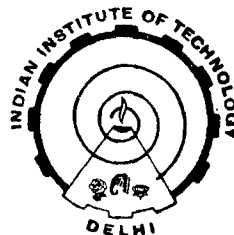


**SYSTEM STUDIES FOR REGIONAL ENVIRONMENTAL  
RESOURCES PLANNING IN A DEVELOPING  
ECONOMY**

By

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A thesis submitted to the  
Indian Institute of Technology, Delhi  
for the award of the degree of  
DOCTOR OF PHILOSOPHY



CENTRE FOR SYSTEMS AND MANAGEMENT STUDIES  
INDIAN INSTITUTE OF TECHNOLOGY, DELHI

1984

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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ACKNOWLEDGEMENT

The author is extremely grateful to Dr. M.C. Chaturvedi, Professor, Applied Mechanics Department, Indian Institute of Technology, Delhi, for encouraging him to work in this interesting field of research. His continued guidance and help at every stage has enabled this investigation to achieve the present form and status.

The author is obliged to the authorities of the Government of Uttar Pradesh, Irrigation Department of Uttar Pradesh and the Ford Foundation for providing him an opportunity to work for this training and research project of U.P. -Ford Foundation.

The author is also grateful to the faculty of the centre for Systems and Management Studies, the Computer Centre who helped him in more ways than one to complete this work and Shri Satish Chopra for typing the thesis.

The list of acknowledgement would be voluminous considering the kind cooperation and help the author has received from various departments, organizations, colleagues, friends and his family. He wishes to acknowledge the contribution made by all of them.

  
( B.N. ASTHANA )

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

	Page	
CERTIFICATE	i	
ACKNOWLEDGEMENT	ii	
ABSTRACT	iii	
TABLE OF CONTENTS	v	
LIST OF TABLES	ix	
LIST OF FIGURES	xii	
CHAPTER		
I	INTRODUCTION	1
	1.1 Rationale for Water Resources Planning	1
	1.2 Issues in Water Resources Planning	4
	1.3 Rationale for Systems Approach and Regional Planning	7
	1.4 Objective of the Study	9
	1.5 Methodology	10
	1.6 Scope	11
	1.7 Limitations	12
	1.8 Overview	13
2	LITERATURE SURVEY	15
	2.1 Methodologies for Large Scale System Analysis	15
	2.1.1 Background	15
	2.1.2 Programming Approach	16
	2.1.3 Principles of Decomposition	17
	2.2 System Studies for Regional Planning of Water Resources	20

	2.3	A Review of Studies	24
3		PROBLEM APPROACH AND MODEL DEVELOPMENT	28
	3.1	First Level Study - Subsystem Policy Study	35
	3.1.1	The Model	40
	3.2	Second Level Study - Regional Policy Study	46
4		THE SYSTEM	52
	4.1	Location and Physiography	54
	4.2	Climate	55
	4.3	The Rainfall	55
	4.4	Droughts and Floods	57
	4.5	Land Use	57
	4.6	Water Resources	57
	4.6.1	Surface Water	61
	4.6.2	Ground Water	61
	4.7	Water Utilisation	64
	4.8	Projected Demands	66
	4.8.1	Population Projection	68
	4.8.2	Food Requirement Projection	69
	4.8.3	Land and Agriculture	71
	4.8.4	Water Demand	73
	4.9	Issues in Water Availability and Utilisation Over time	75
5		RESULTS AND DISCUSSION - SUBSYSTEM STUDIES	78
	5.1	Ganga - Yamuna Subsystem	80

5.1.1	Study 1 - Crop Pattern	82
5.1.2	Study 2 - Choice of Irrigation Technology	85
5.1.3	Study 3 - Limiting Maximum Use of Ground Water in a Month	86
5.1.4	Study 4 - Downstream Releases	93
5.1.5	Study 5 - Price of Water	94
5.1.6	Study 6 - Return Value of Crops	104
5.1.7	Study 7 - Variable Surface Flows	112
5.1.8	Study 8 - Future Technological Choices and Trajectory for Water Resources Development - 1990 AD.	116
5.1.8.1	Ground Water Development	117
5.1.8.2	Increase in Canal Capacities	121
5.1.8.3	Combination of Ground Water Development and Increase in Canal Capacities	121
5.1.8.4	Water Management Activities	124
5.1.8.5	Water Resource Development Trajectory - 1990	130
5.1.9	Study 9 - Planning for the Year 2000 AD	131
5.1.9.1	Ground Water Development and Water Management Activities	133
5.1.9.2	Storage Reservoirs	136
5.1.9.3	Food Production and Employment	138
5.1.9.4	Limitation on Monthly Use of Ground Water	142
5.1.9.5	Storage Release Pattern	144
5.1.10	Study 10- Multiobjective Analysis	144
5.1.10.1	Downstream Release from Environment Consideration	144

	5.1.10.2	Cereals Requirement and Production	145
	5.1.10.3	Employment	148
5.2		Ganga - Ramganga Subsystem	148
	5.2.1	Study 1 - Crop Pattern Under Existing Conditions	153
	5.2.2	Study 2 - Future Technological Choices and Trajectory for Development - 1990 AD	155
	5.2.3	Study 3 - Planning for the Year - 2000 AD	158
5.3		Ganga - Ramganga - Ghagra Subsystem	160
	5.3.1	Study 1 - Crop Pattern under Existing Conditions	163
	5.3.2	Study 2 - Future Technological Choices and Trajectory of Development 1990 AD	165
	5.3.3	Study 3 - Planning for the Year 2000 AD	168
6		SUBSYSTEMS COORDINATION STUDIES	174
	6.1	Heuristic Coordination	176
	6.2	Trade off Between Economic Efficiency and Equity	176
	6.3	Langrangian Multiplier	179
7		SUMMARY AND CONCLUSION	183
	7.1	The Summary	183
	7.2	The Conclusions	184
	7.3	The Contributions	188
	7.4	Recommendations for Further Extension	189
		REFERENCES	191
		APPENDIX	197