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Raising of earthworms (vermitech) for environmentally-sound uses

1. GENERAL INFORMATION

1.1 Title of practice or experience

Raising of earthworms (vermitech) for environmentally-sound uses

1.2 Category of practice/experience and brief description

The social innovation described here – vermitech or earthworm-raising – is useful for several purposes: from safe handling of domestic organic waste to the generation of rich compost that can be used for a wide range of applications ranging from raising crops and kitchen gardens to bioremediation of difficult soils. The nature of the technology prescribed is easily replicable for the production and multiplication of earthworm populations with their attendant benefits.

1.3 Name of person or institution responsible for the practice or experience

Institute of Research in Soil Biology and Biotechnology

1.4 Name and position of key or relevant persons or officials involved

Dr Sultan Ahmed Ismail, Director

***1.5** Details of institution*

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1.6 Name of person and/or institution conducting the research

As in 1.4 above

1.7 Details of research person/institution

As in 1.5 above

2. THE PROBLEM OR SITUATION BEING ADDRESSED BY THE PRACTICE/INNOVATIVE EXPERIENCE

Though the problems addressed by this note about vermitech are diverse, the technology described herein is the basic process that enables people to raise earthworms. Essentially, many domestic residents, residential colonies, village organisations, and even town and city municipalities and industrialists face acute problems concerning the disposal of organic wastes generated by them either in the kitchen or in the factory sites. The treatment of such wastes using chemicals or other technological processes like incineration is not only expensive, but also requires a great deal of expertise and trained manpower. Not only that, it also harms the environment and is a danger to public health.

Garbage or organic wastes produced by every home make up the municipal or corporation garbage which today is a growing environmental problem. Composting can convert all such wastes into wealth. Every home or municipality can vermicompost its organic wastes after predigestion without the need to transport such wastes over long distances for disposal. This is an environment-friendly technique entailing no pollution whatsoever. Hence vermicomposting is a more sustainable technique for solid-waste disposal, compared to the conventional methods like landfilling, incineration, biogas production and composting by the efflux of time. Nutrients in earthworm castings are predigested and hence are readily soluble in water for uptake by plants.

Earthworms are today being successfully used for the purpose of treating a wide variety of organic wastes. Though scientists recommend two to three species of earthworms the world over, Dr Ismail recommends native species of earthworms for the said purpose.

The other major objective of using earthworms is to improve the fertility and the condition of the soil. Earthworm pits, containers or sheds eventually generate a large quantity of enriched vermicompost which can be worked into the soil to improve it. Worm-worked soils are conspicuously different from soils devoid of earthworms. Moreover, the tunnels formed by the worms aid in the passage of water which also washes the nutrients from earthworm channels to the plant roots that extend quite rapidly along these channels.

The present practice described here is basically a low-cost method of maintaining and multiplying local varieties of earthworms so that a large population of them is made available for the problems or situations described above. It is still necessary and desirable to harness the potential of several other surface and sub-surface species of local varieties of earthworms. These efforts, in fact, will realise the desired goals in improving the soil faunal component of a given soil ecosystem.

Vermitechis a worm-powered technology of not only applying earthworms to organic wastes for production of compost but also introducing earthworms into the soil for bioremediation of the soil. This is the most natural, ancient and perhaps the best among all sustainable agricultural practices.

3. DESCRIPTION OF THE PRACTICE/INNOVATIVE EXPERIENCE AND ITS MAIN FEATURES

Soils have different species of earthworms and hence choosing a local or native species of earthworm for a given soil type and for vermicomposting is an important step. There is no necessity to import or transfer earthworms from elsewhere. The advantages of using local varieties of earthworms are many. It is not advisable to use alien species as history is littered with examples of confrontations between indigenous and foreign organisms. Although the introduction of foreign species of earthworms has time and again been justified by a few scientists, it is inadvisable and undesirable to tamper with the local biodiversity.

