CHAPTER VI

GENERAL CONCLUSION

Kerala is situated on the southwest, wet side of the Western Ghats, one of the biodiversity hot spots of the world. Many studies are there on algae of different localities from the State. All of those studies refer to diversity, ecology or distribution of aquatic algae. Algal flora of soils of this wet zone of the Western Ghats-State remained quite unknown till this present study. Therefore, the present thesis can be considered as the outcome of a pioneer intensive research work on the ecology and diversity of soil community of a representative area of the region, the Pathanamthitta District.

In addition to a thorough understanding of the seasonal variations in the physico-chemical characteristics of the Oxic Dystrustepts soils from the three major kinds of vegetation such as forests, teak plantations and rubber plantations, the structure and seasonal dynamics of total soil-algae as well as the different categories of them such as green-algae, blue-green algae and diatoms- in relation to soil parameters and three different kinds of vegetation are worked out in this thesis.

Edaphic habitats are very suitable abode for all algae. Algae of soil habitats are usually called edaphic or soil-algae. Soil-algae may be obligate or facultative species of soils, which are yet to be established. However, it is well known that algae form a stable autotrophic community of all soils, especially in the wet conditions. In all soils algae play significant and definite role towards the sustenance of soil fertility. The current investigation has generated clear evidence to this fact that Oxic Dystrustepts in the Western Ghats has distinct soil community in relation to the type of vegetation.
during all seasons and also in accordance with variations in physico-chemical characteristics of these soils.

It is well known that edaphic algae are mostly found near the soil surface due to their phototrophic nature and some of the edaphic algae can withstand dark condition as heterotrophs. Present investigations has crystal clearly established the fact that green-algae, blue-green algae and diatoms are significant autotrophic component of the wet and slightly acidic *Oxic Dystrustepts* soils. And this is the first report of soil-algae of tropical *Oxic-Dystrustepts* in the Western Ghats of south India.

Study of soil-algae is noteworthy in many ways. Learning the biodiversity of soil-algae from the different soils under the different vegetations during different seasons is the prime relevance of the study. However, these types of conventional studies are quite rarely carried out in tropical soils. Identification of soil-algae in relation to certain physico-chemical characteristics in a fairly unexplored and very sensitive soil system of the *Oxic Dystrustepts* was quite tedious. Therefore, the present thesis is highly relevant and significant to the understanding the ecology of tropical soils in general and the data generated through this research work will have applications in the sustainable management of tropical soils in general.

A large number of quite new species and varieties of algae are observed in the *Oxic Dystrustepts* soils. Almost 10% of soil-algae observed in the present study of the *Oxic Dystrustepts* soils in this district were found to be quite new to science. Since algae are valuable components of soil ecosystems for maintaining the structure of soils as well, accounting of them before they being get extinct but of environmental changes such as the ongoing climate change is highly relevant. Moreover, algae are economically highly useful in diverse ways. Therefore, the present investigations can be considered highly successful from these ecological and economic points of views.
Moreover, the present study point to the imminent need of a thorough investigation of the ecology and diversity of soil-algae of the whole Western Ghats.

Soil-algae are ecologically important and some have high economic potentials. Algae contribute considerably to the total amount of organic matter in soils. Moreover, majority of blue-green algae secrete polysaccharides useful for soil aggregation, which binds soil particles favouring soil structure and conservation of water in soils. Algae are also useful in phytoremediation or bioremediation of soils as well as the monitoring of pollution status of soils. Learning of the role of algae in general and that of specific algae is highly relevant to design and development of sustainable agriculture. The present discovery of about seventy seven species of algae specific to vegetations and seasons in *Oxic Dystrustepts* at Pathanamthitta District, a representative zone of the Western Ghats opens up quite a broad and novel area of ecological research of high potentials on tropical soils in general. Therefore, the research would definitely attract tremendous attention of ecologists and soil biologists in general. The research efforts of this present endeavour would be much rewarding in these ways.

Methodology of the present research was quite comprehensive and the approach was quite integrated. Soil samples were collected systematically from the soils of Pathanamthitta District under three different kinds of vegetation such as natural forest, teak and rubber plantations in three different seasons of the year. Soil temperature, moisture, rainfall, pH, electrical conductivity, total nitrogen, organic carbon, plant available phosphorous and plant available soil potassium was the soil parameters examined as per standard methods. Observations of the variations in all these parameters of different seasons and vegetation are correlated to the corresponding observations of algal diversity. Direct microscopic analysis, culture
studies and ‘growth slides’ (moist cultures) of algae in soils revealed almost completely the total diversity of the rich algal flora of these Oxic Dystrustepts soils.

