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SHORT COMMUNICATION

KITCHEN WASTE MANAGEMENT IN BUMTHANG VALLEY: A HIGH-ALTITUDE VERMICOMPOSTING

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ABSTRACT

Vermicomposting was done for the first time in Bumthang valley, a town where temperature plummets to below sub-zero during winters and yearly annual temperature is -5.99% lower than Bhutan's averages. Vermicomposting is highly beneficial in the face of increasing solid waste both at the national and global level besides being a rich soil amendment, packed with essential micro and macro nutrients.

KEYWORDS

Vermicomposting, high altitude, waste management, Bumthang

1. INTRODUCTION

Bumthang has an area of 2667.76 sq.km and is located in the north-central part of Bhutan at altitude ranging from 2000-6800 masl. The city's annual temperature is 9.61°C (49.3°F) and it is -5.99% lower than Bhutan's average temperature. (*Bumthang, BT Climate Zone, Monthly Weather Averages and Historical Data*, n.d.). Vermicomposting has never been tried at this altitude range and temperature in Bhutan as the ideal temperature for vermicomposting is between 10°C-35°C. (Garg and Gupta, 2011). The temperature plummets below sub-zero during winters in Bumthang which makes vermicomposting even more challenging. Vermicomposting unit in Bumthang is the first of its kind at this altitude (~3000 masl) and a novel initiative in any nursery within the ambit of the Department of Forests and Park Services under the Ministry of Energy and Natural Resources, Bhutan.

With the increase in population in the country, waste is ever becoming a social and environmental menace with a total of 172.16 metric tons of solid waste being generated with the per capita waste being 0.23 kg on a daily basis (Bhutan. Rgyal-yongs Rtsis-dpyad Bkod-'dzin & Bhutan. Rgyal-yongs Rtsis-dpyad Bkod-'dzin, n.d.). In 2020, an estimated 2.24 billion tons of solid waste was generated worldwide and is expected to increase by 73% in 2050 (*Solid Waste Management*, n.d.).

There are a multitude of alternatives adopted to tackle solid wastes, vermicomposting is one of the easiest and eco-friendly ways of taking care of solid wastes. Vermicomposting is a biological process of converting organic wastes into a rich soil amendment using earthworms (Ganti, 2018). Vermicompost when used on soil improves both the soil's physiochemical (bulk density, porosity, water holding capacity, pH, organic matter, micro and macro-nutrients) and biological properties (soil microbes) (Piya et al., 2018). Worm castings contain 5 times more nitrogen, 7 times more potash and 1.5 times more calcium than 15cm of good topsoil and its nutrient life is 6 times more compared to other potting mixes (Adhikary, 2012).

For the preparation of vermicompost, cow dung, vegetable wastes, rural and urban wastes, leaf litter, weed biomass and other biodegradable wastes may be used (Asif Aziz et al., 2017). Since as much as 34.4% of the total wastes generated can be composted, vermicomposting could not only ease the pressure of waste management on municipal offices but also contribute to circular economy (Owojori et al., 2020). Vermicompost is an

excellent replacement for chemical fertilizers which when overused pollutes environment through the accumulation of nitrates and cadmiums in the drinking water and agricultural produce (-Ur-Rehman et al., 2020).

Vermicomposting, a sustainable waste management practice, holds significant promise for Bhutan's environmental conservation efforts. The country's commitment to transitioning all agriculture to organic processes aligns well with the principles of vermicomposting, which can effectively recycle organic waste into nutrient-rich compost (*Bhutan Organic Standard BOS 02.2022 National Centre for Organic Agriculture (NCOA) Department of Agriculture Ministry of Agriculture and Forests (MoAF) Royal Government of Bhutan 2*, n.d.). By diverting organic waste from landfills into vermicomposting systems, Bhutan can reduce environmental pollution and contribute to its goal of achieving sustainable waste management practices. While Bhutan has made strides in waste management, challenges persist, including the need for improved awareness and practices among stakeholders.

Implementing vermicomposting on a larger scale would require addressing technological, economic, and social barriers to ensure effective waste segregation and processing. Collaborative efforts involving government agencies, local communities, and businesses will be essential in promoting vermicomposting as a viable solution for organic waste management in Bhutan. In conclusion, vermicomposting presents a valuable opportunity for Bhutan to enhance its waste management practices in line with its sustainability goals. By leveraging the principles of circular economy, organic farming, and sustainable development, Bhutan can integrate vermicomposting into its waste management strategies to promote environmental conservation and achieve its vision of becoming a zero-waste nation.