The compost prepared by using earthworms is called vermicompost. Vermicompost today is a very important aspect of an organic farming package. It is easy to prepare, has excellent properties and is absolutely harmless to plants. While vermiculture is culture of the earthworms, vermicastings are faecal matter released by the earthworms.

Earthworms can be raised in any kind of shed, tank or container placed either within the soil or above it. **A** compost pit of any convenient dimension can be dug in the backyard or garden or in **a** field. The most convenient pit of easily manageable size is one that measures 2 m x 1 m **x** 0.75 m. They can also be reared in unlined pits. Where containers are used (either plastic, wooden or rubber), care has to be taken to enable water that is sprayed on the mixtures to drain out of the vessel. Earthworms are raised in a vermibed within such controlled spaces.

(Please see Diagrams 1-3).

The vermibed comprises a base layer of broken bricks or pebbles mixed with sand to a thickness of 6 to 7.5 cm to ensure proper drainage. On top of this **is** added a layer of soil not less than 15 cm in height. Into this soil are

inoculated about 50-100 locally collected earthworms. One should also place small quantities of cattle dung at different places on the soil and top it with a layer of straw or hay not exceeding 10 cm. These serve as feed providing nitrogen and carbon to the worms for their growth and multiplication.

The earthworm pit is to be in the shade or covered with fronds or old jute bags and liberally watered. The weep holes at the bottom, in the case of containers and tanks, will enable excess water to run out. The entire bed must be kept moist, but should not be soggy. The moisture should be maintained at a regular degree for about thirty days after the introduction of the worms. During this period, the earthworms multiply in number and then one can commence laying organic wastes or domestic refuse layer by layer periodically on the vermibed. **As** the organic waste is deposited, it decomposes and is gradually digested through the intestines of the earthworms. The organic wastes in the pit may be turned over occasionally. Once the pit is filled up completely and the composting is complete, one can reduce the use of water, ***so*** that the earthworms migrate below. The rich compost can be removed and the process started all over again on the same vermibed.

Passage of material through the earthworm gut converts the locked-up minerals into available forms which are readily assimilable by plants. This is made possible by a large number of microflora in the gut **of** earthworms. Moreover, castings produced by the earthworms have a bacterial population nearly 100 times higher than in the surrounding soils.

Collecting local varieties of earthworms is a very simple and pleasurable job. Soil near organically maintained trees or open culverts carrying organic wash water from domestic kitchens or restaurants, where worms are generally noticed and which is rich in vermicastings, is first identified. Handfuls of cattle dung are scattered over a one m2 area, followed by hay or leaf litter, and covered with an old jute cloth or jute bag. The place is kept moist by regular watering (not flooding with water). In about a fortnight's time, both surface and sub-surface worms may be observed **in** that place. The worms should then be transferred for culture along with some quantity ***of*** native soil. This ensures not only survival but also the passive inoculation of cocoons from the area of collection.

If the first attempt is not very successful, then 1 kg of jaggery and 1 kg **of** fresh cow dung dissolved in 20 litres of non-saline water should be applied to that area once or twice **a** week to attract earthworms. (Do not try this on places where there are absolutely no earthworms.)

The water which trickles from the weep holes forms a type of vermiwash (please see Diagram **4)** which can be used as a foliar spray on vegetable plants like okra, tomato, beans and eggplants and also on lawns, golf courses and orchids. If need be, this venniwash may be diluted with water.

4. DESCRIPTION OF THE INSTITUTION RESPONSIBLE AND ITS ORGANISATIONAL ASPECTS

The Institute of Research in Soil Biology and Biotechnology (IRSBB) is attached to the New College in Chennai, India. The New College is a minority institute run with government assistance. The IRSBB was started and developed at the personal initiative of Dr Sultan Ismail. Dr Ismail has converted the Institute into a focal point for earthworm and earthworm-related research in the country. His pioneering work has been reported in a number of science journals and he also has a number of books on vermicology to his credit. The Institute carries out research work in the following aspects:

(a) Earthworm biology, ecology, population density and diversity and their relevance to ecosystems.

