

# Vermicomposting - A Boon for Waste Minimization and Soil Quality

Sunil J. Kulkarni

Datta Meghe College of Engineering, Airoli, Navi Mumbai, Maharashtra, India

## ABSTRACT

The solid waste from garbage and household materials, flowers and waste food needs proper treatment as it can contaminate groundwater resources. The most commonly used method for waste treatment is open dumping. This method is cheap but dangerous from health perspectives. Vermicomposting is one of the most practiced methods for domestic and household solid waste. In this, earthworms feed on anything that is biodegradable. Extra care is needed to prevent plant damage as high plant nutrients and plant growth stimulators can inhibit seed germination and growth to some degree. Investigations indicated increase in the parameters like total nitrogen (%), Available phosphorus (%) and Exchangeable potassium (%). Vermicomposting may supply an opportunity for employment. Many investigations have been reported on vermicomposting. The current review provides an insight on studies and research on vermicomposting.

**Key words:** Incineration, anaerobic and aerobic digestion, stabilization, pre-compost, landfill.

## INTRODUCTION

The municipal waste treatment creates sizeable amount of waste sludge. Also the solid waste from garbage and household materials, flowers, domestic food waste needs proper treatment as it can contaminate groundwater resources. <sup>[1]</sup> The most commonly used method for solid waste treatment is open dumping. This method is cheap but dangerous. The waste is exposed to atmosphere, which deteriorates air quality and smells very badly. Sanitary landfill is better alternative.

Other methods such as incineration, anaerobic and aerobic digestion can be used for solid waste. <sup>[2-4]</sup> Some specific waste materials can be used for synthesis of ethanol like compounds. <sup>[5,6]</sup> Anaerobic methods reduce the volume and also provide methane gas which can be used as a fuel. <sup>[7-9]</sup> Vermicomposting is one of the most practiced methods for domestic and

household solid waste. In this, earthworms feed on anything that is biodegradable. This method does not have any adverse effect on the soil. <sup>[10]</sup> The vermin-composting technology helps in organic waste management. The method is in accordance with the principles of sustainable development. <sup>[11]</sup>

## VERMICOMPOSTING- A BOON FOR WASTE MINIMIZATION AND SOIL QUALITY

Manaf et.al.carried out investigation on influences of bedding material in vermicomposting process. <sup>[12]</sup> They considered the parameters like the growth rate (pH), number of worm, number of cocoons and worm biomass. They carried out Dunken test which demonstrated that newspaper bedding was more influential in worm biomass production. They also observed that sawdust bedding was better for cocoons

production and number of worm. Quaik et.al. review edpotential of vermicomposting leachate as organic foliar fertilizer and nutrient solution in hydroponic culture. [13] According to them, a green technology that produces vermicompost, which has been proven to be effective as a plant nutrient supplement. According to them, extra care is needed to prevent plant damage as high plant nutrients and plant growth stimulators can inhibit seed germination and growth to some degree. Subbulakshmi and Thiruneelakandan observed that vermicomposting improves the soil structure, enhancing soil fertility, moisture holding capacity and in turn increase the crop yield. [14] According to them earthworm can solve various environmental problems from waste management to land fertility.

Albasha et.al. carried out investigation on kitchen waste treatment by vermicomposting with Earthworm, *Eudrilus Eugeniae*. [15] They mixed a mixture of kitchen waste and cow dung. They obtained good quality of compost in 60 days. During vermicomposting, they observed increase in the parameters like total nitrogen (%), available phosphorus (%) and exchangeable potassium (%). Also they observed a decrease in pH. Sarma et.al. conducted studies on the efficiency of the low cost vermicomposting unit as compared to conventional units. [16] They conducted experiments at Dryland Technology Park, (All India Coordinated Research Project for Dryland Agriculture) Biswanath Chariali Center Biswanath College of Agriculture, Assam. They used locally available low cost materials such as bamboo, dried banana leaves for fabrication of Low cost vermicomposting units. They used five replicated randomized block designs consisting of 4 treatments. They carried out experiments with four pathways, namely Vermicomposting in concrete tanks (Control)(T1), Vermicomposting in low cost vermincomposting unit[2.5 m(L) X 1.2 m(B) X 0.76 m(D)](T2), Vermicomposting in low cost vermincomposting tanks[2.5

