

Table: Economies of vermicomposting

Inputs			
Materials	Quantity	Rate (Rs.)	Amount (Rs.)
Depreciation cost of vermibed (5year lifespan) and shade	3 Nos	600.00	1800.00
Cowdung	Two tractor load	1000.00	2000.00
Organic residues	Two tractor load	500	2000.00
Vermiworm	3 kg	400	1200.00
Miscellaneous items (gunny bag, packing materials etc)	Ls		500.00
Labour			
Filling of pits (4MDYS),watering (10 MDYS), harvesting (6 MDYS) and packing (4 MDYS)	30 MDYs	300.00	9000.00
Total production cost			16500.00
Output			
Vermicompost	3000 kg	10.00	30000.00
Verms	12 kg	400	4800.00
Total return			34800.00
Net profit			18300.00
Rupee return per Rupee invested			1: 2.10

Vermicomposting is a highly environment friendly, economically viable and efficient biological process to convert organic matter into compost amenable for assimilation by plants. In tribal regions of Odisha farmers can utilize their own farm generated organic residues, animal waste, and available family labour to produce vermicompost at cheaper rate at their back yard. The farm generated nutrients and amendments will help to sustain the agricultural production with least outsourcing of costly inputs.

Vermicomposting for Sustainable Crop Production in Hill and Tribal Regions of Odisha

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Vermiculture is a biological process by which all types of organic waste like crop residues, kitchen wastes, market wastes, bio-wastes of agro based industries, livestock wastes and weeds are converted into value added product like vermicompost. Vermicomposting involves breaking down of complex organic materials into nutrient rich compost by earthworm by its ingestion and digestion. In this process worms help in transforming organic waste materials into high quality manure with ample amount of macro and micro nutrients for plant growth and development. The process is very simple and can be easily executed by the farmers and farmwomen in their back yards. It is not only a cost effective method to convert organic waste into useful nutrient rich manure but the method is also an environmental friendly technology which can easily be adopted by the small and marginal farmers of tribal regions of Odisha. It is helpful in sustainable agricultural production without pollution hazard to soil, water and environment. The technology is very useful for kitchen gardens and urban horticulture. Backyard gardening and cultivation of field crops by using a little or without any chemical fertilizer is a common practice in tribal dominant district 'Kandhamal' of Odisha. Vermicomposting in the backyard will helpful to utilize the available plant and animal waste to produce valuable plant nutrients and soil conditioners and which will helpful promote to 'Parparik krishi' in tribal belt of Odisha.

Types of vermicomposting

There are several methods to produce vermicompost depending on the type of substrate used and bedding method followed. Among these, flooring, bed and mataka methods are most common practice followed in Odisha. Similarly depending on type of substrate used vermicompost are known as paddy straw, organic residues, coir pith and weeds vermicompost.

Materials required for vermicomposting

Earthworm cultures

Selection of earthworm species is the one of the important criteria to harness the potential of earthworms in vermicomposting process. The red wiggler or tiger worm (*Eisenia fetida* or *Eisenia andrei*) (Fig 1) is commonly used earthworm, but African Night crawlers (*Eudrilus eugeniae*) are another set of popular composters can be used for vermicomposting.



Fig.1 Red vermiworm culture

For initial inoculation, farmers are advised to collect the earthworm cultures from reputed agencies or firms located in their region.

Vermicomposting units

Several types of structures are recommended for the preparation of vermicompost i.e. Permanent flooring structure beds and Rhino vermi bed method.

Permanent structure vermicomposting beds

- A well drained land with shades is preferred for construction of Vermicomposting unit.

- A thatched roofshed preferably open from all sides is required for making vermi beds.
- The sheds should be erected in east-west direction length wise to protect the site from direct sunlight.
- To facilitate drainage the base of the site should be raised at least 6 inches above the ground level.
- The size of the shed depends upon the quantity of waste to be treated and the availability of space.
- An area of 12 ft x 12 ft would be enough for three 10 ft x 3 ft x 2 ft (Length x Breadth x Height) vermibeds with 1 ft space in between the beds.
- The height of roof can be kept at 7-8 feet from the centre and 5-6 feet from the sides.
- Prepare the vermi beds by bricks and cement mortar keeping the bottom of the bed without plastering.
- A water channel should be made around the top of the brick wall to deter ants from entering the beds.
- Keep drainage outlet at lower side of bed to collect vermiwash (Fig 3).



Fig.2 Permanent Protected Vermicomposting units with drainage outlet

Rhino vermi bed method

- Low cost readymade portable vermicomposting beds of size 12 ft x 4 ft x 2 ft made up of polyethylene net window with netted outlet at the bottom of the bed.
- Rhino bed method is very easy to install and easy to carry/shift from one place to another.
- This method is superior than permanent brick wall methods in terms of moisture retention capacity and quality of final product produce.

Substrate for vermicomposting

Organic waste like crop residues, kitchen wastes, market wastes, bio-wastes of agro based industries, livestock wastes, weeds and other biodegradable wastes.



