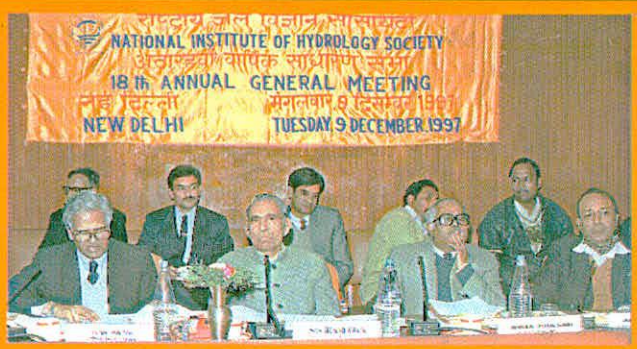
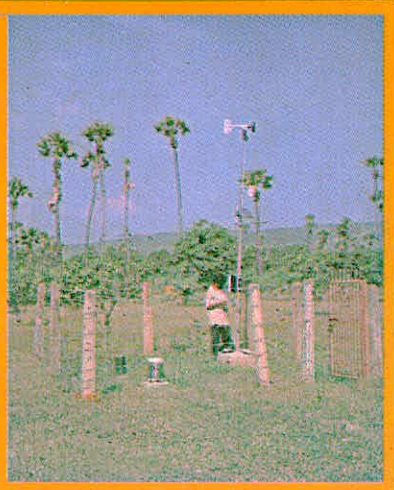
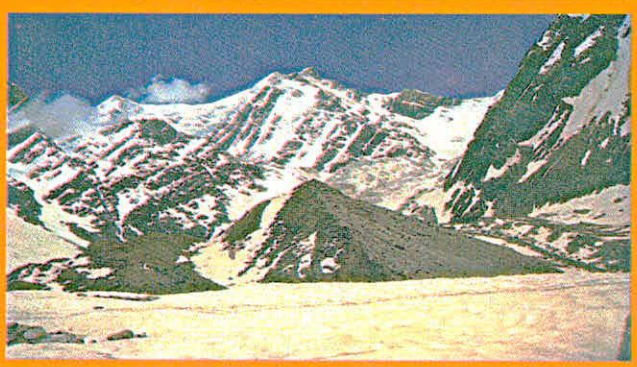
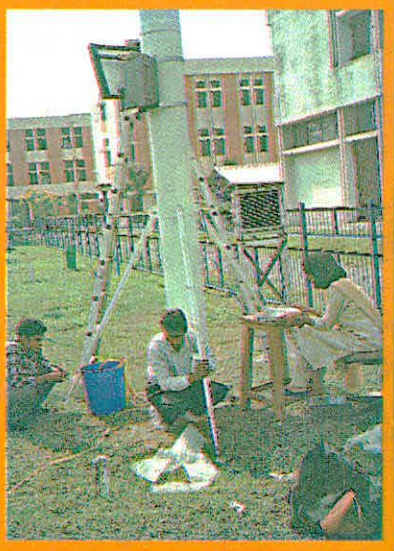
Annual Report

1997-98







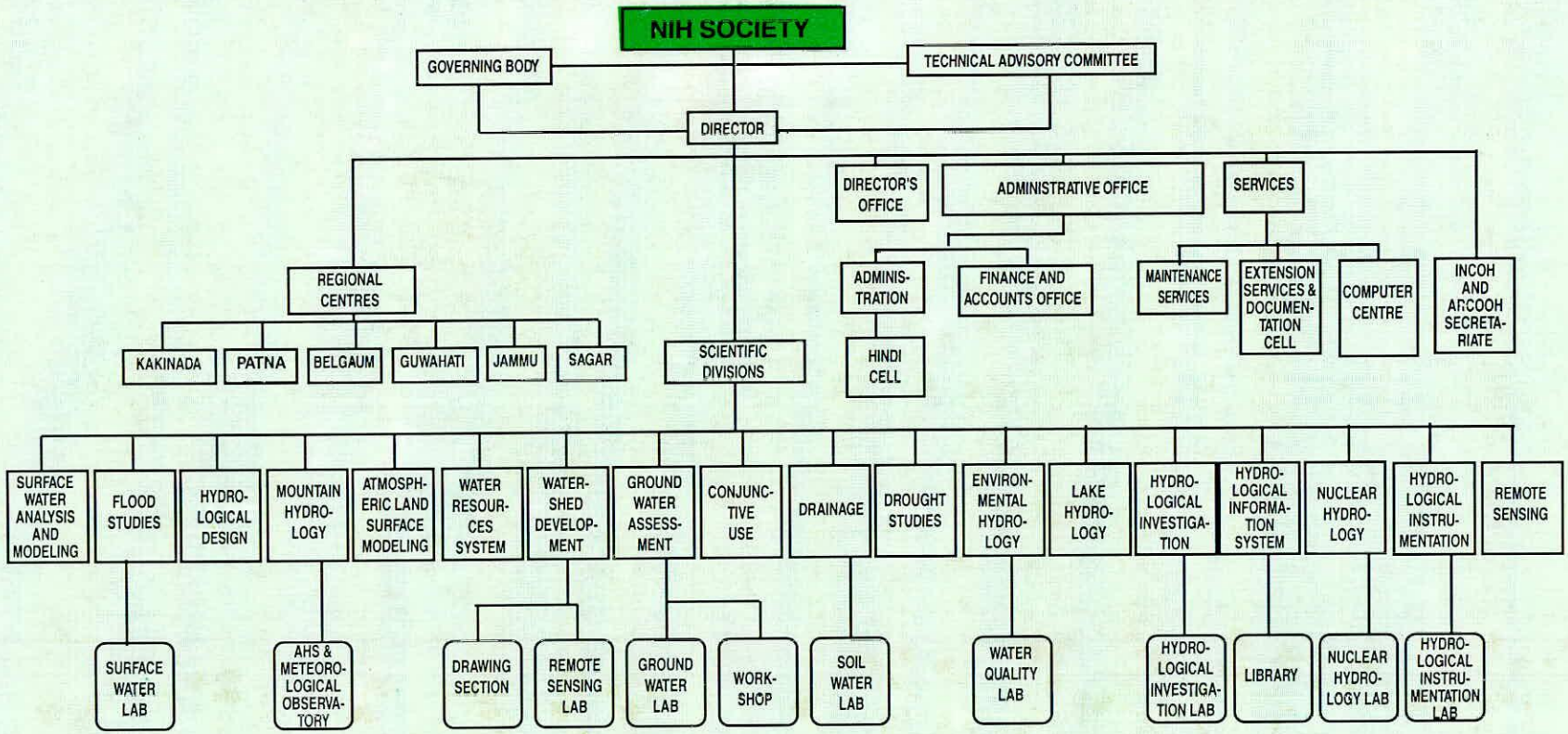


NATIONAL INSTITUTE OF HYDROLOGY
राष्ट्रीय जलविज्ञान संस्थान

आपो हि ष्ठा मयोभुवः

National Institute of Hydrology

Roorkee - 247667 (U.P.)



NATIONAL INSTITUTE OF HYDROLOGY
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NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE
ORGANISATIONAL STRUCTURE

Contents

Director's Report

It is a matter of great pleasure for me to present the Annual Report for the year 1997-98 which describes the activities and the achievements of National Institute of Hydrology (NIH), the premier organisation in the field of hydrology in the country. During the year there has been significant growth in the activities of the Institute which are spread all over the country through its regional centres and its strong technology transfer programme. The Institute continued to pursue studies and R&D activities in the thrust areas of hydrology with emphasis on technology transfer and demand driven research. It also continued to provide the necessary leadership and guidance for the development of hydrology in the country. The Institute has endeavoured to develop and carefully nurture a policy of description, prescription and demonstration through its advanced research programmes in various emerging areas of hydrology. The activities of NIH have received further impetus during the year by provision of additional equipment, staff and advanced training for strengthening its capabilities for field oriented studies at the regional centres.

As is well known, in view of the importance of hydrology in the assessment, development and management of the water resources of the country and to achieve excellence in hydrological research, the Government of India had set up the National Institute of Hydrology at Roorkee in the year 1978 as an autonomous society under the Ministry of Water Resources (the then Ministry of Agriculture and Irrigation). In keeping with the objectives of the Institute and the national aspirations for sustainable water resources development, the Institute through its contributions by way of basic and applied research and technology transfer, has been fulfilling its role as an apex organisation in hydrology for the last two decades.

The Institute during the year 1997-98, continued to effectively interact with and provide guidance to the various organisations in the hydrology and water resources sector in the country and provided necessary support to the state organisations on various technical matters. The Institute also interacted actively with international organisations/ experts through UNDP and World Bank aided projects.

The studies and research conducted by the Institute covered various aspects of hydrology as per the approved work programme under 18 scientific divisions at the headquarters. The six regional centres at Belgaum, Guwahati, Jammu, Kakinada, Patna and Sagar functioned effectively. There was a gradual shift to demand driven research for field oriented problems which is proving very beneficial to the scientists of the Institute and is providing an insight into real life problems. In the regional centres as well as at the headquarters, studies and research were conducted using available data and advanced computers duly supported by field investigations and laboratory analysis. With the provision of facilities like high capacity PCs, work stations and portable machines, the Institute has been involved in the advanced hydrological analysis, modelling and simulation studies. Various modern techniques for hydrological data /information gathering viz. remote sensing, nuclear techniques etc. have also been effectively utilised for technical and scientific studies. I am happy to inform that the reports of these studies are being circulated to central and state Government organisations, academic and research institutions and individual experts and have been appreciated.

It is a matter of pride that the Institute continued to pursue its objective of research in all facets of hydrology. The work of the Institute has been broadly classified into 3 categories, surface water, ground water and hydrologic observation and instrumentation. The studies and research carried out by the scientific divisions progressed well during the year and activities related to development of new procedures, software, manuals and guidelines and development of indigenous instruments for hydrologic measurements have provided useful outputs. Some of the important areas covered included - development of expert system for unit hydrograph analysis, development of software for estimation of seepage losses in a canal, reservoir sedimentation studies using remote sensing techniques, GIS based studies, hydrological studies on small watersheds, lake studies, water quality studies, glacier studies and ground water modelling studies.

It is heartening to report that studies and research work in all the six regional centres has progressed satisfactorily. I am happy to report that the office and residential buildings at Patna Centre have been occupied and the construction work at Kakinada is complete in all respects. All the centres, on the advise of the concerned states and Regional Coordination Committees took up relevant field and computer based studies as per the scheduled programme. The regional centres also continued to make available the expertise and render assistance to the states in matters related to advance hydrologic analysis and design.

I am happy to inform that the institute has also been actively involved in studies and research under sponsored and consultancy projects having emphasis on research & development component. These projects have been sponsored or referred to the Institute by various Central and State Ministries/organisations and public sector undertakings. During this year, work on nine projects which were started earlier progressed satisfactorily

Proper dissemination of research results to various users is very important. The scientists and scientific staff of the institute were encouraged to contribute technical papers to national and international journals and participate in seminars and symposia. During the year under report, 153 papers were published/accepted for publication in international and national journals and proceedings of conferences/seminars/symposia.

The United Nations Development Project (UNDP) aided project on "Development of Capabilities for Hydrological Studies in Frontal Areas" has been under operation in the institute for the last six years. It has provided assistance for developing facilities and capabilities in frontal areas of hydrology through equipment, visits of consultants, study tours by senior scientists, and training of scientists of the institute at reputed institutions abroad. The year 1997-98 being the concluding year of the project, the activities of the project progressed at a fast pace during the year. Besides procuring sophisticated equipment for the laboratories, the Institute hass also benefited by visits of 13 consultants; 10 study tours were completed; and 19 scientists of the Institute were trained abroad.

