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GROUND WATER RECHARGE EVALUATION USING SATELLITE DATA

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ABSTRACT

For optimal planning of water resources developmental activities accurate assessment of water resources is very essential. Land with all its various features viz., soil, land cover, geology, topography, climatic factors etc. are influencial to water resources. Decision making must reconcile a complex array of often conflicting issues. Hence large data set is required. Conventional method of data collection are not only uneconomical and difficut, but by the time information could be compiled they are out dated. Remote sensing techniques provide basic data bank which can be organised and controlled in near real time. In the paper an approach has been put forth for evaluation of ground water recharge and storage available for development using satellite data. The results compare well with observed data.

INTRODUCTION

Optimal use of water resources is essential for meeting the growing need of the country. In order to meet ever increasing demand of water keeping a breast with development adequate time and cost effective method for assessment of water resources has to be developed. Water resources of a region is influenced by climatic and catchment characteristics. One of the problem that plays an important role in many projects is uncertainity of representativeness of data. Hydrologic processes are space time phenomena, whereas measurement is a point phenomena. Conventional method of data collection is very expensive and provides the information with time lag. As a result planning is generally based on questionable data. Satellite data have capability of providing synoptic coverage as well as point definition. Information available from satellite and required for hydrologic study are different. A qualitative or quantitative correlation study may be carried out.

APPLIED ASPECTS

Satellite data can be utilised for describing inter relationship between landscape factors and hydrological processes. A methodology considering the integrated effect of all the parameters has to be developed for water resources evaluation. Parameter evaluation by specialists of those fields may not serve the purpose optimally, as it will take more time, much of the data will be superflouous and more over translating various surveys in hydrological sense is still left. In search of useful hydrologic data, in data scare or non existant areas an approach has to be developed whereby indirect hydrologic data obtained by satellite can be utilised.

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Requirement of Remotelysensed Data

Choice of proper remotelysensed data plays an important role regarding quality and cost of work. Black and white photoproducts are used for general purpose and topographical mapping. C and CIR photoproducts are used for identification of soils, rockout crops, vegetation and subsurface exploration commonly adopted scale is 1:50,000 with the advent of satellite data collection system, generally used scale is 1:250,000 and commonly used procedure is to analyse satellite derived information and then results are compared with sample study on aerial photographs. Reliability of aerial photographic interpretation has to be tested by some ground surveys.

MATHEMATICAL MODELLING

Landcover is influenced by Geological, Meteorological and other landscape parameters. As such landcover is a dynamic parameter and hence effect of these parameters on coefficient of recharge will change from time to time. Let l_{ij} is land cover of jth type under influencing zone of ith hydrographic station, p_i is the depth of precipitation at i^{th} station and r_j is the coefficient of recharge, Ground water contribution GWC, can be equated as

$$GWC = p_i l_{ij} r_j$$

$$\frac{GWC}{p_i} = l_{ij} r_j$$

In matrix notation it can be written as

$$S = LR$$

where S is a column vector, having n values as GWC/p_i, L is n x m landcover system matrix and R is rainfall recharge matrix. If L is non singular square matrix, its unique inverse as L^{-1} and solution for R can be written as

$$R = L^{-1} S$$

If L is nonsingular rectangular matrix, then solution can be obtained as under

$$R = (L^T L)^{-1} L^T S$$

PROPOSED STEPS FOR DATA ANALYSIS

(1) Evaluation of Geological, Geomorphical, pedological and botanical parameters using remotelysensed data

(2) Consolidation and synthesis of interpreted results, existing climatological and hydrological data

(3) Field work for checking of interpreted results and collection of hydrological data

(4) Revision if any of the interpreted results. Correlation of interpreted data and hydrological field data

(5) Hydrological description

ANALYSIS OF DATA AND RESULTS

Meteorological, well data and other related data has been collected. Landcover map of the study area has been prepared using band 5 and 7 satellite imagery blow up at 1:250,000 scale. The map was taken to the field and checked and revised and finalised.

From the available raingauge stations, Thiessen Polygon was drawn, from these Thiesen polygon land cover system matrix has been evaluated. The landcover of the area consists of forest, intensively agricultural moderately agricultural and bare land. A computer program has been developed for proposed model. Recharge coefficient for forest, intensively agricultural, moderately agricultural and bare land has been evaluated as 16, 30, 36, 45% respectively, using 11 years data w.e.f. 1972 to 1982.

Using these recharge rates, dynamic ground water storage has been evaluated as 112.58 MCM whereas by observed ground water fluctuation method it is 120.90 MCM.

CONCLUSIONS

Results of the study indicates that remote sensing techniques can be used for ground water evaluation. Quantitative and qualitative information can be obtained from remotelysensed data. Some ground truth is definitely required for precise work. The technique mentioned above can be suitably used for planning purposes.

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