Farmers in our country have always been practicing traditional cultivation by utilising indigenous technologies and inputs, mostly in line with organic farming principles.

Huge amount of organic residues, animal manures and household wastes are produced every year. These organic wastes have large nutrient value and could be used in agriculture to restore the soil fertility. However, they are either burnt or disposed off casually causing environment hazards. Composting of these wastes not only reduce the level of organic contaminants, but also retain most of the organic nutrients.

Application of compost to soil improves soil structure and increases its cation exchange capacity. Earthworms excreta (vermicast) is a nutritive organic fertilizer rich in humus, nutrients, beneficial soil microbes, nitrogen-fixing, phosphate solubilizing bacteria, actinomycetes and growth hormones like auxins, gibberlins and cytokinins. Both vermi-compost and its body liquid (vermi-wash) are proven as growth promoters and protectors for crop plants.

Vermi-compost is the excreta of earthworm, which are capable of improving soil health and nutrient status. Vermiculture is a process by which all types of biodegradable wastes such as farm wastes, kitchen wastes, market wastes, bio-wastes of agro-based industries, livestock wastes, etc. are converted while passing through the worm-gut to nutrient rich vermicompost.

Worms used here act as biological agents to consume those wastes and to deposit excreta in the process called vermi composting. Earthworms consume various organic wastes and reduce the volume by 40 to 60 percent. Each earthworm weighs about 0.5 to 0.6 g, eats waste equivalent to its body weight and produces cast equivalent to about 50 percent of the waste it consumes in a day. The moisture content of castings ranges between 32 to 66 percent and the pH is around 7.0.

Vermicompost contains enzymes like amylase, lipase, cellulase and chitinase, which can break down the organic matter in the soil to release the nutrients and make it available to the plant roots.
The most effective use of earthworms in organic waste management could be achieved when a detailed understanding of biology, population dynamics, productivity and the life cycles of earthworms are known. Earthworms belong to the family Lumbricidae. Earthworms are hermaphrodites but self-fertilization is rarity. Cocoons or eggs are small varying according to earthworm species. Cocoon colour changes with aging. At the age of 6 weeks, earthworm starts laying cocoons.

In favorable food and weather conditions one pair of earthworms could produce approximately 100 cocoons in 6 weeks to 6 months. Cocoons incubate roughly for about 3-5 weeks. The doubling time i.e. the time taken by a given earthworm population to double in its number or biomass, specifically depends upon the earthworm species, type of food, climatic condition etc. The adult worm might live for about two years. There are about 3000 species of earthworms distributed all over world and about 384 species are reported in India.

*Eudrilus eugeniae* is a manure worm, which has been extensively used for vermi composting because of its voracious appetite, high rate of growth, and reproductive ability. The other epigeic species used in large-scale vermi culture is *Eisenia fetida*, which has high potential for bio-converting organic waste into vermi casts.

Earth worms can be multiplied in 1:1 mixture of cow dung and decaying leaves kept in a cement tank or wooden box or plastic bucket with proper drainage facilities. The nucleus culture of the worms needs to be introduced into the above mixture at the rate of 50 worms per 10 kg of organic wastes properly mulched with dried grass or straw in a wet gunny bag. The unit should be kept in shade. Sufficient moisture level should be maintained by occasional sprinkling of water. Within 1-2 months, the worms multiply 300 times, which can be used for large-scale vermi composting.

Harvesting the compost and adding fresh bedding, at least twice a year is necessary to keep the worms healthy. The compost can be harvested by spreading a sheet of plastic under a bright light. The contents of the bed leaving the bedding materials are divided into a number of heaps on the sheet. The worms will crawl away from the light into the center of each heap and the vermicompost can be brushed away on the outside by hand. The crawling worms will be collected for re-use.

**African species more suitable**

- The African species of earthworms, *Eisenia fetida* and *Eudrilus eugeniae* are ideal for the preparation of vermicompost. Most Indian species are not suitable for the purpose.
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- The African species of earthworms, _Eisenia fetida_ and _Eudrilus eugeniae_ are ideal for the preparation of vermicompost. Most Indian species are not suitable for the purpose.
- Only plant-based materials such as grass, leaves or vegetable peelings should be utilized in preparing vermicompost.

- Materials of animal origin such as eggshells, meat, bone, chicken droppings, etc. are not suitable for preparing vermicompost.

- Gliricidia loppings, tobacco leaves, onion, garlic, chilli etc. of kitchen wastes are not suitable for rearing earthworms.

- The earthworms should be protected against birds, termites, ants and rats.

- Adequate moisture should be maintained during the process. Either stagnant water or lack of moisture could kill the earthworms.

