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# RECYCLING OF KITCHEN WASTE INTO VERMICOMPOST

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**ABSTRACT:**

Due to industrialization and urbanization resulted in huge amount of solid waste generation; its management has become one of the biggest problems in the present scenario. Solid wastes can be disposed off by methods like incineration, land fills, waste compaction, biogas generation, recycling, and composting, but its overproduction has led to inappropriate disposal practices. In many cities, the urban waste is managed by the city corporation, it is still ineffective unless each small family takes the responsibility and care for their own waste produced. This organic wastes can be used for vermicomposting; it is an effective recycling technique that improves the quality of the products which is disinfected, detoxified, and highly nutritive. It is a low cost, eco-friendly process of waste management in which earthworms are used with microorganisms in order to convert biodegradable wastes into organic rich manure. Vermicompost is a nutrient rich, natural fertilizer and rich in humus, soil conditioner which can be used as the top soil or the organic manure in the fields to prevent organic carbon deficiency and soil erosion. Vermicompost is a suitable alternative to chemical fertilizers, being an excellent growth promoter and protector for crop plants. Thus, vermicompost is beneficial for sustainable organic agriculture and for maintaining ecosystem.

***Key words:*** *- organic waste earthworms vermicompost nutrients*

## INTRODUCTION:

Household waste management is an issue not to be ignored. In the wake of rapidly depleting natural resources of health hazards caused by the huge amount of waste produced. Much of the organic wastes are highly infectious as they contain a variety of pathogenic microorganisms. Dumping of organic wastes in open areas generates serious environmental issues such as the accumulation of heavy metals in soil, pollution of ground and surface waters due to leaching and run-off of nutrients.

But gradually the perception is changing and waste is now being looked upon as a 'resource' or 'urban ones' which contain recoverable materials and energy. In developing countries like India, the waste generated is largely organize and biodegradable in nature. Composting of organic waste has been practiced for a long time. Wherein, biodegradable materials undergo decomposition and the end products are a material rich in nutrients, called as organic manure. Decomposition is the natural process of biological degradation and composting is the process of sanitary disposal and reclamation of organic material is termed as composting **(Abbasi, S. A., 2001)**

The compost prepared from organic materials using earthworms is a low cost and ecofriendly technology called vermicomposting. The fine granular peat-like end product, vermicompost that is produced contains higher levels of nitrogen, phosphorus, and potassium (NPK) in available form, micronutrients, microflora, enzymes, and growth regulators. Vermicomposting is one of the most efficient means to manage environmental pollution problems. Many studies are being done to establish vermicompost as one of the ideal organic substitutes to chemical fertilizers.

### 1. Vermicompost – an effective approach to organic farming

Vermicomposting is the method of making compost with the use of earthworms. Earthworm

species such as Eisenia foetida, Perionyx excavatus and Eudrilus Eugenia are easily adaptable to agricultural wastes like after harvesting stribbles, sugarcane thrash, coir waste, paper pulp, faecal matter of cow, sheep, horse, activated sludge and biogas sludge of poultry droppings. The break-down of these materials or the degrades organic matter by a worm activity is called the **"vermicompost"**. Vermicompost is a nutrient-rich, natural fertilizer and soil conditioner, which can be used as the top soil or the organic manure in the fields to prevent organic carbon deficiency and soil erosion. The process of producing vermicompost is calle**d 'vermicomposting' (Bhatnagar & Palta, 1996)**