Fig.3 Low cost Rhino vermi bed

Cowdung

Cowdung is considered as additive for initial feeding of earth worms and partially decomposed cowdung is ideal for vermicomposting.



Fig.4 Substrate for vermicomposting

Process of vermicomposting

- Chop the available crop residues, kitchen wastes, market wastes, bio-wastes of agro based industries, livestock wastes, weeds etc. into convenient size and shade dried for few days.
- Put 4-6 inch layers of the shade dried organic waste materials in to the bottom of the bed and sprinkle one inch layer of cow dung over it. Over this layer another layer of organic residues is spread followed by spraying of cow dung slurry uniformly. This process is repeated till the spread of the organic residues six inch above the top of the pit.
- After partial decomposition of organic residues (attained in 10-15 days) the earthworms are released @ 1 kg (around 1000 worms) per bed, consisting of one ton organic residues, by making holes at the top of the bed on four corners and centre of the pit.
- The bed can finally be covered with a jute bag or mat to protect earthworms from birds and insects.
- Water needs to be sprinkled daily on the vermi beds according to the requirement and season to keep them moist.
- The appearance of black granular crumbly vermicompost on top of the vermi beds indicates maturity of the compost.
- The mature vermicompost is light in weight and does not emit any foul smell. The pH of the mature vermicompost remains in neutral range.
- Watering is stopped for at least 5 days before final harvest from the top layers. Generally harvesting can be done within 2.5 to 3 months.
- Harvest the vermicompost by scrapping layer wise from the top of the pit and heap under shed.
- The harvested vermicompost has to be sieved. Sieving helps in the separation of the earthworms, cocoons and eggs from the compost.
- After sieving, the compost should be shade dried for a couple of hours, packed and stored in shade.

Precautions to be taken for vermicomposting

- Care should be taken to avoid any non-biodegradable components in the compost mixture like plastic, iron or glass pieces.
- The vermi beds should be protected under the roof. The temperature of the bed should not exceed 35 °C.

- Chemical fertilizers should not be added in vermicompost beds. The vermi beds should be protected from insecticidal sprays.
- The worms should be protected from ants, frogs, rats and birds.
- Moisture level of the beds should be monitored regularly (40-50% moisture) and water should be sprayed on the beds as and when required.
- Do not allow any stagnation of water in the bed by providing suitable drainage.

Products of vermiculture

Vermicompost

- The final product of vermicomposting is black granular crumbly organic manure, which contains plant nutrients like Organic Carbon (9.15 to 17.98%), total Nitrogen (1.5 to 2.1%), total Phosphorus (1.0 to 1.5%), total Potassium (0.6%), available Sulphur (128 to 548 ppm), Calcium and Magnesium 22 to 70 me/100 g, Copper 100ppm, Iron 1800 ppm and Zinc 50 ppm.
- It also contains growth promoting hormone "Auxins", "Cytokinins" and flowering hormone "Gibberellins" secreted by earth-worms thus has a positive effect on vegetative growth, stimulating shoot and root development.
- It contains some antibiotics and actinomycetes that help in increasing resistance of crop plants against pest and diseases.
- Vermicompost also has very high porosity, aeration, drainage and water holding capacity which will be helpful for maintenance of soil health.

Vermiwash

- Vermiwash is a liquid that is collected after the passage of water through a column of worm action and is very useful as a foliar spray. It is a collection of excretory products and mucus secretion of earthworms along with micronutrients from the soil organic molecules.



Fig.5 Vermicompost, vermiwash and vermiworm



• The liquid byproduct can be used in agriculture as fertilizer and growth promoter.

Earth worms

- Vermiculture can also be adopted to produce earth worms which are in demand as protein source for poultry, fishery, pigs and pets.

Importance of vermicompost

- With increase in awareness of organic farming in rural and urban area, the demand for vermicompost is increasing.
- Vermicompost can be used as a component of integrated nutrient management to reduce the use of inorganic fertilizers in agriculture.
- It can be used as soil conditioner to maintain soil health.
- Vermiwash which can be used in agriculture as fertilizers and growth promoter.
- Earth worms can be used as protein source for poultry, fishery, pigs and pets.
- The technology not only reduces the use of harmful chemical fertilizer but also helps in reuse and recycling of organic wastes for the welfare of the mankind.
- The small and marginal farmers can adopt vermicomposting for sustaining their livelihood security.
- Both Central and State governments are promoting the vermiculture through different welfare schemes.
- For field crops, use 4 to 5 t /ha of vermicompost and for vegetable crop apply 8-10 t/ha as basal dose.

Establish favorable thriving conditions prior to releasing earthworm into the bed

- Maintain correct C: N-ratio
- Moisture level -60-70%
- Temperature between- 20-30°C
- Light-avoid strong light
- PH not below- 6
- Verify that the organic waste undergone partial decomposition for 15-20 days

Economics

- One vermiculture unit having 3 Nos. of vermibeds (size 12 ft x 4 ft x 2 foot) can produce about 3 tons of vermicompost and a farmer can get net return of Rs.18300 in 100 days.