CHAPTER 1:

INTRODUCTION

1. INTRODUCTION

Rapid population outburst is the major threat to modern civilization, especially in several developing countries of Asia and Africa. The per capita arable land area of 0.33 ha in 1977 declined by 33 % to 0.22 ha in 1998, is projected to decrease to 0.16 ha by 2025 and may stabilize at 0.10 ha by the year 2100 under global scenario **(Lal, 2000)**. The rapid increase of global population and the simultaneous shrinkage of cultivable land will be the main reason threatening the food insecurity in near future. World over, an estimated 840 million people, more than the combined population of North America and Western Europe are chronically under-nourished, unable to grow or obtain enough food to lead healthy active lives which, also includes more than 200 million children under the age of 5 years who go to bed hungry every night lacking the essential calories and protein **(Ghosh, 2000)**. Hunger not only cut short the lives of individuals, it also damages the peace and prosperity of the nation. As the human development itself gets impaired the country faces a staggering loss in terms of productivity, disease and disability. As an offshoot of chronic hunger, the nation faces conflicts and social unrest, often accompanied by blatant misuse of fragile natural resources.

Ramanathan (2000), under Indian scenario opined about the exponential increase of population from 361.09 million in 1951 to 1000 million plus in 2000, while the food grain production has increased from 50.8 (Mt) in 1950-51 to 203.9 (Mt) in 1999-2000. This is an achievement for which we can certainly feel proud. But this closely followed by challenges of resource management of a magnitude our country never faced before.

Agriculture is the mainstay of Indian economy. The corner stone of India's agricultural policy since independence has been to produce enough food to feed its

growing population. A thoroughly planned land use suggestion is thus necessary to improve, optimize and maintain natural resources. Land use, according to **Vink (1975)**, is the application of human control of natural ecosystem in a relatively systematic manner, in order to derive benefit from it. Man as an inherent part of the ecosystem tries to manipulate it. In this context, the Government of India utilized natural resources by involving human potential by funding different watershed development programmes; among which the 'Drought Prone Area Programme (DPAP) and 'Desert Development Programme (DDP)' were the first adopted watershed approaches during 1987. Later, in October 1990 the Watershed Development Project was adopted in the name of 'National Watershed Development Programme for Rainfed Areas (NWDPRA)' **(Paul *et al.*, 1998)**, with the aim to manage land and water resources for sustained agricultural production, which envisaged the bottom-up and top-down holistic approaches **(Ali *et al.*, 2000)**. The holistic approach may become fruitful when awareness can be generated amongst the poorer watershed's inhabitants (bottom up) regarding natural resource conservation through proper land use / management by the resourceful government or non-government 'Project Implementing Agency' (top down).

Watershed refers to a 'Geo-hydrological Unit' that drains at a common point. The watershed does ***not*** allow water to flow from outside of the catchments and must have ridgeline higher than its surroundings, inner as well as outer areas **(Oswal, 1999; Singh, 2000 a)**. In this approach, the development is not confined just to agricultural land alone, but covers the area, starting from the highest point of the area (ridge line) to the outlet of the *Nala* (Channel) or the natural stream. This will involve implementation of ameliorative measures even on barren hill slopes,

marginal lands, privately owned agricultural lands and badly cut *Nala* and river courses **(Dhruvanarayana *et al.*, 1997)**.

For optimum management of a watershed an up-to-date information and development of various natural resources is necessary. The integration of natural resources may bring an idea about the problems and potentials of the target area. In terms of resource information and developments, it starts from the most important ones, like soil and water, and then extends to the resources like fuel, fodder, livestock and all other associate components. Among these various components of natural resources, 'Soil Resource Information' in the form of mapping is very much essential. **Sidhu *et al.* (2000)** suggested about the importance of mapping of soil resources, which can facilitate the integration of different spatial and non-spatial voluminous data generated through various survey and analysis. The information and mapping of soil resources lead to an idea regarding the limitations of an area, which required urgent land treatment on priority basis as ameliorative or protective measure.

The challenge to sustain food security through unplanned land use will be difficult for any country like India where a large portion of land is rainfed. The rainfed area accounts for about 70% of India's cultivated land with a major portion of such area lying in the Eastern India, where the present study site was located **(Paroda, 1998)**. Since, rice is the staple food of our country and the popular crop of the selected area; therefore its cultivation under rainfed condition should be taken care of. But according to **Sharma and De Datta (1994),** in all rainfed areas, the actual rice yields are generally much lower than the potential yields because of several soil-environmental constraints. The key factor in increasing the production of rainfed rice is to utilize water properly, along with necessary amelioration or

protection against soil related problems. The study of soil site suitability was performed for rainfed rice and other 5 locally dominated crops (viz. irrigated rice, wheat, maize, groundnut and potato) as a comparative or alternate land use options, which was relevant for rainfed areas. The present investigations were undertaken with the soils of '*Patloi Nala* micro-watershed' (area of any micro watershed lies within 500-1000 ha, here it is 684.2 ha) under "*Upper Kasai* Watershed", Puruliya district, West Bengal. According to **Fagi *et al.* (1986)** most of the monsoonal Asian countries (like Eastern Plateau of India) receive 50-90 % of the annual rainfall during May-September, and in most areas these rains are concentrated within a short span of 4-6 weeks per monsoonal season **(Abeywardene, 1987)**. The *Upper Kasai* river is non-perennial due to erratic rainfall (more than 80 % rainfall occurs within June to September, vide: Table 5) and is situated within the area comprising of undulating topography and relatively coarser permeable soil. So, in the present context the choice of *Upper Kasai* watershed as a study area is justified. To render agriculture more productive and profitable in such ecologically constrained and resource poor regions, there is a need for making special effort to exploit the soil potentials in the form of 'Watershed Management'which, is the interdisciplinary integrated approach of development. It is performed by using land according to its capabilities through adoption of technologies for augmenting production by managing and conserving soil and moisture. Good watershed management serves the purpose of agricultural development through properly adopted land use. Properly 'Suggested Land Use' plays a great role for managing the productivity, which on the other hand, is mainly based upon 'Soil Resource Information' and subsequent ' Soil Site Suitability' **(Sys *et al.*, 1993)** study. Soil Site Suitability is the user information on

crop requirements with regard to climate, landscape and soil conditions for a wide range of crops commonly cultivated in the tropical and sub-tropical regions.

To suggest the soil site suitability of any crop, the soil / land resource information (along with climatic database) is necessary. The ultimate success of gathering soil resource inventory is dependent on the ability to precisely define the variability of certain soil properties in the form of mapping with the help of Geographic Information System (GIS) tool comprising of hardware and software for storage, manipulation and retrieval of data, which is geo-referenced. GIS coupled with external Relational Database Management System (RDBMS) provides a both way boost to spatial as well as attribute information. **Peterson *et al.* (1995)** reported that the GIS technology aided by the thematic maps, allows the examination of a wider range of variables than is generally considered in traditional soil resource management system. The GIS aided thematic maps in the present context guided to identify the existing soil / land resources, critical patches (area suffering from problems like erosion, low fertility etc.) and also to locate the positions those required urgent action plan.