To improve India's institutional and technical capabilities to measure, collate, analyze, disseminate and use data concerned with quantities and quality of surface and ground water, including the use of data for design and hydrologic analysis, the Ministry of Water Resources had approved the Hydrology Project for peninsular India for a duration of six years (1995-96 to 2000-2001) The project aims at strengthening the sector of hydrological observations and related data by way of research, equipment, training, software etc. The Institute has been entrusted with the responsibility of training the field engineers in some areas related to

hydrology with emphasis on software for data entry and processing. During the year, two training courses were organised by the Institute at Roorkee for providing training to field engineers. The Institute has also drawn up a program for the next two years in consultation with Project Coordination Secretariat in the Ministry of Water Resources. Another major component of the Hydrology Project is to take up demand driven research projects relating to hydrological problems being faced by participating states. In this direction the Institute has prepared two project proposals dealing with : (i) Irrigation return flow for Karnataka State and (ii) Joint reservoir operation studies for Bhima for Maharashtra State. These proposals alongwith one proposal on fresh-saline water interface in coastal areas of A.P. were discussed at meetings held on 23rd January, 1998 and 10th March 1998. The project proposal 'Fresh Water - Saline Water interface in Coastal Andhra Pradesh' has been approved. It was decided that NIH and its Regional Centres would work on these projects in collaboration with the concerned organisations in the participating states.

With a view to pursue its objective of promoting hydrological activities and applications in the country, the Institute has been actively involved in transfer of advanced methods and techniques to the field organisations by organising short duration workshops on various topics of hydrology at Roorkee and in the States. The emphasis has been to impart training to field engineers and hydrologists, in use of appropriate methodologies involving the use of computers and the software for the advanced techniques of hydrological analysis and modelling used/developed at the Institute. During the year, 5 workshops were organised at Roorkee and 3 workshops were held in various States.

There has been significant expansion in infrastructural facilities in the form of buildings, equipment etc. during the year. The Institute procured number of high speed, large memory computers for enhancing the capabilities for scientific work. The construction work at the staff colony and the campus of the Institute at Roorkee have progressed satisfactorily and number of residential quarters in the colony and the second laboratory block (Wing C) in the campus were completed. M/s National Project Construction Corporation Ltd have been entrusted with the construction of an Auditorium with a seating capacity of 350. The work of the Auditorium which was started in 1997 is expected to be completed in year 1999.

In order to achieve the objectives of the Institute namely to undertake, aid, promote and coordinate studies in various aspects of hydrology, the scientists and staff of the Institute have strived hard. It is the institute's endeavour to further strengthen and consolidate the achievements to take up appropriate studies and research as well as other activities under the directions and guidance of Technical Advisory Committee, the Governing Body and the Society of National Institute of Hydrology. The Institute fully supports the policy that scientific and technological research must contribute more effectively to national prosperity and to improvements in quality of life.

The Institute is already well advanced in field of R&D in hydrology and realises that the task of hydrology and water resources management is not only to study and point out deficits, failure and damages with specific environmental or socio-economic side effects, but also to develop the techniques/methods which allow to mitigate current and likely future problems in these fields.Accordingly, the Institute is striving hard for effectively contributing for solution of water related problems and for sustainable water resources development, by acquiring and developing special knowledge and expertise and disseminating it to concerned organisations.

While presenting the previous annual reports, I had mentioned of fond hope of all employees that the Institute will continue to rise to higher levels of achievements, I am happy to say that this year's progress has been quite satisfying. I am sure that this report would provide a good glimpse of the working of the Institute and the contributions made by it in the field of hydrology during the year and hope that the Institute will continue to attain higher levels of achievements in the years to come.

(S M Seth)
DIRECTOR

Performance During the Year at a Glance

- In pursuance of the objectives laid down while setting up the Institute and keeping in view the National Water Policy the Institute has carried out a number of studies with the aim of conducting basic and applied research in hydrology.
- These studies and research were carried out under the eighteen scientific divisions at Roorkee and at six Regional Centres as per work programme approved by the Technical Advisory Committee and Regional Coordination Committees respectively.
- The Institute has prepared number of user friendly, interactive software packages.
- Some new procedures for hydrological analysis were developed by the Institute. These procedures are being applied for seeking solutions of real life problems.
- The scientists and staff of the Institute were encouraged to publish their research findings and fifty six papers were published in national and international journals and 21 papers have been accepted for publication.
- 76 papers prepared by scientists and other scientific staff have been included in the Proceedings of national and international conferences/seminars/symposia.
- As part of technology transfer programme 8 workshops were organised at Roorkee and in states wherein about 146 engineers and scientists were trained on computer oriented approach for analysis in specialised areas of hydrology.
- The work continued on 9 Consultancy/sponsored projects during the year.
- Laboratories at Headquarters and Regional Centres were strengthened by procuring equipment through UNDP Project and Institute funds received under Government of India grants. These equipment are being used for carrying out various laboratory/field oriented studies as per work programme.
- 19 scientists were trained abroad under UNDP project and 13 consultants visited the Institute and its Regional Centres. Besides these 10 study tours were completed.
- The Institute has organised a Brain Storming Session on "Hydrological Problems of Coastal Regions" at Chennai.
- The studies and research carried out by the Institute have received national and international recognition.
- The Institute actively participated in Hydrology Project taken up by Government of India. The Institute is the nodal agency for providing training to field engineers and is responsible for training of trainers. During the year, 2 training courses were organised under the project.
- The office building and other works at the Eastern Deltaic Regional Centre, Kakinada were completed during the year. The office building at Ganga Plains North Regional Centre, Patna was occupied during the year.
- The construction of third wing of second Laboratory Block was completed and it is ready for occupation.
- The staff colony of the Institute being constructed on Roorkee-Hardwar road is progressing well and drainage, water supply, internal roads and 80 residences have been completed.

1.0 Introduction

1.1 General

The National Institute of Hydrology has been functioning as a premier Institute in the area of hydrology in the country since December 1978. It was established with Headquarters at Roorkee by the Government of India as an autonomous society aided by the Ministry of Water Resources, Government of India.

The NIH Society is headed by Union Minister for Water Resources as its President and the Union Minister of State for Water Resources as its Vice-President. The Ministers-in-charge of Irrigation in the States (for ten States to be nominated for every three years by the President of the Society), the Secretaries of different Ministries in the Govt. of India concerned with water and related areas; and experts in hydrology and water resources are members of the Society. The membership of Society is 47 including the President and it reviews the progress and performance of the Institute in its meeting held atleast once a year. The Society has a Governing Body with a total membership of 14 including the Secretary, Ministry of Water Resources, Govt.of India as the Chairman. The Governing Body looks over the administration, performance and utilisation of funds of the Society by drawing annual and supplementary budgets; allocate funds for various purposes and determine agreements with other organisations either in India or foreign for joint endeavours. The Institute's research and other technical activities are monitored and guided by the Technical Advisory Committee (TAC) with 15 members including the Chairman, Central Water Commission as its Chairman.

Keeping in view the need to deal with the specific hydrological problems of different regions of the country and for providing effective interaction at field level with the states, the Institute started setting up Regional Centres from 1987 onwards. The Regional Centres for Hard Rock region, North Eastern region and Western Himalayan region were established at Belgaum, Guwahati and Jammu respectively during the seventh five year plan period (1985-1990). In 1991, under eighth five year plan scheme one Regional Centre for Ganga Plains at Patna in Bihar and one for Deltaic and East Coast region at Kakinada in Andhra Pradesh were set up. One more Centre for Ganga Plains at Sagar in Madhya Pradesh was set-up in December 1995.

Keeping in view the requirements for hydrological research and studies in the country for a period of five years, the TAC and Governing body of NIH had approved the areas of study and research for the Institute for the IXth plan period (1997-2002). The annual programmes are formulated and considered by the working groups and the TAC.

Director of the Institute is the Principal Executive Officer of the Society, and is appointed by the Government of India. The staff of the Institute comprises of scientists, supporting scientific & technical staff and administrative staff. The Institute has highly qualified scientists in various areas of hydrology and water resources. Out of the 77 scientists in position in the Institute and its regional centres, as on 31.3.1998, 21 have Ph.D degree and 56 have ME/M.Tech. degree.

1.2 Objectives

The National Institute of Hydrology has been established with the following main objectives :

i. to undertake, aid, promote and coordinate systematic and scientific work in all aspects of hydrology;

ii. to cooperate and collaborate with other national, foreign and international organisations in the field of hydrology;

iii. to establish and maintain a research and reference library in pursuance of the objectives of the society and equip the same with books, reviews, magazines 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 objectives for which the Institute has been established.

As per the guidelines given to NIH, the time devoted for basic and applied research activities should be atleast 60%, while for the sponsored research and consultancy activities not more than 20% and technology transfer activities not more than 20% of the total time of scientists and scientific staff should be normally used.

1.3 Activities During the Year

The Institute's activities are mainly focused in its Headquarters and its 6 Regional Centres. During the year, the scientists and scientific staff of the Institute have published large number of technical papers in international and national journals, and proceedings of international and national conferences and symposia. Reports on studies and research covering several topics including identified thrust areas in hydrology have been prepared.

The development of automated hydrological instruments with indigenously available components and systems is under progress. The instruments developed by the Institute are being tested under field conditions at Dhanaulti (UP); Tehri (UP); and Shimla (HP) and their performance is being evaluated for further improvements.

Under the technology transfer programme besides publication and circulation of technical reports, the Institute organises five day workshops on different topics relevant to field engineers. During the year, the Institute has organised 8 workshops on Urban Hydrology; Hydrological Data Processing and Analysis for Mountainous Catchments, New Approaches to Water Management towards Sustainable Solutions; Hydrological Instrumentation; Catchment Hydrology; Coastal Hydrology; Basic Computer Skills; Application of Remote Sensing and GIS Techniques in Hydrology, etc.. These workshops were organised at Roorkee and in various States.

The Institute is also assisting several organisations in the country for solving various complex and typical field problems through sponsored projects and consultancy projects. During the year 1997-98, the work has been continuing on 9 ongoing projects. Besides this, the Institute also completed 5 sponsored projects which were taken up in earlier years.

Under the aegis of the Indian National Committee on Hydrology and with a view to disseminate hydrological knowledge in the country, the Institute brings out State-of-Art reports in emerging and thrust areas of hydrology. These reports contributed by national experts are released on different occasions and are received by the hydrologic community with great interest. These reports are being circulated in India and abroad.

The UNDP funded project on "Development of Capabilities for Hydrological Studies in Frontal Areas" was started in the year 1991 and all activities under the project are scheduled to be completed in first half of 1998 and project would be over in 1998. The Project had mainly four components - training of scientists, study tours by senior scientists, visit of consultants and procurement of equipment. The progress on all the four components was as per schedule and 19 scientists were sent for training abroad and 10 study tour visits were undertaken by senior scientists, and 13 consultants visited the Institute during the year under report.

The Hydrology Project for Peninsular rivers of India was finalised by Ministry of Water Resources for funding by the World Bank. The Institute has been entrusted with the responsibility of training the field engineers which is one of the important components of the project. The project is being implemented by five Central Govt. organisations and Irrigation Departments of eight Peninsular States. During the year 1997-98 a two-weeks Training Course in the area of "Basic Computer Skills" was organised which was attended by 11 trainees. The Institute also organised a One Week Course on "Application of Remote Sensing

and GIS Techniques in Hydrology" during March 2-7, 1998 which was attended by 24 trainees.

The Institute has in general, carried out various activities with the objectives of effectively contributing to water sector in the country through basic and applied research in various areas of hydrology. The progress made during the year 1997-98 on various ongoing and newly initiated projects, and a brief account of academic and other activities alongwith the statement of accounts is presented in the following sections.

2.0 Committees and their Activities

2.1 Society

The National Institute of Hydrology Society is the apex body of the Institute and meets at least once a year. It reviews the progress and performance of the Institute and gives such directions as it may deem fit to the Governing Body and the Institute towards the attainment of the objectives enunciated in the Memorandum of Association of the Society. The membership of the Society as revised in 1997 is given in Appendix I.

