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Comparative Biogenecity of Soil Samples from Various Ecosystems of Palakkad District, Kerala, India

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Abstract- Soil organisms are an integral part of agricultural ecosystems. The presence of a range of diverse community of soil organisms is essential for the maintenance of productive soil (Anderson 1975). Present study reviews the abundance, species richness and factors that cause these parameters to vary, of soil fauna in different ecosystems of Palakkad district Kerala, studied as a part of International Year of Soil 2015. The concept that anthropogenic activities act within soil communities is reviewed in the light of these findings, which are placed in the context of the wide literature relating to earthworm, ant and termite diversity, and factors that influence these with particular reference to land management. For the study, different ecosystems of Palakkad district was selected, soil from each ecosystem was extracted uniformly and the soil parameters such as pH, water holding capacity and soil fauna were noted. The influence of edaphic factors on soil faunal diversity is discussed in the context of these studies. We conclude that, even though edaphic factors influence the faunal diversity, human interaction is potentially the main cause of variation. The most profound impacts of human modification of soil was the reduction in key species diversity and their evenness. Habitat heterogeneity and agroforestry conditions which influences the distribution and abundance of soil fauna. In this study, taxonomic richness and abundance of soil fauna was higher in the tree-based systems compared to the annual crops and the agroforestry condition maintain the soil fauna.it help to maintaining of productive soil.

Index Terms- Agroforestry, Anthropogenic factors, Ecosystems, Soil fauna, Tree based ecosystems

I. Introduction

From the moment a natural system is modified by human activities. The agricultural practices are altered to suit human needs and changing agricultural paradigms. Many studies have been performed on the effect of various agricultural practices on the soil fauna and the general trends of these effects. First of all, soil organisms are one of the least concerned and revealed organisms in the scientific world even though a large percent of soil invertebrates have been enlisted in red data book published by the IUCN (Daniel et al.1998). So, if more studies are done considering soil organisms, more relevant information may be disclosed and this can certainly help in providing proper attention as well as practicing appropriate strategies for their conservation.

soil organisms are responsible for a range of ecological functions and ecosystem services including nutrient cycling, nitrogen fixation, control of pest and diseases, carbon sequestration ,maintenance of a good soil structure for plant growth and rain water infiltration, detoxification of contaminants (Swift et al.1979).An excessive reduction in soil biodiversity, especially the loss of species with key function, may result in severe effects including the long term degradation of soil and the loss of agricultural productive capacity. Soil health and soil quality are fundamental to the sustained productivity and viability of agricultural systems worldwide. Agroecosystems are one of the most productive man made ecosystems. It plays an important role in the production of food. The agroecosystems maintain and protect biodiversity for the coexisting cultivated plants and associated biota including microflora and fauna. Each and every organisms are interrelated by food chains and food webs. Depletion of biodiversity destroys the equilibrium of agroecosystem.

In both natural and agricultural systems soil organisms perform vital functions in the soil. The interaction among organisms enhance many of these functions, which are often controlled by the enormous amount of organisms in soil. These functions range from physical effects such as regulation of soil structure and edaphic water regimes, to chemical and biological process. Diversity in natural communities is a key factor in ecosystems structure and function. Disturbance can alter the diversity of an ecosystem directly by affecting survivorship of individual or indirectly by changing resource level. Sometimes diversity measurements reflect the result of disturbance caused by ecological stress. For sustainable land use there is an urgent need for a better understanding of the interaction between the different groups of organisms inhibiting the soil. Human effects on particular soil organisms may lead to changed condition for other organisms below and above ground, which can then cause changes in both soil communities' composition and soil function (Lavelle & Spain 2001).

II. MATERIALS AND METHODS

A total of ten ecosystems were selected from Palakkad district and 15 soil samples were collected from each in order to identify the soil characteristics and faunal diversity of these ecosystems. The selection of ecosystem using such parameter like ecosystem nature, level of anthropogenic activities, plantation type etc. The random soil samples taken were of 15×15×15 cm in dimension (Monolith samples) (Swift & Bignell.2001). The soil colour and texture was noted and the sample was weighed from the field itself. The soil organisms were collected from the sample using appropriate method. Furthermore, their corresponding pH and water holding capacity was determined accordingly.

Different types of selected ecosystems where: Arecanut, Banana plantation, Coconut, Grassland, Household, Paddy field, Rubber plantation, Riverine soil, Vegetable garden and Pond. The investigation was carried out for a period of Six month from first September 2015 to 29th February 2016.Sampling was conducted in ten selected ecosystems of Palakkad regions. The water holding capacity were measured by 50 gm soil was taken in a funnel whose base was covered by a filter paper. Funnel end was placed in a conical flask and the apparatus was held in position with a stand.50 ml Distilled water was then added to the soil through the funnel and kept undisturbed for five minutes. This was repeated with all samples. The water collected after five minutes was taken and volume was determined. Then calculate the water holding capacity of soil. And also using pH meter for determine the soil pH. Collection of soil organisms from Monolith sample by using Hand picking method, Floatation method, Berlesse-Tullgren Funnel and Bearmann Funnel methods. Specimen identification was done by using identification keys, consulting taxonomic experts, past works and internet.