(b) Conversion of biogas slurry into vermicompost, and its utilisation. Recycling of organic solid wastes and grey water through vermitech using local varieties of earthworms, especially the surface and anecic sub-surface varieties, and preparation of vermiwash using local varieties of earthworms.

(c) Bioremediation of sands and subsoils using local varieties of earthworms. Reclamation of highly alkaline sodic soils at Shivari Farms of the Uttar Pradesh Land Development Corporation (UPLDC), Lucknow, India with Memorandum of Understanding signed with UPLDC for this purpose.

(d) Creating awareness, through NGOs, among farmers, housewives, etc. in several states of India.

(e) First to report anti-inflammatory property of earthworms. Dr Ismail's research students have worked in collaboration with Miyazaki Medical College, Japan on fibrinolytic and antihypertensive properties of earthworms.

(f) Reported bioluminescent property of *Lampito mauritii*. First to report on the ultrastructure of copulatory setae of Indian earthworms.

Dr Sultan Ismail is the Director of the Institute. His research students work with him as a team. The Institute is maintained with funds from the New College and from overhead expenses of research projects.

5. PROBLEMS OR OBSTACLES ENCOUNTERED AND HOW THEY WERE OVERCOME

Farmers are highly interested and motivated to use the end product in organic farming, but the non-availability of prepared compost poses an obstacle.

The main problem encountered in introducing cornposting units in domestic sectors is the lack of awareness among the people and their reluctance to accept them. The fear in their minds that these cornposting units may generate an unpleasant odour and project an ugly sight, and may promote the spread of mosquitoes and flies has to be allayed.

Red ants may be attracted to cornposting sites as these ants love to feed on hapless young ones or cocoons of earthworms. Spraying a mixture containing salt, chilli powder and turmeric powder in soap water around (not on!) compost pits keeps the ants away.

Rodents may also be attracted. Domestic compost containers can be placed on short pedestals to dissuade the rats.

6. EFFECTS OF THE PRACTICED/INNOVATIVE EXPERIENCE

The effects of using this innovation are well established and recognised. Dr Ismail and his associates have developed various types of containers for maintaining earthworm populations. These include plastic or wooden crates, concrete rings used for reinforced wells, tubs, tanks, pits, old rubber tyres, etc. He has shown and demonstrated that provided a few important principles are followed, earthworms can be raised with minimal effort within homes, in building compounds or in agricultural fields. Thus, the technology lends itself to a wide range of uses, of which two are extremely important in countries of the South.

Firstly, it is a useful tool in homes where all the organic waste can be deposited so that it does not litter the environment. Littering the environment predictably leads to the spread of rats and other pests.

Secondly, **it** is useful for village people who wish to have a ready source of free compost for use in kitchen gardens. Similar processes can be generated within the compound walls of private residences.

The general effect of using earthworms on a sustained basis makes a significant reduction in the amount of garbage discharged into the environment. Moreover, by processing of garbage, the technology converts the problem into a resource and provides good fertiliser which can be used to enhance the condition of the soil.

7. SUITABILITY AND POSSIBILITY FOR UPSCALING

The method of earthworm-farming propagated by Dr Ismail is, in a certain sense, scale-independent. Housewives can raise earthworms in small crates in the kitchen and reasonably large-scale chicken factory farms can raise earthworms in large sheds or tanks to treat fairly large quantities of waste originat-

ing from such factories. In any event, smaller units would be more efficient and easier to maintain.

Very large volumes of organic wastes, for example, from city markets can also be suitably composted by first digesting the enormous amount of garbage/biomass for a period of 20 to 30 days in controlled conditions by sandwiching layers of biomass with cattle dung slurry. Mesophilic conditions are followed by thermophilic conditions which not only make the seeds and pests, if any, in the biomass ineffective but also reduce the biomass to about a quarter or at least one-third of its initial volume. This material is then fed to the earthworms which convert it to vermicompost.