The 18th Annual General Meeting of the Society was held at New Delhi on 9th December 1997. The Society reviewed the work carried out by the Institute during 1997-98 (upto Nov. 1997), approved the annual report and audited accounts for the year 1996-97 and approved the budget for the year 1998-99.

2.2 Governing Body

The Governing Body is the executive body of the Institute which is responsible to pursue and carry out the activities as per objectives laid down by the Society. The Governing Body exercises all executive and financial powers of the Society. The Governing Body is expected to meet at least twice in a financial year. The membership of the Governing Body as revised in March 1996 is given in Appendix II.

During the year 1997-98, the 51st and 52nd meetings of the Governing Body were held at New Delhi on; 17th November 1997 and 27 March 1998 respectively. Several decisions relating to administrative and financial matters of the Institute were taken. Annual report and audited accounts for the year 1996-97 were considered and recommended for approval by the NIH Society. The revised budget for 1997-98 and budget proposals for 1998-99 were also considered and recommended for consideration by the Society.

2.3 Standing Committee

The Governing Body has constituted a Standing Committee under the Chairmanship of the Additional Secretary (Water Resources), Government of India, to consider the financial and administrative matters pertaining to NIH. The Standing Committee has the powers to approve the matters referred to it by the Governing Body on behalf of the Governing Body and the decisions of the committee are reported to the Governing Body.

2.4 Coordination Committee with University of Roorkee

To ensure effective coordination between the Institute and the University of Roorkee, a Coordination Committee has been constituted. This committee besides ensuring effective coordination also recommends the ways for increasing interaction between the two organisations so that the facilities and expertise of both organisations is optimally utilized. During the year no meeting of the Committee was held. The 21st meeting of the Coordination Committee is scheduled to be held during July 1998.

2.5 Technical Advisory Committee

The Technical Advisory Committee (TAC) carries out technical scrutiny of research programmes of the Institute and recommends priorities. It is also responsible for carrying out technical scrutiny of plans drawn up for five years and the individual schemes submitted for external assistance and expansion of the Institute. The constitution of TAC, as revised in March 1996 is given in Appendix III.

The 37th meeting of TAC was held on September 26, 1997 at NIH, Roorkee. In this meeting, the priority of the thrust areas of studies and research to be taken up during the IX plan was recommended. The meeting also recommended the general work programme to be carried out by the scientific divisions during the IX plan period. The specific work programme for the year 1997-98 was also discussed and finalised by the Committee in the meeting.

The 38th meeting of TAC was held on March 17, 1998 in Sewa Bhavan, Central Water Commission, New Delhi. The Committee reviewed the progress of the work programme for the year 1997-98 and recommended the specific work programme for the year 1998-99. The Committee also reviewed the Institute's participation in the R&D studies under the Hydrology Project.

2.6 Working Groups

The Working Groups consider and advise the Institute on the programme of studies to be taken up by the various scientific divisions and review the progress of work. The reports prepared by the divisions in various areas of hydrology are sent to the concerned Working Group members and other experts for their comments and suggestions and after suitable inclusion of these suggestions, the reports are printed and circulated to user agencies as well as academic and research organisations.

There are three Working Groups for the Institute namely

(i) Surface Water Group which deals with the following divisions :

Surface Water Analysis and Modelling, Flood Studies, Hydrologic Design, Mountain Hydrology, Atmospheric Land Surface Process Modelling, Watershed Development, and Water Resources System divisions.

(ii) The Groundwater Working Group deals with :

Groundwater Assessment, Groundwater Modelling and Conjunctive Use, Drainage, Drought Studies, Environmental Hydrology and Lake Hydrology divisions.

(iii) The Hydrological Observation and Instrumentation Working Group deals with :

Hydrological Investigations, Hydrological Information System, Nuclear Hydrology, Hydrological Instrumentation and Remote Sensing Application divisions.

Experts in specialised fields from various field organisations (from Central and State Governments) and academic and research institutions are members of the Working Groups. The constitution of the three Working Groups is given in Appendix IV.

The 7th meeting of the Working Groups for

(a) Surface Water Group;

(b) Hydrological Observation and Instrumentation; and

(c) Ground Water Group of Divisions were held on May 12, 1997; May 14, 1997 and May 16, 1997 respectively at Roorkee.

The 8th meetings of the Working Groups for

(a) Ground Water Group;

(b) Hydrological Observation and Instrumentation Group; and

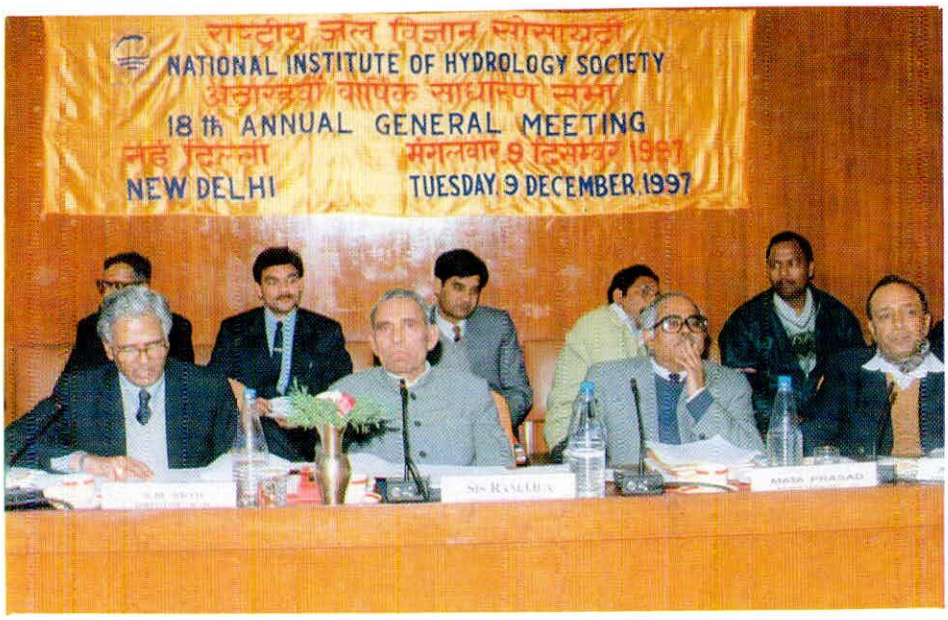
(c) Surface Water Group of Divisions were held on February 24, 1998; February 26, 1998 and February 27, 1998 respectively at Roorkee.

During these meetings each Working Group reviewed the progress of studies and research under the work programme for the year 1997-98 for the scientific divisions under the group, scrutinised the work programme of the Institute for the year 1998-99 and made recommendations for consideration/ approval by the Technical Advisory Committee.

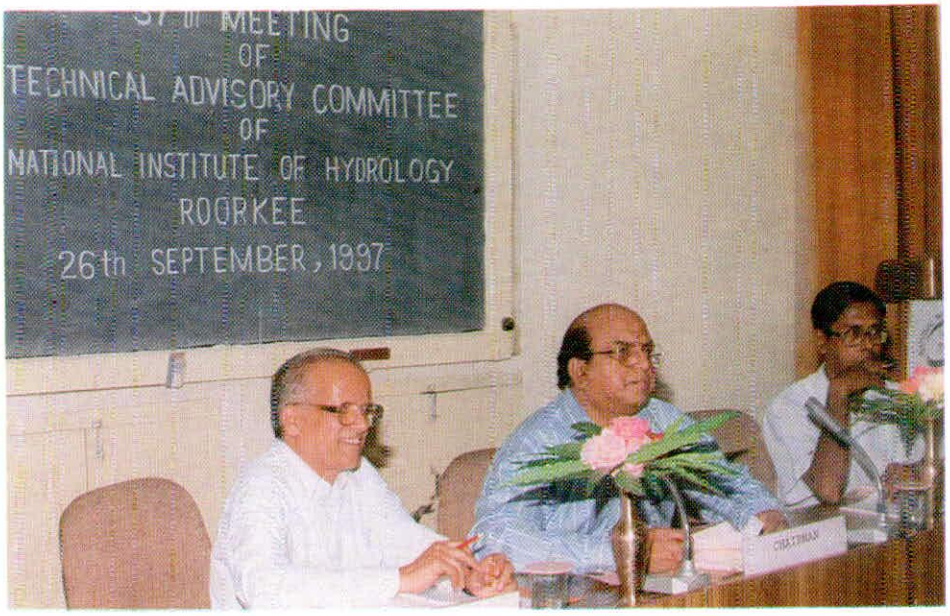
2.7 Regional Coordination Committees

To ensure effective coordination between the regional centre and the various academic and field organisations in the region who are engaged in water resources research and development and to advise the regional centre in all technical and scientific matters, the Society has approved constitution of a Regional Coordination Committee for each Regional Centre. The Regional Coordination Committee also examines the proposals for diversification of activities of the Centre.

Regional Coordination Committees for each of the six Regional Centres of the Institute at Belgaum, Guwahati, Jammu, Kakinada, Patna and Sagar have been constituted. Experts from field organisations and academic Institutes of the region covered by the Regional Centre are members of the



EIGHTEENTH ANNUAL GENERAL MEETING OF NIH SOCIETY IN PROGRESS



CHAIRMAN, CENTRAL WATER COMMISSION CHAIRING THE 37TH MEETING OF TECHNICAL ADVISORY COMMITTEE OF NIH

Regional Coordination Committees with Director, NIH as its Chairman. The membership of the 6 Regional Coordination Committees is given in Appendix V.

The 9th meeting of Regional Coordination Committee (RCC) for Deccan Hard Rock Regional Centre,Belgaum was held on November 11, 1997 at Ground Water Survey and Development Agency, Pune. The 8th meeting of RCC for Deltaic Regional Centre at Kakinada was held on November 19, 1997 at Indian Institute of Technology, Chennai. The 1st meeting of RCC for Ganga Plains South Regional Centre at Sagar was held on January 23, 1998 at Sagar. The meetings of RCCs of Guwahati, Jammu and Patna could not be held, however the work programmes for the year 1997-98 were got approved by circulation.

2.8 Indian National Committee on Hydrology (INCOH)

The Indian National Committee on Hydrology (INCOH) was constituted by the Ministry of Water Resources in the year 1982. It is an apex body with the responsibility of coordinating the various activities concerning hydrology in the country. The committee has Chairman, Central Water Commission as its Chairman with members drawn from Central, and State Governments as well as experts from academic and research organisations besides a few members drawn from non-governmental professional associations. The committee gets a feed back from states and coordinates activities at state level through state coordinators. The Secretariate of INCOH is with NIH. The committee has successfully fulfilled its role and made important contributions for hydrological activities in the country during the past 16 years.

The committee has two expert panels on

(i) Surface Water & Water Resources System and

(ii) Ground Water including Water Quality.

These panels assist the National Committee in preparation of state-of-art reports in thrust areas of research in hydrology and in identifying thrust areas of research for taking up systematic studies under Grant-in-aid scheme of MOWR.

The INCOH has three sub-committees namely

(i) Editorial Advisory Board for Publications of INCOH,

(ii) Steering Committee for providing support to seminars, courses and workshops, and

(iii) Research Committee for initiating, considering, coordination and monitoring of research schemes of MOWR.

The INCOH normally meets twice in a year. The meetings of each panel and sub-committee also take place twice a year. In all there are about 10 meetings a year. During the year 1997-98, the INCOH held one meeting on September 26, 1997 at Roorkee, and took important decisions regarding coordination of hydrological activities in the country. In this meeting, the progress of on-going research projects was also discussed.