OBSERVATION AND RESULTS

A total of ten ecosystems were selected from Palakkad district. The different types of ecosystems show various soil faunal diversity.in selected ecosystems, four ecosystems were monoculture plantation (Arecanut,Coconut,Banana planation, Paddy),two ecosystems were mixed crop system and agroforestry (Rubber plantation :it consist Rubber, Banana, Coconut and Vegetable garden :consist of Chilly ,Brinjal ,Ladies finger and Garden pea),three naturally existing ecosystems(Riverine, Grass land and Pond ecosystem) and one is a heterogeneity ecosystem (House hold ecosystem).

Rubber, Soil in the rubber trait is generally highly weathered and consists mostly of lateritic type. Sedimentary types and non-lateritic type red and alluvial soils are also seen in some non-traditional areas. The soil is mostly very porous, well drained, moderately to highly acidic. Well drained soil is essential for optimum growth and yield of rubber plants. Annual rain fall ranges between 200-450 mm. Maximum temperatures about 29^0C to 34^0C .**Vegetables**basically a tropical crop, grows well in warm and humid climate of which grow best within a temperature range of 20-27°C. Ladies finger, Brinjal and Pea can be grown in a wide range of soils. However, they grow best in loose, mild acidic, well drained sandy loam soil rich in organic matter. Manures were used in the cultivation. The soil type of the area was sand clay loam with a brownish red colour. Both the ecosystems located in a naturally existing forest area Chulanoor Peacock sanctuary,Alathur taluk and also it's a mixed crop system and agroforestry nature. Both ecosystems have a high species richness, a moderate species evenness throughout the whole samples. The mixed crop cultivation was helpful to soil fauna diversity and abundance.

Banana, basically a tropical crop, grows well in a temperature range of 15-35 ^{0}C with relative humidity of 75-85% up to an elevation of 200m. Four months of monsoon (June to September) with an average 650-750 mm rainfall are important for vigorous vegetative growth of banana. The banana plantation selected belongs to the village of Attassery, Karimpuzhapanchayath, Ottappalam taluk. The soil texture of the area was of a mixed type of sandy loam which was loamier.**Paddy**, Rice is a tropical crop and grown where the average temperature during the growing season is between 20°C and 27°C.Abundant sunshine is essential during its four months of growth. The minimum temperature should not go below 15°C as germination cannot take place below that temperature. Paddy requires more water than any other crop. As a result, paddy cultivation is done only in those areas where minimum rainfall is 115cm Paddy also needs flooded conditions with the depth of water varying over 25 mm at the time of transplanting to as much as 150 mm for 10 weeks of the growing period. The selected area was located in Malampuzha, Palakkad taluk. Here, laterite and black clay soil were seen in common. The soil faunal diversity was relatively low, as it was main reason the water level and anthropogenic activity is very high .**Arecanut** are grown well in diverse soil type and they perform well in fertile clay loam soils or gravely laterite soils or red yellow podzolic type. This soil is mainly laterite, the texture of the soil varies from fine to coarse. The selected area was located in KaripodeThattamangalum village, Chittoor taluk. **Coconut**, is grown under different soil types such as loamy, laterite, coastal sandy, alluvial, clayey and reclaimed soils of marshy low lands. The ideal soil conditions of better growth and performance are proper drainage, good water holding capacity, absence of rocky or any hard substratum. The coconut palm selected belongs to Karipode, Tattamangalumvillage,Chitoor taluk. The soil was of the sandy clay loam type with brownish black in appearance.

Pond consists abiotic environmental factors and biotic communities of organisms. The selected pond ecosystem belongs to Govt. Victoria College Palakkad the soil collected has a sticky appearance of clumps which was black clay loam. **Riverine t**hey show wide variation in their physical-chemical properties depending obviously on the nature of alluvium that is deposited and the characteristics of the catchment area through which the river flows. Horizontal differentiation is not well expressed. They are very deep soil with surface texture ranging from sandy loam to clay loam. The sample soil was collected from Kannadi River belonging to Kannadipanchayath, Palakkad taluk. It is one of the main tributaries of Bharathapuzha River originating in the foothills of the Anamalai hills in the eastern fringes of Palakkad district of Kerala. The presence of organic matter helped to the flourished growth of soil fauna in this region. **Grass land** mainly consist of large grassy area. Grassland seasonal drought and fires are very important to biodiversity. The soil of the temperate grass land is deep and dark with fertile upper layer. It is nutrient rich from the growth and decay of deep, many branched grass roots. The rotted roots hold the soil together and provide a source for living plants. Each different species of grass grows best in particular grass land environment (determined by temperature, rain fall and soil conditions).The selected area is located in Sreekrishnapuram, Ottapalam taluk. The soil type was clay loam, brownish colour, the undisturbed area it help to the colony formation.so it help abundance of soil fauna.

