CHAPTER 1

INTRODUCTION

1.1 DAMS AND RESERVOIRS

Dams and Reservoirs are important storage structures that have stabilized irrigation in India after its independence and greatly improved food security. Anicuts and Reservoirs (Kallanai in Cauvery River, South India) are mentioned in ancient Tamil literature and have been part of the social development and civilization at large. However, significant developments in construction of reservoirs took place across the globe only in the last century, especially in the second half of the century in many of the countries, including India. Of the 1,527 reservoirs constructed in the world, 152 were present by 1970 in India (WCD 2000). Today, we have about 4,300 reservoirs in India irrigating 91.8 M ha and provide multiple benefits to the society.

Reservoirs create storage by intercepting the natural flow of water at appropriate locations in the drainage system by an impounding structure called dam and its associated structures permit regulation and release of stored water for various beneficial uses. Two hydrological consequences arise out of impoundment; one is the disruption and discontinuity of river flow or discharge and the second one is the retention of the suspended sediment, transported by the river including the bed load, by the physical structures.
The result is the deposition of sediment within the storage area called reservoir and sediment deposition is generally accepted unavoidable and irreversible.

1.2 SEDIMENTATION

Reservoir sedimentation and the consequent loss of storage capacity affect reservoir function, such as flood control, water supply, irrigation, navigation, power generation, fishing and recreation. In arid and semi-arid regions, reservoir sedimentation problems become most acute where the loss of storage capacity by reservoir sedimentation is above 1 to 2 per cent per year and the lifetime of most reservoirs gets reduced by 20 to 30 years. The rate of silting of reservoirs has been estimated as 1% per year at global level and the problems of sedimentation reduces the useful life of the reservoirs, create technical, water quality problems and promote economical, social and environmental problems.

The reservoir is not an isolated entity in a river basin or watershed. It is to be considered as an integral part of catchment where factors and processes such as surface topography, hydrology, hydraulics, sediment transport, soil erosion and land use categories and its management in the catchment area assume great significance. The hydrology of the catchment is important in that it indicates the pattern and volume of inflows into the reservoir. Extreme hydrological events such as floods are important in subtropical climatic regions and may influence the process of erosion also (Seethapathi et al 2008). The land cover and land use management will influence the rainfall-runoff processes of the catchment as well as the quality of water bodies. The nature of the land use, especially the impact of increasing agriculture accelerate the natural erosion process and the increased human settlement and development add sediment bound pollutants in the run
off (Yu et al 2009), that exacerbate the problem of siltation and create environmental problems for the reservoirs.

The sedimentation of the reservoir over the years results in the accumulation of sediments, due to soil erosion, in the bottom layers which leads to two main problems; the loss of storage and decline in useful life span of the reservoir and the eutrophication of the reservoir water.

1.3 SOIL EROSION

Soil erosion in the catchment areas is now one of the important problems seeking attention in watershed conservation and management efforts.

The plants, animals and human society at large depend upon soil, which is the sustenance, either directly or indirectly, for plants, animals and also human beings. However, soil is also one of the most neglected resources on the earth. The shifting cultivation on the hill slopes, non-adoption of soil conservation techniques and over exploitation of land for crop production lead to loss of top soil downstream.

Soil erosion is a naturally occurring process by which soil is moved from one place to another by the action of wind, water or gravity. But the situation is aggravated in recent times by human activities such as agriculture, forestry and urban development to levels that cause environmental problems, especially for the water bodies. Land degradation from water-induced soil erosion is a serious problem in India and estimation of soil erosion is essential for assessing the input nutrient load into the water bodies.

Especially in the Himalayan regions, landslides and landslips are very serious problems caused by improper land management and the reservoirs constructed under the river-valley projects are being silted up at an
alarming rate owing to the denudation of forest vegetation, the cultivation of steep slopes without adopting any conservation practices, landslides and torrents. Sediment load is one of our greatest agricultural hazards, particularly in the case of rivers and canals. The sediment loads from agricultural lands not only continue to increase, but the sources of sediments are multiplying because of the fast rate of our developmental activities.

Increased soil erosion from the hills to the valley increases silt deposits in riverbeds and reduce the ability to discharge of water, which can result in floods (Asthana 2007). Soil erosion is thus an important social and economic problem. The study and estimation of soil erosion is essential for assessing the health and function of watersheds and manage the eutrophication of its water bodies (Jensen et al 2006). It is found that the estimates of erosion, including sediment transport and storage, in reservoirs, estuaries, irrigation and hydropower systems are important for the better management of land and water.

Globally about 13% of land surface suffer some form of soil erosion contributing sediment deposition in the drainage basins (Yang et al 2003). Catchment areas subjected to intense human activity accelerate erosion naturally caused by steep slopes, poor soil structure (Nolan et al 1997), deforestation and construction activities and overgrazing (Schwab et al 1993). All these disturbances in the catchment enhance the impact of erosion by rainfall and transport silt into the reservoirs.

1.4 EUTROPHICATION

Eutrophication is a widespread problem around the globe, but the same has received little attention than it needs to be, especially in the south Asian subcontinent, including India. Eutrophication is a condition under which surface water undergo excess algal growth resulting in dissolved oxygen depletion and other unwanted water quality changes and related problems. One of the primary reasons of eutrophication is the addition of
excess nutrients (nitrogen and phosphorus) from point and non point sources in the watershed through stream inflow load.

Eutrophication is actually the enhancement in nutrient status (Nitrogen and Phosphorus) of water bodies resulting in algal bloom and deterioration of quality of water for beneficial uses. Eutrophication has emerged as the major cause of water quality concern for reservoirs, especially within the last two decades in India. This is due to the increase in various anthropogenic activities and economical development in the watersheds and in the consequent land use changes promoting degradation of the environment. Inputs from point (such as sewage treatment plants, solid waste dumpsites) and non point sources (such as urban storm water runoff, agricultural drainage) are important sources of nutrients and pollutants into surface waters.

The problems of eutrophication include low dissolved oxygen causing nuisance, toxin producing cyanobacteria and growth of other paraphytes. Disease causing pathogenic bacteria can also be present in such contaminated surface waters. Although, both nitrogen and phosphorus are important for algal growth, their relative contribution towards eutrophication is still under lots of debate and open to further research.

Furthermore, continuous discharge of nutrients in the water bodies over decades could cause nutrient deposition in the sediments of the water body which may become available during later time (internal loading) and affect the quality of water. The nutrients, the nitrogen and phosphate which are the key parameters causing eutrophication of the water bodies and which will be the broad focus of this study.

The specific issues under eutrophication for detailed study will be the sedimentation, the water quality seasonal profiles and the dynamics of a key nutrient in a Reservoir in Tamil Nadu.