m(L)X1.2m(B)X0.46](T3),Vermicomposting in low cost vermincomposting tanks with dimension 2.5 m(L) X 1.2 m (B) X 0.76 m(D),(T4). According to them, by adopting the low cost technology, the farmers can get substantial benefit and augment farm income.

Dominguez and Gomez-Brandon studied composting with earthworms. They explored recycling organic wastes. [17] They investigated the ability of *E. Andrei* to alter the structure and activity of microbial communities through the gut associated processes. Also their investigation included the effectiveness of the active phase of vermicomposting for the short-term stabilization of a plant residue. They observed decrease in population of bacteria in cow manure after transit through the earthworm gut. Also they found that microbial activity was reduced by 30 percent after transit of the organic material through the gut of the earthworm *E. Andrei*. Mupondi et.al. evaluated the effectiveness of different precomposting periods on the sanitization and vermi-composting of dairy manure-waste paper mixtures. [18] They found that within seven days of precomposting, over 95% of fecal coliforms, *Escherichia coli* and of *E. coli* 0157 were eliminated. Also they found that with increase in pre-composting time, microbial biomass carbon and water soluble carbon of waste mixtures decreased. They concluded that a pre-composting period of 1 week was ideal for the effective vermicomposting of dairy manure-waste paper mixtures. According to Londhe and Bhosale, existing waste dumping sites are full beyond capacity. [19] Also these sites lead to unhealthy conditions. They considered vermi-composting as a better alternative. Recycling of different type of organic waste was tried by them. They monitored temperature on weakly basis. After 45 day composting, they observed increase in nutrient content. Ndegwa and Thompson investigated vermi-composting of bio-soilds for effect of C-to-N ratio. [20] According to them, different earthworm

species impact differently by C-to-N ratio and feed mixture type. They established a suitable C-to-N ratio for vermicomposting of fresh bio-solids. Highest stability of the product was obtained at C-to-N ratio of 25.

Koff et. al. discussed household composting with worms. [21] According to them, vermicompost is primarily earthworm excrement. It can improve soil's biological, chemical, and physical properties. According to their studies, plant growth regulators that can enhance plant growth are also present in vermicomposts. Quaik and Ibrahim carried out a review on potential of vermicomposting derived liquids in agricultural use. [22] According to them, use of the liquid byproducts has potential to provide green technology solution. Liquid contain vermicomposting leachate, urine, cow dung, green forage etc. which have high nutrient value. Aalok et. al. discussed vermicomposting as a better choice for solid waste management. [23] They explained various aspects such as vermiculture, vermicomposting and vermicomversion. According to them, vermicomposting in developing countries could prove to be useful. Also they pointed out that vermicomposting may supply an opportunity for employment in areas where creation of low or semi-skilled jobs is considered advantageous. Kashmet et. al., in their work, compared the effect of vermicompost and inorganic fertilizers on vegetative growth and fruit production for tomato. [24] They observed that there was considerable effect on factors shoot length, number of leaves, dry matter weight of shoots and roots, fruit number and fruit weight after the application of vermicompost and NPK fertilizer in the growth media. They also observed that as compared to the plants grown in the inorganic fertilizer amended soil pots, the growth performance of tomato was better in the vermicompost amended soil pots. Bakar et. al. carried out investigation on vermicomposting of vegetable waste (VW) spiked with multiple sources of agro-industrial waste. [25] They precomposted the

waste for 18 days followed by 70 days vermicomposting. Due to the multiple increase of earthworm biomass and number, amendment was required. 50 percent of VW was found to be best amendment for vermiculture by them.

