

annual report
1989-90

national
institute of hydrology





**Director Addressing Employees on
Republic Day on 26th January 1990 at Roorkee**



Front view of the Institute

ANNUAL REPORT
1989-90



NATIONAL INSTITUTE OF HYDROLOGY
ROORKEE

PREFACE

During the year under report, studies and research have been conducted covering various aspects of hydrology, as per the approved work programme for the year under the 14 problem oriented scientific divisions. Significant progress has been made and some of the important studies conducted include (i) Flood frequency analysis (ii) study of moving storms in Krishna basin (iii) Spring flow study (iv) Flood routing models (v) Snowmelt studies (vi) Water balance of lakes (vii) Design of drainage systems (viii) Soil salinity (ix) Modelling of hydrological response of land use changes using SHE Model (x) SHE Model application to various subbasins of Narmada basin (xi) Soil moisture movement (xii) Environmental impact assessment (xiii) Ground water assessment in hard rock (xiv) Hydrological aspect of drought (xv) Water quality and (xvi) Atmospheric land surface process modelling.

Based on the studies conducted, the Institute brought out 43 reports in the form of technical reports, technical notes, user's manuals and case studies. These reports are being widely circulated to State and Central Government organisations. The Institute has been very active in technology transfer by organising short duration workshop on Ground water modelling; Processing & Analysis of Precipitation data; Flood routing and flood forecasting; Flood estimation by unit hydrograph techniques; Application of SHE model to subbasins of Narmada River and Modelling of Hydrological Systems. Special emphasis was laid on transfer of computer software and making them operational on available computers in the states. During the year eight workshops were organised; three in Roorkee, one each in Hyderabad, Madras, Bhopal, Srinagar and Guwahati. The feed back received from these workshops is very encouraging and helped in creating awareness for use of modern techniques amongst engineers.

The scientists of the Institute are encouraged to participate in seminars and symposium, present papers and participate in discussions. The scientists have participated in a number of seminars and symposium and have contributed to technical literature through publication of papers in National and International journals and proceedings of seminars and symposia. The Institute organised a Regional Workshop on 'Modelling of Hydrologic Systems' at Roorkee from Jan 29-Feb. 9, 1990 supported by UNESCO. The Institute also organised a scientific expedition to Kolhai Glacier (J & K) with collaboration of Irrigation and Flood control dept. (J & K), Survey of India, Dehradun for 15 days period. Two scientists participated in the expedition and collected the data related to glacier melt, sediment transport, pH value of melt water and Max. & Min. temp. Third National Symposium on 'Hydrology' with special reference to Man's Influence on Surface Runoff is being organised by the Institute in July 1990 at Pune in collaboration with CWPRS and State Irrigation Dept.

The work programme of the Institute has been diversified to cover field and laboratory oriented studies besides the computer oriented work. The laboratories of remote sensing applications, water quality, ground water, hydrological investigations and the service instrumentation facilities

and workshop were strengthened by adding more equipment. Some equipments have been imported to make the laboratory modern. Some of the major equipment procured during the year are Gas Chromatograph and paint Jet plotter procured under the SHE model project. VT Terminal and personal computers have been procured and software are being developed for transfer to the States.

The Automatic Hydrologic Station, procured under the UNDP project has been successfully installed, during the year by the Gujarat Communication and Electronics Limited, Vadodara and is operational now.

The need for improvement of hydrological practices and activities in different parts of the country has been given due emphasis in the programme of activities of the Institute. Interaction and collaboration with the States forms an essential part of this programme and contacts have been established through visit and correspondence with several states. The Institute has emphasised with the States the establishment of hydrological units to enable a very effective interaction with the States. The response from the states is encouraging and some states have already planned their programme of establishment of hydrological units. Realising the difference in climate, geology, land use, soil and environmental conditions leading to typical hydrological conditions in different regions, the Institute has divided the country into 7 regions and planned to establish seven regional centres. During the seventh plan period 3 regional centres have to be established. The regional centre for Deccan Hard Rock region has been established in Belgaum and is operational with skeleton staff. The regional centre for the North-Eastern Mountainous Region was established at Guwahati during the year 1988 for which the Assam State has provided an Inspection house as temporary accommodation for the centre. The regional centre for North-Western Himalayan Region was established at Jammu in January 1990. Besides conducting hydrological studies for the regions at the regional centres, atleast one representative basin with appropriate instrumentation would also be established in each region. The data collected from these basins over an extended period would be used to develop model parameters applicable to that region.

During the year under EEC/GOI project on transfer of hydrological computerised modelling system (SHE), three scientists have been trained under the project and studies have been completed for three subbasin of Narmada basin. Simulation studies were carried out using data of subbasins of Narmada basin. The project is being financially supported by European Economic Community in agreement with Govt. of India. A number of project for international cooperation are with the Ministry at different stages. These project involve scientific collaboration with the Netherlands, West Germany, Japan, USSR and USA.

The Institute is presently involved in consultancy projects referred to the Institute from the Central and State Government Organisations. During the year four consultancy projects related to Water accounting studies in 7 problem districts, Machhu Reservoir Operation studies, Flash flood studies of Bist Doab region and Dharoi reservoir operation studies are progressing satisfactorily.

The Indian National Committee on Hydrology (INCOH) Secretariat which is attached to the institute and integrated with it, has continued to be active during the year. One meeting of INCOH, eight meetings of the panels, four meetings of sub-committees were held during the year. A delegation of INCOH participated in the ninth session of the intergovernmental council

of the IHP of Unesco during 1989 at Paris, Eleven seminar/symposia/workshops and one research project were sponsored and funded by INCOH. Two issues of the Jalvigyan Sameeksha were also brought out.

The ARCCOH Secretariat as a part of INCOH Secretariat functioned well during the year and third volume of the directory of hydrologists of ARCCOH region are under finalization. The quarterly ARCCOH Newsletters have been brought out and circulated to the various member countries of the region.

During the year, extension of lab. block has been completed. Construction of museum-cum-recreation centre and addition to laboratory block are at advanced stage of construction and is expected to be completed during next financial year. Due to non availability of land from U.P. Government, the construction of staff colony could not be started.

The National Institute of Hydrology has constituted the National Hydrology Award to be given to any Indian Engineer, Technologist or Scientist working in the area of Hydrology or those who have made significant contributions for promotion of hydrology over the years in the subject area of the award. The topic of the award for 1988 was decided as FLOOD. Nominations for the award were invited. The meeting of the Judging Committee for deciding the awards will be held soon.

The National Institute of Hydrology has also instituted a 'BHARAT SINGH AWARD' biennially in honour of Professor Bharat Singh, Ex-Vice Chancellor, University of Roorkee, Roorkee through an endowment amount provided by M/s Hoysala Group of companies, Bangalore with the objective of providing incentives and encouragement for simulating outstanding original research, organisation and promotion of research activities in the area of Hydrology in the country. Nominations for the award for the year 1988 were invited. The report of trust board is still awaited.

The Institute has, therefore, continued to proceed in the right direction towards the fulfilment of the objectives for which the Institute has been established. The studies and research and other programmes of the Institute have made significant progress and impact.

SATISH CHANDRA
DIRECTOR

CONTENTS

	Page No.
1.0 INTRODUCTION	
1.1 General	1
1.2 Objectives	1
1.3 Work Review	2
2.0 ORGANISATION AND MEETINGS	
2.1 Society	5
2.2 Governing Body	5
2.3 Technical Advisory Committee	5
2.4 Working Groups	6
2.5 Coordination Committee	6
2.6 Indian National Committee on Hydrology (INCOH)	6
2.7 Asian Regional Coordinating Committee on Hydrology (ARCCOH)	7
2.8 Institute Personnel	7
3.0 RESEARCH AND DEVELOPMENT & CONSULTANCY	
3.1 General	10
3.2 Studies and Research Activities	14
3.2.1 Hydrologic Design	14
3.2.2 Surface Water Analysis & Modelling	16
3.2.3 Flood Studies	16
3.2.4 Mountain Hydrology	17
3.2.5 Ground Water Assessment	18
3.2.6 Conjunctive Use	19
3.2.7 Drainage	20
3.2.8 Drought Studies	20
3.2.9 Water Resources System	22
3.2.10 Man's Influence	22
3.2.11 Information System	24
3.2.12 Hydrological Investigation	25
3.2.13 Atmospheric Land Surface Modelling	25
3.3 Consultancy Projects	26
3.4 Participation in Seminar/Symposium & Papers published	29

4.0 FACILITIES

4.1	Building and Infrastructural	—	30
4.2	Maintenance	—	30
4.3	Laboratories	—	30
4.3.1	Water Quality Laboratory	—	30
4.3.2	Ground Water Laboratory	—	31
4.3.3	Hydrological Instrumentation Laboratory	—	31
4.3.4	Hydrometeorological Observatory	—	31
4.3.5	Automatic Hydrologic Station	—	31
4.3.6	Laboratories of Regional Centre	—	33
4.4	Central Service Facilities	—	33
4.4.1	Drawing Section	—	33
4.4.2	Duplicating and Photocopying Section	—	33
4.5	Central Technical Facilities	—	33
4.5.1	Computer Centre	—	33
4.5.2	Remote Sensing Applications & Photographic Laboratory	—	34
4.5.3	Workshop and Service Instrumentation Unit	—	34
4.6	Library	—	34

5.0 REGIONAL PROGRAMMES

5.1	Interaction with States	—	36
5.2	Regional Centres	—	36
5.2.1	Deccan Hard Rock Region at Belgaum	—	36
5.2.2	North-Eastern Regional Centre at Guwahati	—	40
5.2.3	North-Western Himalayan Regional Centre at Jammu	—	41
5.3	Transfer of Technology	—	41
5.3.1	Workshops Organised	—	41
5.3.2	Regional Workshop on Modelling of Hydrology Systems	—	41

6.0 INDIAN NATIONAL COMMITTEE ON HYDROLOGY (INCOH)

6.1	Meeting of INCOH	—	43
6.2	Panels and their meetings	—	44
6.3	Sub-Committee and their meetings	—	44
6.4	Indian Delegation to Various International meetings	—	44
6.5	Support to Research Projects/Seminars/Courses	—	45

6.6	Publications	—	46
6.7	Yearwise activities of INCOH	—	46
6.8	Activities of Asian Regional Coordinating Committee on Hydrology (ARCCOH)	—	46
7.0	EXTERNAL ASSISTANCE		
7.1	NIH/DHI Project on Transfer of 'Hydrological Computerised Modelling System, (SHE) Financed by CEC	—	48
7.2	Scientific and Technical Cooperation with USSR	—	50
7.3	International Cooperation with The Netherlands	—	50
7.4	UNDP Project on 'Developing Capabilities for Hydrological Studies'	—	50
7.5	Projects for bilateral cooperation Programmes	—	51
8.0	PUBLICITY		
8.1	Water Resources Day	—	52
8.2	Water Conservation	—	52
8.3	Newsletters	—	53
9.0	MISCELLANEOUS		
9.1	Hindi Week	—	54
9.2	Use of Hindi	—	54
9.3	Quami Ekta Week	—	54
9.4	Recreation and Welfare Activities	—	54
9.5	Hydrology Terminology	—	54
9.6	Independence Day/Republic Day Celebration	—	55
9.7	Awards	—	55
9.8	Visitors	—	56
10.0	FINANCE AND ACCOUNTS	—	57
11.0	ACKNOWLEDGEMENTS	—	59

AT A GLANCE

IMPORTANT STUDIES

Research and studies have been carried out covering various aspects of hydrology under the 14 problem oriented scientific divisions. Some of the important studies conducted during the year includes (i) Flood frequency analysis (ii) Study of moving storms in Krishna basin (iii) Spring flow study (iv) Flood routing models (v) Snow melt studies (vi) Water balance of lakes (vii) Soil salinity (viii) Design of drainage systems (ix) Modelling of hydrological response of land use changes using SHE Model (x) SHE model application to various subbasins of Narmada basin (xi) Soil moisture movement (xii) Environmental impact assessment (xiii) Ground water assessment in hard rock (xiv) Hydrological Aspect of drought (xv) Water quality and (xvi) Atmospheric land surface process modelling.

INDIAN NATIONAL COMMITTEE ON HYDROLOGY (INCOH)

One annual meeting of INCOH, eight meetings of the panels and four meetings of sub-committee were held during the year. Eleven seminars/symposiums, workshops and one research project were sponsored and funded by INCOH. Two issues of Jalvigyan Sameeksha and quarterly ARCCOH Newsletter have been brought out and circulated to various central/state govt. organisations and to the various member countries of the region.

ESTABLISHMENT OF LABORATORIES AND IMPROVEMENT OF COMPUTER FACILITIES

During the year, extension of laboratories block has been completed. The construction of museum-cum-recreation centre and addition to lab block are at advanced stage of construction. Some of the major equipment procured during the year are Gas Chromatograph and paint jet plotter. VT terminal and personal computers have also been procured.

TECHNOLOGY TRANSFER

The Institute has been very active in transfer of technology by organising several workshops on various topics namely processing and analysis of precipitation data, ground water modelling, flood routing and flood forecasting, unit hydrograph and application of SHE model to Narmada basin.

The Institute also organised a Regional workshop on Modelling of Hydrologic Systems at Roorkee supported by UNESCO.

REGIONAL CENTRES

The regional centre for North-Western Himalayan regions was established at Jammu during 1989-90.

EXTERNAL ASSISTANCE

Under EEC/GOI project of transfer of hydrological computerised modelling system (SHE), simulation studies were carried out using data of three subbasin of Narmada. The project is being financially supported by E.E.C. in agreement with Govt, of India.

CONSULTANCY

During the year, four consultancy projects related to water accounting studies, flash flood studies, reservoir operation and development of forecasting model linking with rainfall are in progress.

NATIONAL WATER POLICY

The National Institute of Hydrology has carried out the following work related to storage determination of a multipurpose reservoir; operation of a reservoir with real time data-Machhu reservoir; Reservoir operation for conservation purpose-Pong reservoir; Application of Dam Break model to Dharoi Dam and Hydrological Aspects of drought to fulfil the objectives.

RASHTRIYA BARH AYOOG

Recently many states faced acute flood problems in Assam, West Bengal, J & K and some parts of eastern U.P. The flood plain zoning downstream of Machhu Dam-II, flood forecasting & regional frequency analysis studies have been taken up by the Institute.

INTERACTION WITH STATES

The Institute has emphasised with the states, the establishment of hydrological units to enable a very effective interaction. The response from the state is encouraging and some states have already planned their programme of establishment of hydrological units.

PUBLICATIONS AND AWARDS

Based on the studies conducted, the Institute brought out 43 reports in the form of technical notes, technical reports, case studies & user manuals. The scientists have published 38 papers in national and international journals and proceedings of seminars and symposia.

The National Institute of Hydrology has constituted the 'National Hydrology Award' and 'Bharat Singh Award' to promote and encourage research activities in the area of hydrology in the country. Nominations for the award for the year 1988 were invited.

1.0 INTRODUCTION

1.1 General

The National Institute of Hydrology has been in existence since December 1978, having been set up at Roorkee by Government of India as a registered society under the Societies Registration Act 1860, fully aided by Ministry of Water Resources (formerly Ministry of Irrigation), Govt. of India. The Union Minister for Water Resources is the President of the Society; Minister of State for Water Resources is the Vice President of the Society; Secretary to Government of India, Ministry of Water Resources is the Chairman of the Governing Body (GB); and Chairman, Central Water Commission and Ex-Officio Secretary to Government of India is the Chairman of the Technical Advisory Committee.

The Institute is located within the campus of the University of Roorkee on 6.5 acres of the land provided by the University of Roorkee on long term lease to the Institute. The main building of the Institute has been in use since December 1982; A laboratory block was constructed in 1985 to house the laboratories. The laboratories of water quality, remote sensing applications, instrumentation and ground water are operational in this building. The extension of laboratory block is completed and extension of other infrastructural facilities are in progress.

The Institute has taken up the task of solving the hydrological problems of different regions of the country through regional centres. One regional centre at Belgaum was established in June 1987 and is operational to handle the hydrological problems of Deccan hard rock region. The regional centre for the North Eastern Region was established in August 1988 at Guwahati and the third regional centre for Western Himalayan region is established in January 1990 at Jammu.

1.2 Objectives

The National Institute of Hydrology has been established :

- (i) To undertake, aid, promote and coordinate systematic and scientific work in all aspects of hydrology;
- (ii) to cooperate and collaborate with other national and international organisations in the field of hydrology;
- (iii) to establish and maintain a research reference library in pursuance of the objectives of the Society and equip the same with books, reviews, magazines, newspapers and other relevant publications, and
- (v) to do all other such things as the Society may consider necessary, incidental or conducive to the attainment of the above objectives.

1.3 Work Review

In the earlier stages of the establishment of the Institute emphasis was laid on creation of necessary infrastructural facilities like buildings, recruitment of staff, training of manpower and provision of computer facilities. Initially, the Institute concentrated on the studies pertaining to computer oriented studies and research in eight priority areas as defined by Technical Advisory Committee (TAC) and Governing Body (GB) and in training of manpower. During this period the Institute had procured, developed, implemented and tested a number of computer programmes covering the areas of frequency analysis, watershed modelling, flood estimation, reservoir operation, water quality modelling and ground water modelling. The Institute has acquired a sophisticated fourth generation VAX-11/780 computer system with various peripherals including a colour graphic terminal under the UNDP Project. Comptal Image Processing system for digital analysis of remotely sensed data has been installed to improve the computer facility.

With effect from the year 1984-85, the Institute has embarked on a much larger programme covering field and laboratory oriented studies in addition to computer oriented studies and research, so that it can serve the role of an apex research Institute and body in the field of hydrology in the country. The Institute has taken up studies in the wider areas of hydrology to develop methodologies and systematic procedures and to standardise methods of analysis, planning and design.

Keeping in view the future requirements of the country in the field of hydrology, the work programme for the Seventh Plan period (1985-90) was prepared by TAC and Governing Body. Based on the approved work programme, the infrastructural facilities and manpower requirements were worked out and the EFC Memo of the Institute for the Seventh Plan period was finalized. During the period of preparation of the EFC Memo the Institute conceived the establishment of a Drought Studies Division in view of the acute drought problem faced by the country and Atmospheric Land Surface Process Division to develop modelling methodologies of the integrated system for operation of water resources projects. The EFC Memo with a financial outlay of 4.5 crores was approved under plan. In view of the financial constraints, the building component was suitably modified while maintaining appropriate emphasis on the procurement of equipment and recruitment of manpower so that the studies and research activity of the approved work programme can be carried out reasonably well at the required level.

In view of the various problems which require immediate attention and with the available staff the work programme is divided into 14 problem oriented divisions and the work has been initiated in most of the divisions with the available staff. These divisions include the frontier areas like remote sensing applications, urban drainage, snow hydrology, man's influence on water resources, drought and flood. The 14 divisions are :

- (i) Hydrologic Design
- (ii) Surface Water Analysis and Modelling
- (iii) Flood Studies
- (iv) Mountain Hydrology
- (v) Ground Water Assessment
- (vi) Conjunctive Use

- (vii) Drainage
- (viii) Drought Studies
- (ix) Water Resources System
- (x) Man's Influence
- (xi) Information System and Data Management
- (xii) Remote Sensing Applications
- (xiii) Hydrological Investigations
- (xiv) Hydrological Application of Climatic Information.

Realising the importance of laboratory oriented studies the following laboratories were established which are being strengthened as per the requirement of research needs :

- i) Water Quality Laboratory
- ii) Remote Sensing Laboratory
- iii) Ground Water Laboratory
- iv) Hydrological Investigation Laboratory and Instrumentation Service facility and Workshop.

The Institute has procured sophisticated and appropriate equipments to strengthen the facilities in these laboratories and computer centre. A number of studies relating to laboratory and computer oriented research have been carried out using these facilities.

The Institute brings out comprehensive reports under various categories based on the studies and research carried out in the Institute, which are circulated to various State and Central Government Organisations. Besides the circulation of the technical and scientific work in the form of reports, the Institute organized workshops both at Roorkee, and in the States for transfer of technology to the personnel of States and Central Government Organisations engaged in water resources development. Through these workshops the Institute transfers the methods of analysis, planning and design and the related software is made operational on the computers of the organisation concerned.

The hydrological problems of different regions of the country are unique due to differences in climate, geography, geology, land use and cover characteristics, soil drainability, environmental condition and the economic growth of the region to be able to study the complete hydrological problems of different regions, the country has been divided into seven hydrological regions. It is that each of these regions, have a regional centre. To start with these regional centres proposed will have the following main activities :

- a) Review the existing regional formulae and develop suitable revised formula making use of the available data;
- b) Prepare year books of typical basins;
- c) Establish representative basins and experimental catchments, monitor data collection, data compilation, processing and analysis;
- d) Compile, process and analyse the data;

- e) Interact with State agencies and extend help in conduct of hydrological studies;
- f) Conduct representative basin studies.

During the Seventh Plan period three of these regional centres have become operational.

During the year, based on the studies conducted at the Institute, 43 scientific reports were prepared under various categories: Technical Notes, Technical Reports, User's Manuals, Case Studies, and a hydrological year book, and were circulated widely to the States and Central Government Organisations. 38 technical and research papers were contributed to various scientific journals, seminar/symposia by the scientists of the Institute. Eight workshops were also organized under transfer of technology programme which were attended by officers belonging to various States, Central and Academic organisations.

The scope of the research work undertaken by the Institute is increasing manifold and in order to carry out the programme of work envisaged during the Seventh Plan under EFC Memo, infrastructural facilities have been improved by way of increased office space, laboratory space, construction of trainees hostel and other related buildings. At the time of the establishment of the Institute, the University of Roorkee has provided some residential accommodation funded by the Government of Uttar Pradesh. However, realising the need for additional accommodation in the form of staff colony in stages will be established.

The Institute is, therefore, growing and proceeding in the right direction towards the fulfilment of its objectives laid down at the time of the establishment. The studies and research activities are gaining momentum and expertise is being created at the Institute which will significantly contribute to the assessment of water resources and their planning for optimal utilisation.

2.0 ORGANISATION AND MEETINGS

2.1 Society

The National Institute of Hydrology Society is the apex body and meets atleast once in a year. It reviews the progress and performance of the Institute towards the attainment of the objectives and gives such policy directions, as it may deem fit, to the Governing Body and the Institute. The membership of the Society is given in Appendix-I.

The 10th Annual General Meeting of National Institute of Hydrology Society was originally scheduled to be held on Jan. 31, 1990. Due to unavoidable circumstances the meeting could not be held on Jan. 31, 1990. The meeting of the Society was held on May 24th, 1990 at Delhi. The society reviewed the work carried out at the Institute during the year 1989-90, approved the Annual Report and audited accounts for the year 1988-89 and approved the budget for the year 1990-91. Also the recommendation of Governing Body based on the recommendations of the Achievements Review Committee of NIH were considered and approved.

The special meeting of the Society was also held on May 24, 1990. The amendments, relating to Regional Centres and redesignation of Administrative office were adopted at the meeting.

2.2 Governing Body

The Governing Body is the executive body of the Institute to pursue and carry out the activities as per objectives of the Society, and implement the policy, direction and guidelines laid down by the Society. The Governing Body exercises all executive and financial powers of the Society. The Governing Body is required to meet atleast twice in a financial year. The membership of the Governing Body is given in Appendix-II.

As per the requirements, two meetings of the Governing Body were held on October 11, 1989 and March 30, 1990. Several decisions were taken concerning the administration of the Institute, creation and recruitment to additional posts of scientists and other staff, creation of infrastructural facilities and staff colony for the employees of the Institute. Annual Report and audited accounts for 1988-89 were approved for consideration by Society. Revised budget for 1989-90 and budget proposals for 1990-91 were also considered and approved.

2.3 Technical Advisory Committee

The Technical Advisory Committee (TAC) is responsible for the technical scrutiny of the studies and research programme of the Institute for inclusion in the Annual/Five Year Plans/External Assistance including proposals for expansion of the Institute and recommend priorities. The

committee is expected to meet atleast once in six months. During the year Technical Advisory Committee met on July 21, 1989, August 23, 1989 and Feb. 22nd, 1990. The membership of the committee is given in Appendix-III.

2.4 Working Groups

The Institute has 14 working groups relating to 14 divisions of the Institute for reviewing the annual studies and research programme of the Institute and evaluate the technical reports before printing.

During the year the working groups reviewed the reports of the studies carried out by the Institute before these were sent for publication. The working group also considered the proposed technical work programme of the Institute for the year, 1990-91 and the work programme for eighth plan period 1990-95 before consideration by the Technical Advisory Committee. One meeting each of 14 working group were held during the year as given in Appendix-IV.

Appendix-IV also presents the status of the meeting of the Governing Body and Technical Advisory Committee held during the year,

2.5 Coordination Committee

The Coordination Committee of the Institute is for coordination with the University of Roorkee. The Committee is required to ensure effective coordination between University of Roorkee and the National Institute of Hydrology, to recommend assistance to be obtained from the University, to decide the norms of payment of charges to the University on no profit no loss basis for assistance rendered to the Institute and to decide the working arrangement for utilising the facilities available in the two organisations for mutual benefit.

The progress of construction work being carried out by University for Institute Buildings, telephone connections and residential accommodation for employees of the Institute is being reviewed in these meetings.

2.6 Indian National Committee on Hydrology (INCOH)

The National Committee on Hydrology (INCOH) was constituted by the Government in 1982. National Institute of Hydrology provides the Secretariat to this committee. The functions of INCOH are to collect state of hydrological research in the country and to disseminate it; to identify the areas of hydrology which need immediate attention; to encourage National Institutions to take up the research in hydrology which need to be taken up on priority; to promote education and training programme; to foster collaboration with other countries; and coordinate effective participation by India in International Hydrological Programme (IHP) of UNESCO and Operational Hydrological Programme of WMO, to disseminate information and improve standards to advise Central and State Government agencies, etc.

The membership of this committee is drawn from various organisations in the country having interest in monitoring, evaluation, analysis the utilization of water resources. The constitution of INCOH is presented in Appendix-V.



**Honourable Union Minister of Water Resources
Shri Manubhai Kotadia going through the Exhibition**



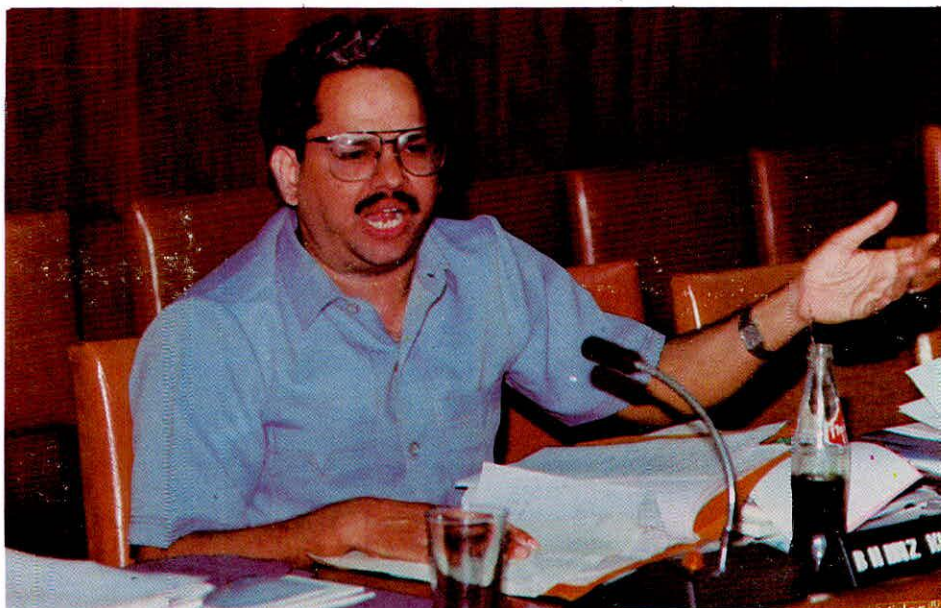
Tenth Annual General Meeting of NIH Society



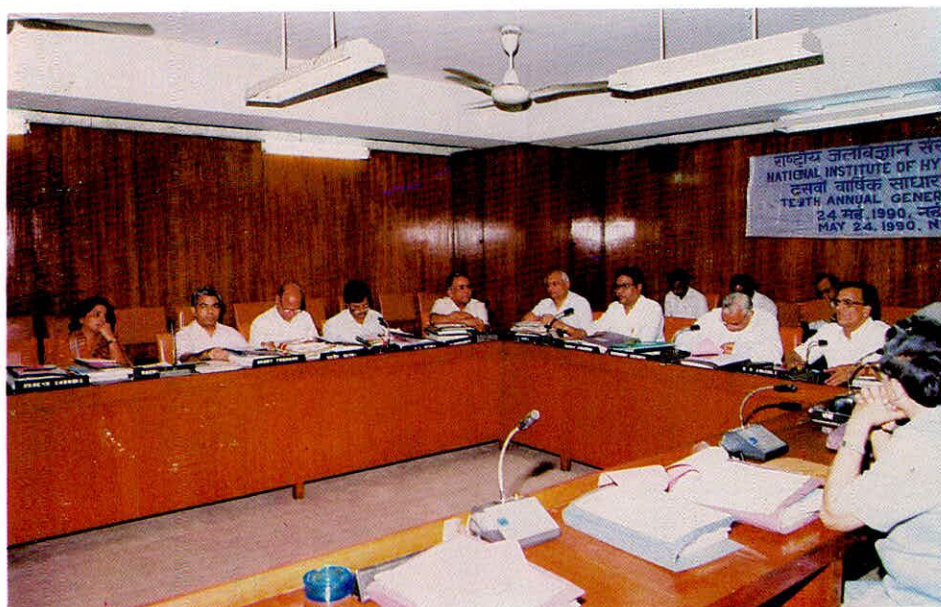
**Honourable Union Minister of Water Resources
Shri Mahubhai Kotadia and President of Society
addressing the Society Members**



**Honourable Union Minister of Water Resources
and President, NIH Society,
Shri Manubhai Kotadia**



Dr. B.H. Brizkishore, Member of Achievements Review Committee and Member of NIH Society expressing his views during the meeting



Dr. M.A. Chitale, Secretary addressing members of Society



**Chairman, CWC and Chairman Technical Advisory
Committee of NIH addressing the members
of the Committee**



**Meeting of Technical Advisory Committee
in progress**

2.7 Asian Regional Coordinating Committee on Hydrology (ARCCOH)

The second meeting of panels of experts for the preparation of Hydrogeological map of Asia was held on Oct. 24-26, 1988 at Delhi. The fourth meeting of the Steering Committee of ARCCOH was held by representative from Nepal, Pakistan, Iran, Malaysia, Thailand and India. The meeting discussed the progress of compilation of Hydrogeological map of Asia,

2.8 Institute Personnel

The Institute has 14 scientific divisions and 3 units of administration, finance and miscellaneous services. The organisational structure of the Institute is presented in Figure-I. During the 6th plan the Institute had sanctioned strength of 121 posts and 20 posts of HILTECH (out of which 14 posts were released and ban relaxation has yet to be given by the Ministry for the remaining 6 posts). Besides this out of 178 posts sanctioned during the 7th plan, 156 posts have been released by the Ministry so far. Thus, a total of 291 posts were available to the Institute (135 under nonplan and 156 under plan). At the beginning of the year the Institute had besides the Director, 35 scientists, 91 scientific supporting staff leaving a total of 86 posts vacant at the beginning of the year.

