suggest that the experimental conditions provided a conducive environment for earthworm development, supporting consistent and substantial growth over the monitored time points.

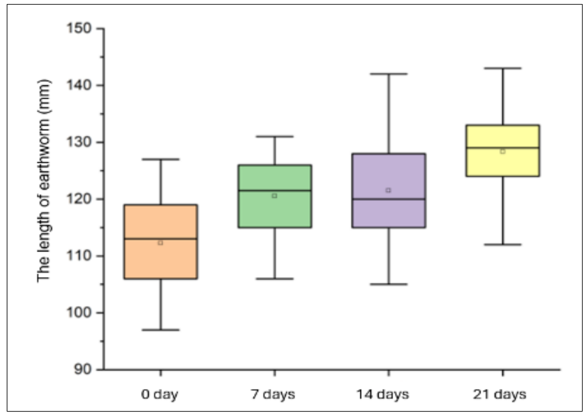


Figure 7. *Earthworm length measurements over time*

3.4. Three- tier vermicomposting bin mmodel

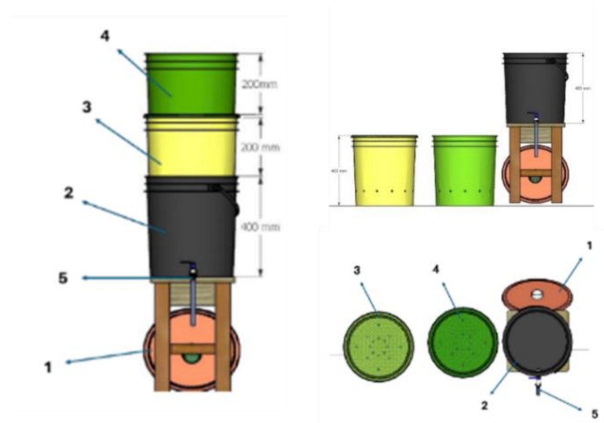


Figure 8. *Three-tier vermicomposting bin model for households*
1- The lid; 2- The bottom bin; 3- The middle bin;
4- The top bin; 5- Vermiwash drain

The three-tier vermicomposting model was proposed based on the results of 5-liter container trials, which provided controlled data on substrate-specific decomposition and worm development. The multi-tier design supports semi-continuous operation, self-sorting of vermicast, and worm migration, addressing limitations of static bins in domestic settings. The earthworm-to-waste ratio of 1:3 (by fresh weight) was selected from both literature and field trial observations, balancing efficient decomposition with biological safety for P. excavatus. This ratio ensures substrate is consumed within 2–3 weeks, limits leachate accumulation, and supports worm reproduction cycles, making it scalable for household adoption. The basal container functions as a reservoir for the collection of vermiwash produced during decomposition, and features a discharge tap to facilitate convenient retrieval and application as a liquid fertiliser. The middle and upper containers house near-fully decomposed organic matter, establishing an optimal habitat for the earthworms. The uppermost container serves as the input layer for fresh organic waste, providing a readily available food source that encourages active earthworm processing and the continuation of waste decomposition. The upper and middle containers are interconnected via small perforations drilled into the base of the upper container. These apertures permit the unimpeded movement of earthworms between the layers. When the earthworms require additional organic material, they exhibit a natural upward migration into the uppermost container to continue the decomposition process and generate vermicompost.

Figure 9. *Practical three-tier vermicomposting bin*

The three-tier vermicomposting bin was constructed from three 20-litre plastic containers, each equipped with a lid, and has overall dimensions of Ø355 mm (top) × Ø315 mm (base) × H361 mm (height). The uppermost and middle containers each feature 12 drainage apertures at their base and 10 ventilation apertures (approximately 5 mm in diameter) along their sides. The lowermost container is fitted with a tap for the extraction of vermiwash. The uppermost container provides a usable volume of 20 litres (utilising its full capacity), serving as the chamber for the introduction of fresh organic waste. The middle container offers a usable volume of 10 litres (50% of its capacity), where partially decomposed waste undergoes further processing. The basal container, also with a 10-litre capacity, functions as the vermiwash collection reservoir. Based on the temporal organic waste reduction rates presented in Figure 5, and employing a worm-to-organic-waste ratio of 1:3 (50 grams of worms per 150 grams of organic waste), coupled with an organic waste density of 300 g/L, the maximum organic waste capacity of each container and the corresponding earthworm biomass required for decomposition can be readily estimated. Consequently, with a usable volume of 10 litres, the middle container can accommodate up to 3,000 grams of organic waste, requiring 1,000 grams of earthworms for processing. Similarly, the uppermost container, with a usable volume of 20 litres, can hold up to 6,000 grams of organic waste.

