SYSTEM STUDIES FOR REGIONAL ENVIRONMENTAL RESOURCES PLANNING IN A DEVELOPING ECONOMY

By

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CERTIFICATE

This is to certify that the thesis entitled, 'SYSTEM STUDIES FOR REGIONAL ENVIRONMENTAL RESOURCES PLANNING IN A DEVELOPING ECONOMY' being submitted by Mr. B.N.Asthana to the Indian Institute of Technology,Delhi,India, for the award of the degree of DOCTOR OF PHILOSOPHY, is a record of bonafide research work carried out by him under my supervision and guidance. The thesis work, in my opinion, has reached the standard, fulfilling the requirements for DOCTOR OF PHILOSOPHY degree. The research report and the results presented in this thesis have not been submitted, in part or in full, to any other University or Institute, for the award of any degree or diploma.

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ABSTRACT

Land and water are the two environmental resource of a region and the two together form the basic system for agriculture. Water is a major input for other sectors of economic growth also besides agriculture and an appropriate methodology for planning would be an intersectional iterative process, which is a time consuming exercise. In developing countries emphasis is on agriculture because it provides food and fibre, employment to large section of the labour force, and contributes the maximum to the total economy. In this situation planning water resource for agriculture sector only would not be inappropriate. In this context following interrelated policy issues regarding regional land-water availability and utilisation over a period of time have been investigated.

(i) What should be the policy in respect of irrigation under water deficit conditions.

(ii) What should be the trajectory of development to meet the requirements of agriculture, employment and environment over period of time.

(iii) What should be the technological choices for water resources development and management in this context.

(iv) To what extent the intra-regional water transfers can help in improving regional economy and/or reducing intra-regional economic imbalances.

The problem has been attempted through decomposition approach of Large Scale System Analysis. The system is decomposed into subsystems so that there is minimum interdependence and interaction between the subsystems. These subsystems are optimised independently and integrated to optimise

the system as a whole both through heuristic multilevel optimisation in terms of shadow price based incremental marching process and using Langrangian Multipliers.

A simple and easy to run LP multiresource - multiperiod - multi-irrigation level model has been developed. It is modified under multi-objective framework using constraint method. The chance constrained approach is used to study the effect of variability of surface flows. The study is divided into two parts. The first part deals with subsystem policy studies which investigates through thought experiments, the issues such as cropping pattern, level of irrigation, limit on monthly ground water draft, mandatory downstream releases, change in water price, change in return value of crops, variable surface water availability, impact of water management activities, multiobjective trade off etc. The second part deals with regional policy studies in which whole system is optimised in terms of intra-regional water transfer and a transformation curve is developed between economic efficiency and equity.

The applicability of the methodology developed is illustrated in a part of greater Ganga Basin. Results obtained for the region may not be of general applicability as these depend on the present status of development of the region. However, the study contributes to the methodology and shows that the generation of techno-economic data regarding various inter-related policy issues, through thought experiments with the help of mathematical framework of analysis, could be helpful to the real life planners in getting an insight of system's behaviour under changing conditions and in furthering their creative thinking.

TABLE OF CONTENTS