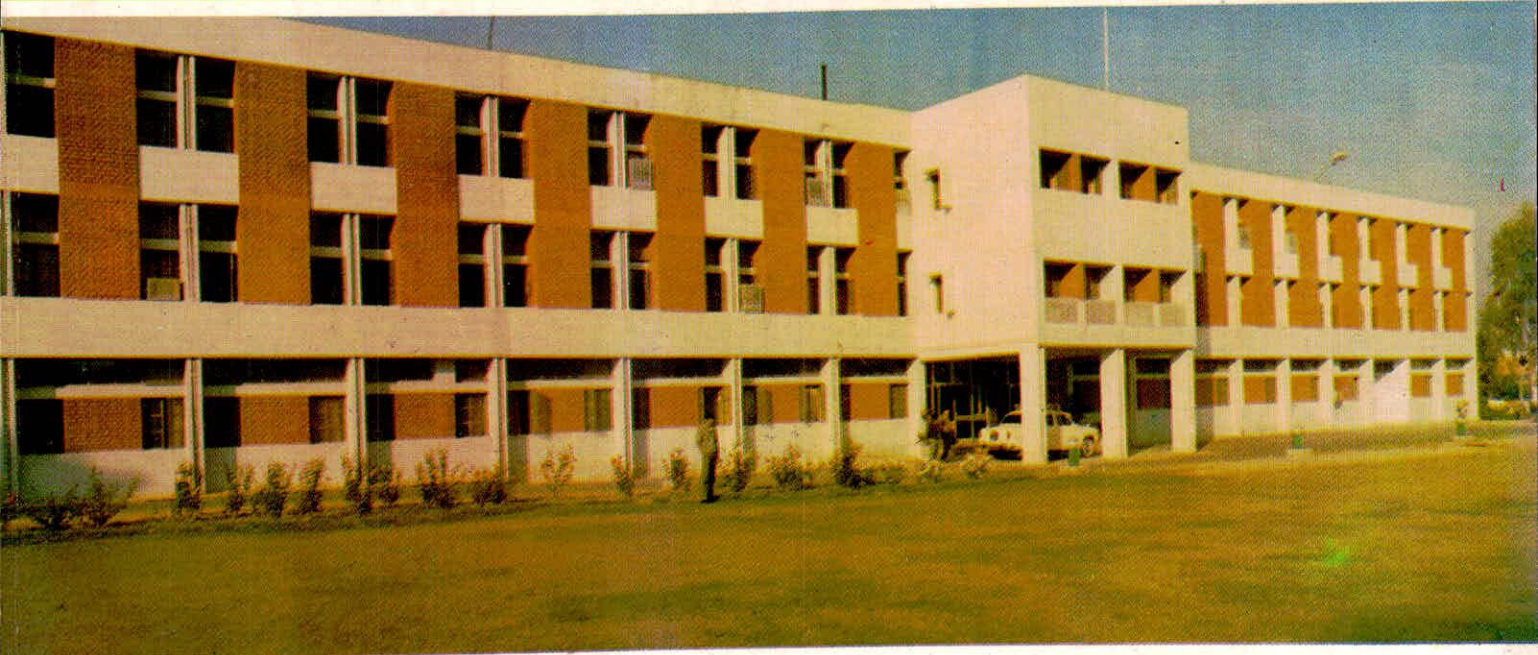


national
institute of hydrology

annual report
1990-1991





Front view of the Institute

ANNUAL REPORT
1990-91



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 including (i) Flood frequency analysis (ii) Real time flood forecasting (iii) Spring flow study (iv) Low flow forecasting (v) Snowmelt studies (vi) Lake studies (vii) Design of drainage systems (viii) Dam Break Studies (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 and recharge using nuclear techniques (xii) Water quality studies (xiii) Stream aquifer interaction (xiv) Hydrological indices of drought (xv) Sediment yield and (xvi) Atmospheric land surface process modelling.

Based on the studies conducted, the Institute brought out 59 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 workshops on Ground water balance, Processing & Analysis of Precipitation data, Flood estimation by unit hydrograph techniques, and Himalayan hydrology with emphasis on spring flow. Special emphasis was laid on transfer of computer software and making them operational on available computers in the states. During the year five workshops were organised; two in Patna, one each in Bhopal, Jaipur and Roorkee. The feed back received from these workshops is very encouraging and helped in creating awareness for use of modern techniques amongst field 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. Third national symposium on 'Hydrology' with special reference to Man's Influence on Surface Runoff was organised by the Institute in July 1990 at Pune in collaboration with CWPRS and State Irrigation Dept. Fourth national symposium on 'Hydrology' is being organised by the Institute in Oct. 1991 at Madras.

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, soil water lab., 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 Pressure Plate apparatus, Guelph permeameter, I.C.W. permeameter, E.C.Salinity probe, 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 automated Hydrological Station, procured under the UNDP project has been successfully installed 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 had 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 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 and the regional centre for Ganga Plain Region has been established in Patna in March 1991. 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) has been completed satisfactorily. Simulation studies were carried out using data of sub-basins of Narmada basin. The project is being financially supported by European Economic Community in agreement with Govt. of India. A number of projects 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, Flashflood studies of Bist Doab region and Dharoi reservoir operation studies are progressing satisfactorily.

The Indian National Committee on Hydrology (INCOH) Secretariate which is attached to the Institute and integrated with it, has continued to be active during the year. Two meetings of INCOH, eight meetings of the panels, five meetings of sub-committees were held during the year. Dr. Satish Chandra, Director, NIH participated in the IPH-IV project meeting -of Unesco during 1990-91 at Paris. Seven seminar/symposia/workshops &

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, construction of second lab. block is in progress and is expected to be ready by mid 1991. Construction of museum-cum-recreation centre and addition to laboratory block, extension of Guest house is completed during the 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 1989 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

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AT A GLANCE

ACHIEVEMENTS

1. Research and studies have been carried out covering various aspects of hydrology under the 14 problems oriented scientific divisions. Some of the important studies conducted during the year includes
 - (i) Flood Frequency Analysis
 - (ii) Real Time Flood Forecasting
 - (iii) Spring Flow Study
 - (iv) Waterbalance of Lakes
 - (v) Low Flow Forecasting
 - (vi) Snow Melt Studies
 - (vii) Design of Drainage
 - (viii) Soil Moisture Movement and Recharge using Nuclear Technique,
 - (ix) Modelling of hydrological response of land use changes using SHE model
 - (x) Soil Moisture Modelling
 - (xi) SHE Model Applications
 - (xii) Sediment Yield
 - (xiii) Ground Water Assessment
 - (xiv) Hydrological indices of drought
 - (xv) Water Quality Modelling
 - (xvi) Dam Break Studies and
 - (xvii) Atmospheric Land Surface Process Modelling.
2. Institute brought-out 60 technical reports/technical notes/ User's manual.
3. 49 Research papers published in various International/national Journals/Seminars/Symposium.
4. Scientists of the Institute Participated in 18 various International/National seminars/symposium.
5. 5 Scientists and 2 Technicians undergone training/courses in the fields of Data Acquisition storage and Retrieval, Instrumentation, Remote Sensing Urban Drainage Hydrometeorology and Isotope Hydrology at International/National Institutes/Laboratories.
6. Technology transfer in the fields of Ground Water Balance, Processing and Analysis of Precipitation Data, Flood Estimation by Unit Hydrograph Techniques and Himalayan Hydrology with emphasis on Spring flow has been carried-out by organising workshops at different places in the country.

7. Various field oriented studies regarding, water quality, remote sensing applications and Isotope applications to Hydrology have been initiated by the Institute.
8. Various existing laboratories strengthened by procuring sophisticated electronic equipments and soil-water laboratory was established.
9. Low flow forecasting model was developed and forecasts were issued for Ganga at Farakka for the period Dec. 90 to may, 91.
10. Keeping in view the accute flood problem faced in many states recently, flood plan zoning, flood forecasting and regional flood forecasting and regional frequency analysis studies have been taken up by the Institutes.
11. Various consultancy projects related to water accounting, flash flood, reservoir operation and development etc. are in progress.
12. Studies related to reservoir operation, application of dam break model and hydrological analysis of drought has been carried-out by the Institute.
13. The Institute encouraged different states to carry-out various hydrological studies. The results are very encouraging.
14. Two annual meeting of INCOH, eight meetings of the panels and five meetings of sub-committees were held. Seven Seminars/symposium, workshops and one research projects were sponsored & funded by INCOH.
15. Two Issues of Jal vigyan Sameeksha and quarterly ARCCOH Newsletters have been brought out and circulated to various state/central Govt. departments under INCOH activities.
16. SHE Model project under EEC/GOI has been completed.
17. The Institute was sanctioned with a UNDP Project amounting to US\$ 3 millions on "Developing capabilities for Hydrological Studies".
18. Regional Centre for Ganga plain region was established at Patna.
19. The Institute has constituted "national Hydrology Award" and "Bharat Singh Award" to promote and encourage research activities in the area of hydrology.
20. Various construction works related to Museum cum Recreation Centre, Guest House, Lab. Block are completed.

1.1.0 INTRODUCTION

1.1.1 General

The National Institute of Hydrology has been in existence since December 1975, having been set up at Roorkee by Government of India as a registered society under the Societies Registration Act 1960, fully aided by Ministry of Water Resources (formerly Minister 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 Organisation structure of the Institute is shown in Figure-I.

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, soil water lab, instrumentation and ground water are operational in this building. The construction of museum-cum-information centre and extension of guest house is completed. The construction of second laboratory block to use surface water lab is 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. The regional centre for Western Himalayan region was established in January 1990 at Jammu and the Regional Centre for Ganga Plains Region has been established at Patna.

1.21.2 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
 - iv) 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 includ-

ing 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 requirement 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.

During the year 1990-91 studies & research have been conducted covering various aspects of hydrology as per approved work programme, some of the major achievements during this period are:

- i) Publication of Hydrology of Ancient India
- ii) Collection of the field data and preparation of the droughts studies report for the year 1988-89
- iii) Four publicity pamphlets on specific topics. The following studies are at advance stage of completion
 - i) Water Science Educational Series
 - ii) Hydrology year book for Sabarmati and Ghatprabha Basin
 - iii) Preparation of drainage manual
- iv) Hydrological terminology in 8 Indian Languages
- v) Hydrological studies for Beti and Hemavati Catchment sub-basins using SHE Model
- vi) Hydrological Information for the year 1990-91

The following items have been taken up during the year on priority basis:

- i) History of Hydrological research since independence
- ii) Snowmelt modelling studies for Sutlej River Basin
- iii) Development of Integrated Hydrological Model as on Indian input
- iv) Soil moisture forecasting model and low flow forecasting model

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, flood studies, 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) Groundwater 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) Atmospheric Land Surface Modelling

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) Soil Water Laboratory
- iii) Remote Sensing Laboratory
- iv) Ground Water Laboratory
- v) Hydrological Investigation Laboratory and Instrumentation Services facility and workshop.

The Institute has procured sophisticated and appropriate equipment 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, 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, 59 scientific reports were prepared under various

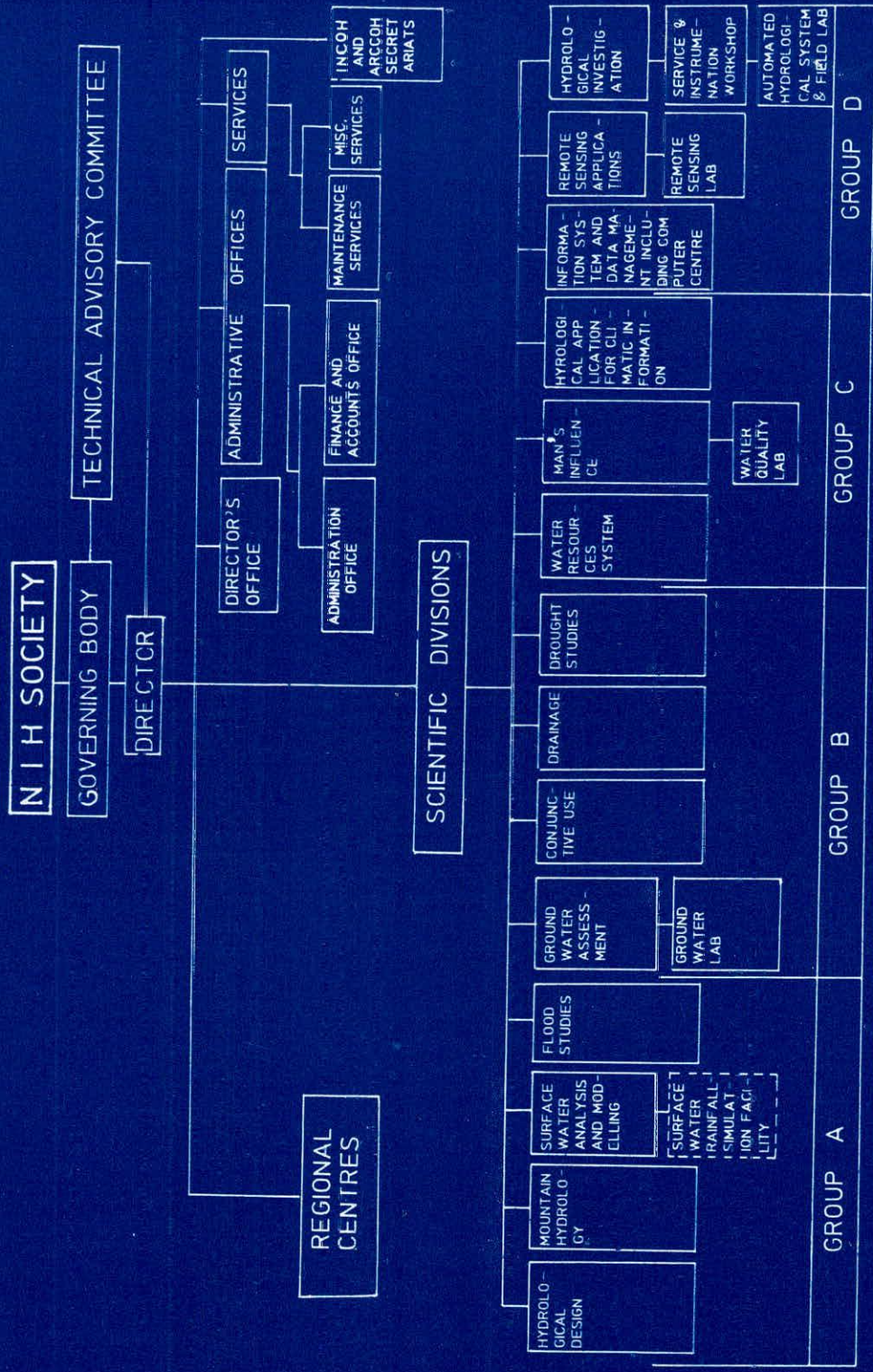


FIG. 1 : ORGANISATION STRUCTURE OF NATIONAL INSTITUTE OF HYDROLOGY ROORKEE

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. 44 technical and research papers were contributed to various scientific journals, seminar/symposia by the scientists of the Institute. Five 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.

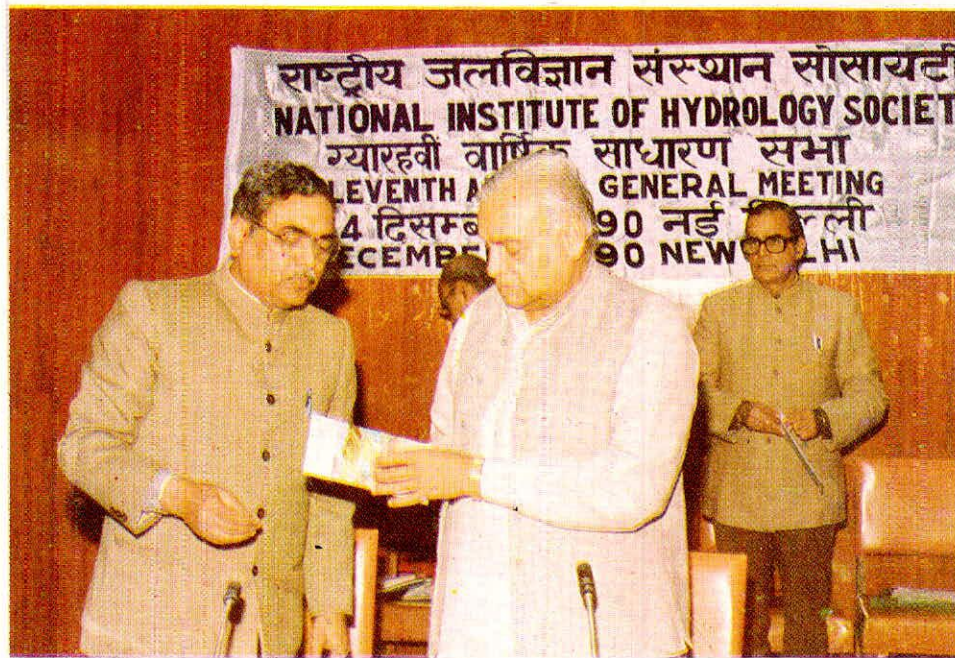
The 10th and 11th Annual General Meetings of National Institute of Hydrology Society was held on May 24th and 12th Nov. 1990 at Delhi respectively. The society reviewed the work carried out at the Institute during the year 1989-90, approved the Annual Report and audited accounts for the year 1989-90 and approved the budget for the year 1991-92. Also the



11th Meeting of NIH Society in Progress



Shri Manubhai Kotadia, then Union Minister of Water Resources and President NIH Society Addressing the 11th AGM of NIH Society



President, NIH Society releasing information booklets prepared by the Institute during Society Meeting



Hon'ble Ministers of Water Resources of Bihar and Haryana leaving after NIH Society Meeting

recommendation of Governing body based on the recommendations of the Achievements Review Committee of NIH were considered and approved in the 10th meeting.

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 26, 1990 and March 21st 1991. 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 1989-90 were approved for consideration by Society. Revised budget for 1990-91 and budget proposals for 1991-92 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 June 27, 1990, Oct 25, 1990, Jan. 29th 1991, and March 13th 1991. 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 , 1991-92. One meeting each of the 14 Working Group was held during the year as given in Appendix-IV. The constitution of working groups is given in Appendix-XIII.

Appendix-IV also presents the status of the meeting of Society, 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 WHO, 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.

2.7 Asian Regional Coordinating Committee on Hydrology (ARCCOH)

Activities at the ARCCOH Secretariat during the year progressed satisfactorily. The Secretariat has been bringing out a quarterly newsletter regularly for over last five years. During the year, 4 issues of newsletter namely June '90, September '90, December '90 and March '91 were brought out. The newsletters included news items concerning hydrological activities in various member countries of ARCCOH, description of major decisions taken at the 9th inter governmental council meeting of IHP, details of the fourth phase of IHP, description of publications in the

area of Hydrology brought out by various member countries, reports of the international seminars/symposia organised in various countries of the region and information about international seminars/symposia/workshops/conferences etc. The newsletters were circulated to all member countries in the region and concerned departments in the country.

As a part of the Major Regional Project for South Central Asia region, one of the components is on Flood Plain Mapping. In order to decide activities under the project, a Consultative meeting of a group of experts were held at Roorkee, India during October 22-23, 1990. The representatives of India, Bangladesh, UNESCO, Delhi and ARCCOH Secretariat participated at the meeting. It was decided to prepare status report on the subject based on the information available from different countries and was also planned to take up case studies in each country and finally to prepare monographs based on the study reports and case studies on the subject. Further, action under the project are on.

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-1. During the 6th plan the Institute had sanctioned strength of 121 posts and 20 posts of INCOH (out of which 14 posts were released and ban relaxation has 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 281 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, 44 Scientists, to scientific supporting staff and 83 other.

During the year the revision of recruitment rules for all categories of staff were taken up and finalized by the Institute. The status of the staff as on 1.4.90 and 31.3.91 is given in Appendix VI. The status of the staff in the last 5 years is presented in Figure II.

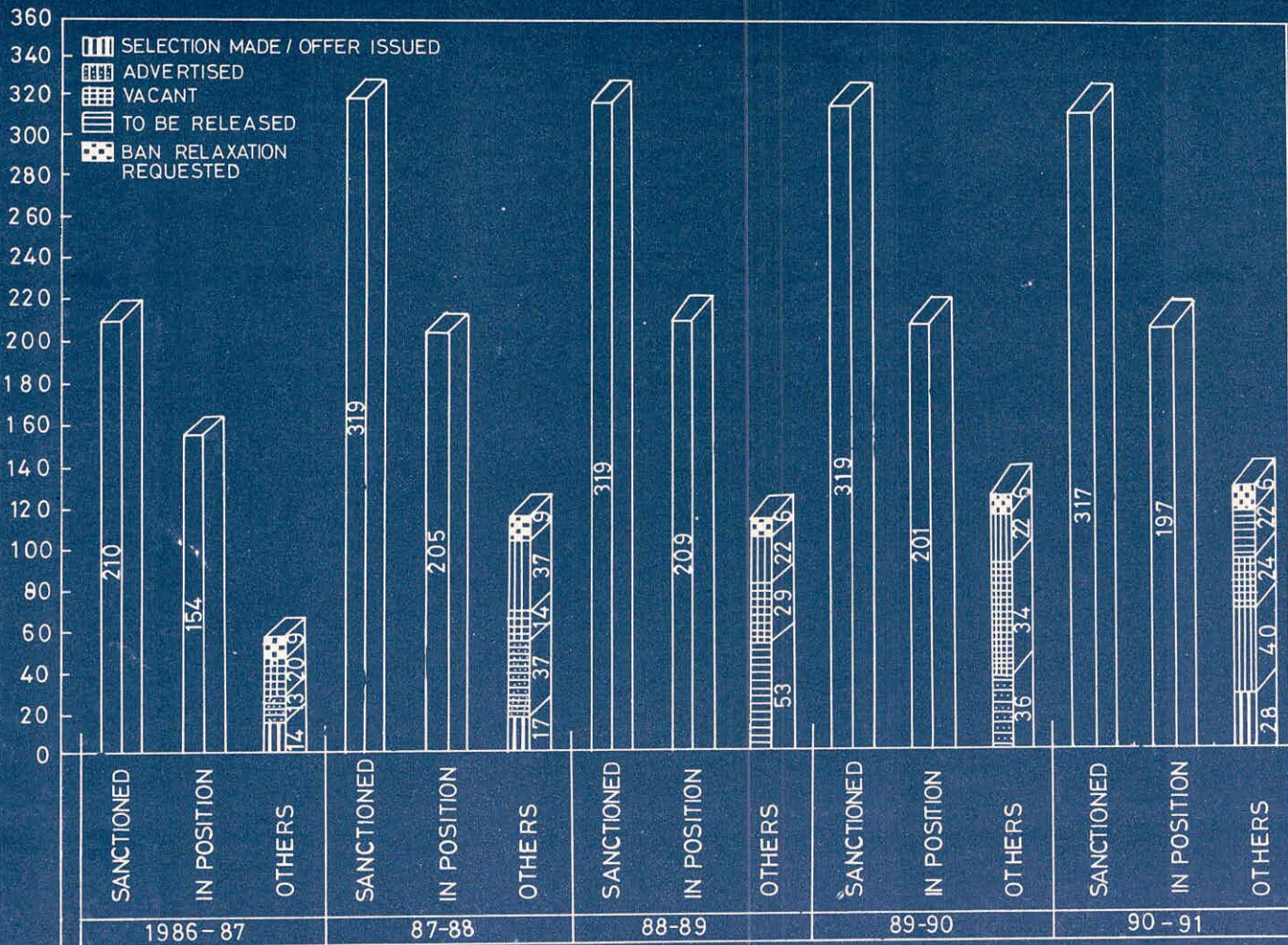


FIG. II - STATUS OF STAFF

3.0 RESEARCH AND DEVELOPMENT ACTIVITIES

3.1 General

The Institute completed the first phase of establishment (1978-85) wherein emphasis was laid on creation of essential infra-structural 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 Plan (1985-90), the Institute was engaged in consolidation, expansion and diversification of its activities. During 1990-91, 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 quantitative assessment, the emphasis was also laid on laboratory and field oriented studies. The number of useful studies were conducted on the actual 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 real time Flood Forecasting, Low Flow Forecasting, Lake Studies, Dam Break Studies, Spring Flow Study, Sediment Yield, Snow Melt Modelling, Stream aquifer interaction, Design of drainage systems, Soil moisture movement and recharge using nuclear techniques, Geomorphological studies, SHE Model application to various sub-basins of Narmada basin, soil moisture modelling, Hydrological indices of drought, ground water assessment in hard rock, hydrological aspect of drought, water quality and atmospheric land surface process modelling.

During the year under report, 59 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

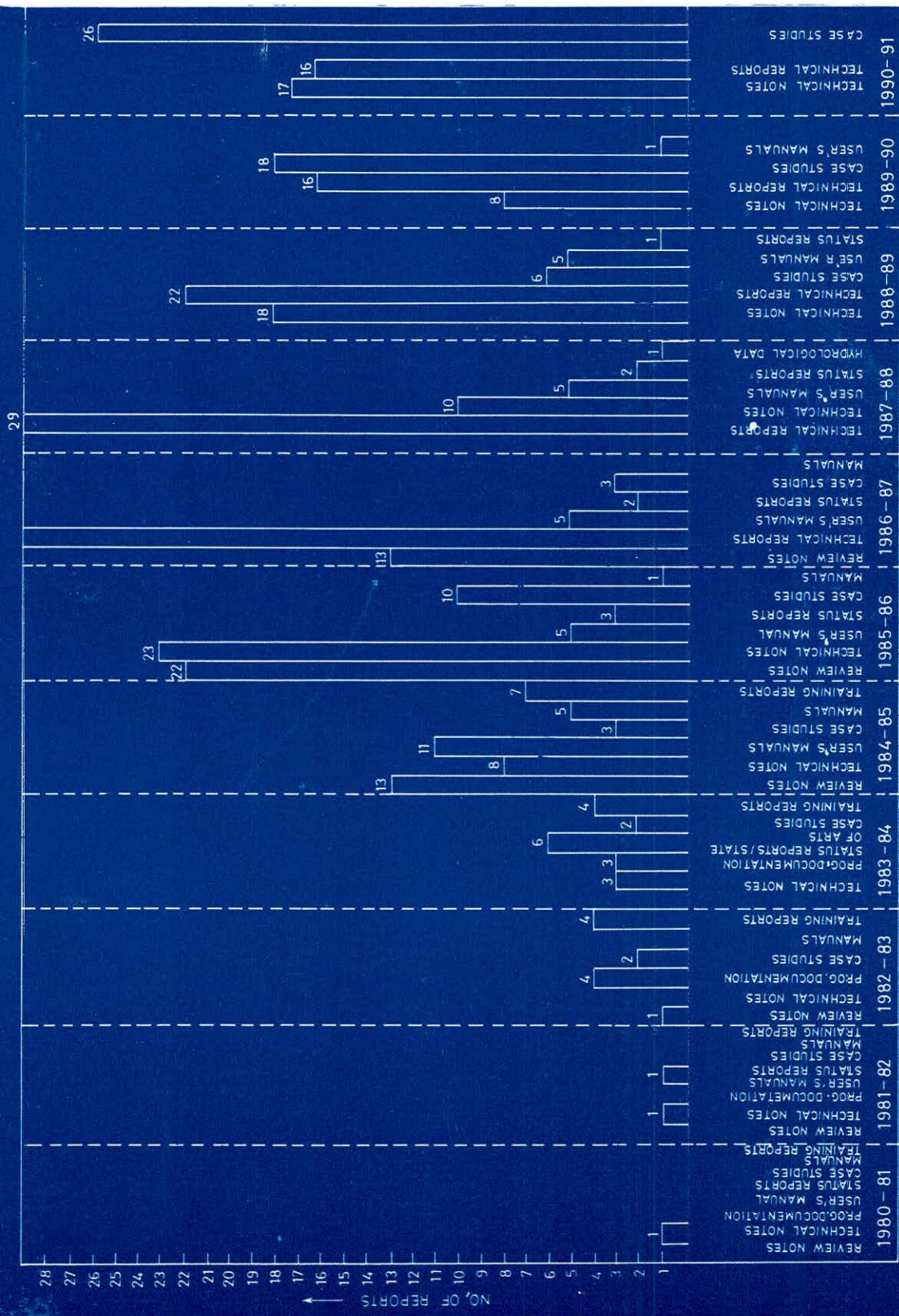


FIG. III : BAR CHART OF STUDY REPORTS AT NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

in Figure-III.

