SATNET ASIA
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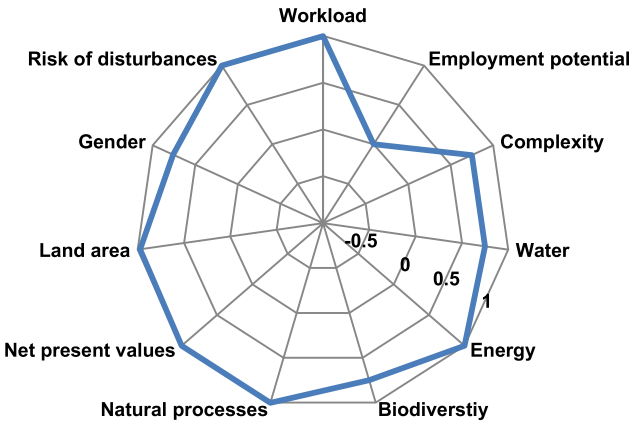
Vermitechnology

Technology fact sheet | 05 / October 2014

Key facts

- Vermitechnology is a simple process, which uses earthworms to produce good quality compost through organic waste recycling.
- A tank constructed from locally available materials.
- The initial investment cost for a tank is about US$ 37.
- The total labour time spent on implementing this technology is about three hours in a month.
- About 5 litres of water per m^2 of ground surface of the tank are required to operate one tank during 30 days.
- The technology exclusively uses renewable material, recycled from different farming and household activities.

This graph summarizes the results of a sustainability assessment conducted for this technology. The closer the line is to the outer edge of the diagram, the better the technology performs in terms of the particular criterion.



What is vermitechnology?

- Vermitechnology is a simple process, which uses earthworms to produce good quality compost (vermicompost) through organic waste recycling. It can be used for managing biodegradable wastes – biomass or organic material that can be degraded or composted.
- The purpose of the technology is to produce good quality compost in a short time. About 4-5 kg of waste can be composted by 1,000 worms (approximately 1 kg) in a day, depending on the worm species. A tank of 5x1x1m allows about 500 kg of waste to be composted by the activity of worms and microorganisms, producing about 250-300 kg of compost in approximately one month.
- The earthworms commonly used for this include *Eudrillus sp. Perionyx sp., Eisenia sp.* or any locally available earthworms living and feeding on the surface of the soil (epigeic worms).
- Vermitechnology can be practised either in tanks or on the ground. However, the major advantage of a tank is the efficiency of composting and keeping the worms captured from escaping. This way, the worms feed only on the waste and do not escape. This is more productive than ground composting.
- The technology requires little investment and technical know-how.

History

- Vermiculture (from Latin *vermes* – worms, and *culture* – farming) has been practised for at least a hundred years.
- After studying earthworms for 40 years, Charles Darwin (1809-1882) estimated that an acre of British farmland contained 50,000 worms, producing about 18 tons of worm-casts (excreta) per year. The first serious experiments on vermiculture were conducted in Holland in 1970.
- A number of vermiculture studies in several countries including Australia, France, Germany, Italy, the Philippines, Spain and the United States of America have demonstrated the considerable economic potential of the technology.
- In 1996, 'Pusa Vermitech' vermicomposting technique was developed by Mr. A. Thimmaiah at the Indian Agricultural Research Institute (IARI), New Delhi, India. As IARI is also known as 'Pusa Institute', this innovative technology was dedicated to the institute and named 'Pusa Vermitech'.
- 'Pusa Vermitech' was developed to provide a simple solution to poor farmers.
- This method has become popular in Bhutan, Costa Rica, India, Italy, Nepal and Sri Lanka.

Where it works

- The technology works well in all agro-climatic conditions.
- Typical successful adopters are those interested in natural resource management and organic farming and institutions aiming to convert waste into compost.
- Open ground composting can be used by farmers who cannot afford to construct a tank or who live in mountainous regions where transporting construction material is not easy.

Technological aspects

The following describes the process of vermicomposting in a tank made from locally available material.

- The height of the tank can vary from 0.75 to 1 m. The width is about 1 m and length about 3-5 m or more, depending on the region (mountain or lowland).

- The base of the tank should be slightly sloped towards two drainage holes. Figure 1 shows the hole of one cross section.
- The tank consists of five layers as shown in Figure 2. The same layering method can be used for composting on the ground.