Composting is also used to treat manures, green wastes or municipal solid wastes. However, vermicomposting gives a higher-quality end product than composting due to joint action of enzymatic and microbial activities that occur during the process. This process is faster than traditional composting as the material passes through the earthworm gut, whereby the resulting earthworm castings are rich in microbial activity and plant growth regulators, and fortified with pest repellence. Thus, vermicompost is considered an ideal manure for organic agriculture as it is nutrient rich and contains high quality humus, plant growth hormones, and substances that are able to protect crops against pests and diseases. Moreover, vermicompost has high porosity, aeration, drainage, and water-holding capacity. Plant growth hormones namely cytokinins and auxins are found in organic wastes processed by earthworms. The composition of commonly available nutrients in vermicompost is as follows: Organic carbon 9.5–17.98%, Nitrogen 0.5–1.50%, Phosphorous 0.1–0.30%, Potassium 0.15–0.56%, Sodium 0.06–0.30%, Calcium and Magnesium 22.67–47.60 meq/100 g, Copper 2–9.50 mg/kg, Iron 2–9.30 mg/kg, Zinc 5.70–11.50 mg/kg, Sulfur 128–548 mg/kg. Hence, vermicomposting enables biological transformation of wastes into a valuable organic fertilizer. (Tamanreet Kaur)

## 2. Earthworm biology

According to **Bhatnagar & Palta, 1996** earthworms are tubular creatures of somewhat lower evolutionary status than insects. However, these have main distinctly advanced features that add to their adaptabilities for life in soil. These are now being exploited by man for economic returns, as well for use in ecological management for soil fertility with organic waste recycling.

Therefore, earthworms attain a high status in present day "Economic Zoology" with applications in many and distantly related fields. Among lower group pf animals, earthworms therefore are now drawing more attention than other.

**Bhatnagar & Palta, 1996**, observed that earthworms constitute a large part of the biomass (living bodies) inhabiting soil. In some situations, these may constitute 80% of the biomass. Zoologically, these have segmented body, so are classified under Phylum Amelida and Class Oligochaeta. Later one is from latin word oligos meaning few and chaete meaning hair like structures, seatae present externally over body of earthworms. Grossly, earthworms are tubular wriggling creatures with worm like appearance. Hence for these, usage of word worm or 'vermi' (latin) have come into popular usage. However, technically, earthworms considerably differ from other worms.

Aristotle says that earthworms are the intestine of the earth**.** While, White and Frunkel (1994) says that through the earthworms are repulsive chain in energy flow, in presence of them, plant grows better than in their absence. Earthworms play a vital role in decomposing dead plants and animals and are responsible for increasing aeration and fertility of soil. Earthworms are called as biological indicators of soil fertility. They are supportive for keeping healthy population of

bacteria, fungi, actinomycetes, protozoans, insects, millipedes and many other organisms present in soil. The importance of earthworm has been advocated by several workers **(Sathe, 2004).**

**Importance of earthworms in agriculture**

- Bring about the decomposition of organic matter.
- Helps in mixing organic matter in soil.
- Alter soil prosperity.
- Increases activity of microbes in soil.
- They make available organic material as food to crops/plants.
- Earthworms increase water holding capacity of soil.
- Roots of the plants grow deep in soil.
- Worms increase aeration capacity of soil.
- Increase percolation of water.
- Increase soil fertility.

### 2.1. Classification of Earthworms

In India, 365 species of earthworms have been reported belonging to 58 genera and 10 families if class Annellida. **(Sathe, 2004)**

According to Jamieson (1971) taxonomically there are five large families recorded in the world which includes, Eudrilidae, Glassoscoleciade, Lumbricidae, Megascolecidae and Moniligastridae. Taxonomic work on Indian species of earthworms have been published by Julka (1975, 1976, 1978, 1979, 1981, 1988), Easton (1982), etc. it is believed that there are about 3600 species of earthworms in the world. Out of which 509 species have been reported from India (Bhatnagar & Palta, 1996). Lee (1985) classified earthworms on the basis of their feeding habits into two groups as Detritivores and Geophages as shown –

**1.1. Earthworm Species and their Use –** Earthworm species such as Eisenia foetida, Perionyx excavates and Eudrilus Eugenia are suitable for vermiculture. The other species that can be used in vermicomposting are Allolobophora parvus. In many temperate countries including India allied species namely Allolobophora subrubricunda, Allolobophora chloritica, Dendrobaena rubida and Lumbricus rubellus are used for vermiculture. Two other species used are Lampito mauritii and Perionyx sansbaricus. Pheretima posthuma is a common species in India, but still not widely used for vermicomposting. The selection of earthworm species for vermiculture is dependent on the objective of the work. All species of earthworms are useful but, they may have different objectives. Nature distributed their work and accordingly they are working for their own but, man manipulated their behaviour for his own interest. Thus, earthworms are visualized for their usage such as organic fertilizer, soil fertility riser, crop yield increaser, an attractant in fishing and food for cattle, etc; The usefulness of some earthworm species is tabulated **(Sathe, 2004)**