The scientists and scientific staff of the Institute have contributed/presented a number of papers in scientific journals (Appendix-VIII) & participated in national and International Conference (Appendix-IX). 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 programme, during the

year, 5 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 and the regional centre for Ganga Plain Region has been established in Patna in March 1991.

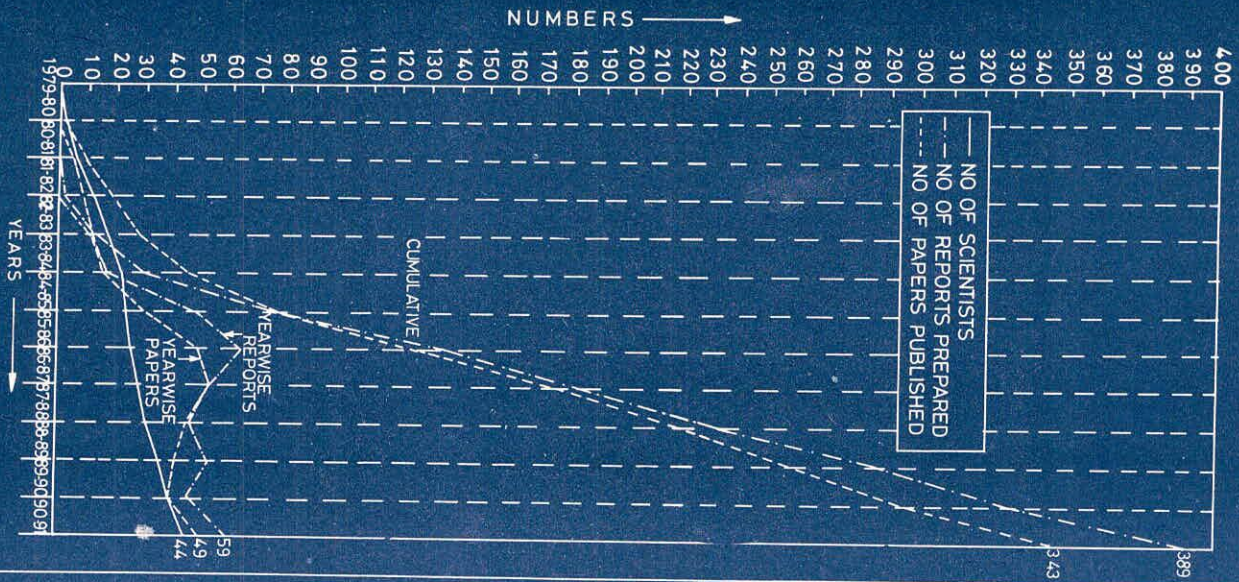


FIG. IV SCIENTIFIC GROTH OF N.I.H.

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 has 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 1988-89 was completed during the year. During the year 1991-92 similar reports for 1989-90 and 1990-91 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) has been completed satisfactorily. 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. UNDP Project is in operational during the year Training of Scientists in India and abroad is shown in Appendix-X.

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 course 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 construction of extension of experts Guest House and Museum-cum-information Centre is completed. The construction of second lab block is in progress.

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) Atmospheric Land Surface Modelling

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

Working Group members discussed the methodology for low flow forecasting in details and advised that for the Southern Indian river basins special care is required to be taken and a multiplicative ARIMA Model should be considered.

The following studies have been

carried out during the year:

(i) Review of Methodology for Flow Forecasting :

In case of major rivers of India, the flows during the lean period are due to groundwater, sub-surface flow and/or snow-melt contribution. The effect of rainfall during the lean period is generally very nominal. However, the abstractions in many cases are quite considerable and are required to be taken into account. In view of well defined monsoon season, appropriate models can be developed for lowflow forecasting with varying lead time. These may be either statistical/stochastic models or deterministic models. The technique to be used for low flow forecasting broadly depends on the following factors ; a) the major source of lowflow i.e. whether the flow is due to snowmelt, groundwater contribution or rainfall during the lean season, b) the extent of extractions either through major reservoir or diversion projects or through medium projects and c) the major changes in the landuse and vegetal cover of the basin. Various available methods of lowflow forecasting have been reviewed.

(ii) Effect of Measurement Errors on Frequency Estimates :

Flood estimates are required for design and economic appraisal of a variety of Engineering works including damy spillways, bridges and flood protection works. Flood estimates are also required for

safe operation of flood control structures for taking measures such as maintenance of flood leaves, evacuating the people to safe locations etc. Such information is provided by flood frequency analysis of the available historical records.

Observed records are required to be accurate and reliable to meet the above referred objectives. Measurement errors may lead to erroneous assessment of water resources. It may lead to very high or low estimates of discharge. In this study, effect of systematic and random errors have been introduced in high, medium and low floods in annual peak flood series for 3 sites and their effect on flood estimates has been analysed. On similar lines, the effect of random errors in the flow series has also been studied and discussed.

3.2.2 Surface Water Analysis and Modelling

Following studies were carried out during the year.

- (i) Application of SHE model to Two Indian Catchments Two case studies dealing with the application of SHE model, which is a physically based distributed hydrological modelling system, to two Indian sub-basins viz. (i) a sub-basin of Machhu river in Saurashtra region of Gujarat and (ii) Hemavathi sub-basin, which is a tributary of river Cauvery in the upper cauvery basin, have been carried out.

The hydrological process of the above two-sub-basins have been successfully modelled using SHE considering spatial and temporal variations of hydrometeorologic inputs as well as spatial variations of the soil and land use characteristics together with other physical characteristics of the catchments. In spite of data limitations, the results have been quite encouraging.

- (ii) Application of Tank Model to Ganjal-sub-basin of River Narmada-comparison with SHE model application. In this study Tank model, which is a lumped conceptual hydrological model, has been applied to simulate the runoff response of Ganjal sub-basin of river Narmada using the same length of records as was used in one of the previous studies on the application of SHE model. The results obtained from the distributed approach of SHE model application should study have been reviewed and compared with that obtained from the application of Tank Model.

- (iii) Review of Interception studies

A technical note covering a comprehensive review of the interception process and its modelling for different types of plants and trees in the country has been prepared. The interception components of

some of the well known models have also been reviewed in order to identify a suitable model structure for Interception process under conditions prevailing in India. Furthermore, some of the experimental studies dealing with interception of different types of plants and trees in the country have been discussed which provide useful information regarding the interception losses.

- iv) Review of Baseflow Separation Techniques

In many hydrological analysis, a relationship between direct surface runoff and effective rainfall needs to be established. The surface flow is obtained by subtracting the baseflow volume from the total runoff volume. a technical note covering the review of most of the reported baseflow separation techniques including those which are usually available in general text books, has been prepared. The advantages and limitations of the different baseflow separation techniques have also been discussed in the report.

- v) Geomorphology of a typical catchment

Geomorphology describes the land forms in terms of lithology and structure. The main objective of geomorphological studies is to regionalize the models describing the rainfall runoff process so as to enable the hydrologists to estimate the runoff for ungauged catchments. In this study various geomorphological character-

istics which include the linear, areal and relief aspects have been derived for Kolar sub-basin of Narmada basin. A computer software for determining the different geomorphological parameters has also been developed and successfully applied for the Kolar sub-basin of river Narmada.

3.2.3 Flood Studies

A brief description of the studies carried out during the year is as follows:

- i) Application of N.W.S. Dam-Break Programme Using Data of an Indian Dam.

The safety of downstream area of a dam against its possible failure is one of the most important aspects to be considered during the planning, design, construction and the operation of the dam. Flood wave due to a failure always assumes large magnitudes and inundates large area in the downstream portion. To estimate the amount of flood discharge reaching at different sections along downstream channel, its elevation and travel time, a large number of mathematical models have been developed in the past. The model named 'DAMBRK' developed by Dr. D.L. Fread of National Weather Service is the most accurate with various levels of data availability and less time consuming on high-tech computers.

The capabilities of this model have already been demonstrated using the data of actual failure of Machhu dam in Gujarat. The model has also been used for simulating a hypothetical failure of Dharoi dam in Gujarat. This study is on similar lines using the data of Gandhi Sagar dam in Madhya Pradesh, with more emphasis on the sensitivity of dam-break flood wave characteristics (such as discharge, stage and time for peak) due to change in various dam failure parameters such as size and shape of break, time taken for breach, reservoir water level at the time of breach and inflow to the reservoir which causes the breach.

It is seen that time for failure and inflow hydrograph to reservoir have insignificant effects on the flood wave characteristics mainly because of the large surface area and storage capacity of the reservoir. However the flood wave characteristics are significantly affected with the increase in the reservoir level and breach size.

- ii) Use of Paleoflood Information in Frequency Analysis.

Paleohydrology can be defined as the science of water of the earth, its composition, distribution and movement on ancient landscape from the first rainfall to the beginning of historic hydrologic records (S.A.Schumm, 1977). The quantity and types of sediments moved through and deposited in

paleochannels have been used in the estimation of paleohydrological components.

This technical note aims at critical review of the state-of-art in this new area and presenting the methodology as well as approaches for the use of paleoflood values in flood frequency analysis.

iii) Real Time Flood Forecasting.

Flood forecasting is required for a number of purposes, e.g., flood control, flood damage reduction, and reservoir operation. Significant improvements in operation of water resources systems can be achieved if reliable forecasts are available with sufficient lead time.

The models which are used for real time flood forecasting can be classified in three categories - black box models, conceptual models, and physically based models. The first category includes models which are mostly based on unit hydrograph theory. The physically based models are still in production stage and the computational requirements vis-a-vis facilities available at a typical installation make them unsuitable for real time application, at least for next several years. The conceptual models provide a framework which is theoretically more sound than the black box models. Further the fact that a basin is not a random assembly of different parts but a geomorphological

system whose parts are related to each other by a long common history, encourages the hope that simplified concepts may be found adequate to describe the operation of the basin in converting rainfall to runoff.

With above background, this report critically reviews the available real time forecasting models and soil moisture accounting and routing model techniques. Special emphasis is placed on application of conceptual models like NWSRFS, SSARR, HBV, Tank model and NAM model and availability of softwares. The attempts made in India in this area have also been reviewed.

3.2.4 Mountain Hydrology

The programme of different activities is given below :

- i) Snowmelt modelling studies in Sutlej catchment

The snowmelt modelling project is a multi-departmental project with participation of NIH, CWC, GSI and BBMB. It is proposed to simulate the snowmelt from the catchment of Sutlej upto Rampur upstream of Bhakra Dam.

During 1990-91, a status report on the data availability and studies carried out by different organisations in the basin have been reviewed. Satellite imagery

corresponding to years of flow data availability were obtained from NRSA. The imagery would be used for delineation of snow cover and extent in the catchment.

ii) Geomorphological Studies in Malaprabha and Ghataprabha Basins.

The advance knowledge of geomorphology of a basin is important because it affects the flow processes quite effectively. Such studies become much more important in ungauged catchments since geomorphological parameters help in regionalisation of hydrological models dealing with runoff estimations. The divisions is working on Geomorphological studies in Westernghats since 1988. During current year the Malaprabha and Ghataprabha basins are chosen for the study. The maps of both basins (on 1" = 1 mile scale) are being worked upon to find different linear, a real and slope parameters of the basin Malaprabha upto Khanapur and Ghataprabha upto Daddi are being considered in the study.

iii) Review of modelling studies in Mountainous Catchments:

During the past a number of rainfall runoff models have been developed to apply for specific basins. The report reviews different modelling studies carried out in different countries. The purpose of the study is to know which type of model be

tried for simulating the Indian mountainous conditions effectively. A number of modelling studies available in the literature are covered under the study.

iv) Lapse rate studies in Sutlej Catchments:

Studies on mean monthly temperature lapse rate in the Satluj catchment has been computed using the mean temperature data of three stations namely: Rampur (1066m), Kolpa (2439 m) and Rakchham (3130 m) The selection of the stations for this study has been made considering the location of stations in the same valley. It is found that actual temperature lapse rate is far from the generally used value of temperature lapse rate in snowmelt models. It is also observed that the rate of decrease of temperature also decreases as the elevation increases. It is proposed that actual temperature lapse rate must be computed for the catchment under consideration for snow-melt modelling studies.

v) Application of HEC-1 model for a mountainous catchment:

The HEC-1 model is designed to simulate the surface runoff response of a river basin to precipitation by representing the basin as an interconnected system of hydrologic and hydraulics components. It is proposed to model Hemavathy river upto Sakleshpur using HEC-1 model.

Hemavathy is part of upper Cauvery river system. The floods during years 1978 to 1980 are identified for the simulation study. The hourly rainfall data from three stations is being used for the study.

3.2.5 Ground Water Assessment

The research programme of this division includes ground water yield and ground water balance (component evaluation and aquifer parameters), network design, study of springs, soil moisture movement and modelling. The following studies have been carried out during the year:

- i) Analysis of flow to a 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. In the present study, analysis of unsteady flow to a partially penetrating dug well has been made taking into account the well storage. Cell theory proposed by Bear has been used for the analysis. The study has been carried out for different well penetration. The time for 90% recovery of the well storage for different penetration has been found. The performance of the well, i.e., contribution of well storage to pumping, has been evaluated for different penetration. The component of the well loss for different penetration has been estimated. Making use of the results presented the appropriate diameter and depth

of a well can be ascertained for required pumping rate and schedule.

- 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 and 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 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 method of their quantification. computer programmes for estimation of aquifer parameters and lumped water balance have been developed .

- iii) Estimation of evaporation Losses from Shallow Water Table for Different Soil Groups

Evaporation is important in all water resource studies. Water evaporates from land, either from bare soils or from soils covered with vegetation, and also from trees, open water and flowing streams. The rate of evaporation varies with the colour and reflective properties of the surface (the

albedo) and is different for surfaces directly exposed to, or shaded from solar radiation. Some of the important meteorological factors affecting evaporation are solar radiation, wind, relative humidity and temperature. In shallow water table areas, the ground water contributes to evaporation through capillary rise. The contribution is determined by the depth of the ground water, the capillary and conductive properties of the soil, and the soil water content in the root zone.

In the present study, it has been envisaged to estimate the evaporation losses from shallow water table for different types of soil overlying a shallow water table by mathematical modelling. The study will be carried out in two parts. In the first part, the soil moisture constants for different values of soil moisture content will be estimated by laboratory measurements. In the second part, a mathematical model will be developed for solving Richards' equation to estimate the evaporation losses from shallow water table. The study is under progress.

iv) Development of a Mathematical Model for Evaluation Springflow Potential

A spring provides a viable and ready source of clean water in a hilly area. Spring discharge can be used for irrigation, power generation, and recreation purposes. Hydrological study of spring is necessary for

establishing spring as a dependable and sustainable source of water. Fluctuations of spring flow are due to variations in recharge and hydrologic boundary conditions. During the period of precipitation the aquifer gets recharged and spring discharge increases. During the dry season, the spring discharge is derived from water stored in the aquifer. The live storage of spring at any time is equal to product of a time factor known as depletion time and discharge of the spring at that time. In the present study a mathematical model for analysing the unsteady flow of a spring has been developed which takes into account the variability in recharge. The springflow domain has been hydrologically decomposed into two zones, the recharge zone and the transition zone. In the recharge zone, the flow has been assumed to be in vertical direction and in the transition zone, the flow has been assumed to be horizontal. For solving the problem, the unsteady state has been assumed to be succession of steady state. An expression for the depletion time which incorporates the hydrogeological parameters and the geometry of the aquifer has been derived. The flow model being linear response of the model to time variant recharge has been obtained using convolution technique. The model has been applied to Parada spring of Nainital.

3.2.6 Conjunctive Use Division

The working Group Members suggested the following :

(a) In respect of study on 'Water availability in seven, drought prone districts, viz. Jamnagar, Kuchchh, Gulbarga, Kalahandi, Sahadol, Barmer and Karnool. The Working Group suggested that non-monsoon analysis may be conducted to obtain an estimate of specific yield and using the same, rainfall recharge analysis can be attempted.

(b) In respect of study on "Development of forecast model for water for availability studies in the Sabarmati basin", the limitation of the data and their consistency alongwith the assumptions made in the study should be incorporated in the final report.

Under Conjunctive use division following two studies were taken up during year 1990-91.

i) Water availability in seven drought prone districts viz.

Jamnagar (Gujarat)
Kuchchh (Gujarat)
Gulbarga (Karnataka)
Karnool (A.P.)
Barmer (Rajasthan)
Sahadol (M.P.)
Kalahandi

With the objective to develop a model, the water availability study in seven drought prone districts has been taken

up. The input to the model will be the monsoon rainfall. Relevant water resources data has been collected. Preliminary analysis such as checking of the data for its consistency, drawing theissen polygons for computing the weighted average monthly rainfall. Rainfall analysis of few districts, weighted average monsoon recharge to the ground water table, posting of data in computer, etc. are in progress.

ii) Predictive model study for water availability in Sabarmati basin

Water availability study in the Sabarmati basin has been taken up to develop a forecast model with monsoon rainfall as input. Relevant water resources data has been collected. Preliminary analysis such as checking of data for its consistency, fixing the area of study, drawing theissen polygons for weighted average monthly rainfall and weighted average monsoon recharge to the ground water table, posting of rainfall, runoff data, etc. are in progress. A computer programme has been developed for rainfall analysis. In the light of the area of study it has to be reoperated.

3.2.7 Drainage

Working Group members suggested that a study on effect of urbanization on rainfall should be undertaken by the Division. The following reports were prepared during the year :

i. Abatement of waterlogging through plantation :

Seepage losses from canals causes water logging problems in the region adjacent to the unlined canals. The water logging problem could be reduced by provisions of intercepting drain or by vertical drainage system.

An alternative way of vertical drainage is by energy plantation near the canal system which will take water as per the potential evapotranspiration requirement of the plant. The deep root of eucalyptus plants consumes considerable amount of water and helps in lowering the water table. The plants may be treated as group of wells taking water from the aquifer continuously. It is envisaged to predict the reduction in water table height due to eucalyptus plantation in an area in the vicinity of the canal. The safe distance of eucalyptus plantation from the canal will be considered so that the root system does not damage the embankment. A mathematical model of groundwater flow will be used to predict the reduction of water table rise due to conjunctive use of the eucalyptus plantation. a review will be made in respect of the consumptive use of eucalyptus during its growth.

ii. Design of Drainage Systems in Waterlogged area in a canal command

Excessive irrigation, seepage losses from the irrigation canal network, lack of drainage facilities are the various factors that contribute to water logging problem.

The total waterlogging area in the country is about 6.00 million hectares. Serious problems of water logging have been reported from many irrigation projects like Chambal in Rajasthan and Madhya Pradesh, Indira Gandhi Canal Project in Rajasthan, Tawa Project in M.P., Jayakwadi project in Maharashtra, Tungabhadra in Karnataka and Gandak, Kosi in Bihar and sharda Sahayak command area in U.P.

Sharda Sahayak command area of Uttar Pradesh is a part of very extensive and fertile gangetic alluvium consisting of sand, silt, clay and Kankar. Sharda Sahayak project, after completion is designed to provide 96% irrigation intensity in culturable command area of about 20 lakhs hectares. Sahayak project has caused waterlogging problems in large tracts predominantly in parts of districts Barabanki, sitapur, Raebareli and lakhimpur-kheri etc.

Out of the above mentioned districts, district Barabanki, has been selected for this study. The water table trend of the area from 1972 to 1985 has been analysed by using the ground water table data of the observation wells located in the study area. Ground watertable contours and depth to watertable contours were plotted to get the trend of waterlogging problem from year 1972 to 1985.

The study aims at designing the vertical drainage system for the waterlogged area. In the present study it is envisaged to design an appropriate well field (locations,

numbers and pumping schedule) and to suggest utilization of the pumped water i.e. to pump the water from the problems area and transport it to the water deficit area.

3.2.8 Drought Studies

Working Group members suggested to prepare reports on hydrological aspects of drought for the year 1987-88 separately for the drought affected States.

Following reports were prepared during the year:

- i. Hydrological Aspects of Droughts 1987-88 in Madhya Pradesh - A Case Study

Drought is a dreadfully familiar word in India. In recent years the country faced three drought years in succession namely 1985, 1986 & 1987. It has been reported intensity wise the drought of year 1987 ranked second in the 20th century, the first one being in year 1918. Statistics on areal coverage indicate that out of the country's total geographic 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.

The recurring incidents of drought lead to reduction in streamflows, depletion of soil moisture storages, decline of reservoir and tank levels and fall in ground-

water tank. This in turn lead to reduced agriculture and fodder production.

In this report the results of studies carried out for the year 1987-88, for the six selected drought prone districts namely ; Jhabua, Khargone, Dhar, Sidhi, Betul & Shahdol of State Madhya Pradesh, have been described.

The report includes analysis of rainfall and groundwater level data for finding deficit of rainfall and trend of groundwater table as result of drought incidents.

The seasonal rainfall departure analysis shows deficiency in all the six selected districts with the extremes lying between 30 percent to 65 percent except sidhi and Shahdol. Monthly rainfall departure analysis show that all the six districts recorded deficient rainfall ranging from 10% to 60% except Sidhi.

The frequency analysis of rainfall showed that the probability values of occurrence of 75% normal rainfall in all the six selected districts namely Jhabua, Khargone, Dhar, sidhi and Shahdol of State Madhya Pradesh are 64, 60, 62, 76 & 79 respectively i.e. below 80, indicating drought proneness of districts based on this analysis as per IMD criteria. However, in case of district Betul the probability value of occurrence of 75% normal rainfall is 82

indicating that out of 100 years, 18 years will experience 75% of the normal rainfall and so less drought prone. Herbst analysis of monthly rainfall data of the district has shown over two dry spells during 1984-87. The district of Sidhi showed maximum no. of drought spells and in general 4-5 spells were found in all districts since 1951. The maximum drought intensity was found in case of Khargone district while the longest spell of days was observed in Betul district during 1978-86. The dry spell analysis, which has been done for one taluk in each of six districts, showed that at 75% probability level, the duration of dry spell ranges from 21-28 days except the taluks of Dhar (Dhar) and Gopad Banas (Sidhi) where the duration of dry spell as expected at 75% probability ranges from 14-21 days.

The groundwater level analysis has been carried out in the districts of Jhabua, Khargona, Dhar, Shohdol & Betul. All the five districts experienced rainfall deficiency during 1987-88 ranging from 33-43%. As a result of declining trend of rainfall over the last three successive years, all the five districts except Shahdol have indicated a falling trend in pre and post monsoon water table levels and in most of the cases the rate of decline has been observed more than the previous year. This continuous

ii. Hydrological Aspects of Droughts 1987-88 in Gujrat - A Case Study

In the recent-past droughts of exceptional severity have caused major

hardship in many areas of the country. The problem of droughts in the country has wider dimensions and is recurrent in nature. Nearly 1/3rd of the country's area (i.e. 107 million ha.) spread over 99 districts in 13 states is either affected by or prone to drought comprising of about 39 percent of the cultivable area of the country (CEC, 1982). In recent years droughts were experienced in the country for three successive years viz. 1985-86, 86-87 and 87-88. The recurring incidents of droughts lead to reduction in streamflow, depletion of soil moisture storages, decline of reservoir and tank levels and fall in groundwater table. This in turn lead to reduced agriculture and fodder.

The present report describes the results of studies carried out for the year 1987-88 in six districts namely Rajkot, Jamnagar, Ahmedabad, Surendranagar, Amreli & Bhavnagar of Gujarat.

These districts lie in Saurashtra region which has mostly black soils which is poor in fertility causing the area prone to drought. These drought affected districts lie in cotton-dry wheat zone and ground nut zone. The Saurashtra region are under rocks hence no tubewells are there for groundwater development.

The report includes analysis of rainfall and groundwater level data for finding effects of deficit of rainfall and trend of groundwater table as result of drought incidents. The rainfall data have been

analysed using various techniques for classification of drought. The report also includes description of land use, population pattern, soils, geology water resources statistics etc. of the state.

The results of rainfall departure analysis shows that all the six districts selected for the study faced more than 60% seasonal deficiency and more than 50% deficiency in individual monsoon months. The probability analysis of annual rainfall for two taluks in each of the six district and districts as a whole has been carried out. The group range of annual rainfall at 75% of normal rainfall in all the six districts namely, Jamnagar, Rajkot, Ahmedabad, Surendranagar, Amreli and Bhavnagar were found as 60, 63, 63, 59, 57 and 63% respectively which are all below 80% further certifying the drought proneness of the districts.

The analysis of monthly rainfall data using Herbst's approach indicated that all the six districts except Bhavnagar had drought spells during 1984-87. The district of Rajkot showed highest intensity of drought during 1985-87. All districts experienced 6-9 drought spells during the period 1959-87. The dry spell analysis which is done for one selected taluk in each of the six districts, indicated that for all the six taluks, the duration of the dry spell ranged from 21-28 days at 75% level of probability. a dry spell was assumed as period of during which rainfall does not exceed 5 mm for at least 2 weeks. The groundwater level analysis

carried out for all the six districts showed a declining trend as a result of reduced rainfall. The water table trend lines for pre and post monsoon periods in 1987-88 showed greater effects on water table as a result of monsoon failure as compared to previous years. The steepest fall in groundwater levels was found in Jamnagar district which was followed by Rajkot and Amreli. The district of Ahmedabad, however, showed lowest rate of decline in pre and post monsoon levels. The study will continue for year 1988-89 to compare status of hydrological parameters for drought and non-drought years decline can be attributed to continued deficient seasonal rainfall and overpumpage of ground water for various usages. The studies are continuing for year 1988-89.

3.2.9 Water Resources System

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

- (i) Real time operation of reservoir

The current day practice of operation of reservoirs is based on obtaining the inflow information and manually computing the inflow into the reservoir thereby operating the reservoir for meeting various demands for water requirements. This process

involves enormous time between the information received about the floods, flood inflows and the decision making regarding the releases. The time lag causes either excess or deficit releases and in some cases the hydraulic structures damage. The Institute thus felt the need of developing technique for reducing the time lag by adopting the real time operation technique. In this technique, the data required for the inflow computations is obtained either through VHF or through satellite or through some wireless mechanism and computer based model is used to estimate the inflows to the reservoir. Knowing such inflows releases are decided and effected. Presently, real time reservoir operation of Dharoi reservoir in Sabarmati Basin in Gujarat is going on. A report on status of data available and further required is being prepared. One review note on Real Time Reservoir Operation is also going on.

3.2.10 Man's Influence

A short note the completed reports is given below.

i) Use of PC for EIA - (TR)

Any water environment or a water project must be evaluated as part of environmental system encompassing physical, chemical, biological, economic, social and cultural components. The evaluation denotes that a certain value is given to a certain situation to be evaluated. However,

in case of evaluating a water situation the difficulty is that there are many factors involved whose positive or negative values have to be given in different units. Otherwise the situation is not new, human beings have always had to make such decisions, often having to weigh different and conflicting requirements and objectives. There are various methods like consulting of an oracle or the stars, seek the advice of wise men. However scientific methods are best suited and logical in case of water projects.

In the present report a framework is given for a multi objective evaluation. It is one of a number of multicriterion decision making technique, which have been earlier shown to be useful in analysing systems where conflicts are present. Such as conflict between social and environmental goals. The systems analysis being utilized permits combination of strictly scientific evaluation with subjective opinions, intuitions, experience and common sense.

The report gives an interactive microcomputer software for evaluating the existing state and selecting the best management options for water resources systems from a joint ecological socioeconomic aspects. The programme is based on the methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development given by Unesco in 1988. Further, it is proposed to test the methodology and computer programme for Indian situation. The report

provides enough information to enable a knowledgeable user to perform the evaluation on virtually on any water body of interest.

ii) Software Development for DO-BOD Model for PC - (TR)

Since Streeter and Phelps presented their oxygen-sag equation over 50 years ago, the field of water quality modelling has witnessed major changes in both scope and complexity. Hundreds of models have been developed, ranging from simple BOD-DO type models to sophisticated multidimensional models of these more comprehensive models has been limited by two obstacles - the preparation and in putting of data, and the interpretation of results.

The preparation of data required for analytic models is both laborious and prone to errors. The second obstacle which limits most models is that output is rarely provided in a form which is directly useable or understandable. Furthermore, it is often difficult to convey adequately various technical solutions to interested, but non-technical individuals. This lack of an effective method for interpreting and communicating models reduces the effectiveness of the modelling effort in the planning process.

