WATER RESOURCES AND MANAGEMENT USING REMOTE SENSING AND GIS-A CASE STUDY OF BALLARY WATERSHED DISTRICT KARNATAKA

***Siddnagowda, Assistant Professor (Group A), Dept. of Civil Engineering. Govt. Engineering College, Raichur.**

Abstracts:

This paper attempted to study the *watershed management and watershed as Management unit. And also it focuses on studding the importance of Water Management in North Karnataka in addition to this it focuses on remote sensing and Geographical Information system. To accomplish the above objectives researcher employed the empirical research method and gathered the data from various sources such as Magazines, Research Article, and various literature. And on the basis of analysed data draw the conclusions. This study concluded that the economy of the Bellary watershed is predominantly dependent on agricultural activities and hence it is essential to achieve optimum utilization of land and water resources. The following suggestion is made with the object of developing the agricultural economy by implementing the watershed management measures in the Bellary watershed. Cultivable–waste lands such as pastures and grazing lands occupy a considerable extent in the Ballary watershed. Measures can be taken for extending agriculture to these lands without disturbing the ecological balance. This can be achieved by augmenting the irrigational facilities by implementing water conservative methods. Thus the gross cropped area can be increased to the maximum extent possible in the watershed, The forest land in the Bellary watershed occupies a large area. Most of the Velikonda hill ranges are barren without vegetative cover resulting into intensive erosion. These forest areas are need to be maintained and improved by growing suitable plant species which are economically beneficial and valuable. This will not only enhance the forest wealth but also can significantly control erosion from the hill ranges*

Keywords: *Hirehalla Sub-Basin, Irrigation, Total Dissolved Solids, Sodium Absorption Ratio*

1. INTRODUCTION

Water is an essential resource for all life on the planet. Of the water resources on earth only three per cent of it is fresh and two-thirds of the freshwater is locked up in ice caps and glaciers. At present only about 0.08 per cent of all the world's fresh water is exploited by mankind in ever increasing demand for sanitation, drinking, manufacturing and agriculture. Water is by far the most important resource, which is relatively stable and can provide relatively permanent supplies as well as permanent restraints and therefore easy for man to manipulate. It is essential for the sustenance of life on the planet earth. In virtue of its immense utility for mankind, water has acquired the synonym "The Liquid Gold". The use of water

resources and their planning is always closely connected to the use of land resources and the latter are connected with the quality as well as quantity of the available water. So, they are interlinked and therefore intimately connected with each other. One of the biggest concerns for our water-based resources in the future is the sustainability of the current and even future water resources allocation. As water becomes more scarce, the importance of how it is managed grows vastly. Finding a balance between what is needed by humans and what is needed in the environment is an important step in the sustainability of water resources. Attempts to create sustainable freshwater systems have been seen on a national level in countries such as Australia and such commitment to the environment could set a model for the rest of the world. The field of water resources management will have to continue to adapt to the current and future issues facing the allocation of water. With the growing uncertainties of global climate change and the long term impacts of management actions, the decision-making becomes even more difficult. It is likely that the on-going climate change will lead to situations that have not been encountered. As a result new management strategies have to be innovated in order to avoid setbacks in the allocation of water resources. A watershed is also called as a drainage basin or catchment area which is defined as an area in which all water flowing into it goes to a common outlet. People and livestock are integral part of watershed and their activities affect the productive status of watersheds and vice-versa. From the hydrological point of view, the different phases of hydrological cycle in a watershed are dependent on the various natural features and human activities. Watershed is not simply the hydrological unit but also socio-political-ecological entity which plays a crucial role in determining food, social and economic security and provides life support services to rural people,(Wani et al.2008).

2. PROFILE OF THE STUDY AREA

The Bellary district with an area of about 8,500 km2 is located almost at the centre of the Indian peninsula between 14° 33´ and 15º 15´ N latitude and 75° 40´ and 77° 10´ E longitude. During the last decade, the district has received an average annual rainfall of about 545 mm with wide spatial variability ranging from 815 mm in the central hilly tract of Sandur schist belt to 243 mm in the rain shadow area immediately east of the belt. The normal average rainy days are 43 in an year. The maximum temperatures range from 23 to 42 °C. The normal potential evapotranspiration of about 1700 mm far exceeds the rainfall. About 51 % of the district area is under agriculture, 12 % under forests, 15 % under open forests and scrubs, 4% uncultivated lands and 18 % as fallow lands (Anonymous, 2005). About 21 % of the district area is under irrigation, most of it from the Tungabhadra irrigation project. The rainfed areas compose of the rocky inselbergs and knobs surrounded by red soils with low water retention. It is here the reserve forests and scrub lands are concentrated. The red soils cover an area of about 55 % of the district and black soils about 45 %. The major black soil area is irrigated from Tungabhadra irrigation project and remaining is cropped by dry crops only after the main rainy season. As such they remain bare and exposed to the splashes of rains during main rainy season and are thus prone to water erosion. The granite hills and inselbergs are seen extensively and the rocky knobs are especially present every where in the red soil areas. Thus, these areas have varied slopes and provide erosive runoffs of rain water. The reserve forests, open

forests and scrub lands are mainly in the red soil region. A thick forest cover exists over the central hilly schist belt.