To establish a continuous and reliable supply of nutrient-rich vermicompost for households while ensuring the uninterrupted processing of organic waste, this research proposes the concurrent operation of two identical three-tier vermicomposting units in an alternating cyclical manner. The operational protocol commences with Unit 1, wherein household kitchen waste is initially introduced into the intermediate 10-litre tier. Upon reaching its full capacity, the upper 20-litre tier is engaged for subsequent waste loading. The kitchen waste input process followed a semi-continuous feeding regime. From day 1 to day 21, fresh waste (444 g/day) was added daily to Unit 1, mimicking typical household disposal behavior. Given the empirically determined average daily household waste generation of 444 grams, the total accumulated organic waste within Unit 1 is projected to reach 9,324 grams by the culmination of a 21-day loading phase. From day 22 to day 42, the system was left undisturbed to allow stabilization and vermicast maturation. This approach balances decomposition kinetics with worm health and bin management simplicity. Concurrently, from day 22 onwards, all newly generated household organic waste is diverted to Unit 2, thereby initiating an identical 21-day loading cycle. While Unit 2 is actively receiving and processing fresh organic waste, Unit 1 continues its decomposition and stabilisation phase in a quiescent state. By day 42, the vermicompost within Unit 1 will have undergone complete processing and achieved a state of stable maturity, rendering it ready for harvesting. At this juncture, an estimated 4,200 grams of high-quality vermicompost can be recovered for direct application as a potent organic fertiliser in household gardening initiatives or broader crop cultivation practices. Throughout the entire vermicomposting process, each unit is meticulously covered to maintain optimal internal humidity levels, crucial for earthworm activity, and to effectively prevent the unwanted egress of the earthworm population.

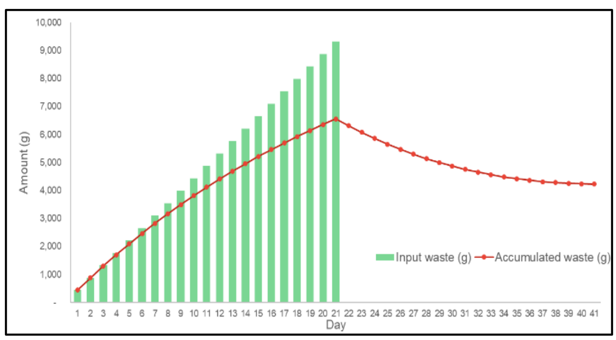


Figure 10. *Accumulation and decomposition of waste over time*

All vermicomposting units were placed in a shaded and ventilated area, protected from direct sunlight, rainfall, and wind. The environmental conditions maintained were aligned with the known habitat preferences of P. excavatus, which thrives under indoor ambient air temperatures, low light exposure, and high humidity. Bin design included drainage holes, aeration slots, and layered substrates to support worm movement and aeration. This carefully orchestrated alternating operational cycle between the two identical vermicomposting units ensures a continuous and sustainable treatment pathway for household-generated organic waste, concurrently providing a reliable and ongoing supply of high-quality, nutrient-rich vermicompost for diverse household applications, thereby contributing to a more circular and environmentally conscious approach to waste management at the domestic level. The temporal dynamics of this process, specifically the daily organic waste input and the resultant accumulated organic waste mass within the three-tier vermicomposting bin over a 41-day period, are clearly illustrated in Figure 10, which demonstrates a significant reduction in waste mass from the initial 9,324 grams to a stable 4,000 grams by day 41, representing an approximate 45% reduction and confirming the model's effectiveness in transforming household organic waste into a valuable agricultural resource.

After harvesting, the worms can be reused in subsequent composting cycles, utilized as a high-protein feed for poultry, fish, or amphibians, or shared with other households to expand local vermicomposting efforts. Alternatively, if not collected separately, earthworms may be released directly into garden soil along with the vermicast, where they continue to enhance nutrient cycling and improve soil structure and fertility. These post-harvest applications increase the practical utility of the system and underscore its role in promoting circular, low-waste models of household organic waste management.

Figure 11. *Vermicomposting cast after 42 days*

4. Conclusion

In conclusion, this research underscores the efficacy of household vermicomposting as a sustainable solution for the pressing issue of organic waste management in rapidly urbanising areas like Da Nang. The three-tier pilot system, employing earthworms, efficiently converted kitchen waste into valuable vermicompost, achieving significant volume reduction within 21 days, particularly with pre-sorted, high-moisture food waste. A 1:3 earthworm-to-waste ratio in a rotational two-unit system enables continuous processing. While optimised for vermicompost production, the model's suitability for solely increasing earthworm numbers may be limited by high oil, salt, or spice content in certain food waste. Therefore, source separation of amenable, high-moisture, low-salt organic matter is recommended. The resulting nutrient-rich vermicompost offers dual environmental and agricultural benefits as an organic fertiliser, making household vermicomposting a practical, eco-friendly approach with significant potential to reduce landfill burden and foster urban sustainability.

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