The organisations having well equipped laboratories with computer system

are not facing these obstacles but those where computer system is not available because of being a very costly affair with respect to setting up and maintenance it is still a problem. The commencement of Personal Computers can solve the problems created by these obstacles.

The present work addresses it self to some task of development of computer software for DO-BOD models on personal computers. For this a simple program is written in FORTRAN-77 and executed on personal computer. The study 'The Assimilative Capacity of Natural Stream' by Donald J.O. Connor is taken for the demonstration. The same programme can be successfully applied for any other stream which we want to study.

iii) Waste Water Re-Use - (TN--)

Many countries are, or soon will be reaching a stage when the available surface, ground and other resources of water would not be in a position to meet the day by day increasing water demand. By resorting to conventional conservation measures, communities may be able to defer for some years the need to develop additional water resources, but for a country like India which largely depends upon monsoon rains and with human population growing exponentially additional water resources will be needed. The re-use of treated/cleaned water can also be an excellent alternative in periods of water stress. The idea of reuse

of renovated waste water is neither new nor radical in as much as many individuals in many countries use water that has been used and cleaned several times. However, the instances of planned use of renovated waste water for municipal supply are very few. Hence, in places where fresh water supplies are limited or fresh water supplies of good quality are limited by surface or ground water pollution or new fresh water source must be developed at long distances etc. waste water reuse offers an excellent opportunity.

Tapping of polluted sources has potential effects that go beyond the increased cost of additional treatment. This sort of indirect reuse of polluted water may expose people to health risks not associated with protected sources. For although the development of modern water treatment practices has enabled us to draw water supplies from large rivers that drain urban and industrial areas without fear of typhoid, cholera, dysentery and other enteric infectious disease, the chemical revolution of the last decades has created vast numbers of long lasting synthetic organic chemicals that pose a health threat of their own. Some of these chemicals have been identified as being carcinogenic, even in trace concentrations, when ingested over long periods of time. These synthetic organic chemicals are not easily monitored or removed in treatment processes. Use of reclaimed water for nonpotable purposes, therefore, offers the potential for exploiting a 'new' resource that

can be substituted for existing sources. By 'sources substitution' - replacing with reclaimed water the potable water used for nonpotable purposes - an increased population can be served from an existing source.

3.2.11 Information System

This division has taken up work programme for the preparation of Hydrological year book, thematic maps, hydrological information of India. The user manual on DSR System and Hydrological Information of India for 1988-89 have been completed. The division envisages to study the effect of reservoirs on local atmosphere for few selected reservoirs as test case. The technical library of the Institute is also managed by the division.

3.2.12 Hydrological Investigation

Working Group members suggested to contact WALMI's Offices, Central Area Zone Research Institute, Jodhpur, CGWB directorates and regional offices and CWC hydrology directorate for the collection of infiltration data. A brief description of the studies carried out and report/research paper prepared is given below.

- i. Soil Moisture Movement and Recharge to Ground Water Using Nuclear Techniques

The Troxler depth moisture gauge 3320 series manufactured by Troxler Electronic laboratories, U.S.A. is being used at NIH campus for measuring in-situ the volumetric moisture content at different depths and times. First of all, the probe is calibrated using the gravimetric analysis approach and after that the vol. moisture contents are recorded for the known supply of water at the surface either due to irrigation or precipitation. The plots of change of volumetric moisture content with depth at different time provide the useful information about variation of moisture content. The integration of moisture content infiltrated below the sun heating zone, provides the information of recharge to ground water due to the water supplied at the surface. Few experiments have been carried-out in the premisses of NIH and further experimental work and analysis of the data are in progress.

This study of ground water recharge using Tritium tagging Technique is planned in the campus of NIH and nearby area in order to compare the results which will be obtained by other techniques. Efforts are being made to obtain the required radio-isotope from BARC, Bombay, in order to conduct the study.

- ii. Stream Aquifer Studies Using Stable Isotopic Techniques along River Ganga between Hardwar and Narora

Study of regeneration (stream-aquifer interaction) of river Ganga was taken-up by

U.P.Irrigation Research Institute, Roorkee between Hardwar and Narora using discharge data. This study was further carried-out by UPIRI using isotopic technique in collaboration with BARC, Bombay. But, the study could not be continued upto the required period, therefore, results obtained in short duration could provide only preliminary information. Keeping the usefulness of the study and preliminary information available, it is felt necessary to continue this study on the recommendation of BARC scientists.

The previous study reveals that water level in river remains higher to the ground water level from June to September at sites, Hardwar, Balawal, Shukurtal, Anupshahar and Narora except Gharmukteshwer where studies were carried out. Therefore, river contributes to ground water. In rest of the period, ground water level remains higher than the water level in river (except Hardwar), therefore, the ground water contributes to river.

In a case where the surface water system is a river, it will be transporting water which has originated as precipitation falling at higher elevations than the area where the surface-ground water relation is under investigation. As a result of altitute effect, for oxygen-18 most commonly about - 0.2 to - 0.3% per 100 m change in elevation, the stable isotopic composition of the river water will be more depleted than that of ground water derived from intiltration of local precipitation. Therefore, by studying

the change of isotopic composition in surface water and ground water at different times and places, the information about the mixing trends of waters with time can be obtained and the zones of regeneration and seepage can be identified.

Preliminary survey of the area has been carried-out and five sites have been selected for the installation of piezometers. Twenty-five to thirty piezometers (3 at each bank) along river Ganga i.e. six piezometers at each site will be installed. The necessary efforts are being made to install the piezometers. The water samples from river and ground water were collected from the selected sites during the preliminary survey. The analysis of these samples for stable isotopic composition and qualitative/chemical composition is almost completed.

A technical note entitled "Stream Aquifer interaction studies using stable isotopic techniques" is being prepared.

iii. Lake Water Balance, Sedimentation and Identification of recharge Zones in Nainital District

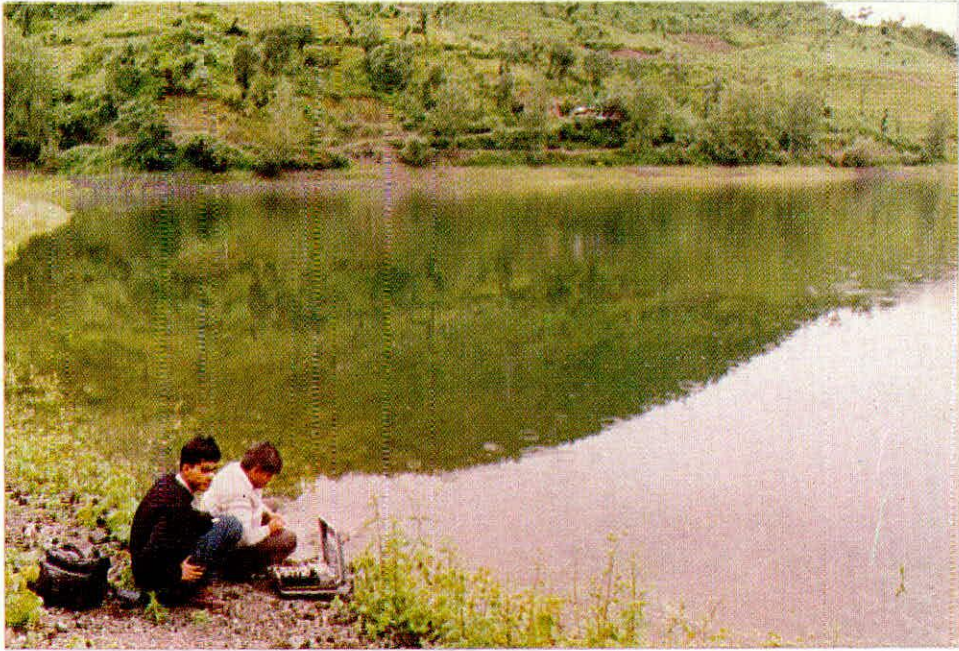
The greater Nainital lakes region comprising of lakes Nainital, Bhimtal, Naukuchiyatal, Sattal, Maluwatal, and Khurpatal from a group of lakes lying in a belt of 24 km. length and 3.2 km. width at an altitude of 1220 meters to 1938 meters.

Keeping in view the importance of lakes as a major source of drinking water and role in maintaining the beauty of the area, these studies have been taken-up under this division. The use of nuclear techniques for the study of various aspects of lakes like water balance, sedimentation, pollution movement and identifying recharge zones have proven in the recent years and these studies can be carried-out easily and accurately.

Stable isotopes Oxygen-18 or Deuterium will be used to study the water balance of lakes evaporation from lake surface, mixing pattern of different layers and the identification of recharge sources. Natural fall out of Cs-137 or Pb-210 and its decay with time will be used for the study of sedimentation rate in lakes. Artificial radioisotope (tritium) will be used for the study of baseflow (seepage) from the lakes and pollution movement. Other conventional techniques will also be used for the study of water quality, temperature variation and bathymetric survey of the lakes.

The preliminary information of the lakes under study in the Nainital district have been collected and efforts are being made to procure the necessary equipment required to conduct the study.

- i) A technical note entitled "Lake water balance, Sedimentation and identification of recharge zones using isotopic techniques" is being prepared.



Collection of water sample from Bheemtal lake under the hydrological study of lakes in Nainital region.

II) Three project proposals have been prepared as per details given below:

- a) Studies of hydrological balance and eutrophication characteristics of lakes submitted to CEC.
- b) Studies of water balance and recharge zones of lakes under Bhimtal project (EEC) submitted to watershed management directorate, Dehradun.
- c) Hydrological studies of lakes in Nainital region - submitted to Deptt. of Hill Development, Govt. of U.P.

iv) Soil Classification and Infiltration Rate Studies in U.P.State including preparation of Thematic Maps

In order to collect required information, efforts are being made to contact the forty different organizations/agencies in our country. Letters were sent to these agencies but no response was received, therefore, the person concerned were contacted personally and some data related to soil type and infiltration rates have been collected. But, still more data is needed to prepare the thematic maps. Therefore, the planning to conduct the experiments at the selected places in U.P. is in progress and cooperation of the U.P. Irrigation Deptt and

U.P. Ground Water Deptt. in order to provide the transportation and staff is also under active consideration by these departments.

v) **Other Activities**

Two project proposals for taking up the work of survey and fabrication of Hydrological Instruments have also been submitted to soil and water conservation wing, Ministry of Agriculture, Govt. of India as per details given below:

- a) Indigenous development of Hydrologic instruments/equipment for the measurement of rainfall, runoff

and sediment load.

- b) Survey and evaluation of hydrologic equipment/instruments and identification of suitable set-up for watershed hydrology for different regions.

3.2.13 Atmospheric Land Surface Modelling

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

- i) Hydrological response of greenhouse effect with emphasis on evaporation and evapotranspiration

Concentrations of several gases viz. carbon dioxide, methane, nitrous oxide,



Site for the installation of piezometers along Sat-tal lake under the hydrological study of lakes in Nainital region

chlorofluorocarbons in the atmosphere have increased significantly since the dawn of the industrial era. Many of these pollutants trap the heat emitted by the surface of the planet, which would have otherwise escaped to space. Hence the observed build-up of the gaseous pollutants has increased the radiative heating of the planet. The changes in the hydrologic cycle that would accompany such warming are subject to far greater uncertainty. The hydrologic parameters such as evaporation and evapotranspiration may change because of atmospheric warming and because of associated changes in other climatic factors.

The present report gives a review of the recent trends of increase in greenhouse gases, impact of increase in greenhouse gases on meteorological parameters, and on hydrological parameters such as runoff, soil moisture, sea level etc. The literature regarding impact of carbon dioxide doubling on evaporation and evapotranspiration has been reviewed and discussed in detail.

(ii) Parameterization of hydrologic process-Evaporation

Land Surface processes are defined as those phenomena which control the fluxes of heat, moisture and momentum between the surface and the atmosphere over the continents. These processes influence both the circulation of the atmosphere, and the climate of the surface.

The parameterization of land surface processes is a key issue both for understanding and projecting long term trends and

trends and for extending the range of numerical weather forecasting.

Evaporation of water into the atmosphere and its condensation to produce rainfall are at the heart of the earth's hydrological cycle as well as land surface processes. A critical review has been carried out on parameterization of hydrologic process with emphasis on evaporation process and reported in this technical note.

iii) Soil and vegetation parameters for GCM

To study the impact of land surface processes on climate on regional scale, there exists a need to evaluate the adequacy of soils data on a regional scale. Because of the spatial variability of the land surface, the climate models aim at incorporating the most critical features of soil behaviour without requiring detailed information on soil characteristics. It is therefore necessary to decide what these critical features are, how they may be functionally related to other soil characteristics and whether adequate regional data on them are available. Besides soil data sets, vegetation data set is important among other data sets required for the validation of atmospheric models. This technical note deals with the aforementioned information and gives details of analysis concerning land surface parameters related with soil and vegetation for the Indian subcontinent.

3.3 Research Publications

3.3.1 Papers Published

The scientists of the Institute have published research papers in various national and international journals, Seminar/Symposia etc. Appendix-VIII presents the list of papers published during the year.

3.3.2 Hydrology in Ancient India

If one studies the ancient Sanskrit literature he observes that it contains valuable references to hydrology. The important concepts of modern hydrology are scattered

in various verses of vedas. Puranas, Meghmala, Mayurchitraka, Vrhat Sanhita and various other ancient Indian works. In this document an attempt has been made to compile information pertaining to hydrology in ancient Indian literature.

In Vedic age Indians had developed the concept that water gets divided into minute particles due to the effect of sun rays and wind. In various places in Puranas it is alluded that water can not be created or destroyed, only its state is changed through various phases of hydrological cycle. Evaporation, condensation, cloud formation, precipitation and its measurement were well understood in India in Vedic and Puranic



Institute's publication on "hydrology in Ancient India"

times. Effects of Yajna, forests, reservoirs etc. on the causation of rainfall, classification of clouds, their colour, rainfall capacity etc. forecasting of rainfall on the basis of natural phenomena like colour of sky, clouds, wind direction, lightening, and the activities of animals was well developed in ancient India well before 10th century B.C. Contrivance to measure rainfall was developed during the time of Kautilya (4th cent. B.C.) which had the same principle as that of modern hydrology except weight measure of Drona, Pala etc. were adopted instead of modern linear measurement of rainfall. Scientific facts like arid regions of Tibetan rain shadow area and no rainfall by polar winds and height of clouds alongwith the division of atmosphere was well developed in Vedic age. The technique of knowing the slope of an area by means of a flowing river and dimensions of meandering rivers alongwith velocity of flow were usefully developed. Mountainous rivers are generally perennial, deposition of fertile soil periodically on flood plains, different types of topography alongwith the classifications of land and soil as black, gravelly, boulders etc. were well known.

In ancient times when the western knowledge about the occurrence of ground water was based on the wild theories, as they were believing that rainfall being inadequate in quantity, can not be the source of ground water, the Indian had the well developed concepts of ground water occurrence, distribution and utilization, Literature also reveals that hydrologic indicators such as physiogra-

phic features, termite mounds, soils, flora, fauna, rocks and minerals were used to detect the presence of ground water. Variation in the height of water table with place, hot and cold springs, ground water utilization by means of wells, well construction methods and equipment are fully described in 54th chapter of Vrhata Sanhita named as 'Dakargala'. Sun rays, wind, humidity, vegetation etc. are the major causes of evapotranspiration was well realized.

It is very interesting to learn that Varahamihira in as early as 550 A.D. presented a simple method for obtaining potable water from a contaminated source of water. Various plant materials alongwith the sun heating, aeration, quenching of water with fire heated stones, gold, silver, iron or sand were used. The change in the quality of water with the months of year and suitability of water from different sources for various uses were described.

Efficient water use, lining of canals, construction of dams, tanks, essential requirements for the construction of good tanks, bank protection methods, spillways and other minor aspects were given due consideration in ancient times in India. Well organized water pricing system was prevalent during the time of Kautilya. Various references are available in Vedas even alluding the importance of efficient water use so as to reduce the intensity of water scarcity and drought etc.

In present study the knowledge of various aspects of water resources and hydrology as contained in ancient Indian literature and summarized above have been analysed. The report has been divided into nine chapters dealing with different aspects of hydrology.

3.3.3 Development of Hydrology in India since Independence

Hydrological developments have been taken place very rapidly in our country since independence. Scientists and engineers have not only solved various water related problems but developed a good infrastructure in order to meet out the future needs of water in our country. Not only this, various educational/technical institutions have started education in the field of hydrology and government/semigovernment organisation/departments/institutes have been established at the level of state and central governments. National Institute of Hydrology, being a premier institute in the country in the field of hydrology has decided to bringout a document having details of progress and developments taken place in the field of hydrology has decided to bringout a document having details of progress and developments taken place in the field of hydrology in our country since independence.

Keeping in view the various aspects of hydrology, it has been decided to prepare the progress and developments taken place in twenty potential areas. The experts have also been identified for preparing a draft write up on each topic. The preparation of this document is in progress. Various topics identified to be included under this document are as given follows:

- 1 Flood hydrology
- 2 High Altitude Hydrology
- 3 Hydrologic Design
- 4 Hydrology of Mountainous Area
- 5 Hydrometeorology
- 6 Surface Water Hydrology
- 7 Agricultural Hydrology and Drainage
- 8 Conjunctive use of surface and ground water
- 9 Ground Water Hydrology
- 10 Hydrology of Hard Rock
- 11 Hydrological Aspects of Drought
- 12 Nuclear Hydrology
- 13 Seepage and Drainage
- 14 Data Storage and Retrieval
- 15 Education and Training
- 16 Hydrological Investigations
- 17 Lake Hydrology
- 18 Man's Influence on Hydrologic Cycle
- 19 Remote Sensing Application to Hydrology
- 20 Water Resources System

4.0 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 belonging 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.

Water availability study in the seven drought prone districts has been taken up to evaluate the available surface and ground water resources and develop a model to predict the availability in relation to the monsoon rainfall. For this purpose relevant water resources data has been

collected for all the seven districts. However toposheets are yet to be obtained in respect of few districts where restrict sheets are to be obtained. Preliminary analysis such as checking the data for its consistency, drawing Thiessen Polygons for computing the weighted average monthly rainfall, weighted average monsoon recharge to the ground water table, preparation of data files in the computer, etc. are in progress in respect of Jamnagar and Kuchchh districts.

- (ii) Predictive Model Studies for Water Availability study in the Sabarmati river Basin

Water availability study in the Sabarmati basin has been taken up with a view to develop a forecast model. Keeping the monsoon rainfall as input. Relevant water resources data has been gathered/collected. Relevant restricted/ordinary toposheets are yet to be obtained. Preliminary analysis in respect of checking the data for its consistency, fixing the area of the study, drawing Thiessen Polygons for computing weighted average monthly rainfall and weighted average monsoon recharge to the ground water table, preparation of data files in the computer, etc. are in progress.

Matter related to the development of models in both the studies has been discussed in the fifth working group meeting of the Conjunctive Use Division.

(iii) Reservoir Operation Studies for Machhu Dam II

The work on this project sponsored by Gujarat State Water Resources Department continued during this year. At the end of the previous year, a draft of the report for conservation storage regulation of Machhu II reservoir was completed. During this year, the draft report for flood control operation of the reservoir was prepared. A computer programme has been developed for flood control operation of the reservoir level, rule and inflow, and computes the releases to be made from the main as well as additional spillway taking into consideration the downstream channel carrying capacity, both for normal as well as emergency situations. The draft report was sent to the Govt. of Gujarat. Some comments have been received from Govt. of Gujarat and are being incorporated.

(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 2178 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 irrigation demands in the command area. The major tributaries viz, Sei and Wakal, 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 Hathmati dams for irrigation purposes and also to prepare a suitable flood forecasting scheme for the operation of Dharoi project.

(v) 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.

(vi) 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.

(vii) 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 steams (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.

The data requirements for the above study have been prepared after discussing with executive engineer and Chief Engineer, Punjab Irrigation and Drainage Work. Subse-

quently 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 and Drainage from the Office of the Chief Engineer, Punjab Irrigation Deptt. Meanwhile, mathematical formulation for the above study is in progress.

5.0 REGIONAL ACTIVITIES

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, Sikkim, West Bengal. Senior scientists also visited Assam, Bihar, Jammu Kashmir, Gujarat, Karnataka, Andhra Pradesh, Madhya Pradesh, 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-actions with states and Central Government Organizations are given in Appendix XI and also presented in Figure V in figure form.

5.2 Regional Centres

The hydrological problems of different regions of the country are unique due to difference 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 VI).

	ANDHRA PRADESH	ASSAM	BHAR	GUJARAT	HARYANA	HIMACHAL PRADESH	J & K	KARNA TAKA	KERALA	MAHARASHTRA	MADHYA PRADESH	MADHYA PRADESH SHTRA	MEGHA LAYA	ORISSA	PUNJAB	RAJASTHAN	TAMIL NADU	UTTAR PRADESH	WEST BENGAL	
REGIONAL FLOOD FORMULA		1		1		1		1		1	1		1	1		1	2	4	1	2
CONSULTANCY				2	2						1							3	4	
WORKSHOP	2	2	2	2	1	1	2	3		3	1	2	1	1	1	1	1	1	1	2
NETWORK DESIGN	1	1	3	1			1	1		1						1				2
REGIONAL CENTRE																				
HYDROLOGICAL STUDY	2	1	5	4	1	1	1	4		8	1	2	1	2	1	1	2	4	1	1
HYDROLOGY YEAR BOOK	3	2		5	1	6	3	6		5	1	1	1	1		1	2	5	4	1
SEMINAR AND SYMPOSIUM	2	2		1			1	1	1					1			1	1	1	1

LEGEND

COMPLETED —————

IN PROGRESS - - - - -

PLANNED - - - - -

NOTE: PROJECT STUDIES REFERRED BY CENTRAL GOVT. ARE CIRCLED

FIG.V : INTERACTION WITH STATES OF NATIONAL INSTITUTE OF HYDROLOGY

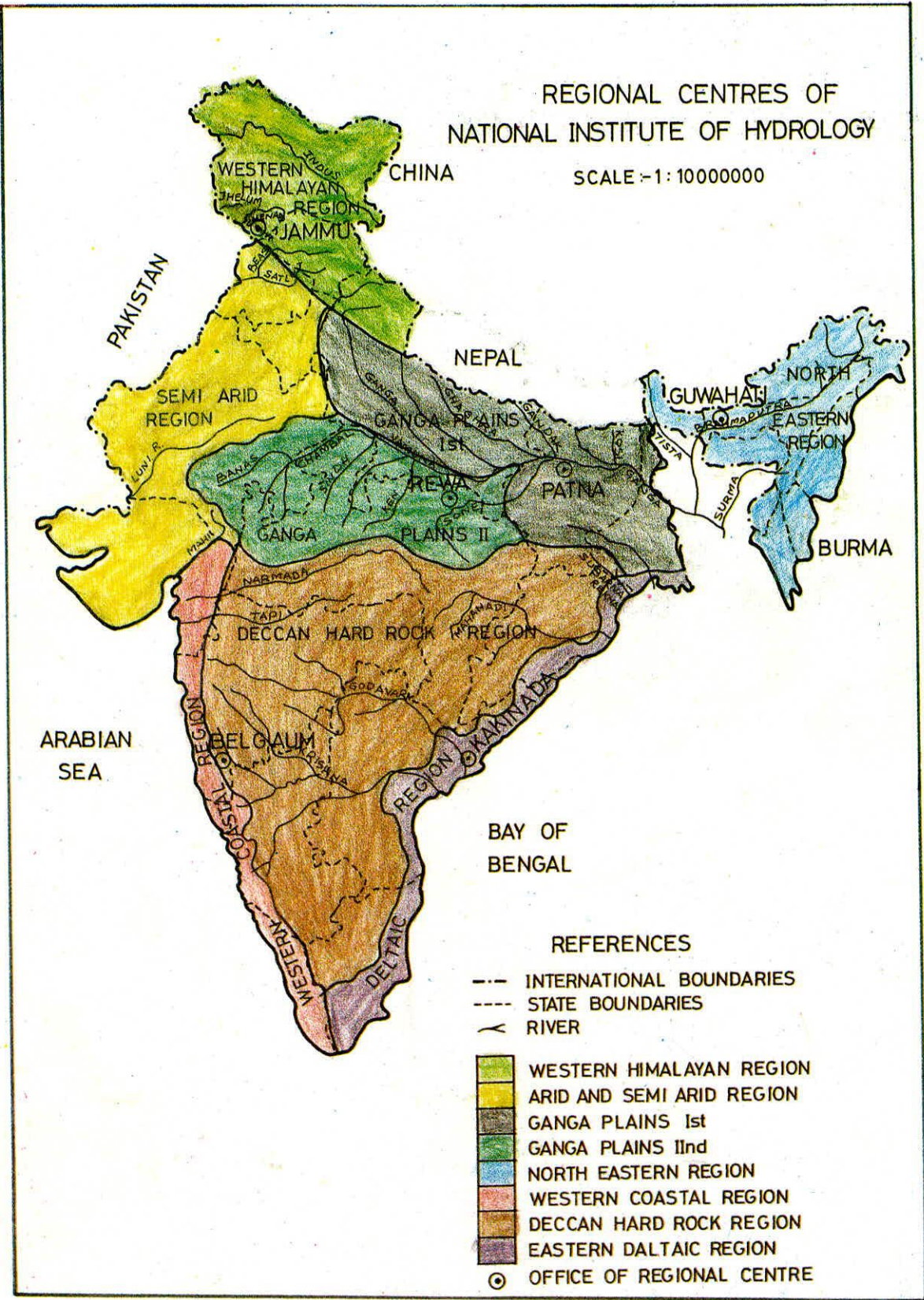


FIG.VIII : REGIONAL CENTRES OF NATIONAL INSTITUTE OF HYDROLOGY

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. During the 8th Plan, the regional centre for Ganga plains has been established at Patna.

5.2.1 Deccan Hard Rock Regional Centre, Belgaum

The regional centre for the hard rock region was established at Belgaum, Karnataka in 1987. The centre covers the hard rock regions in the states of Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra and Tamilnadu. The centre has been set up for carrying out applied and field oriented studies and research in the following areas of hydrology.

- (i) Representative basin studies
- (ii) Reservoir sedimentation
- (iii) Regional flood formulae
- (vi) Hydrological studies of Irrigation tanks
- (vii) Conjunctive use studies
- (viii) Hydrological data year book

During the last three and half years the centre has taken up some of the problems for studies and made significant progress in spite of limited manpower availability.

i) Representative Basin Studies :

For carrying out representative basin studies two catchments namely Ghataprabha upto Daddi and Malaprabha upto Khanapur in Krishna basin were identified. Keeping the existing network of raingauges, observatories and gauge discharge sites in view, observatories and rain gauges in hitherto unrepresented locations were setup in the catchments of Ghataprabha and Malaprabha. So far one observatory at Halkarni and four raingauges at Jamoti, Chandgad, Nesari and Mahagaon have been set up. The observation and collection of the data in the two representative basins was being carried out since May 1989. Field studies for determining river cross section and establishment of gauge discharge relationships have also been carried out.

ii) Reservoir Sedimentation Studies :

Studies on sedimentation in the Tungabhadra reservoir using information derived from satellite imagery have been completed. Similar studies are in progress for the reservoir on Ghataprabha at Hidkal.

iii) Regional Flood Formulae :

As a first step towards development of regional flood formulae frequency

analysis of peak floods observed at Khanapur on river Malaprabha have been completed. Similar studies for Ghataprabha are being taken up.

iv) Hydrological Studies of Irrigation Tanks :

In consultation with the Irrigation departments (Minor Irrigation) in Andhra Pradesh and Karnataka studies on the irrigation tanks have been taken up. On the advise of the respective Irrigation departments, two tanks in Anantapur district (A.P) and one tank each in Belgaum and Bijapur districts (Karnataka) have been taken up. After visiting the catchments of these tanks appropriate sites for setting up of instrumentation have been identified. Installation of the equipment is in progress.

v) Conjunctive Use Studies :

Conjunctive use studies in the command areas of the Hidkal (Ghataprabha) and Naviluteerth (Malaprabha) reservoirs have been taken up. Collection of hydrological and agricultural data is being carried out.

vi) Hydrology Data year Book :

Hydrological data year books for the following sub basins have been prepared to serve as model for the preparation of such year books by the respective state departments.

(a) Hemavaty sub-basin in Cauvery basin

- (b) Malaprabha sub-basin in Krishna basin
- (c) Ghataprabha sub-basin in Krishna basin.