During the year the revision of recruitment rules for all categories of staff were taken up by the Institute, which is expected to be completed by June 1989 so that action to fill the vacant posts could be taken up. As a result during the beginning of the year only 4 additional posts could be filled accounting for the persons joining and leaving the Institute. 29 posts of scientists have been advertised and will be filled after the revised recruitment rules are finalised and approved by the Chairman, Governing Body. The status of the staff as on 1.4.88 and 31.3.89 is given in Appendix VI. The status of the staff in the last 4 years is presented in Figure-II.

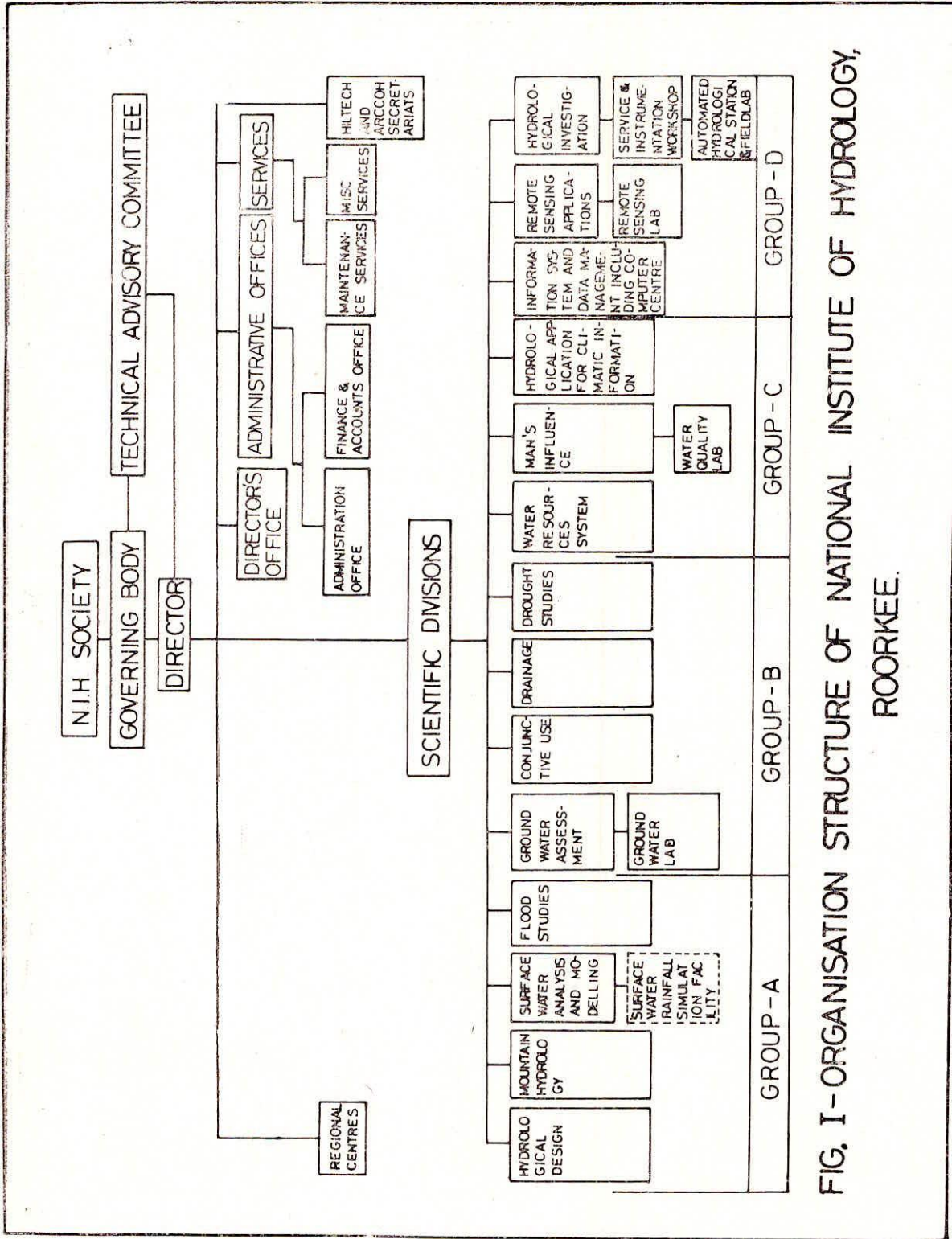


FIG. I - ORGANISATION STRUCTURE OF NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE.

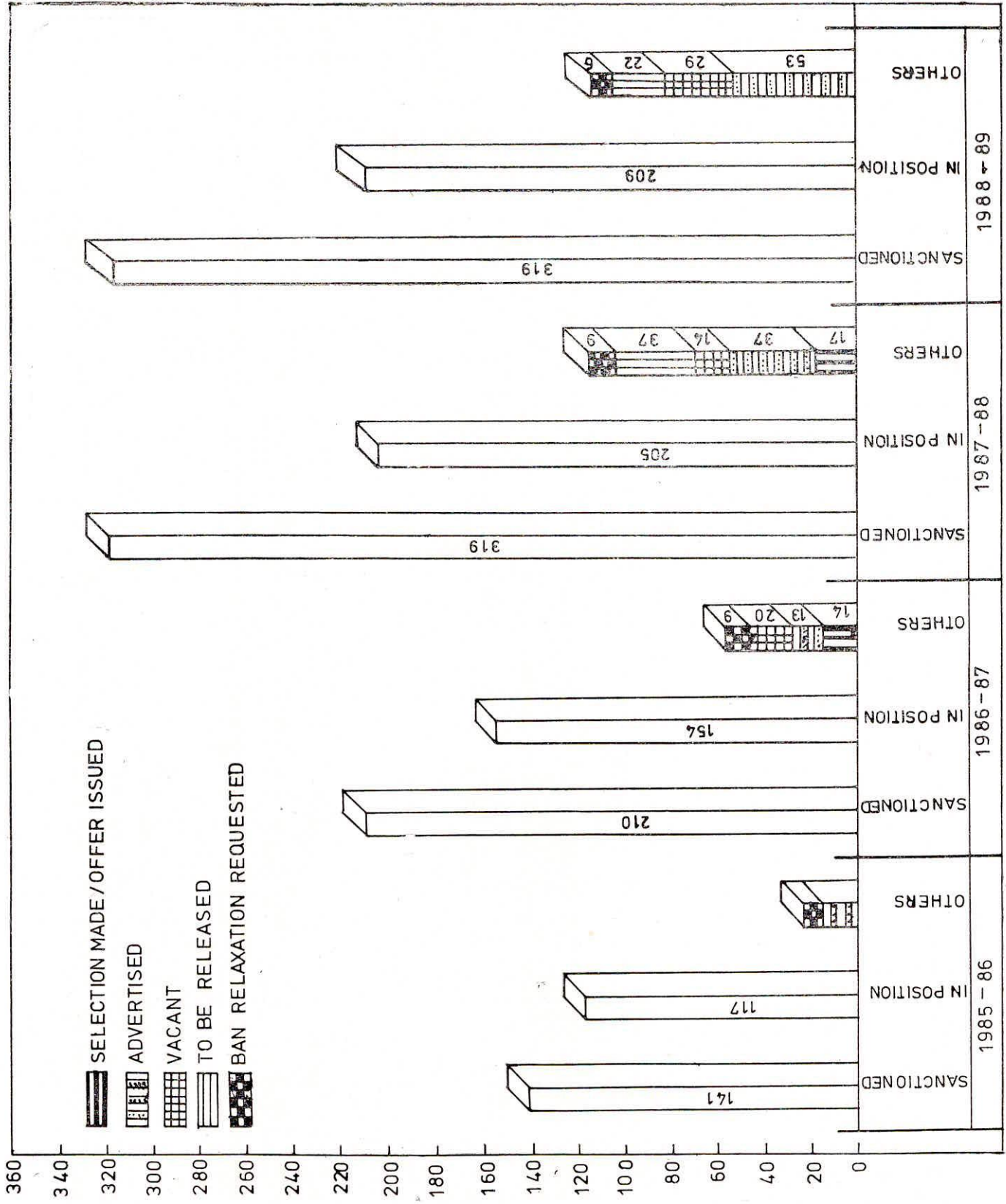


FIG. II - STATUS OF STAFF

3.0 RESEARCH AND DEVELOPMENT & CONSULTANCY

3.1 General

The Institute completed the first phase of establishment (1978-85) wherein emphasis was laid on creation of essential infrastructural facilities, recruitment and training of scientists and other manpower, procurement of equipment and establishment of a technical library. These activities were supported by a UNDP project, under which, besides other equipment, the VAX-11/780 computer system with its peripherals and Automated Hydrologic Station were procured. The project also provided for the training of 17 scientists of the Institute abroad in different areas of hydrology.

During the 7th Five Year Plan (1985-90), the Institute is engaged in consolidation, expansion and diversification of its activities. During 1988-89, while continuing with the computer oriented studies and research on different components of hydrologic cycle, their interaction as well as their quantitative assessment, the emphasis was also laid on laboratory and field oriented studies. The efforts in that direction were consolidated and intensified. A number of useful studies were conducted on the actual field data which were generated in laboratories or collected from or provided by field agencies. During the year, steps were also taken to create necessary infrastructural facilities by strengthening the existing laboratories and establishment of regional centres.

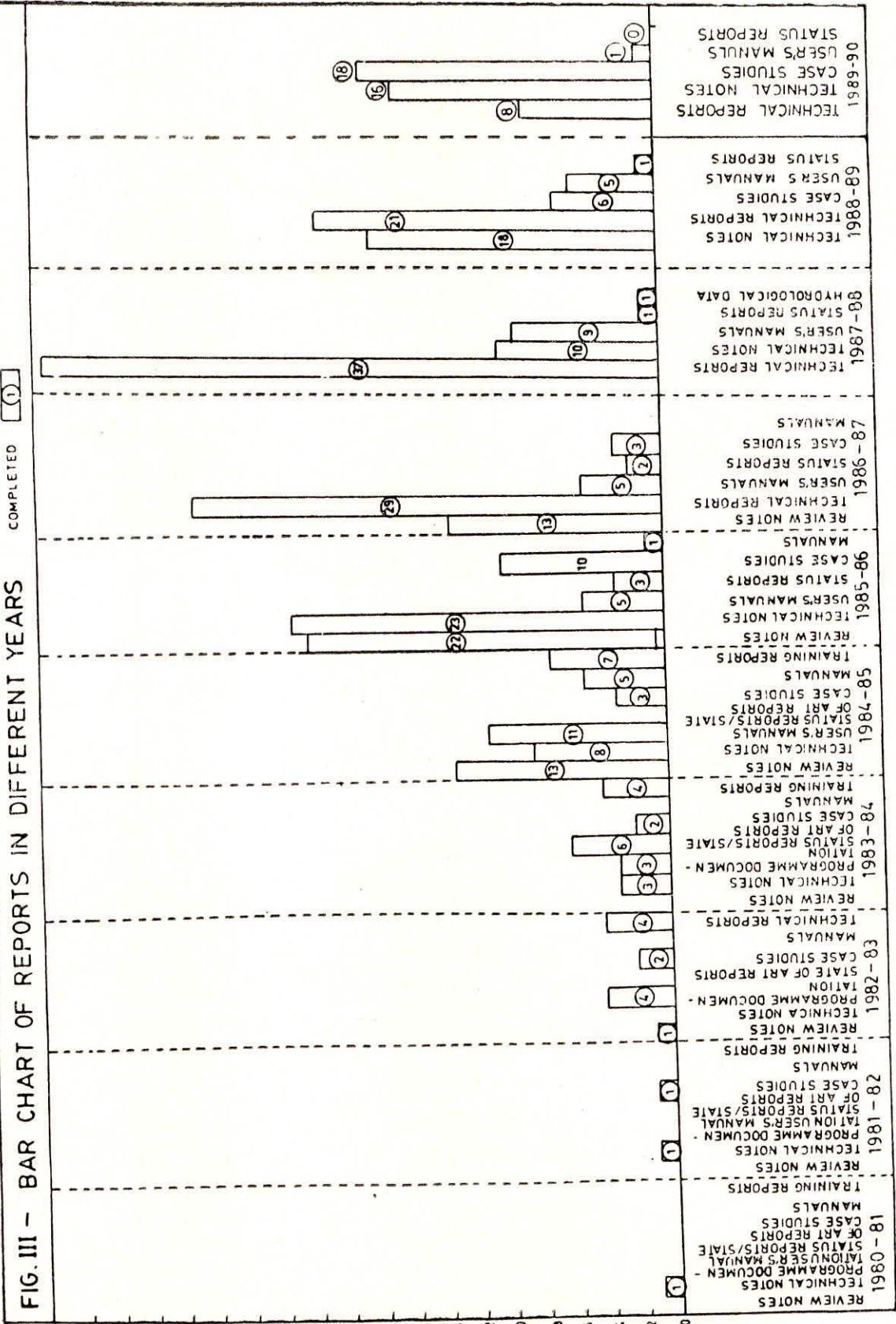
Some of the areas in which studies have been undertaken during the year cover the areas of regional flood frequency analysis, watershed modelling, mathematical modelling of moving storms, flood plain zoning/flood routing models, snow measurement, snow modelling, ground water assessment in hard rocks, conjunctive use of surface and ground water, solute transport in ground water, soil moisture movement, ground water recharge, soil salinity, storm drainage estimation, reservoir operation, ground water pollution, environmental impact assessment, water quality modelling, water conservation, hydrological aspects of drought, evapotranspiration losses, flood plain mapping by satellite data, watershed characteristics etc.

During the year under report, 52 scientific reports were prepared in various categories-technical notes, technical reports, user's manuals, status reports and case studies. The reports prepared by scientists under various divisions were circulated widely. A list of Scientific and Technical reports prepared during the year is given in Appendix-VII. The status of the various reports prepared in different years is given in Figure-III.

The scientists and scientific staff of the Institute have contributed/presented a number of papers in scientific journals and participated in national and international conferences. Scientific growth of the Institute since its inception is presented in Figure-IV.

For dissemination of the results of the studies carried out at the Institute and the technology developed, implemented and tested with field data, workshops were organised at Roorkee and at various State and Central Govt. Organisations. Under the technology transfer

FIG. III - BAR CHART OF REPORTS IN DIFFERENT YEARS



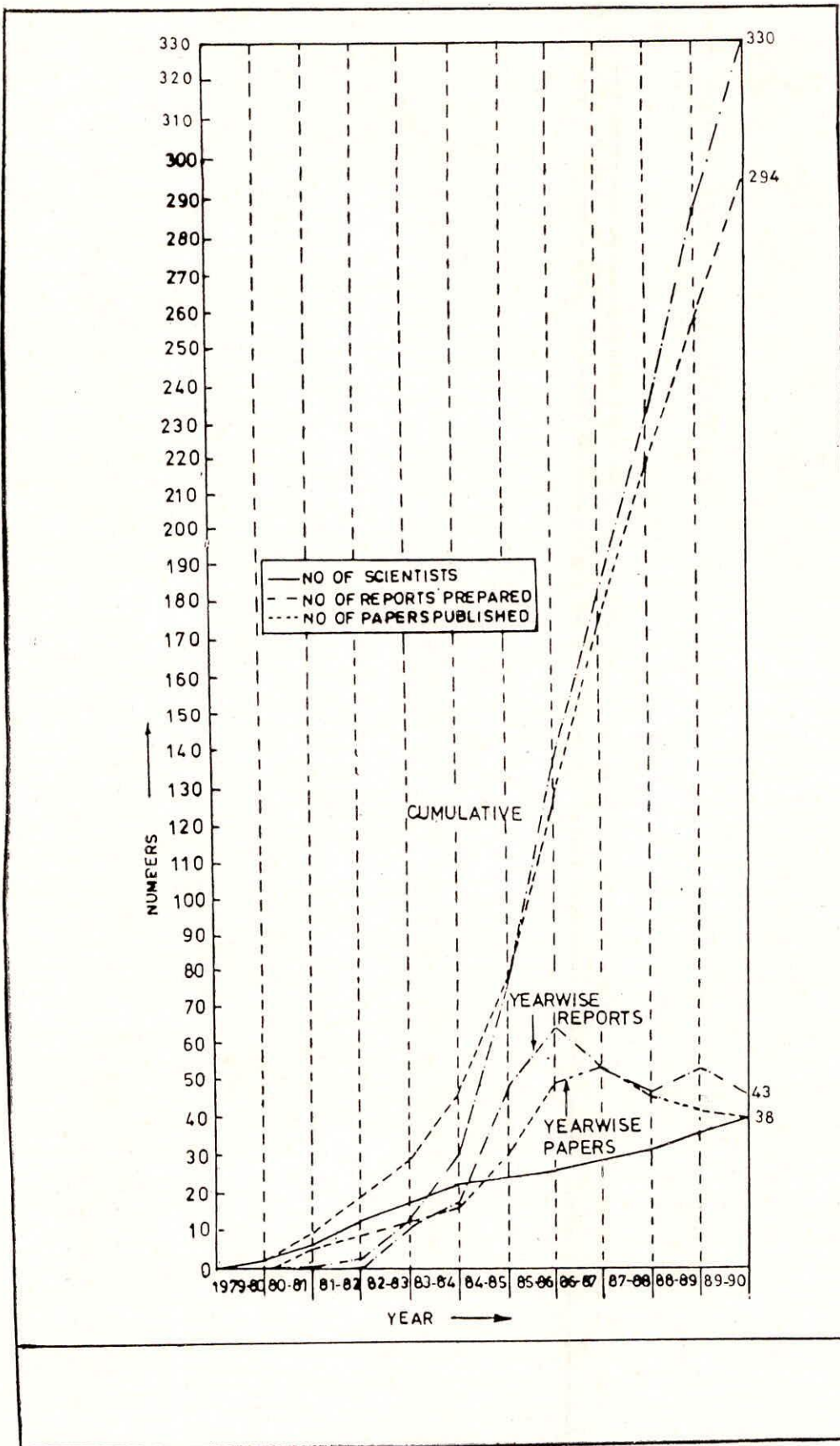


FIG. IV SCIENTIFIC GROWTH OF N.I.H.

the year, 8 workshops were conducted at Roorkee and in different States. The State and Central Govt. Organisations deputed their engineers and scientists to these workshops. The Institute has also established regional centres to cater to the hydrological problems of different regions of the country. One regional centre for the Deccan Hard Rock area was established at Belgaum, Karnataka and is operational. The regional centre for North-Eastern region was established at Guwahati in August 1988 and is functioning satisfactorily. The Regional Centre for North-Western Himalayan Region was established in January 1990 at Jammu.

The interaction with the states has further increased during the year. The Institute is closely interacting with various state organisations through the visits of Director and senior scientists. State organisations are also represented in the advisory bodies such as Technical Advisory Committee and Working Groups.

The scientists of the Institute have been carrying out studies on Hydrological Aspects of Drought. The scientists visited the drought affected areas of states of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan for obtaining first hand information of the drought severity and for collection of relevant data for the assessment of drought and for development of drought management strategies. A report on the hydrological aspects of drought for 1987-88 was complete during the year. During the year 1990-91 similar reports for 1988-89 and 1989-90 will be prepared and circulated.

Hydrology has grown as an interdisciplinary science after launching of the International Hydrological Programme of UNESCO. Realising the importance of systematic, basic and applied research in the areas of hydrology to solve complex field problems, it was thought appropriate to interact with foreign organisations and agencies through international cooperation. A number of projects for international cooperation are with Ministry at different stages. These projects involve scientific collaboration with Denmark, The Netherlands, West Germany, Japan, USSR and USA.

During the years, under EEC/GOI project on transfer of hydrological computerised modelling system (SHE), 3 scientists from Institute were sent to Danish Hydraulic Institute for training in May 1989. Simulation studies were carried out using data of three subbasins of Narmada basin. This project is being financially supported by European Economic Community in agreement with Govt. of India.

The INCOH and ARCCOH have functioned very effectively and the Secretariat at the Institute has handled the work and made further progress. A number of meetings of INCOH, its panel and subcommittees were held during the year which led to the development of programmes for faster growth of hydrological activities in India. National Hydrology projects in surface water (Southern region), ground water and water quality have been prepared after identifying the area of deficiency in the hydrology sector in the country. The surface water project was posed to the World Bank and other projects would also be posed to World Bank, as World Bank has evinced interest in these projects. Project for the Indus, Ganga and Brahmaputra basins is also under preparation. Jal Vigyan Sameeksha (Hydrology Review), a publication of INCOH is being brought out regularly. INCOH also sponsored research projects and partially supported Seminar/Symposia and also sponsored candidates to international courses abroad. Under the activities of ARCCOH, quarterly 'ARCCOH Newsletter' is being brought out regularly and circulated to the countries of Asian region. The second volume of the directory of hydrologists in Asian region has also been

prepared and will be sent for printing soon. A major regional project for South Central Asia supported by UNESCO would be made operational soon.

The extension of lab. block is completed. The construction of extension of experts Guest House and Museum-cum-information Centre are in progress and is expected to be completed by September 1990.

The quarterly newsletter of the Institute 'Jal Vigyan Samachar' is being published regularly. During the year greater emphasis was laid on the use of Hindi in office correspondence and in a limited manner in technical activities also. Recreation and welfare activities have continued with interest during the year.

3.2 Studies and Research Activities

The studies and research activities of the institute encompass different phases and the component process of the hydrological cycle, their interaction and the influence of human activities on the quantity and quality of water resources. The research activities in the Institute were undertaken in the following problem oriented scientific divisions :

- i) Hydrologic Design
- ii) Surface Water Analysis and Modelling
- iii) Flood Studies
- iv) Mountain Hydrology
- v) Ground Water Assessment
- vi) Conjunctive Use
- vii) Drainage
- viii) Drought Studies
- ix) Water Resources Systems
- x) Man's Influence
- xi) Information Systems and Data Management
- xii) Remote Sensing Application
- xiii) Hydrological Investigations
- xiv) Hydrological Application of Climatic Information.

The results of studies and research work have been brought in the form of Review Notes, Technical Reports, Case Studies, Status Reports and User's Manuals and these have been circulated to various State and Central Government Organisations :

A brief account of studies and research conducted during the year in each of the above division is given below :

3.2.1 Hydrologic Design

The activities of this division are mainly focussed on various elements of the hydrological cycle as a part of total design of hydrology component of the projects including design flood

estimation. Besides conventional techniques like unit hydrograph based and flood frequency analysis approaches, the distributed event based models for different terrain situations are also being studied and developed in order to estimate the design floods as a part of the activities of the division. A number of technical reports have been prepared in the above areas. These include :—

i) Regional Flood Frequency Analysis for Two Typical Regions

Regional flood frequency analysis approach is one of the most popular and versatile techniques available in flood frequency analysis literature for the estimation of different recurrence interval floods for data deficient or ungauged basins. The most significant development in regional flood frequency analysis was bringing out of a manual by U.S. Geological Survey in 1969, which was followed by a number of studies including U.K Flood Studies and other typical studies covering general probability consideration, use of historical information, criterial for regional homogeneity etc. During the last 15 years some important developments in regional flood frequency analysis include use of GEV (General Extreme Value) and Wakeby distributions following PWM (Probability Weighted Moments) approach for parameter estimation. It has been found that the application of PWM based regionalisation techniques works well for situations where records are extremely short and streamflow histories are highly skewed and highly kurtotic. In India most of the regional flood studies are based on U.S G.S. procedure. Few studies based on PWM based approaches and transformation techniques have been conducted at National Institute of Hydrology and at some academic Institutions in India.

Two case studies dealing with flood frequency analysis of sub-Himalayan Region and Mahi & Sabarmati sub basin sub zone 3(a) have been conducted involving application of EV1 (PWM), GEV (PWM) and Wakeby (PWM) methods based on : i) at site data, ii) at site and regional data combined and, iii) regional data alone. The annual peak flow records are considered in two parts : One part of the records for parameter estimation and other part as independent test data. Descriptive ability of the various frequency methods considered in analysis have been tested based on goodness of fit criteria.

In order to test the predictive ability of various methods, Monte Carlo Experiments have been conducted using EV1, GEV and Wakeby Distributions. The results obtained from EV1 (PWM), GEV (PWM) and Wakeby (PWM) with generated data have been compared with that of the U.S.G.S. regional flood frequency method. The performance of different methods have been evaluated based on the various predictive ability criteria. Viz bias, root mean square error and co-efficient of variation computed from the generated data, From the study it is found that the methods based on GEV (PWM) and Wakeby (PWM) approaches are more robust than any other methods used in the study.

ii) Seasonal Flow Forecasting Studies for Vaigai Basin

Forecasting of flow is of primary importance for efficient planning, operational and control of water resources systems. If the reservoir concerned or river flow is intended mainly for flood control, short term forecasts would be sufficient. However, long term forecasts are needed for various planning activities such as water supply, frequency of irrigation, planning of cropping pattern and estimation of irrigated areas of the crops, normally cultivated in some regions in the coming season or year. Forecasting of monsoon runoff based upon available runoff upto end of

different monsoon months could be an important aspect for drought management and planning operation of surface water reservoir.

The Vaigai river basin forms one of the important river basins of Southern Tamilnadu. The Vaigai basin covers an area of about 7,031 sq.km. However, the catchment area of 2,253 sq.km. upto the Vaigai dam has been taken into consideration in the present study. For forecasting the monsoon runoff, a methodology based on simple regression relationships has been applied to Vaigai basin to forecast the monsoon runoff on the basis of total runoff upto end of different monsoon months. The effectiveness of these relationships in judging whether the current year is going to be below or above normal, from runoff point of view has been studied taking into consideration the efficiency of these regression relationships.

3.2.2 Surface Water Analysis and Modelling :

The studies and research programme of this division comprise of hydrometeorological analysis, Water availability studies and modelling of streamflow. The studies carried out in this division during the year included analysis of moving storms in Krishna basin, rain storm analysis of October 1983 storm over Coastal Andhra Pradesh.

i) Moving Storms in Mahanadi basin

Shifting of rain storm centre due to movement of storm influences the shape of runoff hydrographs. The study of movement of storms would help in providing appropriate time lag in the rainfall input to hydrological models for simulation of flood hydrographs.

Using hourly rainfall recorded at self recording raingauge stations (SRRG) located in the lower Krishna basin, the movement of four tropical storms which caused flood in the lower Krishna basin has been analysed. Further studies are in progress.

ii) Rainstorm analysis of October 1983 storm

Flash floods in mountain streams are caused by intense precipitation and wet antecedent conditions. A severe cyclonic storm which occurred over northern and central parts of Andhra Pradesh during 3-6 October 1983 caused widespread rain. Distribution of hourly rainfall during 3-6 October 1983 at different stations is shown in Fig. V.

Depth duration analysis and analysis of hourly rainfall data has been carried. A paper describing the studies and results has been presented at the regional workshop on 'Unusual Storm Events and Their relevance to Dam Safety' held at Nagar-junasagar on 19 Feb. 1990.

3.2.3 Flood Studies :

In this scientific division, studies and research programme have been carried out mainly in the area of flood routing. The data collection programme for dam break studies and flood plain zoning was also pursued during the year. The brief description of the studies carried out during the year is as follows :

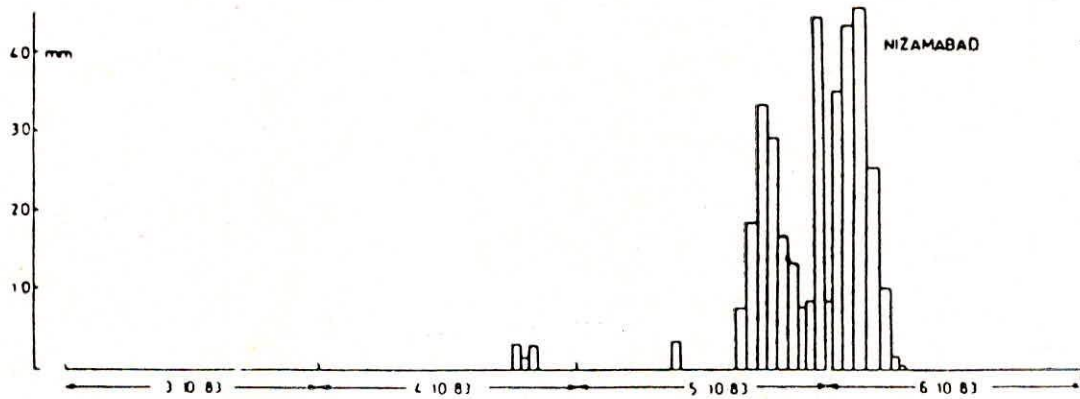
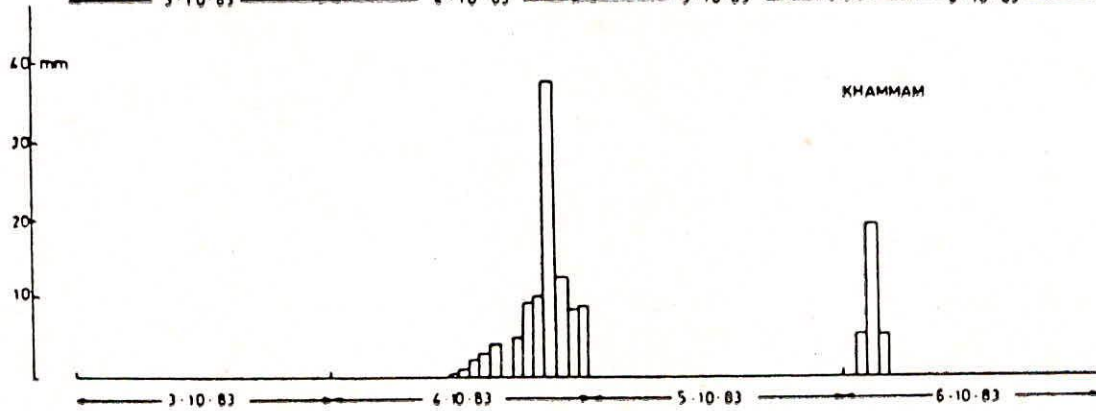
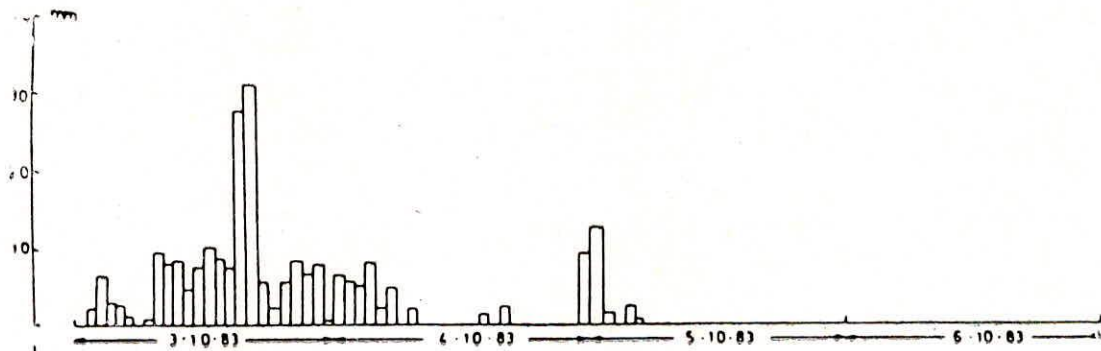


FIG. V : HOURLY RAINFALL DISTRIBUTION AT DIFFERENT STATIONS DURING 3-6 OCTOBER 1983.

i) Comparison of Some Routing Techniques :

Simplified routing techniques are still considered to be important tools of flood routing because of their simplicity in application and lesser data required for their solution. This study attempts to compare the relative performance of five routing techniques namely : Conventional Muskingum Method, Variable Parameter Diffusion Method, and Kalinin-Milyukov Method, using the flood data of river Tapti between Hathnur and Bhusaval. It is seen that the Three Parameter Muskingum type procedure is performing best of all. The Conventional Muskingum method and Kalinin-Milyukov method are standing second and third in performance-wise ranking. The Muskingum-Cunge method and Variable parameter diffusion method are not performing as good as others. It is suggested to use three-parameter Muskingum method in the field as it has also got the advantage of incorporation of lateral inflow. A sensitivity analysis for all the methods has also been made to see the effect of the change in parameters on the results. From the analysis, it is seen that the error in inflow is directly reflected in the results hence the inflow data should be collected very accurately.

