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REVIEW OF RESERVOIR SEDIMENTATION, REMOTE SENSING AND GIS TECHNOLOGY

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ABSTRACT

Water is back-bone of socio-economical, industrial development of nation. Now-a-days demand of water for drinking, industry and food production reached at highest stage. Higher rates of urbanization accelerated demand of water and reservoirs. The imbalance between demand and supply of fresh water affects growth of nation. Water is a natural resource depends upon mood of climate so it is challenge front of the nation to use optimum available natural flows, the higher food production at lower rate of water consumption, development of the economical waste water treatments. Hence, the need of water leads to construction of reservoirs and maintenance of reservoirs.
Reservoir sedimentation is a natural phenomenon. The soil erosion is a natural process occurs in stream, nallas and in the river basin system. Such eroded soil settles down at live storage of reservoirs reducing the utilizable capacity. So, over a period of time, the entire reservoir must have to face a loss of storage potential because of silt load. So to overcome the threat of sedimentation one need to have knowledge about net storage available in the reservoir excluding the silt volume as well as irrigation scheduling. To determine net or live storage, there should be regular periodic sedimentation surveys of reservoir must be done. An integral element of water resources planning is periodic measurement of sediment rate, deposition pattern and net storage availability. This water resources planning and periodic review will promote optimum utilization. To guaranteed performance requires correct estimation of sediment deposit and its quantity and distribution in the entire body of the reservoir, because reservoirs are national assets aims for progress and development of nation.
The research primarily focuses upon problems of reservoir sedimentation and its consequences upon live storage capacity. This research will flash upon differences between conventional and advanced techniques of reservoir surveys and explain methods of managing reservoir sedimentation. The prime aim of research is to generate database for developing regional indices and rational sedimentation planning of future reservoirs. There are lots of methods which help to predict reservoir sedimentation such as Hydrographic survey, Satellite Remote Sensing Techniques etc. In this research major reservoirs in Maharashtra such as Jayakwadi, Ujjani, Koyana etc. has taken for assessment of reservoir sedimentation.

RESERVOIR SEDIMENTATION

Reservoir sedimentation is responsible for water resources management. All sorts of structures are concerned including large dams, fill or concrete dams, river barrages, power plants, locks, impounding dams and dykes. The aim to create reservoirs is storing water; other matters are carried along by the water and are usually deposited there. Other

applications of reservoirs are water supply, irrigation, energy & flood control. The reservoir can have its capacity decreased due to deposition over the years. In an extreme case, this may result in the reservoir becomes filled up with sediments, and the water flows over land again.
A natural reservoir silts up more or less rapidly. In actual fact, reservoirs may completely fill with sediments even within just a few years, whereas natural lakes may remain as stable features of the landscape for as much as 10'000 or 20'000 years after they were formed.
Dam construction investment on other side gets reduces the value or even nullified due to reservoir sedimentation. The use for which a reservoir was built can be sustainable or represent a renewable source of energy only where sedimentation is controlled by adequate management, for which suitable measures should be devised. Lasting use of reservoirs in terms of water resources management involves the need for desedimentation.
The planning and design of a reservoir require the accurate prediction of erosion, sediment transport and deposition in the reservoir. For existing reservoirs, more and wider knowledge is still needed to better understand and solve the sedimentation problem, and hence improve reservoir operation.

REMOTE SENSING

The definition of Remote Sensing says "obtaining information about an object, area or phenomenon without coming in direct contact with it." i.e. by some remote means. If we go by this meaning of Remote Sensing, then a number of things would be coming under Remote Sensor, e.g. Seismographs, fathometer etc.
Remote sensing by other means has been in use like without coming in direct contact with the focus of earthquake, seismograph can measure the intensity of earthquake. Likewise without coming in contact with the ocean floor, fathometer can measure its depth. However, modern Remote Sensing acquires information about earth's land and water surfaces by using reflected or emitted electromagnetic energy.
From the following definitions, we can have a better understanding about Remote Sensing:
According to White (1977), "Remote Sensing includes all methods of obtaining pictures or other forms of electromagnetic records of Earth's surface from a distance, and the treatment and processing of the picture data"
Remote Sensing then in the widest sense is concerned with detecting and recording electromagnetic radiation from the target areas in the field of view of the sensor instrument. This radiation may have originated directly from separate components of the target area, it may be solar energy reflected from them; or it may be reflections of energy transmitted to the target area from the sensor itself.
According to American Society of Photogrammetry, Remote Sensing imagery is acquired with a sensor such as electronic scanning, using radiations outside the normal visual range of the film and camera- microwave, radar, thermal, infra-red, ultraviolet, as well as multispectral, special techniques are applied to process and interpret remote sensing imagery for the purpose of producing conventional maps, thematic maps, resource surveys, etc. in the fields of agriculture, archaeology, forestry, geography, geology and others.
According to James B. Compel, "Remote Sensing is the practice of deriving information about the earth's land and water surfaces using images acquired from an overhead perspective, using electromagnetic radiation in one or more regions of the electromagnetic spectrum, Reflected or emitted from the earth's surface."