House hold type of soil is hard and with soil clumps mainly as a result of regular human intervention. The soil type is loamy and dry in appearance without moisture content. The selected household is located in Thuppanad, Karimbapanchayath, Mannarkade taluk. The faunal diversity was relatively low clearly showing the effect of regular human interventions. But it is heterogeneity ecosystem it contain different types of shrubs, herbs and some trees also so it mainly help to colonization of some organisms like Ants mainly.

From the collected data analyzed, the following were observed. The ants were collected from all land use systems and from all plots, but showed a non-uniform distribution. Annual crops have least ant diversity. Earthworm showed patchy distribution in different land use systems, though they are important components of the soil ecosystem and coined as ecosystem engineers. Their density and distribution was limited to certain habitats of the study area. Different fauna were identified from various soil types and their number also varied. In the habitat wise distribution of these groups, there was a gradual increase in the number of organism from intensively managed agriculture systems to less intensively managed agroforestry systems and natural ecosystems. A popular assumption is that anthropogenic interference results in the loss of biological diversity and the most frequently cited example is of agricultural intensification directly resulting in biodiversity reduction. The data also supports this hypothesis that land intensification has a negative impact on the soil fauna mainly in macrofauna. The highest organism richness and abundance was observed in land use system with minimum disturbance and mixed crops. Increased abundance of species community itself is an indication of ecosystem sustainability. The soil fauna in this study area was scanty and patchy. In summary, richness of ants, termites and earthworms as well as higher taxonomic groups of the entire soi1 macrofauna increased with increasing heterogeneity of the systems and decreasing disturbances. Soil quality and soil macrofauna responded negatively to land use intensification and changed positively in consensus with increasing habitat heterogeneity. The results support the growing body of literature that points towards the negative impact of native vegetation clearance, habitat loss and fragmentation on biodiversity. It also supports the hypothesis that anthropogenic disturbance has negative impacts on soil fauna.

The soil fauna present in different ecosystems belonging to three phylum like Annelida, Arthropoda and Mollusca. Phylum Arthropoda is most dominant soil faunal group. That particular group is well adapted to all environmental conditions (Fig 3) .The comparative analyzing of soil faunal group in selected ecosystems 50% soil fauna belonging to Phylum Arthropoda, 33.33% of soil fauna belonging to Phylum Annelida and Phylum Mollusca having only 16.67% soil fauna were obtained in different selected ecosystems. It mean that the particular group Phylum Mollusca having lest adaptation capacity compared to other major groups. The main reason of least diversity of Phylum Mollusca need higher amount of water compared to other major groups like Arthropoda and Annelida. That group very much sensitive to environmental conditions and nature of ecosystem. (Table 1).The analyzing of water holding capacity and pH of soils from selected ecosystem. The water holding capacity highest in Paddy 33 ml. The pH range of Palakkad district soil range is normally 6.5-8.5 and the selected ecosystem soil also show the particular range 6.5-8 (Fig 1).

Comparison of key indicator like earthworms, ants and termites in selected ecosystems. Earthworm is a major key indicator of an ecosystem, is present in all ecosystems but the abundance of earthworm is vary from one ecosystem to another ecosystem. Ants and termites are absent in paddy ecosystem, the main reason is the agriculture practices. The key indicator are show the patchy distributions, the main reason is the nature of an ecosystems (Fig.2).A better picture on the soil fauna richness in different selected ecosystems could be perceived by comparing the numerical abundance of different organisms present belonging to different orders. The results have tabulated and presented (Table 2).The numerical abundance of soil fauna in each order within a different ecosystems showing discontinuous distribution. Total 23 orders under the different classes. The order Hymenoptera showing the highest numerical abundance, it mean that the particular group well adapted to all environmental conditions. In paddy field shows the very least soil faunal condition, because that area water level is high, compare to other ecosystems.so it mean that the water level is mainly depend on the soil faunal diversity. The presence of water due to agronomic practices.

*__Statistical analyzing of diversity index__

D = (N (N-1))/ (∑ n (n-1)). Species diversity index allows us to compare the species richness of different habitats. More individuals isn't always better, variety is important. The agroforestry tree based mixed crop ecosystem showing the higher diversity 225.the main reason is the nature of ecosystem id very much help to the diversity of soil fauna. Vegetable ecosystem share the almost same character of Rubber ecosystem the diversity index is also high 197.The clear evidence its prove that the Sorenson's coefficient similarity index is 0.971.Normally the anthropogenic factors negatively impact on the soil faunal diversity, but in the case of agroforestry mixed culture system, the average level of anthropogenic activities not very much highly influenced on the soil faunal diversity compared to other cultivations. The anthropogenic activities is present in that particular rubber and Vegetable ecosystem but in the agroforestry mixed culture system it help to minimize the anthropogenic negative impact and it help to maintain or enhance the soil faunal diversity of that particular ecosystems (Table 2).

