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Vermicomposting- A better and more efficient approach for waste management and production of organic manure

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Introduction:

The generation of a huge amount of organic waste from various sectors of society directly leads to environmental degradation. The huge population size of India is one of the major waste generation and management problems. India is producing a large amount of garbage (biodegradable solid waste, such as kitchen waste, paper waste, natural waste, plant leaves, municipal solid waste, cow dung, and so on) that could be harmful to humans as well as the environment. India is a developing country where the majority of people reside in rural areas approximately 64.61%. Most of the population in India depends on agricultural practices to survive.

Environmental organizations and governments are searching for novel ways to manage these wastes effectively, sustainably, and cheaply to reduce. Vermicomposting is a less expensive and environmentally friendly method of composting biodegradable waste. Since 1881, Darwin has recognized the importance of earthworms in the production of vermicompost from biodegradable organic waste. They play a very crucial role in soil fertility because they increase porosity in the soil and release nutrients from their manure into the soil. Increases in nutrients, appropriate aeration, and water-holding capacity boost soil fertility. Microbial activities also have a significant influence on soil fertility. The crop yield increases in direct proportion to the soil fertility. With the aid of epigeic earthworms (*Eesina fetida, Eudrilus eugeniae,* and *Perionyx excavatus*), organic wastes like MSW, kitchen wastes, sewages sludge waste, pulp, and paper mill sludge, etc are converted into nutrient-rich manure vermicast within 45 to 50 days. Earthworms consume soil and, excrete 60 to 80 percent of their food. According to Aristotle, earthworms are the **"intestine of the earth,"** decomposing organic materials such as plant residues, decaying fruit, paper waste, etc.

General description and origin of earthworms:

The body of the earthworms is long and cylindrical, compressed at both ends, and

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coated in a soft, thin pellicle. Earthworms have translucent, temperature-sensitive pellicles.

Body metamerically segmented, the body is divided into 80 to 100 segments. Earthworms are hermaphrodites. The age of six weeks marks the onset of sexual maturity. In an ideal environmental condition, two earthworms can produce more than 100 cocoons in six weeks to six months.

Earthworms' progenitors lived roughly 600 million years ago, and since then, they have improved the soil profile by increasing soil porosity and secreting mucus into the soil. *Lumbricus terrestris* was the first earthworm named by Linnaeus in 1758. *Eisenia fetida* was the next species of earthworm to be identified. Earthworms are found everywhere except in snowy and very hot climates due to their high-temperature sensitivity. They have a variety of habitats, including gardens, paddy fields, and areas with a moisture content between 55 and 60%.

Systematics of Earthworms:

Earthworms belong to the phylum Annelida under the group Oligochaeta. Due to their burrowing and feeding habit of soil, they named earthworms (earth = Soil, worm = creeping animals). All over the world, there are 3627 species of earthworms present out of the total species found in the world; in India approximately 451 species of earthworms are available.

Earthworms are classified into three categories based on their ecological adaptations:

Epigeic earthworms: *Eisenia fetida, Eudrilus eugeniae, Perionyx excavatus,* etc. are examples of epigeic earthworms. Surface-feeding detritivores worms known as epigeic earthworms consume decaying organic wastes, including agricultural residues, leaf litter, plant roots, and animal feces, and turn them into vermicast. The best species worldwide for vermiculture is *E. fetida*. Epigeic earthworms are small, ranging in length from 1 to 18 cm.

Endogeic earthworms: *Allolobophora chlorotica, Apporectodea icterica, Murchieona muldali, Octolasion cyaneum,* and *Octolasion lacteum* Earthworms of the endogeic species are organisms that live beneath the topsoil. The endogeic species ranges in size from 2.5 to 30 cm in length. Endogeic species make horizontal burrows. Although these earthworms are useful for enhancing soil structure, they are not particularly appropriate for vermicomposting.

