CHAPTER I

INTRODUCTION
1.1 INTRODUCTION

Water is a vital resource for human survival and economic development, as population, trade, and industry grow water demand increases while the availability for the resource remains constant. Shortages engage water use conflicts, in terms of both quantity and quality. There is a considerable variation across countries in laws and institutions related to water, planning and project implementation ability is not uniform.

Human habitats spread out on the earth’s surface initially wherever food could be gathered and later where it could be produced. Survival and growth of mankind in the face of adverse environments was due to man’s ingenuity in meeting with the food requirements. Food consumed by mankind comes from agricultural crops and livestock products, both of which require ample supplies of water. Water in the form of rain and snow is made available by nature in the yearly hydrological cycle. Water is recycled continuously through transpiration by biomass and evaporation from land. A river basin is a natural entity for planning beneficial uses for available water from precipitation, which are highly variable in space and time. Often, some parts of a basin are surplus in availability, while other face deficit (Sharma, 2002). Presently, only about 17% of the world’s arable land (i.e., 260 m ha) is covered under irrigation and the rest 83% depend upon only on rainfall and are thus prone to seasonal or prolonged water deficits and droughts. International Water Management Institute (IWMI) water scarcity study reveals that by 2025 (Seckler et al., 1998).

- Nearly one-third of the world’s population, some 2.7 billion people will live in regions that will experience severe water scarcity. One third of the population of India will live in regions that will face absolute water scarcity
- The world’s primary water supply will need to increase by 22 percent to meet the needs of all sectors
- Seventeen percent more irrigation water will be needed for the world to feed itself in 2025
- Groundwater reserves will be increasingly depleted in large areas of the world, more spectacularly in India
- Salinization of soils, compounded in many cases by increasingly saline or poisoned groundwater will continue to seriously affect land that has been highly productive in recent decades
- The people most affected by growing water scarcity will continue to be the poor especially rural poor and among poor people, women and children will suffer most.

Degradation of natural resources is considered the greatest constraint to sustainable agricultural development in most of the developing countries. It is generally accepted that sustainable use and management of land resources could be achieved by adopting a system of improved land, water and vegetation management based on an integrated approach for land resources development with direct involvement and participation of the different sectors.

In recent times, interest in and awareness of the multiple environmental, economic and social benefits provided by watershed development and management has increased greatly. This is particularly true in developing countries where the economy is depending predominantly on agriculture, but with fast growing urban populations depending on water and food supplies on an unprecedented scale.

Watershed management in the implementation of management systems, which ensure the preservation, conservation and sustainable use of all land resource, the development of watershed management, is being recognised as a pre-requisite for the sustainable management of land resource and improvement of the living conditions of upland inhabitants. In fact, watershed management integrates various aspects of forestry, agriculture, hydrology, ecology, soils, physical, climatology and other sciences to provide guidelines for choosing acceptable management alternatives within the social and economic context.
Integrated watershed management through people's participation has become widely accepted as the approach, which ensures sound sustainable natural resources management and a better agriculture economy for upland inhabitants as well as people living in down stream area.

1.2 BRIEF REVIEW OF LITERATURE

According to Gnanakan (2001), the concept of Integrated Water Resource Management (IWRM) is a recent one. The conclusion of the Fourth Stockholm water symposium in 1994 recognized that an integrated approach is required to land and water use planning due to complexity of the land/water interactions (Tyson, 1995).

1.2.1 International

Ramadasan et al., (2000) in their paper have discussed the ecological and conservation strategies of Integrated River Basin Management (IRBM) with a special emphasis on several key components within the context of the "living river system concept". They have proved that IRBM is a powerful approach where all major components biological and non-biological can be brought within the framework of an integral and holistic system.

Bhuwneshwar Prasad et al (1997), have propose a new concept of conservation prioritization by considering sub watershed degradation speed sensitivity index and present rate of soil erosion in eastern regions of Nepal.