(ii) Application of Flood Routing Procedure Incorporating Lateral Inflow :

The treatment of lateral inflow in flood routing has been a matter of concern to the hydrologists. However, most of the studies have considered the lateral inflow as the volumetric difference of outflow and inflow, and the shape being as that of inflow/outflow hydrograph and then adjusting it with either inflow/outflow before/after routing, respectively. These methods, thus, do not take lateral inflow into account implicitly.

O'Donnell (1985) developed a methodology named Three Parameter Muskingum Type procedure which incorporates the lateral inflow with the assumption that it is of the shape of inflow. This has the advantage that it is very simple, efficient and needs less computation efforts in application.

In this technical report, the above said model has been applied to flood events of three sub-reaches of river Tapti with magnitude of floods varying from 933 cumecs to 9592 cumecs. The Computed and observed outflow hydrographs compare well in all the cases. The Model efficiency in simulation of outflow hydrograph varies from 70.98% to 98.82% , indicating satisfactory performance of the methodology in routing of flood events in different reaches of River Tapti.

3 2 4 Mountain Hydrology

The studies and research programme of this Division related to study of geomorphological parameters of mountainous catchments, snow measurement and snowmelt modelling, glacier and glacier melt.

(i) Geomorphological Studies :

Geomorphology is the science of land forms. Geomorphology of a region affects formation of streamflow in the region. In order to correlate the streamflow with geomorphological parameters or regionalise hydrological models describing rainfall runoff process, some of the gauged catchments lying in hydrometeorologically homogeneous regions of ungauged catchments with scarce data were selected and geomorphological parameters were evaluated. A report for some catchments in upper Krishna basin has been published.

(ii) Snowmelt model studies for Beas Catchment :

The temperature index or degree day method has been used for estimation of snowmelt in Beas upto Manali. The Snow-melt Runoff Model (SRM) of Rango and Martinec has been used. Preliminary studies of snow melt modelling with the SRM have been encouraging.

(iii) Glacier Expedition :

The Irrigation and flood control department of Government of Jammu & Kashmir was interested in harnessing the Waters of Lidder river for irrigation and hydropower. For estimating the spring season flow contribution of Kolhai glacier to Lidder river, the J & K Irrigation and Flood Control department desired that a glacier expedition to Kolhai be organised by NIH.

A scientific expedition was organised by NIH in collaboration with J & K Irrigation and Flood Control Department from 12 Aug. to 24 Aug. 1989. The main objective of the expedition was to assess the feasibility of scientific studies on this glacier and to estimate its melt contribution into West Lidder river. Twelve scientists and engineers from NIH, Survey of India and J & K Flood Control Deptt. participated in the expedition.

The hydrological investigations carried out included measurement of glacial melt, sediment load and pH value of meltwater. The observed discharge varied between 175 to 225 cumecs. The sediment load was found to be negligible. The pH value varied between 8.50 and 8.90.

3 2.5 Ground Water Assessment

The research programme of this division includes estimation of ground water potential by water balance approach, study of coastal aquifers, processing and analysis of ground water data and groundwater resources evaluation and development in hard rock areas. The following studies have been carried out during the year :

(i) Analysis of Flow to Dug Well in Hard Rock Area in an Unconfined Aquifer by Cell Theory

Dug wells are used extensively in hard rock areas, for ground water abstraction. Development of ground water in these areas requires the knowledge of the dynamics of flow towards a dug well, i.e the relationship amongst rate of pumping, well storage contribution, aquifer parameters and the recovery of well storage.

The flow towards a well in hard rock areas is governed by the fractures in the rock, the primary and the secondary porosities. In most of the available solutions for wells in alluvial soils (Thies and Hantush), the well has been assumed to be a line sink and the well storage has not been given due importance. Since, the most of the dug wells are of large diameter having considerable storage in them, assessment of the aquifer response to pumping without considering well storage effect may lead to erroneous results.

In the present study, solution of unsteady flow towards partially penetrating dug well has been made. The storage in the well has been taken into account. Cell theory proposed by Bear has been used for development of the model.

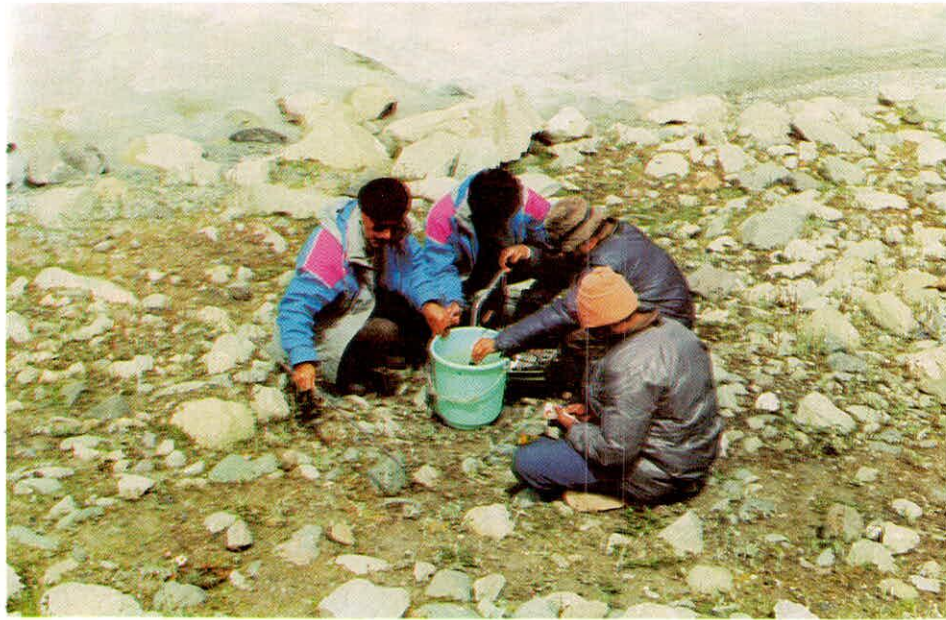
This study is under progress.



**Scientific Expedition team proceeding to
Kolhai Glacier**



Measurement of Glacial melt discharge



**Preparing Mixture for discharge measurement
by Salt dilution**



View of a high altitude lake near Kolhai Glacier

(ii) User's Manual for Processing and Analysis of Ground Water Data

The ground water information is required for the planning, development, management and administration of ground water resources related activities. The amount of information needed in any area is dependent on the present stage of development and the problems involved as well as variation in the geohydrological environment.

In the present study, a procedure has been outlined to evaluate ground water potential by studying the water table fluctuation. Evaluation of components of water balance element, such as seepage losses from canals, irrigation return flow, evapotranspiration from shallow water table, seepage losses from large water bodies etc. are discussed bringing out different methods of their quantification. Computer programmes for estimation of aquifer parameters and lumped water balance have been supplied.

3.2.6 Conjunctive Use

The studies and research programme of this division include the prediction of groundwater regime and mathematical modelling of solute transport. The following reports have been prepared during the year :

(i) 'Long Term Prediction of Ground Water Regime in an internal drainage basin' ;

An internally draining basin is one which is entirely without well defined natural streams or artificial surface drain. An example is the internal basin occupying the western Haryana and north eastern Rajasthan with a constrained outlet to the western part of the Ghaggar Basin in the vicinity of Sirsa. Introduction of surface water irrigation in an internally draining basin changes the groundwater balance of the area which may lead to water logging and soil salinization. Any action which reduces deep percolation slows down the rate of water table rise. These actions are canal and channel lining, improved water application systems, improved water management at farm level and afforestation. It is envisaged in the present study to review the methods to evaluate the efficiency of each of the actions in controlling water table rise in an internally draining basin. Different methods of solving groundwater problem are also discussed in detail.

(ii) Mathematical Modelling of Solute transport in groundwater from a point source of pollution

Considering the large number and variety of pollutants that may be released to the sub-surface and the wide range of environmental situations (geological, hydrological, chemical and biological) that may encounter, it is apparent that a highly systematic approach must be followed in developing a capability for predicting subsurface transport sufficient to meet the goals of groundwater pollution control. Accordingly, the major thrust of transport research should be directed towards the development of models that integrate physical process descriptions with pollutant properties and environmental characteristics to yield quantitative estimates of surface transport,

In the present note, a review of the existing methodologies of solute transport phenomena has been made, keeping in view the ultimate aim that is to provide methodologies which will permit accurate prediction of the effect from a point source pollutant activity will have on the quality of groundwater at points of withdrawal or discharge.

The basic concepts of the transport phenomenon have been described in detail and various mathematical models to solve the advection-dispersion equation have been critically reviewed.

3.2.7 Drainage

The studies and research programme of this divisions include the design of subsurface drainage system, leaching of salts and design of intercepting drains. The following reports have been prepared.

(i) Optimal Design of Sub-surface Drainage System

The sub-surface tile drainage system can be placed at different depth and at different spacing still maintaining the water at desired depth. Out of all these alternatives one of them will be economically optimum. It is intended to find the spacing and the depth at which the drains should be placed in an agricultural land to dispose the excess irrigation return flow so that the cost of installation of the drains system is minimum.

(ii) Optimal Sub-surface Drainage System for Leaching of Salts in Hissar (Haryana)

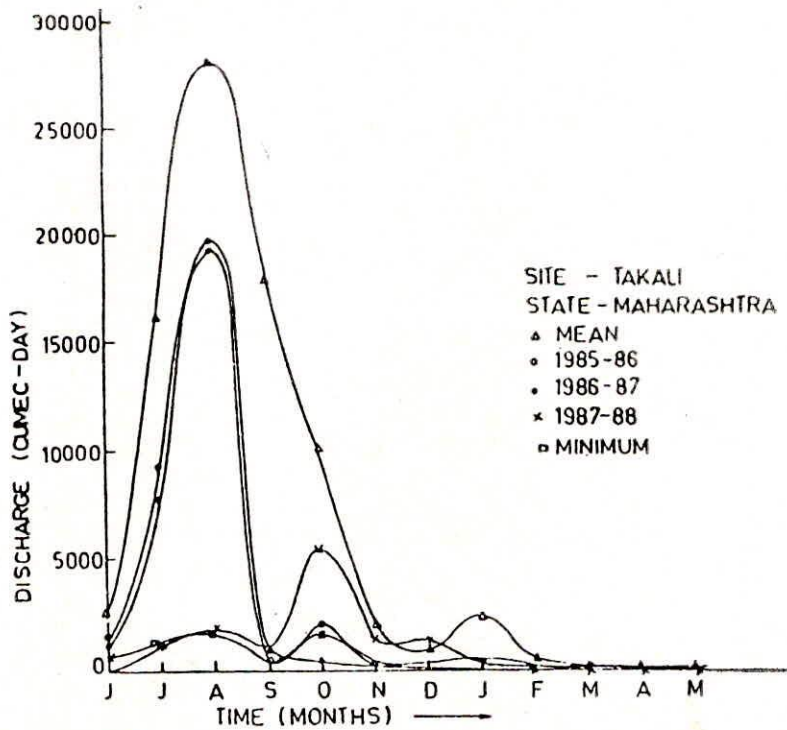
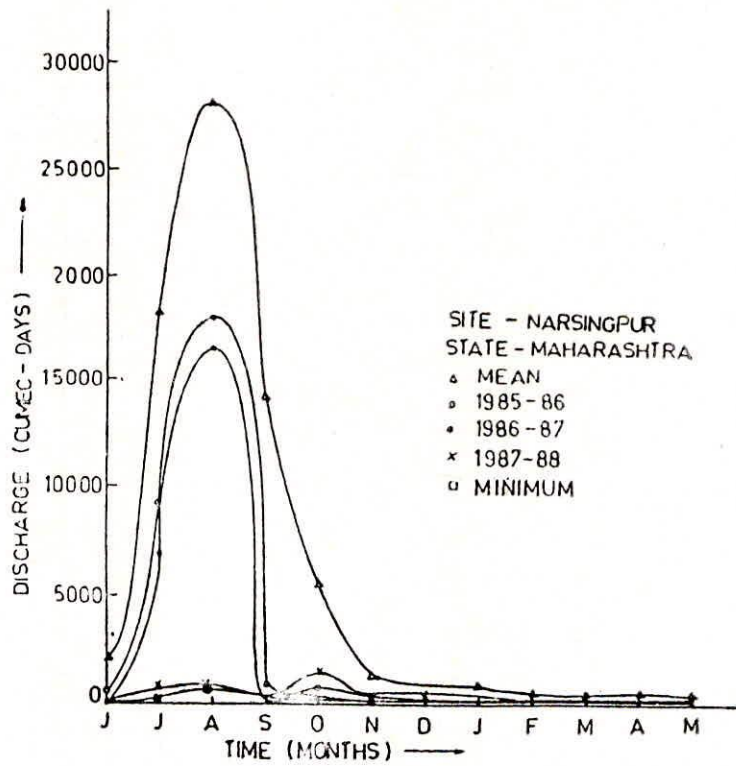
When water is applied for leaching it washes out the salt along with its downward flow. As the water flows down, the concentration of soluble salt will increase therefore the leaching capability of applied water will diminish. From leaching point of view the drain should be placed at the depth beyond which the water applied for leaching ceases to carry further salt along with it. The practice is to place the drain on the underlying impervious layer which is uneconomical because of the high excavation cost. It is intended to find the required depth at which the sub-surface drains should be placed to remove the water applied for leaching.

3.2.8 Drought Studies

A brief description of the activities of drought division are given as below :

The occurrence of drought in India is not a recent phenomenon. Reliable information documents reveal that since 1800, there have been 40 drought years in the country. In recent times, the country has faced three drought years in succession namely 1985, 1986 and 1987. It has been reported intensitywise the drought of year 1987 ranks second in the 20th century, the first one being in year 1918. Statistics on areal coverage indicate that out of the country's geographical area of 328 m ha, 107 m ha. or about one third of the area and 29 percent of the population are affected by drought.

In view of severity of drought problem and less understanding of the hydrological aspects associated with the droughts, the National Institute of Hydrology launched studies in year 1986 to better understand the drought impacts from hydrology point of view. In this venture the Institute started collection of on the spot field data concerning rainfall, streamflow and groundwater in some selected areas of study. Six states of A.P, Gujarat, Karnataka, M.P., Maharashtra and Rajasthan were selected for the study. During the first year of study (1985-86) two districts. in each of these six states were chosen for analysis. Analysis of rainfall, streamflow groundwater and soil moisture data was presented in the report, 'Hydrological Aspects of Drought for (1985-86),' (CS-21) which was printed and circulated to various agencies. In the following year (1986-87)



ANALYSIS OF FLOW HYDROGRAPHS FOR NARSINGPUR AND TAKALI SITES INDICATING DROUGHT IMPACTS

STATE-GUJARAT, DISTT.-RAJKOT

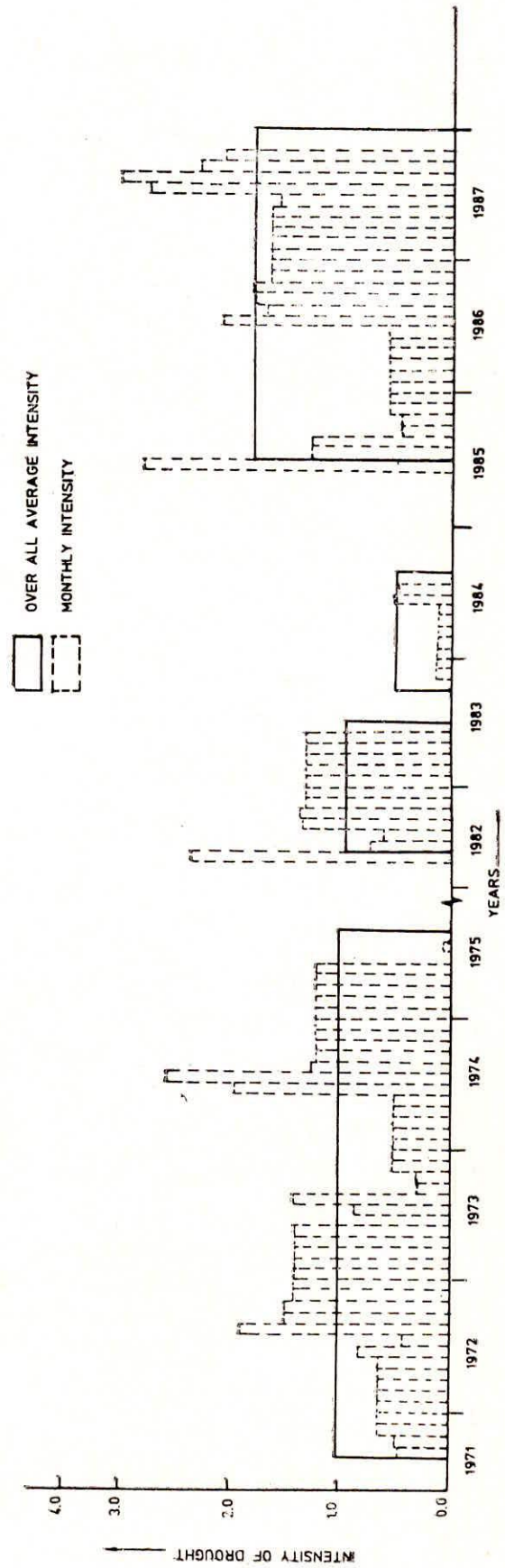
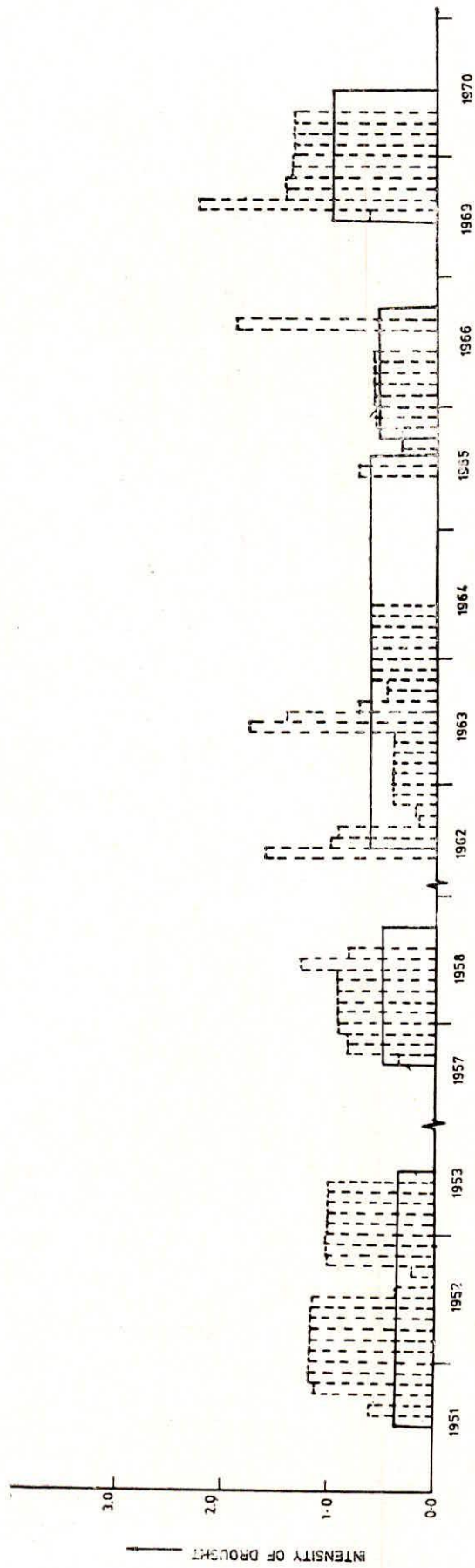


Fig. V (a) : DROUGHT ANALYSIS USING HERBST APPROACH

efforts were intensified to include 4 districts in each six states for the study. Another report giving details of studies highlighting, Hydrological Aspects of Droughts in 1986-87 (CS-24) was prepared and published. This report was released by the then Hon'ble Union Minister of State for Water Resources in November 1989.

In view of continued situation of drought the studies were extended to the year 1987-88. For this study six districts in each of six states were chosen for analysis purpose. These districts are Cuddapah, Anantpur, Chittoor, Prakasam, Kurnol and Mehboobnagar in Andhra Pradesh; Jamnagar, Rajkot, Amreli, Bhavnagar, Surendranagar and Ahmedabad in Gujarat; Bijapur, Belgaum, Gulbarga, Raichur, Bellary and Dharwad, in Karnataka; Khargone, Jhabua, Sidhi, Dhar, Bedul and Shahdol in M.P., Ahmadnagar, Solapur, Pune, Satara, Aurangabad and Sangli in Maharashtra and Banswara, Barmer, Ajmer, Udaipur, Dungarpur and Jodhpur in Rajasthan. Scientific and technical teams of the Institute undertook visits to various district headquarter and state capitals to get data of rainfall, groundwater level and streamflow.

The rainfall data has been subjected to various kinds of analysis including monthly and seasonal departures; probability analysis, Herbst's analysis and dry spell analysis. It was found that almost all districts taken for study from Gujarat, M P, Rajasthan and Maharashtra showed seasonal deficiency in rainfall in 1987-88 by more than 30%. In some districts 100% deficiency in monthly rainfall was observed. In Karnataka and A.P. States the rainfall picture was comparatively better than other four states. The probability analysis of rainfall data from 1901 to 1987 has indicated that all districts barring few exception had less than 80% probability of getting normal annual rainfall. Unlike previous reports, the Herbst's analysis was done taking all 12 month's data. In general 4-12 drought spells were found in these districts during the period 1951-87. The state of Gujarat seems to have had most intense latest drought spell as per Herbst's criteria. The dry spell analysis has yielded the duration of the dry spell from 21-28 days at 75% probability level in all but few districts.

The streamflow analysis has been extended to four new sites of Godavari basin in addition to the earlier chosen sites of Krishna basin. The hydrographs during 1987-88 indicated flows close to minimum flow of last 21 years in case of five sites of Krishna. The analysis of data for Godavari was done upto 1986-87 only due to want of data and the hydrographs showed deficient flows in 1986-87. The annual stream flow volumes were found to be deficient by more than 50% during 1987-88 for Krishna sites as compared to last 21 years data and also for Godavari sites for 1986-87. Statistical parameters of the flow series were evaluated to observe severity of drought years and it was found that most of the sites of Krishna observed severe droughts consecutively for three years. Such analysis for Godavari basin sites indicated moderate drought conditions. The flow series for the sites of Godavari was highly variable as compared to Krishna basin sites. The low flow index values for all sites were established. The analysis also resulted in working out annual maximum deficiency volume and duration for a particular demand level. An analysis to find drought volumes and corresponding drought duration has also been attempted in the report. In order to see effects of monsoon failure on reservoir storages attempts were made to compare storages of some selected reservoirs in some selected months of monsoon season. In most of cases storages in years 1986 and 1987 were recorded less than the previous two years.

The analysis of ground water data was restricted to 30 districts spread over six states. The data from 1976-87, in general, has been used to establish past and pre monsoon trends. The

analysis for the districts of A.P. does not show clear cut picture of ground water regime as a result of drought. The districts in Gujarat have been worst affected ones due to consecutive drought years. In Karnataka, the groundwater picture looked better in year 1987 as compared to previous year 1986. In Madhya Pradesh in general ground water trends (pre and post) were found declining. In Maharashtra state a mixed picture of groundwater level trends was observed with more districts showing falling post monsoon trends. More steeper declining trends were observed during post monsoon levels of the districts of Rajasthan barring few exceptions. In some cases positive development in ground water balance was recorded which is attributed to the contribution of surface water irrigation project in the region.

The report is an attempt of the Institute to bring out hydrological aspects of drought which was experienced by the country during 1987 and is third such study in series. It is expected that with the study of a normal year, the Institute will be able to develop some sound base for developing a comprehensive index for characterising hydrologic drought.

3.2.9 Water Resources Systems Division

The studies and research activities in this division covers the areas of real time operation of single purpose and multipurpose and multi annual reservoirs and system studies of multi reservoir operation. The studies conducted during the year are as follows :—

(i) Operation of reservoirs with real time data.

The current day practice of operation of reservoirs is based on obtaining the inflow information and manual computing the inflow into the reservoir thereby operating the reservoirs for meeting the various demands of water requirements. This process involves enormous time between the information received about the floods, flood inflows and the decision making regarding the releases. This time lag causes either excess as deficit releases and in some cases make even damage structures. The Institute thus felt the needs of developing techniques of reducing the time lag by adopting the real time operation technique. In this technique the data required for the inflow computations are obtained through either VHF or through satellite or through some other mechanism (wireless etc) and computer based model is used to estimate the inflows to the reservoir. The knowing such inflows releases are decided and affected. The software required for such operation of reservoirs was developed by the Institute and presently some case studies are being undertaken. The other programmes include the storage analysis of Tungbhadra multi-purpose reservoir operation for conservation purposes for Pong reservoir. The necessary information and data needed for conducting such studies are being procured.

3.2.10 Man's Influence Division

The studies and research activities in this division covers the following areas :—

(i) Automatic Water Quality Monitoring :

The past few decades have produced a new and accelerated interest in water pollution control activities. Early efforts were primarily concerned with the control of water borne disease, however, it is becoming apparent that water pollution control must be considered as a part of an ecological system which must be continuously monitored and improved if one is to attain the environmental quality goals. This can be achieved through adequate water quality management

on a basin wide basis. In order to achieve this objective, meaningful and economical water quality data collection system are mandatory. It is to this end that this proposed report has been prepared. The report reviews the state of art in this field and to putsforth the experience gained in various countries in automatic water quality data collection techniques. The report brings out definition of automatic water quality monitoring (AWQM), objectives of such monitoring, location of such stations, various parameters to be measured, telemetry, storage and retrieval of data and to give a cost estimates and maintenance of such networks. Automatic water quality monitoring has been used in India to a very limited extent. However its importance for a developing country has already been underlined, probably, the cost involved are the main hinderance hence this report brings out the advantages and involved costs to give an idea of implementing this modern tool.

The study comes out with siting of stations and the role of use of past data, manual vs. automatic stations and system objectives has been stressed. The parameters to be measured are chosen on the basis of need of information available, dependabla instrumentation and economics. The most commonly monitored parameters, by AWQM has bean identified were temperature, meteorological data, conductivity, turbidity, DO, GRP, pH, and chlorides.

(ii) Bio-chemical Demand at Higher Temperature :

Oxygen utilization during the stabilization of organic matter is recognised as one of the most important concerns for characterizing waterquality. The Biochemical Oxygen Demand (BOD) test has been accepted as the standard method for quantifying the oxygen utilised by bacteria. In the present study it was aimed to examine the effects of increased temperatures on BOD exertion rates to facilitate mathematical modelling of oxygen budget in elevated temperature conditions. Water samples were collected from primary setting tanks in sufficient volumes on two separate occasions to allow a series of replicate BOD analysis. The experiments were run at incubation temperatures from 20°C to 45°C. Finally the values of rate coefficient were analysed to assess the range in which optimum growth rate of bacterial occurs. This study is of relevance to Indian conditions because most of the wast treatment systems and receiving bodies in the country have temperatures in excess of 20°C. The study is step towards understanding self purification process in rivers which needs immediate attention.

It has been concluded from the results of the study that the value of the rate coefficient K is maximum in the range of 30°C to 35°C for the samples analysed. This indicates that the optimum bacterial growth rate occurs in the temperature range. The value obtained herein compares favourably with earlier research. Longer test periods are required for experiments of this type to eliminate the possibility of uncertainty associated with nitrification occurring in the 5 to 10 day period.

(iii) Environmental Impact Assessment Studies of Lower Bhavani Basin, Tamil Nadu :

The environmental impact of water resources projects vary greatly with the physiography, climate, soil, characteristics of the river flow, size of project, stage of existing development, socio-economic conditions in the area etc. Keeping in view the crucial role of water resources development for a sustainable growth, the Institute has earlier attempted to contribute in this important area by taking up studies and preparing reports namely identification of hydro-environmental indices, highlighting positive aspects of water resources projects, reviewing of

various techniques of EIA and carrying out environmental impact studies of a completed project in Gujarat.

The present study has been devoted to EIA studies of Lower Bhavani Basin in Tamil Nadu. This study will be helpful in assessing the positive and negative impacts of the project on the environment. In order to conduct the study the data relating to soils, topography, geomorphology, land use pattern, hydrological impact, water supply, flood protection. Changes in ecosystem, socio-economic impacts, water table changes, power generated has been collected. In the part-1 of the report, the study has focussed on the description of the project area, the benefits from the project and the negative aspects of the project vis-a-vis environment. This part is mostly qualitative description of the project and under part-2 of the study, the EIA of the complete project shall be attempted.,

(iv) Modelling of Various Influences Using SHE Model in Sher basin at Beljheri, M.P. :

Effects of forests on various hydrological parameters has been an issue of extensive study. As an outcome of this study as also having acquired the SHE model technology which has the capabilities of modelling the effects of land use changes made in the basin, the SHE model has been used to examine the effects as resulted over years of deforestation in a particular basin namely Sher basin upto Belkheri in M.P. State. This basin was modelled by NIH using SHE model and part of the data for taking up this study were already available. The land use information over years with the help of revenue records and satellite imageries alongwith other hydrological parameters have been collected. The study has given some definite conclusions on the effects of forests on hydrological parameters like runoff, erosion, sedimentation and infiltration etc.