Suthar and Singh used two epigeic earthworms for vermicomposting of domestic waste. [26] They observed maximum mineralization and decomposition rate in experimental container with *P. sansibaricu* than that of *P. excavates*. Also they observed that, *P. sansibaricus* process showed about 6% more total nitrogen. They also observed the parameters like mean individual live weight, maximum individual growth rate (mg wt./worm/day), number of cocoons and reproduction rate (cocoon/worm/day). These values were higher for bedding with *P. sansibaricus*. According to Nagavallema et. al. the degradation of soil is a major concern. [27] They observed that the water holding capacity and nutrient supplying capacity of soil can be enhanced by amending with good quality organic soil additives. They used dry organic waste containing sorghum straw and rice straw (after feeding cattle), dry leaves of crops and trees, pigeonpea (*Cajanuscajan*) stalks, groundnut (*Arachishypogaea*) husk, soybean residues, vegetable wastes, weed (*Parthenium*) plants before flowering, fiber from coconut (*Cocosnucifera*) trees and sugarcane (*Saccharumofficinarum*) trash. Also animal manures, dairy and poultry wastes, food industry wastes, municipal solid wastes, biogas sludge and bagasse from sugarcane factories worked as handy for vermicomposting. Thiruneelakandan and Subbulakshmi pointed out the fact that chemical fertilizers reduce land productivity. [28] According to them, green manures are effective alternatives to chemical fertilizers. Use of organic inputs like well decomposed organic manure or vermicompost can help in improving the soil fertility. Soil amendment by using vermicomposting for main fields is very effective alternative to improve soil quality.

Sequeira and Chandrashekar investigated biodegradable residential solid waste for vermicomposting. [29] They divided this waste as food waste, paper waste, vegetable waste and garden trimmings with grass and leaves. In converting residential waste into vermicompost, *Eudrilus* species were found to be very effective. According to their studies, even dilute cow dung slurry is sufficient to practice vermicomposting in a small scale. Chan et. al. investigated greenhouse gas (GHG) emissions from three different home waste treatment methods namely aerobic composting, anaerobic digestion and vermicomposting. [30] They observed that the aerobic composting bins released lower amounts of CH<sub>4</sub>. The vermicomposting released intermediate amount of methane and anaerobic method released maximum amount of methane. Vermicomposting released least amount of N<sub>2</sub>O. According to them, compared to centralized composting and anaerobic digestion facilities, landfilling and incineration; home composting has potential for reducing GHG emissions.

## CONCLUSION

Vermicomposting is one of the most practiced methods for domestic and household solid waste. In this, earthworms feed on anything that is biodegradable. Extra care is needed to prevent plant damage as high plant nutrients and plant growth stimulators can inhibit seed germination and growth to some degree. It has advantages over anaerobic digestion. In anaerobic digestion the foul smell causes irritation to people in nearby locality. Aerobic digestion method is time consuming, costly and needs more space. Additional advantage of improving the soil fertility and soil amendment makes this method more acceptable.

## REFERENCES

1. Ololade, I.A., Adewunmi, A. Ologundudu, A. and Adeleye, A., "Effects of Household Wastes on Surface and Underground Waters", International