According to **Sorenson's coefficient**, it help to compare the two different ecosystems soil faunal compositions. The Rubber is tree based agro ecosystem that ecosystem have the maximum species diversity so it taken as the typical ecosystem and also in the case of agroforestry heterogeneity ecosystem. So the similarity index between Rubber and vegetable have the maximum similarity, i.e. 0.971. The main reason vegetable ecosystem is also an agroforestry condition so the soil faunal diversity is very high. The lowest similarity index is noted in paddy field 0.090, the main reason the paddy field is a monoculture and the anthropogenic interference is very high. Based on Sorenson's coefficient similarity index Rubber ecosystem is taken as typical and its compared other ecosystem showing the similarity in the order of descending order the highest similarity is Vegetable (0.971) then followed to Banana (0.838),Coconut (0.812),Arecanut (0.812),Grassland (0.774),Pond (0.750),House hold (0.714),Riverine (0.583) and Paddy (0.090) (Table 3).

The species richness is high in polyculture agroforestry system but in the case of the species abundance is less compared to other natural ecosystems. The phylum Arthropoda is a largest and dominant group in the nature. Analyzing of Arthropoda groups, belonging to Arthropoda three classes were obtained under the each class several orders are present. Based on this data, it give the correct picturization of Arthropoda diversity. The absence of soil Arthropoda groups in paddy cultivation field because the main reason is high anthropogenic non sustainable agricultural practices. (Fig 3).

* **Simpson's diversity index-** Simpson's dominance index (**D**) measure of diversity of soil fauna of different selected ecosystems. $\boldsymbol{D = 1 - \frac{\sum n(n-1)}{N(N-1)}}$ The highest diversity of soil fauna present in Rubber (0.906) then it followed by Banana (0.894),Vegetable (0.878), Coconut (0.878), Arecanut (0.872),Pond (0.870),Grassland (0.854), Riverine (0.796), Household (0.766), Paddy (0.731).The paddy field show the lowest diversity index. Simpson index is a dominance index, because it gives more weight to common or dominant species.in this case, a few rare species with only a few representative will not affect the diversity.

III. DISCUSSION

The study were conducted among the different types of ecosystems, of the different regions of Palakkad district, it was found that major soil fauna consist of Phylum Arthropoda.

Ants were the important components of ecosystems, their biodiversity is incredibly high and these organisms are highly responsive to human impact, which obviously reduces its richness (Folgaralt 1998) .Ants occur throughout the world and constitute an important fraction of the animal biomass in terrestrial ecosystems (Holldobleret al.1990). Inthe current study, ant diversity was high compared to termites and earthworms. This heterogeneity in the vegetation would have contributed to the ant diversity by providing food and foraging habitats to different species.Studied the ant diversity across different disturbance regimesand their results support the present study, in that the highly disturbed area has less abundance, compared to moderately and less disturbed land use systems (Graham et al.2004). Of the four main ecosystems studied here (annual crops, plantation, agroforestry and natural ecosystem), annual cropping and plantation showed less abundance while agroforests and naturally existing ecosystems showed the high abundance.

Termites are the most important decomposers by virtue of their numerical dominance (Eggletonet al.1995). Disturbance affects termites by reducing their diversity (especially of soil-feeding forms) and some species may reach pest status, owing to changes in the availability of organic matter. There was a negative or inverse relation between earthworm and termite density in different land use systems (Decaenset al.1994). Abundance of termite was found varying between habitats and across land use systems and plots. It was reported that abundance and biomass showed strong dependence on the quantity of organic matter and nitrogen in the soil and in the current study land use systems with comparatively high organic matter, termite showed high abundance and diversity. This supports the previous findings that favourable soil conditions enhance soil fauna. It was also reported that, above ground vegetation and habitat heterogeneity have positive effect on termite community (Gillisonet al.2003). This can be used as a good strategy for ecosystem recovery and have great impact on soil fertility and ecosystem function.

Earthworm activity is very important in agricultural soils with a high degree of compaction and improving water infiltration offering new paths for root penetration. Termite's excavation activity has a similar effect on soils (Gullan et al.1994),and in some cases can reduce the compaction of surface layers were organic matter is present in the soil, the bioturbations and decomposing activities of termites can reduce soil compaction, increase its porosity and improve its water infiltration and retention capabilities (Mando 1997).The lower diversity and abundance of soil fauna in the intensively managed annual cropping system could be due to poor heterogeneity and food resources.in the annual cropping systems, the land is utilized year around for growing crops compared to the agroforestry systems and natural ecosystems (Giller et al.1997),show very close correlation between increasing agricultural intensification and reduced soil biodiversity. This intensification may also lead to soil erosion which in turn can reduce the abundance and diversity of soil biota by physically removing them destroying their microhabitats and changing the microclimatic conditions within soil (Harvey 1996).

Studies show that habitat destruction adversely affecting survival of major soil faunal components like earthworms, ants and termites. Habitat fragmentation, climate change, invasive animals, plants and anthropogenic activities are other important factors that threatens their survival (Woodman et al.2008).Maintaining and improving the capacity of soils to function is essential to human survival, and healthy soil is an essential element within this process (Pankhurst 1997). The ecological attributes of the soil are important since they have implications beyond the quality of the soil or its health, the capacity to produce a particular crop. They are associated with the soil biota, its diversity, its food-web structure, its activity and the range of functions it performs in the system. The soil biota is a vital force that serves to maintain the health of the soils. Larger organisms such as springtails, insect larvae, ants, termites, earthworms and ground beetles etc. Most are helpful to plants, enhancing the availability of nutrients and producing chemicals that stimulate plant growth. A healthy soil produces healthy crops with minimal amounts of external inputs and few to no adverse ecological effects. It has favourable biological, physical and chemical properties.