5.2.2 North Eastern Regional Centre at Guwahati

Realising the typical hydrological problems of the North Eastern Region of the country and keeping in view the peculiar climatological and topographical, situation of the Region the Institute decided to establish one of its planned seven Regional Centres in the North Eastern Region. The North Eastern Regional Centre (NERC) was established at Guwahati in August 1988. The Govt. of Assam also agreed to provide suitable land on long term lease to the Institute for establishing its Regional Centre, laboratories and accommodation for staff. Presently the Regional Centre is located at an Inspection Bungalow of the Irrigation Department which has been temporarily provided to the Institute on rental basis. The Govt. of Assam is considering parting with 5 to 6 acres of land for the permanent location of the Regional Centre.

The N.E. Regional Centre covers the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura besides the hilly regions of west Bengal and Sikkim. The N.E. Region of the country comprising of seven Indian states has the largest quantum of water resources with abundance of rainfall resulting in severe floods. This needs to be studied in depth and suitably harnessed using modern technology

in the best interest of the Region. Also there are serious problems of large scale deforestation and soil erosion on hill slopes which need to be tackled urgently to save the land & people and irreparable damage to the ecology of the Region.

Scientific Studies

Keeping in view the various problems of the region and after discussions with some of the State Govt. the Regional Centre has initiated the following studies which are continuing.

i) Representative Basin Studies in a Typical Basin :

Research on water balance forms an important component for a realistic appraisal of the water resources for their effective development and utilisation. For this it is imperative to carry out intensive studies on representative basins on an experimental basis to identify and evaluate methods for assessing changes in the hydrological regime of a catchment due to changing land and water use. The results of studies could be extended to ungauged catchments.

In consultation with various concerned Departments like Irrigation Deptt ; Govt. of Assam, Brahmaputra Board as also considering the approachability of the basin, representativeness of the basin and size of the basin the NERC has taken up the representative basin and virginity of the basin studies in Kulsi basin. The basin is about 1860 sq.km. in area and is about 50 km from

Guwahati. There are 4 discharge/gauge sites and 4 rainfall stations in the basin and 4 rainfall stations around the basin. However there are no self recording stations in the basin. The main objectives of the study are to properly and adequately instrument the basin, collect intensive hydrometric data and compile them, to collect all available hydrologic and other data, to develop generalised relationships between river flow and catchment characteristics, to carry out detailed water balance studies to understand component processes and to study the effect of land and water use changes on the river flow.

The study has already started and part of data have been collected. The network of instrumentation to be installed in the basin and their locations are being worked out and the instruments are being procured.

ii) Water Year Book for a Typical Basin

Water year Books are essential base of information for planning and design of water resources projects as they contain valuable information for this purpose. In consultation with various agencies working for the development of water resources in the North Eastern Region, considering the availability of hydrologic and meteorologic data, keeping in view the various development works already taken up and being proposed to be taken up in the basin it was decided to take up preparation of Water Year Book for the Kopili basin. This shall contain the description of the basin,

present status of development, existing network of hydrologic and hydrometeorological stations in the basin, and their salient features. The study shall also contain a number of maps like index map, contour map, location of raingauges and discharge sites, location of ground water observation wells, soil and land use maps, annual isohyetal maps etc. The cross-section and longitudinal sections where available shall also be given. Some statistical parameters of the available data shall also be computed and given.

The work on this study is progressing and all efforts are being made to collect data on all aspects related to the preparation of this useful book. The various Departments like Brahmaputra Board, Flood Control Dept. & Irrigation Deptt., Assam and state Electricity Board etc. are being contacted for procuring the data and information.

iii). Distribution of Rainfall over N-E Region

Study of distribution of rainfall in North Eastern Region is very interesting and useful as the rainfall in the N-E Region is quite different than the other parts of the country. Rich forests and unique topography directly affects the distribution. The Region is blessed by two major river systems i.e. Brahmaputra and Barak. The annual rainfall in these two basins is the major source of water in the Region. Also the seasonal rainfall is the main contributor to the floods in the Region. Thus the study of the distribution

of rainfall in the Region shall help in understanding the floods in the Region.

In this report the study of distribution of rainfall in the Region is carried out based on the meteorological sub-divisions, Brahmaputra valley and Kulsi basin. For these catchments the available rainfall data have been analysed and distribution of annual/seasonal rainfall has been discussed.

iv). Impact of Shifting Cultivation on hydrology of Small Streams :

Shifting cultivation which is locally known as "Jhuming" or "Zooming" is extensive in the whole North Eastern Region of the country. The system consists in shifting the area under production with the migration of the household.

Jhuming is confined mainly to tribal communities. It involves rotation of fields rather than crops and shifting of homes close to fields. The land is abandoned after harvesting for considerable number of years to regain natural fertility.

In Assam, the practice is followed widely in two hill districts of the State viz. Karbi Anglong and North Cachar Hills. A total of 32.2% hill area of Assam is presently under this practice. The Jhuming cycle is around 6 years. In Meghalaya about 75% of the cultivable land and 42% of the hill population depend on Jhuming. 18.46% of the total area is under the practice. The cycle is about 5 years. In Manipur about 5% of the

total area is under the practice. The Jhum cycle here varies from 5 to 15 years. In pura the Jhum area covers about 21% of the total area. The practice is being adopted by about 30% of the population. The cycle varies from 5 to 10 years. In Nagaland the area under Jhum is about 37% of the total geographical area of the State. The cycle is from 6 to 15 years. In Arunachal Pradesh the practice is being adopted in only 3% of the total area. However the Jhum cycle has come down to almost 1 year. In Mizoram Jhuming is universal and almost 30% of the total area.

In the entire Region about 3 million hectare of forest land are affected by Jhuming and nearly half a million tribal families are involved. Keeping in view the importance of the practice in the Region and considering its impact on the hydrology of small streams a study has been initiated to see the influence of the practice on the discharges of small streams. Presently a state of art of the prevailing practice is being prepared. This shall bring to focus the areas severely affected by the practice and shall help in selecting the small watersheds where the detailed studies can be taken up.

Technology Transfer

During the year the Institute organised one 5 Day's Workshop for the engineers of the Region. The Workshop was organised on "Ground Water Balance" during November 27 to December 3, 1990 at Tezpur. The Workshop was conducted by the North

Eastern Regional Institute for Water and Land Management (NERIWALM) and was sponsored by the North Eastern Council (NEC). The faculty for the Workshop was completely from the NIH. The Workshop was attended by 15 participants from various States of the Region. The Workshop was organised at the request of the State Governments of the Region. In this workshop the participants were imparted training on the theoretical and practical aspects of ground water balance. The lectures were followed by tutorials and actual case studies were explained

Procurement of Equipment

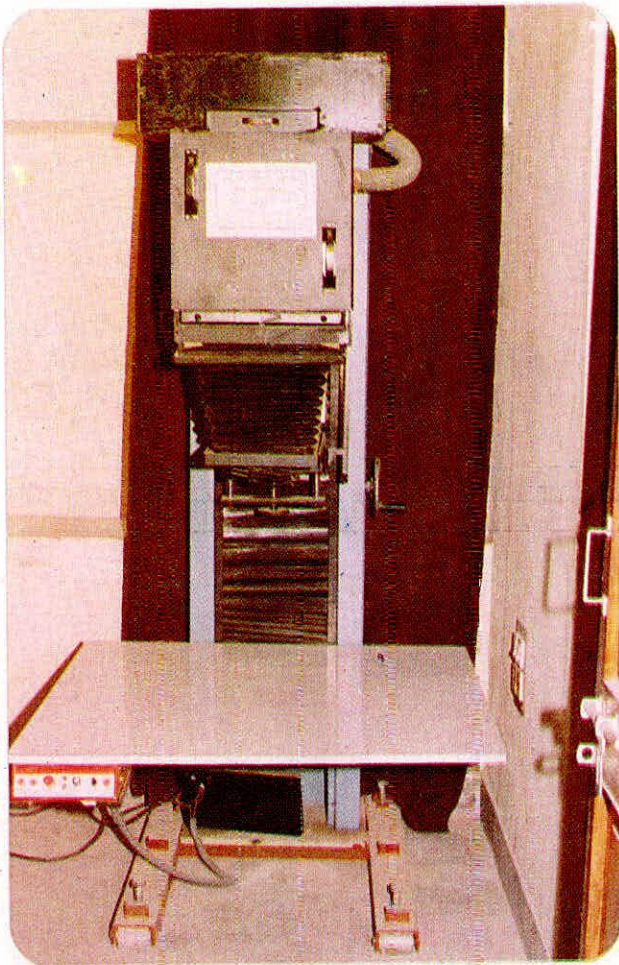
During the year the following equipment were procured/made operational:

a) Personal Computer (P.C./AT):

The P.C./AT which was procured during the last financial year has been installed. The P.C. has colour monitor. The computer is being used for scientific studies and the data which is being collected from various agencies is being stored in proper format for easy retrieval.

b). Colour composite Printer:

The colour composite enlarger is an equipment basically designed for remote sensing applications. This enlarger is capable of producing colour, composites. Colour enlargements and black/white enlargements from the film size upto 240 mm x 240 mm.



The equipment is operational and is being used where necessary. With the procurement of the above mentioned equipment and already existing remote sensing equipment like optical reflecting projector, enlarger with 4 times facility and light table with coordinate measuring system, the Regional Centre has fairly good capabilities for taking up remote sensing applications work. During this year the order has also been placed to the National Remote Sensing Agency, Hyderabad for procuring the land sat imageries of the complete N-E Region.

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 Control Department of Jammu. The Centre started functioning since January 29, 1990. Personal Computer, Equipment for Interpreting Remotely Sensed Data, Meteorological equipment have been purchased.

The following studies have been taken

up and are in progress at the regional centre:

- i) Hydrology of river Chenab
- ii) Hydrology of river Tawi
- iii) Status of hydrology in Sutlej basin upto Rampur (1960-89)

Four river basins have been identified to carry out representative basin study. Work such as preparation of maps, installation of observatories, creating infrastructure for representative basins are in progress.

5.2.4 Ganga Plains Regional Centre at Patna

The Regional Centre for Ganga Plain region has since been established. Govt of Bihar has already allotted 4 Acre of land for the office & residential buildings and the meteorological observatory etc. in the WALMI complex situated near the irrigation Research Station, Khagaul, Patna. Necessary actions have already been initiated for the construction of the office & residential buildings. In the meantime, the office is being established in a hired accommodation.

The centre has been set up for carrying out applied & field oriented studies & research covering the specific hydrological problems of this region.

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 Himalayan hydrology with emphasis on spring flow. Flood estimating by unit hydrograph techniques, processing and analysis of precipitation data and Ground Water balance. Five such workshops have been organised, two at Patna and 1 each at Bhopal, Tejpur and Roorkee.

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 XII.

6.0 FACILITIES

6.1 Building and Infrastructural

The construction of Museum-cum-Information Centre and extension of Guest House is completed. The construction of second Laboratory Block to use Surface Water Laboratory and few other laboratories is in progress and is expected to be ready for occupation by May 1991. The Ministry has cleared the proposal for the purchase of land for the staff colony and it is expected that the land will be available in the first

quarter of 1991. An automatic exchange was procured to provide telephone connections both at residences and the office premises. The exchange is expected to be installed in April 1991.

6.2 Maintenance

The Institute established a maintenance unit which looks after the electrical and civil maintenance of the campus. Besides this, the unit also takes up petty



Flow Injection Analysis Systems

construction works, campus cleaning, Horticulture activities. Maintenance of lawn and gardens, water supply etc.

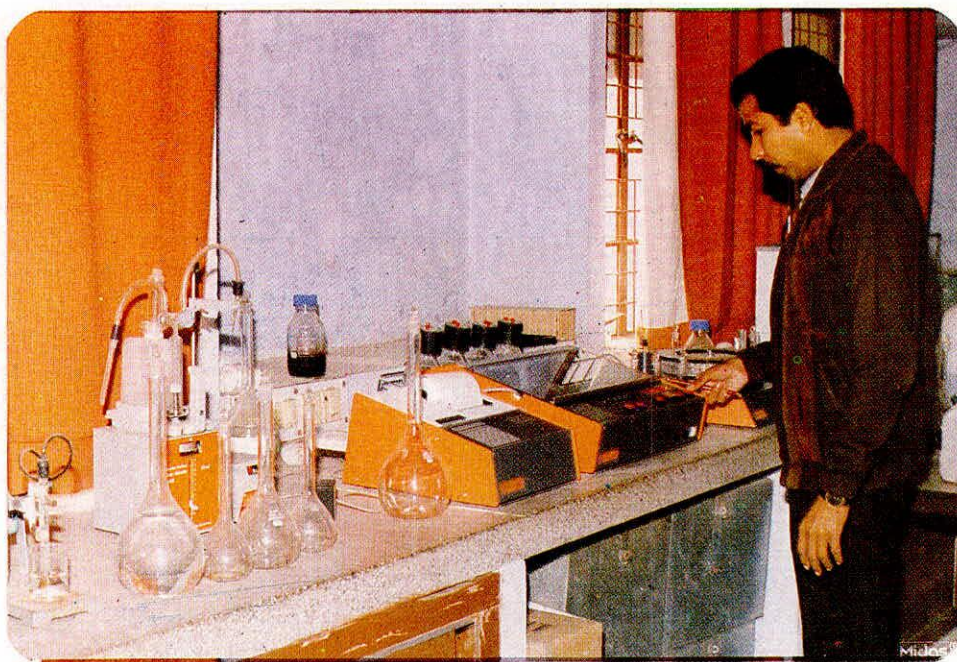
6.3 Laboratories

6.3.1 Water Quality Laboratory:

The Water quality laboratory in the Institute has been in operation for the couple of years. It is being efficiently utilised to monitor surface and ground water quality of various water bodies like river, canal and for oth sources of water. The laboratory has the capability to take care of the physical, chemical and to a limited extent biological parameters of work and waste water. The laboratory has the capability to

determine almost 80 physical, chemical and biological parameters with different degree of accuracy. Major equipment like Gas Chrometograph to determine the inorganic compounds and amount of pesticides is being installed and expected to be under operation very shortly. During the year equipments for movile Hydrology van, which will have the facility to ascertain the meteorological and water quality parameters, have been procured.

During the year, water samples were collected from different wells and from the river Kali in connection with the research work and analysed in the laboratory. The data obtained from the analysis are being used for development of model.

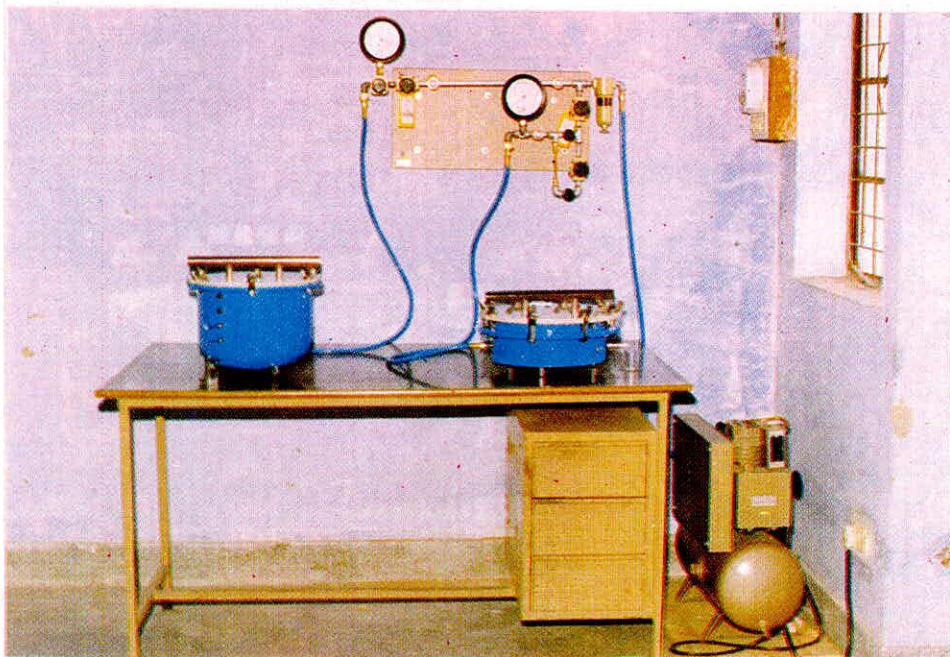


View of Water Quality Laboratory

6.3.2 Soil Water Laboratory

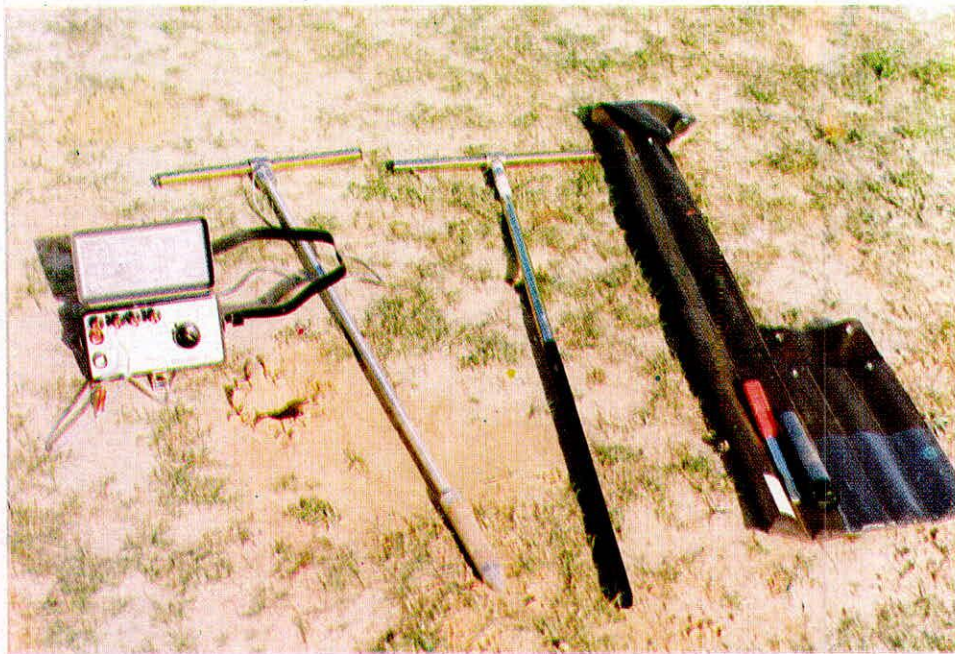
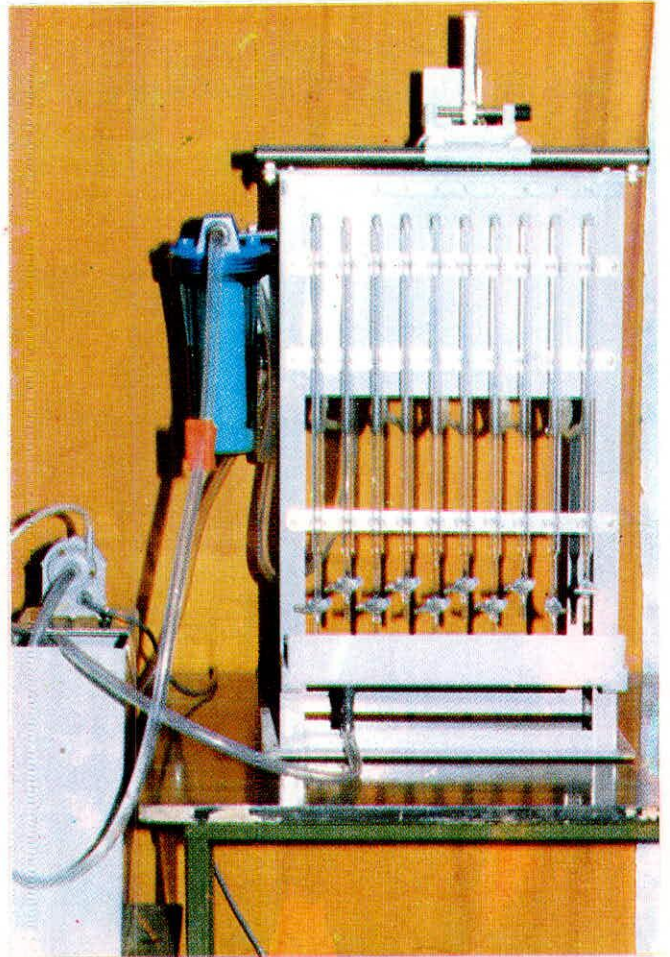
The soil water laboratory in the Institute has been established during the year with the main objective of determination/measurement of various soil water parameters. The laboratory is equipped with pressure plate apparatus, soil moisture meter, I.C.W. permeameter, guelph permeameter for measurement/

determination of soil moisture retention curve, soil moisture, saturated hydraulic conductivity and in situ hydraulic conductivity respectively. Tensiometer of varying length ranging from 15 cm to 150 cm is being used for measurement of soil moisture at different depth in the field. The laboratory is also equipped with E.C. salinity probe for measurement of soil salinity at different depths.



Pressure Plate apparatus for determination of soil moisture characteristics curves

I.C.W. lab permeameter for saturated hydraulic conductivity measurement



E.C. Probe for soil salinity measurement

6.3.3 Ground Water Laboratory

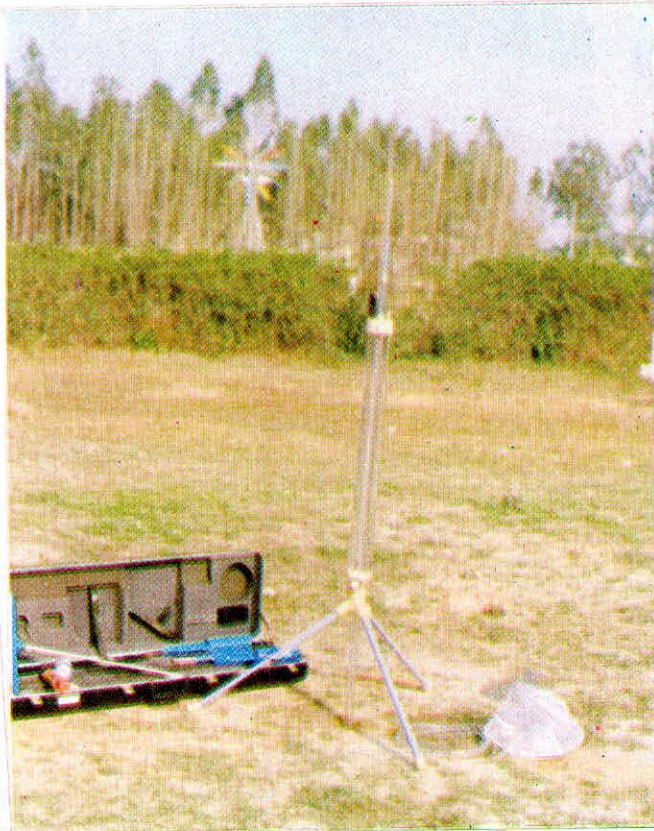
The ground water laboratory was set up with the prime objective of carrying out studies related to flow through unsaturated soil, two dimensional seepage and ground water recharge. The laboratory is equipped with infiltrometers, constant head and falling head permeameters, tensiometers, electrical analogue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

During the year, particle size analysis and permeability measurements were carried out for different soil samples. A programme for estimation of soil moisture characteristics and unsaturated hydraulic conductivity for different soil groups is

planned for study of soil moisture movement and modelling.

6.3.4 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.



Guelph Permeameter for field saturated hydraulic conductivity measurement

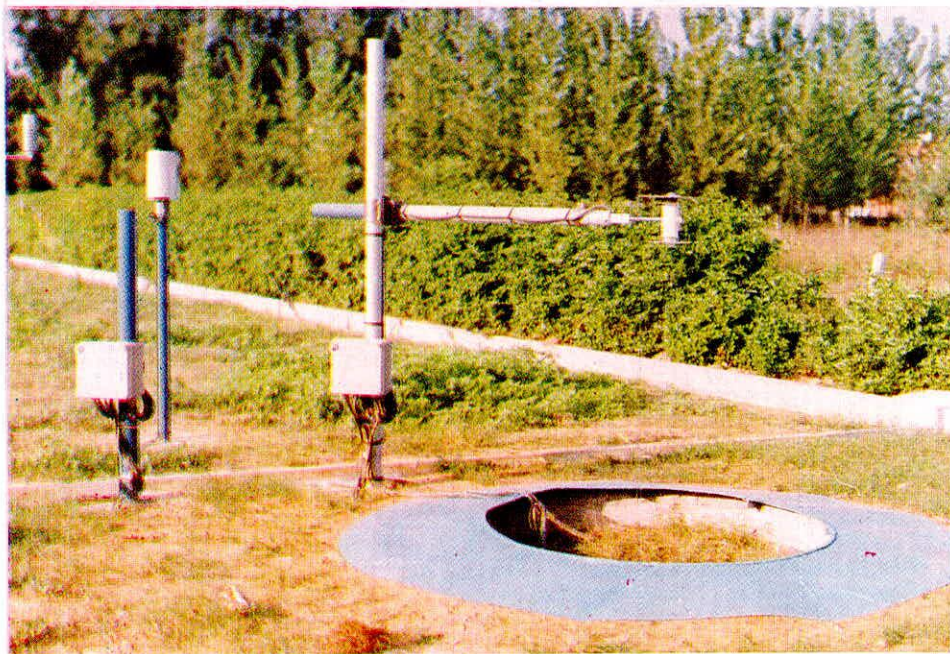
6.3.5 Automatic Hydrologic Station

With long felt need of precision and accuracy in the measurement of hydrological and hydrometeorological data, the institute procured an Automated Hydrologic Station (AHS) from CIR, Switzerland under UNDP project. The system is providing half hourly data for air temp., soil temp. (both at three different depths : 30 cm, 50 cm, and 80 cm), wind direction and speed, relative humidity, sunshine duration, rainfall, atmospheric pressure and change in weight of the lysimeter, runoff from the lysimeter and infiltration value through the lysimeter. In addition, data for electrical conductivity of soil at three different depths, balance radiation and global radiation are also received on data cassette and on paper as

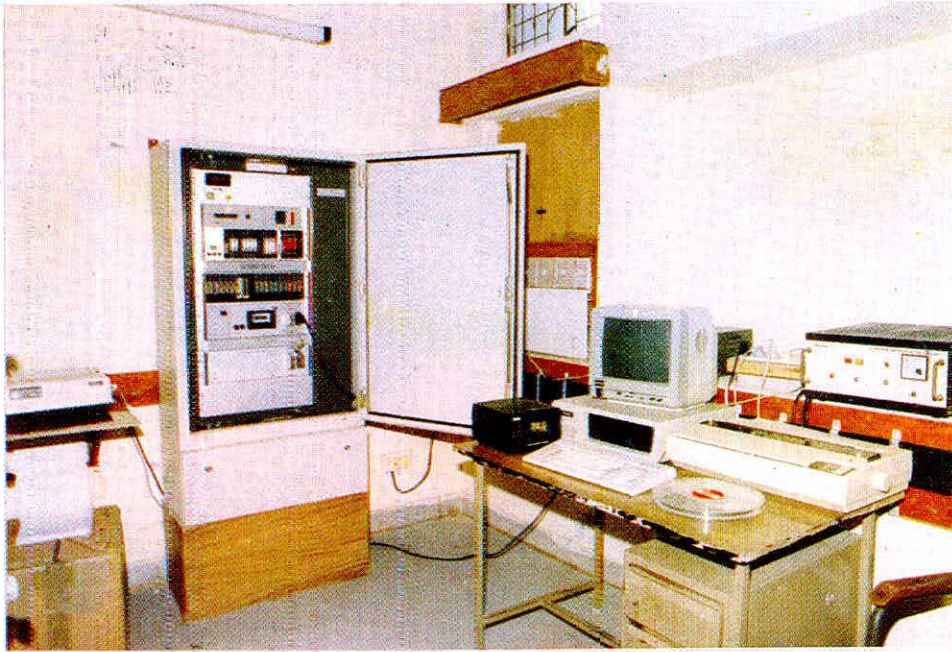
print out. The system was installed and made operational in 1990 by Gujarat communication Electronics Ltd. Baroda, Gujarat. The staff of the Institute has developed methodologies for transfer of the cassette data on PC's/Floppies etc. The data has been transferred on main frame (VAX11/780) computer system. A computer programme has been developed to compile data in a suitable format. Compiled data for the year 1990 has been stored and further processing is in progress.