Figure 1. Cross section on an empty tank

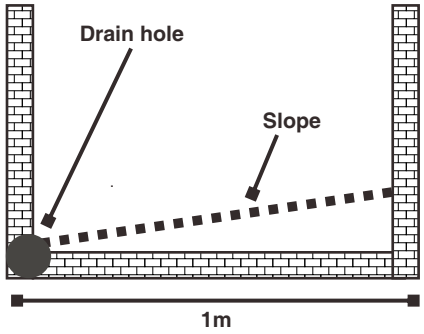
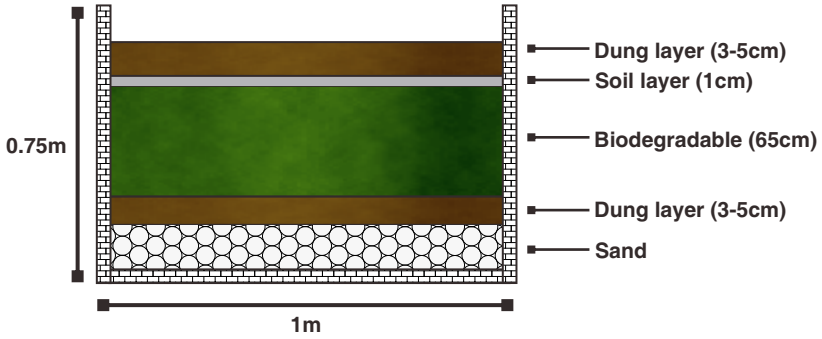


Figure 2. Cross section of a tank with materials



- The first layer of 2-3 cm at the base is of sand. The sand helps to drain excess water and prevent the worms from moving into deeper layers of soil or out of the tank.
- A layer of 3-5 cm of month-old dung is laid on top of the sand.
- Next is a 65-cm layer of any biodegradable waste.
- The wastes are covered with a thin soil layer of 1-2 cm.
- The top layer in the tank is month-old mature dung (recognized by the reduced ammonia odour) with a thickness of 3-5 cm and uniformly spread over the soil layer.
- After setting up the five layers of different materials as described above, these are moistened with water for seven days to achieve a 40-50 per cent moisture level to pre-decompose the contents. To assess the moisture level, press a handful of the material. If a few drops of water seep out, the moisture content is right.
- When the material is partially degraded, which takes about one week in summer and 10-14 days in winter, the worms can be introduced by placing them on top of the pre-decomposed material.
- On average, a tank of 1 m^3 contains about 100 kg of pre-decomposed farm waste. As a rule of thumb, about 1,000 worms (approximately 1 kg) are sufficient for 5 m^3 of waste or 500 kg of pre-decomposed material.
- Water the compost regularly to maintain a 30-40 per cent moisture level to make the worms more active, but avoid making it too soggy or moist as this will kill the earthworms. Watering once a week in summer (twice a week if temperatures are very high) and once in two weeks in winter is sufficient. A moisture meter can be used to measure moisture content.
- In summer, cover the tank with a gunny sack to avoid evaporation of moisture. To protect the worms from predators such as rats and lizards, cover the tanks with wire mesh.
- Farmers can harvest partial amounts of the degraded compost on a weekly basis. The compost is ready when tiny pellets of the compost start appearing on the top. Harvesting the compost weekly speeds up the process. The compost removed from the top of the heap does not have to be sieved to separate it from the worms.
- If farmers regularly harvest all compost and immediately set up a new batch, about 12-15 batches of compost can be produced in a year using the same tank.
- The vermicomposting site should be covered with a low-cost shelter made of local material.

Economic aspects

- No initial investment costs for composting on bare ground. The initial investment cost for a 5x1x1 m tank is about $37 (approximately Nu 2,000) in Bhutan.
- The shelter can be made from locally available material like bamboo and palm leaves or from iron or aluminium sheets. If made of bamboo, the shelter's cost can be $5, going up to $20-$30 per pair of tanks if iron sheets are used.
- It takes 16 hours to build a tank: two men can construct a 5x1x1m tank in one day, working eight hours each.
- The variable production cost per unit (tank) during one production cycle (30 days) includes labour and unexpected expenses such as changing the container for watering or borrowing waste material from neighbours in case of a shortage in winter. The variable construction costs are $5 per tank per month.
- The value of compost is $0.5 per kg while a kilogram of worms cost $10.
- Labour requirements for composting: two hours for filling one tank with available waste (or four tanks per person per day); total of 40 minutes of watering in summer and 20 minutes in

winter, per month (10 minutes watering each time); and 40 minutes for harvesting one tank (or 50 tanks per person per day). The total labour time spent on this technology in a month is 3 hours and 20 minutes in summer and 3 hours in winter.