Criteria for the selection of suitable of earthworm to be used in vermicomposting are as follows:

- ✓ The earthworm species selected should be prolific breeder having high multiplication rate.
- ✓ They should have short life cycle with less mortality.
- ✓ They should be voracious feeders and should give high quality vermicast.
- ✓ They should be easy to handle as well as sturdy and capable of throughout the year.
- ✓ They should have at least 1-3 year of longevity.
- ✓ They should be economically feasible and easily available.

### 3. Role of Earthworms

Earthworms are very important components for the maintenance of soil fertility and nutrient cycling. The Pioneering Zoologist, **Charles Darwin,** is actually first to have brought to our knowledge the importance of earthworm in

increasing soil fertility. Earthworms are able to convert organic part of municipal solid into rich manure. They are also able to deodourize the composting process (Bhawalkar, 1992). In India, at least 60 percent of the solid wastes are organic in nature. These wastes are often rich plant nutrients. Vermitechnology is both ecologically and economically viable process and can be adopted least technically by a common man. Thus, these tubular creatures are largely exploited now, for economic returns by the man. They also have a role in ecological soil management and organic waste recycling. (Trivedy & Kumar 1998)

Earthworms are intestine of earth and have main role in formation of 'vegetable mould', i.e. humified soil layer on which we grow our food plants. Earthworms build the later in far lesser time than it would develop or from in natural process of over hundred of years. These simple creatures can turn **"Waste into Gold"**, i.e. by converting decomposable organic wastes into valuable vermicompost. **(Trivedy & Kumar 1998)**

**Uses of Earthworms – (Trivedy & Kumar 1998)**

- Important role in medicine.
- It is used antipyretic, antipyrin, antidote and as blood vessel shrinker.
- They are rich in protein (65%), fat (14%), carbohydrates (14%) and ash (3%), they are used as a feed for domestic animals and human beings, pig, prawns, shrimp and for fishing, etc;
- They are also used as livestock feed in poultry industry.

**4. Vermicomposting materials (Sathe 2004)**

Almost all types of biologically degradable and decomposable organic wastes can be used in vermiculture and vermicomposting. However, constituents vary, viz., poultry droppings are rich in calcium, phosphates and other salts. This has to be diluted by mixing with leaf litter, soil and cow dung. Similarly all types of leaf litter is not preferred by all species if earthworms. All such materials can be put to preliminary testing discussed under maintenance if base culture.

**Commonly used composting materials are listed below :**

1. **Animal dung :-** like cattle dung, sheep dung, horse dung, goat dung and poultry dropping etc. In use of animal dung and other than cattle dung, various preliminary testing and precautions for pathogens and responses to earthworms are necessary. With use of horse dung, operators have to be extremely, cautions of Tetanus virus that is common in particular within horse dung and is lethal to human beings. In sheep dung immediate growth is poor.

2. **Agricultural waste :-** These comprise all items discarded after harvesting and threshing of the produce. Thus stem, leaves, husk (excepting paddy husk), peels, vegetables waste, orchard leaf litter, processed food wastes, sugarcane trash and baggase; and processing wasted.

3. **Forestry wastes :-** These also comprise carious types of plant products like wood shavings, peels, saw dust and pulp. All these besides various types of forest leaf litter can be used.

4. **City leaf litter :-** As yet no data is available on tannage of leaf litter form avenue or residential areas that is burnt. All this can be converted into vermicompost. This would keep cities clean and would provide useful product the vermicompost.

5. **Waste paper and cotton cloth etc :-** these are decomposable organic waste. These if are not being recycled for other useful products, can be recycled with Vermicomposting.