Anecic earthworms: *Aporrectodea longa, Aporrectodea nocturna, Lumbricus friend,* and *Lumbricus terrestris* Anecic earthworms live in vertical burrows in the deeper soil. Anecic earthworms make vertical burrows with a diameter of around 2 cm. Anecic earthworms improve soil texture and

aid in blending organic nutrients into the soil (paedogenesis).

Role of earthworms in crop improvement and waste management:

Rich organic production and a healthy soil environment are required for better and higher crop production and nutrient yields. Different plant growth regulators are excreted by earthworms in the form of mucus-like auxin and cytokinin. The by-product of earthworm excrement numerous inorganic and organic nutrients are abundant in vermicast. The concentration of inorganic salt that is utilized by plant roots is increased by vermicast. Using earthworms and their vermicast, soybean and wheat yield increased by 51% and 47%, respectively.

Adaptive advanced vermicompost production technologies:

Vermicomposting is the process of converting biodegradable organic waste into vermicast, nutrient-rich organic manure, using worms and other microbes. We convert organic, biodegradable garbage into manure by using earthworms.

The biggest problem facing the globe now is solid waste management. Natural waste is produced in large quantities in India, and we lack effective innovation to address this problem. The cheap and most efficient method of composting natural waste into nutrient-rich manure is vermicomposting, which transforms trash into humus-based products (Vermicompost).

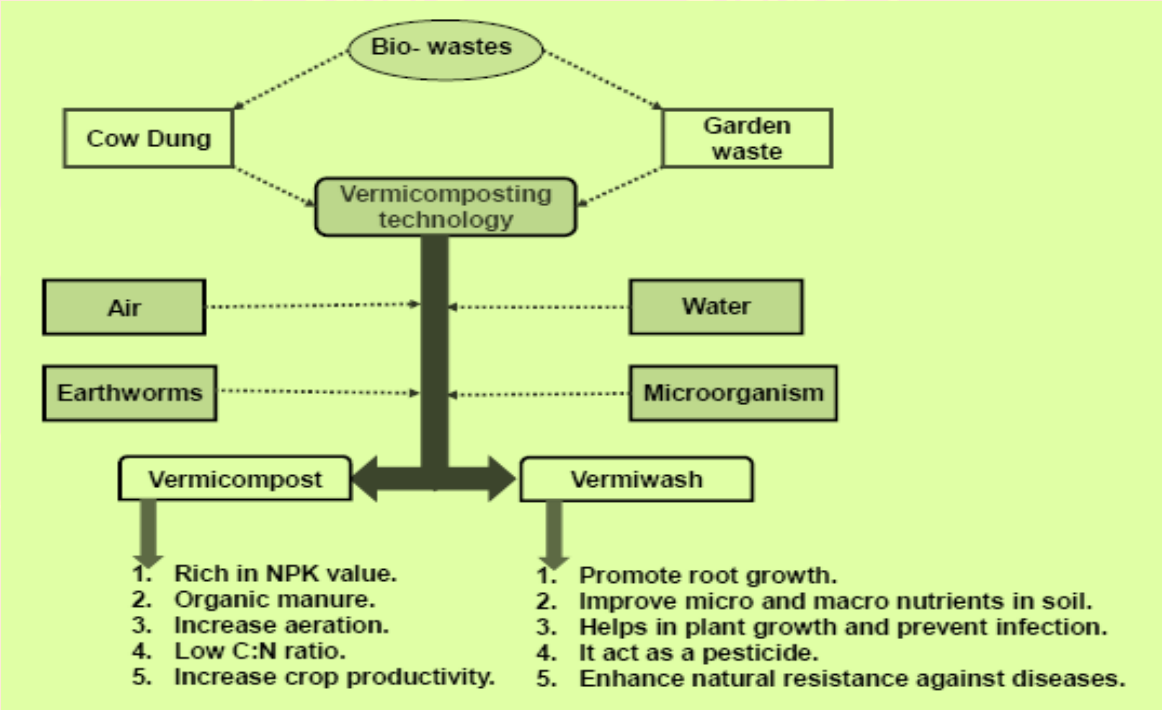

Figure 1: Shows the vermicomposting process of organic waste through *Eisenia fetida* and the use of vermicompost and vermiwash for crop improvement and soil fertility.

