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Potential of Remote Sensing and Geographical Information System in Water Resource Management

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Abstract

Water the source of life, is passionate. Too passionate to manage. Excess of it leads to flood and lack of it results in drought and famine. Overgrowing demand of water and increasing shortage of it may lead to major conflicts. It is important to make people aware of values of water more so that they will waste less and pollute less amount of water. Remote sensing technology and Geographical Information system have been extensively used in exploitation of ground and surface water in many areas. Now, time has come to use these technologies to realize the concepts such as artificial recharge, water harvesting and watershed management. These technologies have the potential to help in reaching the ultimate goal of water resource management so that every one can get sufficient amount of water. This article explores the potential of remote sensing and Geographical Information System in water resources management, development, and its capability to handle the issues related to water management and development

Key words: ***Remote Sensing, Geographical Information System, Water Resources***

Introduction

Water, the elixir of life, has highly uneven availability in space, time and quantity. Water shortage or excess may have disastrous consequences. On the one hand there are droughts, on the other, flood devastates vast tract of land year after year. The myriad needs of the thronging population, burgeoning economic ambitions, demanding agriculture, expanding urbanization, increasing industrialization have caused great challenges in the best use of the available water resources. Consequently, the need for planning, conservation, optimum utilization and management of this natural resource is paramount for the economic upheaval of a country.

Water resources world over are under pressure due to land use change, urbanization, overuse and environmental polluting activities. The rapid advances made in spatial data acquisition technology over the last two decades, has given a unique advantage in synoptic, temporal coverage with vastly improved scales of observation.
The most important areas of application of Remote Sensing and GIS in water resource management are:

- Rainfall monitoring, including severe storm and flash flood forecasting and evaluation. (Andrawis *et al.* 1978, Kumar 1993)
- Surface water inventory and monitoring. (Chaurasia *et al.* 1993)
- Snow mapping, measurement and monitoring.
- Soil moisture measurement through mainly for un-vegetated or sparsely vegetated localities. (Brucker and Stenage 1988)
- Evapo-transpiration estimation and monitoring.
- River morphology.(Kumar *et al.* 1993)
- Sedimentation patterns rate in reservoirs and deposition in rivers.(Rao and Mahabaleswara 1990, Jain and Goel 1993)
- Ground water mapping and assessment.(Aggarwal and Mishra 1992, Ravindran and Manchanda 1993)
- Water pollution monitoring.(Baman 1993)
- Hydrological forecasting of the above parameters and phenomena and numerous dependant variables.
- Watershed conservation, planning and management.(Ja and Walsh 1992)

- Drought monitoring.
- Estuary studies and coastal zone management.

Remote Sensing Sensors Used for Water Resource Management Studies

Currently aircraft and spacecraft employ a whole range of sensors for collection of water resources information. Polar orbiting satellites, such as IRS, land sat, SoPT and other satellites have scanners to provide panchromatic and multi spectral information of varying spectral, spatial, and temporal and radiometric resolution. TheNoAA series of satellites in addition to weather related data provide terrain related information of use in snow studies, sea surface temperature, flood mapping and vegetation monitoring. Satellites such as ERS and Radarsat are carrying microwave instruments, like altimeter; scatter meter and synthetic aperture radar to study ocean and related phenomena.

Remote Sensing for Monitoring Water Availability

Remote sensing represents a very supportive tool in the following areas

1. Detection and monitoring of water bodies
2. Water volume estimation
3. Detection of potential ground water sites
4. Population estimation for water supply planning
5. Monitoring agricultural uses in the boundaries of the city for water supply planning
6. Estimating hydrological parameters like runoff, soil moisture and drainage network for estimating water availability.

Remote Sensing for Updating Water Infrastructure

Remote sensing techniques may represent an economic tool for supporting water infrastructure design and maintenance. Particularly, remote sensing is successfully used in different applications

1. Runoff estimation for supporting sewage system design
2. Geological studies for Dam construction
3. Monitoring urban expansion for updating the water supply and sewage systems

Remote Sensing for Monitoring Wastewater

Remote sensing provides an alternative means for obtaining relatively low cost spatial and temporal data about surface water condition from a large geographic area. landsat TM and MSS, Spot multi-spectral images, Air borne Imaging spectrometer AVIRIS can be used for detecting spatial and temporal variation in surface suspended sediments, organic yellow matter, chlorophyll and green algae and bacteria.

Remote Sensing for Monitoring Solid Waste Disposal

Solid waste is not efficiently collected and disposed off. Runoff and leaches can pollute and contaminate surface water and groundwater resources. Therefore, efficient and economic techniques are needed that allow water authorities to identify and monitor illegal dumping sites. Here remote sensing automatic classification techniques find a potential application to detect and monitor solid waste landfills (Karthiketeyan *et al.*,1993). It is to be noted that large landfills could not be resolved due to limited spatial resolution of current sensors.

Integration of SAR data and passive data represent an efficient alternative for increasing accuracy in the detection of landfills by combining high spatial resolution of SAR data with the spatial information contained in the optical remote sensing imagery.

Remote Sensing for Uncontrolled Extraction of Natural Resources

Remote sensing is an efficient tool to monitor environmental degradation. The use of change detection maps, generated by using multi temporal remotely sensed images, allows changes in landscapes to be identified and monitored. This information of land degradation, deforestation and desertification is used for identifying lakes, rivers or wetlands particularly exposed to mud-slides, sediment discharge or floods.

In particular, the main characteristics, which make remote sensing techniques suitable to support water resource management, are

1. Remote sensing data allows a wide variety of information concerning land and water to be extracted
2. Data can be obtained and analyzed with the necessary frequency.
3. A single remote sensing image covers all regions and provides information of the whole area.
4. Remote sensing technique avoids loss of data, or gaps in information.
5. Automatic remote sensing techniques reduce the possible human errors that can occur when manipulating large quantities of data.
6. The integration of remote sensing and GIS provides a very supportive tool for monitoring water resources in large and complex geographic areas.

Main Advantages of Integrated GIS and RS

1. An efficient GIS needs a continuous updating of the various data elements held in its system and RS is an important information source.
2. Remotely sensed data are the only data sources that make a real time information system possible.
3. RS benefits from access to highly accurate ancillary data, available in a GIS, for increasing classification accuracy.
4. RS techniques allow a wide variety of geological, hydrological and urban information to be extracted from imagery data.
5. The capabilities of GIS for displaying geographic information prove very supportive tools for decisions makers.
6. The integration of RS and GIS provide a solid basis for developing a shared database among all the different entities involved in the water management activities.

In this context, an efficient integration of both Geographic Information System and remote sensing data represent a powerful tool for management of water resources and support decision making of water resources experts.

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