5. MATERIALS AND METHODS

5.1. SELECTION OF EARTHWORM SPECIES

5.2. Selection of *Eisenia foetida*.

The exotic species of earthworm viz, *E. foetida* has been chosen for the following reasons. An exotic as well as epigeic species of *E. foetida* Hartenstein et al. (1979 a, 1979 b) had been used in converting organic wastes into vermicompost. It is a surface dwelling worm and inhabits wherever organic wastes abound. It processes 20 times of its own weight or volume of material in 10 days time i.e. per day it processes 2 times of its own weight and then only starts searching for fresh food material (Hartenstein, 1983).

Earthworms are omnivorous animals but often selective in their food habits. Earthworms derive their nutrition from organic materials, living bacteria, fungus, diatoms, algae, protozoa, nematodes and decomposing animals. The dead worms (*E. foetida*) contain 62 to 64 % protein with 4.3% lysine, 2.3% systine and 2.2% methionine.

Further the worms also play an important role in waste disposal and pollution control. Hartenstein et al (1979 b) found that cocoon production in *E. foetida* began when the earthworms were about 4 to 6 weeks old. Riffalda and Leximinzi (1983) found that manure samples inoculated with *E. foetida* decompose more rapidly and show a higher degree of humification than uninoculated samples. It has a shorter incubation period, higher fecundity and shorter life cycle.

5.3 Selection of *Eudrilus eugeniae*

The exotic earthworm, *E. eugeniae* has been selected for the present study for the following reasons.
It is an exotic epigeic species. *E. eugeniae* have been used in converting organic wastes into vermicompost (Kale and Bano, 1988). These surface dwellers are capable of working hard on the organic waste into vermicompost. They are nocturnal and move about only at night. These species have been recommended for use in the breakdown of the organic wastes. Since the worms are tropical in origin they perform well at tropical and subtropical conditions. It remains active all through the year if the conditions are favorable.

It works through its substrate for 24 hrs a day and has high throughput capacity for organic and soil (Hartenstein and Bisesi, 1989). It also has shorter transit time for food than the endogeic worm (Kale, 1992). It shows higher feeding rate, rapid growth rate than other epigeic worms such as *P. excavatus*. It is a voracious feeder on organic matter, and prefers food richer in nitrogen, cellulose and micro organisms (Hartenstein and Bisesi, 1989). The biomass turnover is the most important factor in the species selection for vermicomposting. Though India is rich in earthworm fauna the majority of them are deep dwellers, humus feeders and characterized by long life cycle and low fecundity or those with higher fecundity will be too small to give good biomass. On the other hand *E. eugeniae* attains higher biomass within shorter period of time with higher fecundity than any other species of earthworm (Hartenstein and Bisesi, 1989). Hence it is highly effective in turning organic waste into vermicompost (Kale, 1992). It has a shorter incubation period, higher fecundity and shorter life cycle with longevity of life more than a year. The casts of this species are easily collectable from the surface. It is most suited for easy maintenance in the laboratory.

5.4 Selection of *Lampito mauritii*

An indigenous, anecic and native species of *L. mauritii* for vermicomposting operations in Indian conditions was selected for following reasons.

It is also known as garden worm. It is the main sub-species of the south Indian earthworms, commonly available throughout the year and easily maintainable in the laboratory. It is an efficient decomposer of organic wastes Senapati et al (1980) and
5.5 A SCHEMATIC DIAGRAM OF THE STUDY

Interspecific variations of three ecological types of earthworm species upon the bioconversion of organic wastes into vermicompost in Tirunelveli, Tamil Nadu, South India.

Animal wastes

Cow dung, Bat excreta, poultry excreta, Goat dung, Sheep dung, Rabbit dung, Silkworm excreta,

Taken

Types of earthworm’s species utilized for study

Eisenia foetida
Eudrilus eugeniae
Lampito mauritii

Cow dung, Bat excreta, Poultry excreta, Goat dung, Sheep dung, Rabbit dung, Silkworm excreta

Cow dung, Bat excreta, Poultry excreta, Goat dung, Sheep dung, Rabbit dung, Silkworm excreta

Cow dung, Bat excreta, Poultry excreta, Goat dung, Sheep dung, Rabbit dung, Silkworm excreta

60 days
Experiment

60 Days

Growth Study

Vermicompost

Physico-Chemical analysis of parameters

Microbial Analysis
suitable for vermicompost (Senapati, 1993) and is one of the most dominant anecic earthworm in various agro Eco-systems of India. It inhabits the topsoil within 20cm depth, feeding, mainly upon organic wastes and easily adaptable to environmental factors like temperature, moisture etc. It has higher protein, fat and essential amino acid contents. These worms could be used to prepare worm meal for other animals (Dash and Dash, 1990). It has a higher rate of fecundity with moderate biomass production together with a longer period of survival and reproductive capacity. Adult worms are available throughout the year in the moist places and compost pits, but occur abundantly during the beginning of monsoon (June to October).

