5. Summary

The proposed investigation is designed to elicit for the first time a detailed study on:

1. Earthworm resources of Cauvery delta areas, Tamilnadu state, India: Community characteristics of earthworms with reference to soil ecological parameters in different agro-ecosystems.

2. Vermiculture and vermicomposting: Potential use of predominantly available indigenous epigeic earthworm, *Perionyx excavatus* (Perrier) from the above said various agroecosystem for vermicomposting of enormously available and unutilized lignocellulosoic solid organic waste resources – cashew leaf litter admixed with different animal dung as bulking material, and during this process also to study the growth and reproductive performance of earthworm and quali-quantitative production of vermifertilizer

3. Efficiency of vermifertilizer on soil quality and quality characteristics of chilli: response of chilli – *Capsicum annuum* L., on amendment of the field with vermifertilizer and vermifertilizer supplement with inorganic fertilizers.

A total of nine species of earthworms belonging to seven genera, four families and two order of the class Oligochaeta were collected from five agroecosystem of two different cultivable land, out of 23 taluks, 3 different districts of Cauvery delta area, Tamilnadu, India. Among them, five species were from Megascolecidae family – *Perionyx excavatus* (Perrier), *P. ceylanensis* (Michaelsen), *P.sansibaricus* (Perrier), *Lampito mauritii* (Kinberg) and
*Polypheretima elongata* (Perrier); two species from Moniligastridae – *Drawida willsi* (Michaelsen) and *Metaphire houlleti* (Perrier) and one species of each from Octochaetidae- *Dichogaster bolau* (Stephenson) and Glossocolecidae - *Pontoscolex corethrurus* (Muller). Among five different agroecosystems studied, paddy field had the largest earthworm population, followed by sugarcane and banana field, and coconut field the lowest in terms of species richness, followed by groundnut field. *D. bolau*, *P. corethrurus*, *P. ceylanensis*, *P. excavatus*, *P. sansibaricus*, *L. mauritii*, *P. elongata*, *D. willsi* and *M. houlleti* were found in the wet land cultivable areas (paddy> sugarcane> banana). Both wed and dry land areas were inhabited by *L. mauritii* and *P. excavatus*. Among 9 species studied, only two species (*L. mauritii* and *P. excavatus*) were found to be ubiquitous. *D. bolau*, *P. ceylanensis*, *P. sansibaricus*, *P. elongata* showed wide range of distribution in Cauvery delta area. Strikingly other species like *P. corethrurus*, *D. willsi* and *M. houlleti* showed restricted distribution in the Cauvery delta area. This indicates the structural composition in earthworm communities varies depending on the type of agroecosystems.

Of the 9 species found in the study sites of Cauvery delta area, 4 species (*D. bolau*, *P. ceylanensis*, *P. excavatus*, *P. sansibaricus*) were epigeic, one species (*P. corethrurus*) was endogeic, 2 species (*L. mauritii*, *P. elongatae*) were anecic and 2 species (*D. willsi*, *M. houlleti*) were epianeic categories. Density and biomass of epigeic and anecic earthworms were higher significantly in the paddy field, followed by sugarcane field compared to the other fields. The wet land cultivable fields harboured earthworms in four (epigeic, endogeic, anecic and epianeic) and dry land cultivable field in two
(epigeic and anecic) ecological categories, respectively. This indicates the survival superiority / strong competitive edge over other earthworm species/ continuously available food sources in these areas for these worms.

Significantly higher earthworm densities and biomasses were found in the wet land areas than dry land areas. *L. mauritii* and *P. excavatus* exhibited higher densities and biomasses in the both land areas but remaining species *D. bolai*, *P. corethrurus*, *P. ceylanensis*, *P. sansibaricus*, *P. elongata*, *D. willsi* and *M. houlleti* showed higher densities and biomasses only in the wet land areas, not in the dry land areas. Highest relative density of earthworms were found in the both land areas (*L. mauritii* and *P. excavatus*). The ratio of *L. mauritii* and *P. excavatus* with other species were more in both land areas. On the basis of Engelmann’s scale of dominance, the paddy field was characterized by the presence of 4 dominant, 5 subdominant; sugarcane field by 4 dominant and 4 subdominant and banana field by 6 dominant and 3 subdominant species of earthworms. The coconut and groundnut field, on the otherhand, each had only 2 eudominent species of earthworms. Wet land areas (paddy> sugarcane> banana) had a significantly lower species richness index, index of dominance, index of diversity and species evenness index than dry land areas (coconut > groundnut). This indicates the unstable and immature communities of earthworms and no dominance of earthworms due to the presence of numerous earthworm species in these Cauvery delta areas.

Among the five different agroecosystems, only two types of soil are found, namely sandy loam and clay loam. This type of soil variation in the study sites of Cauvery delta areas are due to the
nature of earlier agricultural activity and the nature of soil texture. Followed by the population dynamics of earthworms (density and biomass), correspondingly a significant optimal and favourable soil physico-chemical and biological parameters like pH, moisture, temperature, organic carbon, total nitrogen, available phosphorus and potassium, C-N ratio and microbial activity were found in the wet land cultivable fields (paddy > sugarcane > banana) than dry land cultivable fields (groundnut > coconut). This indicates the optimal and favourable soil edaphic factors for survival and reproduction of earthworm in these areas. In addition to soil edaphic factors, microorganism (rich in N and protein) acts as a food that support better growth and reproduction of earthworms. The synergistic role of soil physico-chemical and biological parameters involved to influence the population dynamics of earthworms in different agroecosystem of Cauvery delta areas.