We can quickly convert natural waste into vermicompost by using a night crawler in vermicomposting. Kitchen waste is also a huge problem; however, vermicomposting effectively breaks down the vast majority of kitchen waste. Numerous studies have found that earthworm diversity contributes to improved soil fertility and increased agricultural output. Organic materials are digested by earthworms and turned into humus-like products. Inorganic salts like N, P, K, and Ca, which are the key component that increases crop yield, are highly rich in humus.

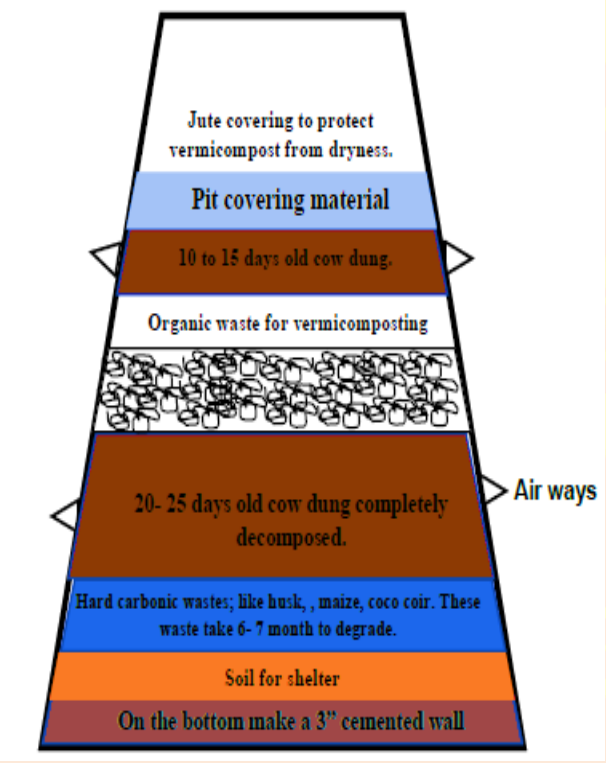

Figure 2: Vermicomposting bed filling process for efficient and environment-friendly organic waste decomposition

The soil profile, texture, and stabilization of the microbial population in the soil are upregulated by vermicast or earthworm manure. Therefore, it is crucial to consider how earthworm biodiversity affects soil fertility and agricultural improvement.

Distribution of earthworms in India:

Currently, in India, there are about 451 species of earthworms under 71 genera.

SI. No.	Family	Genus (No)	Species (No)
1	Acanthodrilidae	03	43
2	Almidae	02	5
3	Eudrilidae	01	1
4	Lumbricidae	09	16
5	Megascolecidae	14	149
6	Moniligastridae	03	85
7	Ocnerodrilidae	08	17
8	Octochaetidae	30	134
9	Rhinodrilidae	01	1

Most of the native earthworm species come under the Megascolecidae family and genus megascolex. In India about **71%** of genera and approx. **89%** of species are endemic. Some exotic earthworm species are also found.

Conclusion:

India is one of the major agro-based economy. About 64.61% out of the total population live in the villages and depend on agricultural practices for their survival. India is a developing county as compared to developed countries India does have not eco-friendly and efficient waste management that's why food and agricultural residue are not decomposed properly. India is located at 20.5937° N,

78.9629° E, and is also a major biodiversity hotspot due to its zoogeographical location. Approximately 451 species of earthworms are found in India. This major waste management problem minimizes by the use of vermicomposting technology. In this technique, epigeic earthworms are used to decompose organic waste with the help of microbes and in the presence of air. Vermicomposting is an Eco biotechnological waste management technique to decompose waste. It is an efficient, eco-friendly, and cheap method of decomposing organic waste.