



Vermiculture: A Sustainable Approach to Solid Waste Management and Soil Health Enhancement

*¹ Thabbe Nivedita

*¹ Lecturer, Department of Zoology, D.M.S. Mandal's, Bhauroa Kakatkar College, Belagavi, Karnataka, INDIA.

ARTICLE DETAILS

Article History:

Received Date: 19-03-2026

Revised Date: 22-03-2026

Accepted Date: 24-03-2026

Published Online: 26-03-2026

Keywords

Solid Waste Management, Vermiculture, Vermicomposting, Organic Waste Recycling, Sustainable Agriculture

* Corresponding Author

Email: niveditarthabbe11@gmail.com

ABSTRACT

Abstract: The rapid increase in solid waste generation due to urbanization, population growth, and industrial development has emerged as a major environmental challenge worldwide. In India, nearly 25 million tonnes of urban solid waste are generated annually, with a significant proportion being biodegradable. Conventional disposal methods such as open dumping and landfilling contribute to soil and water pollution, necessitating eco-friendly alternatives. Vermiculture biotechnology, which utilizes earthworms as natural bioreactors, offers an efficient and sustainable solution for converting organic waste into nutrient-rich compost. This process not only reduces environmental degradation but also enhances soil fertility and supports agricultural productivity. Additionally, vermicomposting has the potential to generate employment and promote rural development. Global experiences demonstrate its scalability and effectiveness, highlighting the need for wider adoption and standardization in India. Therefore, vermiculture presents a promising, cost-effective strategy for integrated solid waste management and sustainable development.

1. Introduction

Management of solid waste has become one of the biggest problems we are facing today. The rapid increase in the amount of waste is one aspect of the environmental crisis, accompanying recent global development (rapid urbanization encroachment of fertile area and booming population is leading to generation of massive waste).

Solid waste is defined as the organic and inorganic waste materials produced by different sources and have lost value in the eye of their owner. It has been estimated that India as a whole, generates as much as 25 million tons of urban solid waste of diverse composition per year. But per capita waste production in India is minuscules compared to the per capita production of wastes in the industrialized countries. It is estimated that the per capita waste generated in India is about 0.4 kg/day with the compostable matter approximately 50-60%. Most common practices of waste processing are uncontrolled dumping which causes mainly water and soil pollution; besides dumping or sanitary land filling, the final disposal of solid waste can be carried out by other methods like incineration and composting. Earthworm farming (vermiculture) is another bio-technique for converting the solid organic waste into compost. An innovative discipline of vermiculture biotechnology, the breeding and propagation of earthworms and the use of its castings has become an important tool of waste recycling the world over. Essentially, the vermiculture provides for the use of earthworms as natural bioreactor for cost-effective and environmentally sound waste management. Now there is an all-round recognition that adoption and exploitation of vermiculture biotechnology besides arresting ecological degradation could go a long way towards meeting the nutrient needs of the agricultural sector in a big way. On another front, widespread use of vermicultural biotechnology could result an increased employment opportunity and rapid development of the rural areas. It is high time that the scientific community of the country gave a serious attention to standardizing and popularizing vermiculture technology on a countrywide basis. Role of earthworms in the breakdown of organic debris on soil surface and soil turn over process was first highlighted by Darwin (1881). Since then, it has taken almost a century to appreciate their important contribution in curbing organic pollution and providing topsoil to impoverished lands. Although this realization has awakened the global population to give a serious thought to utilize them for the benefit of mankind, by the turn of this century (Kale, 1998). Vermicomposting was started in Ontario (Canada) in 1970 and is now processing about 75 tons of refuse per week. American Earthworm Company (AEC) began a farm in 1978-79 with about 500 tones capacity per month. Aoka Sangyo Co. Ltd., Japan has three 1000 tons per month plants processing wastes from pulp and food industries. Besides these, there are about 3000 other vermicomposting plants in Japan with 5-50 tones capacity per month. It has also started in Italy and in the Philippines. It is now time for India to think about vermiculture technology commercially (Palaniappan et.al., 2005).

