Left: Structure used for vermicomposting showing above ground bin, cover, and shed (Samden Sherpa)
Right: Ready to use vermicompost (Samden Sherpa)

Vermicomposting

Nepal: गड्यौला प्रयोग गरी मल बनाउने प्रबिधि

Vermicomposting or worm composting is a simple technology for converting biodegradable waste into organic manure with the help of earthworms.

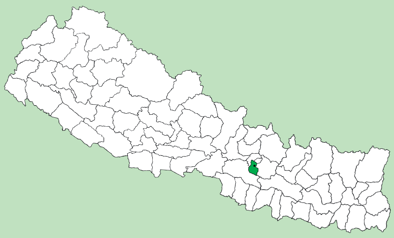
Earthworms are valued by farmers because, in addition to aerating the soil, they digest organic matter and produce castings that are a valuable source of humus. Vermicomposting, or worm composting is a simple technology that takes advantage of this to convert biodegradable waste into organic manure with the help of earthworms (the red worm *Eisenia foetida*) with no pile turning, no smell, and fast production of compost. The earthworms are bred in a mix of cow dung, soil, and agricultural residues or predecomposed leaf-litter. The whole mass is converted into casts or vermicompost, which can be used as a fertilizer on all types of plants in vegetable beds, landscaping areas, or lawns.

Worms are so effective at processing organic waste that they can digest almost half their own weight in debris every day. Vermicomposting is a simple composting process that takes advantage of what earthworms do naturally, but confines the worms to bins making it easier for farmers to feed them and to harvest their nutrient-rich compost. Since all worms digest organic matter, in principle, any type of worm can be used; however, not all are equally well adapted to living in bins since some worms prefer to live deep in the soil while others are better adapted to living closer to the surface. The red worm (*Eisenia foetida*) is ideal for vermicomposting because its natural habitat is close to the surface and it is accustomed to a diet rich in organic matter, this makes it ideally suited to digesting kitchen scraps and to living in bins.

Vermicomposting can be carried out in different types of containers. There are only a few requirements for a good worm pit, the most important being good ventilation; the pit needs to have more surface area than depth (wide and shallow) and it needs to have relatively low sides. The base of the worm pit is prepared with a layer of sand then alternating layers of shredded dry cow dung and degradable dry biomass and soil are added. Under ideal conditions, 1,000 earthworms can covert 45 kg of wet biomass per week into about 25 kg of vermicompost.

Worm castings contain five times more nitrogen, seven times more phosphorous, and eleven times more potassium than ordinary soil, the main minerals needed for plant growth. The vermicompost is so rich in nutrients that it should be mixed 1:4 with soil for plants to be grown in pots and containers. Vermicompost should not be allowed to dry out before using.

Note: This type of vermicomposting is sometimes referred to as 'Pusa' vermicomposting because it was popularized in South Asia by the Rajendra Agricultural University located in Pusa, Bihar, India.



WOCAT database reference: QT NEP 36
Location: ICIMOD Knowledge Park at Godavari, Lalitpur District, Nepal
Technology area: Demonstration plot
Conservation measure(s): Agronomic and management
Land Use: Annual/perennial cropping on rainfed agricultural land
Stage of intervention: Prevention of land degradation
Origin: Innovation through experiment and research
Climate: Subhumid/temperate
Other related technology: Improved compost preparation (QT NEP 7), Better quality farmyard manure through improved decomposition(QT NEP 8), Improved farmyard manure through sunlight, rain and runoff protection (QT NEP 9), Black plastic covered farmyard manure (QT NEP 16)
Compiled by: Samden Lama Sherpa, ICIMOD
Date: June 2011, updated March 2013

The technology was documented using the WOCAT (www.wocat.org) tool.

Classification

Land use problems

Crop productivity is limited by poor soil fertility, intense cropping, and a scarcity of irrigation water. Farmers notice a marked decrease in the health of their crops and degraded soil conditions when chemical fertilizers are overused. Vermicomposting is a low input response to this problem.

Land use

Annual cropping

Perennial cropping

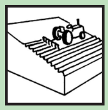
Climate

Subhumid/temperate

Degradation

Chemical degradation: fertility decline

Conservation measures



Agronomic measure

Stage of intervention

- [x] Prevention of land degradation
- [ ] Mitigation/reduction
- [ ] Rehabilitation

Origin

- [ ] Land users' initiative
- [x] Experiments: demonstration
- [x] externally introduced
- [ ] Other (specify)

Level of technical knowledge

- [ ] Low
- [x] Medium: land users, technicians
- [ ] High

Main causes of land degradation: Improper soil management

Technical function/impact

Main:
- Improves soil fertility
- Increases available nutrients
- Increases available nutrients

Secondary:
- Improves structure of topsoil
- Stabilizes the soil

Environment

Natural environment

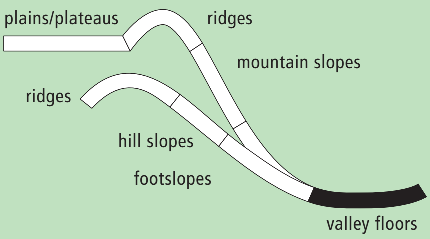
Average annual rainfall (mm)

