Salient findings and future prospects
Earthworms are the natural bioreactors converting organic wastes into valuable products such as biofertilizers, biopesticides, vitamins, enzymes, antibiotics, growth hormones and proteinous worm biomass. Their detrivorous feeding habit is being exploited commercially in waste management and biodegradation technology. The ever increasing knowledge of their activity particularly, their ability to abate environmental pollution and enhancing soil fertility and plant productivity has earned earthworms the name nature’s miniature factories that produce humus rich biogold.

On the basis of observation of growth and reproduction of the two exotic species of *Eisenia foetida* and *Eudrilus eugeniae* and indigenous and an anecic species of *Lampito mauritii* in cow dung, donkey dung, elephant dung, horse dung and biogas slurry have shown all the above said manure have better nourishing qualities and there by support better growth and reproduction than other waste. Hence cow dung, donkey dung, elephant dung, horse dung and biogas slurry could be effectively used to raise *Eisenia foetida*, and cow dung, donkey dung and elephant dung could be effectively used to raise *Eudrilus eugeniae* and *Lampito mauritii*. Cocoon production, hatchlings in large numbers under laboratory conditions make any species an ideal one that could be utilized for vermicomposting practices. The present study showed that *Eisenia foetida* and *Eudrilus eugeniae* are bestowed with rapid growth, large size, quicker attainment of sexual maturity, higher rate of cocoon production,
shorter incubation period than *Lampito mauritii* which shows slow growth, small size, slow attainment of sexual maturity, slow rate of cocoon production and long incubation period, when cultured in cow dung, donkey dung, elephant dung, horse dung and biogas slurry.

Though *Lampito mauritii*’s activities are confined to 0-20cm depth in mineral soil layer and during summer even upto 30cm depth, there are many constraints for the continuous maintenance of this worm population in the agricultural land due to ploughing, high temperature, inadequate moisture and nutrient availability and hazards due to heavy application of pesticides. Under such adverse circumstances, *Lampito mauritii* can be cultured on cow dung, donkey dung and elephant dung in large scale under laboratory conditions and released into agricultural field after planting crops. Such a practice involving *Lampito mauritii* could be aimed to provide a continuous supply of vermicasts to the growing plants besides maintaining soil physico-chemical properties and fertility. And also that the introduction of laboratory cultured (in cow dung, donkey dung and elephant dung) *Lampito mauritii* into the cropland, premanured with cow dung, donkey dung and elephant dung would further augment the vermicast production and subsequently increase plant growth and crop yield.

A maximum biomass production at an early period and attainment of peak growth rate within short period are the two possible indices to assess the nutrient quality of food and a food which enables an organism to achieve these two is deemed to be an ideal food. In cow
dung, donkey dung, elephant dung, horse dung and biogas slurry substrate, the *Eisenia foetida* are able to achieve maximum biomass and high growth rate at an early period. Similarly in cow dung, donkey dung and elephant dung substrate, both *Eudrilus eugeniae* and *Lampito mauritii* were able to achieve maximum biomass and high growth rate at an early period than soil.

Physico-chemical analysis indicated that cow dung, donkey dung, elephant dung, horse dung and biogas slurry and vermicompost(cast) obtained from *Eisenia foetida*. Similarly cow dung, donkey dung and elephant dung and vermicompost(cast) obtained from *Eudrilus eugeniae* and *Lampito mauritii* worked manure are richer in nutrients than other organic wastes, which support growth and reproduction of *Eisenia foetida*, *Eudrilus eugeniae* and *Lampito mauritii*. The differences in the levels of nutrients in the vermicomposts produced from different combinations of organic wastes revealed that the nutrient levels of vermicomposts depends on (I) the nutrient status of organic wastes used for vermicomposting (ii) the rate of degradation of organic wastes when passing through worm's gut and (iii) the degradation capacity of the earthworm species.

The vermicompost produced from different organic wastes showed increased numbers in the microbial population. The microorganisms and earthworms behaved symbiotically to enhance the decomposition of animal organic matter which in turn probably enhanced the organic matter degradation. So vermicompost not only provides
mineralogical fertility factors to the soil but also contributes to the biological fertility factors to the soil. Thus vermicompost was found to be a repository of microorganisms as well as same as a potential medium for their growth.

The following are the highlights of the present study

1. The presently unutilized, largely available, nutrient rich cow dung, donkey dung, elephant dung, horse dung and biogas slurry manure could be beneficially utilized as a growth medium to raise *Eisenia foetida*, *Eudrilus eugeniae* and *Lampito mauritii*.

2. By providing nutrient rich manure for vermicomposting many problems could be solved and multivarious benefits could be derived simultaneously as follows (a) organic fertilizer requirement for agriculture by the way of production of vermicompost (b) ecofriendly disposal of large quantities of cow dung, donkey dung, elephant dung, horse dung and biogas slurry etc (c) secondary utilization of biogas slurry for vermiculture and by which disposal of biogas slurry from the biogas plant area (d) decreases the bulk density of wastes and helps to combat environmental pollution caused by these wastes and (e) possibility of creating job opportunities for unemployed persons through large scale vermicomposting practices or providing additional income for poor rural people by establishing small scale vermicomposting unit

3. The present investigation on vermicomposting provides package of technology and innovation on the integrated waste management as
Fig. 37: Biorecycling of Cow Dung

- Biogas Production
  - Bio digested slurry
  - Vermiculture and Vermicomposting
  - Organic Manure
  - Cow Dung
    - Feed for Cow
    - Organic Waste
      - Crop
      - Bio fertilizer
      - Vermicompost
presented in Fig 37 which is aimed at the complete utilization of
cow dung.

4. The usefulness of multi-dimensional benefits of vermicompost is
diagramatically represented in Fig.1 (Chapter 1). Further vermicompost
when applied to crop field provides (I) food and protection for beneficial
aerobic free living soil microbes which in turn continue further
degradation of organic wastes (2) directly contributes nutrients to soil
and growing plants (3) and also activates the endogeic and on anecic
species of humus feeding earth worms by acting as food source for
them. From the above said aspects of vermicompost it is clear that
vermicompost maintains soil physico-chemical properties, reduces bulk
density and eliminates obnoxious odour and enhances the waste
management, options reduce environment pollution, maintain soil
fertility, crop growth and yield.

Thus the present study makes it possible for effective
utilization of enormously available organic wastes for vermicompost
production using *Eisenia foetida*, *Eudrilus eugeniae* and *Lampito mauritii*.
Vermicompost may be resorted to due to quality enhancement and
reduction in duration of vermicomposting period. Such option potentially
could help solve modern waste disposal problem especially with regard to
cow dung, donkey dung, elephant dung, horse dung and biogas slurry
which diminish pollution of the environment create value added bio-
products from animal wastes and evolve cost effective eco-friendly
bioremediation technology.