1.2.2 National

In India, by using remote sensing techniques, information on spatial distribution of soils, vegetation, landforms, drainages and erodibility status has been studied by Regional Remote Sensing Service Centers (RRSSC’S) of Indian Space Research Organization (ISRO) located at Bangalore, Dehradun, Jodhpur, Karagpur, and Nagpur on different aspects of watershed development (ISRO, 2002).

The experiences gained through the extensive use of space imageries, the Department of Space in India embarked upon a major national mission of great significance, for integrated land and water resource management. The primary goal of the Integrated Mission for Sustainable Development (IMSD) is to integrate all the information on natural resources derived from remote sensing with relevant collateral data at each watershed level, to arrive at locale specific action plan for development (Rao, 1996).

Remote sensing and GIS has been found to be very useful in inventorying, monitoring, and management of natural resources. This technology offers an appropriate method for integrating the land and water resources information (FAO, 1986, Karale and Rao, 1987, NRSA, 1988).

Dutta et al., (2001) have demonstrated the spatial modelling for a watershed in Neem ka thana tehsil in Rajasthan. For watershed response analysis of the watershed, the authors have used various thematic maps like, landform, soil, landuse and land cover, major drainages and geological features through a sequence of knowledge based logical operations.

Bothale et al., (1979) have studied the seven sub-watershed of Bajaj Sagar dam for watershed prioritization using Remote Sensing and GIS techniques. They have used Watershed Erosion Response Model (WERM) for watershed prioritization using vegetation density, Soil Brightness Index (SBI), slope and morphometric parameters keeping in view of the range of values for each parameter.
Ravindran et al., (1992) made an integrated approach for resource planning using Remote Sensing and GIS for Song watershed of Dehra Dun district. Various resource maps generated using IRS-LISS II data are integrated along with collateral data to generate derive maps, viz., hydrological soil group, composite map of soil groups and landuse and land cover, surface runoff potential, erosion hazard, groundwater potential, afforestation sites and fuel wood. They have optioned that composite map of hydrological soil group and landuse, is important for evaluating appropriation of the present landuse and to plan proper utilisation of land. Erosion hazard map is a composite derivative of slope, vegetation, hydrological soil group and geomorphology to depict different erosion classes. Similarly groundwater potential map are prepared by integrating geology and geomorphology maps.


Karnataka is one of the first states to pick up the clue and initiate development of integrated farming system on the principles of watershed management.

In Karnataka, Ramesh et al., (1998) prioritization the west flowing rivers in Dakshina Kannada district using SOI topomaps, IRS LISS III data, soil, geology, landuse and land cover, village boundary and location etc. Considering the present land use and land cover, soils and erosion status, hydrogeomorphology by adopting elimination techniques has been carried out for prioritization of west flowing rivers.

Manavalan et al (1993) analyzed the response of Doddalahalla watershed of Tungabhadra-Krishna basin by integrating satellite-derived information with slope length through Watershed Response Analysis (WARA) model. The model is used to obtain the first information on soil erosion susceptibility and overland flows.
Ravikumar (1994) has carried out soil loss assessment by Universal Soil Loss Equation (USLE) method for optimal land use planning for Bevi Bikkana halli Dodda halla watershed in Kolar district. He has used various thematic maps, viz., hydrogeomorphology, soil, slope, land use for integration and to suggest alternate landuse in 580 sq km basin.

Jagadeesha (1995) has attempted integrated study on watershed development and management of Haristala sub-watershed of Chikkaballapur taluk of Kolar district.

1.3 LOCATION OF THE STUDY AREA

The river Varada, which is the tributary of Tungabhadra, takes it origin in Varadamula near Ikkeri of Sagar taluq of Shimoga district. Geographically the basin extends from 74° 48' 15" to 75° 12' 25" E longitude and 14° 05' 25" to 14° 42' 25" N latitude, and it is covered by the Survey of India Toposheet 48 J/14, 48 J/15, 48 J/16, 48 N/2, 48 N/3, and 48 N/4 (Fig. 1.1 and 1.2).

According to the legends (Hayavadana Rao, 1930) Varada - boon-giving river originated in the Bhagirathi. The water poured from the counc of Narayana (Vishnu) on the head of Shiva at Varadamula, the hermitage of Sri Agnimuni in order to subdue (pacify) the flames of austeries which threatened to consume the gods, performed by Shiva to atone for his sin in pulling off one of Braham’s five heads.