By this combined process of digesting and composting, several tons of biomass can be converted through properly designed composting yards into value-added end products such as manure. This could also serve as a micro-enterprise. This supports the dictum: waste to wealth and trash to treasure.

Of the several species of earthworms, those most popularly used in worm farms are *Eiseniafoetida, Eudrilus euginiae, Lumbricus rubellus* and *Perionyx excavatus*. Of these, *P. excavatus* is widely found, from the Himalayan mountains to the plains of South India. They are excellent worms which are effective both in nutrient-poor soils as well as in manures. *Lampito mauritii* is a remarkable sub-surface species which is an efficient cornposter and soil conditioner.

Worm breeders should be clear as to the function for which they are raising earthworms. If worms are cultured only for the sake of multiplication for use in angling or for the process of waste digestion, then surface species of earthworms may be preferred. But these surface worms will offer no significant contribution to the *in situ* improvement of soils. In agricultural situations, where the motive is not just addition of compost but also improvement of soil structure, a complement of sub-surface species of earthworms along with surface worms is essential. **If** surface worms can predominantly convert agrowaste and other organics into compost, then the sub-surface worms not only assist in the conversion of organic debris into compost but, by virtue of making drilospheres (tunnels), can also effectively convey the material to the plants.

8. SIGNIFICANCE FOR (AND IMPACT ON) POLICY-MAKING

Policy-makers are recognising the importance of reliable earthworm-based schemes with regard to several of the problems they face. Municipalities and companies, for example, want to reduce costs by reorienting the present practices of waste disposal. **A** sound system of garbage disposal will not require the creation of any further dumping grounds and/or landfills. Such landfills

are becoming a major headache to those in charge of public institutions since they create their own environmental hazards and local communities invariably object to their locations.

Agriculture departments see earthworm-farming as an important source of soil nutrients, especially in the wake of more expensive chemical inputs, based as they are on imported fuels requiring foreign exchange. Moreover, soils are losing their potential and require nourishment in the form of compost to regain their health.

Rural development agencies can also propagate earthworm-farming as a major employment-oriented activity with vast social and environmental benefits.

9. POSSIBILITY AND SCOPE OF TRANSFERRING TO OTHER COMMUNITIES OR COUNTRIES

Earthworm technology based on the use of local earthworms is a fairly well tried and tested process and can easily be transferred from community to community with the assistance of simple manuals, and audio and visual aids.

10. OTHER COMMENTS

Soils with earthworms support healthy populations of bacteria, fungi, actinomycetes, protozoans, insects, spiders, millipedes and a host of others that are essential for sustaining healthy soil. The advent of chemicals and their large-scale application in the name of fertilisers and biocides have changed the structure of soils and have, in most cases, eliminated soil organisms. These soils are dying. Only soil with faunal components constitutes living soil.

The pace at which soil degradation has taken place since the Green Revolution is apparent and there are no divided opinions towards restoring soil health. The simultaneous awareness in human minds of the dangerous effects of chemical residues, and the demand for food grown with organic fertilisers have made farmers and agriculturalists prefer organic inputs.

Several organic alternatives from traditional Indian farming practices are being reiterated. Organic farming packages could be designed integrating green manure, farmyard manure (FYM), vermicompost, vermiculture and *in situ* earthworm management, and encouraging soil faunal and soil organic-matter components. Farmers in the world are now aware of the contributions of earthworms towards encouraging soil faunal diversity and promoting soil fertility. People need only look for the worms just beneath their feet as there are no earthworms superior to those found in one's own soil. Adding preferred inputs can multiply the local worm population many times over *in situ* in farm-

ers' fields where they function as nature's ploughs and fertiliser units.

By virtue of their behavioural properties, earthworms improve soil structure and soil fertility, promote soil aggregation, encourage favourable soil reactions and enrich the nutrient status of the soils, thereby promoting plant growth and improving the quality of produce.

Large-scale vermiculture operations produce two saleable products, worms and vermicompost. However, the economic viability of any vermiculture system for the next several years will probably depend upon the financial return from compost production rather than from worm protein.