(v) Spatial Concentration Distribution in Mixing Zones in Shallow Rivers :

Waste water effluents are discharged into streams and rivars so as to minimize any potential adverse effects on river water quality by suitable siting of outfalls. Generally for this purpos, pipes or diffuser outfalls located near a bank or at a suitable location in cross-section are employed. The stream zone between the outfall and the nearest cross-section of uniform concentration distribution is known as "mixing zone". Within the mixing zone, a portion of the cross-section termed "limited use zone" or "zone of non-compliance" occurs wherein the concentration of a pollutant may not comply with the specified water quality objective. In the present study an attempt has been made to use mathematical formulations applicable to mixing zone in rivers to develop a model. Various parameters, their reach dependency, decay functions, etc have been studied. An attempt has also been made to give computer programmes applicable to personal computers. Such studies shall give an insight into mixing of pollutant in rivers and the exact spots where effluents should be discharged in flowing waters.

3.2.11 Information System

Information system division envisages to document information concerning different facts of hydrology. Preparation of hydrological data year book for different river basins is one of the major task. Thematic maps on different hydrologic themes for selected river basins are being prepared. A compilation of hydrological information of India is also under preparation for the year 1988-89. Hydrological data year book for Hemavatty river basin has been prepared and

circulated. The similar data year book for Sabarmati basin is under preparation. User Manual on Data Storage and Retrieval System has been prepared.

Besides, software for Library information management has been designed, The technical library which has been functioning with these division has render commendable service to readers and has procured a good number of books, journals etc. dealing with hydrology and water resources to enrich its collection. The total books and reports so far procured has crossed seven thousand mark.

3.2.12 Hydrological Investigation Division

This division is engaged in carrying out research in the area of soil moisture studies using nuclear and geophysical techniques and development of hydrological instrumentation. The division has prepared the following report :

(i) Soil moisture Measurement and Management in Agricultural Fields

Soil moisture content is an important variable that determines the response of a soil plant system to any water input. Continual monitoring is therefore, of significance in irrigation management. Determination of soil moisture content, its variation in time and space and redistribution during and after rain fall or irrigation are necessary in order to decide when to irrigate and what is the optimum quantity of water needed in agricultural fields. As successful crop production requires an adequate supply of soil moisture throughout the growing season, it is essential to study the factors influencing the soil moisture movement in agricultural fields.

In this report a brief discussion on several methods available for the measurement of soil moisture content and soil moisture tension with particular emphasis on the methods making use on neutron probe, gamma-ray spectrometer and tensiometer have been given followed by comprehensive review on the effective applicability of these methods for the measurement and movement of soil moisture in agricultural fields.

3.2.13 Atmospheric Land Surface Modelling Division

A brief description of the studies carried out by Atmospheric Land Surface Modelling Division and the reports prepared by the division during the year are given as under :

(i) Long Range forecasting of onset of Drought conditions in tropical and subtropical regions.

Droughts of great magnitude in various tropical and sub-tropical regions have been a matter of concern in the recent past. Their socio-economic consequences have resulted in the studies and research on predicting the droughts well in advance. The long range prediction of droughts has been based on the analysis of various meteorological events that usually prevail before the drought occurs.

The present report deals with the long range forecasting of onset of drought condition in tropics and sub tropics with special emphasis on forecasting of Indian monsoon, the ill distributed rainfall accompanying which results in droughts over different parts of India. The meteorological

conditions in the tropics and sub-tropics have been emphasised in the note and the physical linkages of various parameters as atmospheric circulations, surface temperature, sea surface pressure and temperature, EL Nino and southern oscillation, sunspot cycles and snow cover with drought conditions have been discussed. The techniques applied in long range forecasting of rainfall in tropics, specially in India have been reviewed.

(ii) Acquisition of land surface parameters for GCM

The two major uses of land surface climatological parameters are (i) for advancing the state of the art of climate modelling and prediction, and (ii) for monitoring climatic changes and impacts in those transitional regions of the globe that are most sensitive to such changes. The best way for the derivation of land surface parameters for the use in General Circulation Models (GCMs) is from satellite of establishing homogeneous data sets for parameters such as extension of seasonal snow cover, ice sheets, tropical forests and rangelands. Consequently, satellites are the ideal tool for any study for which extent is global and the timescale long. Such measurements may therefore greatly contribute to study of climate change and their impact. The land surface parameters to be acquired for GCM are the vegetation index, surface radiation budget, surface temperature, snow cover and depth, precipitation, soil moisture and evapotranspiration.

The entire area of determination of land-surface quantities from satellite observations though apparently feasible for most, is still in the research and development stage, with the one exception of snow cover extent. The most critical requirement at present is for pilot field studies to test and validate the existing techniques. The aim of the present study is to review the current status of the derivation of land surface climatological quantities from satellite and land based observations for the use in atmosphere land surface coupled models.

3.3 Consultancy Projects

The Institute has been carrying out the research studies sponsored by various States/Central Government Organisations. The following consultancy projects have been taken up and are in progress.

(i) Water Accounting Studies in 7 Problem Districts belong to 7 States

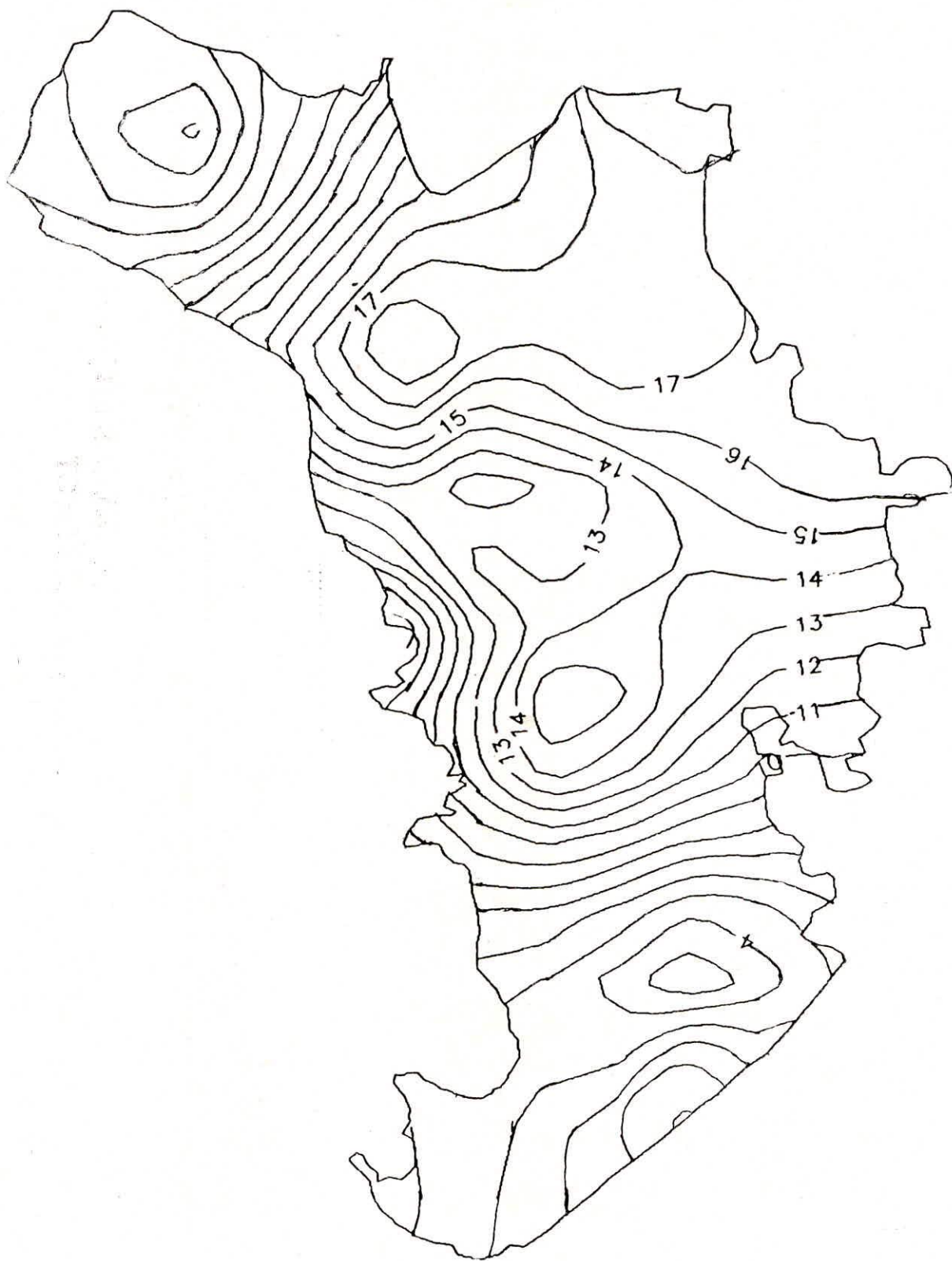
National Institute of Hydrology was entrusted to undertake the study for development of a model to forecast the availability of drinking water in drought prone areas of the country linking it with monsoon performance. Drinking water availability has to be assessed both from surface water sources and from ground water reserve. With the ever increasing demand of water supply and inadequate surface water in drought prone areas more attention has to be given on ground water reserve.

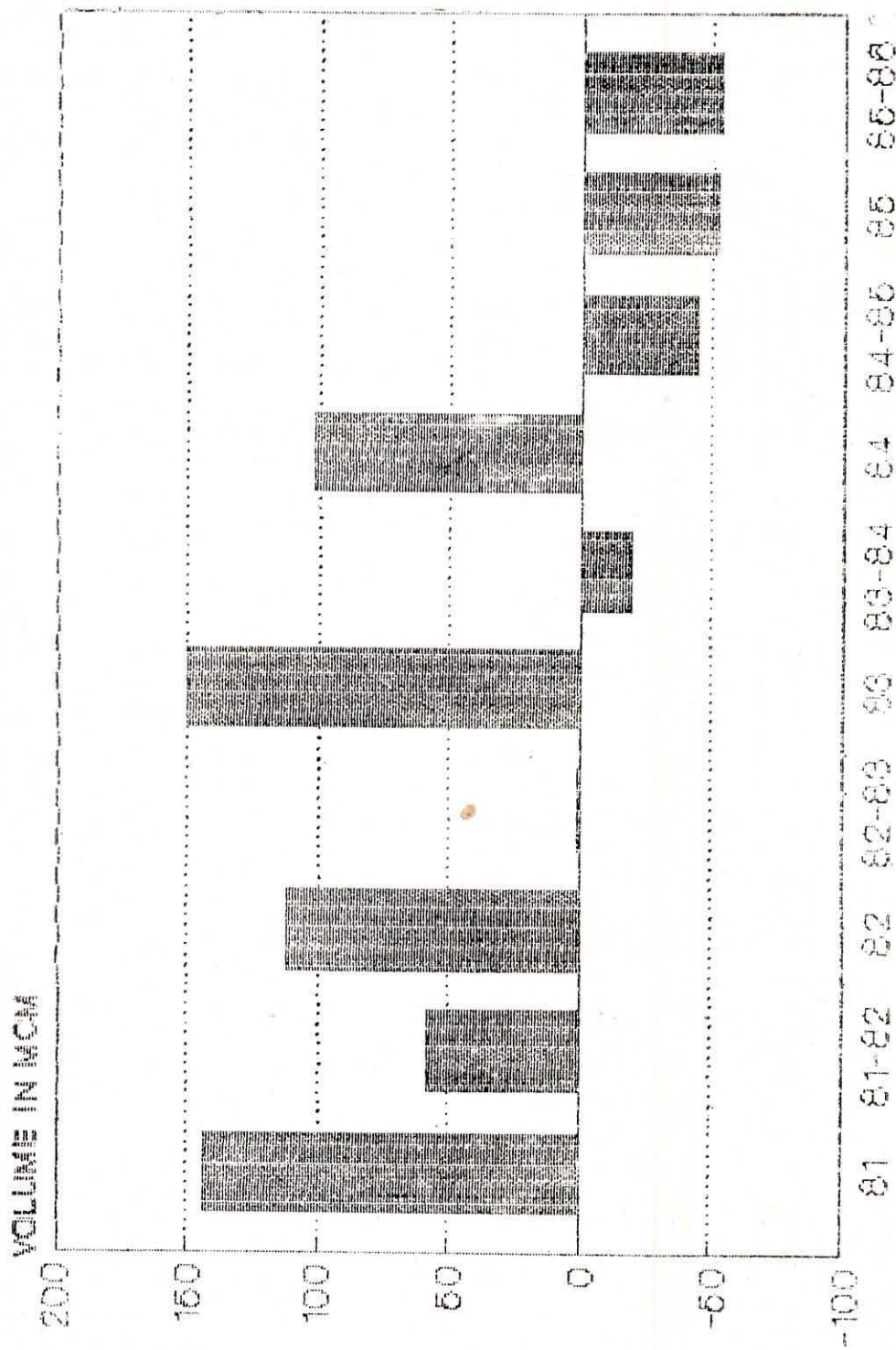
The study on the project 'Water availability studies in 7 drought prone districts' in the states of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Orissa and Rajasthan is going on satisfactorily. Interim report containing estimation of dynamic and static storage of groundwater for Jamnagar district has been prepared and such report for Kutch district is under preparation.

(ii) Predictive Model Studies for Water Availability in Sabarmati River Basin

A two dimensional finite difference model will be developed to simulate the aquifer behaviour in the Sabarmati River Basin considering the interaction between surface and sub-surface water

DEPTH TO WATER TABLE DURING MAY 1987





YEAR
 GROUNDWATER AVAILABILITY OF
 JAMNAGAR DISTRICT

bodies with subsurface water. Various components of recharge and discharge to and from aquifer system would be identified and water balance studies would be conducted. The rainfall recharge to the aquifer system would be studied after calibration and validating the model thus developed with the historical data. Later the same will be used for forecasting water table levels on monthly basis for various scenarios of rainfall.

The project would involve in processing and analysis of data and development of ground water model. Most of the data has been collected from the concerned agencies and the water balance studies are being initiated.

(iii) Reservoir Operation Studies for Machhu System

The work on this project sponsored by Gujarat State Water Resources Department has progressed well during the year. Using the monthly inflow series for Machhu-II reservoir for the period 1958 to 1984 and information about average monthly water supply and irrigation demand, etc. a number of rule curves for reservoir operation were developed using various scenarios. An exhaustive reservoir operation simulation study was undertaken using these rules curves and after inter-comparison of the results, the operation policy, that best met the objective of the conservation storage regulation, was recommended. A draft of the report for conservation storage regulation on Machhu-II reservoir was sent to Govt. of Gujarat in February 1990.

The procedure for flood control operation of the reservoir is being developed incorporating operation rule considering reservoir level, rule level, inflow, rate of change of inflow, and downstream channel capacity.

(iv) Preparation of Reservoir Operation Manual and Flood Forecasting System of Dharoi Project

The Sabarmati system consists of five main rivers: Sabarmati, Sei, Wakal, Harnav and Hathmati. The major structure in this system is Dharoi dam which is located on river Sabarmati at a distance of 165 km. upstream of Ahmedabad. The storage capacity of Dharoi reservoir is 7.36 lakh Aft with a catchment area of 2179 sq. km. The purposes of the reservoir are to moderate the incoming floods so that the controlled discharge at Ahmedabad city does not exceed 5 lakhs cusecs, to meet water supply requirements for the city of Ahmedabad and to meet irrigation demands in the command area. The major tributaries viz., Sei and Wakai, join the river Sabarmati upstream of Dharoi dam. Each of these tributaries has one dam built on them.

Objectives of the present study as suggested by Irrigation Deptt. are to prepare operation manual for Dharoi reservoir for conservation as well as flood control purposes and to develop operation procedure for Harnav, Guhai and Hathmathi dams for irrigation purposes and also to prepare a suitable flood forecasting scheme for the operation of Dharoi project.

(v) Hydrological Studies at Karwar

A naval base in Karwar was proposed with total frontage of nearly 4 km to be covered by the harbour. The studies require to identify the seasonal fluctuations of the ground water level, the slope of the ground water level, from the hills to the beaches and the permeability of the sandy layers, in order to avoid block up the water front from solid quay walls thus creating water pressure and for designing weep holes for providing access for natural flow of sub-soil water under varied conditions of the tidal waters. The project is yet to be offered to the Institute.

(vi) Study of Interaction of Surface and Groundwater for River Ganga from Narora to Kanpur

This consultancy project has been referred by Investigation and Planning of Water Resources, U.P. The purpose of the study is to find the exchange of flow rate between river Ganga and the adjacent aquifer between Narora and Kanpur during the passage of the floods and during the lean flow period. The data have been supplied and the study is under progress.

(vii) Scope of Work for Software on Water Management Regulation for Optimum Use

The work involves formulation of computer module for optimisation of power generation from water resources projects with implications of thermal power stations additions in the future. The task pertains to be development of reservoir operation criteria and forecasting system with a view that full hydro energy is utilised and spill is avoided or minimised to the maximum extent.

The hydro power stations in the area cover a wide variety of schemes with complex inter-connections and inter-dependent operation. The storages provided vary from a limited pondage/seasonal storages to large carry over storages. This introduces complexity of operation and decision taken at any point of time would have both short term and long term implications. Hence the operation of the hydro stations would have to be carefully analysed to maximise the power benefits and minimise the wastage of water at the same time meeting the capacity and energy requirements as also any commitments of power supply outside the area.

In addition, operation of some of the reservoirs and power stations may involve upstream diversions for irrigation minimum release requirements for downstream commitments to provide irrigation, salinity control, drinking water supply, industrial water requirements etc. The big hydro power projects would have to operated on the basis of a long term carry over operation while water supplies to reservoirs in the border areas are to be regulated by inter-state agreement. The coordinated operation of this complex system of hydro power stations may have to be operated to ensure maximisation of the benefits and also enable evaluation of options available for operation and their implication in the context of uncertainties in regard to the future flow.

viii) Flash Flood Studies of Bist. Doab Region in Punjab.

In July 1985 there was a flash flood in the Bist Doab region of Punjab resulting in the failure of the training works of various flashy streams (locally known as choes) and extensive damage to Jalandhar Pathankot railway line for a distance of 36 km. Also the Jalandhar distributary got damaged extensively due to this flash flood. There was about 60 cm. rainfall recorded just in four days which was supposed to be responsible for the flash flood causing extensive damages in the region.

Keeping in view the extent of damages caused by the flash flood, Government of Punjab has referred the above study to NIH, in order to suggest some improvements, if required in the existing engineering measures after comparing their design floods with estimated peak discharges due to the un-precedented rainfall during July 1985 for the respective engineering measures. Furthermore, the design flood estimates would also be expected to be revised for various engineering measures proposed in the region in view of the unprecedented rainfall event.

During 1989-90, the data requirements for the above study have been prepared after discussing with executive engineer and Chief Engineer, Punjab Irrigation and Drainage Work. Subsequently they have been requested to provide the required data to carry out the study. A part of the required data has been received from the Chief Engineer, Punjab Irrigation and Drainage Deptt. and being processed. The remaining data would be collected from the Office of the Chief Engineer, Punjab Irrigation Deptt. Meanwhile, mathematical formulation for the above study is in progress.

3.4 Participation in Seminar/Symposium & Papers Published.

The Scientists and Scientific staff of the Institute have participated in several national and international Seminar/Symposium/Conferences as shown in Appendix VIII and have published a number of papers in scientific journals as listed in Appendix IX.

40. FACILITIES

4.1 Buildings and Infrastructural

The extension to the experts guest house has been completed and is being equipped. The field hostel which was constructed during the last year became operational. The extension of laboratory block with a committee hall was completed. The construction of Museum-cum-Recreation Centre, 2nd lab block are progressing well and are expected to be ready during the next financial year (1990-91).

Construction of garrages, water tank are at the initial stages. The approach road to the field hostel is nearing completion. Efforts are being made for the procurement of the land for the construction of staff colony and it is expected that during the current financial year, the initiation of construction activity will be made. For the convenience of the staff working in the Institute, intercom facilities have been provided.

4.2 Maintenance

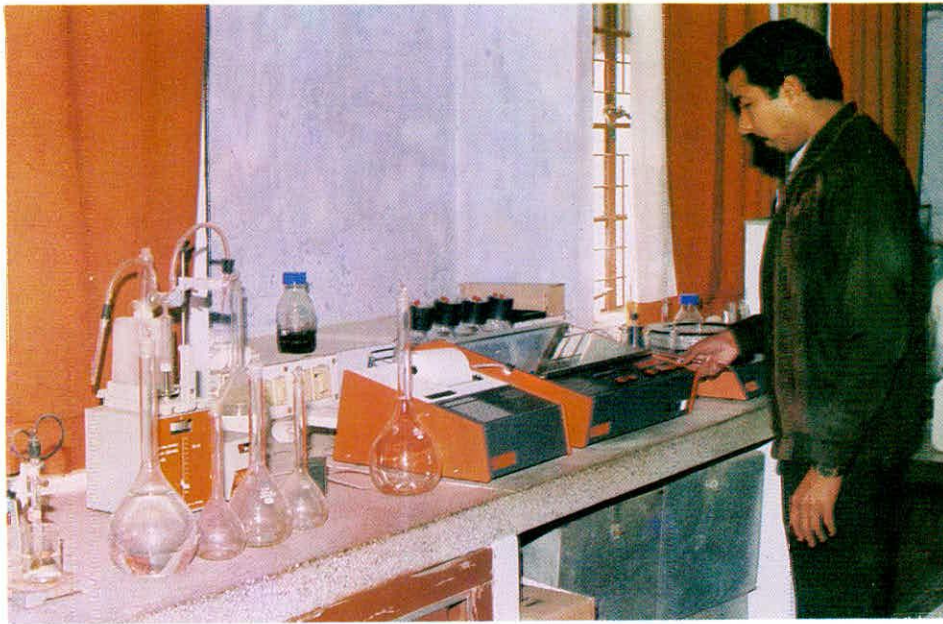
The Institute has established a maintenance services with the responsibility of looking after the civil and electrical maintenance of the campus, watch and ward of the Institute. Besides this, the division also takes up minor construction works, campus upkeep, horticultural activities, maintenance of lawns and gardens, water supply, power supply, operation of D.G. set, operation of AC plant etc. The unit carried out all the routine jobs satisfactorily as well as took up number of minor construction works relating to civil items like installation of AHS etc.

4.3 Laboratories

4.3.1 Water Quality Laboratory

The water quality laboratory in the Institute has been in operation for the last four years. It is being efficiently utilised to monitor surface and ground water quality of various water bodies like rivers, canal and for other sources of water. The laboratory has the capability to take care of physical, chemical and to a limited extent biological parameters. During the year some major equipment like Gas chromatograph, SGT meter and Laminar Flow were procured. The laboratory is now equipped with Flow Injection Analysis System (FIASSTAR), COD assembly, water testing kits, BOD incubator, Flame photometer, Microscopes etc. The laboratory has the capability to determine almost 80 physical, chemical & biological parameters with different degree of accuracy.

During the year, water samples were collected from the river Gangas at different locations, from the canal, from wells and other sites close to land fill sites to generate data for use, in mathematical models as well as for collection of base line data. The complete analysis and interpretation is being done in the laboratory.



Flow Injection Analysis System



Scientific Staff at work on Computer

4.3.2 Ground Water Laboratory

The ground water laboratory was set up in 1987 with the prime objective of carrying out studies relating to flow through unsaturated soil, two phase fluid flow, two dimensional seepage and ground water recharge. The laboratory is equipped with infiltrometers, constant head and falling head permeameters, tensiometers, electric analogue apparatus, Hele Shaw apparatus, and equipment for determining grain size distribution.

During the year, particle size analysis and permeability measurements were carried out for soil samples taken at different sites in Kolar basin (M.P.) for SHE model studies.

4.3.3 Hydrological Investigation Laboratory

The hydrological investigation laboratory has the main objective of proper evaluation and assessment of water resources using nuclear and geophysical techniques. It also intended for development of hydrological instruments. The laboratory has a Troxler nucleonic gauge, infrared moisture balance, radiation survey meter, resistivity meter, electronic balance, synchroscope and other general purpose electronic equipment. The nucleonic gauge is being used for estimation of soil moisture content in unsaturated zones.

4.3.4. Hydrometeorological Observatory

A class I hydrometeorological observatory has been functioning at the institute premises since 1985. Parameters like rainfall, temperature, humidity, evaporation and wind speed and direction are measured twice daily using both manual and autographic instruments. The variation of rainfall and temperature (Max and Min) during 1989-90 are shown in Figure VI.

4.3.5 Automatic Hydrologic Station

For proper understanding of different components of Hydrologic cycle, the hydrologists need data of various hydrometeorological and hydrological variables with considerable precision and accuracy. With this long felt need, the Institute procured Automatic Hydrologic Station (AHS) from CIR, Switzerland under UNDP programme. This is the first of its kind in INDIA and has the facility for continuous sensing and automatic digital recording of parameters like; Air temp., Soil Temp. at three different depths, wind velocity, humidity sunshine duration, rainfall, atmospheric pressure, differential weight of the Lysimeter, runoff from the Lysimeter, and infiltration value through the Lysimeter, conductivity of soil at three different depths, balance radiation and global radiation on Cassette in addition to printout on paper. During the year the Station was installed by Gujarat Communications Electronics Limited (GCEL), Baroda, Gujarat and made operational. Short interval (30 minutes data) for all above hydrometeorological and hydrological parameters are being acquired and recorded continuously. The staff of the Institute has been able to develop methodologies to transfer the tape recorded data on to hard disc of PCs/Floppies or on VAX-II/780 main frame computer system for further processing and retrieval. The system is being operated and maintained by the Institute staff.

The data of AHS will be useful for :

1. understanding and establishing the inter-relationship between different components of hydrologic cycle.

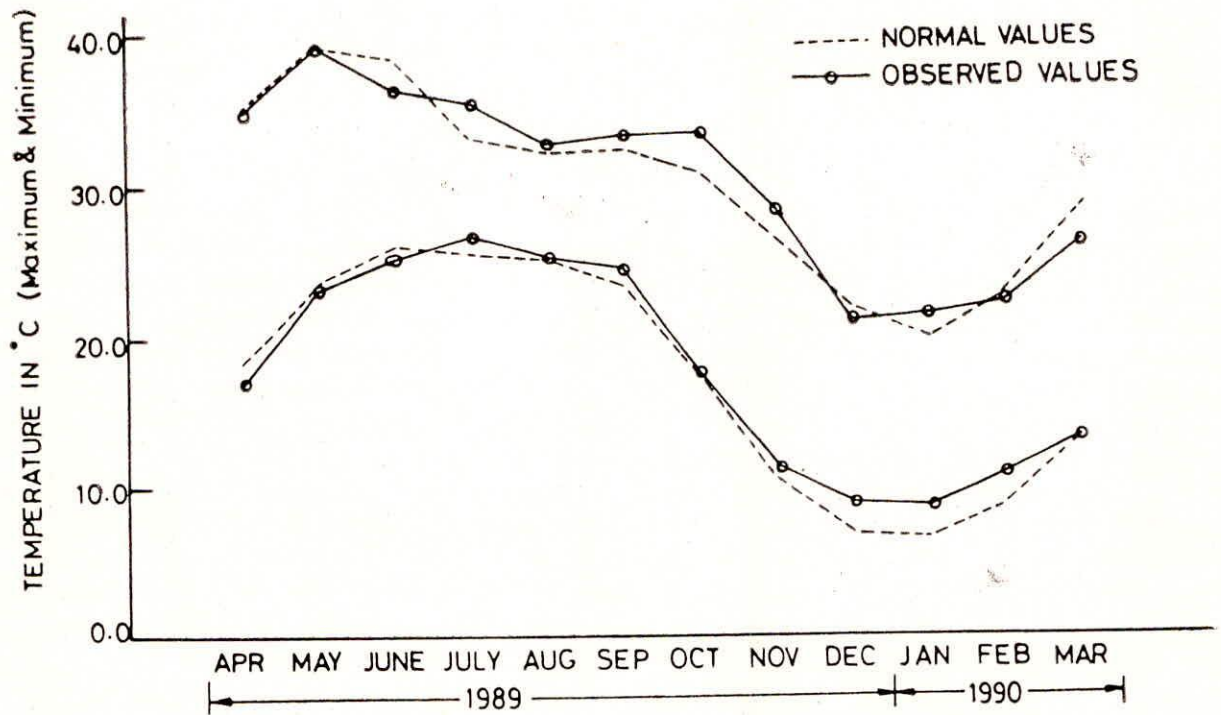
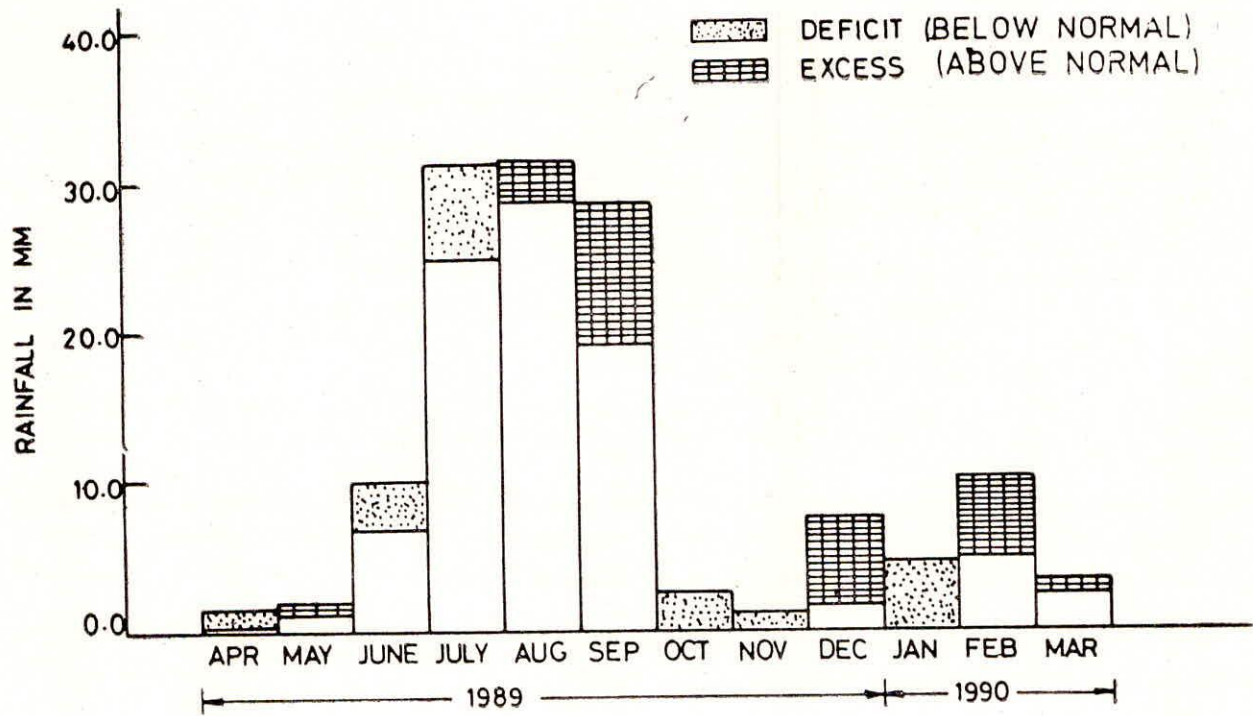


FIG. VI : SUMMARY OF OBSERVATIONS MADE AT NIH HYDROMET OBSERVATORY

2. developing and validating the hydrologic cycle.
3. developing and implementing the procedures for the use and analysis of short interval data,
4. testing and developing the models for computation of actual evapotranspiration,
5. providing help in carrying out water budget studies in representative and experimental basins.