6. **City refuge :-** City refuge or garbage on daily production basis compromise important items if city factors affecting pollution. Its management (collection and disposal) costs lot due to various factors. Composition of city refuge widely varies. Considerable portion of city refuge can be got sorted and recycled or composed. For composting however, essential requirement is that citizens avoid mixing of toxicants, i.e. sorting or separation commences right at generation or producer's level. Simple solution is that more awareness is developed with appropriate development of disposal systems to check mixing of decomposable, recyclable, non-cyclable, and chemical contaminated city refuge including sewage. Most of household as kitchen waste with little manipulation can be vermicomposted.

7. **Biogas slurry :-** After recovery of biogas, if not required for agricultural use, viz., in conventional composting can be used for Vermicomposting.

8. **Industrial wastes :-** Some types of industrial wastes, viz., waste from food processing, distillery etc. can also be used in vermiculture with some manipulations in regard to vermicompostable conditions.

### 4.1. Preliminary treatment of composting material

Organic wastes that are decomposable are to be subjected to certain preliminary treatments. This is to enhance vermi-compostability and its efficiency.

First step is proper collection, sorting or separation of compostable, non-compostable and non-biodegradables like plastics, stone, glass, ceramics and metals. Wastes heavily contaminated with chemicals should be separated as most would kill earthworms. Even in kitchen wastes, heavily spicy wastes should be heaped and large lumps should be broken. At this stage little awareness of points on decomposition processes discussed in succeeding pages is desirable.

Separated matter, if possible be spread in a layer upto1 foot and be exposed to sum for a day also. This kills many unwanted organisms. It also removes foul smell. This is always not possible in present day city living where open space is limiting factor. In such situations mixing of daily organic waste produce be done with somewhat pre-treated leaf litter in approximate ratio ranging from 10 to 40% of the waste to be vermicomposted.

Pre-treatment of leaf litter and agricultural waste is also very simple. These should be heaped on ground and exposed to sun. Heaps should then be beaten with some stick or bamboo to break into smaller pieces. Materials like crop plant stems and baggase etc. are required to be cut into smaller pieces for enhancing decomposition and Vermicomposting processes. Non-marketable vegetable produce, i.e. one infected with some insect pest, require some chemical treatment. This is because some insect pest life stages

continue in wastes and hinder earthworm activities, i.e. vermicompostibility. Such hindering insect activities are varied, viz., webbing, lumping and at times some insect larval stages due to inknown factors reduce feeding in earthworms. Common example to these is insect pest popularly known as Brinjal borers which effect several vegetables.

For controlling insect pests of non-marketable vegetable wastes is to chop waste into smaller pieces upto 4" size and spread over ground. This layer be then sprayed with 4% aqueous solution of some Neem insecticidal formulation. This would gradually kill insect pests stages without making waste unfit for Vermicomposting. Neem and taking out seed kernel as we take out almonds by removing hard outer covering. 20-25 gm Neem seed kernel be wrapped in a cloth over night and squeezed in half litre of water with repeated in dipping and squeezing with turning movements. Solution so obtained is insufficient concentration to kill most insect pests stages. **(Bhatnagar & Palta, 1996).**

**METHOD AND METHODOLOGY:**

Vermicomposting is done by various methods among them two methods are common they are -

**Bed method –** Composting is done on the pucca/kachcha floor by making beds (6x2x2 feet size) of organic mixture. This method is easy to maintain and to practice.

**Pit method -** Composting is done in the cemented pits of size 5x5x3 feet. The unit is covered with thatch grass or any other locally available materials. This method is not preferred due to poor aeration, water logging at bottom.

**4.2. Requirements for Vermicomposting –**

**(Bhatnagar & Palta, 1996).**

1. Container :- Vermi-composting container can be of any shape or size and requirement depends upon quantity of waste to be composed and number of live earthworms we want to culture.

On average, 2000 adult earthworms can be maintained in containers of 1 $m^2$ dimension. These with appropriate conditioning of composting material would convert approximately 200 Kgs wastes every month. Interestingly, roughly in a container of 2.23 x 2.23 mtr it is possible to maintain 10 kgs of earthworms to have an expected conversion normally only upper 9-12" layer is composted. This should be softly scrapped off.

