Chapter 1

INTRODUCTION

Soil the non renewable natural resource is a source of infinite life and under most conditions is formed at a rate of approximately 1cm in every 100 to 400 years. Once it is eroded by water or wind, physically degraded or chemically depleted, it is very expensive to remitate or to improve. So is it is our bound duty to safeguard the soil for future generations, while obtaining the best benefit from its use now (Stoops and Cheverry, 1992). Soil fertility refers to the amount of nutrients in the soil and the capacity of soil to provide plants with enough assimilable nutrients and moisture to produce crops. Fertility is a very dynamic property because it can change rapidly under the influence of natural condition and farming practices.

Man started agriculture on virgin and fertile soil by felling forest trees without the addition of any artificial nutrient inputs. Continuous cultivation of agricultural crops on the same land resulted in low productivity owing to the depletion of soil organic carbon and associated essential nutrients for plants. As part of green revolution, lot of inorganic nutrients were dumped to the soil with the hope of increasing the productivity of agricultural crops. Of course, there was a temporary boosting of productivity for a shorter period due to the usage of chemical fertilizers and plant protection chemicals. But in the long run, it was realized that crops are unable to give expected return in chemical farming and the basic amenities of life like soil, water and air are loaded with toxic chemicals, threatening the very existence of life.

Declining soil fertility has been identified as one of the major reasons responsible for reduced response of crops to applied nutrients and lower profits to farmers. Evaluation of soil nutrients help to explain the crop failures and to determine the effect on plant growth. The deficiency of nutrients becomes one of the major restrictions for the productivity, stability and sustainability of soils. The soil must provide the sufficient quantity of nutrients for the growth of plants and for the synthesis of food.

Efficient use of agro-chemicals is beneficial for farmers as well as for the environment. Spatial and temporal optimization of farm management will increase productivity and reduce the amount of agro-chemicals. This type of management is precision agriculture.

The aim of precision farming research is to help farmers optimize the management of their fie1ds so that gross returns are maximized for each unit of management area. For this the farmer needs to know how the conditions for growing crops vary over the area of interest.

In the twenty-first century information technologies play an increasingly important role in crop production and natural resource management. Currently, agriculture production is facing many challenges such as increased cost of production, shortage of irrigation water, adverse impacts of agriculture on the environment *etc*. For countries like India, it is a challenging task to meet the food demands of the growing population in future. To survive in the highly competitive world market of agricultural commodities, agricultural producers must produce high quality products at low prices while using environmentally sound practices. In this contest, GIS has a significant role to play in the decision making process in agriculture at various levels *i.e*. field, regional, national and global levels.

Geographic information system (GIS) provides powerful set of tools for collecting, storing, retrieving, transforming and displaying spatial data from the real world (Burrough and Mc Donnell, 1998). It helps in the management and analysis of the large amount of basic data and information, statistical, spatial and temporal, needed to generate information products in the form of maps as well as tabular and textural reports for land use decisions. In recent years FAO has been developing GIS in linkage with agro ecological zoning. There has been remarkable progress in developing GIS based tools for soil resource management at regional scale. The geographical information systems (GIS), modeling and geostatistics tools are becoming progressively more suitable in agricultural research. (Ben-Asher *et al*., 1998; Gary *et al*., 1998; Bocchi *et al*., 2000; Basso *et al*., 2001). More specifically, these technologies can enable micro-management techniques on a site-specific basis to account for the natural and human induced variations that exist in agricultural fields such as variation in soil type, moisture, topography, chemistry, physical properties and other factors. These technologies promise the possibility of optimizing profit and reducing the adverse environmental impact of farming (Larson *et al*., 1991).

It is important to monitor the fertility status of soil from time to time with a view to monitor the soil health. So, geo-referenced information on the location, extent, quality of land and display of spatial data is very important for soil fertility management. GIS can be used in producing a soil fertility map of an area, which will help in formulating balanced fertiliser recommendation and to understand the status of soil fertility spatially

and temporally. Soil map is a map showing distribution of soil properties in an area and they are most commonly used for land evaluation, spatial planning, agricultural extension and environmental protection. Soil maps produced using geostatistical techniques also include an estimate of the model uncertainty. GIS is utilized to develop spatial variability maps of the study areas. The different geo-statistical analyses and interpolation methods for data analysis and interpretation will be assessed to select the appropriate method for creating map with a continuous surface of soil nutrient and other soil data within the sampling boundary. GIS will also be utilized to create yield map of the village and this will be correlated with the available nutrient contents of the soil. Correlation between nutrient uptake and soil nutrient contents will be assessed to determine average nutrient content in the plants at harvest to produce unit yield.

Soil mapping involves locating and identifying the different soils that occur, collecting information about their location, nature, properties, potential use and recording this information on maps and in supporting documents to show the spatial distribution of soil types. Soil fertility maps are meant for highlighting the nutrient needs, based on fertility status of soils to realize good crop yields. Soil resource and agro ecology based spatial distribution and the spatial dependence levels vary within the field. Evaluating agricultural land management practices need good knowledge of spatial variability of soil properties in the field. A soil fertility map for a particular area can prove highly beneficial in guiding the farmers and planners in ascertaining the requirement of various fertilizers in a season/year and making projections for increased requirement based on cropping pattern and intensity. Agricultural development should be the strategy for exploiting renewable resources on which our nation must be built and grow to full fill the cherished dreams. So this study is aimed to develop a GIS based soil fertility map of Thrissur district for site specific nutrient management in various agro ecosystems.

1.1. Objectives

- To determine the soil fertility status of various agro ecosystems in Thrissur District.
- To assess spatial variation of soil fertility in the study area.
- To develop soil fertility map of the study area depicting extent of deficiency and toxicities of nutrients using GIS.