Water Resourse: Role of GIS and Remote Sensing

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***Abstract*- With the advancement of technology now it is more convenient to allocate the surface and subsurface water resources optimally by means of GIS and remote sensing technology for different purposes. These technologies have been extensively used to organize the data in a scientific manner. It is helpful to acquire data over a wide area regularly by remote sensing and the desired results can be obtained by processing the data with the help of GIS. In respect to areal and temporal acquisition of data sets remote sensing has some limitations, that would be expected to be fulfilled in the near future due to rapid improvement in satellite technology. The present study outlines the role of GIS and Remote Sensing in the field of water resource engineering with the help of research literature available in this area. It is believed that these techniques will, for many cases, be the most effective tools for the assessment and effective management of scarce water resource in the years to come.GIS and Remote Sensing techniques have to be effectively used to replace, complement and supplement ground data collection in various facets of different kinds of water resources projects.**

Keywords- Remote Sensing, GIS, Flood Mapping, water

I. INTRODUCTION

Water is an important natural resource on the earth and plays a vital role in every aspect of life. The sources of consumable water are mainly groundwater, rainfall and surface water bodies like river, ponds and lakes, but the competitors are too many like domestic, agriculture, infrastructure and industrial sectors. The amount of fresh water in the world is constant irrespective of the spatial and temporal variation and, in many locations, there is in *sufficient* water to fulfil the demand due to rapid grow thin population. Drought in one region may coincide with the heavy rain and flood in others. With the limited availability of natural water resources it is made mandatory to use them optimally, and to allocate the underground water resources by means of GIS (Geographic Information System) and satellite remote sensing techniques, so that the need of each sector will be fulfilled with justification. Moreover, it is the responsibility of water scientists, hydrologists and water engineers to make people understand the inherent phenomena, the prevailing ecosystem and the inter-relationship of the components. The application of a GIS and Remote Sensing is now commonly applied in the area of natural resource management and water resource engineering. Remote sensing provides critical data sources for mapping water resources and changes, while GIS provides the best tool for water resource and flood risk management, presentation, visualization and publication education.

A. Remote Sensing

Remote sensing means assessing the characteristics of a place (usually meant as the surface of the earth) from a distance. It provides the necessary data in a regular sequence and on a regional, continental or global scale to measure monitor and model complex natural, hydrological and manmade features. The remotely sensed images are captured by sensors fitted to satellites (and at times below aircrafts) that work on two basic technologies. One of these, the Passive System, records the reflected electromagnetic energy of the earth, the source of the energy being the radiation of the Sun. The other, called the Active System, employs its self-generated pulses and records the reflected pulse. The active remote sensing systems mostly use radars that emit radiation in the microwave band of the electromagnetic spectrum. In most of the cases of floods images taken by the passive systems are blocked by cloud cover since incidents of floods are most common during the monsoons and are almost coincident with heavy cloudy days. Radar based systems, on the other hand, are able to penetrate the cloud cover and give a clear picture of the flood inundation extent.

B. GIS

A GIS is a computer application program that stores Spatial and Non-Spatial information in a digital form. Spatial information for an area is what is traditionally represented in maps of that region. Non-Spatial data, also called Attributes, refer to information like demographic distribution of a town or a village, width or identification tag of a road, daily discharge of a river at a particular place, etc. Thus, a GIS conveniently manages all variety of data of a given region in a single electronic file in a computer. This is helpful to any regional planner, including that of a Water Resources Project since all information is conveniently stored and accessed with the computer.

II. LITERATURE REVIEW

A vast diversity of research has been undertake ninth ear e a of water resource management. The use of GIS and remote sensing is a rapidly developing area in which data from a number of sources is being utilized. For example, artificial recharge sites have been identified through the use of

aerospace imagery and visual interpretation of geological maps [20]. A method has been developed to characterize the subsurface strata using an artificial neural network and GIS [9]. Suspended solid concentration has been modeled in near coastal waters using remote lysensed data [7]. A temporal pattern of shore line changes has been identified using Land sat Multi Spectral Scanner and a GIS package [8]. Secchi disc depth and chlorophyll content in coastal waters have been estimated using multi-date Land sat The matic mapper data [17]. Using visible and infrared remote sensing images, the snow melt-runoff mode ling has been applied to the Italian Alps [22]. An integrated package of GIS has been proposed to upgrade the Hong Kong water supply scheme [18].Ground water salinity has been mapped using Indian Remote Sensing-IB Linear Imaging Self-Scanning Sensor II data and a GIS package in Uttar Pradesh India [21]. The extent of water vapor transformation over Calcutta has been studied using radiometric studies and a GIS system[11].The software SWAT models with GIS interface was used to assist the modeler in finding the locations of areas having potential instability problem that might occur in Tasik Harapan. The results show that GIS is a versatile tool for water resources management, as interface for modeling at river basin level using Soil and Water Assessment Tools (SWAT 2005) and as a tool to assist the preparation of geometric input for the two-dimensional model CCHE2D to analyze the flow pattern in a lake. [27].The hydro geologic interpretation of satellite data have been proved to be a valuable survey tool in areas of the world where little geologic and cartographic information exists or is not accurate (Engman and Gurney, 1991). Satellite data provide quick and useful base line information about the factors controlling the occurrence and movement of groundwater like geology, lithology, geomorphology, soils, land use/cover, drainage patterns, lineaments, etc.(Bobba *et al*., 1992; Meijerink, 2000).Structural features such as faults, fracture traces and other such linear or curvilinear features can indicate the possible presence of groundwater (Engman and Gurney, 1991).