IV. CONCLUSION

Analysis of the soil parameters such as pH and water holding capacity differ greatly proving that the ecosystems of Palakkad regions show a gradual variation in soil faunal diversity. The study was mainly focused on mesofaunal diversities. Major soil fauna under the three phylum like Annelida, Arthropoda and Mollusca. The survey of soil fauna the major group is Arthropoda and it consist 3 classes Arachnida, Insecta and Myriapoda. Belonging to each classes several orders were present under the class Arachnida five orders, Insecta and Myriapoda have 12 and 2 orders respectively. Under the Phylum Mollusca having one class Gastropoda, belonging this class two orders were present and under the Phylum Annelida have 2

Classes each class consist one order. In the current study, the dominant Orders are Hymenoptera,Coleoptera and Isoptera**.**

The count data on earthworms, ants, beetles and termites indicate spatial contagion in the density distribution of these taxa. This is also an indication of habitat heterogeneity which influences the distribution and abundance of macrofauna. The abundance and diversity of soil animals is often influenced by a wide range of management practices including tillage, treatment of crop residues, crop rotation, application of pesticides and fertilizers. In this study, taxonomic richness and abundance of meso and macrofauna was higher in the tree-based systems compared to the annual crops. This is probably because trees and shrubs in forest ecosystems and agroforestry systems provide more favourable microclimate to soil fauna.Trees bring about a whole complex of environmental changes, affecting light, airtemperature, humidity, soil temperature, soil moisture content, wind movement, and pest and disease complexes. These changes have impacts both on plants and a wide array of soil macrofauna.The sampling covered different ranges of agricultural intensification-from intensive annual cropping systems to less managed, highly stratified polyculture and home garden agroforestry systems and the results indicate that there was increasing diversity and abundance of soil fauna from intensively managed annual cropping systems to less intensively managed agroforests and natural forest ecosystems. In conclusion, negative impact of native vegetation clearance, habitat loss and fragmentation on biodiversity. It also supports the hypothesis that anthropogenic disturbance has negative impacts on soil fauna.

Characterization of soil fauna diversity with shifting land use has great significance. Land use changes have great impact on biodiversity. Land use change is projected to have the largest global impact on biodiversity within 100 years (Sala et al.2000).biodiversity in managed landscapes gain more attention of conservation value, because as much as 90 % of the biodiversity resource in the tropics are located in human dominated or working landscapes. Land use intensification witness extreme events like continuous utilization of same land for years, the permanent agriculture (Giller et al.1997) at one end to low intensified agroforestry systems with multipurpose tree crops (MPT) at other end which have vital role in the tropical biodiversity conservation.

REFERENCES

[1] Anderson, J. M**.** 1975. *The enigma of soil animal species diversity*. In: Vanek, J.*Progress in Soil Zoology*. Czech Acad. of Sciences, Prague. pp. 51–58.

[2] Daniel, BA.,Molur, S and Walker, S (Eds.). 1998. Report of the workshop "*Conservation* Assessment and Management Plan for Selected Soil Invertebrates of South India" (BCCP-Endangered Species Report), Zoo Outreach Organization-Conservation Breeding Specialist Group, India, 76p.

[3] Decaens T., Lavelle P., Jim'enez J J. Escobar G and Rippenstein G. 1994. Impact of land management on soil macrofauna in the Oriental Llanos of Colombia. *European Journal of Soil Biology*, 30:157-168.

[4] Eggleton P E. Bignell D E. Sands W A., Waite B, Wood T G and Lawton J H. 1995. The species richness of termites (Isoptera) under differing levels of forest disturbance in the Mbalmayo Forest Reserve, southern Cameroon. *Journal of* Tropical Ecology. 11:85-98.

[5] Folgaralt P J. 1998. Ant biodiversity and its relationship to ecosystem functioning: a review ..Biodiversity and Conservation, 7: 1221-1244.

[6] Gillison A N, Jones D T, Susilo F X and Bignell D E. 2003. Vegetation indicates diversity of soil macroinvertebrates: a case study with termites along a land-use intensification gradient in lowland Sumatra. *Organisms Diversity and* Evolution, 3: 111-126.

[7] Giller, KE.,Beare, MH., lavelle, P., Izac, AMN and Swift, MJ. 1997. Agricultural intensification, soil biodiversity and agroecosystem function. *Applied Soil* Ecology, 6:3-16.

[8] [8]. Graham, J H., Hughie H H , Jones S., Wrinn K., Krzysik, Al., Duda, J J., Freeman, D C Emlen, J M Zak Je, Kovacic D A, Graham C and Balbach H. 2004. Habitat disturbance and the diversity and abundance of ants (Formicidae) in the Southeastern Fall-Line Sandhills. *Journal of Insect* Science, 4(30): 1-15

[9] Gullan, P. J. & Cranston, P. S.1994. *The Insects. An Outline of Entomology*. Chapman and Hall, London.