In addition it will help in familiarisation of Scientific man power with the working of latest hydrologic instrumentation and data acquisition system for hydrologic collection and development of a model station for demonstration purposes.

4.3.6 Laboratories of Regional Centre

The regional centres are having field laboratories for conducting representative basin studies. Two set of observatories are operational in Ghataprabha and Malaprabha river basins.

The Institute has also procured large format optical enlarger, optical reflecting projector, light table with coordinate measuring system and D.C /A.T. with EGA map, Personal Computer for the regional centres established at Belgaum in Karnataka and Guwahati in Assam.

The regional centre at Jammu has started functioning since January 1990. Personal Computer, equipment for interpreting Remotely Sensed Data, Meteorological equipment have been purchased.

4.4 Central Service Facilities

For having proper coordination and utilisation, certain facilities like drawing office, photo copying section have been brought under Central Service Facilities Cell.

4.4.1 Drawing Section

The Institute is having the drafting facilities in the drawing section on besides the tracing facilities. The section is having ammonia printing facilities, pentograph, digital planimeter etc. This section fulfils the requirements of the entire institute in preparing maps, graphs, drawing of contours and other associated works which are required for preparation of technical reports, technical papers etc. Drawing equipment Rotring NC Scriber CS-100 has been procured during the year.

4.4.2 Duplicating and Photocopying Section

The Institute has 4 photocopiers and 2 duplicators. The requirements of duplication works of the various scientific divisions are carried out by this section, These facilities are also utilised by the Administrative Wing of the Institute for carrying out day to day administrative works

4.6 Central Technical Facilities

4.5.1 Computer Centre

The Institute has VAX-11/780 computer system with VMS 4.2 version. The configuration includes two removable disk drives, one winchester drive, two tape drives, 13 monochrome

terminals, one colour graphic terminal, one digitizer, one line printer, one dot matrix printer, one card reader and one dual mode plotter. In order to increase use of computers in administrative and finance wings, one IBM compatible PC/AT is given to each of these wings. Besides this Director and the Sr. Scientists have been provided with one IBM compatible PC/AT. This has tremendously increased the use of computers in both scientific/administrative and technical use. Other users have been provided with 5 IBM compatible PC/ATs located at the computer centre itself.

The Institute also procured VAX-3200 work station with networking facilities with VAX-11/780 main frame system. The software developed on the main frame system were solving various hydrologic problems are being modified so as to run on personal computers. This will facilitate in disseminating the hydrologic programmes to the various users of State and Central Departments. Some of the software thus developed in Personal computers have already been provided to the various states where the dissemination programmes have been organised.

Necessary environmental conditions were provided with 30 tonnes central air-conditioning plant. The computer centre was also connected with an interrupted power supply unit supported by a battery bank to take care of the frequent breakdowns. For longer run during the power supply a Diesel Generating Set of 125 KVA capacity is also operational.

4.5.2 Remote Sensing Applications and Photographic Laboratory

Remote Sensing Applications Laboratory was established during 1986 to develop capabilities to prepare outputs by interpretations of imageries as an input to hydrological studies. The Laboratory is equipped with large format enlarger, diazo printer, mirror stereoscope, optical pentagraph, colour composite printer, spectra radiometer, GT radiometer, stereozoam transfereoscope. An image processing console comptal vision 1/20 has been installed in computer centre for having protection from the restricted environment conditions.

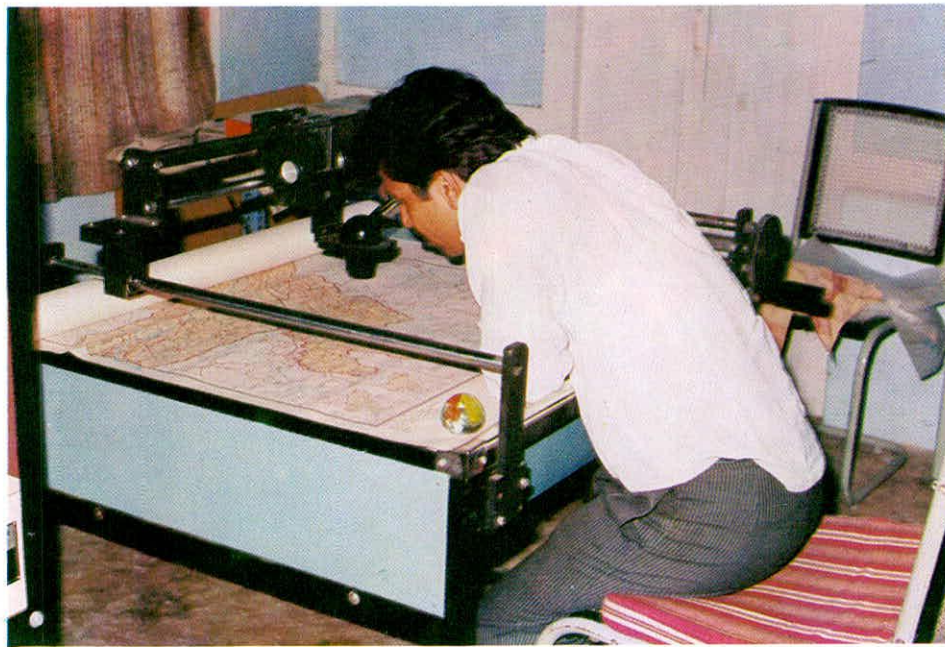
Multi temporal laboratory of Landsat film negative images (1,000,000), MSS/MT, Landsat (MSS/TM), FCCS (1 : 250,000) CCTs for a number of scenes covering various hydrological regions of India has been set up for various remote sensing applications studies pertaining to snow hydrology, drought studies, flood plain mapping, land use/vegetal cover, sedimentation etc. A photolab has also set up to meet the requirements of visual processing.

4.5.3 Workshop and Service Instrumentation Unit

The instrumentation service facilities have been developed to the day to day maintenance of various equipments in different laboratories of the Institute. A mechanical workshop equipped with required machinery is in operation. Apart from attending to the maintenance jobs, the workshop also fabricates instruments for the groundwater laboratory and provides support required for various laboratories.

4.6 Library

The Institute has a well equipped library. Large number of scientific books, journals, documented computer programmes, technical reports, Indian and foreign standards, atlases, maps related to various areas of hydrology are available in the library. Besides the scientific



**Analysis of map using light table with
Coordinating measuring systems**



**A view of Large Format Optical Enlarger in
N.E. Regional Centre, Guwahati**

books, the institute is also procuring some of the books related with the use of Hindi in the office. Some of the bilingual dictionaries and scientific glossaries have also been procured in various regional languages. As on 31 March 1990, the library has 4848 books, 2454 technical reports, 72 Indian and Foreign periodicals, 958 technical papers, 247 standards, 442 computer manuals, 41 microfiches and 1975 maps.

The library in its continuing efforts to serve the readers in an effective and better way has services of documentation and reference.

5.0 REGIONAL PROGRAMMES

5.1 Interaction with States

The Institute is closely interacting with various state organisations with their officers represented on its Advisory Bodies such as Technical Advisory Committee, Working Groups and through informal discussions with officers. There is close interaction with State Water Resources Organisations and Irrigation Departments of a large number of States. Special efforts have been made by the Director and Senior scientists to visit the states and have a first hand idea about specific hydrological problems typical to the states and to properly reorient the studies and research workplan to the various divisions in the Institute to suit the needs of the States.

Visits have been made by the Director to Assam, Bihar, Gujarat, J & K, Karnataka, Maharashtra, Rajasthan, Tamilnadu, Uttar Pradesh, West Bengal. Senior scientists also visited Assam, Jammu & Kashmir, Gujarat, Madhya Pradesh, Rajasthan, Tamilnadu, and had discussions with engineers in the State and personally visited the study areas for first hand assessment of the problem and the likely techniques that may need to be adopted for providing solutions. The studies proposed to be taken up with different states and the status of inter-action with states is given in Appendix X and also presented in Figure VII in figure form.

5.2 Regional Centres

The hydrological problems of different regions of the country are unique due to differences in climate, physiography, geology, land use and vegetal cover characteristics, soil, drainability, environmental conditions, state of development etc. As such no general approach can be used for the entire country while analysing hydrological data for planning of water resources development. Techniques have, therefore, to be developed in data analysis and planning, procedures have to be evolved specific to the region of interest taking into account the special problems due to occurrence of extreme events like floods and droughts.

Keeping in view these requirements of different regions of the country, the country has been divided into 7 regions from the consideration of viability and operation (Figure VIII).

During the 7th plan period, 3 regional centres were to be established in the Deccan hard rock region. North eastern mountainous region and North-western Himalayan region, The regional centre for Deccan hard rock region was established at Belgaum in June 1987 and is functioning satisfactorily. The regional centre for North-eastern mountainous region was established at Guwahati in Aug. 1988. These centres have started working with skeleton staff and have made reasonable progress with the assistance of states in the respective regions. The regional centre for North-western Himalayan region is established at Jammu in Jan. 1990.

5.2.1 Deccan Hard Rock Region at Belgaum

The following studies have been taken up and are in progress :

	ANDHRA PRADESH	ASSAM	BIHAR	GUJARAT	HIMACHAL PRADESH	J & K	KARNATAKA	MADHYA PRADESH	MAHARASHTRA	MEGHALAYA	ORISSA	PUNJAB	RAJASTHAN	TAMIL NADU	UTTAR PRADESH	WEST BENGAL
CONSULTANCY	①			2+② ①			①	①	①		①	1		①	①	
WORKSHOP	2	2	1	1	1	2	2	1	2		1	1		1	1	2
RAINFALL STUDIES & NETWORK DESIGN		1			1	1	1	1					1			
HYDROLOGICAL STUDIES	2		1	1	4	6	4	2	2		1		1	6		5
REGIONAL FLOOD FORMULAE					1		1	1					1	1		
HYDROLOGY YEAR BOOK		1		1		1	1				1		1		1	1

LEGEND :

COMPLETED

IN PROGRESS

PLANNED

NOTE : PROJECT STUDIES REFERRED BY CENTRAL GOVERNMENT ARE CIRCLED

FIG. VII : STATUS OF INTERACTION WITH STATES

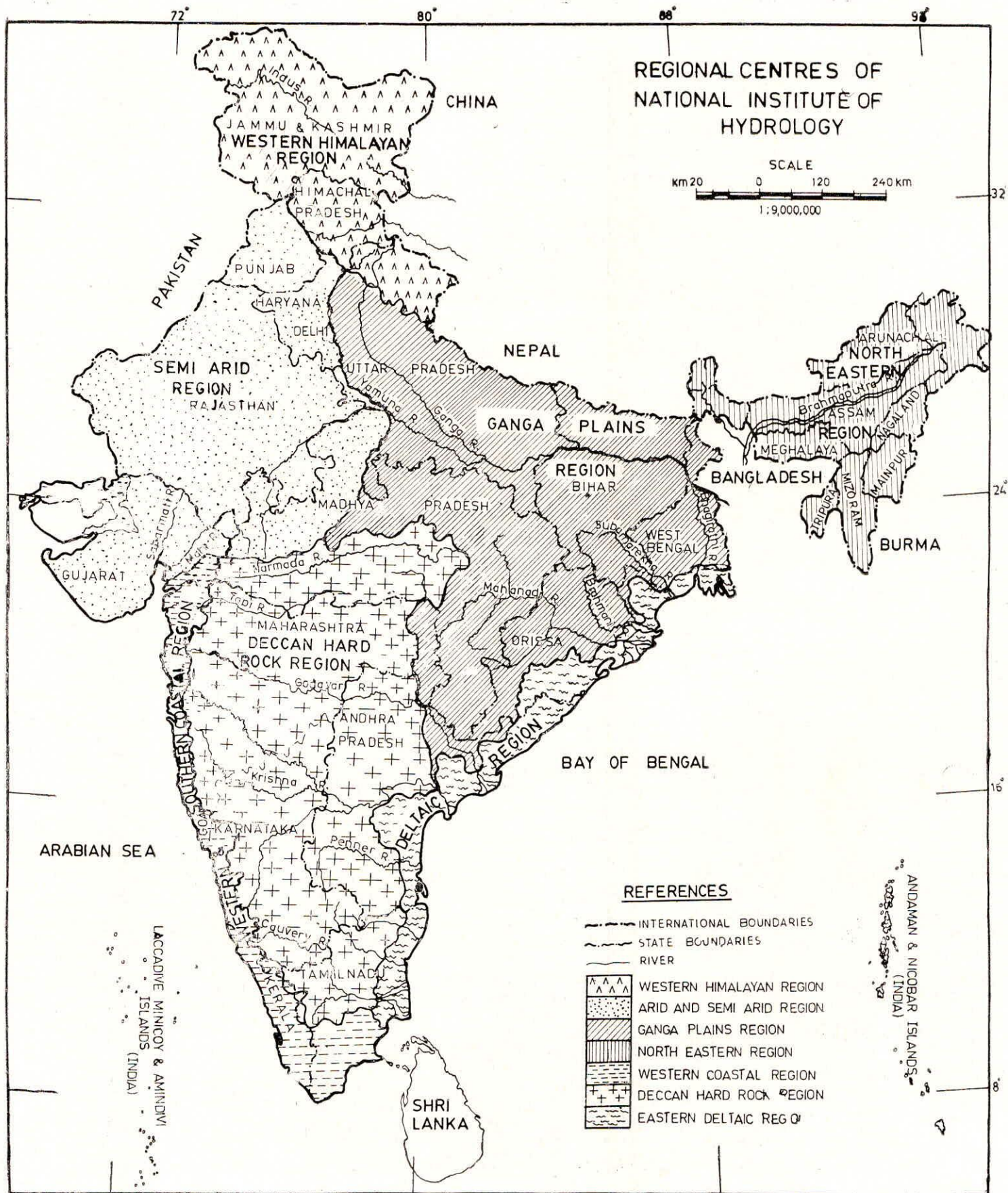


FIG. VIII : REGIONAL CENTRES OF NATIONAL INSTITUTE OF HYDROLOGY



**Hydrometeorological Observatory Halkarni Hard
Rock Regional Centre, Belgaum**





**Raingauge Mahagaon Hard Rock Regional
Centre, Belgaum**



Soil type in Ghataprabha Catchment

i) Representative Basins Studies

Representative basin studies were to be carried as part of the work programme. Originally Malaprabha catchment was identified. Subsequently the Union Minister suggested that Ghataprabha catchment may also be taken up. The existing network was studied. In both the basins in addition to existing network, additional raingauges and one observatory each have been established. The observation and collection of data from the two representative basins has been in operation since Jan. 1989. The infiltration tests are being taken up since the scientists are expected to be in position by the end of March.

ii) Studies on Hydrological aspects of Droughts

Four districts each in the states of Andhra Pradesh, Karnataka, Maharashtra and Madhya Pradesh were selected for study of the hydrological aspects of drought during the years 1985-86 and 1986-87. The analysis has been carried out for daily, monthly and annual rainfall, ground water levels variation and stream flow analysis for nine sites in Krishna basin. The reports on the studies for 1985-86 and 1986-87 have been published and Report for the year 1987-88 are in progress,

iii) Regional Flood Formulae

The upper Convery basin in Karnataka was identified for carrying out these studies. Most of the data has been already collected by the staff for these studies. The studies are likely to be taken up soon.

iv) Reservoir Water Balance

On the basis of the discussions with the engineers of Karnataka, Tungabhadra and Hathikoni reservoirs were identified to study the leakage and seepage from the bed of the reservoir. Most of the data for reservoir water balance of Tungabhadra reservoir has been collected. Studies are in progress.

v) Conjunctive Use and Irrigation Return Flow

The data for Ghataprabha basin has been collected to study the conjunctive use & irrigation return flow.

vi) Hydrology Year Book

The data for Hemavathi basin has been collected and compiled for preparation of hydrology year book.

vii) Reservoir Sedimentation Studies

The staff at the Regional Centre are collecting the necessary field data for the ground truth for Tungabhadra and Ghataprabha reservoirs.

viii) Hydrological Network Improvement

Hydrometeorolgy data of Belgaum, Dharwar districts in Karnataka for the past ten years has been collected.

(ix) Evaporation from Tanks

The data for evaporation from tanks in Maharashtra is being collected for studies to be conducted later.

5.3.2 North Eastern Regional Centre at Guwahati

The following studies/works have been taken up and are in progress at the Regional Centre :

- (i) Representative basin study for Kulshi subbasin is in progress. The basin has been selected in consultation with the official of Irrigation Deptt., Govt. of Assam and Brahmaputra Board. The map of the basin and other relevant maps have been procured and the hydrometeorological network for the basin is being designed so that the instruments can be efficiently installed.
- (ii) In consultation with Irrigation Department and Brahmaputra Board, it was decided to prepare water year book for Jamuna sub-basin with an area of 1600 sq. km. The various organisations are collecting the data for the basin and are being contacted for data collection. This study is being taken up on the lines of the study for Hemavati basin (Karnataka) which has already been completed.
- (iii) During the discussion with official of Irrigation Deptt., Assam at different times, it was expressed that Jorhat district is facing acute ground water pollution problems. Study has been initiated to assess the ground water pollution in the Jorhat district.
- (iv) Effects of deforestation and afforestation on hydrological regime in the Jamuna subbasin of Kopilli basin has been started by collection of relevant information and contacting the organisations for collection of data.
- (v) A workshop on 'Flood Estimation by Unit Hydrograph Techniques' was organised at Guwahati from August 20 to September 1, 1989 which was coordinated by the North-East Regional Centre. The workshop was attended by 23 participants from Govt. of Assam and Central Govt. organisations.
- (vi) Interaction is being done with the various Central and State Govt. organisations for collecting relevant information and assisting in the studies relating to PC Software development and use of remote sensing techniques for hydrological studies. These organisations include CWC, Brahmaputra Board and the Irrigation and Flood Control Departments of Govt of Assam.
- (vii) Data collection has been started for various studies which have been under taken by the Institute in the NE Regional Centre. The information relating to maps, hydrology and hydrometeorology of basins etc is also being collected.
- (viii) A report is being prepared on hydrometeorology of Brahmaputra basin. This report is being compiled to bring at one place various studies which have been earlier done, the hydro-meteorological maps which have been prepared by various organisations so that a complete picture of the hydro-meteorology in the basin is available at one place.
- (ix) The satellite imageries for the NE Regional have been procured and are being interpreted by the equipment which has been installed and is operational at the NE Regional Centre.

5.2.3. North Western Himalayan Regional Centre at Jammu

The Regional Centre for Western Himalayan region was established in the Rawi Tawi complex, Irrigation and Flood Central Department of Jammu. The Centre started functioning since January 29, 1990. Personal Computer, Equipment for Interpreting Remotely Sensed Data, Meteorological equipment have been purchased.

5.3 Transfer of Technology

Towards the fulfilment of objectives of technology transfer, the Institute organises symposia and a series of workshops with National, Regional and International participation.

5.3.1 Workshop Organised

With the objective of transfer of technology to State and Central Government Organisations the Institute is conducting workshops on specialised topics of Hydrology. The workshops organised during the year were directed towards the surface hydrology including Flood routing and flood forecasting, Flood estimating by unit hydrograph techniques, Modelling of hydrological systems and Ground water modelling. Eight such workshops have been organised - 3 at Roorkee and 1 each at Bhopal, Guwahati, Hyderabad, Madras and Srinagar.

The Institute also organised one Regional Workshop in the area of Modelling of hydrologic systems at Roorkee in Jan. - Feb. 1990.

These workshops have provided to the practising engineers and scientists of various organisations an opportunity to express themselves to the techniques and methods of hydrological analysis and design. The details of the workshops organised during the year are given in Appendix XI and the workshops organised during the last 5 years are presented in Fig. IX.

5.3.2 Regional Workshop on Modelling of Hydrologic Systems

The regional workshop on Modelling of Hydrologic Systems was organised by the National Institute of Hydrology, Roorkee at Roorkee from January 29 to February 9, 1990. The workshop was inaugurated by Prof. Bharat Singh, Former Vice Chancellor, University of Roorkee.

The course was attended by academic and field engineers from the following countries :

1. Afghanistan	...	3
2. Bangladesh	...	1
3. India	...	11
4. Nepal	...	4
5. Pakistan	...	2
6. Sri Lanka	...	1

The faculty to the workshop included scientists of National Institute of Hydrology and faculty members from the department of Hydrology, University of Roorkee. The course material in two volumes was given to the participants in advance.

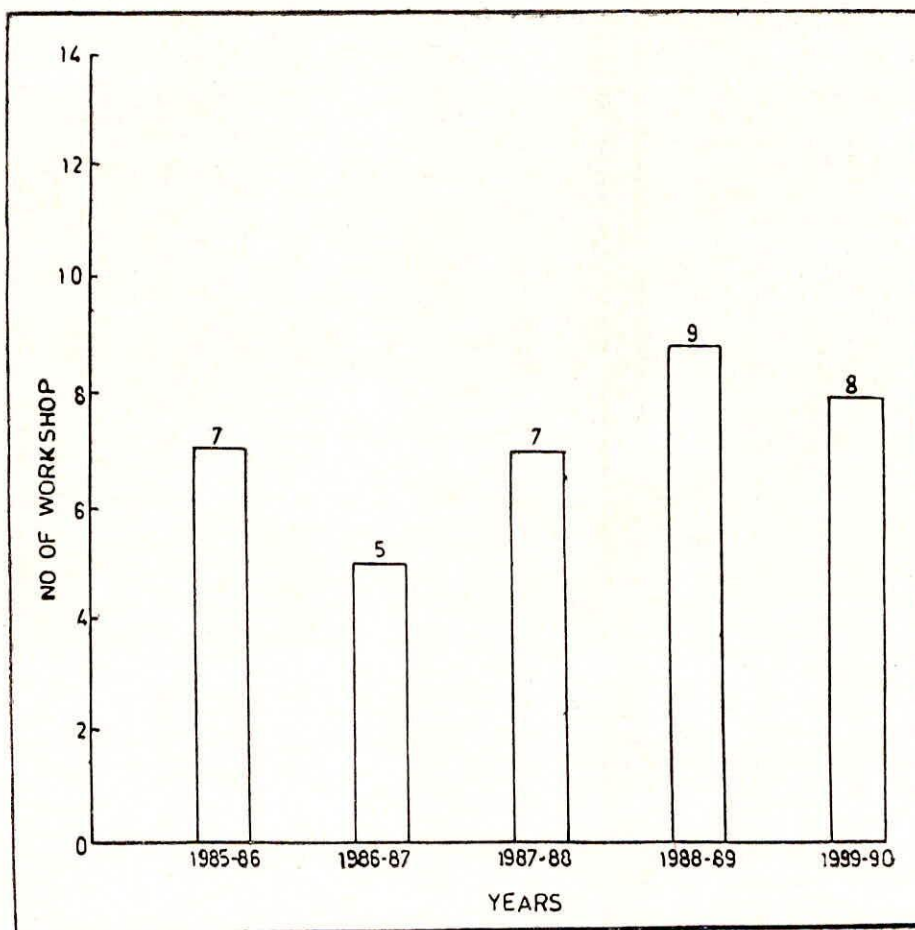


FIG. IX : BAR CHART OF WORKSHOP ORGANISED IN DIFFERENT YEARS

During the second week of the workshop a field trip was organised to the U.P. Irrigation Research Station at Bahadradab which is about 20 km from Roorkee.

During the course of the workshop the participants from different countries in the region had discussions with the faculty and also interacted among themselves and exchanged ideas. Before the conclusion of the workshop participants evaluation on the course content and lecture presentation was obtained. Participants rated the content of lectures to be adequate or more than adequate.



Dr. Satish Chandra, Director, NIH addressing the participants of the Regional Workshop on Modelling of Hydrologic Systems



Dr. R.S. Varshney, Secretary ICID distributing certificate to the participants of Regional Workshop

6.0 INDIAN NATIONAL COMMITTEE ON HYDROLOGY (INCOH)

The Government of India appointed a High Level Technical Committee on Hydrology (HILTECH) in year 1982 as a successor body to the National Committee for International Hydrological Programme (IHP), which was transferred from the CSIR to the Ministry of Irrigation (now Ministry of Water Resources). The main functions of the HILTECH were to prepare and periodically update the state-of-art in the country in different branches of hydrology : to identify thrust areas in the field of hydrology and water resources : to promote education and training in the field of hydrology and water resources : to coordinate effective participation of India in the International Hydrological Programme (IHP) of the UNESCO and the Operational Hydrology Programme of the WMO : to promote research and development activities in the country in the area of hydrology and water resources.

The erstwhile High Level Technical Committee on Hydrology was re-named as the Indian National Committee on Hydrology w.e.f. April 24, 1989. The objectives of the committee were re-defined and the membership was enhanced. The Director, National Institute of Hydrology was designated as the Executive Member. The Secretariat of this committee is with the Institute and has functioned very effectively and carried out the assigned responsibility as envisaged and the programme of the committee. The secretariat of the committee carried out various programme including processing of Indian delegation for participation at the International courses, seminars and symposia. The secretariat also effectively coordinated to the IHP programme of UNESCO. The committee supported number of seminars, symposia and workshops during the year as well as supported research projects also. The Chairman, Central Water Commission is the Chairman of the INCOH. Senior Government Officers and experts are its members. Each state has nominated a State Coordinator for INCOH. The committee has constituted 7 panels and 6 sub-committees for carrying out its functions. The INCOH Secretariat brings out a half yearly publication entitled 'Jal Vigyan Sameeksha'.

The INCOH Secretariat also functions as the secretariat of the Asian Regional Coordination Committee on Hydrology (ARCCOH).

6.1 Meetings of INCOH

During the year, 13th meeting of the INCOH was held at Delhi on May 24, 1989. The meeting was chaired by Sri M.S. Rao, Chairman, INCOH & CWC. The following main issues were discussed during the meeting :

- (i) Consideration of the Annual Report of INCOH for the year 1988-89.
- (ii) Funding of various National and Regional activities by INCOH
- (iii) Future focal theme of Jal Vigyan Sameeksha
- (iv) Organisation of National & Regional Seminars/Symposia to be organised in India
- (v) Progress of National Hydrology Projects
- (vi) Organisation of third National Symposium on Hydrology

6.2 Panels and their Meetings

In order to carry out specific functions and assist the mainbody, the committee has constituted the following seven scientific panels.

- (i) Surface Water
- (ii) Ground Water
- (iii) Hydrometeorology
- (iv) Water Resources System
- (v) Water quality, erosion & sedimentation
- (vi) Snow & Ice
- (vii) Education & training

During the year under report one meeting each of Surface water panel, water resources system panel, Ground water panel, Hydrometeorology panel, Water quality, Erosion & Sedimentation panel and two meetings of Snow & ice panel were held. During these meetings, important decisions regarding preparation of state-of-art report, identification of thrust areas of research, taking up of glacier expedition studies, participation of India in IHP-IV of UNESCO were taken.

6.3 Sub-committees and their Meetings

In order to discharge the functions as entrusted to the committee, the following sub-committees have been constituted by INCOH from time to time :

- (i) Steering committee
- (ii) Editorial advisory board of Jal Vigyan Sameeksha
- (iii) Interaction between research organisations, universities & agencies
- (iv) Man power requirement in hydrology
- (v) P.G. level courses in hydrology
- (vi) Snow & ice sub-committee

During the year under report one meeting of the Steering Committee was held on Dec. 23, 1989. The Editorial Advisory Board of Jal Vigyan Sameeksha met on July 7, 1989 and sub-committee of Snow & ice panel met on April 13, 1989 and Nov. 6, 1989. During these meetings, decisions were taken regarding funding of national & regional activities by INCOH, progress of publication of various issues of Jal Vigyan Sameeksha, and glacier expedition and snow ice modelling studies etc.

6.4 Indian Delegation to Various International Meetings

One of the objectives is to coordinate India's participation in the activities of UNESCO under its International Programme (IHP). Accordingly as per procedure approved by INCOH, and on the recommendation of INCOH, an Indian delegation participated at the Ninth session of Inter-governmental Council of IHP which was held in March 1990 at Paris, France. The following three meetings were held at France during March 15-24, 1990 :

1. 1990 commemorative symposium - 25 years of IHD/IHP
2. Committee on transfer of knowledge & technology
3. Ninth session of the intergovernmental council of IHP of UNESCO.

The INCOH processed the delegation and communicated to Ministry of Water Resources. Dr. Satish Chandra, Director, National Institute of Hydrology participated in the three meetings,

6.6 Support to Research Projects/Seminars/Courses

As per the decisions of INCOH, and to fulfill the objectives of promoting activities, in the area of hydrology and water resources in the country, the INCOH provides partial financial assistance to organisers of such activities. These grants are provided as per the procedure approved by INCOH.

During the year, the following activities have been provided sponsorship by INCOH as per norms duly approved by INCOH :

1. All India seminar on 'Role of hydrology in efficient management in irrigation systems', May 19-20, 1989 at Calcutta by IAH West Bengal Regional Centre.
2. Seminar on 'Reappraisal of hydrologic education', Deptt. of Hydrology, UOR at Roorkee.
3. National workshop on 'Well failure-causes and strategies for effective countering' organised by JNTU, Hyderabad at Hyderabad.
4. Workshop on 'Snow Surveys' organised by Central Water Commission during 30th Jan. to 1st Feb. 1990 at Shimla, HP.
5. Workshop on 'Snow hydrology' organised by Central Water Commission during 13th to 22nd March, 1990 at Shimla, HP.
6. Regional workshop on 'Modelling of hydrologic systems' organised by NIH at Roorkee during Jan 29-Feb. 9, 1990.
7. National symposium on 'Watershed development & management organised by IWRS at Kanpur during Feb. 2-4, 1990.
8. 'Third National Symposium on Hydrology' being organised by CWPRS, Pune jointly with Irrigation Department, Maharashtra at Pune during July 5-7. 1990.
9. 'International workshop on 'River Flow Forecasting' being organised at IIT, Delhi (Financial Assistance still to be provided)
10. National symposium on 'Soil moisture processes and modelling' being organised by IIT, Kharagpur during Dec. 1990.
11. International symposium on Water erosion, sedimentation and Resources conservation being organised by CSWCR & T Institute Dehradun during Oct. 9-12, 1990.
12. Research project on 'Environmental impact of irrigation reservoir project at Pench, Nagpur Distt. by NEERI, Nagpur (Financial grants still to be released).

6.7 Publications

The INCOH has been bringing out a bi-annual journal entitled 'Jal Vigyan Sameeksha' erstwhile known as 'Hydrology Review'. During the year the following two issues of the journal were published and circulated to various organisations in India and abroad :

- i) Water Quality
- ii) Drainage

The publications contained activities of about 30 organisations involved in hydrological works, research paper on specific theme and book review. The publication has been well appreciated and found very useful.