- Journal of Physical Sciences, 2009, 4(1), 022-029.
2. N.H.S. Ray, M.K. Mohanty, R.C. Mohanty, "Anaerobic Digestion of Kitchen Wastes: Biogas Production and Pretreatment of Wastes, A Review", International Journal of Scientific and Research Publications, 2013, 3(11), 1-6.
3. Patil V.S. and Deshmukh H.V., "Anaerobic Digestion of Vegetable Waste for Biogas generation: A Review", International Research Journal of Environment Sciences, 2015, 4(6), 80-83.
4. Apte, V. Cheernam, M. Kamat, S. Kamat, P. Kashikar, and H. Jeswani, "Potential of Using Kitchen Waste in a Biogas Plant", International Journal of Environmental Science and Development, 2013, 4(4), 370-374.
5. Sunil Jayant Kulkarni, "Food Waste Utilization: An Insight into Research and Studies", International Journal of Ethics in Engineering & Management Education, 2016, 3(8), 1-4.
6. Sunil J. Kulkarni, Nilesh L. Shinde, Ajaygiri K. Goswami, "A Review on ethanol production from agricultural waste raw material", International Journal on Scientific Research in Science, Engineering and Technology, 2015, 1(4), 231-233.
7. Sunil J. Kulkarni, "An insight into research and studies on biogas generation from waste", International Journal of Research and Review, 2016, 3(5), 78-81.
8. Rebecca Sebola, Habtom Tesfagiorgis, and Edison Muzenda, "Production of Biogas through Anaerobic Digestion of various Waste: Review", Intl' Conf. on Chemical, Integrated Waste Management and Environmental Engineering (ICCIWEE'2014) April 15-16, 2014 Johannesburg, 196-205.
9. Ravi P. Agrahari, G. N. Tiwari, "The Production of Biogas Using Kitchen Waste", International Journal of Energy Science, 2013, 3(6), 408-415.
10. Danilo V. Rogayan Jr., Edjohn Harold F. Tomboc, Andrew V. Paje, Karl Lyndon P. Lim, John Arthur R. Ararro, Jestoni G. Ocampo, Lashaundra Mae D. Ballon, Monina Joy S. Ico, Werlyn R. Corpus, Hazel S. Gregorio, "Research Paper On Vermiculture And Vermicomposting", Undertaken By Bachelor Of Secondary Education, Biological Science Major Third Year