5.6 PROCUREMENT AND REARING OF STOCK EARTHWORMS

The two exotic and epigeic species of *E.foetida* and *E. eugeniae* were collected from vermiary maintained at Sri Paramakalyani Centre for Environmental Sciences, Manonmaniam Sundaranar University, Alwarkurichi, India. The tropical earthworm like *Lampito mauritii* was collected from the field. The worms were stocked in 55x40x35 cm cement cisterns. Urine free cattle dung, Sundried and powdered was used as substrate to maintain the adults and hatchlings as this was deemed as highly suitable natural feed for worms (Graff, 1981, Hatanaka et al. 1983, Lee,1985). Moisture content 70 to 80% was maintained by sprinkling well water on dung periodically or daily as per the prevailing conditions. The stock culture cisterns were covered with wooden framed iron mesh to prevent the invasion of foreign and outgoing of worms. The temperature of the culture medium was maintained as 29 ± 1°C inside the laboratory. Mulching was done by using paddy straw to prevent evaporation of water content and to retain moisture content. Every 10 days top layer of substrate was removed and replaced with fresh dry cattle dung.

5.7 COLLECTION OF ORGANIC WASTES

India produces about 2000 million tonnes of organic waste annually which could otherwise be utilized for four essential resources like fertilizer, fodder, fuel and food. Enormous quantities of cow dung, Rabbit excreta, Sheep dung, Goat dung, Bat excreta, Silkworm excreta, Poultry excreta are produced. They were not properly
recycled at present but underutilized or inefficiently managed due to various reasons, Organic and inorganic component of waste could be reutilized. In fact, nothing is really waste and we should learn to transform waste into resource. Today’s waste is tomorrow's raw material and waste is wealth, if properly managed. Therefore we should learn to waste not waste- a resourceful material. Further the traditional method of composting of these wastes is highly unscientific, denied food for biodegrading microbes besides resulting in leaching and volatilization. But by and large waste utilization has not yet taken up roots in a majority of developing countries including India although they pay high costs for waste mismanagement. (Dash and Senapati, 1986). So, existing methods of waste disposal though inefficient removes a major hurdle of utilization of these wastes profitably in order to realize their full potential and to avoid pollution. So formulation of integrated schemes based on complete recycling of organic wastes in the only option to make the waste recycling system work in a simple, Scientific and fruitful manner. On the basis of present knowledge of earthworms the agriculture, aquaculture, animal husbandry, waste management, satiations and hygiene and many types of waste-wise ecosystem management will depend on our knowledge about manipulation of these natural elements like earthworms. Vermicomposting is an appropriate biotechnology to create a system of integrated waste management most suited for Indian villages- Why ever for urbanites hence, the following 10 different types of organic wastes were selected for studying parameters, growth, fecundity and vermicomposting studies in the present study.

(i) **Cow dung (CD)**

Urine and straw free cow dung were collected from dairy yard at Sri Parasakthi College for women Campus, Courtallam. It was sun dried and stored in jute bags.

(ii) **Silkworm excreta (SWE)**

Silkworm excreta were collected from Nannagaram Sericulture Centre Tenkasi. It was air dried and packed in nylon bags.
(iii) **Rabbit excreta (RE)**

Rabbit excreta were collected at Tirunelveli, Science Centre. It was air dried and packed in nylon bags.

(iv) **Goat Manure (GM)**

Goat manure was collected from goat rearing sheds at local places and it was air dried and stored in nylon bags.

(v) **Sheep Manure (SM)**

Sheep manure was collected from sheep rearing sheds at local places and it was air dried and stored in nylon bags.

(vi) **Bat excreta (BE)**

Bat excreta were collected from Shencottai temple. It was air dried and packed in nylon bags.

(v) **Poultry excreta (PE)**

These Poultry excreta were collected from local Poultry farm. It was air dried and stored in nylon bags.

In the present study of vermicomposting types of organic wastes Viz, cow dung, Poultry excreta, Rabbit excreta, Sheep dung, goat dung, bat wastes, Silkworm excreta were tested individually for the viability of *E.foetida, E. eugeniae* and *L. mauritii*. Among these seven different organic wastes *E.foetida* preferred only CD, RD and BD only. Hence these seven types of organic wastes were selected for the present study. The availability and present status of these wastes are described below.