- [ ] >4000
- [ ] 3000–4000
- [ ] 2000–3000
- [x] 1500–2000
- [ ] 1000–1500
- [ ] 750–1000
- [ ] 500–750
- [ ] 250–500
- [ ] <250

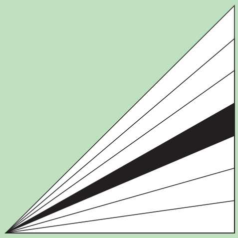
Altitude (masl)

- [ ] >4000
- [ ] 3000–4000
- [ ] 2500–3000
- [ ] 2000–2500
- [x] 1500–2000
- [ ] 1000–1500
- [ ] 500–1000
- [ ] 100–500
- [ ] <100

Landform



Slope (%)



Soil depth (cm)

- [x] 0–20
- [ ] 20–50
- [ ] 50–80
- [ ] 80–120
- [ ] >20

Growing season(s): not relevant
Soil texture: medium loam
Soil fertility: medium
Topsoil organic matter: high (>3%)
Soil drainage/infiltration: medium
Soil water storage capacity: medium

Groundwater table: <5 m
Availability of surface water: good
Water quality: good for drinking and agricultural use
Biodiversity: high (695 species of flora and 230 species of fauna have been documented within the Park's 30 ha area)

Tolerant of climatic extremes: active in warm climates
Sensitive to climatic extremes: sensitive to too hot or too cold temperatures
If sensitive, what modifications were made/are possible: The chamber should be covered and shaded; earthworms should be shielded from direct sunlight. In winter, the pit can be moved to a greenhouse.

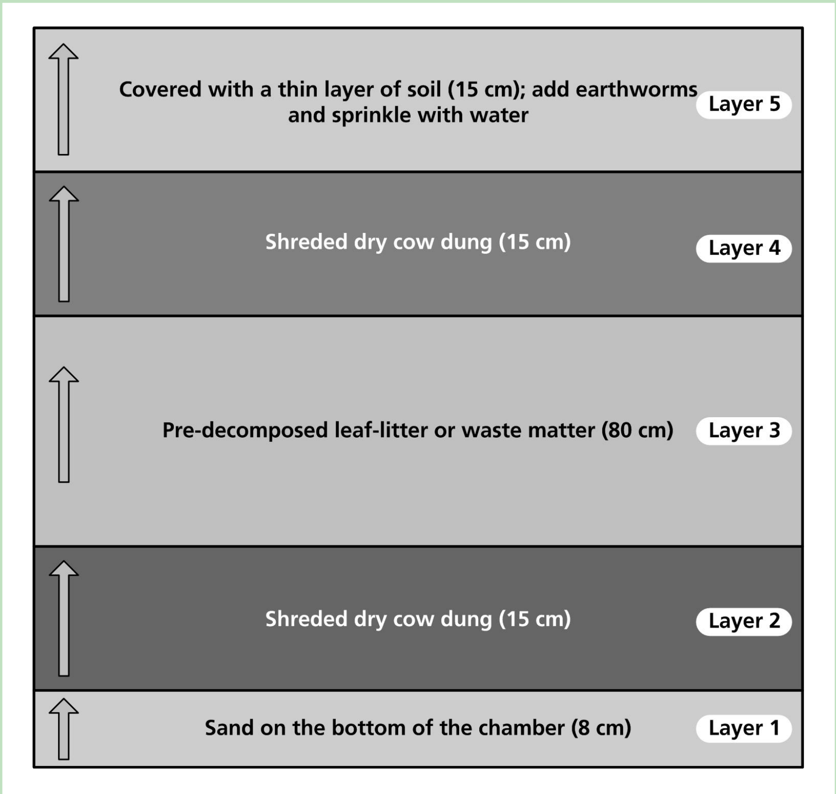
Human environment

Crop land per household (ha)

- [x] <0.5
- [x] 0.5–1
- [ ] 1–2
- [ ] 2–5
- [ ] 5–15
- [ ] 15–50
- [ ] 50–100
- [ ] 100–500
- [ ] 500–1000
- [ ] 1000–10000
- [ ] >10000

Land user: for demonstration and experiment
Population density: >10 persons per km^2
Land ownership: government
Land/water use rights: community/individual
Relative level of wealth: neighbouring communities are poor
Importance of off-farm income: >50% of all households around the demonstration site have off-farm income
Access to service and infrastructure: labour available; road access used to transport crops

Market orientation: mixed subsistence and commercial in the vicinity of the demonstration site
Mechanization: manual and animal traction
Number of livestock: in the vicinity of the demonstration site poor households may have a few goats whereas wealthier farmers often own several cattle
Purpose of forest / woodland use: fodder, fuelwood
Types of other land: scrubland
Level of technical knowledge required: some training required



Establishing a vermicompost pit
Diagram showing the layers needed to set up a vermicompost pit. Note that the middle layer is the thickest; the worms start here and eat both upwards and downwards. It is best to house the pit under a thatched or plastic roof in order to shield it from excessive sunshine and rain.
(AK Thaku)

Implementation activities, inputs and costs

Establishment activities

A low cost pit can be constructed with bricks on a moist or shaded site. A typical outdoor pit can measure 4 m long, 1 m wide and 0.75 m high. If bricks are not available, stones can be used for the pit construction; alternatively, a wooden or bamboo box or a plastic tray can also be used. Vermicompost pits are best started during the summer months.