2. Bedding material :- This is the lower most layer of earthworm feed substrate that is required to be vermicomposted. For this any biodegradable matter is used like banana stem peels, coir pith, coconut leaves, sugarcane trash, stems of crops, grasses or husk. Waste or discarded cattle feed can also be used for bedding.

3. Moisture content :- Moisture content during Vermicomposting should be maintained between 30-40 percent. If moisture is high, dry cow dung manure or leaf litter should be mixed with substrate.

4. Temperature :- Requirement for optimal results is 20-30$^o$C. However, survival of earthworms is even at lower temperatures and upto 48$^o$C air temperature. Obviously with little provision of shade, temperature within worm feed substrate (material to be vermicomposted) can be reduced. For this it is desirable that substrate should not be tightly packed in containers.

5. PH :- PH of substrate should be between 6.8 to 7.5. For non-scientists; measurement of PH, can be done with use of PH paper strips available from chemists. These pH indicator strips are dipped in soil solution (soil and distilled water), colour changes and which is matched with colour chart on cover of strip booklet. 7.0 pH indicates its neutral condition, less than 7 indicates its acidic nature and greater than 7 indicates alkaline condition of soil.

6. Cover of feed substrates :- This required for reducing moisture loss and also save worms from extra movements (outside substrate) or from predators like ants. Moist gunny bag covers also help in conservation of moisture.

7. Selection of right type of Worm species :- in general, species to be used for Vermicomposting should have good survival in high organic matter, conversion rate should be high in terms of growth rate of earthworms (protein conversion), high temperature tolerance, and pressure, as well have high reproduction rate.

**5. Harvesting –**

When raw material is completely decomposed it appears black and granular. Watering should be stopped as compost gets ready. The compost shout be kept over a heap of partially decomposed cow dung so that earthworms could migrate to cow dung from compost After two days compost can be separated and sieved for use.

**Preventive measures –**

- The floor of the unit should be compact to prevent earthworms' migration into the soil.
- 15-20 days old cow dung should be used to avoid excess heat.
- The organic wastes should be free from plastics, chemicals, pesticides and metals etc.
- Aeration should be maintained for proper growth and multiplication of earthworms.
- Optimum moisture level (30-40 %) should be maintained
- 18-25°C temperature should be maintained for proper decomposition.

**Advantages of Vermicomposting –**
**(Bhatnagar & Palta, 1996)**

1. Vermicompost is an eco-friendly fertilizer prepared from biodegradable organic wastes and is free from chemical inputs.

2. Earthworms are harmless organisms so there is no pathogenic activity in the manure hence he manure does not pollute or have any adverse effects on the soil, plant and the environment.

3. It improves soil aeration and texture thereby reducing soil compaction.

4. It improves water retention capacity of the soil because of its high organic matter content.

5. It promotes better root growth and nutrient absorption.

6. It improves nutrient status of soil-both macronutrients and micronutrients.

7. As the waste are used i making composts, it keeps the environment clean by reducing the dumping wastes into it.

8. Huge quantities of domestic, agricultural and rural industrial organic wastes can be recycled for various usages. This also reduces pollution.

9. Vermicompost substitution with fertilizer input will reduce economic input, viz., by substituting certain percent of chemical fertilizer with bio-fertilizer, i.e. the Vermicompost. Thus economic input would go down.

10. Vermicompost can be produced nearest to the site of use. This has many advantages.

Eliminate odour and fly problem.

**RESULT AND DISCUSSION**

Vermicomposting help in recycling the organic materials more frequently by reducing the time required for decomposition of the organic materials. The vegetable waste is highly organic, rich in carbohydrates and proteins. The organisms Rhizobium, Azotobacter and Lactobacillus have utilized these complex organic substances and converted the waste into a reusable fertilizer by improving the quality of compost with adequate amounts of organic carbon and nitrogen. Vermicompost application to the soil drastically improves the soil fertility, increases the yield, improves the soil pH, releases more available nutrients, increases pest resistant, enhances water infiltration and water holding capacity of the soil, reduces irrigation requirement. Improves soil microbial activities, yield produces with the better taste, luster, keeping quality and low pesticide reduces enhancing its exportability. Vermicompost could be a good substitute for chemical fertilizers in practicing organic farming as most of the nutrients in Vermicompost are in readily available form and it increases availability of nutrients to planted crops and hence can support high yields of crop.