2. Methodology

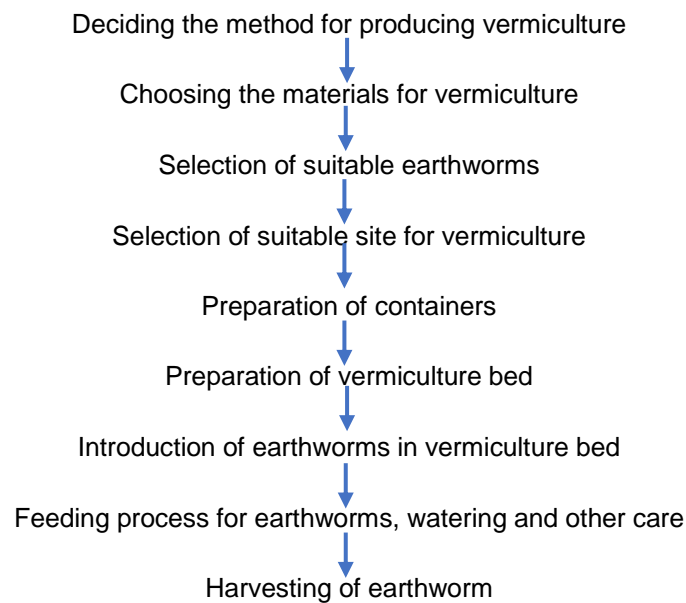
For this study, two vermi pots with different feeding materials were prepared i.e; cow dung and vegetable waste accordingly. 4 sets of each pot were prepared to observe the growth, egg laying capacity and larva ratio for the duration four months.

2.1. Vermiculture procedure

The main purpose of Vermiculture is to Breed and culture the worms, and they need to be harvested i.e., counting the number of worms. So, it becomes necessary to take care that the worms do not spread in ground, for this reason we chosen earthen pots for culturing earthworms.

The ground contains many microorganisms and other harmful insects which can easily cause infections and damage to earthworms.

During rainy season the ph, temperature and other required conditions for the proper growth of earthworms becomes unfavorable. On the other hand, the earthen pots can be shifted in places having Favorable conditions. Feeding and watering process becomes easy. The bin can be easily covered by muslin cloth to prevent scaping of earthworms. The earthen pots we selected for vermiculture are about 30 cm in depth and 25 cm broad at top and 0 cm broad at bottom. Likewise, we performed vermiculture in 8 earthen pots. A hole is constructed at e bottom of the pot for drainage. The Earthen pot is having better aeration than cemented pots. The pots are kept in a shed, protected from harsh environmental conditions and microorganisms etc.



2.2. Materials required

- Crop leftovers
- Vegetable scraps
- Excrement from cattle
- Leaves, dried.
- Sand, bricks, black soil
- Shed
- Pits
- Cloth/cardboard for covering
- Availability of water
- Earthworms

2.3. Selection of earthworm species

Earthworm selection is the most important step in vermiculture. The selected earthworm should have high metabolic rate and high reproduction rate. We chose *Eisenia fetida*, also known as red wiggler, is the most common earthworm used for vermiculture all over the world. This is due to their high metabolic rate and reproductive rate. They are

epigean, rarely found in soil. Red wigglers are reddish-brown in color, have small rings around their body and have a yellowish tail. They have groups of bristles (called setae) on each segment. *E. fetida* is hermaphroditic, and uniparental reproduction is possible, even if usually the reproduction is between copulating individuals. After copulation both worms then secrete cocoons which contain several eggs each. These cocoons are lemon-shaped and are pale yellow at first, becoming more brownish as the worms inside become mature. These cocoons are clearly visible to the naked eye. At 25°C *E. fetida* hatches from its cocoon in about 3 weeks.

2.4. Selection of site for vermiculture

The site should have favorable environmental conditions for luxuriant growth and high reproductive rate of earthworms. Vermiculture pot is kept in cool, shady place to maintain optimum temperature around 18 to 25°C for proper decomposition. Optimum moisture level is 30 - 40% is maintained by regular sprinkling of water. The site should be free from microorganisms, fungi and insects.

2.5. Preparation of vermiculture bed

- An appropriate container is chosen, made a hole at the base for drainage. The bottom layer of the bed is composed of grounded bricks. Bricks help to maintain the temperature and hold on moisture. This layer is about 5 cm in height.
- The second layer is of course grained sand which helps in aeration and movement of earthworms. This layer is 5 cm in deep.
- The third layer is made by black soil. It has high water holding capacity and more elements that serve great for plant growth. This layer is 15cm deep.
- Next layer is of dried leaves; dried crop leftovers above thus layer a uniform amount of cow dung is added. Cow dung is rich in organic matter and it also contains beneficial microorganisms that help in vermicomposting. Now the vermiculture bed uniformly watered and left dire for 1 5 days for Decomposition.

2.6. Feeding process

There are two different types of feed provided to check the reproduction rate at different feeds.

- Type 1 feed - It includes all the kitchen waste like tea powder, leafy vegetable, cooked and uncooked food, etc.
- Type 2 feed - It includes the cow dung.

Watering process- Watering is done once in 2 days during low humid environment and once in 4 days during medium and high humid environment. Care should be taken that the moisture content of the bed should be 40-50%.

