# VERMICOMPOSTING

| Input materials | Pre-condition/Pre-treatment | Operation & maintenance needs | Objectives / Key features | Key technical parameters |
|---|---|---|---|---|
| **Suitable organic waste:**<br>– Garden trimmings<br>– Vegetables/fruit peels<br>– Animal manure<br><br>**Unsuitable waste:**<br>– Big chunk of woody materials<br>– Food leftovers (especially dairy product, meat and fish waste, salty and vinegary food) | Waste segregation at source<br><br>Pre-composting (2 weeks)<br><br>Optional: shredding | Regular low operation and maintenance required.<br><br>! Make sure to have pure organic waste! | Biological process where organic matter is digested by worms and microorganisms to produce vermi-compost. | Process time: 1.5-2.5 months<br><br>Mass reduction: 40-80%<br><br>Space: 300-580 m2/t*d |
| **Outputs / products** | **Technical complexity** | **Maturity level** | **Educational aspect** | |
| Vermicompost<br><br>Worms (animal feed)<br><br>Worm tea | Medium-level skills required on appropriate vermicomposting technique<br><br>Limited infrastructure required (covered area) | Proven technology globally | **Topics:** Microbiology, Biology, Organic degradation, Nutrients recovery, Plant growth<br><br>**Practical exercises:** Observing degradation process, Investigation on crops yield with vermicompost | |

**Vermicomposting is a biological process where organic matter is digested by worms and microorganisms. The products are vermicompost or wormcompost, a stable soil amendment which has higher level of nutrients than compost and the worms themselves.**

Vermicomposting depends on the interaction between microorganisms and earthworms. Microorganisms in the waste prepare the waste for the earthworms through a first step of aerobic degradation [1].

Appropriate earthworm species for vermicomposting are surface worms that have high adaptability to different waste types and conditions, rapid feeding and digestion, and fast growth and reproductive rate. Among these, *Eisenia fetida* is the most frequently used species besides *Lumbricus rubellus, Eisenia andrei, Perionyx excavatus and Eudrilus eugeniae* which is popular in tropical and subtropical countries [1].

Earthworms are able to process a broad range of organic waste but they do not tolerate food waste such as meat and fish waste, grease and oils, salty and vinegary foods. They also do not like onions and spicy peppers.

It is important to provide the waste as feed for eathworms in shallow layers placed into bins or beds and fed at least weekly. Thick layers will result in increase of the temperature in the waste layer or anaerobic conditions; both situations are unfavorable for the worms.

Vermicompost is a mineralized, nutrient-rich, microbiologically active organic amendment [2]. In some contexts, worms can also be used as high-protein animal feed or even for their medicinal properties. Another by-product is worm tea, the leachate from the worm bins. This can used as liquid fertilizer.

**Applicability:** Vermicomposting can be conducted at different scale, from household scale to large-scale facility. Vermicomposting usually takes place in worm bins or beds.

**Design considerations:** The size of the bin or bed will depend on the amount of organic waste available. Holes or mesh are needed for aeration. Spout or holes in the bottom can be added to drain the excess liquid (i.e. worm tea) into a tray for collection [2]. Darkness should be maintained; cover the bins to keep them shaded and protected. To save space, bins can be stacked up. But make sure to also allow fresh air circulation. Roofing for shading and rain protection is recommended but a walled enclosure is not required.

**Materials needed:** Vermicomposting bins and beds are most commonly constructed with plastic (recycled PET, PP) or wood. Plastic bins will require more drainage than wooden ones, however, wooden bins will eventually decay and need to be replaced. Styrofoam and metal materials should be avoided, as well as cedar wood containing resinous oils [2].

Bedding material like shredded papers, cartons, moss, straw should be added to hold moisture and create structure to allow air exchange [2].

It is better to identify locally available earthworms species to introduce foreign species that can be harmful to the local ecology [3].

**Operation & maintenance:** The worms can process waste up to their body weight per day. From that amount, around 50% is converted in vermicompost. A feeding rate of 50% of worm mass per day is adequate for a good operation. Layer of waste should not be above 10cm to avoid heating pile and anaerobic conditions.

**Feeding** worms should happen once a week and water added if the bedding dries up. If the bedding gets too wet, add dry material such as paper strips [3].

Moisture should be always kept between 70 and 85%. The pH should be neutral or slightly above neutral and aerobic conditions maintained in the entire bin. Therefore it is important to not feed fresh waste (acidic) but rather precomposted waste.

**Health and safety:** Vermicomposting is generally a safe activity. Health risks can be minimised if workers adopt basic precautions and hygienic practices and wear personal protective equipment.

**Costs:** Costs of building a vermicomposting facility vary depending the cost of local materials and earthworms but costs are generally low.

**Social, legal, and environmental considerations:** Before considering a vermicomposting system, the concept needs to be discussed with the school community beforehand. If the community has experience with separating organic waste and composting this can be a facilitating factor. Seeing and studying the lifecycle of the worms can be exciting lesson and experience for students.

**Strengths and weaknesses:**

- (+) Simple technology
- (+) Can be built and maintained with locally available materials
- (+) Relatively low capital costs
- (+) No electrical energy required
- (+) High value soil amendment
- (+) Easy to link with education purposes
- (−) Requires a large, well located land area
- (−) Pre-composting phase recommended
- (−) Worms are sensitive to environmental conditions (too hot, too cold, too wet, too much sunlight; if too many) and these must be well controlled

**> References and further reading**

1. Lohri, C.R., et al., Treatment technologies for urban solid biowaste to create value products: a review with focus on low- and middle-income settings. Reviews in Environmental Science and Bio-Technology, 2017. 16(1): p. 81-130.

2. Khadka, R. and S. Chaudhary, Vermicomposting A promising technology to turn kitchen waste to organic compost. 2017.

3. Lenkiewicz, Z. and M. Webster, Making Waste Work: A toolkit - How to turn organic waste into compost using worms, wasteaid, Editor. 2017.

*ISWA: A handbook for schools on organic waste management, 2015*

*MOOC Youtube videos:*

— *MOOC Mod. 3.10 Vermicomposting of biowaste*