Nest of Indian Cliff Swallow *Hirundo fluvicola* Blyth 1885

**CONCLUSION**

The extensive use of chemical fertilizer and pesticides has led to degradation of soil health, pollution of ground water salinity and soil biodiversity. To prevent ecosystem and to protect human health from harmful chemicals “Organic farming” has to be promoted as new concept of farming. Using Organic fertilizer like vermicomposting could be a best substitute over chemical fertilizer.

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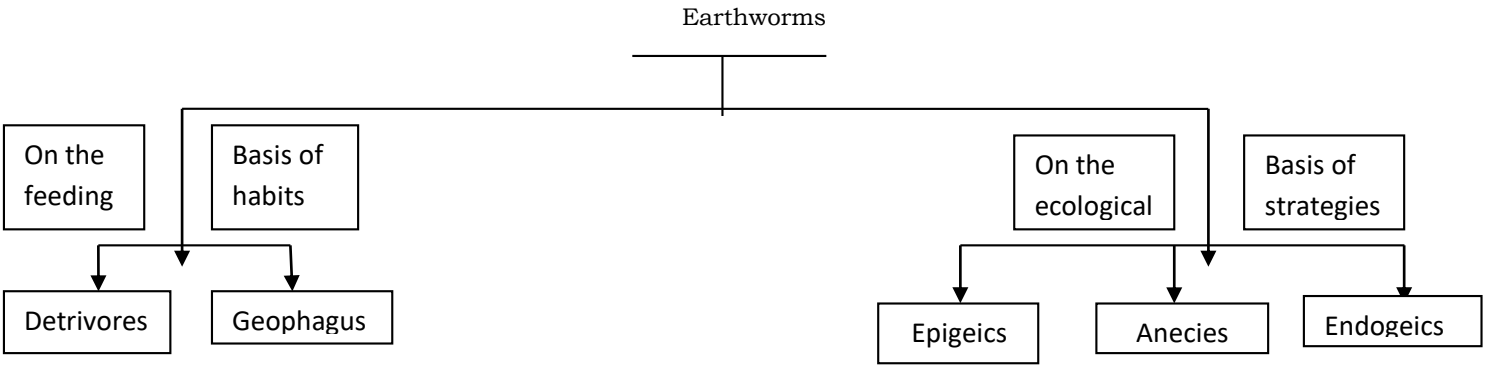
Tamanreet Kaur,”Vermicomposting : An effective option for recycling organic waste”.

| Sr.No. | Detritivores | Geophages |
|---|---|---|
| 1. | Feed at or near the soil | Feed deeper beneath the surface |
| 2. | Feed mainly on plant litter or dead root or mammalian dung. | Ingest large quantities or organically rich soil. |
| 3. | These are humus formers. | These are humus feeders. |
| 4. | Epigeic and Anecic forms | Endogenic earthworms. |
| 5. | Examples : Lampito maueitii, Perionyx Excavates, Eudrilus euginiae, etc. | Examples : Metaphire posthuma Octochaetona thurstoni, etc. |