6.3.6 Data Acquisition System (DAS)

A microprocessor-based Data Acquisition System (DAS) has been developed under an Indo-Dutch collaborative project WAMATRA-II. The battery-powered instru-



Lysimeter and hydrometeorological sensors for collecting data automatically with the help of AHS



Automated hydrological station (AHS)

ment can collect and store data from upto 18 different hydro-meteorological sensors for sufficiently long periods. The DAS has been installed in the institute's campus, initially with three tensiometers, one each soil- and air-temperature probes, and one rain gauge. Testing of the instruments is in progress. The data collected by the instrument can be ofloaded through either a portable computer or a radio - telemetry link. A solar panel countinuously regulates the battery - charging in the field. The DAS has pecial application in the data - collection from remote, and normally inacessible, areas.

6.3.7 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. Personal Computer Remote Sensing equipment have been procured.

The Institute has also procured large format optical enlarger, optical reflecting projector, light table with coordinate measuring system and Personal Computer (P.C./A.T. with EGA card) 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 and Meteorological equipment have been purchased.

6.4 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.

6.4.1 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.

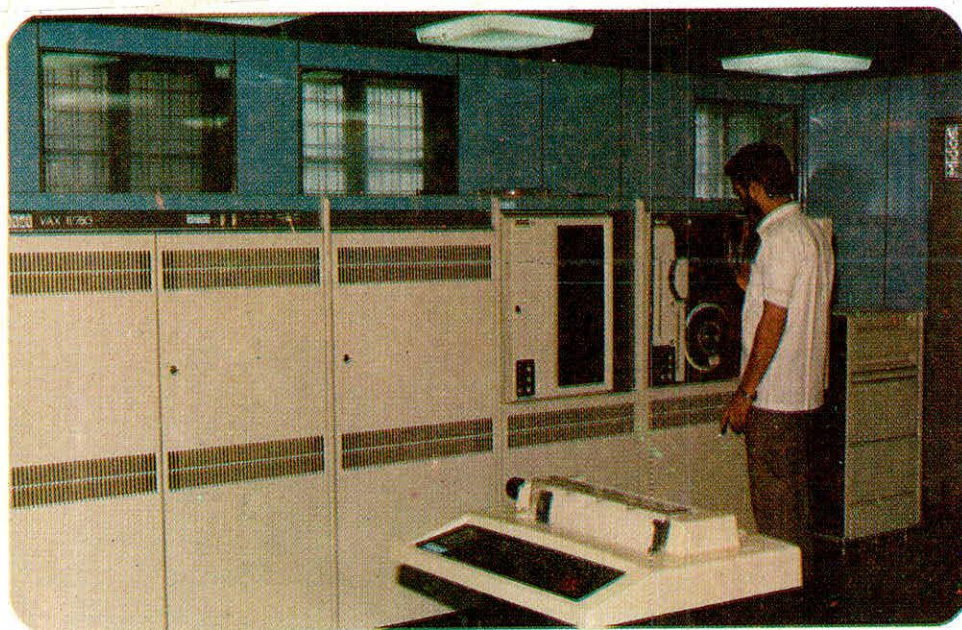
6.4.2 Duplicating and Photocopying Section

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.

6.5 Central Technical Facilities

6.5.1 Computer Centre

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



CPU of VAX - 11/780 computer system



Scientific staff at work on NIH PC Laboratory

graphic terminal, one digitizer, one line printer, one dot matrix printer, one card reader and one dual mode plotter. In order to increase the use of computers in administrative and finance wings, one IBM compatible PC/AT is given to each of these wings. As there is tremendous increase in the use of computers in scientific applications, one PC laboratory is established with 14 IBM compatible PC/ATs.

The Institute also has VAX 3200 workstation networked with the main frame system. The Institute procured one Paint Jet Plotter for get hard copies with colour print outs.

The software developed by the Institute for solving various hydrological problems on the main frame system were modified so as to run on personal

computers. This has facilitated in disseminating the software to various user agencies while organising the workshops.

Necessary environmental conditions were provided to the computer centre with 30 tonnes central air-conditioning plant. The computer centre is also connected with an uninterrupted power supply unit supported by a battery bank for shorter duration of power break-down. DG set of 125 KVA capacity is also provided for taking care of longer duration power break-downs.

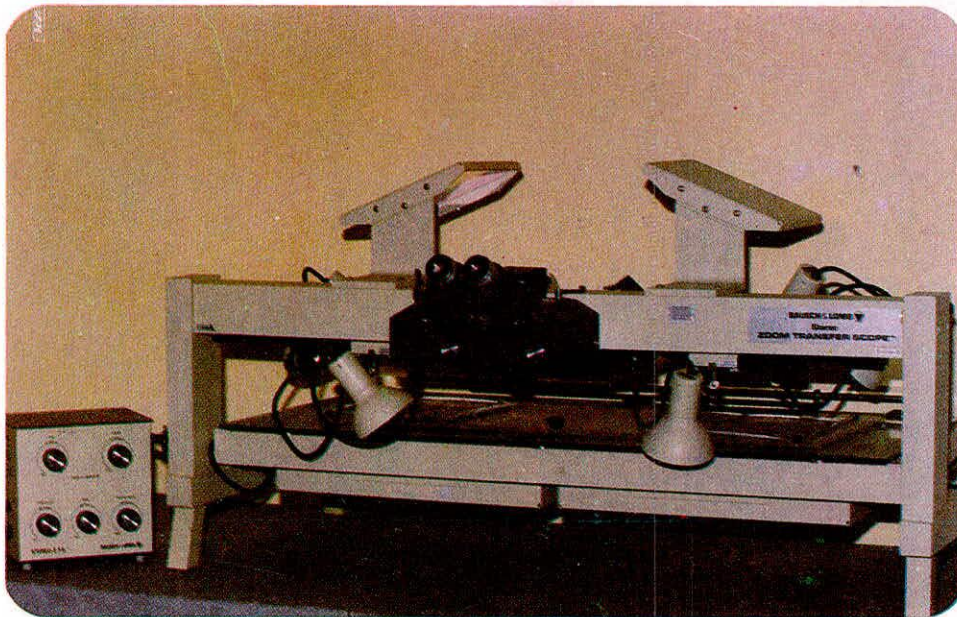
6.5.2 Remote Sensing Applications & Photographic Laboratory

The laboratory is equipped with various equipments like large format enlarger, diazo printer, mirror stereoscope,

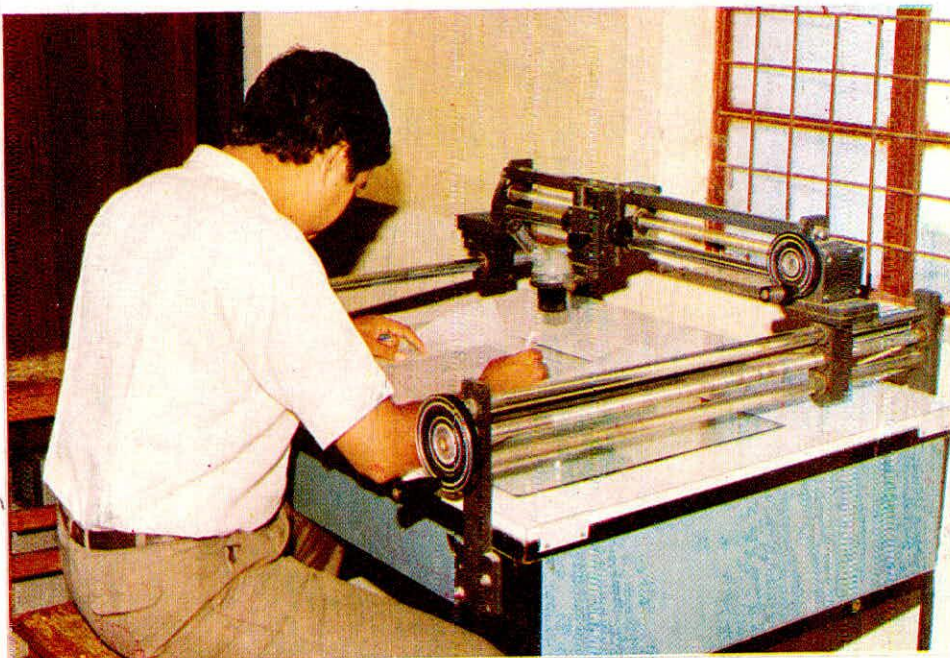
optical pantograph, colour composite printer, spectro radiometer, ground truth radiometer, stereo zoom transferoscope. During the year under reference the CCTs and FCCs of IRS-I A were procured from National Remote Sensing Agency, Hyderabad. These CCTs and FCCs are being used for conducting studies like mapping of water bodies, snow cover mapping, flood plain mapping, soil classification maps, sedimentation studies etc. In order to facilitate digital image processing computer vision 1/20 was procured and installed.

6.5.3 Workshop and Service Instrumentation Unit

The instrumentation service facilities have been developed for day to day maintenance of various equipment including electronic equipment being used in different laboratories of the Institute. A mechanical workshop equipped with required machinery is also in operation. This workshop besides attending to the maintenance jobs, also fabricates instruments for various laboratory users like infiltrometers, augers etc.



Stereo zoom Transfer Scope



Light table with co-ordinate measuring system

The Institute has a 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 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 1991, the library has 5225 books, 2492 technical reports, 79 Indian and foreign periodicals, 975 technical reports, 79 Indian and foreign periodicals, 975 technical papers, 248 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.

7.0 INTERNATIONAL COLLABORATION

7.1 NIH/DHI Project on Transfer of "Hydrological Computerized Modelling System" (SHE) Financed by Commission of European Communities (CEC)

The project now completed is based on an agreement of July 1987 between the Government of India and the Commission of the European Communities. The project has been concerned with the transfer of the SHE to the National Institute of Hydrology, Roorkee and is intended to increase India's capabilities for formulating water and land resource development strategies through mathematical modelling. The transfer has been carried out by the Consultant, a group headed by the Danish Hydraulic Institute, Denmark and composed also of SOGREAH, France and the University of Newcastle upon Tyne, U.K., by upgrading the computer facilities and making the model operational at NIH. The two major strands of the project have been the application of the SHE to focus subbasins in the Narmada River Basin and the training of NIH Staff in the use of the SHE.

During the year, recalibration of the Kolar basin was carried out on the basis

of the information obtained from field and laboratory investigations. The parameter sets were revised accordingly and the results of new calibration were compared with previous simulation. Further sensitivity tests were also carried out to study the effect of uncertainty in evapotranspiration, rainfall and soil depth on the calibration. The soil investigations in field and laboratory provided a physically more realistic representation of the Kolar basin.

Since, the river gauges have been set up in all the six basins in recent years, historical data of runoff to quantify effects of land use changes was not available. Studies were therefore carried out to analyse the effect of land use changes on single soil column representation of a point in the basin. It was seen that the soil depth is of significant importance for the runoff volumes, while the soil type is of relatively less importance. The vegetation type influences both the total runoff volume and the shape of the hydrograph.

The hydrological regime of an irrigation command area have also been investigated with the SHE assuming a hypothetical irrigation system on three

different scales, viz. plot scale, field scale and command scale. The irrigation water has been applied according to two alternative criteria: (i) prespecified irrigation, (ii) automatic irrigation. The simulations have indicated that realistic scenerio can be taken into account into the SHE.

Two independent SHE simulation studies involving calibration for the 600 km² Hemavathi basin upstream of Sankleshpur in Karnataka, and the 540 km² Beti basin in Gujarat were also carried out. The reports on all these studies as well as field and laboratory investigations were completed during the year.

The Workshop on "European Hydrological System Model Applications" was organised by NIH in cooperation with Central Board of Irrigation and Power at New Delhi. About 45 invited senior officers mostly at Chief Engineer level participated in the Workshop. The Workshop was inaugurated on 10th September 1990 by Shri V.B. Patel, Chairman, Central Water Commission and President, Central Board of Irrigation & Power. The workshop sessions were conducted by the Consultant Staff from Europe and NIH Scientists. At the end of the workshop in the afternoon on 11th September 1990, a panel discussion was organised, which was chaired by Shri Pritam Singh, Retd. Chairman, Central Water Commission. All the participants of the workshop were provided with printed material. A display was also organised by the Consultant Staff and

NIH Scientists regarding capabilities and results of SHE Model applications.

For producing color plots required for the efficient operation of SHE, a paint jet plotter was procured from M/s Digital Equipment Corporation and successfully installed in June 1990. Besides this, the facilities for laboratory and field equipments at NIH were upgraded through procurement of equipment for field and laboratory investigations for soil and related parameters for use in SHE simulations. To acquaint the technicians of NIH in the operation of this equipment, a short training programme of 15 days duration was proposed to take place in March 1991 in the Netherlands and Denmark respectively for two technicians.

The Project Coordinator and a senior scientist were deputed for visit to Danish Hydraulic Institute, Denmark during November/December respectively for discussions and interaction regarding preparation of the final report of the project. The Consultant had submitted the final report comprising five volumes in January 1991 and the final wrap up meeting of the Steering Committee was held on 15th January 1991. With the completion of the training of two technicians in March 1991, all the activities envisaged under the Project are completed. With the successful completion of this technology transfer project, NIH has now available both a group of trained scientists and facilities for computation and field investigations for taking up studies in India

involving use of the SHE technology for solution of various hydrological problems.

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 a three-member Soviet delegation visited NIH from 18th November 1990 to 28th November 1990. Scientists from NIH, CWC and CGWB took part in the technical discussions. The visit of Indian delegates to USSR has been postponed because of economy measure.

7.3 International Cooperation with the Netherlands

Under Indo-Dutch training programme on Water Management the scientists of the Institute are being 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

Two scientists have been trained in

instrumentation, data acquisition, storage and retrieval. A microprocessor-based data acquisition system (DAS) for collection of hydrological data has been designed and fabricated during training under the WAMATRA II Project.

A course on HYMOS (system for storage and processing of hydrological data) was conducted by the Dutch experts at NIH during 22nd April to 2nd May 1991. Scientists from CWS and NIH participated in this course.

Identification missions pertaining to Mathematical ground water modelling, and Drainage for agriculture have visited the National Institute of Hydrology from April 22nd to 4th May 1991.

Besides training in the above areas, the Institute would 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 Roerkee and organization of workshops.

The training programme of scientists and visits of the Dutch Experts to the Institute in other areas in process.

7.4 UNDP Project on Developing Capabilities for Hydrological Studies

The Institute was sanctioned with a UNDP Project amounting to US \$ 3 millions. The scope of the project is to develop the

manpower in areas of hydrologic instrumentation, deltaic hydrology, nuclear hydrology, Hydrometeorology, Lake Hydrology, Remote Sensing Techniques, Man's Influence, Snow Hydrology, Catchment Hydrology, data processing and hydrological analysis, forest hydrology and mountain hydrology. Besides the training of manpower in the above areas the project is intended to strengthen the laboratories of remote sensing applications, water quality, computer centre, ground water hydrology including soil science and surface water hydrology. The project is envisaged to be completed in a period of 5 years and will provide an opportunity for the Institute to develop its capabilities for conducting hydrological studies in frontal areas. The project will be executed both at its headquarters as well as at its 3 regional centres established during the 7th plan period viz. Hard Rock Regional Centre at Belgaun, Mountaneous North Eastern Regional Centre at Guwahati and Western Himalayan Regional Centre at Jammu. The project also envisages for the establishment of field laboratories at the 3 regional centres for conducting representative basin studies. The first batch of training of personnel and initial equipment procurement is expected to commence during 1991.

7.5 Progress for bilateral co-operation Programmes :

Apart from the above, more projects for bilateral cooperation programme have also been developed and

are under consideration of minist,

- (a) Cooperation with U.S. Army Corps of Engineers, Portland, Oregon in the area of snowmelt modelling. The objective of the project is to develop the capability of estimation of snowmelt using snowmelt and catchment runoff modelling approaches.
- (b) Cooperation with Louisiana state university, USA for development of mathematical model for Quality Network modelling of ground water system. The objective of the project is to optimally design water Quality networks using mathematical modelling approach to obtain better understanding about contaminant transport in water resources and to apply the modelling approach to sample ground water quality.
- (c) Cooperation with Lennsylvania state university, university park, USA for application of Geographic Information System for water resources planning by conducting hydrological modelling studies. The objective of the project is to use advanced technologies of GIS for providing the location specific analytical capability needed to support, water resources planning by conducting hydrological modelling studies.

- (d) Cooperation with U.S. Geological Survey in the area of Double porosity modelling for hard rock areas. The objective is to develop and implement ground water flow model for a hard rock area considering the double permeability and storativity of the fracture and the surrounding blocks for estimation of aquifer parameters, rainfall recharge and safe yield of the aquifer.
- (e) Cooperation with CEC in the area of Soil Erosion Process and Modelling.

The overall objectives of the study is to suggest a suitable catchment area treatment strategy through appropriate techniques and restore/conservate ecosystem in the study area and thereby contribute to the scientifically based technology for watershed management.

- (f) Cooperation with CEC for studies of hydrological balance and eutrophication characteristics of lakes. The main aim is to assist the Govt. organisations in planning and promoting lake water development programmes, keeping in view the long range perspective.

8.0 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 WMO :to promote resarch 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 programe 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 worksnops 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 3 sub-committees for carrying out its functions. The INCOH Secretariat brings out a half yearly publication entitled 'Jal Vigyan Sameeksha'.

During the year 1990-91 the committee with the assistance of its various panels and sub-committees has functioned very effectively and has discharged its role of disseminating hydrological activities in the country, preparation of state-of-art reports,

identifying emerging areas in hydrology, encouraging national and state level organisations to take up research activities as well as promoting education and training with the assistance of IHP of UNESCO. The INCOH has also contributed significantly to hydrology by supporting organisation of training programme and seminars/symposia. The role of various organisations in participation of IHP-IV (1990-95) was also defined by INCOH through its sub-committee. A brief summary of various activities of INCOH during the year are given in the following sections :

8.1 Meetings of INCOH

During the year, two meetings of INCOH were held on May 18, 1990 and August 31, 1990 at Roorkee. the following-main issues were discussed during the two meetings:

- (i) Formation of State Level Committee (SCH) in various states.
- (ii) Organisation of 3rd National Symposium on 'Hydrology' at pune with focal theme of 'Man's Influence on surface Runoff'.
- (iii) Role and participation of various organisations in IHP-IV of UNESCO.
- (iv) Constitution of committee on IHP-IV for monitoring India's participation in IHP-IV.
- (v) Review of progress of preparation of 'State-of-art' reports by experts identified by INCOH Panels.
- (vi) Review or progress of ARCCOH activities.

- (vii) Finalisation of Annual Report of INCOH for the yar 1989-90.
- (viii) Evolving an action plan for Technician Training in India.
- (ix) Consideration of funding provided by the Steering Committee of INCOH.
- (x) Organisation of 4th National Symposium on 'Hydrology' with focal theme of 'Hydrology of Minor Water Resources Schemes'.

8.2 Meetings of Panels and Sub-committees

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

- (i) Surface Water
- (ii) Ground Water
- (iii) Hydromcteorology
- (iv) Water Resources System
- (v) Water Quality, Erosion & Sedimentation
- (vi) Snow & Ice
- (vii) Education & training

In order to discharge thfe 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

During the year the following meetings of panels and sub-committees took place, as shown in Figure VII.

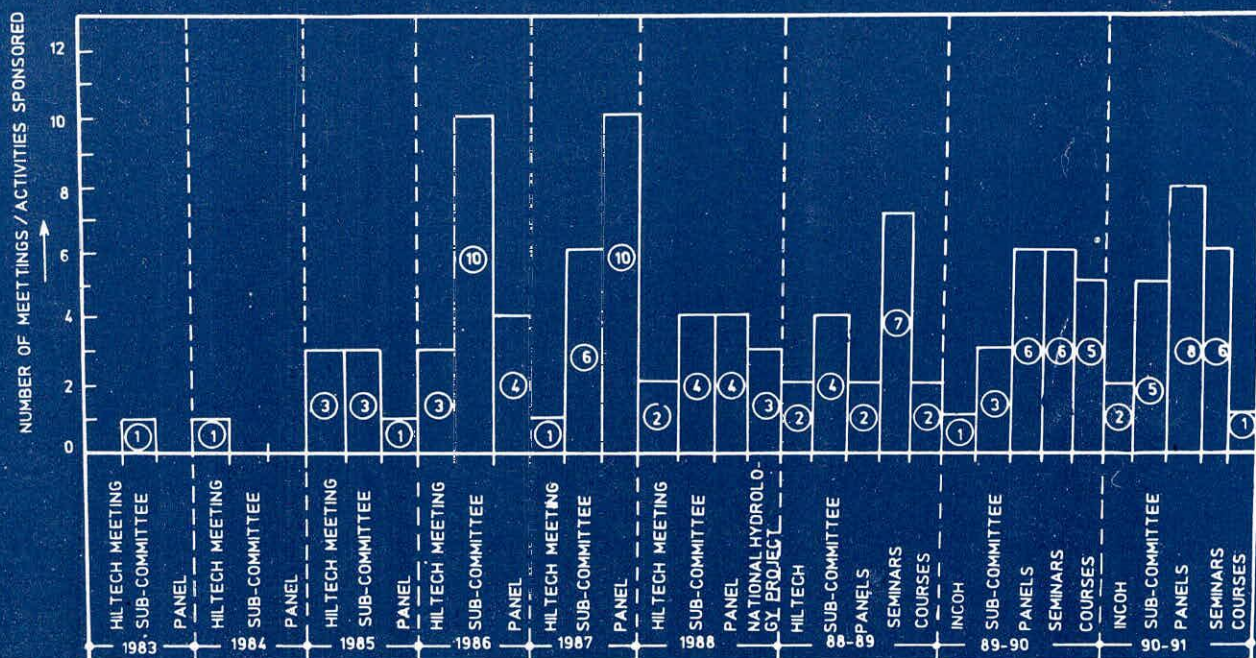


FIG. VII : BARHCHART OF YEAR WISE ACTIVITIES OF INCOH AND IT'S COMMITTEES

- i) Fifth meeting of Surface Water Panel
- ii) Tenth meeting of Steering Committee
- iii) Eighth meeting of Editorial Advisory Board of Jal Vigyan Sameedsha
- iv) Fifth meeting of Water Quality Erosion & Sedimentation Panel
- v) Sixth meeting of Water Resources System Panel
- vi) Eighth meeting of snow & Ice Panel
- vii) Fifth meeting of Hydrometeorology Panel

- viii) Eleventh meeting of Steering Committee
- ix) Sixth meeting of Hydrometeorology Panel
- x) Ninth meeting of Snow & Ice Panel
- xi) Sixth meeting of Water Quality, Erosion and Sedimentation Panel

During these meetings the following main items were discussed and decisions were taken to achieve the objectives of INCOH:

- a. Review of the State of Art reports being prepared by experts identified by respective panels.
- b. Finalisation of State of Art reports prepared by various panels.
- c. Identification of thrust areas of research in the areas falling under domain of each panel.
- d. Identification of specific areas in which State-of-art reports are to be prepared and nominating experts to write such reports.
- e. Defining role of various organisations in taking up projects under IHP-IV (1990-95) of UNESCO.
- f. Formulation of research projects to be taken up jointly by various organisations.
- g. Identifying organisations to conduct workshops/Seminars in specific areas of hydrology.
- h. Identify experts to write papers in Jal Vigyan Sameeksha and themes on which the future issues are to be brought out. The EAB also monitored progress of various issues of the Jal Vigyan Sameeksha.
- i. The steering committee considered various proposals of organisation of seminars/symposia training workshops and took decisions to support such activities as per the approved rules of funding of INCOH.

8.3 India's Participation in IHP-IV of UNESCO

The Fourth phase of International Hydrological programme (IHP) of UNESCO has a duration of six years and has commence from 1990. The detailed programme, themes and projects were finalised during the Inter-governmental council meeting during March 1990 at Paris. India has been actively participating in various phases of IHP through the Indian National Committee on Hydrology. The Ministry of Water Resources had shown concern about the contributions made by India under IHP-III. Keeping this in view Ministry of Water Resources had desired that a committee of specialists be constituted under the Chairmanship of Director, NIH to evolve an action plan for India's participation in IHP-IV and this committee shall continuously monitor the progress made.

Dr. Satish Chandra, Executive Member, INCOH and Director, NIH constituted a committee for IHP-IV.

As per the decisions of the committee various expert groups were constituted (40 in number) to go into each project and suggest India's contribution in the project in next 6 years. The expert groups held their meetings during June, July & Aug. 1990 and came out with their recommendations. The recommendations were considered by IHP-IV committee on August 30, 1990.

The Indian participation in IHP-IV is being finalised by the committee and INCOH.

8.4 Indian Delegation to Various International Meetings

One of the objectives of INCOH is to coordinate India's participation in the activities of UNESCO under its International Hydrological Programme (IHP). India is a member of the Intergovernmental Council for IHP of UNESCO since 1987. This term of membership for Intergovernmental Council for IHP will expire in 1991.

Dr. Satish Chandra, Director, NIH was invited to attend the meeting of IHP-IV

project of Unesco at Paris from March 2-10, 1991.

8.5 Support to Research Projects/Seminars/Courses.

As a part of its objectives, the INCOH provides sponsorship to various organisations in the country for organising national and international events on hydrology and water resources. During the year, the committee has actively provided support to various organisations in the country for holding different activities as per following:

- a. Third National Symposium on "Hydrology", Pune July 5-7, 1990



Shri Nitish Kumar, Union Minister of State for Agriculture delivering Inaugural Address at the 3rd National Symposium on Hydrology, Pune



All India Seminar on Water Logging and Drainage
Dec., 7-8, 1990, I.E. (India), Roorkee Local Centre,

The Central Water and Power Research Station (CWPRS), Pune, and the Irrigation Department, Govt. of Maharashtra, jointly organised a National Symposium on Hydrology at the CWPRS during 5-7 July, 1990. The symposium was sponsored by the Indian National Committee on Hydrology (INCOH); and was the third in a series of national symposia, on the broad theme of hydrology, supported by the INCOH.

- b. Regional Seminar of 'Hydrological Problems Relating to Tanks', Madras, Oct 4-5, 1990.
- c. International Symposium on "Water Erosion sedimentation and Resource

Conservation", Dehradun, Oct. 9-13, 1990

- d. National Seminar on "Soil Moisture Processes and Modelling", Kharagpur during Dec. 27-29, 1990.
- e. All India Seminar on "Water Logging and Drainage" at Roorkee during Dec. 7-8, 1990.
- f. National seminar on 'Use of Computers in Hydrology and Water Resources' to be organised by CWC, Delhi at Delhi during 1991-92.
- g. Regional seminar on 'Flood Estimation and Management' being organised by Govt. of Assam at Guwahati during 1991-92.
- h. Fourth National Symposium on

Hydrology being organised by Govt. of Tamilnadu at Madras during 1991-92.

- i. Regional seminar on 'Water Planning in Drought Prone Areas of Arid & Semi arid Regions' by Govt. of Rajasthan at Jodhpur during 1991-92.
- j. A Regional Training Course on Ground Water Exploration and Assessment was held at Dept. of Earth Sciences, UOR, Roorkee from March 11-29, 1991.
- k. The INCOH provided partial financial assistance for publication of IAH Journal on Hydrology.
- l. The INCOH provided financial assistance for printing of brochure concerning:
 - (a) Water Conservation by Evaporation Control Retardants & their applications.
 - (b) Water Harvesting Practices Percepts by Water Management forum of Institution of Engineers (India), Gujarat State Centre.
- m. The INCOH has provided partial financial assistance to Indian Association of Hydrologist for organising a National Symposium on 25 years of India Hydrology (1965-90). The seminar is yet to take place.
- n. The INCOH has been designated as the National focal point for coördinating India's participation in a regional project on Erosion and sedimentation in a Asia (RAS/88/

025) which is being sponsored by UNDP, UNESCO and IRTCES, Beijing, China. As part of project activity a regional training course on Reservoir Sedimentation and Control is being organised by CWC, New Delhi on behalf of INCOH in collaboration with Roorkee University and IRTCSS, China.

- o. A research project on 'Environmental Impact of Irrigation Project at Pench' being proposed by NEERI, Nagpur is under active consideration of funding by INCOH.

8.6 Publications

The INCOH Secretariat has been bringing out a bi-annual journal entitled 'Jal Vigyan Sameeksha' (Hydrology Review). This activity has been taken up to disseminate information and thereby promote improvement in the standards of hydrological activities in the country. The papers are by invitation only and each issue is devoted to a specific theme. Since starting this activity, the various issues have been brought out on themes as below.

