In this thesis work, an effort was made to understand the critical factors influencing the growth of microalgae in natural system and in an engineered system after conducting a detailed review of the subject. A suitable method was also developed for culturing microalgae in pilot scale with respect to biofuel.

Initially, a study was carried out to understand the general diversity and distribution pattern of microalgae in fresh water systems by selecting a pond and a lake in tropical region. There were variations in species diversity of unicellular algae between lake and pond system. Status of the hydrological parameters of both lake and pond was observed all seasons in a year shows slightly higher level of nutrients than the oligotrophic status but with normal dissolved oxygen. The colony forming Microcystis sp and Scenedesmus sp were the dominating microalgae in both the fresh water systems throughout the period as seen eutrophic water. Their biological potential to utilize the hydrological conditions, such as fast growth characteristics and floating mechanisms as well as their biotic advantages to protect from predators and heterotrophic bacteria could be made them competitive in the fresh water ecosystems.

Prominent growth of several microalgae was resulted in the flask culture by the supply of nutrients in distributed pattern when compared to the growth of few species with the addition of nutrients in higher doses of one or two. This finding support the view that microalgal diversity is higher towards oligotrophic condition
of water bodies and on the contrary towards eutrophication confined the growth of two or three species.

In an effort to develop a suitable culturing method a raceway pond reactor was set up for developing microalgal biomass of desired properties. The changes in microalgal community and total biomass were studied in both batch and continuous raceway pond systems under nitrogen and phosphorous limitations. To develop a self-settling microalgal consortium the raceway pond was operated using a specially designed settler for daily harvest and recycle rest of the biomass as start up culture in the RPR. By reducing liquid and solid retention time in the culture, we were able to control the grazing fauna. At steady-state condition an autofloculating and self-settling two member consortium of microalgae was developed which had mainly *Fragilaria* sp and filamentous *Ulothrix* sp. The maximum biomass concentration obtained was 140 mg/L with a daily harvest of 50% of the biomass. The biomass was found to be rich in neutral lipid droplets.

The microalgal consortium developed as above was further studied to enhance the biomass and lipid production. It is impracticable to maintain the consortium as stable and perpetual unless the limitations are managed. It was observed that sodium silicate addition could increase the abundance of *Fragilaria* sp in the consortium and in turn raised the lipid content to 28% of the dry biomass. Effect of pH on biomass and lipid production were also scrutinized and found that the high pH in the reactor would increase lipid production together with a decrease in biomass growth. Similarly at lower pH, biomass production increased with lesser lipid content. Cell division pattern was successfully controlled during night hours by supplying nutrients at night and its role on lipid production was also identified.
Besides these factors role of silica, photosynthetically active radiation and chlorophyll$_a$ on biomass growth and lipid productivity were studied in RPR.

This self-settling and lipid-producing microalgal consortium can be a suitable source of biomass for lipid extraction and biodiesel production. This microalgal consortium was selected without the complex genetic engineering techniques or monoculture method but by deploying process engineering practices. The process developed for microalgal culture in this study is scalable to large operations, because of the technical feasibility and ease of operation. Further research can be extended to its application for the production of high value biomass and waste water treatment. In conclusion this is an effort to present the environmental factors influencing the growth of microalgal ecosystem in water bodies and engineered raceway pond reactor.