Diagram 1: (A, B, C): Setting up a vermicompost unit

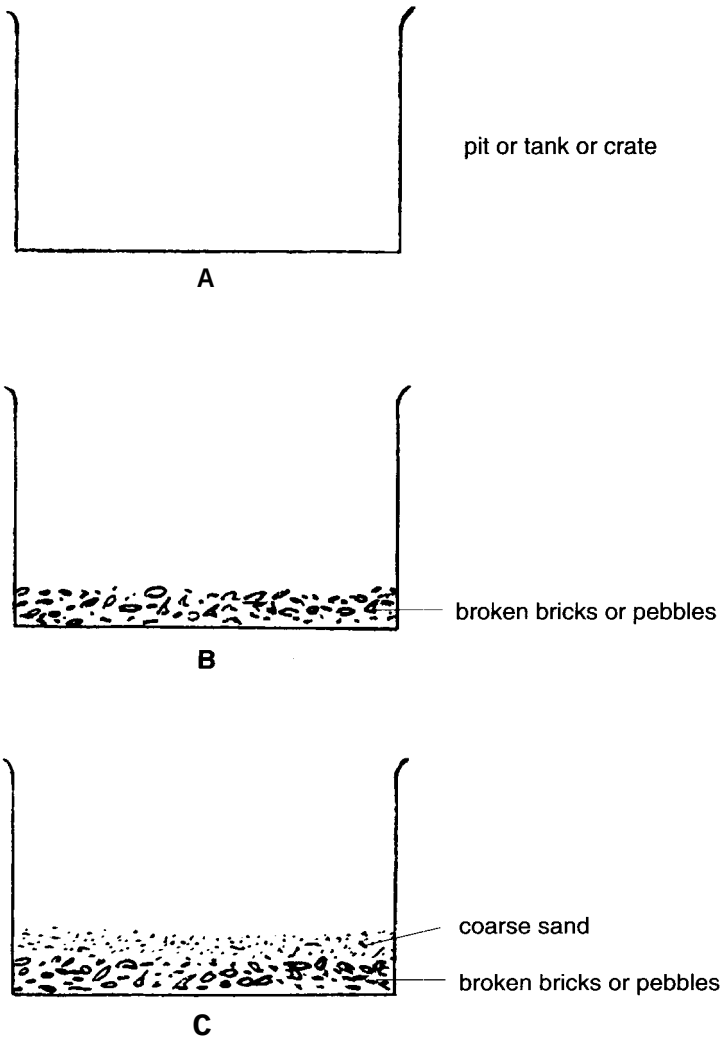

Diagram 2: (D, E, F): Setting up a vermicompost unit