3. OBJECTIVES OF STUDY

- To study the watershed management and watershed as Management unit.
- To study importance of Water Management in North Karnataka
- To study about the Remote sensing and Geographical Information system

4. RESEARCH METHODLOGY

To accomplish the above objectives researcher employed the empirical research method and gathered the data from various sources such as Magazines, Research Article, and various literature. And on the basis of analysed data draw the conclusions.

5. WATERSHED MANAGEMENT

Watershed management is an adaptive, comprehensive, integrated multiresource management planning process that seeks to balance healthy ecological, economic, and cultural,social conditions within a watershed. Watershed management serves to integrate planning for land and water; it takes into account both ground and surface water flow, recognizing and planning for the interaction of water, plants, animals and human landuse found within the physical boundaries of a watershed. Watershed management provides a framework for integrated decision-making to help; assess the nature and status of the watershed; identify watershed issues; define and re-evaluate short and long-term objectives, actions and goals; assess benefits and costs and implement and evaluate actions. Watershed management assumes an exceedingly important role not only for the production of more food but also for prevention of degradation of land and water in the area. It has been proved that watershed management has so far yielded rich dividend and provided valuable insight into the aspects of management of natural resources such as land and water. Study of assessing the water resources and watershed management is not a passing fad, it is intricately related with an extremely beneficial need for the lives of millions of farmers. Watershed management is the process of guiding and organizing landuse and use of other resources in the watershed to provide desired goods and services without adversely affecting soil and water resources. Embedded in this concept is the recognition of the inter-relationships among landuse, soil and water and the linkages between uplands and downstream areas.

6. WATERSHED AD AS MANAGEMENT UNIT

Watershed provides a natural unit for implementation of land and water resources management programmes. This is because the quantity of water resources available at a given geographical location is determined by its hydrological boundaries i.e watershed/ catchment boundaries. The whole area consists of

series of catchments and every river catchment can be further subdivided into any number of smaller catchments or more convenient sizes can be called as micro-watersheds. it is an ideal unit identifiable by their boundaries and study of their characteristics is useful for planning and management.

Watershed management is an integrated technological approach within natural boundaries of a drainage area for optimum development of land, water and plant resources to meet the basic minimum needs of the people in sustained manner. According to Soil Conservation of India (Bali J.S,1988) watershed management means harmonic development and management of land and water resources within the natural boundaries of a watershed so as to promote or produce, on a sustainable basis, abundance of plants and animals and their products and still deliver clean and controlled flow of water to the downstream. Watershed management is the process of creating and implementing plans, programs and projects to sustain and enhance watershed functions that affect the plant, animal and human communities within a watershed boundary.

Watershed management is not only managing natural resources but about managing human activities as it affects these resources greatly. The drainage area of the river provides the natural boundary for managing and mitigating human and environmental interactions. Because human activities include actions of government, municipalities, industries and land owners and hence watershed management must be a cooperative effort. Effective watershed management can prevent community water shortages, poor water quality, flooding and erosion. The expense of undertaking watershed management is for less than the cost of future remediation. The central and state governments have initiated many watershed development programmes in the country. Some of these are implemented by non-governmental organizations also. National Watershed Development Project for Rainfed Agriculture (NWDPRA) was launched in the year 2002. The broad objectives are

1. Conservation, development and sustainable management in a sustained manner
2. Enhancement of agricultural productivity and production in a sustainable manner
3. Restoration of ecological balance in the degraded and fragile rainfed ecosystems by greening these areas through appropriate mixture of trees, shrubs and grasses.
4. Reduction in regional disparity between irrigated and rainfed areas and
5. Creation of sustained employment opportunities for the rural community.

The Govt. of India is giving much importance for Watershed Management Programmes. Ministry of Rural Development, Ministry of Agriculture and Co-operative Development, NABARD and CAPART introduced their revised guidelines for implementing the Watershed Development Projects. The State Groundwater Department, Panchayat Raj Department, Agriculture Department, Irrigation Department and District Water management Agency of the state government are involved in the implementation of watershed management programmes in Karnataka

7. IMPORTANCE OF WATER MANAGEMENT IN NORTH KARNATAKA

Karnataka is lack of water resources, especially in its arid and semiarid regions. So the management of water resources in these areas is very important. The annual average rainfall of 50 cm for the whole country and its totality area, it has been discovered that total water resources in India are of the order of 167 million hectare meters. It has further been calculated that only 66 million hectare meters of water resources in India can be employed for irrigation. The population of India as on 2011 stood at 1,210,193,422 (1.21 billion) persons. Thus, India supports about 1/6 th of world population, 1/50 th of world's land and 1/25 th of world's water resources. India also has a livestock population of 500 million, which is about 20 per cent of the world's total livestock population. More than half of these are cattle, forming the backbone of Indian agriculture. The total utilizable water resources of the country are assessed as 1086 km 3 . Geoinformatics technology has its special advantage in this aspect. The paper introduces the applications of Geoinformatics, including remote sensing, geographical information system and global positioning system, in this field, such as surface water resources, groundwater exploration, dynamic monitoring of floods, water environment and drought monitoring, planning of water diversion project between basins and so on. It shows that Geoinformatics technology can play important role for North Karnataka development, especially in India. India is still an agricultural country; the water consumed in agriculture is the most significant one.

8. REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM

- **Remote sensing**

Remote sensing can be defined as the science and art of acquiring information (spectral, spatial or temporal) about physical objects or areas without coming into physical contact with it. Remote sensing uses electromagnetic spectrum to image the land, ocean and atmosphere by using electromagnetic radiation (EMR) at different wavelengths (visible, red, near-infrared, thermal infrared, microwave). The unique spectral signatures of each object on the earth's surface can be detected at these wavelengths and can be interpreted to generate quantitative information on hydrological processes.

There are large numbers of satellites in the earth's orbit, which are being used to acquire information on hydrological and biophysical parameters. Pixel size varies from few metres to kilometres and temporal resolution varies from 3-hours to many months. For example, term provides 3-hour rainfall rate estimates at 25 km pixel resolution since 1997. The Advanced Microwave Scanning Radiometer-Earth Observing System (AMSR-E) observes atmospheric, land and oceanic parameters. Daily soil moisture estimates at 25 km pixel resolution are available through AMSR-E. Daily evapo-transpiration can be estimated by using AMSR-E and MODIS satellites at 1 km grids. NDVI, LAI, land use, albedo, biomass at 1 km resolution can also be estimated from MODIS, SPOT vegetation etc. Ground water levels can be estimated using the GRACE satellite that provides monthly changes in storage change at 400 km grids. There are two types of remote sensing systems available. First is Active and second is Passive.

- **Active Remote Sensing**

In active remote sensing, the sensors have their own sources of energy. They emit radiations towards the target under investigation and detect and measure radiances from objects as is the case of radar (Fig. 16a). Regardless the time of day or season, active sensors have the advantage to take measurement anytime. Active sensors are widely used for the wavelengths that are not adequately provided by the sun. The energy requirements for the better illumination of the target in case of these systems are quite large. Some examples of active sensors are synthetic aperture radar (SAR), LASER and European Remote Sensing Satellite (ERS).

- **Types of Remote Sensing**

  - **Passive Remote Sensing:** In passive remote sensing, the sensors detect and measure the reflected or emitted EMR from objects that gets energy from natural sources. For remote sensing sun is the primary largest source of energy. The energy is either absorbed or reflected (optical) and then re-emitted, as it is for thermal infrared wavelengths. Earth itself emits radiations that are taken up by the passive sensors e.g. in microwave region of wavelength spectrum.

  - **Geographical Information System:** GIS is used for spatial mapping of objects that integrates space science, survey and the mapping. The GIS can be used to manage data as well as to integrate and analyse spatial data obtained from different sources (field surveys, remote sensing) with diverse structures, resolution and projections. Remote Sensing and GIS use in the field of water resources management has been increased manifold during the last decade. Data on hydrology can be acquired from satellites. As for irrigation water problems are concerned, high to moderate resolution imagery from satellites give prime information of different hydrological components for water resources management practices.

9. CONCLUSION

The economy of the Bellary watershed is predominantly dependent on agricultural activities and hence it is essential to achieve optimum utilization of land and water resources. The following suggestions are made with the object of developing the agricultural economy by implementing the watershed management measures in the Bellary watershed.

1. Cultivable–waste lands such as pastures and grazing lands occupy a considerable extent in the Bellary watershed. Measures can be taken for extending agriculture to these lands without disturbing the ecological balance. This can be achieved by augmenting the irrigational facilities by implementing water conservative methods. Thus the gross cropped area can be increased to the maximum extent possible in the watershed.

2. The forest land in the Bellary watershed occupies a large area. Most of the Velikonda hill ranges are barren without vegetative cover resulting into intensive erosion. These forest areas are need to be maintained and improved by growing suitable plant species which are economically beneficial and valuable. This will not only enhance the forest wealth but also can significantly control erosion from the hill ranges.

3. The watershed is normally useful for the production of fuel, fodder and timber and can be developed in watershed programmes. Apart from this, the foreshores of tanks are suitable places for plantations and species like tamarind and other fodder and fuel trees which can be planted based on the people's need. These are the innovative components in the watershed management programmes to enhance the biomass production.

4. The basic aim of watershed management programmes are conservation of surface and groundwater resources. In the villages of Bellary watershed basin method of irrigation is practiced for cultivation of crops. The basins are constructed by the farmers by land or animal traction. The surface irrigation methods are commonly found in all the villages. This type of irrigation is mostly suitable for clay soils with low infiltration rates.

5. Sprinkler and drip irrigation methods are preferred than surface irrigation on steeper slopes or unevenly sloping lands as they require little or no land levelling. Sprinkler and drip irrigation, because of their high capital investment, are mostly used for high value cash crops, vegetables and fruits. Drip irrigation is suited to irrigate individual plants or trees or row crops such as sugarcane, mango, lemon, plantain etc. In the areas of short supply of water resources sprinkler and drip irrigation methods are preferred than surface irrigation.

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