- Students At Ramon Magsaysay Technological University, SanMarcelino, Zambales, Presented To: Prof. Mila Mariñas Patrian, In Partial Fulfillment Of The Requirements For Major 6 (Ecology) October 2010, 1-23.
11. Joanna Kostecka, MariolaGarczyńska, GrzegorzPączka, JanuszMroczek, “Modelling the Processes of Vermicomposting in an Ecological Box – Recognized Critical Points”, Contemporary Problems of Management and Environmental Protection (Some Aspects of Environmental Impact of Waste Dumps), 2011, 9, 143-156.
  12. LatifahAbdManaf, MohdLokmanCheJusoh, MohdKamilYusoff, TengkuHanidzaTengku Ismail, RostaHarun and HafizanJuahir, “Influences of Bedding Material in Vermicomposting Process”, International Journal of Biology, 2009, 1(1), 81-91.
  13. ShlreneQuaik, AshaEmbrandiri, Parveen F. Rupani and Mahamad H. Ibrahim, “Potential of Vermicomposting Leachate as Organic Foliar Fertilizer and Nutrient Solution in Hydroponic Culture: A Review”, 2nd International Conference on Environment and BioScience IPCBEE, IACSIT Press, Singapore, 2012, 44(10), 43-47. DOI: 10.7763/IPCBEE. 2012.
  14. G.Subbulakshmi, R.Thiruneelakandan, “Vermicomposting Is Valiant In Vandalizing The Waste Material”, International Journal of Plant, Animal and Environmental Sciences, 2011, 1(3), 134-141.
  15. Mohamed Omer Albasha, P.Gupta, and P.W. Ramteke, “Management of Kitchen Waste by Vermicomposting Using Earthworm, *EudrilusEugeniae*”, International Conference on Advances in Agricultural, Biological & Environmental Sciences (AABES-2015), July 22-23, 2015, London(UK),81-84.
  16. P.K.Sarma, P.Saikia, T.C.Baruah, “A study on the efficiency of low cost vermicomposting structure”, Rahmann G andAksoy U (Eds.) (2014) Proceedings of the 4th ISOFAR Scientific Conference. ‘Building Organic Bridges’, [Rahmann G &Aksoy U (Eds.)] (2014) at the Organic World Congress 2014, 13-15 Oct., Istanbul, Turkey (eprint ID 23720), 663-666.
  17. Jorge Dominguez and Maria Gomez-Brandon, “Vermicomposting: Composting with Earthworms to Recycle Organic Wastes”, IntechOpen, Management of Organic Waste, 2012, 1, 29-50.
  18. Lushian T Mupondi, Pearson NS Mkeni and Pardon Muchaonyerwa, “Effects of a precomposting step on the vermicomposting of dairy manure–waste paper mixtures”, Waste Management & Research, 2011, 29(2), 219-228.
  19. P.B.Londhe, S.M.Bhosale, “Recycling Of Solid Wastes Into Organic Fertilizers Using Low Cost Treatment: Vermicomposting”, International Journal Of Innovations In Engineering Research And Technology, 2015, 2(6), 1-11.
  20. Pius M. Ndegwa, S.A. Thompson, “Effects of C-to-N ratio on vermicomposting of biosolids”, Bioresource Technology, 2000, 75, 7-12.
  21. Jason P. de Koff , Brad D. Lee, Michael V. Mickelbart, “Household Composting with Worms”, Home and Environment, Purdue Extension, 2005, 1,1-8.
  22. ShlreneQuaik, MahamadHakimi Ibrahim, “A Review on Potential of Vermicomposting Derived Liquids in Agricultural Use”, International Journal of Scientific and Research Publications, 2013, 3(3), 1-6.
  23. AshaAalok, A.K. Tripathi and P. Soni, “Vermicomposting: A Better Option for Organic Solid Waste Management”, J. Hum. Ecol., 2008, 24(1), 59-64.
  24. Md. AbulKashem, AshokaSarker, Imam Hossain, Md. Shoffikul Islam, “Comparison of the Effect of Vermicompost and Inorganic Fertilizers on Vegetative Growth and Fruit Production of Tomato (*SolanumlycopersicumL.*)”, Open Journal of Soil Science, 2015, 5, 53-58.
  25. Azizi Abu Bakar, SyarifahNurulAfzan Syed Mohd Gawi1, Noor ZalinaMahmood, Noorlidah Abdullah, “Vermicomposting of Vegetable Waste Amended with Different Sources of Agro-Industrial By-Product Using *Lumbricusrubellus*”, Pol. J. Environ. Stud., 2014, 23(5), 1491-1498.
  26. S. Suthar, S. Singh, “Vermicomposting of domestic waste by using two epigeic earthworms (*Perionyxexcavatus* and *Perionyxsansibaricus*)”, Int. J. Environ. Sci. Tech., 2008, 5 (1), 99-106.
  27. Nagavallema K P, Wani S P, StephaneLacroix, Padmaja V V, Vineela C, BabuRao M and Sahrawat K L,

- “Vermicomposting: Recycling wastes into valuable organic fertilizer. Global Theme on Agrecosystems”, 20014, Report no. 8., Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics., 1-20.
28. R.Thiruneelakandan, G.Subbulakshmi, “Vermicomposting: A Superlative For Soil, Plant, And Environment”, International Conference on Engineering Technology and Science-(ICETS'14), International Journal of Innovative Research in Science, Engineering and Technology, February 2014, 3(Special Issue 1), 930-938.
29. Vincent Sequeira and J.S. Chandrashekar, “Vermicomposting of Biodegradable Municipal Solid Waste Using Indigenous Eudrilus Sp. Earthworms”, Int.J. Curr.Microbiol. App.Sci., 2015, 4(4), 356-365.
30. Yiu C Chan, Rajiv K Sinha and Weijin Wang, “Emission of greenhouse gases from home aerobic composting, anaerobic digestion and vermicomposting of household wastes in Brisbane (Australia)”, Waste Management and Research, 2010, 29(5), 540–548.

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