Theme	Year
Drought	June, 1986
Hydrological Forecasting	Dec., 1986
Ground Water Management	June, 1987
Hydrological Network Design	Dec., 1987
Water Quality	June, 1986
Drainage	Dec., 1988

During the year the two issues covering

the period-1989 were brought out on the following two themes:

- 1 Remote sensing
- 2 P.C. Applications in Hydrology
(Under printing)

The journal also covers hydrological activities of about 40 organisations in the country which are working in hydrology and related areas. The journal also has a portion devoted to review of 4-5 recent books in hydrology. The journal is being very well received by hydrological community in India and abroad where it is circulated free of cost.

9.0 MASS COMMUNICATION

9.1 Water Resources Day

The Institute celebrated Water Resources Day on May 19, 1990 at Roorkee. The celebration was jointly organised along with other organisations including University of Roorkee, U.P. Irrigation Department, Institution of Engineers (India), Roorkee Local Centre, Indian Water Resources Society (IWRS) and Indian Association of Hydrologists (IAH).

The celebration was inaugurated by the then Hon'ble Union Minister of Water Resources, Shri Manu Bhai Kotadia who was the Chief Guest on the occasion. In his thought provoking address, the chief guest underlined the special role of Roorkee based organisations in Water resources development of the country. He urged the technocrats to evolve strategies for water conservation and develop acceptable



Shri Manubhai Kotadia, then Union Minister of Water Resources lighting lamp during Water Resources Day Function at Roorkee

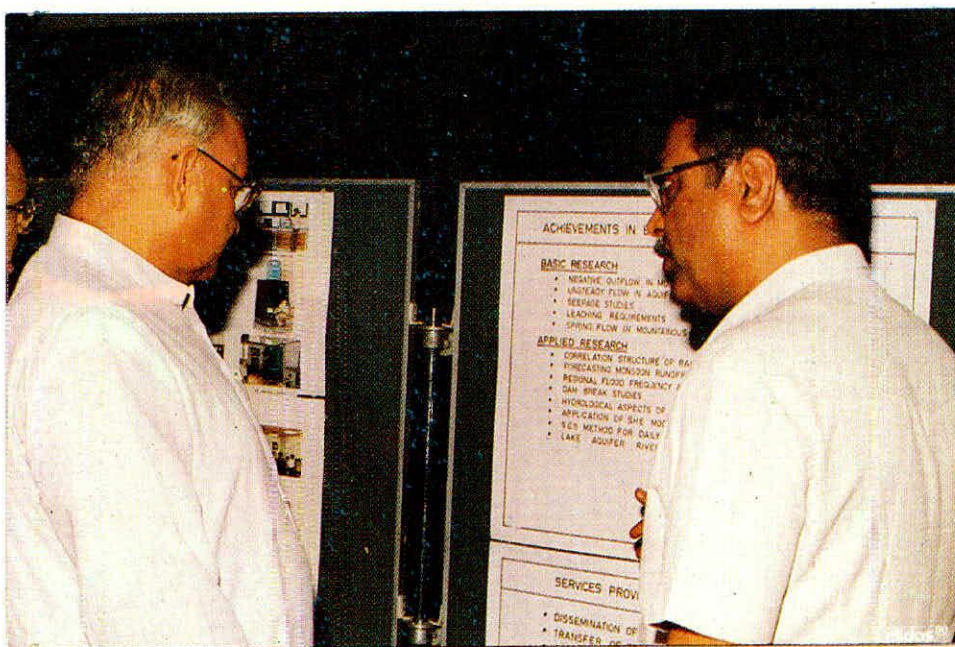


Shri Manubhai Kotadia, Then Union Minister of Water Resources releasing two information booklets prepared by the Institute, during Water Resources Day Fuction at Roorkee

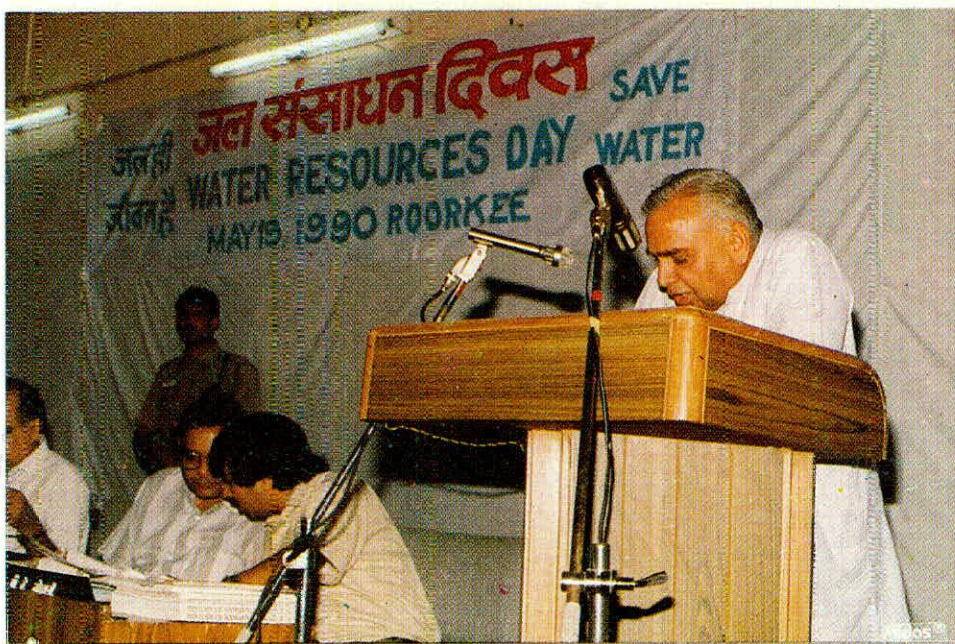
techniques for proper distribution of interstate river waters for proper utilisation of water which is otherwise going as a waste. The Chief guest released two information booklets prepared by the Institute on this occasion.

Shri V.B. Patel, Chairman, Central Water Commission presided over the function. He briefly described the progress of water resources development in the country and emphasised the role of peopl participation in the development and management of water resources. Dr. H.C. Visvesvaraya, Vice Chancellor, University of Roorkee welcomed the distinguished delegates and the Chief Guest to the campus of Roorkee

University. Dr. Satish Chandra, Director, NIH while delivering his address gave relevant statistics on water resources development potential and stressed the role of hydrologic analysis and modelling for proper development of water resources. Dr. G.N. Yoganarasimhan read out the message of the Hon'ble Prime Minister on this occasion. Shri Narendra Singh, Chief Engineer, Irrigation Design Organisation, U.P. Irrigation drew the attention towards water requirements of the future. Dr. S.K. Kaushik, Hony, Secretary, IE(I), RLC proposed a formal vote of thanks. Shri V.K. Lohani, Scientist of the Institute conducted the function.



Director explaining to then Union Minister of Water Resources During an exhibition set up as a part of Water Resources Day Celebration



Shri Manubhai Kotadia, Then Union Minister of Water Resources addressing the gathering during Water Resources Day Function at Roorkee



A view of participants during Water Resources Day Celebration

In view of the important role of farmers in development and management of water resources, a session devoted on farmers problems was also organised. 22 farmers from the neighbouring villages representing various age group participated in the session. The queries raised by farmers were replied by Senior officials representing the host organisations. The farmers expressed their appreciation for involving them in such activities.

As a part of celebration, a technical discussion on the focus theme of 'Water for the future' was organised wherein officers of host organisations actively participated.

9.2 Water Conservation

Water Conservation is an important input for overall economic development of the nation. The requirement of water has been increasing in all sectors for last several years. But, the available quantity of water which can be put for beneficial use is finite in nature. Also, unsystematic use of this finite resource leads to wastage, pollution or degradation. It is in this context 'Water conservation' assumes a significant role. The national water policy adopted by the government in year 1987 also states that water conservation consciousness should be promoted through education, regulation, incentives and disincentives. In view of the national awareness of water

conservation, the Institute launched an enthusiastic plan to bring out publicity material on various aspects of water conservation and hydrology for creating public awareness. A proposal to this effect was considered during the 22nd meeting of the Technical Advisory Committee and as per the decision, 5 information booklets were brought out for this purpose during the year. A brief description of these brochures is given below:

i) Control Evaporation - Save Water
(English & Hindi)

This booklet describes the process of evaporation, factors affecting evaporation and the techniques to control evaporation from water bodies. The booklet also includes statistical figures about the evaporation rates, effectiveness of evaporation reduction techniques etc., for the purpose of general use. The annual evaporation rate contours over map of country are also included in the booklet.

ii) Sediment Yield from different land uses (English)

In view of the significance of studying the soil erosion and sediment yield problems in the country, this booklet gives information on various aspects of sediment yield as affected by land use changes. The factors which are responsible for sediment yield are included. The annual rate of silting as observed in some important reservoirs in the country are also included. The booklet

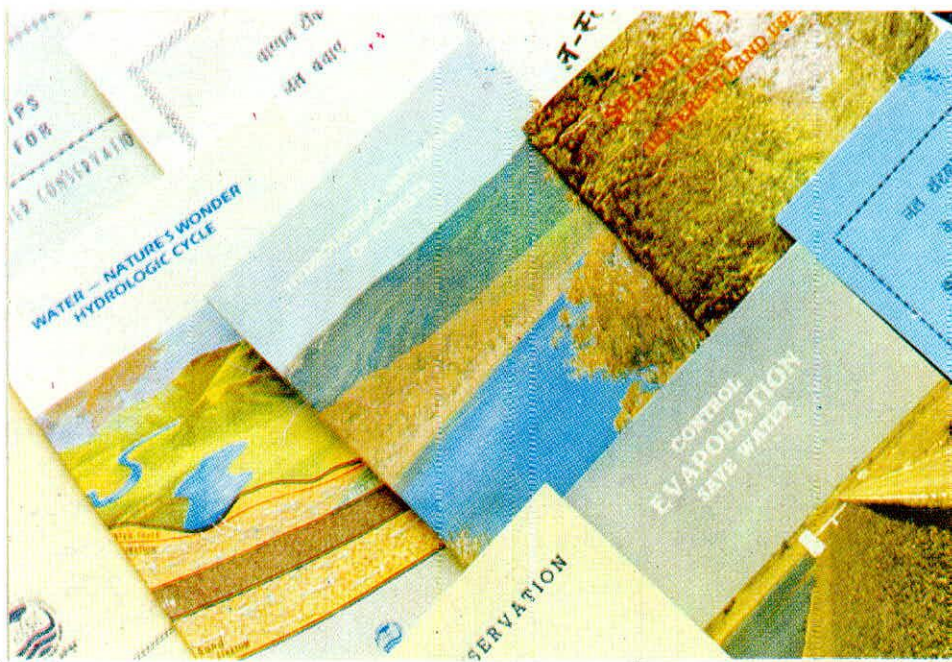
also gives the gist of studies carried out in the country on effects of various land use changes on sediment yield covering various agroclimatic regions of the country. A summary table giving yield of sediment from various kinds of land use is included in the booklet.

iii) Hydrological Influences of Forests
(English)

Forests have an important role in the overall hydrologic cycle, there has been a lot of debate on this issue. The booklet includes a brief description on world forest resources and India's forest wealth. The results of studies as reported by various researchers on evaluation of effects of forests on various components of hydrologic cycle including rainfall, interception, infiltration, surface runoff, soil moisture, ground water, evapotranspiration etc. are discussed in the booklet.

iv) Hydrological Influences of Land Use Changes (English)

Land and water resources are two vital gifts of nature to mankind. Being closely related, unscientific and over utilisation of one resource has strong influence on the other. The changes in land use of a watershed has direct bearing on its hydrological response. The booklet includes studies as carried out world over to assess impacts of land use changes on various hydrological parameters. The various land uses which have been evaluated for their impacts include agricultural land, forest land,



Publicity activity in the area of Water Management and Conservation

grassland and urbanisation. The concept of vegetation management for increasing water yield has also been included in the text.

The first two booklets as above were released by the then Hon'ble Union Minister for State for Water Resources during the Water Resources Day function held at Roorkee in the month of May 1990. The publications at sl.no.iii & iv as above were released by the then Hon'ble Minister of State for Water Resources during the 10th Annual General Meeting of the NIH Society. The publication on 'Hydrological influences of land use changes' is slated to be released during the forthcoming celebration of Water Resources Day at Delhi for year 1991 which is scheduled to be held on April 12, '91.

In order to continue Institute's activities in this direction during the 25th meeting of the Technical Advisory Committee which was held on March 18, 1991, it was decided to bring out pamphlets or leaflets on some more pertinent topics which are listed as below:

- Impact of Changing Hydrological Processes on different life forms
- Hydrological Response of climate change
- Man's influence on hydrologic cycle
- Conjunctive use and drainage
- Water quality conservation
- Rainwater harvesting
- Urban drainage
- Water conservation

Actions to prepare these pamphlets/ leaflets are in progress

9.3 NEWSLETTERS

9.3.1 Jalvigyan Samachar

The news letter of the Institute is published quarterly. During the year, four issues of the Jal vigyan samachar were published in april, July, October 1990 and January 1991. 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

reports from various central/state Governments are published. This has been found to be very effective forum for interaction with hydrologic community.

9.3.2 Arccoh Newsletter

The institute has been holding secretariate of an Asian Regional Coordination Committee on Hydrology (ARCCOH) which was formulated in the 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 secretariate 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.

10.0 MISCELLANEOUS

10.1 Hindi Week

Hindi week was celebrated from September 10 to 14, in the Institute. Essay, Noting, Drafting, Typing, Quiz and Poem recitation competitions were held during the week.

10.2 Use of Hindi

In accordance with official language Annual Programme for the year 1990-91, continued efforts were made by the Institute towards implementation of various provisions given thereunder. The official language implementation committee of the Institute held regular meetings and took important decisions regarding implementation of Hindi in day to day official proceedings and activities.

10.3 Quami Ekta Week

It was celebrated from 19 to 25th November, 1990 by the Institute. The following programmes were organised

- i) PLEDGE was taken by the staff of the Institute at 1000 Hrs. on 23.11.90 on the lawns of the Institute which

was administered by the Director.

- ii) On 23.11.90 at 5.00 P.M. the ESSAY WRITING competition under the activity of Literary Function, was organised by the President, NIH Recreation Club.

10.4 Recreation and Welfare Activities

Recreation club organised a visit to Shakumbari Devi temple which is 50 km from Roorkee near Shivalik range. Staff and family members visited the temple with great enthusiasm. The club also organised volleyball, Badminton, Cricket, weight lifting and Track field events during the year.

10.5 Hydrological Terminology

The Institute is engaged in the preparation of Hydrological Terminology in eight regional language of India. Some 400 hydrological words have been selected and their equivalents in Bengali, Gujarati, Hindi, Kanada, Malayalam, Marathi, Tamil and Telugu have been prepared. Terminology in each language has been

sent to the respective states for their comments and suggestions regarding any improvements. It is proposed to hold a seminar of experts in the field of hydrology & linguists to give national approval to the Terminology.

10.6 Independence Day/Republic Day Function

The Independence day was celebrated in the Institute on 15th August 1990. The National Flag hoisted by Director. Director emphasis as the need of hard & dedicated work for the progress of the country. The celebration was well attended of the employees and their families.

10.7 Awards and Higher Degrees

In view of the outstanding and important contribution in the field of Hydrology (FLOODS) the following persons have been awarded the National Hydrology Award for the year 1988

- | | | | |
|---|---|---|----------------------------|
| 1 | Dr. S.M.Seth
Scientist 'F'
NIH, Roorkee | : First Award : | Rs.4,000/-
and a plaque |
| 2 | Sh. R.S. Prasad
Chief Engineer (Hq)
NWADA, New Delhi | : Second Award : | Rs.2,000/-
and a plaque |
| 3 | Sh. A.K. Chakraborti
Scientist SF and Head
Water Resources Division
IIRS, Dehradun | : Certificate of Merit with a cash prize of
Rs.1,000/- | |
| 4 | Dr. B.S. Thandaveswara
Asstt. Professor
Hydraulics and Water
Resources Engg.,
IIT, Madras | : Certificate of Merit with a cash prize of
Rs.1,000/- | |

The Republic Day function was celebrated in the Institute on 26th January, 1991. Before the end of the programme, the prizes were distributed by the Director to the winners of various events organised by the Institute on the HINDI SAPTAH celebrations and to the winners of ESSAY WRITING competition organised by the NIH Recreation Club, during the celebration of QUAMI EKTA WEEK.

After the Republic Day celebration, the Children Fancy Dress Show, Balika Race and Children Race was organised by the NIH Recreation Club and the Director distributed the prizes to the winners and also to the participants so of these events.

Shri S.K. Jain, Scientist 'C' and Shri V.K. Choube, Scientist 'C' of the Institute have been awarded Ph.D. degree by the University of Roorkee and Jawahar Lal Nehru Univeristy, New Delhi respectively in the year under consideration.

10.8 VISITORS

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

	Name of Visiter	Date of Visit
I.	FOREINGNER	
1	Mr. B.W.G. Block Delft Hydraulics, Lab. The Netherlands	24.4.90 to 28.4.90
2	Mr. H.J.M. Ogniko Delft Hydraulics The Netherlands	24.4.90 to 27.4.90
3	Prof. L.Starkel Polish Academy of Sciences, Poland.	10.3.90 to 28.11.90
4.	Mr. D.A. Manukaian Russian Experts	18.11.90 to 28.11.90
5	Mr.V.A. Leonidor Russian Experts	18.11.90 to 28.11.90
6.	Mrs. N.P.Karpenkov Russian Experts	18.11.90 to 28.11.90
7.	Dr. A.M.J. Meijerink Dutch Expert	3.1.91 to 4.1.91
8.	Ms.Valentina Priyajinskaya Russian Expert	8.1.91 to 12.1.91
9.	Dr. Daniel Rathovich Russian Expert	8.1.91 to 12.1.91
10.	Dr. A.A. Jacobs Dutch Expert	17.1.91 to 29.1.91

11.	Shri V.B. Patel Chairman, CWC	18.5.90 to 19.5.90 16.2.91 to 17.2.91
12.	Shri Abhay Prakash Jt. Secretary MOWR, New Delhi	1.6.90 to 2.6.90 26.12.90 to 26.12.90
13.	Shri Y.D. Pendse Former Member (WP) New Delhi	5.7.90 to 6.7.90 13.7.90 to 14.7.90 13.8.90 to 14.8.90
14.	Mr. L.A. Mandali UNESCO, New Delhi.	12.7.90 to 15.7.90
15.	Shri S.P. Gupta Chief Engineer Haryana.	14.7.90 to 15.7.90
16.	Shri R.S.Seksena Chief Engineer Minor Irrigation Deptt. New Delhi.	14.7.90 to 15.7.90
17.	Dr. M.S. Alam UNESCO New Delhi.	16.8.90 to 17.8.90
18.	Kr. Vijay Singh Randhawa Chandigarh	6.10.90 to 7.10.90
19.	Shri PVS Chinnamani ICAR, New Delhi.	10.10.90 to 11.6.90
20.	Shri B.K.Rao Chairman R.C.CMRS , Dhanabad.	3.12.90 to 4.12.90 8.12.90 to 9.12.90
21.	Jaswant Singh Visiting Prof. Jammu, J. & K.	6.12.90 to 9.12.90 13.3.91 to 16.3.91
22.	Shri Pritam Singh (Ex. Chairman, CWC) New Delhi.	6.12.90 to 8.12.90
23.	Dr. D.K. Dutt New Delhi.	28.12.90 to 30.12.90

- | | | |
|-----|---|--------------------|
| 24. | Shri V.P. Kamdar
Secretary
Govt. of Gujarat | 7.2.91 to 7.2.91 |
| 25. | Dr. Y.P. Kakar
Min. of Environment &
Forests, New Delhi. | 18.2.91 to 19.2.91 |
| 26. | Shri P.A. Kapoor
Member, BBMB,
Chandigarh. | 10.3.91 to 12.3.91 |
| 27. | Shri C.P. Vohra
Sr. Dy. Director-General
GSI, Calcutta | 10.3.91 to 12.3.91 |
| 28. | Smt. Radha Singh
Jt. Secretary
MWOR
New Delhi. | 11.3.91 to 12.3.91 |
| 29. | Shri V. Rajagopalan
Dy. Secretary
Min. of Water Resources
New Delhi. | 11.3.91 to 12.3.91 |

11.0 FINANCE AND ACCOUNTS

During the year under review, Ministry of Water Resources, Govt. of India provided an amount of Rs.177.00 lakhs and Rs.109.00 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.2,68,46,143.55 in plan and non-plan heads. The accounts of the Kotwalia

& Co., Chartered Accountants, Dehradun and a copy of the audited statement of accounts consisting of receipts and payments accounts, income and expenditure accounts and the balance sheet for upto March, 91 duly certified by the Auditors is given in Appendix-XIV. It will be seen from the Auditor's report an additional worth of Rs.148.97 lakhs were made to the fixed assets of the Institute during the year.

Assets Fund Accounts

Increase in fixed Assets	(+)	1,48,96,712.22
Decrease in works-in-progress	(-)	36,89,475.18
Increase in Deposit	(+)	14,000.00
Increase in Advance	(+)	40,06,755.35
Decrease in Prepaid	(-)	90,837.10
<hr/>		
Sub-Total		1,51,37,155.29
<hr/>		
Less:-		
Increase in		
Liabilities (+) 1,44,119.20	(-)	1,44,119.20
<hr/>		
Total		1,49,93,036.09
<hr/>		

AUDITORS' REPORT

We have audited the Balance sheet of the NATIONAL INSTITUTE OF HYDROLOGY as at 31st March, 1991 and also the annexed Income and Expenditure Account for the year ended on that date and report that :-

- 1 We have obtained all the 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 & expenditure account dealt with by the report are in agreement with the books of account.
- 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 give a true and fair view:
 - i In the case of the Balance Sheet of the state of affairs as at March 31st, 1991 and
 - ii in the case of the Income & Expenditure Account of the Deficit for the year ended on that date.

For S.K. KOTWALIA & CO.
CHARTERED ACCOUNTANTS

Sd/-

SURESH KUMAR
PARTNER

ROORKEE
3rd Day of Oct. 1991

12.0 ACKNOWLEDGEMENTS

The different activities of the institute have progressed well under the directions 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.

13.0 APPENDICES

APPENDIX-I	:	NATIONAL INSTITUTE OF HYDROLOGY SOCIETY	(I)
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APPENDIX-III	:	TECHNICAL ADVISORY COMMITTEE	(VI)
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NATIONAL INSTITUTE OF HYDROLOGY SOCIETY

PRESIDENT

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

MEMBERS

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

Minister-in-Charge of
 Irrigation,
 Govt. of U.P.,
 LUCKNOW.

Minister-in Charge
 of Irrigation
 Govt. of Haryana,
 CHANDIGARH

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 Orrisa,
 BHUBNESHWAR

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

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

Minster-in-Charge
of Irrigation
Govt. of Maharastra
BOMBAY-32

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

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

Sri M.A. Chitale
Secretarty to Govt of India
Ministry of Water Resources,
Shram Shakti Bhawan,
Rafi Marg.,
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

Chairman
Central Water Commission
Sewa Bhawan,
R.K. Puram,
NEW DELHI-66

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

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-1.
Vidyanarnyapura Layout,
Jalahilli,
BANGALORE-560 013

Prof. Subhash Chander
Deptt. of 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
Plot No. 378/A
New Swami Narayan Temple,
Sector 23,
GANDHINAGAR

Chairman
Ganga Flood Control
Commission, Sinchai Bhawan,
PATNA-800 015

Vice Chairman
Brahmaputra Board
Beltola
GUWAHATI-781 028

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

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

Dr. B.H. Briz Kishore
Regional Manager
Water and Power Consultancy
Services (India) Ltd.
Preg Bagh
Beside Barkatpura P.O.
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

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

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

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

Director General
Geological Survey of India,
27 J L Nehru Marg,
CALCUTTA-700 016

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

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

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

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

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
MEMBER SECRETARY	:	Director National Institute of Hydrolgy, ROORKEE

MEMBERS

Secretary of Govt. of India
Dept. of Expenditure
Ministry of Finance,
NEW DELHI

Advisor (Irrigation & CAD)
Planning Commission
Yojna Bhawan,
NEW DELHI

Chairman
Central Water Commission
Sewa Bhawan, NEW DELHI

Additional Secretary to
Govt. of India,
Ministry of Water Resources,
NEW DELHI

Financial Advisor &
Joint Secretary (Finance)
Ministry of Water Resources
NEW DELHI

Secretary to Govt. of Assam
Irrigation Dept.,
Chandmari,
GUWAHATI

Chief Engineer
Water Resources Development
Organisation
Ananda Rao Circle
BANGALORE

Chief Engineer
Kashmir Irrigation and
Flood Control Deptt.,
Srinagar, J&K

Secretary (Irrigation)
Govt. of U.P.,
Sachivalaya,
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

Director
School of Env. Engg.
JNTU,
HYDERABAD

Member (River Management)
Central Water Commission
NEW DELHI

Chairman of the Sectional
Committees of River Valley
Projects of Bureau of
India Standards, DELHI.

Member (HE)
Central Electrical Authority
NEW DELHI

Director of one of the
Water Technology Centres at
Delhi, Bhubaneswar, COIMBATORE

Chairman
Central Ground Water Board
NEW DELHI

Two experts in Hydrology
(to be nominated by
Chairman, G.B.)

Representative of
India Meteorological Dept.,
NEW DELHI

Three representatives of
States (where hydrology cell
have been set up).

Representative of
Dept. of Hydrology
University of Roorkee
ROORKEE

Representative of
Association of hydrologists

Director
Water Resources Centre
PATNA

Scientist 'F'
NIH, ROORKEE

APPENDIX-IV

Meeting of Bodies, Committees and Working Groups

Title	Date
Society	
(i) 10th meeting	24.5.90
(ii) 11th meeting	12.11.90
Governing Body	
(i) 37th Meeting	26.10.90
(ii) 38th meeting	21.3.91
Working Groups	
(i) Surface Water Analysis and Modelling	5.3.91
(ii) Flood Studies	4.3.91
(iii) Hydraulic Design	6.3.91
(iv) Mountain Hydrology	13.3.91
(v) Atmospheric Land Surface Modelling	5.3.91
(vi) Ground Water Assessment	11.3.91
(vii) Conjunctive use	8.3.91
(viii) Drainage	11.3.91
(ix) Man's Influence	12.3.91
(x) Water Resources System	7.3.91
(xi) Hydrologic Investigation	8.3.91
(xii) Information System	
(xiii) Drought	12.3.91
(xiv) Remote Sensing Applications	7.3.91

LIST OF INCOH MEMBERS

Chairman
Central Water Commission
Sewa Bhawan, R.K. Puram,
New Delhi-110066.

Director
National Institute of Hydrology
Jal Vigyan Bhawan,
Roorkee-247667.

Chairman
Central Ground Water Board
Jamnagar House, Mansingh Road,
New Delhi-110001

Director-General
Indian Council of Agricultural
Research,
Krishi Bhawan,
New Delhi-110001.

Director-General
C.S.I.R.
Rafi Marg,
New Delhi-110001

Director-General
Geological Survey of India
27, Jawaharlal Nehru Marg,
Calcutta-700016.

Director-General
Indian Meteorological Deptt.
Lodi Road,
New Delhi-110003.

Chairman
Central Pollution Control
Board, Parivesh Bhawan
CBD Cum Office Complex
Delhi-110032.

Chairman
Central Electricity Authority
Ministry of Energy
Sewa Bhawan, North Wing
R.K. Puram,
New Delhi-110066.

President
Forest Research Institute
& Colleges
P.C. New Forest
Dehradun-248006.

Adviser
CPH EEO
Ministry of Works & Housing
Nirman Bhawan
New Delhi-110011.

Director
National Remote Sensing
Agency, Balanagar,
Hyderabad-500037

Chairman
Brahmaputra Board,
Basistha
Guwahati-781028

Engineer-in-Chief
Irrigation Deptt. (UP)
1, Canal Colony
Lucknow-226001

Chief Engineer
(Water Resources) & Joint
Secretary, Irrigation Deptt.
Govt. of Maharashtra
Mantralaya Bombay-400032.

Dr. Subhash Chander
Deptt. of Civil Engg.
I.I.T., Hauz Khas,
New Delhi-110016.