2. MATERIALS AND METHODS

2.1 REQUIREMENTS

1. Green house
2. Tub/container with a drain hole placed at an inclination
3. Vermicomposting worms- red wigglers/Tiger worms/ *Eisenia fetida*
4. Soil sifter (smaller the diameter, better it is)
5. Trowel

6. Shallow bowls
7. Bucket
8. Watering can/pipe with hose nozzle
9. Gunny bags/sacks
10. Cattle dung

2.2 Custom Wooden Tub

A tub measuring 2m*1.5m*0.5m was made from Bluepine wood for vermicomposting kitchen wastes. A small drain hole with a diameter of 2 cm was made at the bottom end of the tub to collect vermiwash at the end of every harvesting season. The drain hole was plugged with cloth material to prevent leaching of vermicomposting constituents including the worms.

2.3 Red Wiggler Worms

About 1.5 kg of Red wigglers aka Tiger worms (*Eisenia fetida*) was acquired from National Soil Services Center, Thimphu Bhutan.

2.4 Procedure

2.4.1 Place tub/container inside a shed

- Place the tub/container on a raised platform to avoid burrowing insects like ants
- Preferably, place the tub/container at a slope using wooden pegs to drain out excess water through the drain hole and for the convenient collection of vermiwash at the end of vermicast harvest.

2.4.2 Prepare bedding

1. Place about 5 cm of shredded papers (or sawdust or husk)
2. Above the shredded papers, place 5 cm of sifted sand
3. Above the sand, place 5 cm of sifted garden soil/forest top soil
4. Sprinkle water after laying each bedding layer

Note: We avoided use of saw dust as the vermicast had brownish colouration which is not appealing to eyes.

2.4.3 Place worms

Place worms uniformly on the bedding

2.4.4 Feed worms

- Vegetable refuse and fruit peels are best worm food.
- Chop worm food into pieces so that it becomes easier for the worms to feed on
- Feed the worms by spraying worm food uniformly over the bedding
- Feed adequate amount of food once every week
- Add a layer of bedding each time the foods are placed
- Spray water after additional layer of bedding has been laid each time the worms are fed.

2.4.5 Foods to avoid

- Onion, garlic, oil, salt, vegetables or fruits with hard peel like potato peel, carrot peel and radish peel, pepper

Note: Over feeding worms is not advisable as it can invite unwanted pests. Remember to check for bad odour as a sign of over-feeding. Depending on the consumption, add or lower feeds for the worms.

2.4.6 Moisture organic heap inside the tub

- It is necessary to keep the layers moist but not to that extent that water begin to pool up.
- Check the layers periodically (once in 2-3 days)

2.5 Cover the tub

Worms prefer darker environment. Ensure that the tub/container is

properly covered with the help of cloths or gunny bags. Avoid solid lid as worms need air to breathe.

2.6 Insulating Vermicomposting set-up

We placed the vermicomposting set-up inside a nursery greenhouse to make up for the ideal temperature. The set-up could be kept anywhere warm like inside a cattle-shed or a in one of the corners of a house.

2.7 Harvesting vermicast

After checking the organic heap inside the tub/container for dark colouration which will normally take anywhere from 3-6 months, prepare to harvest vermicast.

- Stop spraying water for atleast a week before harvesting
- Stop feeding worm food for atleast a week or two before harvesting
- Scoop the vermicast from the tub (preferably in the presence of light so that the worms burrow down and avoid unintentional injuries during the harvest) remember to scoop 2-3 inches into the castings to avoid accidentally injuring the wigglers. You need to remove castings until the very bottom of the tub.
- Place the castings on a shallow bowl
- Wait for few minutes to let some earthworms that might have come with the castings to burrow down
- Work out the castings to remove worms and their eggs to place them back to the vermicomposting tub
- Sift the castings using soil sifter into a collection bowl
- Wash off the tub and collect the vermiwash placed below the drain hole of the vermicomposting tub
- Place the sorted-out worms in a container filled with bedding materials

Note: Sorting out worms and their eggs is time-consuming. We may need atleast 4-5 men to carry out sieving and sorting out of worms and their eggs.

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