Taxonomy and ecology of seventy seven species of algae belonging to the three major classes- Chlorophyceae, Cyanophyceae and Bacillariophyceae are found out. Among them sixty six species of algae were observed from fresh field soils, and in vitro culture of soils but eleven of them were found only from in vitro culture. Light micrographs (LM) of algae were prepared for green and blue-green algae whereas LM and scanning electron micrographs were prepared for diatoms for the maximum understanding of the structural details of all species. Population dynamics such as relative abundance, species richness, species evenness, diversity index and correlation of the algae were determined and correlated to three different kinds of vegetation and seasons.

Comparisons of different vegetations on certain fertility parameters of Oxic Dystrustepts in the Western Ghats of south India have revealed significant variation in soil parameters over the plantations and forest in different seasons. The influence of rubber plantations on soil fertility was found to be more negative than teak plantations. Present observations of vegetational influence on soil fertility are expected to have applications towards sustainable agro-ecosystems in biodiversity rich tropics in general.

Altogether thirty six species of green-algae were found out in these Oxic Dystrustepts soil. Among them five are found to have unique characteristics to be considered as hitherto unreported new species and one a new variety. Morphological characteristics of all the species are described in detail. Among the thirty six species of green-algae, six were observed only in in vitro culture of soils using MBBM with nitrogen. Population dynamics of all the green-algae such as relative abundance,
species richness, evenness and diversity index are also analysed and discussed. The highest of green-algal diversity was recorded in soils of the natural forest, followed by rubber and teak plantations. Correlations of green-algal diversity index to soil characteristics was also determined and properly discussed.

Out of the thirty one species of blue-green algae observed from these soils, only one of them showed unique features to be identified as new species. Systematic positions and morphology of the blue-green algae observed were also worked out. Among the thirty one species of blue-green algae observed, five were found out from the MBBM in vitro culture of soils without nitrogen. Population dynamics of blue-green algae such as relative abundance, species richness, species evenness and diversity index were also measured. The highest blue-green algal diversity was recorded in the rubber plantations, followed by natural forest and teak plantations. Correlations of blue-green algal diversity index to soil characteristics were also determined and properly discussed.

Altogether ten species of diatoms were found out from these soils. Among the total diatoms observed, one was found to have unique features to be considered as a new variety. Morphology and taxonomy of all of these species of diatoms are discussed. All the species were observed from moist soil and also in the in vitro culture of these soils. Distribution of these algae is also discussed. Population dynamics of diatoms such as relative abundance, species richness, species evenness and diversity index were quantified. The highest diversity of diatoms was recorded in the natural forest, followed by rubber and teak plantations. Correlations of diatom diversity index to soil characteristics were also determined and properly discussed.

Ultimately the overall diversity and ecology of all soil-algae is analysed and correlated to vegetation, seasons and physico-chemical characteristics of soils.
Altogether seventy seven species of algae were found out from the *Oxic Dystrustepts* soil. Among them sixty six species of soil-algae were observed from the field conditions as well as *in vitro* culture of soils. Eleven species of algae were noticed from the *in vitro* culture of soils in modified Bold's Basal (MBBM) alone. Influence of different vegetations on the total diversity of soil-algae in *Oxic Dystrustepts* of the Western Ghats of south India at Pathanamthitta district is carried out. Significant variations in the ecology and diversity of total algae over vegetation, seasons and soil characteristics are discussed on the basis of previous observations in this regard.

The present pioneer observations of diversity and ecology of soil-algae in *Oxic Dystrustepts* of Pathanamthitta District of Kerala, South India in the Western Ghats pointed out that tropical soils of the Western Ghats in general are enriched with highly diversified algal flora. Green-algae and diatoms are the major groups of algae in natural forest soils whereas blue-green algae are the major community of rubber plantations. It would be also of interesting to conclude that the structure of algal communities in *Oxic Dystrustepts* is influenced by the combined effects of soil physico-chemical parameters and vegetations rather than seasons. Six new species and two new varieties observed in this representative soil of the Western Ghats also disclosed that this zone, one of the biodiversity hot-spots in the world is a definite zone of high diversity of algal flora, much of which remain quite unexplored. Since algae are ecologically and economically valuable, it is high time that all of them are explored and the economic and ecologic potentials of all of them are assessed. In these ways the present investigation could very well establish the fact that accounting of the maximum diversity of soil-algal flora of *Oxic Dystrustepts* soil is quite worthy and timely.