It is intended to test whether the Cashew leaf litter (CLL) could be used for vermiculture and vermicomposting. Therefore, a series of study were carried out to convert CLL admixed with different animal dungs (AD) - in to vermifertilizer using indigenous earthworm, *Perionyx excavates* (Perrier). The study was to examine the activity of earthworm (growth-biomass, reproduction-cocoon and hatchling number and recovery rate of vermifertilizer) in different AD (100%)-cowdung (CD), horse dung (HD) and sheep dung (SD) and each AD admixed with different proportions of CLL (25% 50% and 75%) and the nutrient status of the vermifertilizer (VF) (C/N ratio below 20:1) produced from each treatments (T1 - T12). The pronounced and better earthworm activity was found in all treatments (T1 – T12), especially more in CD T1 (100%), CD:CLL T3
(50:50%), T₅ HD(100%), T₇ HD : CLL (50:50%), T₉ SD (100%) and T₁₁ SD:CLL (50:50%) treatments. This seems to be due to rich cellulose, OC, N, P, microbial activity and enhanced water holding capacity.

The microbial activity and humic acid content in VF also have significantly increased than 0-day initial substrates and normal worm unworked compost (T-T₁₂), especially more in VF from T₁ and T₃ treatments. This would be due to higher rate of feeding / higher nutrient concentration/optimal moisture/multiplication of microbes while passing through the worm gut. Among the different treatments, VF from T₁ and T₃ treatments showed significant increase in NPK content and normalized pH value, decline in OC, C-N and C-P ratio than VF from other treatments. The increased mineralization and conversion of nutrient is due to the biocatalytic role of *P. excavatus* in the decomposition and conversion mechanism. Also increased microbial-enzymatic activities contribute increase in NPK contents in the VF through nitrification, phosphate solubilization and mineralization.

Significant reduction of lignin, cellulose, hemicellulose and humic acid content in the VF from all the treatments especially more in T₁ and T₃ treatments are due to the combined action of gut microflora and earthworm in the vermicomposting process and utilization of these contents by their growth and reproduction of earthworm. Finally, it is concluded that lignocellulosic solid organic waste resource, cashew leaf litter admixed with different animal dungs, very particularly cowdung at 2:2 ratio may be used for fast bioconversion into a agronomic value added nutrient rich vermifertilizer. This vermifertilizer can also be used as bio-organic
fertilizer for maintaining sustainable soil health, fertility, productivity, waste degradation, soil reclamation, land restoration practices and human health.

Field experiments were conducted during 2012 – 2013 on clay loam soil at Vallampadugai, Chidambaram, Cuddalore district, Tamilnadu, India, to evaluate the efficacy of vermicompost (VF) on the soil quality characteristics, and on the yield and quality characteristics of chilli – Capsicum annuum L., in comparison to inorganic fertilizers (NPK). VF (5 tons/ha) and VF supplemented with recommended dose of inorganic fertilizer (RDCF) (120:60:30 kg.ha) (w/w) had significantly increased the pore space, water holding capacity, cation exchange capacity, organic carbon, available N, P, K, other micro-macro nutrients – Ca, Mg, Na, Fe, Mn, Zn, Cu and microbial population - activity and humic acid content, reduced particle and bulk density, pH, EC in the field soil. Also the yield (both fresh and dry fruit weight) and quality (vitamin A, Vitamin C and Capsaicin content) of chilli was enhanced in the soil. On the contrary, the application of NPK alone has resulted in reduced porosity, compaction of soil, organic carbon, microbial population, microbial activity and humic acid content. In overall investigations, the obtained results specified that the combined application of VF and RDCF show promising results in the cultivation of chilli and better for obtaining the higher quality chilli and further the VF reduce 50% RDCF to the chilli crop and also enhances soil quality, yield and quality characteristics of chilli than 100% application of RDCF on chilli.
**Recommendation and future perspectives**

**Recommendation**

Among the nine indigenous earthworm species identified in the various agroecosystem of Cauvery delta areas, *Perionyx excavatus* (epigeic) only is sustainable for vermiculture and vermicomposting practices.

Presently unutilized and enormously available organic waste, cashew leaf litter admixed with animal dungs at 2:2 ratio using *P. excavatus* can be utilized for the production of organic manure – vermifertilizer.

Vermifertilizer generated from the above ratio biowastes as well as vermifertilizer supplemented with 50% NPK are recommended for agricultural practices to enhance soil quality and quality of chilli.

**Future perspectives**

Need further deeper studies on the (i) earthworm species identification at cyto-molecular level, (ii) vermicomposting effectiveness of various indigenous earthworm species, (iii) chemical structure of vermifertilizer, (iv) vermicomposting of cashew leaf litter with agro industrial wastes as bulking material, (v) development of integrated system of vermicomposting method (with biomoculants) for producing quality vermifertilizer in large scale, and (vi) impact of application of vermifertilizer generated from the biowastes on the different types of soil and quality products of various crops.