### 5.8 COW DUNG AND ITS AVAILABILITY

The present population of bovines in India consists of 201-206 million cattle and 76-80 million buffaloes. It is projected to be 282 million heads by the end of century. Cattle and buffaloes make up 60% of the total livestock population but are the source of 91% of the total dung produced. Dung produced per animal per year (dry...
weight basis) is calculated as 110 tones for cattle (Cow/ ox) and 1.35 tones for buffaloes (Jain and SushilKumar, 1995).

The faces of livestock consist of undigested food. It also contains residue from digestive fluids, waste mineral matter, worm out cells from the intestinal lining, mucus, bacteria, undigested protein, calcium magnesium, iron and phosphorus, undigested protein is excreted in the urine as uric acid or urea. Potassium is absorbed during digestion between most of it is excreted through urine calcium, magnesium, iron and phosphorus are excreted in the faeces. Further in the animal excreta solid concentration range from 4.20 % and in cattle dung from 15-20 %. Animal excreta and their composition differ due to various factors such as animal age, species, protein and fibre contents of the food, environment and productivity (Jain and SushilKumar, 1995).

5.9 PRESENT UTILIZATION OF COW DUNG AND PROBLEMS IN UTILIZATION OF COW DUNG

At present cow dung (cattle dung) is used as manure, feed stock for biogas plant etc. 85% of the dung collected is diverted into manure pits and only 13 % is converted into dung. Cakes as compared to 58 % diverted into manure pits and 40% converted into dung cakes during winter (Jain and SushilKumar, 1995). Yawalkar et al (1977) reported that only 50% of the total dung produced in India is used as manure and rest of them used for preparation of dung cakes and burnt away as fuel.

The use of dung as fuel is continuously increasing since easy availability of firewood is becoming scarce, leaving progressively lesser amount for manure production. A significant amount of nitrogen (More than 50%) is lost by volatilization and leaching, through conventional of cattle dungs (Chinnasamy, 1994). Further the burnt cattle dung loses virtually all the nitrogen through vaporization and also causes air pollution. Also the accumulation of cattle dung near the living places leads to sanitation and pollution problems.
5.10 PRESENT UTILIZATION OF GOAT DUNG, SHEEP DUNG, RABBIT DUNG, POULTRY DUNG AND SILKWORM EXCRETA

The wastes from ruminants such as goat and sheep have a different composition from the wastes of poultry which are highly digestible. The annual production of sheep and goat dung is 0.1-0.2 tones/year and on an average, production of poultry drops in 0.14 tones/year and other like rabbit waste and silkworm excreta are also produced but in very lesser amount. Silkworm excreta containing nitrogenous compounds like protein are metabolized and excreted principally as uric acid. They also excrete calcium oxalate (Krishnaswami et al., 1973). A significant amount of nitrogen is lost by volatization and leaching by accumulation and also accumulation near the living places leads to sanitation, hygienic and pollution problems.

5.11 PREPARATION OF VERMIBEDS

These organic animal excreta were powdered and passed through a 1mm mesh sieve to obtain a medium with a particle size less than 1mm as suggested by Reinecke and Venter, (1985). Reduced particle size of the culture medium was found to be favorable for raising young worms of *E.foetida* (Reinecke and Venter. 1985) also suggested that the small particle size provides more surface area per volume of culture as well as moisture availability.

*E.foetida* processed about 20 times of its own weight or volume of material in 10 days i.e. per days, it processed 2 times of its own weight and then they may begin to search for fresh food material (Harteinstein, 1983). Further Viljoen and Reinecke, (1994) have reported a maximum mean biomass of 3.2 g for *E. eugeniae* cultured in cattle dung. Based on the above data, in the present study these organic wastes were prepared in the following fermented method or indoor method as described by Bano and Kale (1992) and Jambhekar (1994). The experiments were conducted with 5 Kg of individual organic wastes; it was weighed separately moistened and medium was left over for 24 hrs (to Stabilize, before the experimental animals were introduced into it) in. Plastic troughs of (45x15x30cm) size with five replicates. Ten numbers of
clitellate earthworms of *E. foetida*, *E. eugeniae* and *L. mauritii* were individually introduced into separate sets of troughs containing specific type of animal excreta. Due to availability of large space inside the vermiculture house, the vermicomposting experiments were carried out with three species simultaneously control was also maintained without earthworm. Water was sprinkled on alternate days in order to maintain the optimal moisture (40-50%) for the growth of worms. The experimental troughs were kept in a laboratory to avoid direct sunlight to prevent water evaporation in vain (to prevent excess moisture) and to protect them from predators.

**PREPARATION OF VERMIBEDS**

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 MULCHING
   ↓
 COW DUNG
   ↓
 LEAF LITTER
   ↓
 COW DUNG
   ↓
 GARDEN SOIL + EARTHWORM
   ↓
 PEBBLES + SAND
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