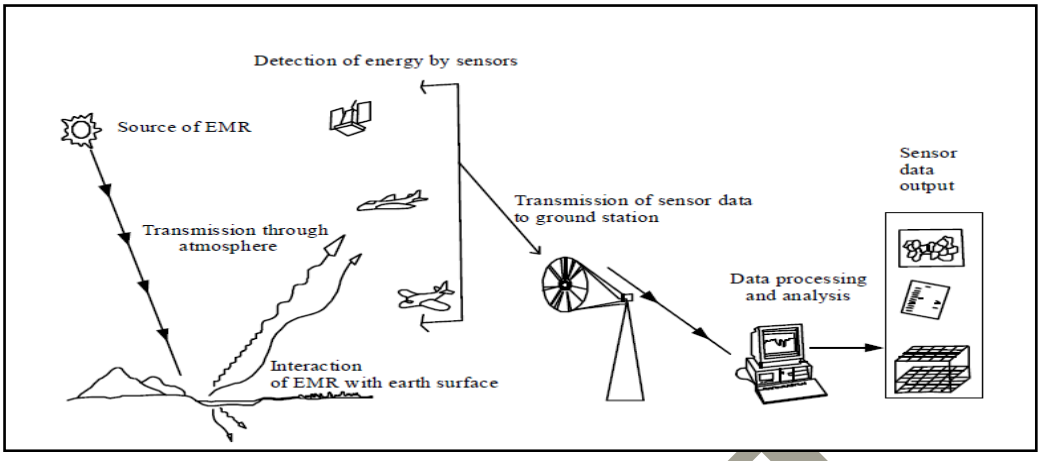

Fig. No.1 Remote sensing technology

LIMITATIONS OF THE SATELLITE REMOTE SENSING

- The Remote Sensing based capacity estimation, works between FRL and the minimum water level in the reservoir only. Thus changes can be estimated only in this zone of reservoir. For the capacity estimation below minimum water level in reservoir, other method like hydrographic survey is to be conducted.
- Availability of cloud free dates through reservoir operation period is the problem. Hence data from different year was selected
- Remote Sensing technique gives accurate estimation for fan shaped reservoir where there is a considerable change in water-spread area for incremental change in water level,
- Another source of general error lies in the identification of tail end of reservoir particularly, in rainy season.

GEOGRAPHICAL INFORMATION SYSTEM

The GIS is nothing but Geographic Information System which comprises of three words, viz. Geographic, Information and System.
Here the word 'Geographic' deals with spatial objects or features which can be referenced or related to a specific location on the earth surface. The object may be physical / natural or may be cultural / man made.
Similarly the word 'Information' deals with the large volume of data about a particular object on the earth surface. The data includes a set of qualitative and quantitative aspects which the real world objects acquire.
The term 'System' is used to represent systems approach where the complex environment is broken down into their component parts for easy understanding and handling, but is considered to form an integrated whole for managing and decision making this is possible in a very short span of time with the development of sophisticated computer hardware and software.
Hence, GIS is a computer based information system which attaches a variety of qualities and characteristics to geographical location and helps in planning and decision making.

A Geographic Information System (GIS) may be defined in different manners. International Training Centre (ITC), Holland defined Geographic Information System (GIS) as a "computerized system that facilitates the phases of data entry, data analysis and data presentation especially in cases when we are dealing with geo referenced data."
Indian Society of Geomatics (ISG) and Indian Space Application Centre (ISRO) defined GIS as a "system which provides a computerized mechanism for integrating various geo information data sets and analyzing them in order to generate information relevant to planning needs in a context."