6.8 Yearwise activities of INCOH

The yearwise activities of INCOH are presented in Figure-X under Meetings of INCOH, its sub-committees & Panels and support provided by INCOH to seminars, courses and projects.

6.9 Activities of Asian Regional Coordinating Committee on Hydrology (ARCCOH)

The Institute has also been providing Secretariat to an Asia level committee known as Asian Regional Coordinating Committee on Hydrology (ARCCOH) since inception of this committee in

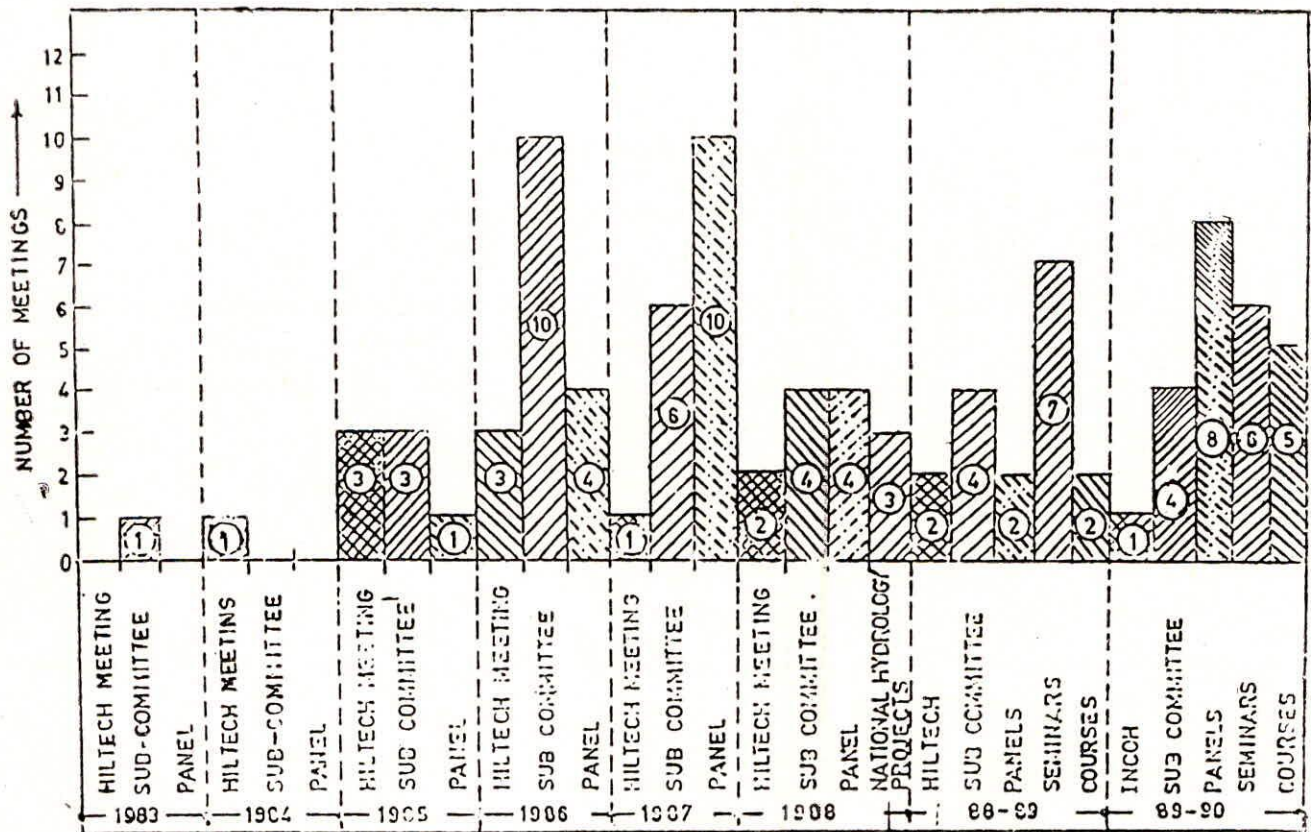


FIG. X BAR CHART OF YEARWISE MEETINGS OF INCOH AND ITS COMMITTEES

year 1977. The basic objectives of this committee are to implement and coordinate activities under IHP at Asia level.

The activities of ARCCOH progressed satisfactorily during the period. The following activities were taken up during the period :

1. During June-July 1989, the ARCCOH Secretariat drafted two resolutions proposed for discussion during General Conference of UNESCO held at Paris during Oct.-Nov. 1989. The resolution included continuation of the first phase of MRP during the year 1990-91, and expansion of activities under MRP during subsequent years. These resolutions were as per decisions taken at Steering Committee meeting of ARCCOH held at Pakistan during Oct.-Nov., 1988 which were approved by INCOH during its 13th meeting.
2. The ARCCOH Secretariat has been compiling information regarding experts in hydrology in the Region in order to compile the 3rd volume of Directory of Hydrologists. It may be mentioned that already two volumes of such Directory have been published, and circulated widely. Till now biographies of 60 experts of the region have been received. The Directory is expected to be ready shortly.
3. As a follow up action of a decision taken at ARCCOH Steering Committee meeting (Pakistan, Oct.-Nov., 1988) an Annual Bulletin of ARCCOH is under preparation. However due to non-receipt of country reports from few member countries, the publication is getting delayed. Reminders are being regularly sent to various countries requesting desired information.
4. The base preparations for taking up various Major Regional Projects (MRP) for South-Central Asia are being done by the Secretariat and the lead country and the participating countries are being contacted for expediting the studies. The taking up of MRP for South-Central Asia was earlier approved by UNESCO as per recommendation of ARCCOH Steering Committee. The work plan for Flood Risk Mapping and Urban Hydrological Research Projects are being finalised.
5. The ARCCOH Secretariat has been bringing out quarterly newsletter describing various activities of its member countries in the field of hydrology and water resources in general and under IHP in particular since 1985. This newsletter is being circulated widely in India and abroad. During the year, four issues of newsletter i.e. June 1989, Sept., 1989, Dec., 1989 March, 1990 were brought out. The ARCCOH Secretariat has been constantly requesting the member countries to send the required information for future issues of newsletter.
6. The Secretariat has requested the Unesco, Headquarters Paris to accord formal status to ARCCOH for furthering its aims and objectives.

7.0 EXTERNAL ASSISTANCE

In keeping with the objectives of the Institute, the Institute has been pursuing project proposals for international collaboration to strengthen laboratory facilities, undertake field oriented studies and develop expertise in new areas of research such as snow hydrology, remote sensing applications, data storage and retrieval system, forest influence on hydrological cycle, geomorphological studies. The details of various on going projects and projects under consideration at various levels are as follows :

7.1 NIH/DHI Project on Transfer of 'Hydrological Computerized Modelling Systems' (SHE) financed by CEC

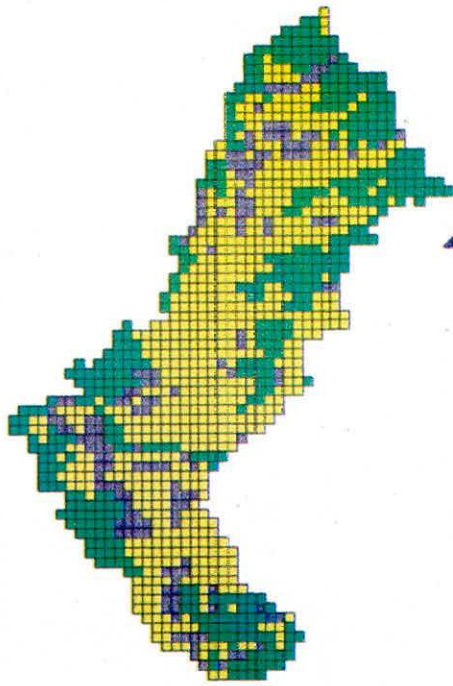
This project for transfer of SHE model (Hydrological Computerized Modelling System) to the National Institute of Hydrology was started in November 1987. The Project is funded by Commission European Committees (CEC) and executed on its behalf by Danish Hydraulic Institute (DHI), Denmark.

During the year 3 scientists of NIH were sent to DHI for 4 months training in August 1989. These scientists successfully completed the training in December 1989. During the training simulation studies were carried out involving applications of SHE Model to 3 sub basins of River Narmada, namely: (i) Ganjal upto Chidgaon, (ii) Hiran upto Patan, and (iii) Narmada upto Manot. A comparison of observed and simulated discharge for Narmada basin (upto Manot) is shown in Fig. XI. These basins are considerably larger in size in comparison to those used in training programme during 1988 and considerable effort had been involved in data assembly and processing.

A Senior Scientist was deputed for one month visit to DHI, Denmark; SOGREAH, France; and University of Newcastle, U.K. during 9 October 1989 to 8 November 1989. He participated in the discussions regarding finalisation of programme for SHE Model Workshop in Bhopal, field investigation in Kolar basin, programme of activities during 1990, and also provided guidance to the 3 NIH Scientists undergoing simulation studies at DHI. A Chief Engineer, from U.P. Irrigation Department also visited DHI, Denmark for two weeks period in October 1989 and participated in various discussions regarding programme for workshop and field investigation.

The Workshop on 'Application of SHE Model to Sub-basins of River Narmada' was organised at Bhopal from December 13-16, 1989 with the active cooperation of M.P. Irrigation Department. 29 participants from various Central and State Government organisations attended the workshop. They were provided with course material covering the concepts and various components of SHE Model as well as details of data preparation and results of application to sub-basins of River Narmada. The workshop was conducted by Consultants and Scientists of NIH, and generated useful discussions besides providing a forum for interaction among the Consultant Staff, NIH Scientists and participants.

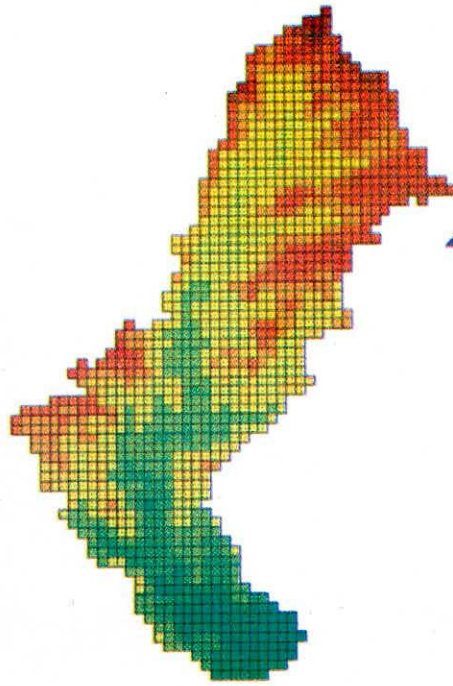
NARMADA (UPTO MANOT) BASIN



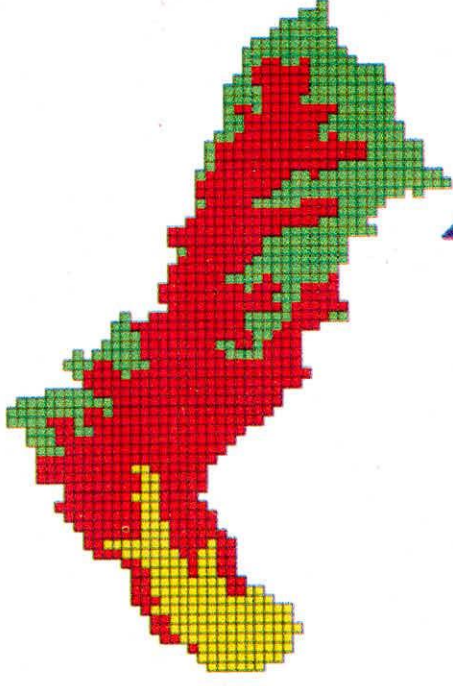
LAND USE



SOIL TYPE



TOPOGRAPHY



SOIL DEPTH

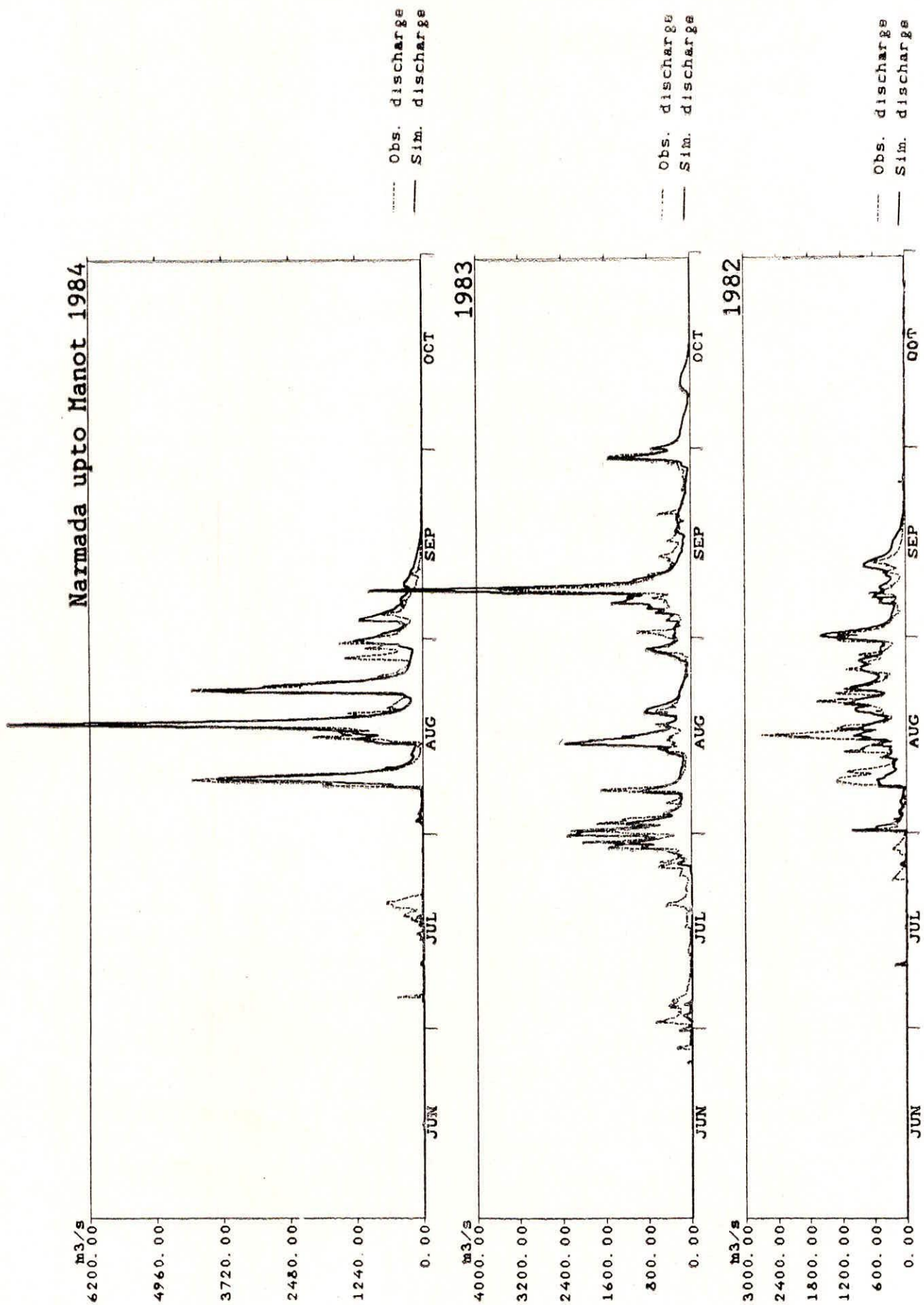


FIG. XI : OBSERVED AND SIMULATED DISCHARGE FOR NARMADA BASIN UPTO MANOT

In the course of application studies of SHE Model, it was realised that there is considerable uncertainty in the model parameters value related with soil characteristics, and a programme of field measurement and laboratory analysis was proposed. The field investigations in Kolar basin and Barna basin were carried out during 10-25 January 1990 with active support and participation of M.P Irrigation Department, besides Consultant Staff and Scientists and Scientific Staff of NIH. The information collected during field investigation and the soil samples collected from the basin are being analysed further at Roorkee. The reports of field investigation and laboratory analysis are being prepared for use in updating of Kolar basin calibration.

7.2 Scientific and Technical Cooperation with USSR

Conjunctive use of surface and ground water is essential for optimal development of water resources. The project optimization of conjunctive use of surface and ground water is one of the items of the scientific and technical cooperation between USSR and India. Under this project there will be exchange of visits of experts to bring out scientific and methodological principles of the conjunctive use of surface and groundwater.

7.3 International Cooperation with the Netherlands

Under Indo-Dutch training programme on Water Management the scientists of the Institute would be trained in the following areas :

- (i) Instrumentation, data acquisition, storage and retrieval
- (ii) Remote sensing application to hydrology
- (iii) Water quality
- (iv) Mathematical ground water modelling, and
- (v) Drainage for agriculture

Besides training in the above areas, the Institute would also be provided with equipment for data storage and retrieval system, water quality and remote sensing application, and expert visits for training of NIH personnel at Roorkee and organisation of workshops.

An identification mission pertaining to Instrumentation, data acquisition, storage and retrieval has visited the National Institute of Hydrology and the training programme of scientists and visits of The Dutch Experts to the Institute are in process.

7.4 UNDP Project on 'Developing Capabilities for Hydrological Studies

The project entitled 'Developing Capabilities for Hydrological Studies' is aimed :

- (i) to develop capabilities and facilities at the Institute for undertaking hydrological studies for optimal utilization of water resources in order to meet the growing demands of rising population of the country.
- (ii) to establish capacity and capability in NIH Regional Centres to undertake water balance studies in catchments with different water balance characteristics.

The project have components of training of Scientists, visit of consultants and procurement of sophisticated equipment of expertise in the following areas :

1. Hydrologic Instrumentation
- 2 Deltaic Hydrology
3. Nuclear Hydrology
4. Hydrometeorology
5. Lake Hydrology
6. Remote Sensing Applications
- 7, Man's Influence
8. Snow Hydrology
9. Catchment Hydrology
10. Data Processing and Hydrological Analysis
11. Forest Hydrology
12. Mountain Hydrology

The project also envisages establishment of new laboratories by sophisticated equipment. The project is under consideration by UNDP and expected to be approved during 1990-91.

7.5 Apart from the above, three more projects for bilateral cooperation programme have also been developed and are under consideration of Ministry

- (a) Cooperation with university of Arizona, USA and Indian organisation for development of technology of paleo floods in the Narmada and head reaches of Krishna with USAID support.
- (b) Cooperation with Braunschweig Technical University, West Germany in the areas of representative and experimental basins and techniques of water availability in reservoirs,
- (c) Cooperation with Louisiana State University, USA and Gujarat Government under USAID for development of a hydrological model using geomorphological parameters.

8.0 PUBLICITY

8.1 Water Resources Day

The Institute celebrated 'Water Resources Day' during the year on May 6th 1989. The event was organised jointly by the National Institute of Hydrology, University of Roorkee, Irrigation Department of U.P. Government, Institution of Engineers (India), Roorkee Local Centre and professional bodies, Indian Water Resources Society (IWRS) and Indian Association of Hydrologists (IAH). The Day was celebrated with great enthusiasm and senior officers of the organising departments, academicians, field engineers, and trainee officers pursuing higher training at Roorkee attended the celebration. Since this year's focus theme for Water Resources Day was on 'Peoples Participations in the Development and Management of Water', participation of local farmers and expression of their views brought grace to the occasion. About 250 persons participated in the function.

Dr. Bharat Singh, former Vice-Chancellor of the University of Roorkee was the Chief Guest on the occasion. In his thought provoking address he mentioned that despite having abundant natural resources in the country, a sizeable number of people suffer from non-availability of adequate food, clothing etc. and for which the explosion of population was one of the reasons. In order to remove the disparities and poverty, the water resources development is an important element, he added. Dr. B.S. Mathur, Professor of Hydrology at Roorkee University spoke about the Education and Training in the area of Hydrology and Water Resources in the country and highlighted the need to develop suitable policies to cater to rural needs as far as water resources was concerned. Dr. A.S. Chawla, Director of the Water Resources Development & Training Centre stressed the need for peoples participation in the development and management of water on the occasion. Dr. D.N. Bhargava, Chief Engineer, of U.P. Irrigation Department stressed the need for developing water resources in the valleys of Ganga and Yamuna rivers for strengthening national economy.

Dr. Satish Chandra, Director of the National Institute of Hydrology gave the relevant statistics regarding the water resources of the country and described the various major and medium projects being taken up in the country to be able to achieve the targeted food production needs of 2025 A.D. He further gave an excellent overview of the advanced techniques being developed and presented possible use for the development in the water resources sector. Shri Asha Ram Saini, one of the local farmers, expressed the opinion of the farmers as far as their need of water for agriculture is concerned.

8.2 Water Conservation

The importance of creating consciousness among users of water regarding conservation of water is a long felt need at all levels of Government. The National Water Policy adopted by the Govt. of India in year 1987 states that water conservation consciousness should be provided



**Dr. Bharat Singh, Ex. V.C. of University of Roorkee
and Chief Guest inaugurating the
Water Resources Day**



**Dr. Bharat Singh, Ex. V.C. University of Roorkee
& Chief Guest, Dr. Satish Chandra, Director, NIH
and other distinguished speakers on the
occasion of Water Resources Day**

through education, regulation, incentives and disincentives. In view of this the Institute initiated an action plan to prepare publicity material on water conservation during the year. The proposal was discussed at the 22nd meeting of the Technical Advisory Committee (TAC) of the Institute. The TAC agreed to preparation of publicity material on the following themes :

- i) Sediment yield from different land uses
- ii) Control evaporation-save water
- iii) Hydrological cycle
- iv) Man's influence on Hydrological cycle
- v) Hydrological Influences of Forests

The work on first two pamphlets as above was completed during the year and these will be released on some suitable occasion possibly the 'Water Resources Day' function of year 1990.

8.3 Newsletters

8.3.1 Jalvigyan Samachar—the newsletter of the Institute is published quarterly. During the year, four issues of the Jal Vigyan Samachar were published in April, July, October 1989 and January 1990. The Newsletter contain the plan, programme and progress about the Institute. Besides, information of general interest to the hydrologic community are also provided.

The newsletter is circulated to various Central/State Governments and academic organisations dealing with water resources. Hydrologic news received from reporters from various Central/State Governments are published. This has been found to be very effective forum for interaction with hydrologic community.

8.3.2 ARCCOH Newsletter

The Institute has been holding secretariat of an Asian Regional Coordinating Committee on Hydrology (ARCCOH) which was formulated in year 1977 with the objectives of implementing the International Hydrological Programme (IHP) of the UNESCO in the Asian Region since year 1982. As a part of its activities, the Secretariat brings out a quarterly ARCCOH Newsletter which is circulated to various Members countries and related organisations in the country. The Newsletter includes information on hydrological activities of the member countries and under IHP, besides other news worthy items

9.0 MISCELLANEOUS

9.1 Hindi Week

With a view to provide impetus to Hindi and its use in official work, particularly in the Nehru Birth Centenary, Hindi Week was celebrated in the Institute from 11 to 15 September. The Week was inaugurated by Dr. Shyam Singh Shastri, Director, Publications Department, Govt. of India under the Chairmanship of Dr. Satish Chandra, Director, NIH, Dr. Satish Chandra gave an elaborate information regarding the Hindi work going on in the Institute. Other invited guests also spoke on this occasion.

An exhibition of important Hindi publications was held with the active participation of different departments of the Govt. of India during this week. It was inaugurated by Dr. Satish Chandra, Director of the Institute.

Hindi day was celebrated on 14th Sept. The Chief guest of the function was Dr. Amba Prasad 'Suman' who emphasised upon the need of making Hindi popular. Other eminent scientists and educators expressed their opinions on this occasion.

In addition to the above, competitions for drafting, noting, typing and shorthand typing in Hindi were held in the week so as to encourage the staff to more work-in-Hindi.

9.2 Use of Hindi

In accordance with official language annual programme for the year 1989-90, continued efforts were made by the Institute towards implementation of various provisions given there under. The official language implementation committee of the Institute organised quarterly meetings at the Institute and taken important decisions for implementation of Hindi in day to day official proceedings in her different divisions and sections.

9.3 Quami Ekta Week

'Quami Ekta Week' was celebrated in the Institute from 20.11.89 in which National Integration Pledge was taken collectively by the employees.

9.4 Recreation and Welfare Activities

Recreation club organised some activities for the recreation and benefits of the staff and their family members. The club also organised volleyball and cricket matches during the year.

9.5 Hydrology Terminology

The Institute has started efforts to prepare a hydrological dictionary in different languages for example Bengali, Tamil and Hindi.



Dr. Shyam Singh Shastri, Director Publication Deptt. Govt. of India & Chief Guest addressing on the occasion of Hindi week held at the Institute during 11-15 Sept. 1989



Dr. Satish Chandra, Director, NIH inaugurating the Exhibition of Hindi Books.



Dr. Amba Prasad 'Suman', Chief Guest inaugurating the Hindi Day celebrated on 14th September 1989 at the Institute.



A view of distinguished speakers and employees of NIH during Hindi Day Celebration.

9.6 Independence Day/Republic Day Celebration

The Independence Day was celebrated in the Institute on 15th August 1989. The National flag was hoisted by Director. The Director emphasised the need of hard and dedicated work for the progress of the country. The celebration was well attended by the employees and their families. Patriotic songs were presented by the children of the employees on the occasion. Republic Day was celebrated in the Institute on 26th January 1990.

9.7 Awards

Bharat Singh Award.

The National Institute of Hydrology has instituted a 'BHARAT SINGH AWARD' biennially in honour of Professor Bharat Singh, Ex-Vice-Chancellor, University of Roorkee, Roorkee through an endowment amount provided by M/s Hoysala Group of Companies, Bangalore with the objective of providing incentives and encouragement for simulating outstanding original research, organization and promotion of research activities in the area of Hydrology in the country through a cash award of Rs. 10,000/-.

The award consisting of cash prize of Rs. 10,000/- is bestowed once in two years on a person who in the opinion of the Trust Board has made conspicuously important contributions as revealed through publication of books, monographs papers or any other published account of his or her research work or activities carried out by him/her in the promotion of Hydrology.

Nominations for the award for the year 1989 were invited. Based on the recommendations of the Judging Committee the trust Board has to approve the recommendations of the Judging Committee. The report of trust board is still awaited.

National Hydrology Award - 1989

The National Institute of Hydrology has constituted the following award to be given to any Indian Engineer, Technologists or Scientists working in the area of Hydrology or those who have made significant contributions for promotion of hydrology over the years in the subject area of the award. The award shall be given to the person who in the opinion of the judging committee has made important contributions revealed through publications or the research work or activities carried out by him/her in the promotion of hydrology.

1. 1st award : Rs. 4000/- and a plaque
2. 2nd award : Rs. 2000/- and a plaque
3. Certificate of merit : Two nos. Rs. 1000/- each

The Governing Body of NIH has decided the topic of the award for the year 1988 as FLOOD. Nominations for award were invited. The meeting of the judging committee for deciding the awards will be held soon.

9.8 Visitors

The following distinguished persons have visited Institute during the year in connection with official meetings, International Seminar and International Collaborative projects :

1. Prof. Grygory Voropaey
Director
Water Problems Institute
USSR Academy of Science
MOSCOW, USSR
2. Mr. B. Zimmer
Danish Hydraulic Institute
DENMARK
3. Mr. J.C. Refsgaard
D.H.I. expert
DENMARK
4. Mr. R.W. Herschy
2 Queens Borough Drive
Reading RGA7JA
U.K.
6. Prof. V.A. Vavilin
Scientist, Water Problems Institute,
USSR, Academy of Sciences
MOSCOW
7. Dr. Saeed Shah
Head, Hydrology Div.
University of Engg. & Tech.
Lahore-31, PAKISTAN

10.0 FINANCE AND ACCOUNTS

During the year under review, Ministry of Water Resources, Govt. of India provided an amount of Rs. 73 lakhs and Rs. 64.60 lakhs as Grants-in-aid to the Institute under plan and non-plan heads. The actual expenditure during the year under review after taking into account the amount carried forward from the previous year was Rs. 13953702.60 in plan and non-plan heads. The accounts of the Institute for the year under review have been audited by M/s. S.K. Kotwalia & Co. Chartered Accountants, Dehradun and a copy of the audited statement of accounts consisting of receipt and payments accounts, income and expenditure accounts and the balance sheet for upto March 90 duly certified by the Auditors is given in Appendix XII. It will be seen from the Auditor's report an addition worth of Rs. 62.72 lakhs were made to the fixed assets of the Institute during the year. Auditor's observations are given below and the point wise replies to these observations are as follows :

1. Working Results

During the year under audit, the net revenue expenditure incurred by the Institute works out of Rs. 1,01,34,073.52 as against Rs. 95,28,376.84 in the previous year. The net revenue expenditure has been shown as deduction in the Balance Sheet from the Grants-in-aids received from Govt. of India, Ministry of Water Resources, New Delhi.

2. Assets Fund Account

A sum of Rs. 38,19,629-08 has been transferred to assets fund account from Grant-in-aids being cost of acquisition of fixed and other assets during the year under audit. The details are as under :

PARTICULARS	AMOUNT
1. Increases in fixed assets	(+) 6272485 90
2. Increase in work-in-progress	(-) 1843,579.00
3. Increase in advance	(+) 9000 00
4. Increase in Prepaid	(-) 1015440.45
5. Decrease in Liabilities	(+) 448205.10
	38,70,671.55
Less :	
Decrease in Deposits	(-) 4741.48
Increase in liabilities	(+) 55783.95
	51042.47
	3819629.08

S.K. Kotwalia and Co.
Chartered Accountants

Phones : 526219
2919/20, 1st Floor,
Rui Mandi, Main
Bahadurgarh Road,
Sadar Bazar,
DELHI - 110 006

AUDITOR'S REPORT

We have audited the Balance Sheet of the National Institute of Hydrology as at 31st March 1990 and also the annexed Income and Expenditure Account for the year ended on that date and report that—

1. Subject to the notes to the accounts we have obtained all information and explanations which to the best of our knowledge and belief were necessary for the purpose of our audit ;
2. The balance sheet and the Income and Expenditure Account dealt with by the report are in agreement with the books of accounts;
3. In our opinion and to the best of our information and according to the explanation given to us, the statements together with the schedule attached and subject to Notes to the accounts give a true and fair view;
 - (i) in the case of the balance Sheet of the state of affairs as at March 31st, 1990 and
 - (ii) In the case of the Income and Expenditure Account of the Deficit for the year ended on that date.

SEAL

For : S.K. KOTWALIA AND COMPANY
CHARTERED ACCOUNTANTS

DELHI
Dated : 13th day of Oct. 1990

Sd/-
(SURESH KUMAR)
PARTNER

11.0 ACKNOWLEDGEMENTS

The different activities of the Institute have progressed well under the blessings of the President and Vice-President of the Society and direction and guidance from Chairman of the Governing Body, and Technical Advisory Committee and Members of the Society, Governing Body and TAC. Support and help from UNDP, UNESCO, EEC, Department of Economic Affairs and from officers of Ministry of Water Resources, Central Water Commission, India Meteorological Department, University of Roorkee and several other Central and State Government organisation is gratefully acknowledge. Whatever has been achieved by the Institute since its establishment in particular during the year under report, would not have been possible without their help and guidance. The institute also acknowledges the help and cooperation received from Members of Working Groups, Scientists and Engineers from many academic and research organisations.