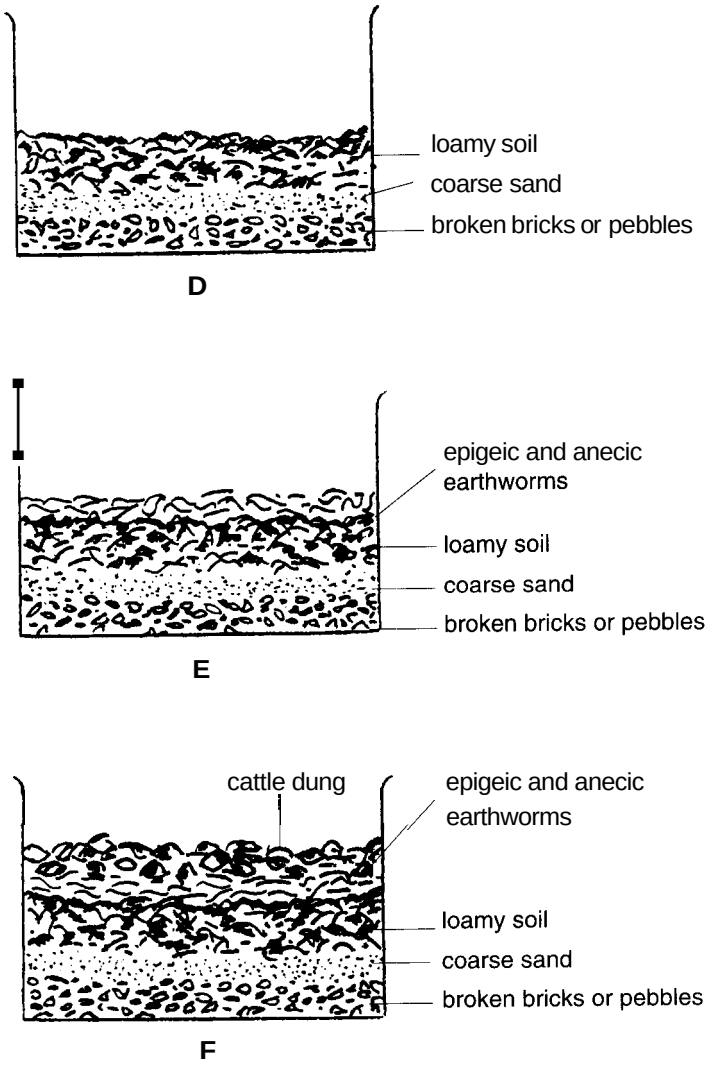

Diagram 3: (G, H, I): Setting up a vermicompost unit

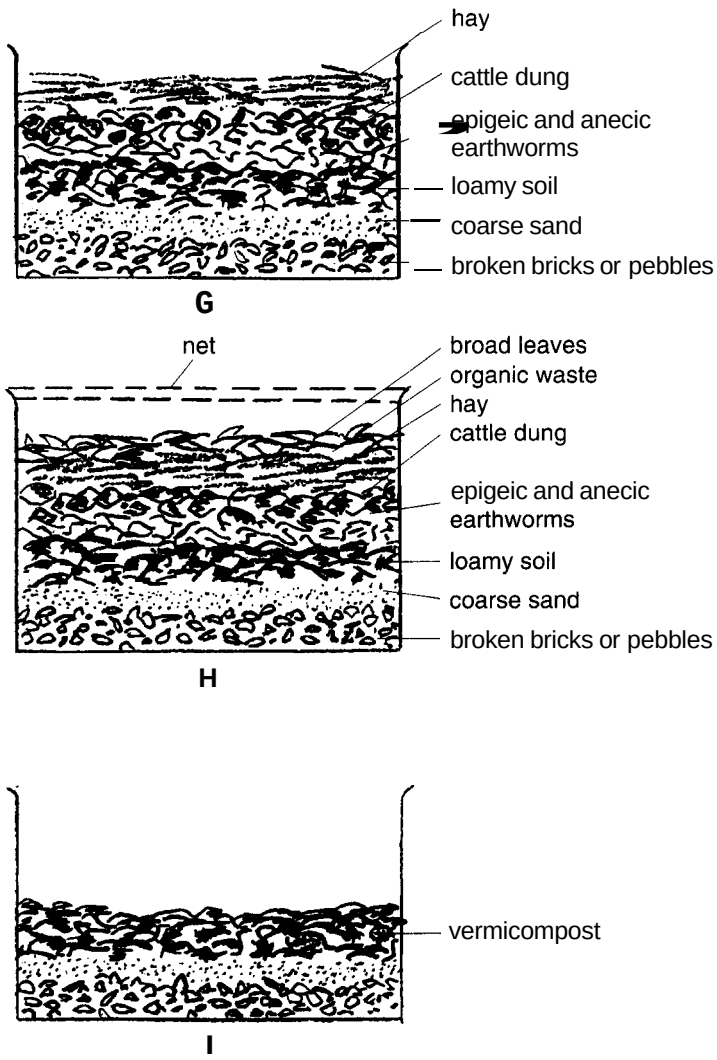

Diagram 4: Setting up a vermiwash unit