The river originates at a height of 732 m, where there is a perennial tank (Fig 1.3) in front of Varada Devi temple. The source of water for this tank is from underground drainage and rainfall. The excess water from this tank, which overflows, becomes Varada river. From the place of its origin the Varada river flow to a distance of 68 km towards north, north-west direction in Shimoga district, and flows for about 100 km in Haveri district in north north -west direction before conflicting with Tungabhadra. The upper part of the Varada river which flow in Shimoga district which covers an area of 1464 sq.km is selected for the study.
Fig. 1.1 Location map of the study area
Fig. 1.2 Satellite imagery of Varada river basin acquired on November 2001
The total area of the basin considered for study is about 1464 sq.km. Administratively river basin covers 4 taluqs – Sagar and Sorab taluq of Shimoga and Siddapur and Sirsi of Uttara Kannada districts and covers about 370 villages (Fig. 1.4).

The elevation of the basin varies from 540 to 850 m. The south and southwestern part of the basin rests upon the Western Ghats, which is also known as Sahaydri. The area is deeply dissected, heavily forested and it is a stage of extreme youth. It is also a region of heavy rainfall and intensive erosion (Radhakrishna, 1966).

1.4 AIM AND OBJECTIVES OF THE PRESENT STUDY

Previous literature for this basin reveals that most of the investigations is related to hydrochemistry and aquifer studies pertaining to lower Varada river basin of Dharwad district only. But a study relating to upper part of Varada basin has not been carried out so far. Therefore, there is need for the systematic study of
development and management of the upper part of Varada river basin for the future generation.

Watershed management essentially relates to land and water conservation in the watershed, which means proper land use and protection of land against all forms of deterioration. Every watershed having its own characteristic features and problems, thus making it unique. In order to get maximum benefit out of these resources, in a sustainable way, the watershed is treated as a single unit.

The main aim of the present study is to develop and manage land and water resources in Varada river basin using Remote Sensing and Geographic Information System (GIS).

1.5 OBJECTIVES

The main objectives of the study is to:

- Prepare various thematic maps
- Generate database for the basin
- Analyse the morphometric parameters of the basin
- Assess physicochemical properties of water and soil and its suitability for domestic and irrigational purposes
- Analyse the meteorological parameters
- Integration of thematic maps
- Delineation of groundwater potential zones
- To suggest action plan

The present study is an attempt in this part of the country to integrate various geospatial data for development and management of land and water resources in Varada river basin.
Fig. 1.4 Village map of Varada river basin
To accomplish the objectives the following chapters are prepared in the thesis.

Chapter I, introduction to integrated watershed management, brief reviews of the previous work, carried out in different regions are discussed along with aim and objectives.

Chapter 2, deals with spatial distribution of lithology of Karnataka in general and the Varada river basin in particular.

Chapter 3, different hyrdometeorological parameters along with groundwater fluctuation data of the basin are analysed and the results are graphically represented.

Chapter 4, morphometric analysis of the Varada river basin and its sub basins are analysed and slope map of the study area is delineated.

Chapter 5, remote sensing study of the Varada river basin is made and land use and land cover, soil, hydrogeomorphology, lineament maps are prepared.

Chapter 6, groundwater samples collected from the study area are subjected to physicochemical analysis for two seasons. Further, water samples are classified with respect to drinking and irrigation water quality. Soil samples collected from the field are tested for their fertility.

Chapter 7, spatial integration of different thematic maps are carried out on GIS platform to know the behaviour of stream in respect of lithology, slope, land use and land cover and water level fluctuation and groundwater potential zones in the study area is delineated by integrating eight thematic maps.
Chapter 8, for watershed development and management of the basin, sites for suitable vegetative and structural measures have been suggested to control soil erosion. Similarly, rainwater harvesting/groundwater recharge sites are also selected to augment groundwater/surface water by integrating various thematic maps.

Summary and conclusions are highlighted in Chapter nine.