III. APPLICATIONS AND CASE STUDIES

A. Runoff Modeling from a Snow Covered Area

The assessment of snow depth is further considered by analyzing the spectral signatures of pure snow area. The radiance obtained from channel1 is categorized into different zones based upon the difference in the radiance between the highest and lowest pixel values. The range of classification is encoded as a snow depth having maximum, medium and minimum coverage, which is compared with the ground truth data from there on under consideration. It is possible to differentiate the dry and wet snow because visible (band3) and near-infrared (band4) wavelengths depend on the snow grain size distribution, the depth and density of snow pack, the extent of insoluble and soluble impurities and the liquid water inclusion[25]. Soot concentrations as low as 0.1ppmw (parts per million by weight) are enough to reduce there flectance of snow [10,6and2]. The near infrared reflectance of snow decreases significantly with melting [16, 24, 5, and 23].

B. Flood Mapping

With the help of remote sensing images, particularly with very high resolution, it is possible to demarcate the flood pro near as over wide regions including the main branches and tributaries of a river system. The comparison of the flood stage can then be performed with the values directly measured or calculated from a hydro dynamic model (e.g.HEC-2).The wide application of the European Remote Sensing Satellite-l is occurring in this area of investigation. The general procedure involves the analysis of satellite image using GIS software to demarcate the bank (at the water's edge) within a specified interval of time. The width of the river at a number of transects is also taken from the satellite imagery. The possible sources of errors are due to topographic map in accuracies and operate or positioning. Error due to altitude and the error due to geometric distortion have to be removed before hand to compute the discharge in the tributaries and in the main river from the satellite images. Once, the slope of the terrain is obtained (as lope map can be readily generated in a GIS from topographic data), the discharge is simply computed from manning's equation or similar for open channel flow. River cross sections are measured from ground survey at a number of transects and are used to calculate the flow from a hydro dynamic model. In normal circumstances, the GIS approach provides results within eighty-percent accuracy of flood profile [3].

C. Erosion and Accretion Along the Banks and Coastal Areas

The study of the soil type and the morphology (particularly slope) will provide additional information about the type of area that would be eroded or accreted. By making the use of ground cover, elevation, slope and soil type, it is possible to predict erosion and sedimentation [8]. A number of studies demonstrate the capability of remote sensing technique to detect erosional and accretional trends in areas of rapid changes where access is difficult due to transportation or other restrictions.With high resolution satellite images, the prediction of shore line erosion or accretion can be expected more than eighty percent accurate of the field measurements [8].

D. Identification of Ground Water Zones

By preparing a land use map, land cover map, soil map and a geological map at a certain scale, usually ranging from 1:30000 to 1:100000 from there motley sensed image sand conventional techniques, ground water zones can be demarcated relatively precisely. Different researchers have developed the methodologies in this respect, where they have extensively applied the options within GIS software in order to interpret the images /maps and correlate the different features against the presence of ground water [I, 13,12and4]. The map of drainage density, slope class and soil map can be developed from the existing topographic map of that region. Based on the soil type and the land use characteristics, the area is divided into regions having high ground water potential, medium to high potential, medium potential, and medium to low potential and low ground water potential zones. The prediction is compared with the yield obtained from wells in the field and provides the range of accuracy from 0.65 to 0.9 with regard to the spatial variation of the ground water zones [14].

IV. CONCLUSIONS

The GIS software can handle large amounts of satellite data sets in a user friendly window-based environment interface, as there is continuous improvement in software and computer technology. The task is further simplified by the case with which satellite images can be imported into GIS systems. The problems associated with the water resource engineering encompassing large areas can easily be tackled by the application of GIS and remote sensing. The availability of regular time-based data has further facilitated to cope with the problems in a real time manner. For these reasons, GIS and remote sensing is becoming popular among the hydrologists, water scientists and water managers. It can be outlined that GIS and Remote sensing technology will have greater potential to deal with the problems associated with the water resource management in the years to come.

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