CHAPTER 1

INTRODUCTION

1.1 Introduction

Water was primarily regarded as a natural resource necessarily free for human settlement. Society was least aware about its unsustainable exploitation issues. With the manifold increase in population and to meet its food and changed livelihood requirements, increased water (surface and ground water) use has led to overexploitation. That area of land can be said overexploited where annual water use is more than annual availability, resulting in depletion of ground water levels and a consequent non maintainability of minimum flow requirements in rivers for human and livestock livelihood activities. It is only very recently, particularly during the second half of the twentieth century, the community attitude towards water has changed and has led to the recognition that water is tending to become a "scarce resource" because of "overexploited." Today some visionaries even say that, water management will be the most critical resource management in the twenty-first century.

In the beginning of the 1980s, this debate led to the introduction of the concept of sustainable development in any natural resource development program. Brundtland Commission defined sustainable development that meets the consumptive needs of the

present generation without compromising the needs for future generations. It was during the preparatory meeting for the UN Conference on Environment and Development (UNCED) in Rio de Janeiro, that the concepts of sustainable and integrated water resources management were widely discussed and adopted by the international community. At this meeting, the Dublin, principles of 1992 on water management were established.

1.2 The Dublin principles

Principle No. 1 -Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment. Since water sustains life, effective management of water resources demands a holistic approach, linking social and economic development with protection of natural ecosystems. Effective management links land and water uses across the whole of a catchment area or groundwater aquifer.

Principle No. 2 - talks of participatory approach.

Principle No. 3- talks of women participation in water resource management at all levels.

Principle No. 4 -Water has an economic value in all its competing uses and should be recognized as an economic good. Within this principle, it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price.

It is clear from the conceived Dublin principles that water management requires a holistic approach and therefore integrated and economic planning including protection of social development and ecology.

1.3 State Water Policy

Sustainable and integrated environmental water management is a key for maintaining overall sustainability of water resources in the state so as to keep water resources under harmony or in safe situations on spatial basis. State Water policy 1999 has a provision of conjunctive water management for effective and sustainable water development. The Government of UP adopted a State Water Policy (SWP) in May 1999 with the following objectives:

1. Ensure preservation of the scarce water resources and to optimize the utilization of the available resources.

2. Bring about qualitative improvement in water resource management which should include user's participation and decentralization of authority.

3. Maintain water quality, both surface and underground, to established norms and standards.

4. Promote formulation of projects as far as and whenever possible on the concept of basin or sub-basin, treating both surface and the ground water as a unitary

resource, ensuring multipurpose use of the water resource. This would inter alia consist of the following main uses:

i. Provide adequate water for drinking and domestic use.
ii. Providing water for irrigation.
iii. Maximize hydro power generation within the constraints imposed by other users.
iv. Provide water for industries including Agro industries.
v. Provide water for navigation, recreation, health and for other uses.

5. Ensure ecological and environmental balance while developing water resources.
6. Promote equity and social justice among individuals and groups of users in water resource allocation and management.
7. Ensure self-sustainability in water resource development.
8. Ensure Flood Management and drainage as integral part of water resource development.
9. Provide a substantive legal framework for management.
10. Provide a Management Information System (M.I.S.) for effective monitoring of policy implementation.
11. Promote research and training facilities in the water resource sector.
12. Provide mechanism for the resolution of conflicts between various users.

So the state water policy clearly emphasis that the sustainable and integrated water resource management treating water as single unitary resource in a holistic

manner, ensuring multipurpose use of the water resource and maintaining ecological & environmental flows under river basin frame work is the only sustainable solution.

1.4 Integrated Management of Water Resources

In holistic and integrated approach water is treated as single unitary resource irrespective of source or place of occurrence. Integrated approach requires conjunctive management of surface water and ground water including optimization along with fulfilling the ecological and environmental flow requirements for present and future. Sustainable management adds a certain normative constraint on use, whereas integrated management may not pre-include a certain constraint statement about the main objective of development.