The Committee sponsored 13 seminars/ symposia during the year. Out of these, 5 activities were of international nature. The Eighth National Symposium on Hydrology with the focal theme of "Coastal Hydrology" was organised at Calcutta during 11-12 April 1997. One meeting of Research Committee was held on September 24, 1997 wherein decisions were taken to recommend the research projects for funding by Ministry of Water Resources. Two state-of-art reports were prepared and are under print.

Regarding India's participation in IHP-V, Director, NIH visited Unesco Paris to attend the meeting of Unesco Working Group on IHP-V "Project 5.1: Hydrological Processes in Arid and Semi-Arid Zones" at Unesco Paris on April 13-17, 1997. The work areas have been identified with their leading/supporting organisations. The proposed programs constitutes a framework for applied research and education in the field of hydrology and water management. It is a dynamic concept whose aim is to improve links between research, application and education and to promote scientific and educational activities within the framework outlines in the IHP-V document.

2.9 Asian Regional Coordinating Committee on Hydrology (ARCCOH)

Among various recommendations made at the meeting of the IHP National Committee of North, East, Central and South Asia in 1977, it was resolved that a committee at Asia level, to be named as Asian Regional Coordinating Committee on Hydrology (ARCCOH), be formed for ensuring regional cooperation within the framework of the

IHP/UNESCO. It was also resolved that Government of India be requested to provide secretariat to ARCCOH. Upon such a request from the UNESCO, the Government of India agreed to provide secretariat to ARCCOH through secretariat of the Indian National Committee for IHP, now named as the Indian National Committee on Hydrology (INCOH) with secretariate at NIH.

The Secretariate has been bringing out a quarterly newsletter for the last 10 years. The newsletter includes the news concerning the hydrological activities in the region and also includes the activities performed by the member countries. The newsletter also carries information about the various International Conferences/ Seminars/Symposia and Courses etc. To a limited extent new developments and new publications brought out in hydrology are also listed. The newsletter is circulated to all the member countries in the region (Indonesia, Japan, The Republic of Korea, Democratic People's Republic of Korea, China, Malaysia, Papua New Guinea, Philippines, Thailand, Bangladesh, Burma, Afghanistan, Islamic Republic of Iran, Republic of Maldives, India, Nepal, Mongolia, Sri Lanka, Pakistan, Bhutan,) and to about 600 other organisations in the country and abroad. Besides bringing out of the newsletter, the committee also interacts with UNESCO for Major Regional Projects and other related activities. The activities of ARCCOH Secretariat progressed satisfactorily during the year 1997-98.

3.0 Research and Development Activities

Keeping in view the needs of water sector, and as per the discussions in various meetings the following thrust areas/ specific problems are to be taken up by the Institute for R&D activities during the Ninth Plan period :

- Disaster studies including droughts and floods
- Reservoir operation and real time forecasting
- Lake and reservoir sedimentation studies
- Watershed development studies
- Snow and glacier studies
- Hydrologic modelling (surface water, ground water, and water quality)
- Water yield (surface water and ground water)
- Water balance
- Conjunctive use of surface and ground water
- Artificial recharge and water conservation
- Urban hydrology
- Risk based hydrological design including dam break problems
- Optimization and simulation studies for water resources planning and management
- Hydrological instrumentation & hydrological data processing
- Impact of environment/climate change on hydrological parameters
- Waterlogging and drainage (surface water and ground water)
- Hydrodynamics and hydrochemistry of water bodies
- Hydrological soil classification and soil erosion
- Investigation for project planning including remote sensing and GIS techniques
- Investigation for ground water prospecting including nuclear techniques
- Geomorphological studies

3.1 Scientific Activities

During the year under report, studies and research were carried out under the 18 problem oriented scientific divisions at the Headquarters, Roorkee and at the six Regional Centres of the Institute. The 18 Scientific Divisions are :

- Hydrologic Design
- Surface Water Analysis and Modelling
- Flood Studies
- Mountain Hydrology
- Ground Water Assessment
- Ground Water Modelling and Conjunctive Use
- Drought Studies
- Drainage
- Water Resources System
- Environmental Hydrology
- Atmospheric Land Surface Process Modelling
- Lake Hydrology
- Nuclear Hydrology
- Hydrological Investigations
- Hydrological Instrumentation
- Hydrological Information System
- Remote Sensing Applications
- Watershed Hydrology

The programme of studies and research as proposed by the Institute for each of the divisions for the year 1997-98 was considered by the working groups and approved by the TAC.

Brief description of some of the important studies is given below :

1. Watershed Modelling with GIS Based Distributed Unit Hydrograph Approach

In this study a spatially distributed unit hydrograph for Temur watershed at railway bridge no.293 was developed.The method for distributed unit hydrograph computation allows for spatial non-uniformity of excess rainfall. Consequently, it is based on the time-area method derived using GIS. The GIS allows development of a watershed's channel network for calculation of realistic travel times, it handles the distributed excess rainfall in calculating local surface runoff rate as inputs for channel flow and it compiles the time-area diagram from which distributed unit hydrograph is derived. Simulation results shows that the errors between observed and simulated peak discharge are from -5.8% to 22.1% which is well within acceptable limits for designing small structures on this stream. However, the errors between observed and simulated time to peak is large compared to errors in peak discharge simulation. Graphical comparison of observed and simulated discharge shows that the rising limb of computed hydrograph match well with rising limb of observed hydrograph in all cases, however, the recession shape of observed and simulated hydrograph do not match very well. This could be attributed to the fact that a very simple method for velocity simulation was used and no calibration of parameters has been performed. Also a pure translation model is used in this study which could be responsible for lack of agreement in the shape of hydrograph. As can be seen from topographic map of the catchment, the catchment is having mild slopes in majority of area and there is every likelihood of storage effects due to this mild slope.

From this study it can be concluded that the method works well for simulation of peak discharge. However, for overall shape and time to peak discharge simulation, further refinements in the method are required. It is, therefore, appropriate to simulate this catchment with model which take both translation and storage effects into consideration.

2. Soil Erosion and Sediment Yield Modelling Using Kinematic Wave in GIS Environment

GIS techniques have been utilized for spatial discretization of a catchment in to time-area segments to be used in numerical solutions of the governing differential equations for rainfall-runoff-erosion process. Various thematic layers such as soil, land use, slope, flow direction, DEM were generated for the Karso catchment using various tools available in GIS. These thematic layers were further utilized to generate attribute information such as Manning's n, USLE K and C parameters for use in rainfall-runoff-soil erosion model. Based on DEM and related attributed information of the catchment, time-area map of the catchment was prepared and used for spatial discretization of the catchment.

Rainfall abstraction has been carried out by phi-index method.The excess rainfall falling on each of the time-area segments was routed to outlet using numerical solutions of kinematic wave equation using fully implicit four-point finite difference scheme. The sediment yield has been estimated by solving sediment continuity equation using fully implicit finite difference scheme. Comparison of results indicated applicability of this modelling concept for Karso catchment.

3. Estimation of Evaporation Losses from Water Surface - A Study of Tawa Reservoir

This study has been taken to assess the adaptability of different methods for estimation of evaporation from free water surfaces in semi-arid areas. The data of Tawa reservoir have been used. The estimates of evaporation from free water surface obtained by four methods namely Penman, Kohler, Van Bavel and Morton were compared with observed pan evaporation values on monthly, seasonal and annual basis. The estimates of the mean value of evaporation in winter months were found to be lower than those of corrected pan evaporation using pan coefficient values, whereas in spring and summer season differences were comparatively less and estimates were closer to pan values. All the methods gave comparable estimates of evaporation for spring and summer months.The comparison of monthly values indicated that the estimates of evaporation by both Kohler and Morton methods gave better correlation with corrected pan values for all the months. Also on the basis of comparison of annual

values, the results of both Kohler and Morton methods were in good agreement with pan evaporation values as compared to Penman and Van Bavel models.

The Institute had earlier conducted studies for the Malaprabha and the Bargi reservoir sites wherein more or less similar results as that of the Tawa reservoir site were obtained. It may be concluded that both Kohler and Morton methods are reasonably reliable approaches for estimation of evaporation from reservoirs and lakes in semi arid areas. However, the coefficients used for adjusting pan evaporation to lake are tentative and need confirmation by further studies for more sites.

4. Regional Flood Frequency Analysis Using L Moments

Whenever, rainfall or river flow records are not available at or near the site of interest, it is difficult for engineers to derive reliable flood estimates. In such a situation, regional flood frequency relationships or the flood formulae developed for the region are the alternative methods for estimation of design floods, specially for small to medium catchments. L-moments of a random variable were first introduced in the year 1996, L-moments are defined as linear combinations of the Probability Weighted Moments (PWMs). L-moments are analogous to conventional moments, but are estimated as linear combinations of order statics. In a wide range of hydrologic applications, L-moments provide simple and efficient estimators of characteristics of hydrologic data and of a distribution's parameters. Both goodness-of-fit analysis and L-moments ratio diagram analysis indicates that the three-parameter General Extreme Value (GEV) distribution is suitable for flood frequency analysis while the two-parameter Gumbel distribution is not.

In the present study, regional flood frequency curves were developed by fitting L-moments based General Extreme Value (GEV) distribution to annual maximum peak flood data of small to medium size catchments of the seven hydrometeorological subzones of zone 3 and combined zone 3 of India. These seven subzones cover an area of about 10, 41, 661 sq. km. Effect of regional heterogeneity was studied by comparing the growth factors of various subzones and combined zone 3. Relationships developed between mean annual peak flood and catchment area were coupled with the respective regional flood frequency curves for derivation of the regional flood formulae. The regional flood frequency curves developed for each subzone together with at site mean annual peak floods may be used for gauged catchments; while for ungauged catchments, regional flood formulae developed for the respective subzones may be used for obtaining rational estimates of design flood of specific return period.

5. Sensitivity of Design Parameters on Flood Hydrograph

Design flood is an important parameter for safe and efficient design of a water resources project. The procedures based on hydrometeorological approach need input of unit hydrograph and design storm appropriate to the catchment location, shape and size. The Standard Project Storm/Probable Maximum Storm (SPS/PMS) depth obtained are in the form of accumulated amounts of the given durations. These are to be arranged in some chronological pattern of rainfall increments characterising severe storms which have occurred in a catchment in producing maximum probable peak flood for the involved rainfall amount. The incremental rainfall is so arranged that the maximum rainfall increment is placed against the maximum ordinate of unit hydrograph and so on. This sequence of rainfall magnitudes is then reversed for obtaining the critical sequence over the entire design rainfall duration in one bell shape for convoluting with the unit hydrograph. In general, it is observed that maximum duration of a severe spell of rainfall possible within severe most long duration storms is of the order of 10-15 hours. The arrangement of rainfall in one bell is aimed at arriving at the maximum possible peak for the given volume of rainfall excess. Such an extreme possibility of rainfall occurrence in one spell of three days or the duration of design storm is not characteristic of the nature of rainfall and results in higher design flood peaks. Broadly, it can be approximated to one or two bells per day but not over the full period of the long duration storms of high intensity. It is reasonable to consider this aspect in design flood since it is closer to the meteorologic reality. In this study, sensitivity of one or more than one bells per day and other design parameters on flood hydrograph characteristics have been studied.

6. Development of Expert System for Unit Hydrograph Analysis

This report is in the form of a user manual of UHYDEX, an expert system for selection of the most appropriate model for unit hydrograph derivation of a given catchment. The report provides a brief review of expert systems technology and various existing expert systems in surface water analysis and modelling area. It is seen that some expert systems have been developed for selection of suitable models for evapotranspiration estimation and flow measurement in open channels, calibration of various available models such as HSPF (model for hydrological aspects of a watershed); SRM (snowmelt runoff model) and SWMM (storm water management model). However, an expert system is not available for the selection of a suitable model for unit hydrograph analysis.