Secretary-General
I.C.I.D.,
48, Nyaya Marg
Chanakyapuri
New Delhi-110021

Chief Engineer, P.W.D.,
Ground Water Deptt.
Chepuk,
Madras-600005 (T.N.)

Director,
State Water Investigation
Directorate, Sech Bhawan
III Floor, Bidhan Nagar
Calcutta. 700091 (W.B.)

Director
Snow & Avalanche Study
Establishment
Defence Research & Devel.
Organisation, Manali (H.P.)

Member (WP)
Central Water Commission
Sewa Bhawan, R.K. Puram,
New Delhi-110066

Director
Research & Design Standard
Organisation, Manak Nagar,
Min. of Railways, Annexi II
Lucknow-247667(UP)

Professor & Head
Deptt. of Hydrology
Univ. of Roorkee
Roorkee-247 667(U.P.)

Dr. Satish Chandra, President
IAH, C/o, NIH, Roorkee (U.P.)

Chairman,
Narmada Control Authority,
118, Palika Bhawan, Sector-13,
R.K. Puram, New Delhi-66.

APPENDIX-VI

POSITION OF STAFF OF NIH ON 01.4.1990 AND 31.3.1991

S. No.	Description	Existing as on 01.4.90	Remarks 31.3.91
1	Director	1	1
2	Scientist 'F'	3	3
3	Scientist 'E'	5	7
4	Administrative Officer	1	1
5	Scientist 'C'	8	10
6	Finance Officer	1	-
7	Scientist 'B'	22	23
8	Assistant Engineer	-	-
9	Section Officer	1	1
10	Senior Personal Assistant	1	1
11	Senior Research Assistant	10	9
12	Senior Research Assistant (Programming)	-	-
13	Senior Technician	1	1
14	Senior Technical Assistant (Library)	-	-
15	Supereintendent	1	1
16	Research Assistant/Technical Asstt	27	22
17	Hindi Translator	1	1
18	Junior Engineer (Civil)	1	-
19	Junior Engineer (Elect.)	1	1
20	Junior Engineer (Mech.)	-	-
21	Technician Gr. I	-	-
22	Documentation Officer	-	1
23	Stenographer Gr. I	-	1
24	Stenographer Gr. II	7	6
25	Stenographer Gr. III	8	8
26	Draftsman Gr. I	-	-

27.	Technician Gr. II	12	11
28.	Draftsman Gr. II	1	2
29.	Upper Division Clerk	4	5
30.	Receptionist	1	1
31.	Technician Gr.III	10	8
32.	Asst. Superintendent	2	2
33.	Draftsman Gr.III	3	2
34.	L.D.C	15	14
35.	Drivers	5	6
36.	Attendent	13	13
37.	Messengers	23	23
38.	Chowkidar	6	7
39.	Mali	3	3
40.	Safai Karamchari	3	3
<hr/>			
	Total	201	197
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REPORT PREPARED DURING 1990-91

TECNICAL NOTES

1	Use of paleoflood information in frequency analysis	TN 71
2	Review of methodologies and software for real time flood forecasting	TN 72
3	Review of methodology for low flow forecasting	TN 73
4.	Review of interception studies	TN 75
5	Review of baseflow separation technique	TN 76
6.	Review of modelling studies in mountainous catchments	TN 77
7.	Hydrological response of greenhouse effect with emphasis on evaporation and evapotranspiration	TN 78
8.	Parameterisation of hydrologic processes	TN 79
9.	Soil and vegetation parameters for land surface modelling	TN 80
10.	Abatement of waterlogging through plantation	TN 81
11.	Low flow forecasting procedures	TN 82
12	Drought impacts on socio-economic aspects	TN 83
13	Weste Water Reuse	TN 84
14.	Expert system	TN 85
15	Lake Studies	TN 86
16.	Sedimentation of Reservoirs using Nuclear methods	TN 87
17.	Techniques of recharge and discharge using nuclear methods	TN 88

TECHNICAL REPORTS

1	Effect of measurement errors on frequency estimates	TR 97
2	A distributed event based model for design flood estimation	TR 98
3	Geomorphology of Kolar in MP	TR 99
4.	Lapse rate studies in Satluj catchment	TR 100
5	Solution of inverse problem using test pumping data in a partially penetrating well experiencing well loss	TR 101
6.	Development of a mathematical model for evaluation of spring flow potential	TR 102

7.	Development of a soil moisture prediction model	TR 103
8.	Estimation of evaporation loss from shallow WT	TR 104
9.	Development of hydrological indices of drought	TR 105
10.	Software development for DO- BOD Model for P.C	TR 106
11.	Methodology for use of PC for EIA	TR 107
12.	Integration of erosion transport and delivery and sediment yield in a catchment	TR 108
13.	Hydrological information of India for 1989-90	TR 109
14.	Operation system with real time data for Dharoi Reservoir-Model Development	TR 110
15.	Analysis of Data of AHS	TR 111

CASE STUDIES

1	Application of NWS Break Flood Program using data of Gandhi Sagar Dam	CS 49
2	Study of Impact of soil and land use changes on Hydrological Regime using SHE Model	CS 45
3	Flood frequency analysis of Godavari Basin	CS 50
4.	Application of SHE Model to Hemavathy Basin	CS 46
5	Application of SHW Model to Beti catchment	CS 51
6.	Comparative study of typical lumped and distributed models	CS 52
7.	Geomorphological studies in western ghats	CS 53
8.	Snowmelt modelling-Part I	CS 54
9.	Application of appropriate models for Indian mountainous Catchment	CS 55
10.	Modelling of Kolar Sub basin of River Narmada using SHE model	CS 47
11	Design of Drainage System in Canal Command area	CS 48
12	Hydrological impacts of Drought in Andhra Pradesh during 1988-89	CS 57
13	Hydrological impacts of Drought in Gujarat during 1988-89	CS 58
14.	Hydrological impacts of Drought. in Karnataka during 1988-89	CS 59
15.	Hydrological impacts of Drought in Madhya Pradesh 1988-89	CS 60

16.	Hydrological impacts of Drought in Maharashtra during 1988-89	CS 61
17.	Hydrological impacts of Drought in Orissa during 1988-89	CS 62
18.	Hydrological impacts of Drought in Rajasthan during 1988-89	CS 63
19.	Application of SHE model to Hemavati Basin upto Sakleshpur	CS 46
20.	Reservoir operation for conservation purposes (Pong)	CS 64
21.	Water Accounting for determination of water availability in Karnool District, Karnataka	CS 65
22.	Water accounting for determination of water availability in Gulbarga district, Karnataka	CS 66
23.	Water accounting for determination of water availability in Jamnagar district, Gujarat	CS 67
24.	Water accounting for determinatio	
25.	Water accounting for determination of water availability in Sahadol district, Madhya Pradesh	CS 69
26.	Water accounting for determination of water availability in Kalahandi district, Orissa	CS 70
27.	Water accounting for determination of water availability in Barmer district, Rajasthan	CS 71

PAPERS PUBLISHED/FOR PUBLICATION

- 1 Chandra, S., 'Water For Rural Society, key-Note Address, Indian Science Congress, Cochin, Feb.8, 1990.
- 2 Jain, S.K., G.N. Yoganarasimhan and S.M. Seth, "Flood Control Operation policy analysis on a multipurpose reservoir", proc. National Workshop on Water Resources Project Management, IIT, Madras, June 18-20, 1990.
- 3 Kumar A. V.K. Lohani and K.K.S. Bhatia, "Run off based drought indices-a case study", proc 3rd National Symposium on Hydrology, pune, July 5-7, 1990.
- 4 Raghuvansi N.S; V.K. Lohani and K.K.S. Bhatia, "Run off inducement through land treatment measures in drought prone areas", Proc. 3rd National Symposium on Hydrology, Pune, July 5-7, 1990.
- 5 Mishra, G. C. and A. G. Chachadi, "Retention of Ground-water recharge beneath a spreading basin", Proc. 3rd National Symposium on Hydrology, Pune, July 5-7, 1990.
- 6 Kumar, S and S.M. Seth, "Simulation of flood events of river Tapti by three parameter Muskingum type procedure, Proc. 3rd National Symposium on Hydrology, Pune, July 5-7, 1990.
- 7 Seth, S. M. and M. K. Santoshi, 'Flood through constructed river reach', Proc. 3rd National Symposium on Hydrology Pune, July 5-7, 1990.8. Kumer, S. an K. K. S. Bhatia, "Water quality Modelling of Hindon river using QUAL II model", Proc. 3rd National Symposium on Hydrology, Pune, July 5-7, 1990.
- 9 Seth, S. M. and S. K. Mishra, 'Application of flood routing procedure incorporating lateral flow', Proc. 3rd National Symposium on Hydrology, Pune, July 5-7, 1990.
- 10 Ramasastri, K. S. and Vibha Jain, 'On the trends and periodicities of rainfall in some districts of East Rajasthan', Annals of Arid Zone, Vol. 28, No.3 and 4.
- 11 Ramasastri, K. S. 'Simulation of daily runoff of a mountainous catchment using tank model', Proc. Int. Conference of Water Resources in Mountainous regions, Lausanne, Switzerland.
- 12 Mishra, G. C. and A. G. Chachadi, "Assessment of Groundwater Recharge from an injection well to individual aquifer in a multiaquifer system,' Seminar on Ground Water Recharge, Bhopal, Aug. 21, 1990.
- 13 Lohani, V.K., "Water Conservation techniques", Seminar on Ground water Recharge, Bhopal, Aug.21, 1990.
- 14 Ramasastri, K.S., "Study of Change in Climate at Ranchi", Seminar on Environment and Ecology-Indian Scenario, The Institution of Engineers (India), , Sept. 8-9, 1990.

15. Chandra, S., "Water Conservation and Management", Symposium on "Sustainable management of Natural Resources, National Academy of Sciences, India, Pondichery University Pondichery, September 14-15, 1990.
16. Chandra, S., "Assessment of Water Erosion and Sediment Transport", Lead Paper International Symposium on Water Erosion, Sedimentation and Resource Conservation, Central Soil and Water Conservation Research & Training institute Oct. 9-13, 1990.
17. Chandra, S., 'Infrastructural Development for Development for Efficient Water Management (Keynote address)", All India Seminar on Infrastructural Development for Efficient Water Management in Eastern Region, Patna, October 30-31, 1990.
18. Kumar, A., V. K. Lohani and S. K. Goyal, "Rainfall analysis using Herbst approach - A case study" sent for publication for 56th R and D session of CBIP, Jaipur, Nov.'1990.
19. Singh, R. D, Rakesh Kumar and S M Seth, "Regional flood frequency analysis for Godavari basin, sub zone (3), using EVA an OEV approaches' sent for publication for 56th R and D session of CBIP, Jaipur, Nov.'1990.
20. Choubey, V. K. "Meaasurement of spectral sig-ature of suspended sediment in water", sent for publication for 56th R and D session of CBIP, Jaipur, Nov.'1990.
21. Palaniappan, A. B. 'Mathematical modelling of Armour Coat, sent for publication for 56th R and D session of CBIP, Jaipur Nov. '1990.
22. Bhatia, K.K.S. and Sudhir Kumar, 'Groundwater Pollution-A case study of Saharanpur district, U.P.', sent for publication for 56th R and D session of CBIP, Jaipur Nov.'1990.
23. Seethapathi, P V, 'Simulation of Aquifer system with clay intrusion', Paper accepted for publication in International concorence on Groundwater Resources Management, Bangkok, Nov., 90.
24. Mishra, G.C., D N Bhargava and Satish Chandra, "Interference of two parallel canals", paper sent for publication for International Conference or Groundwater esources Management, Bangkok. on Nov. 90.
25. Mishra, G.C. and B. Soni, "Determination of solute concentration during leaching using Green and Ampt infiltration equation", paper sent for publication International Resources Management, Bangkok, on Nov. 90.
26. Lohani, V. K. N.S. Raghuvansi and Satish Chandra, "Hydrological aspects of droughts - A case study in India"-Proc.of international Agriculture Engg. of AIT, Bangkok, Dec, 90.
27. Bhar, A.K. and K. S. Ramasastri, "Show Cover mapping and show melt run off estimation from Remote Sensing data".
28. Bhar, A.K. and A. Bhatia, 'Land use mapping of Upper Yamuna Catchment using remotely sensed data', sent for publication in the journal of Ind. Association of Hydrologists.
29. Bhar, A. K. "Man's Influence on springflow", submitted for publication for National Seminar on Ground Water for Rural Development, Patna, Dec.'1990.

30. Goyal, V.C., "A study of Water infiltration in soils using semi-automated resistivity measurements", submitted for publication in the journal of Ind. Association of Hydrologists.
31. Bhargava, D.N., G.C. Mishra and Satish Chandra, "Mathematical Model for Seepage Studies from Paralll Canals", Irrigation & Power Journal, CBIP. Vol. 47, No.4, Oct.90.
32. Sinha, A. and G.C. Mishra, "Estimation of Groundwater Recharge from Rainfall", National Seminar on Soil Moisture processes and modelling, IIT, Kharagpur, Dec.27-29, 1990.
33. Chachadi, A.G., G.C. Mishra and B B S Singhal, "Drawdown at a large diameter well" Accounting-status", Seminar on "Soil moisture and modelling, IIT, Khargapur, 27-29, 1990.
35. Singh, R.D., and B. Soni "Application of Unit Hydrograph techniques for estimation design flood for drainage studies", Proceedings All India Seminar on Waterlogging and drainage I.E., Roorkee, 7-8, Dec., 1990.
36. Mishra, S K., 'Control of Waterlogging through Groundwater Management - A case study-submitted for publication in the Journal of Institution of Engineers (India).
37. दिव्या, एम.के. शर्मा, एस.एम. सेठ, "ग्रीन हाउस मैसों में वृद्धि क्या ओजोन स्तर की कमी का मौसम विज्ञानीय प्रचालों पर प्रभाव", जर्नल आफ इस्टीट्यूशन आफ इंजीनियर्स, जिन्द 11, 1990 ।
38. झा, आर., कालक्षेत्र "आरेख निदर्शन द्वारा निलंबित अवसाद अनुमान", इन्स्टीट्यूशन आफ इंजीनियर्स, जिल्द 71, खंड हिन्दी 3, दिसम्बर 1990 ।
39. Jha, R. "A sediment graph model for a Himalayan sub-watershed system", Accepted for publication in XXVII Convention of Indian Society of Agricultural Engineers.
40. Jha, R. "Suspended Sediment Yield from Chakhatia Watershed, Uttar Pradesh" Published, Journal of Indian Association Hydrologists, Vol. XIII, No.3
41. Jha, R. "A hydrological model of suspended sediment from a hilly catchment, to be sent for publication to American Soc. of Agricultural Engineers.
42. Pande, R.P. and V.S. Kale, "Diagonosis of Water Logging-A case study at Barna Command", proc. All India Seminar on Water Logging & Drainage, Dec. 7-8, 1990, Roorkee.
43. Singh, R.D., 'Unit Hydrograph Analysis using Personal Computer' submitte for publication in Jalvigyan Sameeksha
44. Kumar, R., 'Unit Hydrograph Modelling of Waterlogged areas., Submitted for publication of Regional Seminar on Drainage Congestion to be held at Patna.
45. Jain, S.K., "Modelling of Kolar sub-basin using SHE model", Paper Presented at Workshop or European Hydrological System Model Applications, Held at New Delhi, 1990.

46. Jain, S.K., "Study of impact of soil and landuse changes on hydrologic regime using SHE model", Paper Presented at Workshop on European Hydrological System Model Applications, Held at New Delhi, 1990.
47. Jain, S.K., "Reservoir operation and simulation using computerized spreadsheets" accepted for publication in Irrigation and Power Journal, CBI&P.
49. Jain, S.K. and S.M. Seth "Development of policy for flood control operation of Machhu II reservoir", Communicated to Journal of Institution of Engineers (India).

PARTICIPATION IN SEMINAR AND SYMPOSIA

1. Shri S.K. Verma and Sri P. Nachiappan, SRA attended the workshop on snow Hydrology, organised by CWC & HPSEB, Shimla, March 13-22, 1990.
2. Dr. Satish Chandra, Director attended the commemorative symposium (25 years of HP) Paris, March 15-17, 1990.
3. Dr. Satish Chandra, Director attended 9th session of intergovernmental council of IHP, Paris, March, 19-24, 1990.
4. Sri Rakesh Kumar, Scientist 'B' attended the seminar on "Collection and Processing Hydrology Data" IAH, Gujrat Centre, Gandhinagar on 18 April, 1990.
5. Dr. S.M. Seth, Scientist 'F' attended the meeting for "Hydrology of Amarkantak Region" convened by MP Council of Science and Technology, Bhopal on 8th June 1990.
6. Sri S.K. Jain, Scientist 'C' attended the National Workshop on "Water Resources Project Management" IIT, Madras, June 18-20, 1990.
7. Dr. S.M. Seth, Sc. 'F' Dr. G.C. Mishra, Sc. 'F', Dr. K.K.S. Bhatia, Sc. 'E', Sh. V.K. Lohani, Sc. 'C' and Shri Surendra Kumar, Sc. 'B' attended the National Symposium on Hydrology, Pune 5-7, 1990.
8. Dr. G.C. Mishra, Sc. 'F' and Sh. V.K. Lohani, Sc. 'C' attended the seminar on Ground Water Recharge, Bhopal, M.P., on Aug. 21, 1990.
9. Shri K.S. Ramasastry, Sc. 'E' attended the seminar on Environment and Ecology - Indian Scenario, Ranchi, 8-9, 1990.
10. Dr. Bhishm Kumar, Sc. 'C' attended a regional IAEA/RCA Training Course on "Isotope Techniques in hydrology, BARC, Bombay and NGRI, Hyderabad from Sept.17 to Oct.5, 1990.
11. Dr. Satish Chandra, Director, Dr. P.V. Seethapathi, Scientist 'F', Dr. K.K.S. Bhatia, Sc. 'E' & R.P. Pandey, Sc. 'B' attended the International seminar on Water erosion, sedimentation and Resource Conservation, Oct. 9-13, 1990.
12. Shri Anil Tyagi, Sc. 'B' had training on Remote Sensing Application to Hydrology at National Remote Sensing Agency, Hyderabad for 3 months.
13. Sri V.C. Goyal and Smt. Deepa Chalisgaonkar, both Sc. 'B' attended the Training in Netherlands in Instrumentation during October-Nov., 1990.
14. Shri M.K. Jain, Sc. 'B' attended the international Course on Urban drainage in developing countries, Essen, Germany, Nov. 12-30, 1990.
15. Dr. S.M.Seth, Sc. 'F' Visited Danish Hydraulics Institute, Denmark for finalisation of report on SHE model Project during Nov. 28-Dec.13,1990.

16. Dr.G.C. Mishra, Sc.'F', Dr. B. Soni, Sc.'E' Sh. V.K. Lohani, Scientist 'C', Sh. T.M. Tripathi, Scientist 'B' and Sh. R.P. Pandey, Sc. 'B' attended the Seminar on "Waterlogging and drainage". The Institution of Engineers (India), Roorkee Local Centre, Roorkee.
17. Sh. S.V. Vijay Kumar, Sc. 'B' attended the workshop on Satellite and rader data use in rainfall runoff models, Dec. 19-20, 1990.
18. Dr. G.C. Mishra, Sc. 'F' and Dr. Bishm Kumar, Sc. 'C' attended seminar on Ground Water Investigation, Management and Geophysical Techniques, U.P. Ground Water Deptt. and UPTRON, Lucknow, Dec. 11-12,1990.

TRAINING OF SCIENTISTS/TECHNICAL STAFF

- | | | |
|---|--|---------------------|
| 1 | Training in The Netherlands | |
| | a) Data Acquisition storage and retrieval | Deepa Chalisgaonkar |
| | b) Instrumentation | V.C. Goyal |
| | Delft Hydraulics Lab, Delft, The Netherlands | |
| | Sept. 9 to Nov. 9, 1990 | |
| 2 | Application of Remote Sensing in Resources Studies | |
| | NRSA, Hyderabad Oct. 24 to Dec. 19, 1990 | A.K. Tyagi |
| 3 | International Course on Urban Drainage | |
| | for Developing countries, | |
| | Inst. of Environment Essen, Univ. of Essen | M.K. Jain |
| | Essen FRG | |
| | Nov. 12 to 30, 1990 | |
| 4 | Satellite and Radar Data Use in | S.V.Vijay Kumar |
| | Rainfall Runoff modelling | |
| | Centre of Studies in Resources Engineering | |
| | (CSRE) IIT Bombay Dec. 19-20, 1990 | |
| 5 | IAEA/RCA Training course on Isotope | Dr. Bhisim Kumar |
| | Techniques in Hydrology, | |
| | BARC, Bombay and NGRI, Hyderabad, | |
| | 17th Sept, 5th Oct., 1990 | |
| 6 | Training course on soil physical analysis | S.L. Srivastava |
| | and testing at HEDESLKABET Danish | |
| | Land Development Service Viborg, | |
| | Denmark, 3rd March to 17th March 1991 | |
| 7 | Training Course on soil physical, | Sanjay Mittal |
| | analysis and testing at EIJKELKAMP | |
| | Agriseach Equipment, Giesbeek, | |
| | The Netherlands, 3rd March to 17th | |
| | March 1991 | |

INTERACTION WITH STATES INCLUDING ORGANISATIONS UNDEDR MINISTRY OF WATER RESOURCES, GOVT. OF INDIA 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 Rayalsecma 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.
- *7. Establishment of Regional Centre.

B BIHAR

- **1 Establishment of Regional Centre at Patna.
- 2 Effect of Embankment on Hydrology of Rivers.
- 3 Rainfall studies for North Bihar Regional
- 4. Identification of Hydrological Problems of North Bihar Region.
- 5 Morphological studies for North Bihar rivers.
- 6. Hydrology Network design for Bihar.

C 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

D HIMACHAL PRADESH

- 1. Representative basin study.
- *2. Drying of springs.
- 3. Choking of Khuls and changing river courses.
- 4. Hydrological studies of glaciers.
- 5. Instrumentation in high altitudes and network improvement and telemetry.
- 6. Organisation of workshops
- 7. Problems of erosion and flooding
- 8. Drought problems in hilly regions.
- 9. Water availability studies.

E JAMMU & KASHMIR

- *1. Studies for otographic effect on precipitation design flood studies in mountaineous areas. snow melt forecasting and glacier melt rainoff.
- 2. Preparation of Status report on effect of deforestation on Snow fall/snow melt.
- *3. Typical study of snow cc er/glaciated area including glacial melt/snow forecasting.
- 4. Design Flood studies for mountaineous 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 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 at Jammu.
- *13. Guidance for opening a Research Institute at Jammu.
- **14. Expedition to Kolhai glacier and ctudies regarding lakes.

F 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 for Hard Rock areas.
- *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.
- **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 in OH.
- 14 Hydrological properties of soils in Malprabha & Ghatprabha basins

G 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.

H 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.
- *14. Establishment of Regional Centre

I NORTH ESTERN REGION/ASSAM

- *1. Establishment of Regional Centre at guwahati.
- *2. Representative Basin studies on Brahmaputra Basin.
3. Development of modified Regional Formulae.
4. Preparation of typical Hydrology Year Book.
5. Study of problem of Flash Flo.
6. Study of water quality problem in rivers and ground water.
- *7. Afforestation deforestation studies in sub-basins of Brahmaputra.

J ORISSA

1. Criteria for design flood with calculated risk guidelines and manual.
- *2. Transfer of Dam break mode
- *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.

K 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.

L 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.
- *9 Establishment of Regional Centre.

M TAMILNADU

- *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.
- 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 Udal reservoir.
- 9 Positive effects of Lower Bhawani Water Resources Project on environment.
- **10 Positive effects of Lower bhawani Water Resources Project on environment.
- 11 Workshop on Ground Water Modelling.

N UTTAR PRADESH

- *1 Seasonal Ground Water Balance and mathematical modelling of UGC Command Area
- 2 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. Postive effects of Water Resources Projects on Environment.
12. Sedimentation of Ramganga Reservoirs using Remote Sensing Techniques.
- **13. workshop on Himalayan Hydrology with emphasis on spring flow
- **14. Regional workshop on "Waterlogging & Drainage

O WEST BENGAL

1. Preparation of Hydrological Year Book for Kalighai Basin & Bhagirathi 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 Rainoff 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 witt 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.
- **14. National Seminar on Soil moisture Process & Modelling

* Under Progress

** Completed

INTERACTION WITH ORGANISTIONS UNDER MWOR, GOVT. OF INDIA

The ground water assessment division prepared a Technical paper entitled 'long term base flow studies' in cooperation with hydrologists of CGWB under ground water panel of INCOH.

In the working group panels of various scientific divisions of the Institute, members have been drawn from Central Water commission, Central Ground Water Board, NWDA and like organisations. Institute is planning to organise various study programmes with cooperation of other organisations under ministry and to organise Training courses for NWDA Engineers.

WORKSHOPS ORGANISED BY THE INSTITUTE DURING 1990-91

S.No.	Topic	Venue	Dates	No. of participants
1	Himalayan Hydrology with emphasis on spring flow (sponsored by UP Watershed management Directorate Dehradun)	Roorkee	Nov.5-7 1990	16
2	Groundwater balance	Tejpur	Nov.26-30 1990	13
3	Processing and analysis of precipitation data.	Patna	Nov.26-30 1991	44
4	Flood estimation by unit hydrograph techniques.	Bhopal	Jan.21-25 1991	22
5	Flood estimation by unit hydrograph techniques.	Patna	Feb.18-22 1991	42

CONSTITUTION OF WORKING GROUPS

I SURFACE WATER ANALYSIS AND MODELLING DIVISION

1	Director, NIH	Chairman
2	Dr. S.M.Seth, Scientist 'F'	Technical Coordinator
3	Divisional Head, Surface Water Analysis & Modelling Division, NIH	Convener

Members

4. Nominee of Central Water Commission, New Delhi
5. Nominee of Narmada Control Authority
6. Nominee of National Water Development Agency
7. Nominee of Central Electricity Authority
8. Nominee of A.P. Engineering Labs., Andhra Pradesh
9. Nominee of Irrigation Department, Maharashtra
10. Nominee of Irrigation Department, West Bengal
11. Nominee of Centre for Water Resources Development and Management, Kunnamangalam, Kerala-673571
12. Dr. U.C.Chaubey, Reader, WRDTC, Univ. of Roorkee
13. Dr. Pandey B.B. Lal, Principal MMM Engineering College, Gorakhpur
14. Dr. Arun Kumar, Professor, Delhi college of Engineering

2. FLOOD STUDIES DIVISION

1	Director, NIH	Chairman
2	Dr. S.M. Seth, Sc. 'F'	Technical Coordinator
3	Divisional Head, Flood Studies Divn.	Convener

Members

4. Nominee of Central Water Commission, New Delhi
5. Nominee of India Meteorological Department, New Delhi.
6. Nominee of Central Water & Power Research Station Pune
7. Nominee of Ganga Flood Control Commission, Patna
8. Nominee of Brahmaputra board,

- 9 Nominee of Assam Irrigation Department, Guwahati
- 10 Nominee of U.P. Irrigation Department, Lucknow
- 11 Shri N.K. Goel, Reader, Department of Hydrology, UOR, Roorkee
- 12 Dr. T.Prasad, Director, Water Resources Studies Programme Bihar College of Engineering, Patna.

3. HYDROLOGIC DESIGN DIVISION

- | | | |
|---|--|-----------------------|
| 1 | Director, NIH | Chairman |
| 2 | Dr. S.M. Seth, Sc. 'F' | Technical Coordinator |
| 3 | Divisional Head,
Hydrologic Design Div. | Convener |

Member

4. Nominee of Central water commission, New Delhi
5. Nominee of RDSO, Lucknow
6. Nominee of Central Electricity Authority, New Delhi
7. Nominee of India Meteorological Department
8. Nominee of Irrigation Department, Madhya Pradesh
9. Nominee of Irrigation Department, Uttar Pradesh
10. Nominee of Irrigation Department, Gujarat
11. Prof. MM Dandekar, M.R.College of Engineering, Jaipur
13. Prof. D.N.Bhargava, University of Roorkee
14. Shri B.P. Parida Assoc. Professor I.I.T. Delhi.