- After completion of the process, the vermicompost should be removed from the bed at regular intervals and replaced by fresh waste materials.

There are two major problems in the process of making vermicompost.

1. Death of worms in large and small numbers

   Worms are dying for the following reasons:
   - If they are not getting enough food, therefore food should be buried into the bedding.
   - Food may be too dry, so moisture should be maintained until it is slightly damp.
   - Food may be too wet, in which case bedding should be added.
   - The bin/media may be too hot, so the bin should be put in the shade.
   - The worms might be eaten by the ants, so the base of the unit installed should be cleaned properly and an insecticide can be applied or the turmeric powder can be spread.

2. Bad smells from the vermi composting grounds
   - It may happen due to poor air circulation. In this case, add dry bedding under and over the worms. Turning of the food may give better result.
   - Presence of some materials such as meat, pet faeces, or greasy foods results in bad smell which should be removed.

Recently, the vermi beds are used for the production of quality vermi compost and vermi wash for organic farming. These beds are the representatives of modern compost technology and serve as unique combination of tough and light weight construction, easy installation with good aeration. Made from reinforced light weight HDPE material, these vermi beds are easy to install and relocate. They are less expensive in comparison to concrete vermi beds. The light weight of these beds made them easy to set them in remote or hard to access locations. This vermi bed has heat sealed multi layer coated woven and reinforced HDPE construction which provides an excellent combination of strength, durability, water proof and resistance to tears.

These are designed with extra stiff outer walls which prevent sagging and bears excellent ultra violet stability for long term exposure to the sun. The beds are fitted with aeration windows that ensure proper maintenance of temperature and moisture build up that helps in growing of microbial population and prevent excess heat build up. The major suppliers of vermibed includes Lamifab Industries (Mohan Palace, T.P.S - 3, 57th Road, Near Bhatia Wadi, Borivili West Mumbai -
Ventricompost and spices

Vadiraj et al (1993) reported enhanced growth and dry matter yield of cardamom seedlings in vermicomposted forest litter compared with other growth media tested. In another rooting experiment that used vermicompost, helped in improving the establishment of vanilla cuttings better than other growth media such as mixtures of coir pith and sand. Similar responses in growth were observed from clove and black pepper grown in 1:1 mixtures of vermicompost and soil.

Black pepper cuttings raised in vermicompost treatment were significantly taller and had more leaves than those grown in commercial potting mixtures. Plant heights, numbers of branches, and the longest taproots were on clove grown in the vermicompost mixtures. For the bush pepper cultivar, Panniyur I and Karimunda grown under green house, analysis of leaf nutrient composition revealed a higher uptake of Calcium, Magnesium and Iron in vermicompost treatment (Srinivasan, 1999).

In cardamom plantation, Srinivasan (2000) observed increase in water holding capacity of the soil from 55 percent in absolute control to 70 percent in vermicompost treatment. Also, quality parameters viz., 1,8 cineol and α terpinyl acetate were found to be significantly high in FYM and vermicompost treatments. In the case of large cardamom, Biswas (2010) reported that application

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**Spice India English**

400092), Surabhi Plantech (No. 11, 4th Cross, Jnanamandir Road, Bogadi, Mysore - 570026), H.K. Global Enterprise (No. 450, Kalika Nagar, Andhra Halli Main Road, Peenya II Stage, Bengaluru - 560058), and Haritha Agro Tech (21 M.G. Colony, Veerakeralam Road, Vadavalli, Coimbatore 641041).

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of vermicompost at the rate of one kg per plant resulted in the maximum immature (23.9) and bearing (9.8) tiller production.

In turmeric, combined application of different organic sources such as the farm yard manure, vermicompost and neem cake resulted in high yield and quality rhizomes. Fresh rhizome yield of 34.4 tonnes/ha was recorded in the combined application of vermicompost and coir pith compost each at 5 tonnes/ha.

Vastrad (1999) and Pradeepa (2003) obtained highest fresh rhizome yield in ginger by the application of vermicompost (2.5 t/ha) with recommended dose of fertilizers. Significant effect due to vermicompost was seen on growth parameters like number of leaves, number of tillers and leaf area at 60 and 150 days after planting. Vermicompost supplied higher amount of major and minor nutrients which has resulted in increased plant height and more number of leaves per shoot which are the source of photosynthetic apparatus

Thus, vermi composting technology involves harnessing earthworms as versatile natural bioreactors playing a vital role in the decomposition of organic matter, maintaining soil fertility and in bringing out efficient nutrient recycling that enhances plant growth. Hence, mass rearing and maintaining worm cultures and tapping of organic wastes for their maintenance has a good scope for cottage industry in developing countries like India.