Keeping this in view, the expert system, UHYDEX has been developed using the shell exsys. It has two separate modules. One for gauged catchments and the other for the ungauged catchments. For the gauged catchments the models considered for UH derivation are conventional method; Collin's method; conventional Nash model; integer Nash model and Clark model. There are many more models available in the literature but as a first exercise, only these commonly used methods/models are selected because their programs are available. Moreover, these FORTRAN programs are interfaced with the rules of the knowledge base so that the ES will make the selection of an appropriate model for UH derivation and will also derive the unit hydrograph for the user for a given catchment. For the ungauged catchments, the Snyder's approach and the regional relationships developed by CWC which are used for the unit hydrograph derivation have been included.

7. Study of Impact of Periodicity in Rainfall Records on the Water Availability Estimates

Long term runoff record is frequency needed for planning, design and operation of reservoirs, for irrigation and water supply, hydropower generation, flood control etc. At most of the Indian sites longer series of runoff is generally not available and the longer time series available from different sites within the similar climatologic regions are rarely coincident in time and may represent different sequence of dry and wet climatic conditions. The shorter length of data apart from other problems, always faces the problem of true representation of periodicity in time series viz. the representation of wet and dry spells.

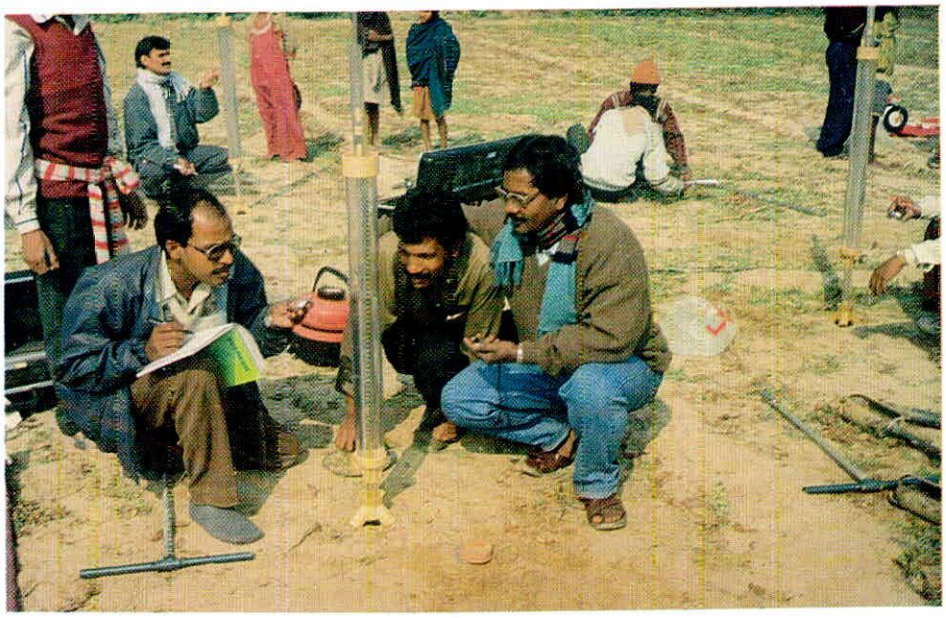
In the absence of availability of sufficient length of recorded runoff series, the best suited alternative is to develop a suitable rainfall-runoff relationship for the basin and then to generate the long term runoff series based on available rainfall series, particularly when the principal aim is to decide the feasibility and storage requirement of a water resources project. For many water resource estimation purposes, a monthly time-step model with relatively low spatial structure may be adequate. In India, monthly time series of runoff is frequency used as a basis for water resource development and management.

This study examines the effect of periodicity in the rainfall records on the water availability of a basin. Based on the rainfall-runoff record of a shorter period, runoff series for a long period has been developed using a water balance model. Percent deviation in water availability as computed using a short term wet or dry record to that of complete record has also been examined. Effect of length of time series on the water availability is also studied.

It is found that a minimum of seven to ten years of record is needed for estimation of water availability on a monthly scale and the effect of wet and dry spells play a crucial role in the determination of water availability.

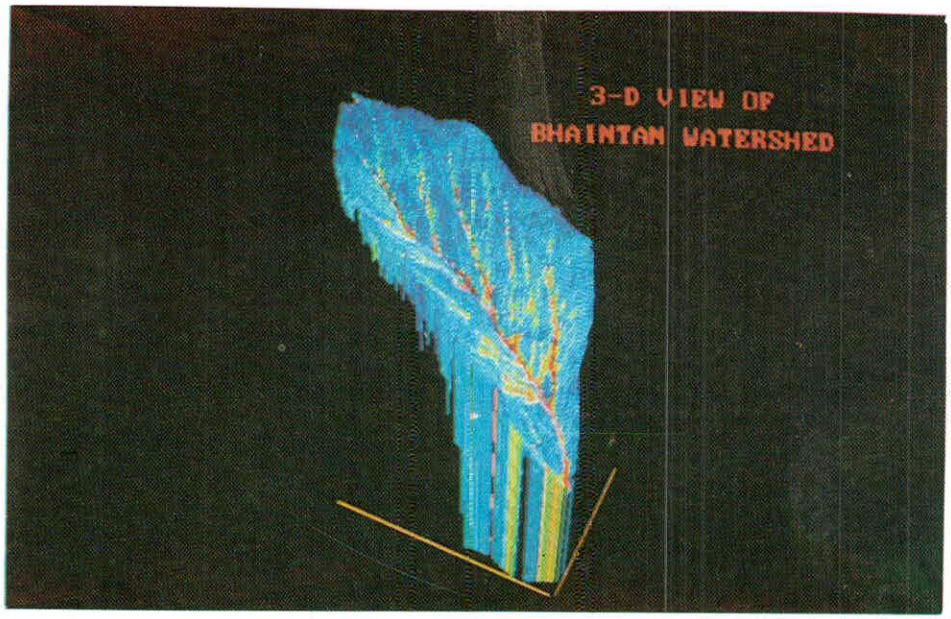
8. Sensitivity Analysis of Melt Runoff due to Temperature and Precipitation

In this study the effect of climate change on snow water equivalent, snowmelt runoff, glacier melt runoff and total streamflow and their distribution has been examined for the Spiti river. Spiti is a high altitude Himalayan river located in the Western Himalayan region and total streamflow of this river has a significant contribution from snow and glacier melt runoff. Plausible hypothetical scenarios of the temperature and precipitation changes based on the simulation of climate change over Indian sub continent by Hamburg climate model were adopted in the present study. The UBC Watershed Model was used to simulate the hydrological response of the basin under changed climatic scenarios. The adopted changes in temperature and precipitation covered a range from 1 to 3°C and -10 to +10%, respectively.

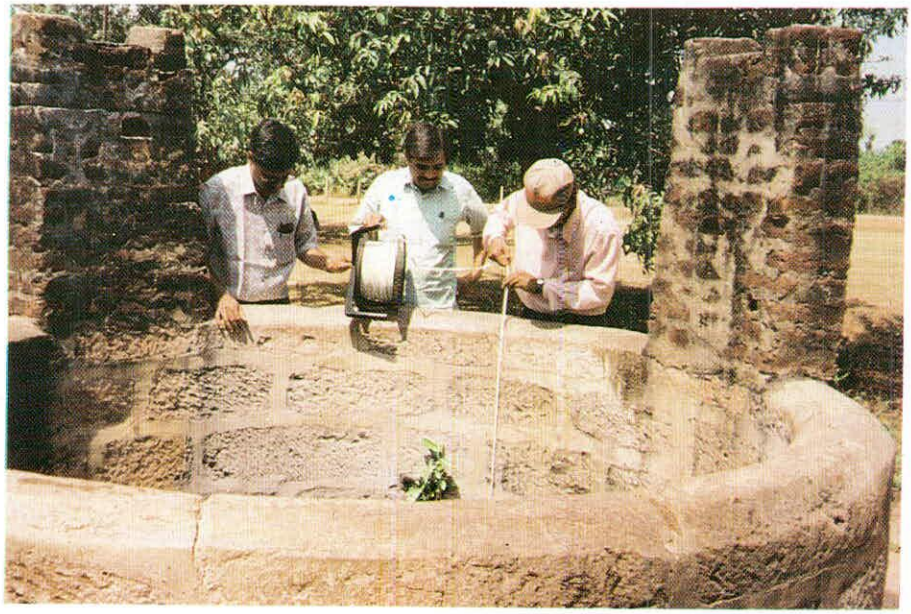


INSITU SATURATED HYDRAULIC CONDUCTIVITY MEASUREMENT BY GUELPH PERMEAMETER IN ARSENIC EFFECTED AREA AT KALYANI (CALCUTTA)

GUELPH PERMEAMETER BEING USED IN THE FIELD



3-D VIEW OF BHAINTAN WATERSHED IN TEHRI GARHWAL ,U.P.



WATER LEVEL OBSERVATIONS IN SUDDAGEDDA REPRESENTATIVE BASIN (ANDHRA PRADESH)

Snow water equivalent generally reduces with an increase in air temperature. However, no significant change is found in the snow water equivalent of the Spiti basin by the projected increase in air temperature (T+1 to T+3°C). An increase of 2°C in air temperature reduced annual snow water equivalent in the range of 1 to 7%. Changes in precipitation results in increased proportional changes in snow water equivalent. It was found that annual snowmelt runoff, glacier melt runoff and total streamflow increase linearly with changes in temperature (1-3°C), but most prominent effect of increase in temperature has been noticed on glacier melt runoff for this high altitude basin. For example an increase of 2°C in air temperature has enhanced annual snowmelt runoff, glacier melt runoff, and total streamflow in the range of 4-18%, 33-38% and 6-12%, respectively. The effect of change in precipitation (P-10 to P+10%) results in a linear increase in snowmelt runoff and total streamflow, while in general, glacier melt runoff is inversely related to changes in precipitation. Snowmelt runoff is found more sensitive than glacier melt runoff to changes in precipitation (P-10 to P+10%). Under a warmer climate scenario, snowmelt runoff and glacier melt runoff cause an earlier response of total streamflow and change in flow distribution. The seasonal analysis of total streamflow indicated that an increase in air temperature produces an increase in the pre-monsoon season (April-June) which is followed by an increase in streamflow in the monsoon season (July-September). Implications of such seasonal changes are also discussed in brief.

9. Temporal Distribution of Glacial Melt Runoff of Dokriani Glacier and its Relationship with Meteorological Parameters

The Institute is involved in carrying out detailed hydrological study of Dokriani glacier including determination of total melt water yield from this glacier and its distribution with time. It involves collection of the meteorological and hydrological data near the snout of the glacier for a period of last three years during summer period. A standard hydrometeorological observatory equipped to monitor all important meteorological parameters with raingauges, evaporimeter, thermograph, hydrograph, anemometer, wind vane and sunshine recorder has been set up at about 4000m altitude. For continuous monitoring of glacier melt runoff an automatic water level recorder was installed in the year 1995 at the gauging site near the snout. Suspended sediment samples are also collected at specified timings. Storage and drainage characteristics of the glacier have been studied and are found to be very peculiar which produce a delaying effect on runoff generation. The melt water yield from the glacier and its distribution with time have been studied. Suitable relationships between glacier melt runoff and meteorological parameters are being developed.

10. Assessment of Irrigation Return Flow

Irrigation return flow is one of the most significant components in the water balance of irrigation command areas. A part of the water applied to irrigated fields percolates deep to recharge the ground water. This part is known as irrigation return flow. In absence of any studies, irrigation return flow is usually taken as 35% of the water applied for irrigation in case of canal irrigation and 30% in case of irrigation from ground water. But this is only an approximate estimate. Scientifically the irrigation return flow will depend upon soil moisture characteristics, meteorological parameters, crop types, method of irrigation, and depth to water table.

This report presents review of the available methodologies for assessment of irrigation return flow.