A thatched roof was built over the pit to help retain moisture in the heap at a level of approximately 40–50%, as well as to maintain an optimal temperature of about 20–30°C.

Sand, soil, cow dung, and leaf litter are piled up as shown in the diagram.

Establishment inputs and costs per unit

Inputs	Cost (USD)	% met by land user
Labour (10 person days)	50	
Materials		
- bricks and cement	70	
- dry cow dung	10	
- plastic sheet/bamboo	70	
- earthworms (2,000)	60	
TOTAL	**260**	**0%**

Maintenance/recurrent activities

- Water regularly
- Collect and harvest vermicompost

The pit is watered regularly. After five to six weeks, the top layer is removed and piled in one corner of the pit. After a few days, the worms will have borrowed down to the bottom of this pile and the compost can be harvested. The compost prepared in the pit should be harvested within 6 months and the pit refurbished as for the first set as discussed above.

Maintenance/recurrent inputs and costs per unit per year

Inputs	Cost (USD)	% met by land user
Labour (5 person days)	25	
Materials		
- dry cow dung	5	
- water pipe	10	
TOTAL	**40**	**0%**

Remarks:
- All costs and amounts are rough estimates by the technicians and authors. Exchange rate USD 1 = NPR 72 in June 2011.
- This was a demonstration project conducted by ICIMOD.

Assessment

Impacts of the technology

Production and socioeconomic benefits		Production and socioeconomic disadvantages	
+ + +	Reduced expenditure on chemical fertilizers	–	Earthworms need to be purchased from outside
+ + +	Improved soil fertility	–	The vermicompost pit needs to be watered and maintained regularly.
+ + +	Can be used to produce organic crops		
Socio-cultural benefits		**Socio-cultural disadvantages**	
none		none	
Ecological benefits		**Ecological disadvantages**	
+ + +	Reduced use of chemical fertilizers	–	If forest leaf-litter is removed for vermicomposting it impoverishes the forest soil
Off-site benefit		**Off-site disadvantages**	
+ + +	Reduced dependence on external inputs	none	

Contribution to human wellbeing/livelihood

+ + + Provides employment opportunities. Quality compost helps to improve the soil and increases crop production.

Benefits/costs according to the land user

Benefits compared with costs	short-term	long-term
Establishment	positive	positive
Maintenance/recurrent	positive	positive

Approximately 2 tonnes of vermicompost can be produced in six months from the size of pit mentioned above with 2000 earthworms. The total cost to produce 2 tonnes of vermicompost is approximately USD 300. The farmer can realize a benefit of approximately USD 700 from selling the vermicompost and USD 300 from selling the excess worms, for net profit of USD 700.

Acceptance/adoption:
Vermicomposting training was provided to farmers in Nuwakot, Rasuwa, Godavari, and Bishankhunarayan VDCs by ICIMOD staff in collaboration with local NGOs. More than 60% of the farmers who received training adopted vermicomposting on their own farms and they have also started selling worms to other farmers. The technology has been adopted by others who have visited the ICIMOD Knowledge Park at Godavari but most of these are just interested in introducing it on a small scale, such as, to produce vermicompost from kitchen waste for household use in their own gardens. The participants were also taught how to collect local earthworms to use for composting.

Drivers of adaptation of the technology

- A simple technology and easy to implement
- Local earthworms can be used.
- Not expensive; farmers can construct pits or uses wooden boxes or plastic trays.
- Produces high quality compost with a high concentration of nutrients
- Helps to reduce pests in the soil
- Can be scaled up to produce compost commercially

Concluding statements

Strengths and ➔ **how to sustain/improve**	**Weaknesses** and ➔ **how to overcome**
The use of vermicompost reduces the need for chemical fertilizers and reduces dependence on outside sources. ➔ Promote the technology by disseminating it to a large number of farmers on both small and big farms.	Purchasing earthworms from outside may be expensive for farmers. ➔ Farmers can be encouraged to harvest local earthworms for composting.
Vermicomposting does not require keeping livestock. ➔ It is considered to be a low-cost alternative that uses local earthworms and materials to produce compost.	Making compost from earthworms is not very popular in rural areas. ➔ Create greater awareness on how earthworms can be used to compost leaf-litter and other kitchen waste.
On-farm composting saves the transportation cost needed to deliver compost to the farm.	

Key reference(s): Vermicomposting: Journey to forever organic garden (no date) [online]. http://journeytoforever.org/compost_worm.html (accessed 14 November 2012)
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