- The cemented parts of the tank last at least 10 years, the upper construction will last three to four years, depending on the quality of the wood used.
- The technology is not patented.

Environmental aspects

- To provide the right moisture content, about 5 l of water are required per m^2 of the tank's ground surface to operate it for 30 days. This means that the approximate average amount of water used per production unit of 5 m^2 is 25 l. Each time the tank is irrigated, approximately 6.25 l of water are added. The total amount will change according to the season: more water is needed in summer and less in winter. No wastewater is produced if the right moisture content is maintained.
- Once the tank is installed, the technology exclusively uses renewable material, recycled from farm and household activities, namely, biomass. The operation does not require any energy.
- Besides some construction inputs, none have to be obtained from outside the community to operate the technology.
- A weight reduction of 40-50 per cent for all materials used occurs after all inputs are converted to compost. This results in an input:output ratio ranging from 2.5:1 to 2:1.
- Combined greenhouse gas emissions from compost are lower compared to other manure storage methods (Pattey *et. al*., 2005). The regular movement of earthworms creates aeration in the organic matter and prevents it from an-aerobic digestion which would release methane to the atmosphere. Excessive moisture in the compost could also lead to an-aerobic digestion and, therefore, must be avoided.
- The key economic and environmental benefits of the technology to an individual, household and/or community are that it closes local nutrient cycling, reduces dependence on chemical fertilizers and other plant nutrients, thereby making farming less dependent on outside inputs.

Social aspects

- The key social benefit of the technology is that households can reuse their daily kitchen, garden and farm waste. This will keep cities, villages, farms and rivers clean and free from pollution.
- Up to five or more household members, depending on the scale of operation, are involved in the construction of the composting tank. However, once the tank is ready, the human labour requirement for composting is minimal. Hence, composting does not have an employment creation potential at the household level.
- The technology carries no environmental or social risks.
- The technology empowers women and disadvantaged sections of the rural population. Women operating the technology can earn an income by selling the worms and compost. No formal data is available in Bhutan on the percentage of female adopters but one expert reports that almost all vermitechnology adopters in the country are women and that most female farmers in Bhutan practise this technology.
- About 20 m^2 of land is sufficient to produce vermicompost for one hectare of farm. More land is needed for commercial-scale production, depending on the scale of the business.

Issues for replication

- The temperature of the tank needs to be checked regularly by immersing a simple wooden stick into the tank for some time. If the stick is warm when pulled out, the worms should not be introduced. If the farmer can afford a thermometer with a probe, then the temperature of the tank contents should be maintained at about 30°C or less.
- If the tank is not shaded or not watered enough, the moisture level goes down, decreasing the efficiency of the earthworms. It can even kill the worms.
- The height of the tank depends on the region/country. For example, in Bhutan the tank height has been reduced to 0.75 m in keeping with the average human height there.
- In a mountainous region, it can be difficult to construct a 5-m long tank. Depending on the region, the length can range from 3 to 5 m.

Contacts

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Related topics

Earthworms can also be used for producing ‘vermiwash’ – an effective method for boosting plant growth and managing plant diseases.

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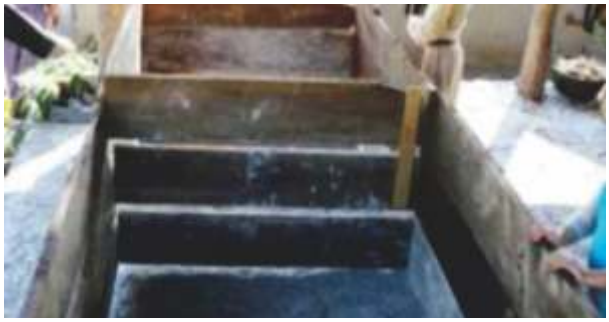
Technological aspects



1. Preparation of vermicomposting tank

2. Waste layer on the dung and sand layer

3. Layer of fresh material

4. Final dung layer

5. Gunny sack to maintain moisture

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