11. Effect of Discontinuous Aquitard on the Seepage From a Static Water Body

In semi-arid areas of India, percolation tanks are in use for artificial recharge of the aquifer. However, the efficacy of the percolation process has not yet been studied in terms of the parameters which influence the recharge. The seepage from a surface water body is dependent on the hydrogeological setup of the region and aquifer characteristics. Present study deals with the seepage pattern beneath a recharging source. A typical case study with recharge/discharge sources in a two layer aquifer system separated by a barrier with possible discontinuities has been considered. A three-dimensional groundwater flow model is employed for simulating flow in a system. The recharging source, a pond/lake, is positioned at the centre of the aquifer system in plan. A number of cases have been studied by making openings of varying widths in the aquitard, symmetrically located below the recharge-source to analyse the impact of a discontinuity on seepage distribution. This study also deals with the influence of the dimensions of

the opening in the aquitard and aquifer characteristics on the discharge as well as on the hydraulic potentials. Distribution of hydraulic potentials in the entire system for different diffusivity values and for various aquitard openings have been analyzed. A number of typical cases were studied and results are presented graphically.

The analyses reveals that

(i) So long as the hydraulic diffusivity (S/T) is kept constant the fractional seepage, (F_{sb}) to the aquifer system is invariant.

(ii) The zone of influence of the recharge source decreases as the hydraulic diffusivity increases.

(iii) Even for a very minor discontinuity the contribution of seepage to the second aquifer is significantly high.

(iv) Further, the seepage is predominantly to the bottom aquifer irrespective of the dimension of discontinuity in the aquitard for large ratios of hydraulic diffusivity.

The study showed that diffusivity has significant effect on the efficiency of a recharge pond rather than the individual aquifer parameters. Also, it is observed that even minor discontinuity in the barrier causes significant change in the seepage pattern.

12. Influence of Fractured Zone on Seepage from a Water Body

Artificial recharge ponds/tanks offer ample scope for replenishing dwindling aquifers. In a multilayered aquifer system the recharging may be influenced by hydrogeological aspects such as geology of various layers, fractures/discontinuities, inhomogeneity and anisotropy in the aquifer. For typical studies with the existence of a confining layer having very low permeability, recharging of an underlying aquifer from a surface water body can not be successful. However, through discontinuities/fractures in the confining layer water may percolate down. Influence of the dimension of a discontinuity in the confining layer on the seepage of water down to a semi-confined aquifer was studied by the Institute earlier.

In continuation to the previous study, the effect of positioning of a fractured zone with respect to the recharge-source in a multilayered aquifer has been investigated in the present study. The behaviour of hydraulic potential/discharge from the aquifer as the discontinuity (a fractured zone) is located at points away from the source is studied. Further, the influence of positioning of the fractured aquitard at different depths in the aquifer system on the flow domain has been also investigated. Normalized heads/potentials in the central section, distribution of potential in the aquifer, change in discharges for various fractured zone positions etc have been used for the purpose of analysis. Evidently, variations in the flow/discharge characteristics of the unconfined top aquifer are not significant. However, location of the opening/fractured zone in the confining layer influences the potential distribution as well as discharge from the bottom semi-confined aquifer. A gradual decrease in hydraulic potential is evidenced by reduced discharge being placed farther from the recharging source. It is found that for a given location the extent of influence of the location of a fractured zone (opening) is high for smaller openings. As the opening becomes large, the influence of its position in the aquitard tends to be minimal. Further, the fractional seepage to the bottom aquifer is found to be decreasing as the position of the fractured aquitard in the system is at larger depths. For a given position of the fractured aquitard, the maximum seepage to the bottom aquifer occurs when the fractured zone irrespective of its dimension is located centrally below the recharging source.

Various cases have been studied with different openings at different locations and with different positions of the fractured aquitard.The hydraulic potential in the aquifer is found to be higher when the fractured aquitard is closer to the impermeable lower boundary, that is when the aquitard is at its lowest position with reference to the datum of the aquifer system. However, the fractional seepage occurring down to the bottom aquifer is found to be decreasing as the aquitard is placed nearer to the lower boundary. The various cases have been repeated for a range of combination of aquifer parameter so as to examine sensitivity with respect to different aquifer systems.

13. Daily Rainfall Runoff Modelling of Rushikulya Basin

The HYSIM model which is a very versatile model having 22 hydrologic and 10 hydraulic parameters has been applied for modelling of the daily flows of Rushikulya river at Purushottampur. The entire drainage area of about 7112 sq. km upto Purushottampur has been treated as a single unit in

applying the model. The model is calibrated and validated for the different data sets using the split data approach for the available data. The model has provided very good simulation results and is recommended for simulation studies of river Rushikulya and its tributaries and hydrologically similar rivers.

14. Overland Flow Modelling for Urban Catchment Considering Random Roughness Coefficient Irregular land surface

Urbanization is defined as the concentration of people in urban settlements and the process of change in land use occupancy resulting from the conversion of rural land into urban, suburban and industrial communities. In more developed countries, about 75% of the population is concentrated in urban areas and in developing countries, like India also, the rate of urban growth is very high. The rapid process of urbanization in India is a challenge for administrators, planners and research workers, since it is causing heavy demands particularly for water and also necessitating increase in the construction of sewerage and drainage facilities. With increase in impervious area due to urbanization, there is increase in runoff peak and runoff volume and decrease in time to peak. Design of drainage facilities, which do not account for this change in runoff characteristics, are inadequate. Thus there is a need to develop an overland flow model for urban catchment in order to estimate the exact runoff and time to peak.

In this study, a two-dimensional overland flow model has been developed considering random roughness coefficients and irregular land surface for the analysis of surface flow component. One-dimensional Richards equation for subsurface flow component has been used for calculating the infiltration from pervious area. The surface and subsurface flow models are linked explicitly at the ground surface through the processes of infiltration. These two models have been validated separately for surface flow and subsurface flow using earlier results. The combined model has been used to simulate runoff from a hypothetical urban catchment.

15. Identification of Water Quality Monitoring Sites on the Kshipra River in Madhya Pradesh

The location of a permanent sampling station is probably the most critical factor in a monitoring network which collects water quality data. If the samples collected are not representative of the water mass, the frequency of sampling as well as the mode of data interpretation and presentation becomes inconsequential.

Besides the economic considerations, there are three levels of design criteria of sampling station location. The macrolocation deals with river reaches in the river basin, the microlocation deals with the location of outfalls or other specific features within a river reach and the third level deals with the representative location points within a river's cross-section. In the present study only the macrolocation have been identified on Kshipra river. The Sharp's procedure which is widely used for selecting locations is used.

One year monthly water quality data monitored at existing nine sites were available. This data were used to analyse both the temporal and spatial trend in water quality. On the basis of trend analysis, the justification of existing monitoring sites is carried out. Further, as monitoring is costly affair, it is also studied whether monitoring at some of the sites could be discontinued or may be less frequent.

Further, macrolocation for water quality monitoring were identified using Sharp's procedure. Because, the flow data were not available, the pollution loading could not be calculated, the pollution indices were used in the Sharp's procedure. The comparison is made between the existing and proposed water quality monitoring sites. It is found that sampling should be done at sites numbers 9,3,4,5 and 7 and sampling can be discontinued at site no.1,2,6 and 8.

16. Temperature Dependence of BOD and its Constants

Biochemical oxygen demand (BOD) is the most widely used parameter for estimating organic pollution in aquatic systems. Since its inception during the latter part of the nineteenth century, the BOD test has been the subject of much controversy and continuing research, and it is a control parameter for treatment plants and a major basis of regulatory action. It is an integral part of dissolved oxygen sag curve analysis and it forms a major basis for design of treatment units.

Seeing the importance of the topic in the field of water pollution control, an investigation is made to see

i. the role of nitrification on oxygen balance,

ii. suitability of first order or second order reaction models in defining the carbonaceous BOD reaction,

iii. the effect of temperature on biochemical oxidation of wastewater particularly on the rate of deoxygenation and the limit of the ultimate carbonaceous BOD.

A large number of biochemical oxygen demand (BOD) determinations were conducted on a raw municipal sewage and synthetic sewage prepared by mixing glucose-glutamic acid in equal ratio, using the dilution technique and at incubation temperatures 20°C, 30°C and 35°C. Initially the dissolved oxygen is observed in an interval of 4 hours for the first day and 6 hours for second day and then the interval is increased from once in a day to once in four days in later stage of the test. The data were used to evaluate the first stage velocity constant and ultimate demand for both the first and second order equation expressions and these in turn were related to temperature. It is found that the velocity constant depends upon both the nature of waste water and incubation temperature. It increases on increasing the incubation temperature. However the ultimate first stage BOD is found to be almost same at all the temperature e.g. 20°C, 30°C and 35°C. It is found that for simple organic waste e.g. glucose-glutamic acid the first order reaction model describe the BOD kinetics more accurately. Whereas, the second order reaction model is found to be more appropriate for complex waste e.g. domestic waste.

The data is also used to show the process of nitrification to proceed simultaneously with the oxidation of carbonaceous BOD. However, the time for it to become active varied with the nature of waste and the incubation temperature.

17. Arsenic Pollution in Ground Water of West Bengal

It is well recognised that a huge alluvial tract along the river Hooghly covering a stretch of around 470 km., encompassing eight districts is affected by arsenic pollution of ground water. The probable source of occurrence of arsenic has been reported to be the geological formation of source material. Occurrence of iron-pyrite and the change of geo-chemical environment due to over-exploitation of ground water or excessive fluctuation of ground water table are the possible reasons of decomposition of pyrite to ferrous sulphate, ferric sulphate and sulfuric acid. However, no definite explanation regarding the source of arsenic could be given.

Number of samples were collected by Institute teams and studied. The arsenic concentration in water samples collected from some selected villages of Nadia district, West Bengal shows elevated concentrations of arsenic. The ground water of the region is characterized by high iron content. The trace element data of lithological log of drill cuttings of the PHED bore hole site at Ghetugachi in Chakdah block, Nadia district show a consistent arsenic contamination in the upper aquifer also.

The hydrochemical study of the river Hooghly also shows a consistent arsenic concentration in water and sediment samples of the river. The content of arsenic in the sediments were quite higher than the associated water due to the prolonged industrial activity along the banks of the river Hooghly.

The Farrakka Super Thermal Power Plant (STPP) operating in the state of West Bengal is another source of arsenic contamination in the nearby area. The analysis of fly ash deposited in the fly ash disposal ponds indicate arsenic content of the order of 400-500 µg/g.The ash generated from thermal plant finds its way into open environment of air, water and soil from atmospheric precipitation, spillage from pipe lines carrying fly ash slurry to ash ponds and from decanted water of ash pond. It contaminates ground water due to seepage and mixing of fly ash into surface and subsurface water.

