

NATIONAL SYMPOSIUM ON HYDROLOGY

DECEMBER 16-18, 1987

**PROCEEDINGS
VOLUME - I**



**NATIONAL INSTITUTE OF HYDROLOGY
ROORKEE**

SPONSORED BY

High Level Technical Committee on Hydrology (HILTECH)

CO-SPONSORED BY

Indian Association of Hydrologists (IAH)

U. P. Irrigation Department

ORGANISED BY

National Institute of Hydrology, Roorkee-247 667 (U.P.)

COPY RIGHT : National Institute of Hydrology, Roorkee

The Organising and the Technical Committee of the Symposium and the publishers are not responsible for the statements or opinions expressed by the authors in this publication.

NATIONAL ADVISORY COMMITTEE

Sri M.A. Chitale Chairman, Central Water Commission & Chairman, HILTECH, New Delhi	Chairman
Sri G.S. Jhakade Member (WP) Central Water Commission, New Delhi	Member
Dr. N.C. Mathur Vice Chancellor University of Roorkee, Roorkee	Member
Dr. R.P. Sarkar Director General India Meteorological Department, New Delhi	Member
Dr. Satish Chandra Director National Institute of Hydrology, Roorkee	Member
Dr. D.K. Dutt Chairman Central Ground Water Board, New Delhi	Member
Sri Paritosh Tyagi Chairman Central Board for Prevention and Control of Water Pollution, New Delhi	Member
Dr. M.N. Qureshy Advisor (ES) Department of Science and Technology, New Delhi	Member
Sri J.F. Mistry Secretary (Irrigation) and President, Indian Association of Hydrologists (IAH), Gandhinagar	Member
Sri R. Chikkanna Secretary Public Works & Irrigation Department, Bangalore	Member
Dr. R.S. Varshney Engineer-in-Chief U.P. Irrigation Department, Lucknow	Member
Secretary Irrigation & Waterways Department, Calcutta	Member

ORGANISING COMMITTEE

1. Dr. Satish Chandra
Director
National Institute of Hydrology
Roorkee
Chairman
2. Sri D.N. Bhargava
C.E. (Design) and Director
U.P. Irrigation Research Institute
Roorkee
Member
3. Dr. B.B.S. Singhal
Professor and Head
Department of Earth Sciences
U.O.R., Roorkee
Member
4. Dr. A.S. Chawla
Director, WRDTC
U.O.R., Roorkee
Member
5. Dr. B.S. Mathur
Professor and Head
Department of Hydrology
U.O.R., Roorkee
Member
6. Sri U.S. Rajvanshi
Superintending Engineer
U.P. I.D., Roorkee
Member
7. Dr. S.M. Seth
Scientist 'F'
NIH, Roorkee
Member
8. Dr. G.C. Mishra
Scientist 'F'
NIH, Roorkee
Member
9. Dr. P.V. Seethapathi
Scientist 'F'
NIH, Roorkee
Member
10. Dr. K.K.S. Bhatia
Scientist 'E'
NIH, Roorkee
Member

11.	Representative of CWC		Member
12.	Representative of IMD		Member
13.	Dr. R.K. Prasad CGWB, New Delhi		Member
14.	Dr. G.N. Yoganarasimhan Professor, WRDTC U.O.R., Roorkee	Convenor, Souvenir Sub-Committee	Member
15.	Shri B.P. Parida Scientist 'E' NIH, Roorkee	Convenor, Meeting Hall Sub-Committee	Member
16.	Dr. Ranvir Singh Reader, Department of Hydrology U.O.R., Roorkee	Convenor, Transport Sub-Committee	Member
17.	Dr. R.P.S. Chhonkar Scientist 'E' NIH, Roorkee	Convenor, Catering Sub-Committee	Member
18.	Sri R.C. Chopra Finance Officer NIH, Roorkee	Convenor, Finance Sub-Committee	Member
19.	Shri Himanshu Joshi Sc. 'C', Department of Civil Engg. U.O.R., Roorkee	Convenor, Cultural Sub-Committee	Member
20.	Dr. D.C. Singhal Reader, Department of Hydrology U.O.R., Roorkee	Secretary, IAH	Member
21.	Sri K.S. Ramasastry Scientist 'E' NIH, Roorkee	Convenor, Reception Sub-Committee	Member
22.	Sri V.K. Lohani Scientist 'C' NIH, Roorkee		Organising Secretary

TECHNICAL COMMITTEE

1. Sri D.N. Bhargava
Director
U.P. Irrigation Research Institute
Roorkee
Chairman
2. Dr. A.S. Chawla
Director
W.R.D.T.C.
University of Roorkee
Roorkee
Member
3. Dr. B.S. Mathur
Professor and Head
Department of Hydrology
University of Roorkee
Roorkee
Member
4. Dr. S.M. Seth
Scientist 'F'
National Institute of Hydrology
Roorkee
Member
5. Dr. G.C. Mishra
Scientist 'F'
National Institute of Hydrology
Roorkee
Member
6. Dr. R.K. Prasad
S.E. (I)
Central Ground Water Board
Faridabad (Haryana)
Member
7. Sri S.D. Kulkarni
Director (Hydrology-South)
Central Water Commission
New Delhi
Member
8. Sri J.K. Sharma
Meteorologist
India Meteorological Department
New Delhi
Member
9. Sri V.K. Lohani
Scientist 'C'
National Institute of Hydrology
Roorkee
Organising
Secretary

PREFACE

Water is a vital natural resource, basic human need and a precious national asset. The full life history of water on the earth is covered under the domain of hydrology. The hydrologic investigations and studies form an important component of water resources development. With the increasing demand of water in various sectors, it has become essential to formulate plans for judicious utilisation of water resources. The frequent disasters like droughts and floods have additionally contributed to lay more emphasis on proper assessment, development and management of water resources of country, for which hydrologic investigations play a key role.

At the 7th session of the Intergovernmental Council (IGC) of the UNESCO's International Hydrological Programme (IHP) held during June, 1986 in Paris, France, it was decided that each member country should arrange to organise one National Symposium on Hydrology every year in respective countries to bring together hydrologists, water resources engineers and allied professionals to report results, exchange ideas and for mutual interaction for better planning, assessment and development of water resources. Keeping this in view, the National Committee on Hydrology (HILTECH), which has the primary responsibility to coordinate hydrological activities in the country, has decided to hold a Symposium every year. To start with, the National Institute of Hydrology, which is the apex body of Government of India to conduct studies in theoretical and applied aspects of hydrology, has been given the responsibility to organise the first such Symposium which is being held from December 16-18, 1987 at Roorkee. This also marks the celebrations of the 10th Foundation Day of the Institute. A very good response from professionals of various disciplines has been received and 64 papers under 8 different themes will be presented and discussed in this Symposium.

It is expected that this Symposium would provide for useful exchange of ideas and information, and definite recommendations would emerge for development and efficient management of water resources of our country.

SATISH CHANDRA

Director

National Institute of Hydrology,

Roorkee-247 667 (U.P.)