[10] Harvey, CA. 1996. Effects of soil and wood depletion on biodiversity. Biodiversity and Conservation, 5: 1121-1130

[11] Holldobler, Band Wilson, EO. 1990. The ants. Harvard University Press, Cambridge, Massachusetts

[12] Lavelle, P. & Spain, A**.** 2001. *Soil Ecology*. Kluwer Academics, The Netherlands.

[13] Mando, A.1997. The role of termites and mulch in the rehabilitation of crustedSahelian soils. Tropical Resource Management Papers 16. Wageningen Agricultural University. The Netherlands. 101 pp.

[14] Mujeeb Rahman P KFRI 2010, Soil macrofaunal assemblage in selected landuse system in Kerala: Spatial pattern and structural dynamics. PhD thesis--CUSAT

[15] Pankhurst C. E., Doube, B. M. & Gupta V. V. S. R**.** 1997. Biological indicator of soil health: synthesis. In: Pankhurst, C. E., Doube, B. M. & Gupta V. V. S. R.(Eds.) *Biological Indicators of Soil Health*. CAB International,Wallingford. Pp 419–435.

[16] Sala, D E., Chapin, FS.,Armesto, J JBerlow, E Bloomfield, J Dirz, R Huber-Sanwald, E.,Huenneke, LF., Jackson, RB., Kinzig, A., Leemans, R., Lodge, DM., Mooney, HA.,Oesterheld, M., Poff, NL., Sykes, MT., Walker, BH., Walker, M and Wall, DH. 2000.Global biodiversity scenarios for the year 2100. *Science,* 287: 1770-1774.

[17] Swift, M.J., W. Heal and J.M. Anderson. 1979. *Decomposition in terrestrial ecosystems*. University of California Press, Berkeley, USA.

[18] Swift, M and Bignell, D. 2001. Standard Methods for Assessment of Soil Biodiversity and Land Use Practice. *International Centre for Research in Agroforestry*, Indonesia,40p .

[19] Woodman M., Baker G H., Evans T A., Colloff, M J and Andersen, A N. 2008. Soil biodiversity and ecology: emphasising earthworms, termites and ants as key macro- invertebrates. National Land and Water Resources Audit, CSIRO, Australia, 119p.

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FIGURE CAPTION LIST

1. Water holding capacity and pH range of various selected ecosystems
2. Relative numerical abundance of Earthworms, Ants and Termites in various selected ecosystems
3. Soil Arthropoda diversity of various ecosystems

TABLE CAPTION LIST

1. Major soil fauna of various ecosystems
2. Diversity of soil fauna in each ecosystems
3. Sorenson's coefficient similarity index of selected ecosystems

Table 1: MAJOR SOIL FAUNA OF VARIOUS ECOSYSTEMS

Sl. No	Phylum	Class	Order	Organisms	Ecosystem
1	Annelida	Oligochaetae	Megadrilaceae	Earthworms	All ecosystems
		Gnathobdellida	Hirudinida	Leech	PC, PE
		Arachnida	Acarina	Mites	CP, AP, VP,RP,GL
			Parasitiformes	Ticks	CP, AP
			Thelyphonida	Whip scorpion	RP,BP
			Scorpionidea	Scorpion	HH,VP,RP,CP,GL
			Araneida	Spiders	PE, AP, VP,RP,BP,CP,GL,HH
			Ephemeroptera	May flies	GL,PE,RE
			Isoptera	Termites	HH, RE, PE, BP, RP, VP,AP,CP,GL
			Hymenoptera	Ants	HH, RE, PE, GL, AP, BP, RP, VP,CP
			Coleoptera	Beetles (Adults & Larva)	HH, RE, PE, GL, CP, AP, BP, RP, VP
			Diptera	Flies (Adults & Larva)	RE, PE, RP,VP,AP,GL
			Dermaptera	Earwigs	PE, RP, VP,BP,AP,CP,GL,HH
			Orthoptera	Cricketes,Gryllotalpa	PE, RP,VP,BP,AP,CP,GL,RE,HH
			Notoptera	Grylloblata	VP,RP,BP,AP,CP,PE,RE
			Protura	Proturans	VP,RP,PE
			Diplura	Diplurans	VP,RP

2	Arthropoda	insecta	Collembola	Collembolans	VP,RP,BP,GL,PE
			Thysanura	Lepisma	RP,VP,BP,AP,CP,GL
		Myriapoda	Diplopoda	Millipedes	RP, VP,AP,CP,HH,BP
			Chilopoda	Centiped	CP,HH,AP, RP, VP,BP,PE
3	Mollusca	Gastropoda	Soleolifera	Slugs	PC
			Pulmonata	Snail	PC