Water resources management refers to a whole range of different activities: resource assessment, demand management, modeling, design of measures and strategies, resource development, operation and maintenance, implementation of policy, monitoring, and evaluation. It also covers supportive activities such as institutional reform. Institutional reforms mean capacity building of institutions for understanding the issues built in within, developing and implementing integrated water resource management plans.

Water resource availability can be defined as natural annually regularly, replenishable resource, whose availability is limited to the performance of hydrological cycle and level of infrastructure development. There has never been one worldwide-

applied recipe for how to manage water. Climate conditions and cultural practices have always varied to such a great extent that one cannot expect that such a recipe will ever be developed. Water management problems of the world are neither homogenous, nor constant or consistent over time. They often vary very significantly from one region to another, even within a single country, from one season to another, and also from one year to another.

Single largest use of water is for agriculture since time immemorial. The requirement of proper water management and development plan for irrigation has been felt more acutely in tropical regions with monsoonal climate where the pattern of rainfall does not correspond to crops evapotranspiration water requirement pattern. In Uttar Pradesh, in certain regions dry weather irrigation canals which were constructed a few centuries ago to support livelihood and provide supplemental irrigation are still in use. Later on these canals were converted into all season canals by making permanent barrages. These canals were largely constructed to provide protection to crops from famines and droughts. The concepts in irrigated agriculture have changed since then to meet the food/fiber production needs of the ever-increasing population and from sustenance to intensive agriculture. This heavy dependence on groundwater resource for intensive cultivation, together with increased use of chemical fertilizers and pesticides has lead to its overexploitation and consequent water table decline at an alarming rate. Response of high yielding varieties is better with chemical fertilizers requiring more and frequent water application.

Due to competition from increasing demands for agriculture, domestic, power, industrial, environmental and other uses, allocation of water to different stakeholders in appropriate quantity and quality has become increasingly difficult. Freely spatial availability, of ground water has increased its use very rapidly. Further it is more easily available on as and when required basis, without requiring any distribution system just like canal network. There is a real need to manage ground water reservoir in the region more effectively to ensure a sustainable dynamic balance between its annual replenishment and draft to sustain agriculture, and other demands for today and future.

1.5 Outline of the Thesis

Thesis is organized into nine chapters structured as follows:

After the introductory Chapter (Chapter 1), Chapter 2 presents the state of the art in the research areas of integrated management of water resources in canal command. After the literature review, Chapter 2 also presents the literature gaps and motivation for this work. Prime objectives as well as specific objectives are discussed in this Chapter. Chapter 3 presents the hydrogeology of the indogangatic plain of Uttar Pradesh. Aquifers of Indogangatic plain and that of Gomti basin are also discussed in the Chapter. For the modeling area districts of Ramganj distributaury and Daulatpur distributaury commands, borelogs, fence diagrams, yield, transmissivity and hydraulic conductivity parameters are also discussed. Chapter 4 presents the availability and utilization of water in Gomti basin. Topography, canal network, ground water behavior analysis based on Arc GIS, land use, climate and rainfall trend has also been discussed. Chapter 5 presents

Spatio temporal mapping of the study area using Arc GIS for ground water behavior in canal command and non command areas. Chapter 6 presents the ground water simulation model for the canal command area. Model calibration, simulation and different management scenarios and its impact has been discussed. Chapter 7 presents integrated model at distributaury level using soil moisture, rainfall runoff, system loss and ground water module on GIS platform. Management options for different type of land use, gross profit and ground water behavior has been discussed. Chapter 8 presents integrated model at Kulawa command upto field level using soil moisture, rainfall runoff, system loss and ground water modules on GIS platform. Different management scenarios for water regulation for land use based on field survey, NIC statistics and remote sensing has been discussed. Impact of rainfall sequence, canal water supply roster and lining on water use efficiency and ground water levels has been discussed. Dual roster for surface water and ground water use at Kulawa level has been developed for effective implementation of integrated water resource management through Water Users Associations. Chapter 9 presents the conclusions and scope for future work