2.7. Harvesting of earthworms

- Harvesting may be gradual or in bulk at one time. It is normally done during the daytime for ease in separating the earthworms.
- The vermicompost is ripe and ready for harvest when the raw materials, except for a few, particularly pieces of a woody stem, are fully decomposed.
- The height of the pile would have dropped down to about one-third to one-half of that of the original pile, and the pile temperature would be close to ambient temperature.
- The organic substrates are no longer distinguishable and the vermicompost appears somewhat darkish brown, crumbly, and smells earthy, like that of freshly excavated fertile soil.
- There are three major techniques in Vermiculture for harvesting worms. These are Manual, Migration and Mechanical.
- Manual Method of Harvesting - This method is generally used by framers for small-scale businesses of selling worms. The worms are harvested from the soil directly by using hands.

- The organic material which contains earthworms is kept on a flat surface and exposed to sunlight. it should be noted that earthworms are sensitive to light, so once they are exposed to sunlight they dive below the surface.
- The harvester will then remove the organic layer above and once the worms are seen they are harvested.

3. RESULT

After harvesting the vermicompost, each pot is examined for reproduction rate of earthworms from set-1 and set-2 in each pot.

Table 1
Reproduction rate of in Cow dung (in reach pot)

POT NO.	No. of Earthworms Introduced	Adults	Larvae	Eggs	Total
POT NO.1	30	36	11	30	47
POT NO.2	30	34	11	00	109
POT NO.3	30	30	04	00	34
POT NO.4	30	31	18	00	49
TOTAL	120	131	108	30	239

Table 2
Reproduction rate of in Kitchen Waste (in reach pot)

POT NO.	No. of Earthworms Introduced	Adults	Larvae	Eggs	Total
POT NO.1	30	14	32	00	46
POT NO.2	30	22	20	00	42
POT NO.3	30	50	15	00	65
POT NO.4	30	45	05	00	50
TOTAL	120	111	72	00	203

After harvesting results shows that both set of cow dung and kitchen waste compost are odourless or no foul smell and all the colour of compost from both set are changes from dark brown to black. The cow dung compost is light weight containing of approximately 10-25% of moisture and kitchen waste compost is quite heavier, because it contains approximately 20-25% of moisture.

Table 3
Collection of Litter Waste (Consolidated)

Week	1 st week	2 nd week	3 rd week	4 th week
Weight	26.3kg	10.33kg	13.6kg	12.5kg
Waste type	Dry	Dry	Dry	Dry

The total amount of litter added in the vermiculture is Average 15.6 kg

Conclusion

During this study, we observed the reproductive patterns of earthworms under two different feeding conditions. The results showed that the earthworms in Set 1, which were fed cow dung, exhibited a higher reproduction rate compared to those in Set 2, which were fed vegetable waste. This difference can be attributed to the presence of fungal contamination in Set 2, as vegetable waste tends to attract insects and other organisms that may negatively affect earthworm growth and reproduction. In contrast, cow dung appears to provide a more suitable environment, possibly acting as a natural insect repellent and offering better nutritional support. Although vegetable waste does contain nutrients, the associated contamination and unfavorable conditions likely reduced reproductive efficiency. Therefore, it can be concluded that cow dung is a more effective feed for enhancing the reproduction rate of earthworms compared to vegetable waste.

References

1. Suthar, S. (2007). Effect of different organic wastes on the growth and reproduction of *Eisenia fetida*. *Bioresource Technology*, 98(6), 1233–1237.
2. Edwards, C. A., Arancon, N. Q., & Sherman, R. (2011). Vermicomposting of organic wastes: A review. In *Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management* (pp. 1–26). CRC Press.
3. Kale, R. D., Bano, K., & Krishnamoorthy, R. V. (1982). Biological efficiency of earthworms in vermicomposting of vegetable wastes. *Pedobiologia*, 23, 419–425.
4. Ndegwa, P. M., & Thompson, S. A. (2001). Integrating composting and vermicomposting in the treatment and bioconversion of biosolids. *Bioresource Technology*, 76(2), 107–112.
5. Loh, T. C., Lee, Y. C., Liang, J. B., & Tan, D. (2005). Vermicomposting of cattle and goat manures by *Eisenia fetida* and their growth and reproduction performance. *Bioresource Technology*, 96(1), 111–114.
6. Sinha, R. K., Agarwal, S., Chauhan, K., & Valani, D. (2010). The wonders of earthworms and its vermicomposting in farm production. *Journal of Agricultural Science*, 2(1), 76–94.
7. Aira, M., Monroy, F., & Domínguez, J. (2007). Earthworms strongly modify microbial biomass and activity triggering enzymatic activities during vermicomposting independently of the application rates of pig slurry. *Science of the Total Environment*, 385(1–3), 252–261.
8. Reinecke, A. J., Viljoen, S. A., & Saayman, R. J. (1992). The suitability of *Eudrilus eugeniae*, *Perionyx excavatus* and *Eisenia fetida* for vermicomposting in Southern Africa in terms of their temperature requirements. *Soil Biology and Biochemistry*, 24(12), 1295–1307.