APPENDICES

APPENDICES

APPENDIX—I	: National Institute of Hydrology Society	(i)
APPENDIX—II	: Governing Body	(v)
APPENDIX—III	: Technical Advisory Committee	(vi)
APPENDIX—IV	: Meetings of Bodies, Committees and Working Groups	(vii)
APPENDIX—V	: Members of High Level Technical Committee on Hydrology (HILTECH)	(viii)
APPENDIX—VI	: Position of staff of NIH on 1.4.1989 and 31.3.90	(x)
APPENDIX—VII	: Scientific and Technical Reports prepared during 1989-90	(xii)
APPENDIX—VIII	: Participation in Seminar and Symposia	(xiv)
APPENDIX—IX	: Papers published in 1989-90 (April 1989 to March 1990)	(xvi)
APPENDIX—X	: Interaction with States and studies conducted, taken up and proposed in the States	(xix)
APPENDIX—XI	: Workshops and Symposia organised	(xxiv)
APPENDIX—XII	: Auditor's Report of the Institute as on 31.3.1990.	(xxv)

NATIONAL INSTITUTE OF HYDROLOGY SOCIETY

PRESIDENT : Sri Manubhai Kotadia
 Hon'ble Minister of State for Water Resources,
 Govt. of India,
 Shram Shakti Bhawan,
 Rafi Marg.,
 NEW DELHI

MEMBERS

Member (Irrigation)
 Planning Commission
 Yojna Bhawan,
 Parliament Street,
 NEW DELHI-1

Shri Reoti Raman Singh
 Minister-in-Charge of
 Irrigation,
 Govt. of U.P.,
 LUCKNOW

Sri Verender Singh
 Minister-in-Charge
 of Irrigation,
 Govt. of Haryana,
 CHANDIGARH

Shri P.B. Gurang
 Minister-in-Charge
 of Irrigation,
 Govt. of Sikkim,
 GANGTOK,
 SIKKIM-737 101

Minister-in-Charge
 of Irrigation
 Govt. of Manipur,
 IMPHAL

Minister-in-Charge
 of Irrigation,
 Govt. of Bihar,
 PATNA

Minister-in-Charge
 of Irrigation,
 Govt. of Orissa,
 BHUBNESHWAR

Minister-in-Charge
 of Water Resources,
 Govt. of Gujarat,
 GANDHINAGAR

Minister-in-Charge
 of Irrigation,
 Govt. of Maharashtra,
 BOMBAY-32

Minister-in-Charge
 of Irrigation
 (Minor Irrigation),
 Govt. of Andhra Pradesh,
 HYDERABAD

Sri Duraimurugan
 Minister-in-Charge
 of Irrigation,
 Govt. of Tamil Nadu,
 MADRAS-9

Sri M.A. Chitale
Secretary to Govt. of India,
Ministry of Water Resources,
Shram Shakti Bhawan,
Rafi Marg.,
NEW DELHI-1

Dr. Vasant Gowariker
Secretary to Govt. of India
Ministry of Science and Technology,
Technology Bhawan,
New Mehrauli Road,
NEW DELHI-29

Secretary to Govt. of India,
Ministry of Agricultural
and Cooperation,
Krishi Bhawan,
NEW DELHI-1

Secretary to Govt. of India,
Ministry of Energy,
Shram Shakti Bhawan,
NEW DELHI-1

Secretary to Govt. of India,
Ministry of Urban
Development,
Nirman Bhawan,
NEW DELHI-2

Secretary to Govt. of India,
Planning Commission,
Yojna Bhawan,
Parliament Street,
NEW DELHI-1

Secretary to Govt. of India,
Ministry of Environment
and Forest,
Paryavaran Bhawan,
CGO Complex, Lodhi Road,
NEW DELHI

Sri Y.B. Patel
Chairman
Central Water Commission
Sewa Bhawan,
R K Puram,
NEW DELHI-66

Sri Bahadur Chand
Chairman
Central Electricity Authority
Sewa Bhawan, R K Puram,
NEW DELHI-66

Dr. J.P. Singh
Additional Secretary to
Govt. of India,
Ministry of Water Resources,
Shram Shakti Bhawan,
Rafi Marg.,
NEW DELHI-1

Vice Chancellor
University of Roorkee,
ROORKEE-247 667

Sri R.V. Ranthidevan
1265, Block-I,
Vidyanarnyapura Layout,
Jalahilli,
BANGALORE-560 013

Prof. Subhash Chander
Professor in Civil Engineering,
Indian Institute of Technology,
Hauz Khas,
NEW DELHI-16

Sri G.S. Jakhade
A-705 Curzon Road
Appartments,
NEW DELHI-1

Dr. R S. Varshney
Secretary General
International Commission
on Irrigation and
Drainage, 48, Nayaya Marg.,
Chanakyapuri,
NEW DELHI-21

Sri J.F. Mistry
President
Indian Association of
Hydrologists, Plot No. 378/A
Near Swami Narayan Temple,
Sector 23, GANDHINAGAR

Sri J.S. Singh
Chairman
Ganga Flood Control
Commission, Sinchai Bhawan,
PATNA-800 015

Vice Chairman
Brahmaputra Board
Beltola
GUWAHATI-781 028

Prof. B.S. Mathur
Professor
Deptt. of Hydrology,
University of Roorkee,
ROORKEE-247 667

Sri M.S. Reddy
Director General
National Water Development Agency,
Office-cum-Shopping Complex,
Community Centre, Near
Anupam Cinema, Saket,
NEW DELHI-17

Dr. B.H. Briz Kishore
Reader
Jawaharlal Nehru
Technological University,
Mahavir Marg.,
HYDERABAD-500 028

Sri M.S. Reddy
Member (Water Planning)
Central Water Commission,
Sewa Bhawan,
R.K. Puram,
NEW DELHI-66

Dr. C. Sudhindra
Member (RM)
Central Water Commission,
Sewa Bhawan, R.K. Puram,
NEW DELHI-66

Sri Baldev Mahajan
Financial Advisor and Joint,
Secretary Govt of India,
Ministry of Water Resources,
Shram Shakti Bhawan,
NEW DELHI-1

Sri Abhay Prakash
Chairman
Central Ground Water Board,
Jamnagar House, Block No. 11,
Mansingh Road, Gallary No. 18,
NEW DELHI-11

Dr. S.M. Kulshresht
Director General
(Meteorology)
India Meteorological Deptt.,
Lodi Road,
NEW DELHI-3

Sri D.P. Dhoundiyal
Director General
Geological Survey of India,
27 J L Nehru Marg.,
CALCUTTA-700016

Sri Paritosh C Tyagi
Chairman
Central Pollution Control Board,
Ministry of Environment and Forests,
Parivesh Bhawan, CBD-cum-
Office Complex,
East Arjun Nagar,
NEW DELHI-110 092

Sri Abhay Prakash
Joint Secretary
(Administration)
Ministry of Water Resources,
Shram Shakti Bhawan,
NEW DELHI-1

Smt. Radha Singh
Commissioner (PP)
Ministry of Water Resources,
Shram Shakti Bhawan,
NEW DELHI-1

Sri K.S. Sharma
Commissioner (Indus Basin)
INDUS (CGO Complex)
8th Floor, Block-11
Lodi Estate,
NEW DELHI-3

Sri Ramesh Chandra
Member
Joint River Commission,
Ministry of Water Resources
Shram Shakti Bhawan,
NEW DELHI-1

Dr. Satish Chandra
Director
National Institute of
Hydrology,
ROORKEE-247 667

GOVERNING BODY

- CHAIRMAN** : Secretary to Govt. of India
Ministry of Water Resources,
NEW DELHI
- VICE CHAIRMAN** : Vice Chancellor
University of Roorkee,
ROORKEE-247 667
- MEMBER SECRETARY** : Director
National Institute of
Hydrology,
ROORKEE

MEMBERS

1. Secretary to Govt. of India
Dept. of Expenditure,
Ministry of Finance,
NEW DELHI
2. Secretary to Govt. of India
Planning Commission
Yojna Bhawan,
NEW DELHI
3. Chairman
Central Water Commission
Sewa Bhawan,
NEW DELHI
4. Additional Secretary to
Govt. of India,
Ministry of Water Resources,
NEW DELHI
5. Secretary to Govt. of Assam
Irrigation Dept.,
Chandmari,
GUWAHATI
6. Secretary to Govt. of Karnataka
Public Works and CAD and
Electricity Dept.,
Vidhan Soudha
Bangalore
7. Chief Engineer
Kashmir Irrigation and Flood Control Dept.,
Srinagar, J & K
8. Secretary (Irrigation)
Govt. of U.P.,
LUCKNOW

TECHNICAL ADVISORY COMMITTEE

CHAIRMAN : Chairman
Central Water Commission
New Delhi

CONVENOR : Director
National Institute of Hydrology
Roorkee

MEMBERS

Member (Water Planning)
Central Water Commission
NEW DELHI

Dr. Subhash Chander
Professor in Civil Engg.,
Indian Institute of Technology,
NEW DELHI

Member (River Management)
Central Water Commission
NEW DELHI

Dr. A.S. Chawla
Professor
Water Resources Development
and Training Centre,
University of Roorkee,
ROORKEE

A representative of Central
Electricity Authority
Meteorological Department
NEW DELHI

Shri J.F. Mistry
Secretary (Irrigation)
Govt. of Gujarat,
Gandhinagar,
GUJARAT

Director
Central Water and Power
Research Station
Khadakwasla
PUNE

Chief Engineer (WR) and
Joint Secretary,
to Govt. of Maharashtra,
Irrigation Department,
BOMBAY

A representative of Deptt.,
of Science and Technology,
Government of India
NEW DELHI

MEETING OF BODIES, COMMITTEES AND WORKING GROUPS

TITLE	DATE OF MEETING
Governing Body	
1. 35th Meeting	11.10.89
2. 36th Meeting	30.03.90
Technical Advisory Committee	
1. 21st Meeting	21.07.89
2. 22nd Meeting	23.08.89
3. 23rd Meeting	02.02.90
Working Groups	
1. S.W. Analysis and Modelling	25.08.89
2. Flood Studies	28.08.89
3. Hydrologic Design	—
4. Mountain Hydrology	13.09.89
5. Land Surface Process	25.09.89
6. Ground Water Assessment	01.08.89
7. Conjunctive Use	17.08.89
8. Drainage	12.09.89
9. Man's Influence	14.09.89
10. Water Resources System	04.09.89
11. Hydrologic Investigations	05.10.89
12. Information System	31.08.89
13. Drought	15.09.89
14. Remote Sensing Application	—

MEMBERS OF INDIAN NATIONAL COMMITTEE ON HYDROLOGY

CHAIRMAN : Chairman
Central Water Commission,
Sewa Bhawan, R.K. Puram
NEW DELHI

EXECUTIVE MEMBER : Director
National Institute of Hydrology,
ROORKEE

MEMBERS

- | | |
|--|---|
| <p>1. Director-General
Indian Council of Agricultural Research,
Krishi Bhawan,
New Delhi-110 001</p> | <p>6. Chairman
Central Pollution Control
Board, Parivesh Bhawan,
CBO cum Office Complex,
East Arjun Nagar,
Delhi-110 032</p> |
| <p>2. Director-General
C.S.I.R.,
Rafi Marg.,
New Delhi-110 001</p> | <p>7. Chairman
Narmada Control Authority,
110, Palika Bhawan,
Sector-XIII, R.K. Puram,
New Delhi-110 066</p> |
| <p>3. Director-General
Geological Survey of India,
27, Jawaharlal Nehru Marg.,
Calcutta-700 016</p> | <p>8. Chief Engineer
(Water Resources) and Joint
Secretary, Irrigation Deptt.,
Govt. of Maharashtra,
Mantralaya,
Bombay-400 032</p> |
| <p>4. Director-General
India Meteorological Deptt.,
Lodi Road,
New Delhi-110 003</p> | <p>9. Engineer-in-Chief
Irrigation Deptt., (UP)
1, Canal Colony,
Lucknow-226 001</p> |
| <p>5. Chairman
Central Electricity Authority,
Ministry of Energy,
Sewa Bhawan, North Wing,
R.K. Puram,
New Delhi-110 066</p> | <p>10. Secretary-General
I.C.I.D.,
40, Nyaya Marg.,
Chanakyapuri,
New Delhi-110 021</p> |

11. President
Forest Research Institute
and College,
P.O. New Forest
Dehradun-240 006
12. Chairman
Central Ground Water Board
Krishi Bhawan,
New Delhi-110 001
13. Chairman
Brahmaputra Board,
Basistha
Guwahati-701 028
14. Director
National Remote Sensing
Agency,
Balanagar,
Hyderabad-500 037
15. Dr. Subhash Chander
Deptt. of Civil Engg.,
Indian Institute of
Technology,
Hauz Khas,
New Delhi-110 016
16. Advisor
CPH EEO
Ministry of Works and
Housing, Nirman Bhawan,
New Delhi-110 011
17. Chief Engineer,
P.W D ,
Ground Water Deptt.,
Chepauk,
Madras-600 005 (TN)
18. Director
State Water Investigation
Directorate, Sechi Bhawan,
IIIrd Floor, Bidhan Nagar,
Calcutta-700 091 (W.B.)
19. Director
Snow and Avalanche Study
Establishment,
Defence Research and
Development Organisation,
Manali (H.P.)
20. Member (WP)
Central Water Commission
Sewa Bhawan, R.K. Puram,
New Delhi-110 066
21. Director
Research and Design Standard
Organisation, Manak Nagar,
Ministry of Railways,
Lucknow-226 001 (UP)
22. Sh. J.F. Mistry
President
Indian Association of
Hydrologists,
KH-219, Sector-19,
Gandhinagar-382 019
(Gujarat)
23. Dr. B.S. Mathur
Professor and Head
Deptt. of Hydrology,
University of Roorkee,
Roorkee-247 667
24. Senior Scientist
INCOH Secretariat,
NIH,
Roorkee-247 667

APPENDIX-VI

POSITION OF STAFF OF NIH ON 01.4.1989 AND 31.3.1990

S. No.	Description	Existing as on		Remarks
		01.4.89	31.3.90	
1.	Director	1	1	
2.	Scientist 'F'	3	3	
3.	Scientist 'E'	3	5	
4.	Chief Administrative Officer	—	1	
5.	Scientist 'C'	8	7	
6.	Finance Officer	—	1	
7.	Scientist 'B'	24	22	
8.	Assistant Engineer	—	—	
9.	Section Officer	1	1	
10.	Senior Personal Assistant	1	1	
11.	Senior Research Assistant	17	10	
12.	Senior Research Assistant (Programming)	1	—	
13.	Research Supervisor	1	1	
14.	Senior Technical Assistant (Lib.)	—	—	
15.	Superintendent	1	1	
16.	Personal Assistant	7	7	
17.	Research Assistant/Tech. Asstt.	25	23	
18.	Senior Computer Operator	1	1	
19.	Hindi Translator	1	1	
20.	Junior Engineer (Civil)	1	1	
21.	Junior Engineer (Elect.)	1	1	
22.	Foreman (E & M)	—	—	
23.	Senior Technician	—	—	
24.	Technical Assistant (Photography)	1	1	
25.	Work Supervisor	1	1	
26.	Technician (Grade I)	—	—	
27.	Senior Draftsman	—	—	
28.	Technician (Grade II)	7	7	
29.	Draftsman	1	1	

30. Senior Laboratory Assistant	3	2
31. Computer Operator	1	1
32. Mechanic (Grade I)	3	3
33. Stenographer (Including Hindi)	8	8
34. Upper Division Clerk	6	4
35. Receptionist	1	1
36. Laboratory Assistant	3	3
37. Mechanic (Grade II)	3	2
38. Lineman	1	1
39. Asstt. Supdt.	—	2
40. Tracers	3	3
41. Horticulture Assistant	1	1
42. Observers	3	3
43. Lower Division Clerk	14	14
44. L.D.C. (Telex)	1	1
45. Drivers	4	5
46. Laboratory Attendant	6	6
47. Library Attendant	1	1
48. Laboratory Attendant (Sub-Station)	4	3
49. Laboratory Attendant (Tubewells)	1	1
50. Photocopier Operator	1	1
51. Ammonia Print Operator	1	1
52. Duplicating Machine Operator	—	—
53. Messenger	21	23
54. Chowkidar	6	6
55. Mali	3	3
56. Safai Karamchari	3	3
	<hr/>	<hr/>
Total	209	201
	<hr/>	<hr/>

SCIENTIFIC AND TECHNICAL REPORTS PREPARED DURING 1989-90

TECHNICAL NOTE

1. Study of Water Balance of Lakes	SWA	TN	61
2. Acquisition of land surface parameters for land surface process modelling	LSPM	TN	62
3. Long range forecasting of onset of drought condition in tropics and subtropics	LPSM	TN	63
4. Optimal design of sub-surface drainage system	DD	TN	65
5. Automatic water quality monitoring	MI	TN	66
6. Time domain reflectometry for soil moisture measurement	HI	TN	68
7. Geographical information system	CTFC	TN	69
8. Long Range forecasting of onset of drought conditions in Tropics and subtropics.	DS	TN	70

CASE STUDIES

1. Flood Frequency Study of Mahi and Sabarmati basin	HD	CS	34
2. Flood Frequency study of sub-Himalayan Regions	HD	CS	35
3. Seasonal flow forecasting for Vaghai Basin	HD	CS	36
4. Hydrological aspects of drought for 1987-88	DS	CS	37
5. Hydrological aspects of drought for 1987-88, Madhya Pradesh	DS	CS	38
6. Hydrological aspects of drought for 1987-88, Rajasthan	DS	CS	39
7. Hydrological aspects of drought for 1987-88, Gujarat	DS	CS	40
8. Hydrological aspects of drought for 1987-88, Andhra Pradesh	DS	CS	41
9. Hydrological aspects of drought for 1987-88, Maharashtra	DS	CS	42
10. Hydrological aspects of drought for 1987-88, Karnataka	DS	CS	43
11. EIA Studies of Lower Bhawani Basin (TN) Part I	MI	CS	44
12. Modelling of hydrological response of land use changes for Sher sub-basin of Narmada using SHE Model.	MI	CS	45

TECHNICAL REPORT

1. Comparative study of Hydrological routing methods	FS	TR	82
2. Application of Flood Routing procedure incorporating lateral inflow	FS	TR	80
3. Study of moving storms in Krishna Basin and their effect on stream flows	SWA	TR	83

4. Snow melt model studies of Beas catchment	MH	TR	84
5. Analysis of Glacier Data collected during expedition to Kolhai Glacier	MH	TR	85
6. Determination of aquifer parameters from water level fluctuation in an observation well caused by tidal fluctuation. Part I Mathematical formation.	GWA	TR	86
7. Analysis of flow to a dug well in hard rock areas in an unconfined aquifer by cell theory. Part I	GWA	TR	87
8. Prediction of Ground Water in Sarda Sahayak command area due to introduction of canal irrigation. Part I	CU	TR	88
9. Spring flow study for Pardah spring Nainital	CU	TR	89
10. Optimal sub-surface drainage for leaching of salts in Hissar	DD	TR	90
11. EIA of Ukai Dam	MI	TR	91
12. Spatial concentration distribution in mixing zones in shallow rivers	MI	TR	92
13. Biochemical oxygen demand of higher temperatures	MI	TR	93
14. Soil salinity measurement using resistivity techniques	HI	TR	94
15. Field measurement of soil moisture movement in agricultural field using Neutron probe.	HI	TR	95
USER'S MANUAL			
1. Processing and analysis of ground water data	GWA	UM	37
SHE MODEL			
1. Application of SHE model to Ganjal Sub-basin of Narmada		CS	28
2. Application of SHE model to Narmada (upto Manot) Sub-basin of Narmada		CS	29
3. Application of SHE model to Hiran Sub-basin of Narmada		CS	30
4. Application of SHE Model to Sher Sub-basin of Narmada		CS	31
5. Application of SHE Model to Barna Sub-basin of Narmada		CS	32
6. Application of SHE Model to Kolar Sub-basin of Narmada		CS	33
7. Field Investigations in Kolar Sub-basin of River Narmada		TR	81

PARTICIPATION IN SEMINARS AND SYMPOSIA

1. Dr. K.K.S. Bhatia, Scientist 'E' and Shri V.K. Lohani, Scientist 'C' attended the Indo-Dutch Workshop on 'Environmental Impact Assessment', organised by WRDTC, Roorkee and Ministry of Environment, Govt. of India at Roorkee from April 3-7, 1989.
2. Dr. Satish Chandra, Director attended the National Seminar on New Perspective in Water Management at Indore, organised by Indian National Academy of Engineering and Ministry of Water Resources, Govt. of India, April, 14-18, 1989.
3. Dr. Satish Chandra, Director attended the Seminar on Quality Assurance at Delhi organised by CBIP on 25th April, 1989.
4. Dr. Satish Chandra, Director attended Third Scientific Assembly of IAHS held at Baltimore, Maryland in May 10-19, 1989.
5. Dr. B. Soni and Shri V K. Lohani, Scientist 'C' attended the 4th National Convention of Agricultural Engineers and Seminar on Agricultural Engineering for Hilly Regions from May 27-29, 1989 at Srinagar.
6. Dr. Satish Chandra, Director, Dr. S.M. Seth, Scientist 'F', Sh. K.S. Ramasastri, Scientist 'E' and Sri A.C. Bhar, Scientist 'C', attended the 55th Research and Development Session of CBIP at Srinagar (J and K) from July 24-27th, 1989. Dr. S.M. Seth chaired the session on 'Hydrology Drought Management'.
7. Dr. Satish Chandra, Director and Dr. S.M. Seth, Scientist 'F' attended the seminar on 'Management of Natural Water Resources' at Jaipur from Sept. 22-24, 1989 organised by WAPCOS as a part of the French Festival in India.
8. Sh. Vikas Goyal, Scientist 'B' participated in the National Symposium on Instrumentation held at Indian Institute of Sciences, Bangalore during Oct. 3-6, 1989 and presented a paper entitled 'Hydrologic Instrumentation in India-Needs of the future'.
9. Dr. Satish Chandra, Director participated in the International Seminar on 'Use of Computers for Sustainable Water Management' organised by IWRA in Moscow, USSR during 24-29 October, 1989 and presented a paper on 'Use of Computers in Sustainable Development of Ground Water' and the progress made by India in this regard.
10. Dr. Satish Chandra, Director, Dr. K.K.S. Bhatia, Scientist 'E' and Shri S.K. Goel, SRA attended the International Workshop on 'Evaporation from Open Water Surfaces' organised by CBI and P and Vadoddata from 7-14 November, 1989. A paper authored by Sri S.K. Goyal, Sri V.K. Lohani and Dr. K.K.S. Bhatia was presented in the Workshop.

11. Dr. Satish Chandra, Director, Dr. P.V. Seethapathi, Scientist 'F', Sri V.K. Lohani, Scientist 'C' and Dr. Divya, Scientist 'B' attended the International Symposium on 'Ground Water Resources Management in Drought Prone Areas' which was organised by CGWB at New Delhi from November 27-December 1, 1989. A paper authored by Dr. Satish Chandra and Shri V.K. Lohani was presented. Dr. Satish Chandra, Director chaired one of the technical sessions of the symposium.
12. Dr. Satish Chandra, Director, Dr. S.M. Seth, Scientist 'F', Dr. P.V. Seethapathi, Scientist 'F' and Shri K.S. Ramasastri, Scientist 'E' attended the International Seminar on 'Education and Training in Water Resources in Developing Countries' held at Aurangabad during 4-8 December, 1989. Dr. P.V. Seethapathi, Sc. 'F' presented a paper entitled 'Specialized Training Programmes in Water Resources Engineering'. A paper entitled 'Development of Hydrology by Technology Transfer' authored by Dr. S.M. Seth, Sc. 'F' was also included.
13. Shri K.S. Ramasastri, Scientist 'E' attended the Regional Workshop on 'Hydrology of Mountainous Areas' at Kathmandu, Nepal from 11-14 December, 1989 and presented two papers.
14. Shri V.K. Choubey, Sc. 'C' attended the National Symposium on 'Engineering Applications of Remote Sensing' organised by Indian Society of Remote Sensing at Indore during 21-23 December, 1989.
15. Dr. Satish Chandra, Director attended the 4th Indian Engineering Congress on Creative Design The Institution of Engineers (I), Bhubaneshwar from Dec. 31, 1989 to Jan 2, 1990.
16. Dr. Satish Chandra, Director, Dr. K.K. S, Bhatia, Sc. 'E' and Shri V.K. Lohani, Sc. 'C' attended the Symposium on Monitoring and Management of Ecological aspects in Development of Water Resources power projects, CBIP, Delhi, Jan. 31, 1990 and presented a paper.
17. Sri N.S. Raghuvansi, Sc. 'B' participated in a National Seminar on Watershed Development and Management, organised by Indian Water Resources Society, Kanpur, Feb. 3-5, 1990.
18. Sri K.S. Ramasastri, Sc. 'E' attended workshop on 'Unusual storms and their relevance to dam safety', CBIP, Nagarjunasagar, Feb, 19, 1990.

APPENDIX IX

PAPERS PUBLISHED IN 1989-90 (APRIL 1989 — MARCH 1990)

1. Chandra, S., 'Hydrological Responses of Land Uses', National Seminar on Water Management, April 15-16, 1989, Narmadasagar (MP).
2. Kumar, R. and S.M. Seth, 'Hydrology and Water Resources of Ancient India', J. Bhagirath, April-June, 1989.
3. Ramasastri, K.S., S.M. Seth and P. Nirupma, 'On aspects of rainfall time series in Belgaum district, Karnataka', J. Vayu Mandal, V. 18, No. 3, and 4, May 1989.
4. Singh, P., 'Snowmelt simulation using SRM in Beas Basin', paper presented at 55th R and D Session of CBIP, July, 1989.
5. Ramasastri, K.S., 'Hydrometeorological aspects of severe rainstorms in western India', National seminar on unusual storm with respect to dam safety, Narmada Sagar, Sept., 1989.
6. Palaniappan, A.B., 'Muskingum Cunge Method of Flood Routing - a case study', J. Civl Engg., Div. of the IE (India), Vol. 70, Sept., 1989.
7. Goyal, V.C., 'Hydrologic Instrumentation in India-Needs of the Future', in National Symposium in Instrumentation, held during 3-6th Oct., 1989 at Indian Institute of Science, Bangalore.
8. Chandra, S., 'Use of Computers for sustainable development of ground water', paper presented in the International seminar on use of computers for sustainable water management, Moscow, USSR, Oct., 24-28, 1989.
9. Bhatia, K.K.S., V.K. Lohani and S.K. Goyal, 'Evaporation Reduction Measures for Water Surfaces for Drought Management', International Symposium on Evaporation Reduction from Land and Water Interfaces, Nov. 7-14, 1989, Vadodara.
10. Chandra, S. and V.K. Lohani, 'Planning of Groundwater Development in Drought Prone Areas', International Symposium on Groundwater Resources Management in Drought Prone Areas, Nov, 27 — Dec. 1, 1989, New Delhi.
11. Chandra, S., 'Application of New Trends in Water Resources Engineering', International Seminar on Education and Training in Water Resources in Developing Countries, 4-8 Dec, 1989, CBIP, Aurangabad.
12. Seth, S.M. 'Developing of Hydrology by Technology Transfer International Seminar on Education and Training in Water Resources in Developing Countries, 4 8 Dec., 1989, CBIP, Aurangabad.

13. Seethapati, P.V., 'Specialized Training Programme in Water Resources Engineering' International Seminar on Education and Training in Water Resources in Developing Countries, held at Aurangabad, CBIP, 4-8, Dec, 1989.
14. Ramasastri, K.S., 'General Education in Water Resources for School, Colleges etc.', International Seminar on Education and Training in Water Resources in Developing Countries, 4-8 Dec., 1989, CBIP, Aurangabad.
15. Palaniappan, A.B., and S M. Seth, 'Flood Routing with flood plain — A Review', J. Hyd. of IAH, Vol. XII, No. 4, Dec., 1989.
16. Jain, S.K. and G.N. Yoganarasimhan, 'A multipurpose reservoir duration policy analysis', Water 30, A.I.T., Bangkok 1989.
17. Bhatia, K.K.S, and V.K. Lohani, 'Step wise procedure for environmental impact assessment of water resources project', Symposium on Monitoring and Management of Ecological aspects in Development of W.R. Projects, CBIP, Delhi, Jan, 1990.
18. Mishra, G.C., B. Soni, 'Surface Drainage System for Agricultural Watershed', Vol. III, No. 2, Jal Vigyan Sameeksha.
19. दिव्या, मुकेश कुमार एवं एस० एम० सेठ, "ग्रीन हाऊस गैसों में वृद्धि तथा ओजोन स्तर में कमी का मौसम-विज्ञानीय प्राचलों पर प्रभाव, जर्नल आफ इंस्टीट्यूशन आफ इंजीनियर्स, हिन्दी विभाग 71, 2, 1990.
20. Kumar, S. and K.K.S. Bhatia, 'Water Quality Modelling of Hindon River using quality II Model' paper accepted for 3rd National Symposium on Hydrology to be held at Pune July 1990.
21. Raghuvanshi, N.S., V.K. Lohani and K.K.S. Bhatia, 'Runoff inducement through land treatment measures in Drought Prone areas' paper accepted for 3rd National Symposium on Hydrology to be held at Pune.
22. Seth, S.M. and S.K. Mishra, 'Application of Flood routing Procedure incorporating later, flow' paper accepted for 3rd National Symposium on Hydrology to be held at Pune, July 1990.
23. Seth, S.M. and Santoshi, 'Flood Flows through constricted River Reach', paper accepted for 3rd National Symposium on Hydrology to be held at Pune, July 1990.
24. Kumar, A., V.K. Lohani, S.K. Goyal and T. Ahmed, 'Rainfall based drought indices' paper accepted for 3rd National Symposium on Hydrology to be held at Pune, July, 1990.
25. Ramasastri, K.S., 'Hydrometeorological aspects of Oct. 1983 Storm over Coastal Andhra Pradesh, CBIP, Feb., 1990.
26. Ramasastri, K.S. and Vibha Jain, 'Trends and Periodicity of Rainfall in East Rajasthan', Paper accepted for publication in Journal of Arid Zone.
27. एस० एम० सेठ एवं सुरेन्द्र कुमार, "परिवर्तनशील नियंत्रण स्थिति में निर्धारित वृत्त की स्थापना — दि इंस्टीट्यूशन आफ इंजीनियर्स (इन्डिया)

28. Bhatia, K.K.S. and V.K. Lohani, 'Integrated environmental evaluation of WR Development', paper sent for inclusion in CBIP Conference.
29. Nautiyal, M.D., G.C. Mishra and Satish Chandra, 'Unsteady flow to a multiaquifer well open to an unconfined Aquifer with delayed yield and an confined Aquifer Separated by an aquiclude' abstract accepted for Intl. Conference on WR in Mountainous Regions to be held at Switzerland, 1990.
30. Arya, G.C. and K.S. Ramasastri, 'Application of tank model to subbasin Malaprabha in Karnataka', paper accepted for Intl. Conference on W.R. in Mountainous Regions to be held at Switzerland, 1990.
31. Bhargava, D.N., G.C. Mishra and Satish Chandra, 'Interference of Two Parallel Canals', Paper accepted in the International Conference on Groundwater Resources Management to be held at Bangkok, Nov. 1990.
32. Mishra, G.C. and B. Soni, 'Determination of Solute Concentration During Leaching Using Green and Ampt Infiltration equation', Paper accepted for Intl. Conference on GW Resources Management to be held at Bangkok, Nov. 1990.
33. Lohani, V.K., Raghuvanshi, N.S. and Satish Chandra, 'Hydrological Aspects of Drought — A Case Study in India' accepted for Intl. Conference of Agri. Engg. Bangkok, Dec., 1990.
34. Bhargava, D.N., G.C. Mishra and Satish Chandra, 'Analysis of recharge from a stream which is non-linearly dependent on the potential difference between the stream and aquifer', Abstract sent to Intl. Conference on Calibration and reliability in groundwater modelling. The Hague, Sept., 3-6, 1990.
35. Goyal, S.K. and A.K. Sikka, 'Estimation of Evaporation from Reservoirs', accepted for publication in CBIP Journal.
36. Lohani, V.K. and Pawan Kumar, 'Groundwater analysis for typical drought prone areas' — A case study', sent for publication to the Indian Association of Hydrologists, Roorkee.
37. Seth S.M. and P.K. Garg, 'Jal Santulan', (in Hindi). J. Bhagirath sent for publication in J. Bhagirath.
38. Singh, S.K., and P.V. Seethapathi, 'Lake aquifer river interaction', sent to The Institution of Engineers (I) Civil Engg. Division.