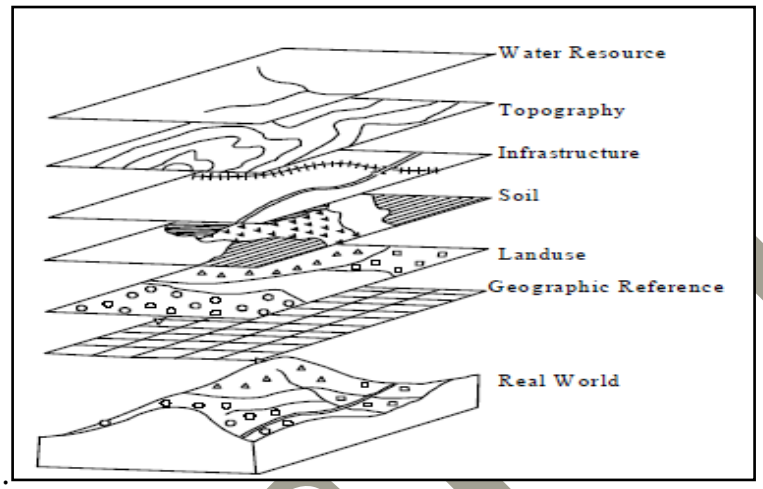

Fig.No.2 GIS

LITERATURE STUDY

U.C ROMAN S SREEKANTH KAMUJU NARASAYYA

Concluded that remote sensing is proved to be a useful tool to provide an instantaneous and synoptic view of suspended sediments in rivers and estuaries reservoir. In their paper a reservoir namely 'Panshet' a popular name 'Tanaji sagar' has taken for assessment of reservoir sedimentation. After adopted this procedure the loss in reservoir capacity due to sediment deposition for a period of 25 years (1975-2002) was estimated at 25.08 Mm3, which gives an average sedimentation rate of 1.00Mm3per year. The overall loss in the capacity is observed to be 8.25% of the total gross storage in 25 years. However, the comparison of deposition pattern of Panshet reservoir with the standard types of deposition pattern suggested by Borland and Miller indicated that the sediment deposition pattern in Panshet reservoir remained close to Type I during period 1977- 2002.

KAMUJU NARASAYYA, U C ROMAN, S. SREEKANTH AND SUNNETA JATWA

Described assessment of sedimentation carried out for the Srisailam Reservoir using Remote Sensing satellite imageries. The area capacity curve of year the 1976, when actual impoundment was started, is used as a base for sedimentation assessment for the year 2004. The results of Remote Sensing survey for the period 2001-04 are compared with the deposition pattern of Srisailam Reservoir with the standard types of deposition pattern as per Area Reduction Method suggested by Borland and Miller

S.R.MANDWAR, DR. H.V. HAJARE , DR. A.R.GAJBHIYE

Their Paper deals with the case study of Totla Doh dam for capacity evaluation and sedimentation. They also suggest necessity for planning the water use more effectively. The findings of their study has been summed up below.

Table No.1

Sr. no.	Details of the study	Reduction in Live storage	Period in Years.	Rate of Sedimentation
1	Between original capacity1982-83 and SRS 2002-03	46.181 Mm^3	20	2.31 Mm^3 / yr.
2	Between 1st SRS 2002-03 and 2nd SRS 2006-07.	18.514 Mm^3	4	4.63 Mm^3 / yr.
3	Between 2nd SRS 2002-03 and 3rd SRS 2006-07.	9.912 Mm^3	4	2.48 Mm^3 / yr.
4	Between original capacity 1982-83 and 3rd SRS 2006-07.	74.606 Mm^3	28	2.66 Mm^3 / yr.

V. JOTHIPRAKASH VAIBHAV GARG,

In their paper they focused on the ANN approach and it was employed for estimation of the sedimentation in Gobindsagar Reservoir on a yearly basis. It was found that the sedimentation amount was well estimated by the feed forward 3-5-1 ANN model with *sigmoid* activation function and RP as the learning rule. A need to create large databases in India, for improving ANN models for sediment yield estimation and prediction, is also apparent from their work.

J. SCHLEISS G. DE CESARE AND J. JENZER ALTHAUS

Their investigations showed that turbidity currents can be influenced effectively by properly designed constructive measures. After the discussion of reasons and problems of reservoir sedimentation, possible measures against sedimentation are presented. Then some examples of application of mitigation measures against turbidity currents are given together with design recommendations.

DR. PUNYATOYA PATRA

Has emphasized on use of Remote Sensing and GIS also they stated that Remote sensing and GIS are integral to each other and the development of Remote Sensing is of no use without the development of GIS and vice versa. Remote Sensing has the capability of providing large amount of data of the whole earth and also very frequently. GIS has the capabilities of analyzing a large amount of data within no time. These voluminous data would have become useless without the development of GIS. Manual handling of one time remote sensing data would take years together, by the time a number of multi date data would have piled for analysis.

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SANJAY K. JAIN, PRATAP SINGH

In their study they used a remote-sensing approach for assessment of sedimentation in Bhakra Reservoir, located on the Satluj River in the foothills of the Himalayas. Multi date remote sensing data provided the information on the water-spread area of the reservoir, which was used for computing the sedimentation rate. The revised capacity of the reservoir between maximum and minimum levels was computed using the trapezoidal form ula. The loss in reservoir capacity due to deposition of sediments for a period of 32 years (1965-1997) was

determined to be 807.35 Mm', which gives an average sedimentation rate of 25.23 Mm' year"1. The average rat£ of sedimentation using hydrographic survey data for the same period was 20.84 Mm' year"1. A comparison of the results showed that the rate of sedimentation assessed using the remote sensing based approach was close to the results obtained from the hydrographic survey.

SUMMARY

Remote sensing has the capability of providing large amount of data of the whole earth & also very frequently. GIS has the capabilities of analyzing a large amount of data within no time. The development of Remote sensing is of no use without of GIS & vice versa. By using these two methods I will collect the data of sedimentation in the Ujjani reservoir.

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