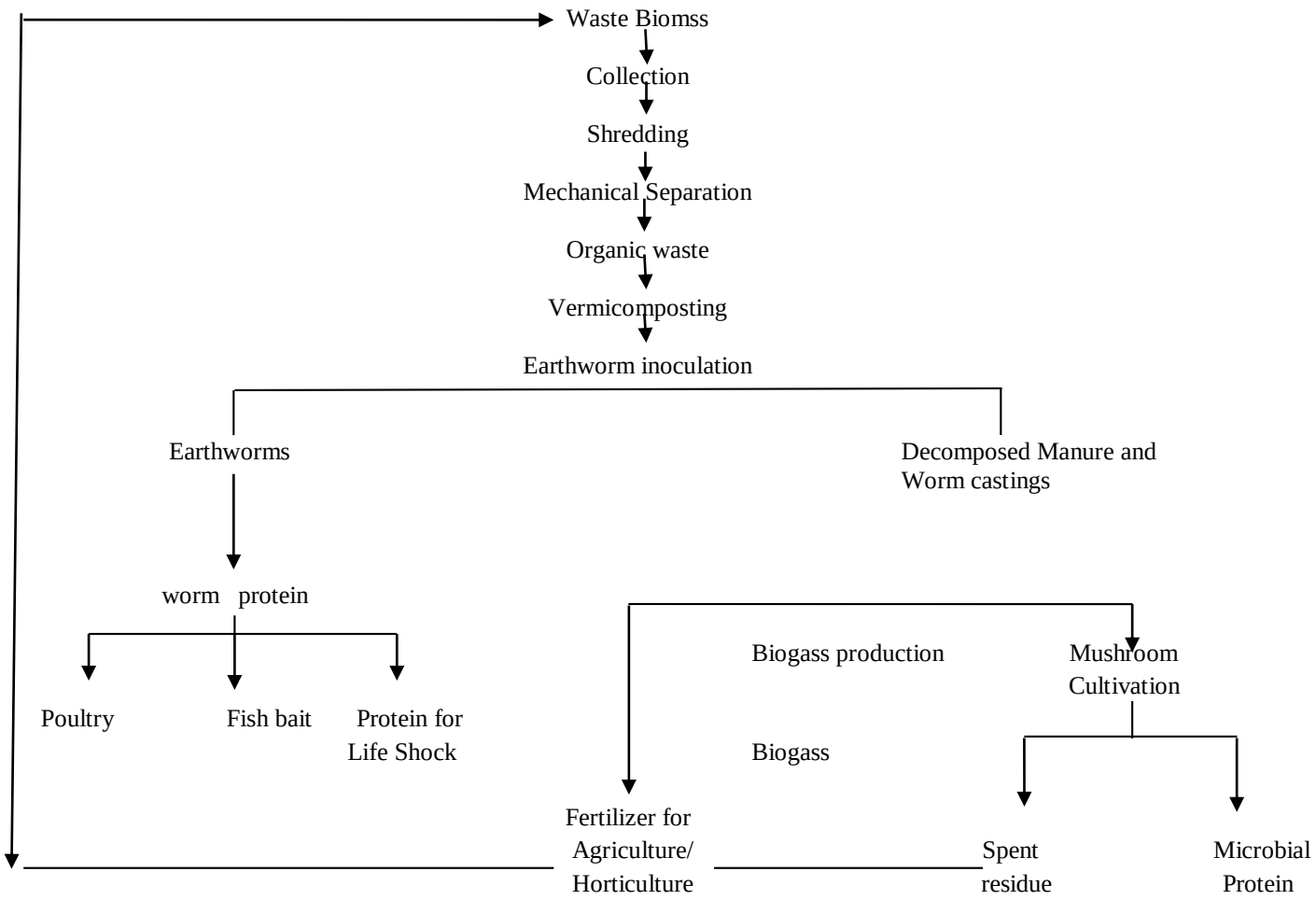
In general earthworms are divided into two groups:

1. Microdrilli worms – which are aquatic and represented by 280 species.
2. Megadrilli worms – which are terrestrial and are called earthworms.

Earthworm Classifications




| Sr.No. | Species | Uses |
|---|---|---|
| 1. | Eisenia foetida | Used in converting organic wastes into vermicompost. |
| 2. | Eudrilus Eugenia | - Used in converting organic wastes into Vermicompost. |
| 3. | Lampito mauritii | - Used in soil management helping in Compost production. |
| 4. | Perionyx excavates | - Used in soil management |
| 5. | Local varieties and | - Used in vermitech by Ismail in 1993, and combined (epigeic process of litter and soil management anecic varieties) |




**Earthworms in organic waste recycling**