INTERACTION WITH STATES AND STUDIES CONDUCTED, TAKEN UP AND
PROPOSED IN THE STATES

A. ANDHRA PRADESH

- **1. Workshop on Flood Frequency Studies.
- **2. Workshop on Flood Routing and Flood Forecasting.
 - 3. Problems of Rayalseema Region of Andhra Pradesh.
- *4. Water Accounting Studies for Kurnool District.
- *5. Flood Plain Zoning in Badameru basin in Krishna River.
- **6. Study on Hydrological Aspects of Droughts.

B. GUJARAT

- *1. Preparation of typical hydrological year book for Sabarmati Basin.
- **2. Dam Break studies for Machchu Dam II failure.
 - 3. Development of Regional Flood Formulae.
- *4. Reservoir Operation manual for Machchu basin.
- 5. Mathematical Model Studies using Geomorphological parameters.
- *6. Reservoir operation manual for Dharoi Reservoir.
- 7. Conjunctive use model studies for Sabarmati basin.
- *8. Water accounting studies for Jamnagar and Kuch Districts.
- *9. Study of positive effects of WR projects - Ukai and Deo Dam.
- 10. Flood Plain Zoning for Ukai River d/s of Ukai Dam.
- **11. Study of Hydrological Aspects of Droughts.
- **12. Design Flood studies for Sardar Sarovar Dam.
- **13. Dam break studies Machchu.
- **14. Dam break studies Dharoi.

C. HIMACHAL PRADESH

- 1. Establishment of Regional Centre
- 2. Representative basin study
- *3. Drying of springs
- 4. Choking of Khuls and changing river courses
- 5. Hydrological studies of glaciers
- 6. Instrumentation in high altitudes and network improvement and telemetry.

7. Organisation of workshops
8. Problems of erosion and flooding
9. Drought problems in hilly regions.
10. Water availability studies.

D. JAMMU & KASHMIR

- *1. Studies for orographic effect on precipitation design flood studies in mountainous areas, snow melt forecasting and glacier melt runoff.
2. Preparation of Status report on effect of deforestation on Snow fall/snow melt.
- *3. Typical study of snow-cover/glaciated area including glacial melt/snow forecasting.
4. Design Flood studies for mountainous areas in view of orography and presence of snow and glaciers.
5. Water Availability studies
6. Improvement of hydrological network.
- **7. Organisation of workshops on
—Flood routing and Flood forecasting and on Design storm and Design Flood.
8. Forecasting of seasonal rainfall and runoff.
9. Remote sensing applications for snow covered and glaciated areas.
10. Effect of afforestation and deforestation of snowfall and snowmelt.
11. Studies relating to Spring flow.
- **12. Establishment of Regional Centre.
- *13. Guidance for opening a Research Institute at Jammu.
- **14. Expedition to Kolhai Glacier and studies regarding lakes.

E. KARNATAKA

- **1. Preparation of Hydrological Year Book for Hemavati Basin.
- *2. Established a Regional Centre at Belgaum for Hard Rock areas.
- **3. Study of Rainfall trends in Belgaum District.
- **4. Studies on Hydrological aspects of drought,
5. Development of Modified Regional Formulae.
- *6. Reservoir Water Balance.
- *7. Hydrological Study for Conjunctive Use Planning of Ghatprabha and Malaprabha Basins.
- *8. Water Accounting study of Gulbarga District.
- *9. Sedimentation of Tungbhadra Reservoir using remotely sensed data.
10. Representative basin studies in Ghatprabha basin.

* Under Progress

** Completed

**11. Organisation of Workshops on Unit Hydrograph, Design Storm, Design Flood and Flood Routing & Flood Forecasting.

12. Development of modified Regional Formulae,

**13. Assisting the organisation of a Technician Training course under INCOH.

F. MAHARASHTRA

1. Regional Flood frequency analysis.

*2. Study on hydrologic Drought Indices.

3. Impact of droughts on groundwater.

4. Performance study of percolation tanks in drought prone areas.

**5. Workshops on Processing and analysis of precipitation data, Design flood using hydrograph technique and flood frequency analysis.

6. Stable isotope study to investigate river inter-action for river Ganga-Hardwar and Narora (with BARC, Bombay).

**7. Study of hydrological aspects of droughts.

G. MADHYA PRADESH

*1, Application of SHE Model to Narmada Basin.

**2. Design flood studies for Narmada Sagar Project.

**3. Workshop on Processing and Analysis of precipitation data.

*4. Workshop on Flood Estimation by Unit Hydrograph.

**5, Workshop on Design Flood, Flood Routing and Processing and analysis of discharge data.

6. Reservoir Water Balance Study.

7. Study of positive effects of WR projects.

8. Flood Plains Zoning in selected reach

9. Regional flood frequency studies for Hasdeo Basin and Narmada Basin and development of modified regional formulae.

10. Reservoir operational manual for Tawa reservoir.

11. Hydrological Network design for Narmada basin.

**12 Study of hydrological aspects of droughts.

13. Water accounting studies for Shahdol District.

H. NORTH EASTERN REGION/ASSAM

**1. Establishment of Regional Centre at Guwahati

*2. Representative Basin studies on Brahmaputra Basin.

3. Development of modified Regional Formulae.

* Under Progress

** Completed

- *4. Preparation of a typical Hydrology Year Book,
- 5. Study of problem of Flash Flood
- 6. Study of water quality problem in rivers and ground water.
- *7. Afforestation-deforestation studies in sub-basins of Brahmaputra.

I. ORISSA

- 1. Criteria for design flood with calculated risk guidelines and manual,
- **2. Transfer of Dam break model.
- **3. Water availability studies at three sites on Mahanadi.
- 4. Monthly Flow forecasting in Mahanadi at Hirakund.
- 5. Problem of river congestion in delta area
- *6. Organisation of workshop on flood frequency studies
- *7. Water accounting studies for Kalinadi District.

J. PUNJAB

- *1. Flash Flood studies in Bist Doab region
- 2. Workshop on (a) Unit Hydrograph techniques (b) Flood Frequency Analysis (c) Storage, Processing and Analysis of Hydrologic Data.

K. RAJASTHAN

- **1. Design of Network of Raingauges and stages and Discharge measuring sites.
- 2. Design flood for flashy streams
- *3. Regional Flood Frequency studies
- 4. Lake Studies
- *5. Water Accounting Studies in Barmer and Ajmer
- 6. Organisation of Workshops
- *7. Drainage of waterlogged area in command of Indira Gandhi Nahar Pariyojna
- **8. Study of Hydrological aspect of droughts.

L. TAMIL NADU

- *1. Water Accounting studies in Ramanathpuram District.
- *2. Flood Plain Zoning in Vellar river.
- 3. Hydrological aspects of Drought of Dharampuri and Ramanathpuram.
- 4. Dam Break studies for Sathnur Dam
- 5. Seasonal Flow Forecasting Studies for Vegahai basin.

* Under progress

** Completed

6. Modified Regional Formulae for Madras basin.
7. Regional Flood Frequency Analysis for Madras basin,
8. Reservoir Water Balance Study for lower Bhawani Reservoir and Mavoor Udai reservoir.
9. Positive effects of Lower Bhawani Water Resources Project on environment.

M. UTTAR PRADESH

- *1. Seasonal Ground Water Balance and mathematical modelling of UGC Command Area.
- *2. Organisation of a workshop on Unit Hydrograph Techniques.
3. Preparation of typical year book of a River Basin in U.P.
4. Establishment of a representative basin (Pinder river) and Instrumenting it for hydrological response.
- **5. Design Flood Studies for Kishau Dam
- **6. Development of data storage system for GWIO
- **7. Software development for water balance as per NABARD norms GWIO
- **8. Development of well points system for dewatering of foundations for solani aqueduct.
9. Reservoir Water Balance Study.
10. Hydrological Data Year Book.
11. Positive effects of Water Resources Projects on Environment.
12. Sedimentation of Ramganga Reservoirs using Remote Sensing Techniques.

N. WEST BENGAL

1. Preparation of Hydrological Year Book for Kalighai Basin & Bhagirithi River Basin.
2. Hydrological studies of Tidal Basin (Saptamukhi river and Tolleys Nala).
3. Analysis of sedimentation data and Empirical Approach to Flood Forecasting for small reservoirs.
4. Effect of Deforestation and Afforestation on Runoff and Sediment Yield in Ajoy Basin and Kumari Basin.
5. Ground Water balance study and Modelling for Daru Keshwar Basin.
6. Workshop on Ground Water and Modelling at Calcutta.
- **7. Workshop on flood frequency studies.
- **8. Workshop on unit hydrograph techniques.
9. Sedimentation of small reservoirs in Paurila District.
10. Development of flow forecasting Model with limited data.
11. Workshop on flood routing and flood forecasting.
12. Water Accounting of Reservoirs for Maithon Panchet Reservoir.
13. Guiding the State Govt. for the Development of River Research Institute.

* Under Progress

** Completed

WORKSHOPS ORGANISED

S. No.	Topic	Place	Period
1.	Processing and Analysis of Precipitation Data	Taramani Madras (Tamilnadu)	April 24-28, 1989
2.	Ground Water Modelling	Roorkee	April 24-28, 1989
3.	Flood Routing and Flood Forecasting	Hyderabad	May 1-6, 1989
4.	Flood Estimation by Unit Hydrograph Techniques	Guwahati	Aug. 28-Sept. 1, 1989
5.	Flood Estimation by Unit Hydrograph Techniques	Roorkee	Sept. 25-29, 1989
6.	Flood Estimation by Unit Hydrograph Techniques	Srinagar	Oct. 16-20, 1989
7.	Workshop on SHE Model	Bhopal	Dec. 13-16, 1989
8.	Regional workshop on modelling of Hydrological Systems	Roorkee	Jan. 29-Feb. 9, 1990

APPENDIX-XII

S.K. KOTWALA AND CO,
Chartered Accountants

Phones : 526219

2919/20, 1st Floor, Rui Mandi,
Main Bahadurgarh Road
Sadar Bazar, Delhi-110006

UTILISATION CERTIFICATE

Certified that the National Institute of Hydrology, Roorkee has utilised the Grant-in-Aid as detailed hereunder during the year 1989-90 and the same has been verified with reference to accounting records maintained by the Institute and has been found to be correct.

Particulars	Plan	Non-Plan	Total
1. Opening Cash and Bank balance as on 1.4.89	24,66,229.98	2,87,436.96	27,53,666.94
2. Add: Grant-in-aid from Ministry of Water Resources, New Delhi	73,00,000.00	64,60,000.00	137,60,000.00
Total	97,66,229.98	67,47,436.96	165,13,666.94
Expenditure	74,72,221.21	64,81,481.30	139,53,702.60
Closing Cash and Bank Balance as on 31.3.1990	22,94,008.77	2,65,955.57	25,59,964.34

Sd/-

(R. C. JAIN)
Finance Officer

(SATISH CHANDRA)
Director

For S.K. Kotwalia and Co.,
Chartered Accountants

Seal

Sd/-
(SURESH KUMAR)
Partner

Place : Delhi

Dated : 13th day of Oct. '90

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

BALANCE SHEET AS AT 31ST MARCH, 1990

(XXVI)

PREVIOUS YEAR	FUND AND LIABILITES	CURRENT YEAR	PREVIOUS YEAR	ASSETS	CURRENT YEAR
	Grant-in-aid from Govt. of India, Ministry of Water Resources New Delhi.			Fixed Assets (as cost)	2,27,44,071.67
			1,64,71,585.77	As per Schedule 'A'	
35,76,655.34	Opening Balance Received from Govt. of India, Ministry of Water Resources, New Delhi.	25,80,861.94		<u>BUILDING WORKS- IN-PROGRESSES</u>	
			76,54,911.63	As per Schedule 'B'	58,11,332.63
1,55,00,000.00		1,37,60,000.00		<u>DEPOSITS</u>	
1,90,76,655.34		1,63,40,861.94	36,530.00	As per Schedule 'C'	45,530.00
	Less :			<u>CURRFNT ASSETS, LOAD AND ADVANCE</u>	
	a) Cost of acquisition of fixed and other assets transferred to assets fund a/c			As per Schedule 'D'	17,68,407.89
69,67,416.56		38,19,629.08	27,83,848.34	<u>PREPAID EXPENSES</u>	
	b) Transferred to Income and Expenditure A/c to meet the excess of the expenditure over Income for the year			As per Schedule 'G'	10,49,211.10
95,28,376.84		1,01,34,073.52	6,01,006.00	<u>CASH AND BANK BALANCES</u>	
25,80,861.94		23,87,159.34	71,120.31	Cash in hand	69,469.95
			9,450.00	Imprest with the Div. Heads	12,500.00

25,80,961.94					Balance in S.B.I. A/C with S.B.I., U.O.R., Roorkee	24,77,994.39
	ASSETS FUNDS ACCOUNT			26,73,096.63		
2,06,42,353.93	Opening Balance	2,76,09,770.49				
69,67,416.56	Add :	38,19,629.08	3,14,29,399.57			
	Transfer from Grant-in-aid					
2,76,09,770.49						
	CURRENT LIABILI- TIES					
	Deposits (As per Schedule 'F')	4,741.48	Nil			
	Liabilities for expe- nses (as per Sche- dule 'E')	1,06,174.77	1,61,958.72	1,61,958.72		
3,03,01,548.68	Total		3,39,78,517.63	3,03,01,548.68	Total	3,39,78,517.63

Notes to the Accounts as per Schedule 'H'

Note : Schedule No. A to H are forming integral part of this Balance sheet.

As per our report of even date attached.
For S.K. KOTWALIA AND COMPANY
Chartered Accountants

Place : Delhi
Date : 13th day of Oct. '90

Sd/-
(R. C. JAIN)
Finance Officer

Sd/-
(SATISH CHANDRA)
Director

Sd/-
(SURESH KUMAR)
Partner

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDING ON 31ST MARCH, 1990

PREVIOUS YEAR (RS.)	EXPENDITURE	CURRENT YEAR		TOTAL	PREVIOUS YEAR	INCOME	CURRENT YEAR		TOTAL
		PLAN	NON-PLAN				PLAN	NON-PLAN	
55,63,261.50	Salaries, Wages and Allowances	24,57,689.60	36,83,577.65	61,41,267.25	26,380.00	Hire charges of computer	—	34,496.60	34,496.60
4,14,710.00	Travelling and Conveyance	1,25,188.00	3,79,115.00	5,04,303.00	87,620.60	Interest on Saving/ Deposits.	—	1,60,496.25	1,60,496.25
1,15,520.00	News Papers and periodicals	3,235.00	1,50,904.90	1,54,139.90	32,748.05	Misce. Receipts.	3,302.00	21,357.98	24,659.98
1,62,732.95	Electricity water charges and general running exp.	9,591.20	1,82,092.25	1,91,683.45	3,452.30	Interest on Advance	1,063.00	5,952.00	7,015.00
2,93,597.70	Printing and Stationery	47,956.10	1,71,902.65	2,19,858.75	12,691.00	Other receipt	—	—	—
1,37,952.65	Postage, Telephone and Telex	47,346.50	1,37,600.15	1,84,946.65	—	Interest on CPF Balances	—	2,47,299.50	2,47,299.50
3,40,995.00	Advertisements	2,92,863.00	7,646.00	3,00,509.00	—	Regional Course on Urban Hydrology.	—	10,282.61	10,282.61
3,69,298.90	Printing of Technical Books	1,25,699.95	1,25,051.25	2,50,751.20	95,28,376.84	Transferred from GIA A/C to meet the Expenditure for the year	35,61,425.80	65,72,647.72	101,34,073.52
5,000.00	Grant-in-aid subsidies	—	—	—					
21,101.20	Hospitality Expenses	6,115.70	19,099.45	25,215.15					
2,55,241.21	Miscellaneous	56,731.80	2,27,191.60	2,83,923.40					
21,836.00	T.A. to candidates	35,034.00	759.00	35,793.00					
2,03,499.00	Seminar/Conference/Projects	—	3,77,125.00	3,77,125.00					
12,40,024.38	Repair and Maintenance other than Repair and Maintenance of vehicle	2,40,265.65	11,18,913.30	13,59,178.95					

2,16,030.06	Repair and Maint. of Vehicle	43,738.40	1,53,607.16	1,97,345.56
1,98,261.00	Intt. on C.P.F.	59,635.00	2,22,475.00	2,82,110.00
1,32,207.24	Running cost of laboratory/ computer	14,700.90	95,472.30	1,10,173.20

96,91,268.79	Total	35,65,790.80	70,52,532.66	106,18,323.46	96,91,268.79	Total	35,65,790.80	70,52,532.66	106,18,323.46
--------------	-------	--------------	--------------	---------------	--------------	-------	--------------	--------------	---------------

Notes to the Accounts as per schedule 'H

As per our report of even date attached
For S.K. KOTWALIA AND COMPANY
Chartered Accountant

(XIX)

Place : Delhi
Date : 13th day of Oct. '90

Sd/-
(R. C. JAIN)
Finance Officer

Sd/-
(SATISH CHANDRA)
Director

Sd/-
(SURESH KUMAR)
Partner

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDING ON 31ST MARCH, 1990

PREVIOUS YEAR (RS.)	RECEIPTS	CURRENT YEAR (RS.)		TOTAL	PREVIOUS YEAR (RS.)	PAYMENTS	CURRENT YEAR (RS.)		TOTAL
		PLAN	NON-PLAN				PLAN	NON-PLAN	
1	2	3	4	5	6	7	8	9	10
	CASH & BANK BALANCE				5877827.00	Salaries, wages & allowances.	2400189.50	3653382.15	6053571.65
69087.20	Cash in hand	43724.44	27395.87	71120.31	402248.60	Travelling & Conveyance	129755.50	307201.00	436956.50
6700.00	Imprest with Div. Head	Nil	9450.00	9450.00	62583.00	Electric, Water and Gen. running Exp.	9017.90	157368.00	166385.90
1775817.14	Bank Balances	2422505.54	250591.09	2673096.63	172251.00	Printing & Stationery	28999.00	108976.50	137975.50
	GRANT-IN-AID RECEIVED				133969.95	Postage, tele- phone & Telex	14667.00	113804.10	128471.10
15500000.00	From Govt. of India	7300000.00	6460000.00	13760000.00	340995.00	Advertisements	292863.00	7646.00	300509.00
	Ministry of Water Resources, N. Delhi				144333.00	Journals & periodicals	1500.00	199244.90	200744.90
12691.00	Other receipts	Nil	Nil	Nil	365758.95	Printing of Tech. books	125699.95	128591.20	254291.15
26380.00	Computer Hire charges	9989.00	34647.60	44636.60	5000.00	Grant in aid and subsidy	—	—	—
87620.60	Interest from Bank	Nil	160496.25	160496.25	10354.00	Hospitality	22.00	11697.90	11719.90
32748.05	Miscellaneous receipts	156.00	34986.09	35142.09	111516.01	Misce, expendi- ture	36591.60	166346.75	202938.35
3452.30	Interest on advance	1063.00	5952.00	7015.00	2424.00	T.A. to candidates	682.00	—	682.00
Nil	Interest on CPF Balance	Nil	247299.50	247299.50	142470.00	Seminar and conference	—	353887.50	353887.50
	RECOVERIES FROM EMPLOYEES				106348.00	Running cost of Lab/Comp.	5031.40	49852.00	54883.40
511376.00	1. CPF	—	—	—	8629.00	Urban Hydrology (Net)	—	—	—
281247.43	2 Others	—	—	—					
	RECOVERIES OF ADVANCES								
112308.00	Employees	46692.00	128395.00	175087.00					

(XXX)

(ixxx)

1	2	3	4	5	6	7	8	8	10
265410.49	Departmental	3971.40	1505.80	5477.20	1072585.95	Repair and Maint	538744.00	918871.10	1457615.10
22307.00	Firms	4489.06	4982.00	9471.06	186081.72	Repair & Main.	50599.25	104482.70	135081.95
1736.00	U.O.R.	78170.75	—	78170.75		of Vehicle			
232882.00	Bank Margin Money	—	—	—	198795.00	Interest on CPF	59635.00	222475.00	282110.00
3128.00	Excess Credit given by Bank	—	—	—	335845.00	Furniture and fixture	313973.00	4427.00	318400.00
	SECURITY DEPOSITS				132558.00	Office equipments	1327916.00	14736.00	1342652.00
					103421.00	Library books	158381.50	165.00	158546.50
55500.00	1. Recovered back	2100.00	Nil	2100.00	2642327.00	Machinery and equipments	1242572.88	—	1242572.88
611.00	2. Deducted from contractors	—	—	—	1411.00	Deposits	—	4741.48	4741.48
					380.00	Building	21599.00	—	21599.00
6514.00	Workshop on Water Quality Modelling	—	—	—	2675553.96	Advance to other firms/ deposits	751272.19	141321.80	892593.99
					102271.00	Workshop	—	—	—
1897856.00	Bank Margin Money				756133.00	Deptt. advance	129140.75	235934.05	365074.80
		1,46,631.21	6,18,264.24	7,64,895.45	337910.40	Advance to employees	—	146356.00	146356.00
					281581.43	Other remittances (Recovered & paid)	—	—	—
					45000.00	Project	—	48237.50	48237.50
					511492.00	CPF (Recovered & paid)	—	—	—
					181651.00	Advance to UOR	—	—	—
						CASH BANK			
						BALANCE	76,18,852.42	70,99,745.63	1,47,18,588.05
					71120.00	Cash in hand	35472.05	33997.90	69469.95
					9450.00	Imprest with Div. Heads	—	12500.00	12500.00
					2673096.63	Bank Balance	2258536.72	219457.67	2477994.39
20905372.21		9912861.19	7365701.20	17273562.39	20905372.21		9912861.19	7365701.20	17278562.39

SCHEDULE 'A'

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

Fixed Assets as on 31.3.90

Sl. No	Particulars	Costs as on 1.4.1989	Addition during the year	Total balance as on 31.3.90
1.	Building	56,79,144.05	17,69,375.40	74,48,519.45
2.	Furniture and Fixture	12,44,981.48	3,76,779.95	16,21,761.43
3.	Office Equipment	12,45,943.56	14,80,594.10	27,26,537.66
4.	Computer Machinery	11,79,817.00	9,35,750.50	21,15,567.50
5.	Vehicles	3,20,736.06	4,07,985.44	7,28,721.50
6.	Library Books	9,29,277.22	1,69,202.70	10,98,479.92
7.	Machinery and Equipments	56,65,758.40	11,32,797.81	67,98,556.21
8.	Generator Set	2,05,928.00	—	2,05,928.00
Total		1,64,71,585.77	62,72,485.90	2,27,44,071.67
Previous Year		1,31,93,944.64	32,77,641.17	1,64,71,585.77

SCHEDULE 'B'

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

Building Works in Progress as on 31.3.90

Sl. No.	Particulars	Amount as on 1.4.89	Payment during 1989-90	Recovered back/adjusted during 1989-90	Amount as on 31.3.1990
1.	Advance for construction works granted to UOR	59,49,385.34	—	16,20,232.50	43,29,152.84
2.	Steel and Cement with UOR	17,05,526.29	—	2,23,346.50	14,82,179.79
TOTAL (Rs.)		76,54,911.63	—	18,43,579.00	58,11,332.63

SCHEDULE 'C'

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

Deposits as on 31.3.90

Sl. No.	Particulars	Amount (Rs.)
1.	Security deposit for Gas Cylinder	2,250.00
2.	Deposit to UPSEB, Roorkee for Sub-Station	8,480.00
3.	Security Deposite for Telex	10,000.00
4.	Deposit with SAIL, Ghaziabad for Steel	15,000.00
5.	SDO (Telegraph) for Telephone connection	1,800.00
6.	Security Deposit for Telephone, at Regional Centre, Belgaum	8,000.00
TOTAL		45,530.00
Previous Years (31.3.89)		36,530.00

SCHEDULE 'D'

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

Current asset loan and advances as on 31.3.90

Sl. No.	Particulars	Amount (Rs.)
1.	Advance to Firms	
	Plan	12,91,235.64
	Non-Plan	1,13,313.00
		14,04,548.64
2.	Advance to Employees :	
	(a) Cycle Advances	10,362.00
	(b) Festival Advances	13,640.00
	(c) Fan Advances	200.00
	(d) Scooter Advances	2,23,963.00
	(e) Car Advance	70,400.00
	(f) L.T.C. Advances	10,951.00
	(g) T.A. Advances	20,361.00
	(h) Departmental Advances	12,781.85
	(i) Pay Advances	1,200.00
	Total	3,63,859.25
Total		17,68,407.89
Previous Years (31.3.89)		27,83,848.34

SCHEDULE 'E'

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

Outstanding Expenses as on 31.3.90

Sl. No.	Particulars	Amount (Rs.)
1.	Establishment :	
	(a) Salary	3,156.00
	(b) Medical Expenses	15,373.00
	(c) Wages	1,396.00
	(d) Travel Expenses	4,658.00
	(e) Overtime Allowance	959.00
	(f) L.T.C.	730.00
	(g) Tution Fee	2,390.00
	(h) Honorarium	150.00
		28,812.00
2.	Office Expenses :	
	(a) Journal	268.00
	(b) E/W Charges	13,861.50
	(c) Telephone	10,790.00
	(d) Postage	4,109.00
	(e) Stationery and Printing	263.00
	(f) Hospitality	208.00
	(g) Miscellaneous	758.00
	(h) Audit Fee	5,000.00
	(i) Rent, Rate and Taxes	40,933.00
		76,190.50
3.	Maintenance :	
	(a) Office Equipment	711.00
	(b) Vehicle	2,266.00
	(c) Building	569.00
		3,546.00
4.	Recoveries from Employees Salary	1,021.22
5.	Undisbursed Amount (Cash in hand)	52,389.00
		1,61,958.72
	Previous Year (31.3.89)	1,06,174.77

SCHEDULE 'F'**NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE**

Security Deposits made with NIH as on 31.3.90

Sl. No.	Particulars	Amount (Rs.)
	—	NIL
	Total	NIL
	Previous Years (31.3.89)	4,741.48

SCHEDULE 'G'**NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE**

Prepaid Expenses as on 31.3.90

Sl. No.	Particulars	Amount (Rs.)
1.	Rent, Rates and Taxes	1,349.30
2.	Project	25,000.00
3.	Journal	96,129.00
4.	Maintenance of D.G. Set	2,000.00
5.	Maintenance of Office Equipment	16,032.80
6.	Maintenance of Computer Centre	9,08,700.00
	TOTAL	10,49,211.10
	Previous Years (31.3.89)	6,01,006.00

SCHEDULE 'H'

NOTES TO THE ACCOUNTS

1. The Institute is maintaining its accounts on hybrid system of accounting. Both cash Basis and accrual basis are being applied for different accounts heads.
2. No depreciation has been charged on fixed assets of the Institute.
3. In absence of any fixed assets register regarding the Regional Offices, we could not verify the fixed assets.
4. The parties Balances are subject to confirmation.
5. In absence of any utilisation certificate and statement of accounts. Institutes contribution for Seminars, courses and project has been treated as expenditure.
6. As utilisation certificate for the institute is prepared on cash basis, it differs from the amount shown in Balance Sheet and Income and expenditure account.
7. Steel and Cement with UOR, Roorkee represents steel and cement of earlier years which awaits adjustment.
8. No explanation was given to us rearding computer hire charges receipt Rs. 9989-00 under Plan and Receipt from regional course on Urban Hydrology Rs. 10282-61 under non-plan.

for S.K. KOTWALIA & COMPANY
Chartered Accountants

Sd/-
(SURESH KUMAR)
Partner

REPLIES TO "NOTES TO THE ACCOUNTS" OF THE AUDITOR'S REPORT

1. The present hybrid system is followed for the sake of convenience and for reflecting actual utilisation of grants.
2. The depreciation was not charged on the fixed assets as per the Government of India directive vide Ministry of Water Resources letter No. 12 (4)/83-F.D. dated 30.9.1983.
3. The fixed asset registers are also maintained at Regional Centres. A list of all fixed asset registers of Headquarters and Regional Centres would be maintained at headquarters.
4. All the advances have been adjusted except for advance of Rs. 850/- which is outstanding advance to constitution club, New Delhi. This would be adjusted during the current year.
5. Utilisation certificate for the Institute's contribution for Seminars/Symposia and projects will henceforth be obtained.
6. The figures in the utilisation certificate are in agreement with the figures in the balance sheet.
7. Steel and cement provided by the Institute to the University of Roorkee have been utilised and adjusted vide University of Roorkee letter dated 24.10.90.
8. Receipts for computer hire charges are credited to NON-PLAN as indicated in the Receipts and Payments Accounts. This figure of Rs. 9,989.00 represents recoveries out of Deptt. advance under PLAN. So the figure of Rs. 3,971.40 shown as recoveries of Deptt. Advance would be Rs. 13,960.00 Receipts of Rs. 10,282.61 represents recoveries from foreigners attending Regional Course on Urban Hydrology on account of boarding and lodging charges from them and was credited to NIH, NON-PLAN account.