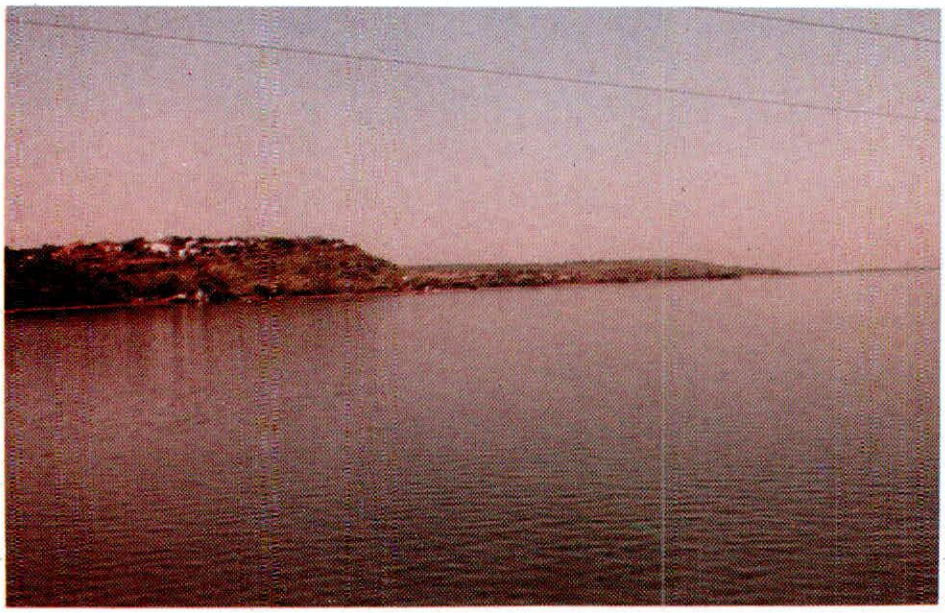
18. Hydrological Data Processing for Watershed Development

The successful and efficient execution of modern hydrological studies depend on a vast and diverse amount of information. Hence it is essential to organize a systematic body of information in the form of a data base system to fulfill the data need for the quantitative hydrological investigation. The accuracy of these investigations/studies depends on the quality of data used. Hence the need of data quality control/processing arises before the actual analysis starts. For this purpose comprehensive study of hydrological processes and data processing

FIELD EXPERIMENTS BEING CONDUCTED IN A FARMER'S FIELD

TESTING OF PRECIPITATION GAUGE

INFILTRATION TEST BEING CONDUCTED IN FIELD



A VIEW OF BHOPAL LAKE, MADHYA PRADESH

techniques is the first step in organising an information base. This includes the rapidly developing area of real time processing which is increasingly used in the operation of hydrological systems. Prior to storage of the data, it is essential that the information be processed, tested and suitably corrected to ensure quality control.

The collection, processing and analysis of the hydrological data forms a very important aspect in the subsequent hydrological modeling studies. Keeping this in view, the Institute has endeavoured to prepare a report which deals with the existing system of data measurement/estimation including rainfall, snow, evaporation, infiltration, stream flow, sedimentation and soil moisture etc. Also, a list of various organisations/universities/agencies which are involved/associated in data collection and processing have been provided in this report. It is expected that the report will be found useful by readers who are interested in status of hydrological data in the country.

19. Hydrological Water Balance and Effect of Sedimentation for Lake Nainital in Kumaun Himalaya, UP

The neotectonic Lake Nainital is the only source of drinking water supply to the city of Nainital. Publications in the recent past inferred accelerated sedimentation threatening the very existence of lake. Water balance studies carried out using conventional methods indicate that 40% to 45% of the total volume of water generated due to rainfall in the lake catchment contributes to lake quickly in the form of direct precipitation on the lake and flow into the lake as surface runoff. Total inflow from Naina Devi drain comes out approximately 1.67 m in terms of depth of water with respect to lake surface area.The total losses of water from the lake due to pumping, evaporation and discharge through sluices are about 41,96,164 m^3 in 1994 and 52,79,603 m^3 in 1995, which in terms of depth of water are equal to 9.06 m and 11.39m respectively. The net balance of subsurface inflow and subsurface outflow has been determined as 2,29,619 m^3 in 1994 and 9,76,332 m^3 in 1995, which is equal to 0.5 m and 2.10 m depth of water in the lake respectively. This variation in subsurface inflow and outflow is due to variation in amount and intensity of rainfall. These values clearly indicate that the ground water contribution to the lake is a major component.

Increase of 1.39×10^6 cubic metre has been recorded in the surface outflow from the lake in the last few years. Out of this increased surface outflow from the lake, 23% is due to the reduction in the capacity of lake (calculated from the estimated sedimentation rate) and 77% due to decreased subsurface outflow as a consequence of sedimentation.

The details of water balance and sedimentation rate/pattern including estimation of life of lake Nainital using conventional and isotopic methods have been discussed in detail in the present report.

20. Estimation of Sedimentation Rates and Useful Life of Lake Nainital in Kumaun Himalaya, UP Using Radiometric Dating Techniques

The Lake Nainital is the only source of drinking water supply to the city of Nainital. Publications in the recent past inferred accelerated sedimentation threatening the very existence of lake. The sedimentation rates in lake Nainital have been estimated using past 36 years lake sounding data for different selected time intervals sediment balance method and radiometric dating of sediment cores collected from different locations in the lake. The sedimentation rates obtained by lake sounding data vary from 0.014 (1960-75) to 0.113 (1965-1970) Million cubic metre per year (Mm^3/yr) depending upon the time span selected while it is 0.021 Mm^3/yr during the time span 1985-1996. The sediment balance method indicated the present sedimentation rate as 0.69 cm/yr. The radiometric dating of sediment revealed sedimentation rates from 0.48 to 1.35 cm/yr, depending upon the location in lake (Average 0.75 by Cesium (Cs)-137) and 0.86 by Lead (Pb)-210 dating techniques).

The predicted life of the lake is between 82 to 380 years as estimated by the earlier investigators using the bathymetric sounding data, collected manually. In the present study, environmental Pb-210 and Cs-137 dating techniques have been used to estimate the lake life. Estimated life comes to be 2163 ± 77 years (Cs-137) and 2479 ± 312 years (Pb-210). If the average of the life estimated by radiometric dating techniques is used, it comes around 2200 yr. The life estimated by sediment method comes around 2681 years while the life estimated by using lake sounding data for different time span vary from 39 years, (based on the data for 1990-1993) to 590 years (based on the

data for the period from (1960-1975). However, the critical analysis of lake sounding data implies that the validity of the data is questionable. Radiometric dating of sediment cores from appropriate areas in lakes/reservoirs provides more precise estimate of sedimentation rate.

21. Study of Recharge to Groundwater due to Monsoon Rains using Tritium Tagging Technique in parts of District Narsinghpur (MP), Part-I and Part-II.

Estimation of recharge to groundwater is crucial for better water resources management, particularly in arid and semi-arid regions. In general, it is difficult to estimate recharge to ground water due to rainfall or irrigation using conventional methods due to unavailability of adequate data. Nuclear methods, specially tritium tagging technique has been widely used successfully for this purpose in many countries.

The Institute, realising the usefulness of estimation of recharge to groundwater, has taken up the estimation due to rainfall and irrigation by tritium tagging technique. The study was undertaken for some parts of the Narsinghpur district in M.P. which lies in Narmada basin. In the study area, experiments were carried out in cultivated as well as uncultivated fields.

In the study area, mainly four types of soils were found, namely clay, clay loam, loam and sandy clay loam in which clay was predominant. The average annual rainfall of the area is 1246 mm.The percentage of recharge to ground water varies from 13.3% to 42.7% in the study area with respect to the type of soil and other geohydrological conditions.

This report presents the details of the area, methodology followed and brings out the results obtained with regard to the values of recharge to ground water obtained mainly due to rains. The study covers the monsoon season of the year 1995 in Part-I and monsoon season for the year 1996 in Part-II.

22. One Dimensional Modelling of Branched free Surface Flow

Branched flows may occur either naturally or artificially. These flows find many engineering applications. A branched flow with a single IWP (simple island type flow) has been studied using a mathematical model.The model assumes steady flow on a rigid bed and is capable of computing the water surface profile and division of flow discharge for all the channels. A parametric study assuming a regular geometry shows quantitatively the effect of width on the flow division for various values of bed roughness and bed slope. The study includes three different cases namely a diversion channel, a cutoff channel, and a river island. A case with irregular cross-sections resembling field situations is also considered. An approximation to the irregular geometry shows that the derived equations for regular geometry can be used with confidence. Although, the present model predicts well the simple case, however, it has been recommended to include a mobile bed and turbulence modelling for dealing with actual field situations.

23. Hydrological Aspect of Flood Disasters

Flooding is the major disaster bringing extensive damage in comparison to other disasters. It also continues as a major unresolved problem and is a global phenomenon. There are climatological and part-climatological causes of flood. Several basin conditions, network conditions and channel conditions intensify the flood. Indirect causes like man's activity may also cause flood. The effects of disastrous flood are; inundation, damage to transport and power supply, deterioration of surface water and ground water quality, and geomorphological changes. An effective flood disaster management (FDM) is essential and it is a multidisciplinary area. Hydrology plays an important role in FDM. FDM is defined as the enhancement of the total productivity of the flood plain wherein losses are only a part of it. Present day trend in FDM moves away from structural measures to non-structural solution. FDM requires complicated computational methods. Flood plain zoning is one of the common techniques in FDM. The three approaches are

(a) modelling susceptibility to flood damage and disruption

(b) modifying flooding and

(c) modifying the impacts of flooding.

The areal inundation of a given flood depends on the flood plain character and the hydrodynamics of the flow.

In case of coastal regions, effective methods for predicting the effect of tidal rivers are yet to

be developed. Cyclone warning and weather satellites are used for forecasting and monitoring. Satellite data can be used for preparation of flood inundation maps. The data bank for an optimal flood disaster management consists of values of cross-section and flood plain, discharge and water level, flood inundation map, flood loss, river bank and breach, sediment, morphological change and land slide. Mega floods are also caused by dam failures. Though many mathematical models are available, issues like dam failure mechanics and aggradation and degradation are still open. Different hydrological aspects concerning flood disaster management need further research.

The present report is a compilation of information on the important hydrological aspects of flood disasters and examines the above issues in relationship to the needs for flood disaster management.

24. Reservoir System Software

A user friendly menu driven software named SRA has been developed.This software can do various analysis related with reservoir system. The software is being sold at Rs.1000/-. A few organisations have purchased it and have found it to be very useful in their analysis. It can be used for the following tasks :

- To compute reservoir capacity using Sequent Peak algorithm.
- To interpolate elevation area capacity table for any elevation interval.
- To determine the firm power from a reservoir or to simulate the operation of a hydropower project.
- To simulate the operation of a multipurpose multireservoir system for conservation purposes. This module is used for policy evaluation and refinement.
- To carry out flow routing through a reservoir using the hydrologic routing methods. Four methods of reservoir routing are available.
- To determine the reservoir operation policy using Stretched Thread method.
- To determine the rule curve levels using mass balance approach
- To determine the required reservoir storage for a given yield or vice versa.

In addition to the analysis, the software includes graphical facilities also. After carrying out the analysis for a particular module, the software prompts whether a graphical display of the results is desired. Positive response produces on-screen graphs of the analysis.

3.2 Technical Publications

Based on the studies and research conducted by the various scientific divisions, a number of reports have been published under different categories. A number of individuals and organisations have been provided with the reports on request. The list of such organizations is given in Appendix VII. The list of scientific and technical studies carried out during 1997-98 is given in Appendix VIII.a. Reports on these studies are under various stages of preparation and finalisation for publication. The list of all publications brought out so far by the Institute, since inception is also given in Appendix VIII.b.

The scientists and the scientific staff of the Institute have published a number of technical papers in English and Hindi in the national and international journals. Papers have also been published in the proceedings of the national and international seminars and symposia organised in India and abroad. The list of papers published / accepted for publication during the year 1997-98 is given in Appendix IX.

4.0 Regional Centres

The National Institute of Hydrology since its establishment in 1979 has been involved in research in basic and applied hydrology, development of new methodologies and software, undertaking sponsored and consultancy projects and technology transfer to user organisations of central and state Governments.

India is a vast country with diverse climates, topography, geography, soil types and land cover and land use patterns. These diverse elements with varied combinations provide a variety of hydrological problems in different regions of the country. To take care of these problems of different regions, the scientists of the Institute have to work in the regions and develop an understanding of the specific problems of the area and conduct hydrological studies of interest to that region using modern modelling techniques.

The country has been divided into more than 20 agro-climatic regions by the Department of Agriculture. Similarly the Central Water Commission has divided the country into various sub-zones based on river basins. The Central Ground Water Board has categorized the country into various homogeneous hydrogeological regions. Therefore, if the country has to be divided into various hydrological regions there would be many. Keeping in view, the viability and economic considerations, the country has been divided into eight hydrological/ geographical regions.