4. MOUNTAIN HYDROLOGY DIVISION

- | | | |
|---|---|-----------------------|
| 1 | Director, NIH | Chairman |
| 2 | Dr. S.M. Seth, Sc. 'F' | Technical Coordinator |
| 3 | Divisional Head, Mountain
Hydrology Division | Convener |

Members

4. Nominee of Central Water Commission, New Delhi
5. Nominee of Central Electricity Authority, New Delhi
6. Nominee of India Meteorological Department, New Delhi
7. Nominee of Space Application Centre, Ahmedabad
8. Nominee of Geological Survey of India, Lucknow.
9. Nominee of Bhakra Beas Management Board
10. Nominee of Irrigation & Public Health Engg. Department, H.P.

11. Nominee of Irrigation & Flood Control Department, J & K
12. Nominee of Central for water Resources Development & Management, Kozhikode, Kerala
13. Nominee of Irrigation Department, Uttar Pradesh
14. Nominee of Himachal Pradesh State Electricity board
15. Prof. B.S.Mathur, Deptt. of Hydrology, Univ. of Roorkee
16. Prof. B.V.Rao, Indian Institute of Technology, Bombay

5. ATMOSPHERIC LAND SURFACE PROCESS MODELLING DIVISION

- | | | |
|---|--|-----------------------|
| 1 | Director, NIH | Chairman |
| 2 | Dr. S.M. Seth, Sc. 'F' | Technical Coordinator |
| 3 | Divisional Head Atmospheric
Land Surface Process Modelling division | Convener |

Members

4. Nominee of India Meteorological Department, New Delhi
5. Nominee of Indian Institute of Tropical Meteorology, Pune
6. Nominee of Central Water Commission, New Delhi
7. Nominee of All India soil & Land Use Survey
8. Nominee of Irrigation Department, Gujarat
9. Nominee of Irrigation Department, M.P.
10. Nominee of Irrigation Department, Orissa
11. Prof. M.P. Singh, Centre for Atmospheric Sciences, IIT Delhi
12. Dr. R.K.Datta, National Centre for Medium Range Forecasting, New Delhi
13. Dr. R.N.Keshavmurthy, Physical Research Laboratory, ahmedabad

6. GROUND WATER ASSESSMENT DIVISION

- | | | |
|---|---|-----------------------|
| 1 | Director, NIH | Chairman |
| 2 | Dr. G.C. Mishra | Technical Coordinator |
| 3 | Divisional Head, Ground Water
Assessment Division, NIH | Convener |

Members

4. Nominee of Central Ground Water Board, New Delhi
5. Nominee of NABARD, Bombay
6. Nominee of Ground Water Survey Development Agency, Maharashtra
7. Nominee of Ground Water Department, Rajasthan
8. Nominee of Ground Water Department, Orissa

9. Dr. B.B.S. Singhal , Professor , Department of Earth Sciences, University of Roorkee - 247 667
10. Prof. A.S. Chawla, water Resources Development Training Centre, University of Roorkee, Roorkee
11. Dr. S.K. Goyal, Punjab engg. College, Chandigarh
12. Dr. R.D.Verma, Malaviya Regional Engg. College, Jaipur
13. Sri S.P. Sanghal, Dy, General Manager (Retd.), National Bank for Agriculture and Rural Development, Bombay.

7. CONJUNCTIVE USE DIVISION

- | | | |
|---|---|-----------------------|
| 1 | Director, NIH | Chairman |
| 2 | Dr.P.V. Sethapathi | Technical Coordinator |
| 3 | Divisional Head, Conjunctive Use Division | Conver |

Members

4. Nominee of Central Ground Water Board, New Delhi
5. Nominee of Ministry of Agriculture, New Delhi
6. Chief Engineer (CAD), Ministry of Water Resources
7. Nominee of Ground Water Investigation Organisation, Uttar Pradesh
8. Nominee of Ground Water Department, Tamil Nadu
9. Nominee of Ground Water Department, Andhra Pradesh
10. Dr. R.S.Varshney, Secretary - General, International Commission on Irrigation and Drainage, Nayaya Marg Chankyapuri, New Delhi
11. Dr. Vedula, Indian Institute of Science, Bangalore
12. Dr. P.B.S. Sarma, Water Technology Centre, Indian Agricultural Research Institute, Pusa complex, New Delhi
13. Dr. Deepak Kashyap, Reader, Deptt. of Hydrology, University of Roorkee
14. Sri R.S. Saksena, Chief Engineer (MI) Retd., Ministry of Water Resources

8 DRAINAGE DIVISION

- | | | |
|---|---|-----------------------|
| 1 | Director, NIH | Chairman |
| 2 | Dr. G.G.Mishra | Technical Coordinator |
| 3 | Divisional Head Drainage Division , NIH | Convener |

Members

4. Nominee of Central Water Commission, New Delhi

9. MAN'S INFLUENCE DIVISION

1	Director, NIH	Chairman
2	Dr. G.C. Mishra	Technical Coordinator
3	Divisional Head, Man's Influence Division, NIH	Convener

Members

4. Nominee of Department of Environment, Govt. of India, New Delhi.
5. Nominee of Central board for Prevention and control of Water Pollution, New Delhi.
6. Nominee of Central Water Commission, New Delhi.
7. Nominee of Central Soil and Water Conservation Research and Training Institute, Dehradun.
8. Nominee of forest Research Institute, Dehradun.
9. Central Electricity Authority, New Delhi.
10. Nominee of Narmada Valley Development Agency.
11. Nominee of Delhi Administration.
12. Nominee of U.P. Forest Department.
13. Dr. P.Khanna, Director, National Environmental Engineering Research Institute, Nagpur.
14. Dr. D.C. Das, Department of Environment, New Delhi.
15. Dr. T. Hallappa Gowda, Professor, A.C. College of Engineering, Mysore.
16. Prof. P.s. Panesar, Professor, Department of Chemical Engineering, University of Roorkee.
17. Dr. B.K. Handa, Chief Chemist (retd.), Central Ground Water Board, Lucknow.

10. WATER RESOURCES SYSTEM DIVISION

1	Director, NIH	Chairman
2	Dr. P.V. Seethapathi	Technical Coordinator
3	Divisional Head, Water Resources System Div.	Convener

Members

4. Nominee of Central Water Commission, New Delhi

5. Nominee of Bhakra Beas Management Board
6. Nominee of Central Electricity Authority, New Delhi.
7. Nominee of Irrigation Department, Maharashtra.
8. Nominee of Gujarat Irrigation Department, Gandhinagar.
9. Nominee of Orissa Irrigation Department, Bhubaneswar.
10. Nominee of Uttar Pradesh Irrigation Dept.
11. Prof. hari Krishna, E-203 Narvana apartment, 89 Patparganj, New Delhi-110092.
12. Shri Y D P endse, Retd. Member (WP), CWC.
13. Dr. P V Rao, Principal Punjab Engg. College, Chandigarh.
14. Dr. D K Srivastava, Professor, Dept. of Hydrology.

11. HYDROLOGICAL INVESTIGATION DIVISION

- | | | |
|---|---|-----------------------|
| 1 | Director, NIH | Chairman |
| 2 | Dr. P.V. Seethapathi | Technical Coordinator |
| 3 | Div. Head, Hydrological
Investigation Div. | Convener |

Member

4. Nominee of Central Water commission.
5. Nominee of Isotope Division, BARC, bombay
6. Nominee of NWDA, New Delhi.
7. Nominee of Central ground Water board, New Delhi.
8. Nominee of Central Electricity Authority, New Delhi.
9. Nominee of Uttar Pradesh Irrigation Department
10. Nominee of Gujarat Irrigation Department, GERI, Vadodara
11. Nominee of Karnataka Irrigation Department, WRDO, Bangalore.
12. Nominee of West Bengal Irrigation Department
13. Dr. B.P. Singh, Director, University Grants Commission, New Delhi.
14. Dr. D.C. singhal, Deptt. of Hydrology, University of Roorkee, Roorkee.
15. Sri Prakash Bahadur, Retd. Director, Sector c, Indira Nagar, Lucknow.

12. CONSTITUTION OF WORKING GROUP ON INFORMATION SYSTEM

1	Director, NIH	Chairman
2	Dr. G.C. Mishra	Technical Coordinator
3	Divisional Head, Information System & computer	Convener

Members

4. Nominee of Central Water Commission, New Delhi
5. Nominee of National Informatic Centre.
6. Nominee of Ministry of Agriculture (Soil Conservation)
7. Nominee of India Meteorological Department.
8. Nominee of Central water & Power Research Station, Pune.
9. Nominee of Central Electricity Authority.
10. Nominee of Andhra Pradesh Engg. Research laboratory.
11. Nominee of Karnataka Irrigation Department.
12. Nominee of I.R.I., Roorkee
13. Dr. N.K. Nanda, Professor, Department of Electronics and Communication Engineering, University of Roorkee, Roorkee.
14. Prof. P.K. Pandey Deptt. of Civil Engineering, Univ. of Roorkee, Roorkee.
15. Prof. J.S.R. Murty, Indian Institute of Technology, Bombay.

13. DROUGHT STUDIES DIVISION

1	Director, NIH	Chairman
2	Dr. G.C. Mishra	Technical Coordinator
3	Divisional Head, Drought Studies Division, NIH	Convener
4.	Nominee of India Meteorological Department, New Delhi.	
5	Nominee of Ministry of Agriculture, New Delhi.	
6.	Nominee of Central Water Commission, New Delhi.	
7.	Nominee of Central Ground Water Board, New Delhi.	
8.	Nominee of Central Arid Zone Research Institute, Jodhpur	
9.	Nominee of Dept. of Space (Dr. D.P. Rao, Chairman, T.F., NRSA, Hyderabad)	
10.	Nominee of Irrigation Department, Karnataka.	
11.	Nominee of Irrigation Department, gujarat.	

- 12 Dr. B.H.Briz Kishore, Director. Jawaharlal Nehru Technological University, A.P., Hyderabad.
- 13 Prof. Jaswant Singh, Chief Scientist,
Sher-E-Kashmir University of Agricultural Sciences & Technology, Water Management Research Centre, Ponichak, Jammu.
- 14 Dr. Ranvir Singh, Reader, Department of Hydrology,
University of Roorkee, Roorkee.

14. CONSTITUTION OF WORKING GROUP OF REMOTE SENSING APPLICATIONS DIVISION

- | | | |
|---|---|-----------------------|
| 1 | Director, NIH | Chairman |
| 2 | Dr.P.V. Seethapathi | Technical Coordinator |
| 3 | Divisional Head, Remote Sensing Applications Div.,
NIH | Convener |

Members

4. Nominee of National Remote Sensing Agency
5. Nominee of Central Water commission.
6. Nominee of Space Application Centre.
7. Nominee of Survey of India, Dehradun.
8. Nominee of Central Electricity Authority, New Delhi.
9. Nominee of All India soil and Land use Survey, new Delhi.
10. Nominee of Central Arid Zone Research Institute, Jodhpur
11. Nominee of U.P. remote Sensing Agency.
12. Institute of Hydraulics & Hydrology, Poondi.
13. Prof. R.K. Katti, Head, Centre of Studies in Resources. Engg. I.I.T, Powai, Bombay-400 075.
14. Prof. R.P. Gupta, Univ. of Roorkee.

UTILISATION CERTIFICATE

Certified that the National Institute of Hydrology, Roorkee has utilised the Grant-in-aid as detailed hereunder during the year 1990-91 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
Opening Cash & Bank Balances as on 01.4.90	22,94,008.77	2,65,955.57	25,59,964.34
Add : Grants-in-aid from Ministry of Water Resources, New Delhi	1,77,00,000.00	1,09,00,000.00	2,86,00,000.00
Total	1,99,94,008.77	1,11,65,995.57	3,11,59,964.34
Payments	1,57,21,568.60	1,11,24,574.95	2,68,46,143.55
Closing Cash & Bank Balances as on 31.3.91	42,72,440.17	41,380.62	43,13,820.79

Sd/-
(N.C. Ghosh)
Finance Officer

Sd/-
(Satish Chandra)
Director

For S.K. Kotwalia & Co.
Chartered Accountant

PLACE : Roorkee
DATED : 3-10-91

[Suresh Kumar]
Partner

National Institute of Hydrology
Roorkee

Fixed Assets as on 31.3.1991

Sl No.	Particulars	Cost as on 01.4.90	Addition during the year	Total balance as on 31.3.91
1	Building	74,48,519.45	61,41,814.68	1,35,90,334.13
2	Furniture & Fixture	16,21,761.43	10,58,307.36	26,80,068.79
3	Office Equipments	27,26,537.66	8,44,260.33	35,70,797.99
4	Computer Machinery	21,15,567.50	9,58,360.50	30,73,928.00
5	Vehicles	7,28,721.50	2,12,797.00	9,41,518.50
6	Library Books	10,98,479.92	1,75,611.10	12,74,091.02
7	Mechinery & Equipments	67,98,556.21	55,05,561.25	1,23,04,117.46
8	Generator Set	2,05,928.00	NIL	2,05,928.00
	Total	2,27,44,071.67	1,48,96,712.22	3,76,40,783.89
	Previous Year	1,64,71,585.77	62,72,485.90	2,27,44,071.67

NATIONAL INSTITUTE OF HYDROLOGY
ROORKEE

Building Works in Progress as on 31.3.1991

Sl No.	Particulars	Amount as on 01.4.90	Payment during 1990-91	Recovered Back Adjusted during 1990-91	Amount as on 31.3.1991
1	Advance for Cont. Work granted to UOR Roorkee	43,29,152.84	21,85,283.00	43,92,578.39	21,21,857.45
2	Steel and cement with UOR Roorkee	14,82,179.79	NIL	14,82,179.79	NIL
	Total	58,11,532.63	21,85,283.00	58,74,758.18	21,21,857.45

Schedule 'C'

National Institute of Hydrology
Roorkee

Deposits (made by NIH with outside parties as on 31.3.1991)

Sl No.	Particulars	Amount (Rs.)		Amount Rs.
		Plan	Non-Plan	
1	Security Deposits for Gas Cylinder	1,900.00	350.00	2,250.00
2	Deposits to UPSEB-Roorkee for sub-stn.	-	8480.00	8,480.00
3	Security Deposit for Telex	-	10,000.00	10,000.00
4	Deposit with SAIL, Ghaziabad for steel	15,000.00	-	15,000.00
5	SDO (Telegraph) for Telephone connection		18,00.00	18,00.00
6	Security Deposit for Telephone at R.C. Belgaum.	8,000.00	-	8,000.00
7	District G.M. (Tel) Guwahati.	8,000.00	-	8,000.00
8	Accounts Officer (Tel) Jammu.	6,000.00	-	6,000.00
	Total	38,900.00	20,630.00	59,53,000.00
	Previous Year (31.3.90)	24,900.00	20,630.00	45,53,000.00

(XXXX)

National Institute of Hydrology
Roorkee
Current assets Loans & Advances as on 31.3.1991

Sl. No.	Particulars	Amount		Amount (Rs.)
		PLAN	NON-PLAN	
1	Advances to firms	48,76,923.37	71,368.00	49,48,291.37
2	Advances to employees :			
	(a) Cycle Advance	NIL	8,927.00	
	(b) Festival Advance	NIL	10,960.00	
	(c) Fan Advance	NIL	160.00	
	(d) Scooter Advance	NIL	2,20,031.00	
	(e) Car Advance	NIL	60,800.00	
	(f) L.T.C. Advance	NIL	15,107.00	
	(g) T.A. Advance	NIL	61,324.40	
	(h) Depttl. Advance	NIL	2,388.00	
	(i) Pay Advance	NIL	8,220.00	
	(j) Advances to Div. Head	NIL	14,000.00	
			4,01,917.40	4,01,917.40
3	Amount Transferred to R.C.			
	(a) R.C. Belgaum	10,426.74	74,537.85	
	(b) R.C. Guwahati	1,50,500.00	19,690.29	
	(c) R.C. Jammu	1,32,384.57	37,415.02	
		2,93,311.31	1,31,643.16	4,24,954.47
	Total	51,70,234.68	6,04,928.56	57,75,163.24
	Previous Years (31.3.90)	13,14,583.24	4,53,824.65	17,68,407.89

National Institute of Hydrology
Roorkee

Outstanding Expenses as on 31.3.1991

Sl. No.	Particulars	Amount		Total (Rs.)
		PLAN	NON-PLAN	
1.	Establishment			
	T.A.	-	11998.00	
	Wages	-	3,975.00	
	R.T.F.	-	2,176.00	
	O.T.A.	-	245.00	
	Medical Exp.	-	2,739.00	21,133.00
2	Office Expenses :			
	Journal	-	343.00	
	Telephone	-	1,758.00	
	Electricity	-	12,292.00	
	Postage	-	3,051.00	
	Audit fee	-	5,000.00	
	Advertisement	-	2,12,727.00	
	Running Cost of Lab -		5,744.00	
	Stationery/Printing -		19,747.00	
	Hospitality	-	295.00	
	Misc.	-	623.00	2,61,580.00
3	Maintenance :			
	Computer	-	10,000.00	
	Office Equipment	-	7,200.00	
	Building	-	9.00	
	Vehicle	-	1,455.00	
	A/c Plant	-	15.00	18,769.00
4	Recoveries from Employees-		4,595.92	4,595.92
Total	3,06,077.92	-	3,06,077.92	3,06,077.92
Previous Year (31.3.1990)	33,945.00		1,28,013.72	1,61,958.72

National institute of Hydrology
Roorkee
Pre-Paid Expenses as on 31.3.91

Sl. No.	Particulars	PLAN	NON PLAN	AMOUNT (Rs.)
1	Journal	91,046.00	1,103.00	92,149.00
2	Seminar & Conference	-	25,000.00	25,000.00
3	Maintenance of Office Equipment	-	8,250.00	8,250.00
4	Maintenance of computer	-	8,32,975.00	8,32,975.00
	Total	91,046.00	8,67,328.00	9,58,374.00
	Previous Year (31.3.90)	392,700.00	6,56,511.10	10,49,211.10

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE
RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDING ON 31ST MARCH, 1991

PREVIOUS YEAR RECEIPTS	PLAN	CURRENT YEAR NON-PLAN	TOTAL	PREVIOUS YEAR	PAYMENTS	CURRENT YEAR PLAN	NON-PLAN	TOTAL
	<u>CASH AND BANK BALNCES</u>							
71,120.31	CASH IN HAND 35,472.05	33,997.90	69,469.95	60,53,571.65	Salaries, Wages and allowances	39,173.85	67,55,782.15	67,84,956.00
9,450.00	IMPREST WITH DIV. Heads -	12,500.00	12,500.00		Travelling and Conveyance	26,450.00	5,99,337.60	6,25,787.60
26,73,096.63	Bank Balances 22,58,536.72	2,19,457.67	24,77,994.39	4,36,956.50	Elect Water and Gen.run.Ex.	3,500.90	2,11,357.90	2,14,857.90
<u>27,53,666.94</u>	<u>SUB-TOTAL 22,94,008.77</u>	<u>2,65,955.57</u>	<u>25,59,964.34</u>	1,66,385.90	Printing and Stationery	94.70	3,77,221.75	3,77,316.45
	<u>GRANTS-IN-AID RECEIVED</u>			1,37,975.50	Postage, Telephone and Telex	147.00	2,39,296.45	2,39,443.45
1,37,60,000.00	From GOI/MOWR,N. 1,77,00,000.00	1,09,00,000.00	2,86,00,000.00	1,28,471.10	Adevertisements	-	3,72,773.00	3,72,773.00
	Delhi From UNESCO	18,000.00	18,000.00	3,00,509.00	Journals and Periodicals	2,59,255.00	23,981.00	2,83,236.00
44,636.60	Computer hire Charges -	39,970.00	39,970.00	2,00,744.90	Printing of Tech.Books	84,015.00	38,322.00	1,22,337.00
1,60,496.25	Interest from Bank -	14,117.90	14,117.90	2,54,291.15	Advances to Reg. Centres	2,93,311.31	19,690.29	3,13,001.60
35,142.09	Misc. Receipts 275.00	92,742.20	93,017.20	-	Hospitality	543.50	28,804.10	29,347.60
7,015.00	Interest on Advances 13.00	10,596.00	10,609.00	11,719.90	Misc. Expenses	3,491.75	3,76,234.61	3,79,726.36
2,47,299.50	Interest on CPF-Balance -	2,11,336.00	2,11,336.00	2,02,938.35	T.A. to Candidates	-	23,997.00	23,997.00
-	Permanent Imprest Refund -	4,269.65	4,269.65	682.00	Seminar and Conferences	-	1,53,580.25	1,53,580.25
	<u>RECOVERIES OF ADVANCES</u>			3,53,887.50	Running Cost Lab. and Computer	40,541.00	9,299.05	49,840.05
1,75,087.00	Employees -	1,91,907.00	1,91,907.00	54,887.40	Repair Mint Other than Vehicle	1,67,444.00	15,60,349.15	17,27,793.15
5,477.20	Departmental 2,193.58	5,604.25	7,797.83	14,57,615.10	Repair and Maint of Veh.	1,157.30	2,51,914.48	2,53,071.78
9,471.06	Firms -	-	-	1,35,081.95	Interst on CPF	-	3,64,431.00	3,64,481.00
78,170.75	UOR -	3,274.70	3,274.70	2,82,110.00	Furniture and Fixture	9,63,615.36	2,000.00	9,65,615.36
-	NIH/GSLI final Payment -	300.00	300.00	3,18,400.00	Office Equipment	7,21,989.33	-	7,21,989.33
-	Other recovery from employees -	-	-	13,42,652.00	Library Books	1,75,612.10	-	1,75,612.10
	<u>SECURITY DEPOSITS</u>			12,42,572.88	Machinery and Equipments	17,13,302.44	-	17,13,302.44
2,100.00	Recovered Back -	-	-	4,741.48	Deposits	14,000.00	-	14,000.00
				21,599.00	Building	2,67,056.50	-	2,67,066.50
				8,92,593.99	Advances to firms/ Deposits	87,64,067.04	580.00	87,64,647.04
				3,65,074.80	Departmental Advance	-	1,24,440.87	1,24,440.87
				1,46,356.00	Advances to Employees	-	1,74,300.00	1,74,300.00
				48,237.50	Project	-	9,000.00	9,000.00
				-	Advances to U.O.R.	21,85,283.00	-	21,85,283.00
				25,59,964.34	Closing Blance	42,72,440.17	41,380.62	43,13,820.79
1,72,78,562.39	Total	1,99,96,490.35	3,17,54,563.62	1,72,78,572.39	Total	1,99,96,490.35	1,17,58,073.27	3,17,54,563.62

As per our report of even date attached
For S.K. KOTWALIA AND
COMPANY
CHARTERED ACCOUNTANTS
(SURESH KUMAR)
PARTNER

Place : Roorkee
Date : 3rd Oct 1991

(N.C GOSH)
FINANCE OFFICER

(SATISH CHANDRA)
DIRECTOR

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE
RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDING ON 31ST MARCH, 1991

PREVIOUS YEAR	FUND AND LIABILITIES	CURRENT YEAR	PREVIOUS YEAR	ASSETS	CURRENT YEAR
	Grant-in-aid from Govt of India Ministry of Water Resources, New Delhi.		2,27,44,071.67	Fixed Assets (As Cost) As per Schedule 'A'	3,76,40,783.89
25,80,861.94	Opening Balance	23,87,154.34	58,11,332.63	<u>BUILDING WORKS-IN-PROGRESS</u> As per Schedule 'B'	21,21,857.45
	Received from govt of India, Ministry of Water Resources, New Delhi	<u>2,86,00,000.00</u> 3,09,87,159.34	45,530.00	<u>DEPOSITS</u> As per Schedule 'C'	59,530.00
<u>1,37,60,000.00</u> 1,63,40,961.94	Less		17,68,407.89	<u>CURRENT ASSETS, LOAN AND ADVANCES</u> As per Schedule 'C'	57,75,163.24
	a) Cost of acquisition of fixed and other assets transferred to assets fund account	1,49,93,036.09	10,49,211.10	<u>PREPAID EXPENSES</u> As pr Schedule 'F'	9,58,374.00
38,19,629.08	b) Transferred to Income and Expenditure A/C to meet the excess of expenditure over income for the year	<u>1,18,53,107.46</u> 41,41,015.79	69,469.95 12,500.00 24,77,994.39	Cash in hand	---
<u>1,01,34,073.52</u> 23,87,159.34				Imprest with Divisional Heads	---
	<u>ASSETS FUND ACCOUNT</u>	3,14,29,399.57		Balances in SBI A/c with SBI, UOR, Roorkee.	43,13,820.79
2,76,09,770.49	Opening Balance	1,49,93,036.094			
<u>38,19,629.08</u> 3,14,29,399.57	Add: Transfer from Grant-in-aid	64,22,435.66			
	<u>CURRENT LIABILITIES</u>	3,06,077.92			
,958.72	Liabilities for expenses (as per Schedule 'E')				
3,39,78,517.63	Total	5,08,69,529.37	3,39,78,517.63	Total	5,08,69,529.37

Note : Schedule No. 'A' to 'F' are forming intergral part of this Balance Sheets.

As per our report of even date attached
For S.K. KOTWALIA AND
COMPANY
CHARTERED ACCOUNTANTS
(SURESH KUMAR)
PARTNER

Place : Roorkee
Date : 3rd Oct. 1991

(N.C GOSH)
FINANCE OFFICER

(SATISH CHANDRA)
DIRECTOR

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE
RECEIPT AND PAYMENT ACCOUNT FOR THE YEAR ENDING ON 31ST MARCH, 1991

PREVIOUS YEAR (Rs.)	EXPENDITURE	PLAN	CURRENT YEAR	TOTAL	PREVIOUS YEAR	INCOME	CURRENT YEAR PLAN	NON-PLAN	TOTAL
61,41,267.25	Salaries, Wages and allowances	2,898.85	67,16,995.15	67,19,894.00	34,496.60	Hire Charges of Computer	-	39,970.00	39,970.00
5,04,303.00	Travelling and Conveyance	43,400.00	5,45,372.60	5,88,772.60	1,60,496.25	Interest on Saving/Deposits.	-	14,117.90	14,117.90
1,54,139.90	News papers and Periodicals	1,68,209.00	1,19,081.00	2,87,290.00	24,659.98	Misc. Receipts	275.00	92,742.20	93,017.20
1,91,683.45	Electricity Water charges and General running cost		2,09,788.30	2,09,788.30	7,015.00	Interest on Advance	13.00	10,596.00	10,609.00
2,19,858.75	Printing and Stationary	94.70	4,36,608.75	4,36,703.45	-	Other Receipts	-	18,000.00	18,000.00
1,84,945.65	Postage, Telephone and Telex.	147.00	2,29,855.95	2,30,002.95	2,47,299.50	Interest on CPF Balance	-	2,11,336.00	2,11,336.00
3,00,509.00	Advertisements	-	5,85,500.00	5,85,500.00	10,282.61	Regional Course on Urban-Hydrology			
2,50,751.20	Printing and Technical Books	84,015.00	38,322.00	1,22,337.00		Refund/Receipt in Cash:			
25,215.15	Hospitality Expenses	543.50	29,409.55	29,953.05	-	Deptt. Advance	2,193.58	5,604.25	7,797.83
2,83,923.40	Misc.	6,991.75	3,42,051.76	3,49,043.51	-	NIHGSLI	-	3,274.70	3,274.70
35,793.00	T.A. to candidates	-	23,997.00	23,997.00	-	Permanent Adv.	-	4,269.65	4,269.65
3,77,125.00	Seminar/Conference/Projects	-	1,62,580.25	1,62,580.25	-	Recovery from Employees	-	300.00	300.00
13,59,178.95	Repair and Maintenance other than Repair and Maintenance of Vehicle	5,60,144.00	12,70,931.20	18,31,075.20	1,01,34,073.52	Transferred from GIA A/c to meet the Expenditure for the year	9,08,794.54	1,00,14,312.00	1,18,53,107.46
1,97,345.56	Repair and Maintenance of Vehicle	4,291.32	2,54,356.06	2,58,647.38					
2,82,110.00	Interest on CPF		3,64,431.00	3,64,431.00					
1,10,173.20	Running cost of Lab./Computer	40,541.00	15,243.05	55,784.05					
1,06,18,323.46	Total	9,11,276.12	1,13,44,523.62	1,22,55,799.74	1,06,18,323.46	Total	9,11,276.12	1,13,44,523.62	1,22,55,799.74

As per our report of even date attached
For S.K. KOTWALIA AND
COMPANY
CHARTERED ACCOUNTANTS
(SURESH KUMAR)
PARTNER

Place : Roorkee
Date : 3rd Oct. 1991

(N.C GOSHI)
FINANCE OFFICER

(SATISH CHANDRA)
DIRECTOR