VP - Vegetable Plantation PC – Paddy cultivation RP – Rubber Plantation

GL – Grass Land BP – Banana Plantation PE – Pond Ecosystem

AP – Arecanut Plantation RE – Riverine ecosystem CP – Coconut Plantation

HH - House Hold

TABLE 2: DIVERSITY OF SOIL FAUNA IN EACH ECOSYTEMS

Order	**SELECTED ECOSYSTEMS**									
	Vegetable	**Rubber**	**Banana**	**Arecanut**	**Coconut**	**Paddy**	**Grass land**	**Pond**	**Riverine**	**House hold**
Megadrilacea	15	16	12	15	15	6	24	3	9	5
Hirudinidae	0	0	0	0	0	7	0	4	0	0
Acarinia	18	20	0	27	24	0	6	0	0	0
Parasitiformes	0	0	0	48	30	0	0	0	0	0
Thelyphonida	0	4	2	0	0	0	0	0	0	0
Scorpionidea	4	3	0	0	4	0	1	0	0	3
Araneida	11	6	9	6	4	0	2	12	0	9
Ephemeroptera	0	0	0	0	0	0	24	6	8	0
Isoptera	25	30	9	24	18	0	8	45	21	15
Hymenoptera	54	42	6	30	18	0	36	24	35	42
Coleoptera	15	26	9	15	12	0	7	24	6	4
Diptera	4	12	0	6	0	0	12	27	17	0

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Dermaptera	4	6	4	10	4	0	6	13	0	3
Orthoptera	4	6	2	3	2	0	6	12	5	3
Notoptera	4	2	2	6	2	0	0	2	2	0
Protura	6	12	0	0	0	0	0	4	0	0
Diplura	9	4	0	0	0	0	0	0	0	0
Collembola	6	7	4	0	0	0	3	4	0	0
Thysanura	6	9	5	6	4	0	5	0	0	0
Diplopoda	9	12	1	4	5	0	0	0	0	12
Chilopoda	4	9	5	2	4	0	0	6	0	3
Soleolifera	0	0	0	0	0	12	0	0	0	0
Pulmonata	0	0	0	0	0	10	0	0	0	0
Diversity index **$D = \frac{N(N-1)}{\sum n(n-1)}$**	**197**	**225**	**69**	**201**	**145**	**34**	**139**	**187**	**102**	**98**

Table 3: SORENSON'S COEFFICIENT SIMILARITY INDEX (S) OF SELECTED ECOSYSTEMS

Similarity index(s)	Vegetable	Rubber	Banana	Arecanut	Coconut	Paddy	Grass land	Pond	Riverine	House hold
Vegetable	**1.000**	0.971	0.800	0.838	0.838	0.095	0.800	0.774	0.560	0.740
Rubber	0.971	**1.000**	0.838	0.812	0.812	0.090	0.774	0.750	0.583	0.714
Banana	0.800	0.838	**1.000**	0.814	0.814	0.117	0.692	0.740	0.571	0.782
Arecanut	0.838	0.812	0.814	**1.000**	0.928	0.111	0.740	0.714	0.636	0.750
Coconut	0.838	0.812	0.814	0.928	**1.000**	0.111	0.740	0.571	0.545	0.833
Paddy	0.095	0.090	0.117	0.111	0.111	**1.000**	0.117	0.222	0.166	0.142
Grass land	0.800	0.774	0.692	0.740	0.740	0.117	**1.000**	0.740	0.666	0.695
Pond	0.774	0.750	0.740	0.714	0.571	0.222	0.740	**1.000**	0.727	0.666

Riverine	0.560	0.583	0.571	0.636	0.545	0.166	0.666	0.727	**1.000**	0.555
House hold	0.740	0.714	0.782	0.750	0.833	0.142	0.695	0.666	0.555	**1.000**

Fig 1:WATER HOLDING CAPACITY AND pH RANGE OF VARIOUS SELECTED ECOSYSTEMS.

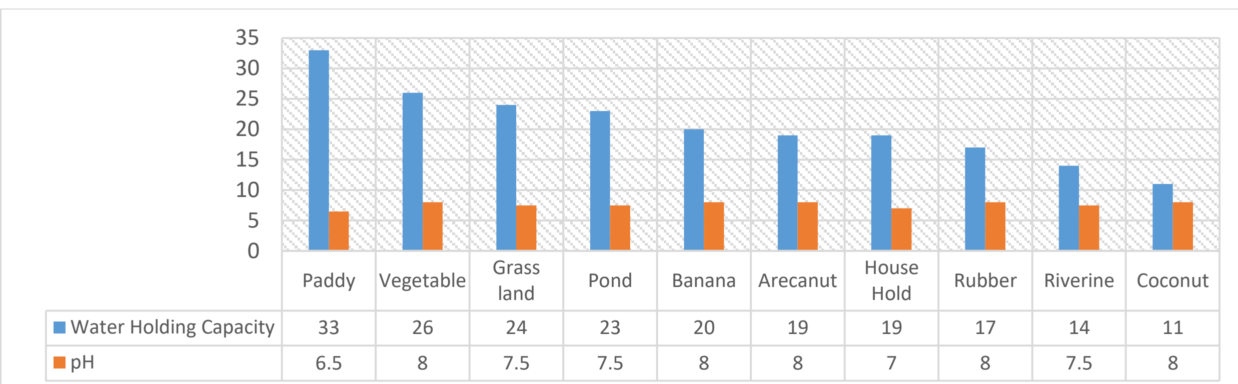


Fig 2: RELATIVE NUMERICAL ABUNDANCE OF EARTHWORMS, ANTS AND TERMITES IN VARIOUS SELECTED ECOSYSTEMS.

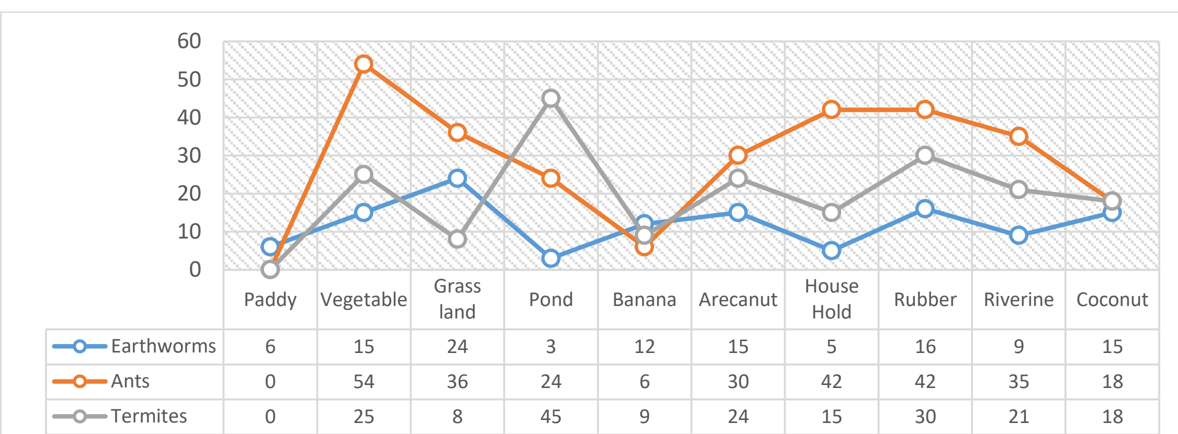
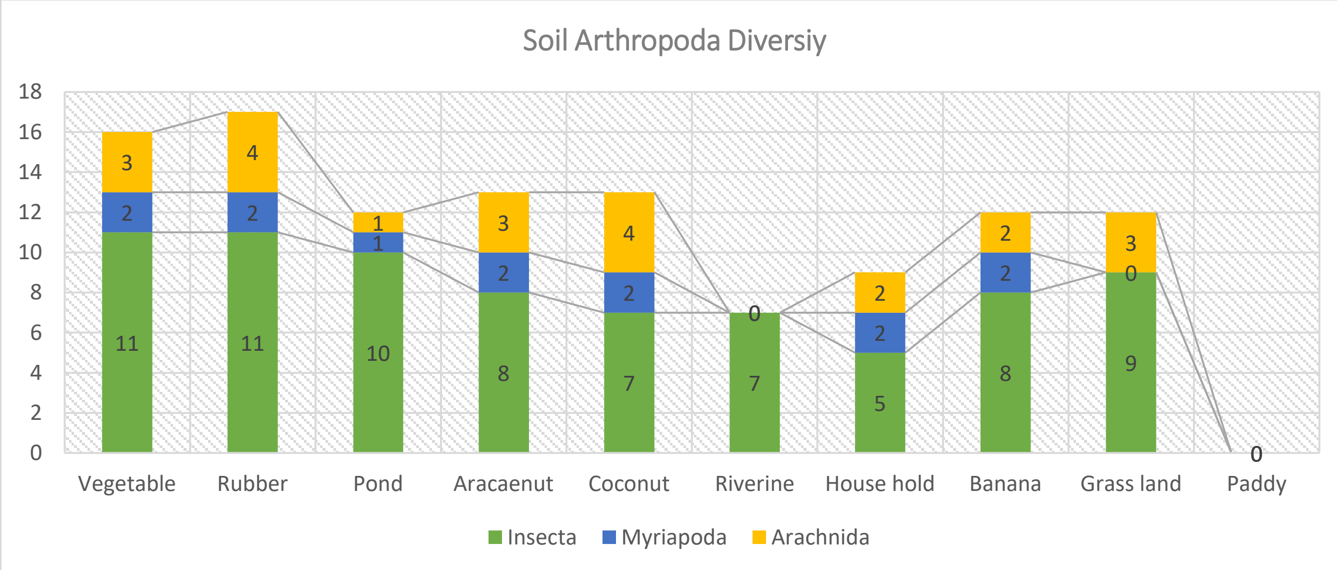


Fig. 3: THE SOIL ARTHROPODA DIVERSITY OF VARIOUS ECOSYSTEMS


Soil Arthropoda Diversiy
18
16
14
12
10
8
6
4
2
0
3
2
11
4
2
11
1
1
10
3
2
8
4
2
7
0
7
2
2
5
2
2
8
3
0
9
0
Vegetable
Rubber
Pond
Aracaenut
Coconut
Riverine
House hold
Banana
Grass land
Paddy
Insecta
Myriapoda
Arachnida