The National Institute of Hydrology after completion of initial phase of establishing itself as a premier Institute in hydrology in the country and after carrying out eight years of fruitful computer and theoretical oriented studies, started to diversify its activities for taking up laboratory and field oriented studies. With this objective in view, the country was divided into eight hydrological regions. Though it was very well realised that for a country of the size of India, eight regions are also very large geographical units, however, for the sake of administrative convenience and viability, at the beginning it was thought appropriate to establish regional centres for the following eight regions in a phased manner :

i. Deccan Hard Rock Region
ii. West Coast Region
iii. Deltaic and East Coast Region
iv. Ganga Plains Region I Covering rivers north of Ganga
v. Ganga Plains Region II Covering rivers south of Ganga
vi. Arid and Semi-arid Region
vii. Western Himalayan Region
viii. North Eastern Region

The establishment of three regional centres of NIH during the seventh plan period at Belgaum (Karnataka), Guwahati (Assam) and Jammu (J&K) for the Deccan Hard Rock Region, for the North Eastern Region and for the Western Himalayan Region respectively was approved by Ministry of Water Resources, Government of India. These three centres were established in July 1987, August 1988 and January 1990 respectively.

Realising the need and importance of the Regional Centres, the Government of India approved the establishment of three more regional centres of NIH during the eighth plan period at Patna (Bihar) for the Ganga Plains Region I, at Sagar (Madhya Pradesh) for the Ganga Plains Region II and at Kakinada (Andhra Pradesh) for the Deltaic and East Coast Region. The two centres at Patna and Kakinada were established in June 1991 and

September 1991 respectively and the regional centre at Sagar was established in Dec. 1995.

For each Regional Centre, Regional Coordination Committee has been constituted to advise on the programme of studies and research, and to ensure effective coordination between the regional centre and the various academic and field organisations of the region who are engaged in activities related with water resources research and development.

A brief description of activities of these centres is given in following sections and the list of scientific and technical studies carried out by each of these Centres during the year 1997-98 is given in Appendix VIII.a.

4.1 Deccan Hard Rock Regional Centre, Belgaum

The first of the regional centres, catering to the problems associated with hard rock areas in the country, was established in 1987 with its office at Belgaum in Karnataka state. The areas covered under this regional centre include Karnataka, parts of Andhra Pradesh, Tamilnadu, Madhya Pradesh and Maharashtra.

The Regional Coordination Committee of each Regional Centre and Technical Advisory Committee of the Institute had suggested certain work programme to be carried out by each Regional Centre on long term basis. The study areas defined for the Hard Rock Regional Centre are as follows:

i. Representative basin studies.
ii. Hydrological modelling
iii. Development of regional flood formulae
iv. Conjunctive use studies
v. Preparation of hydrology year book.
vi. Reservoir sedimentation studies
vii. Hydrometeorological network improvement
viii. Environmental hydrology
ix. Watershed development studies
x. Hydrological studies of tanks
xi. Drought studies.

Regional Coordination Committee (RCC) meetings are normally held twice a year subject to the convenience of the host State organisation. Work programme for each year is decided and progress is monitored at these meetings after discussions with the members, and invited representatives of Central and State Govt. agencies of the hard rock region.

The regional centre over the years has developed fairly good facilities in the areas of remote sensing, water quality analysis, soil testing, and computer related analysis including GIS.

Following studies have been completed during the year :

1. Application of TOPMODEL to Malaprabha catchment

In this study, the TOPMODEL has been applied to Malaprabha catchment in Karnataka. The Malaprabha is a tributary of river Krishna. The catchment area of Malaprabha upto discharge measuring site Khanapur is 520 sq. km. The TOPMODEL is used to simulate the daily flows at Khanapur. The model uses topographic index for the formation of runoff. The topographic index for Malaprabha catchment was derived by developing a digital elevation model by interpolating the contours in the basin at the grid size of 300m x 300m.

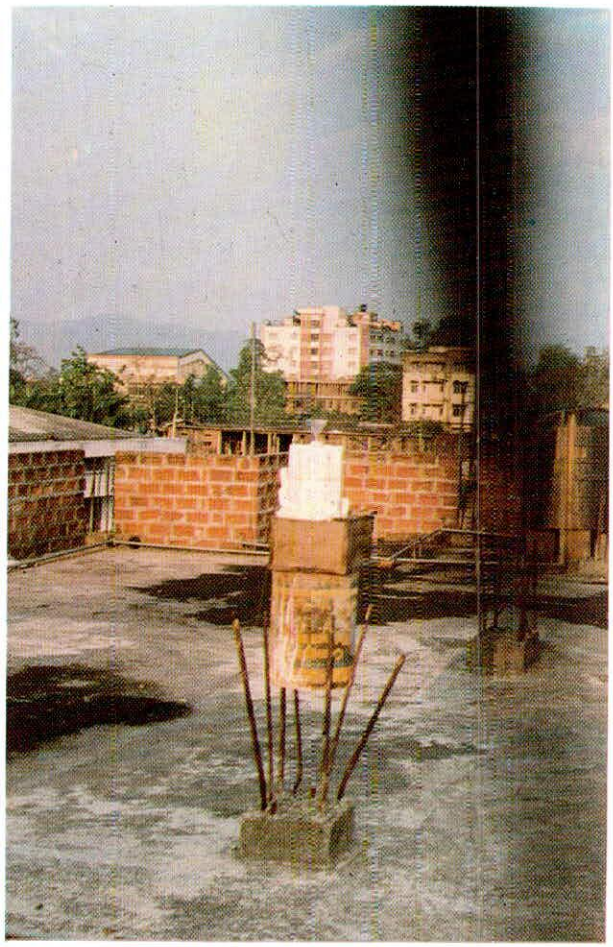
The results indicate that the model can be used to simulate the flows in the dry catchment quite accurately as reflected by the efficiency of the model which is 0.89 and 0.79 respectively in calibration and validation run. Also, TOPMODEL is able to simulate the timing and magnitude of the peak flows satisfactorily.

2. Soil erosion and Sedimentation Studies Using WEPP, WATBAL and WATSED models - a case study

Industrial development accompanied by the management activities during the past few decades have caused an increasing pressure on land and water resources in all regions of the world. Due to increasing demands for water for domestic, agricultural, industrial, recreational and other uses and due to an increasing pollution of surface and ground water, water resources have become scarce natural resources. The impact of various management activities such as construction, road, building, mining, logging, or any other related activities causes soil erosion and water quality degradation. It is reported that the soil erosion rate increases from 2 to 40,000 times due to such

NINTH MEETING OF RCC OF DECCAN HARD ROCK REGIONAL CENTRE IN PROGRESS AT PUNE

VISIT TO PHULBARI AREA FOR GROUND TRUTH VERIFICATION IN MEGHALAYA



RAIN WATER COLLECTOR FOR ISOTOPE STUDY IN NORTH-EAST REGION

FIRST READING OF ORG BEING TAKEN AT MAJULI ISLAND, ASSAM
OBSERVATORY SET-UP BY NIH

processes. Millions of tons of this eroded soil end up in rivers, lakes, and reservoirs. Therefore, it is necessary to understand the various hydrological processes which are responsible for creating such a huge loss from both economical and environmental point of view.

In the present study various water and sediment yield models have been applied for predicting runoff and soil loss. The studies have been carried out for one of the representative basin (Malaprabha sub-basin) of the Hard Rock Region. The study provides a good insight into some of the advantages and disadvantages of the applied models.

3. Soil Hydraulic Properties for Forested Watersheds

The role of soil-water in forest management assumes an unusually important place because a high percentage of the lands that are too dry for agricultural use are often relegated to forestry. The supply of moisture in soils largely controls the type of tree which can be grown and, thus, it influences the distribution of forests around the world. However, many of the issues that motivate research in the area of forest hydrology are the same as they were decades ago; water production, flood generation, erosion, sedimentation, and so on. In recent years many other aspects relevant to the larger picture, such as global climate change, quality of habitat, biodiversity, and ecologically sustainable development have come into focus. Inexorable population growth, with exploitation and often irreversible destruction of forests, demands that planners must be supplied with the best scientific basis for managing the forest resources. In this status report an extensive review of literature on forest hydrology has been done with special reference to soil hydraulic properties of the forested watersheds.

4. Sensitivity Analysis of Aquifer Parameters in Anantapur district of Andhra Pradesh

Estimation of ground water balance and its proper management needs certain degree of certainty in the estimation of aquifer parameters. Various methods are available for estimation of these hydraulic parameters but hardly there is any consensus among the hydrogeologists and scientists about the best suitable method for these estimations. This is mainly due to uncertainty involved in the ground water flow condition in hard rock aquifer. Even a very fine network of lithologs and water table monitoring may not be sufficient to define these solutions. Hence the best way is to judge the sensitivity features of draw down and recovery through aquifer parameters estimated through various methods and thier influence on parameter estimation and pumping test design. The work has been carried out in collaboration with Ground Water Department, Andhra Pradesh.

Other Activities :

During the year, 16 papers have been published/accepted for publication and participated in 2 workshops/training courses by the scientists and staff of the Regional Centre.

Prof. Tim Ward, New Mexico State University, USA and Prof. R H Hawkins, University of Arizona, USA visited the centre as UNDP consultants in the area of Mountain Hydrology during July 1997. Prof. B Sevruk, Department of Geography, Swiss Federal Institute of Technology, Zurich, Switzerland and Prof. U Maniak, Technical University, Braunschweig, Germany visited the centre as UNDP consultants in the area of Catchment Hydrology during September 1997.

Automatic Weather Station has been procured under the Unesco Project of Karnataka Forest Department.

The 9th Meeting of Regional Coordination Committee was held on November 11, 1997 at Ground Water Survey Development Agency, Pune.

4.2 North Eastern Regional Centre, Guwahati

The North-Eastern Regional Centre (NERC) covering the region comprising of seven NE states, Sikkim and Eastern hilly regions of West Bengal, was established at Guwahati in August 1988. Since its inception, the centre has been actively interacting with the various water resources organisations in the states covered under the region while carrying out its studies and activities within the frame-work of recommendations of the Regional Coordination Committee in the areas of representative basin studies, remote sensing studies, water quality studies, floods, watershed management etc.

The region is the highest rainfall zone of the country (1000 - 24000 mm). Flood is one of the most devastating natural calamities in this region.

It is a land of numerous unstable rivers (overloaded with sediments due to severe earthquakes, landslides & erosion), narrow valleys, steep slopes in fragile formations, heavy rainfall with long monsoon season, large hill population, high seismicity. Many such factors which create the problems of flood, drainage congestion and bank erosion, are further accentuated by increasing flood plain encroachment and greater developmental and other activities both in the plains and the hills. Degradation of watershed and deforestation further compound the adverse situation.

As per the deliberations of RCC meetings and opinions expressed by concerned states, the Regional Centre has identified the following areas of studies and research :

i. Floods
ii. Infiltration studies
iii. Flood plain mapping
vi. Representative basin studies
v. Development of Regional formulae for floods
vi. Preparation of water year books
vii. Forest management for water yield
viii. Hydrological network design
ix. Flash flood studies
x. Lake studies including high altitude lakes
xi. Erosion and sedimentation
xii. Ground water balance and modelling
xiii. Land use mapping
xiv. Morphological studies
xv. Water quality modelling studies
xvi. Regeneration of flows.

Over the years the regional centre, for carrying out the studies and research, has created facilities like Water Quality Laboratory, Soil Laboratory, Remote Sensing Applications Laboratory and has taken up instrumentation and monitoring of small watershed. For basic research, it has also established one representative basin at Dudhnai and various hydrometeorological equipment have been installed in a meteorological observatory. As an important activity, an Automated Weather Station capable of continuously recording automatically ten weather parameters has also been imported from Australia under UNDP project and currently installed at Guwahati (finally to be shifted to representative basin).

Following studies have been completed during the year :

1. Geomorphological Study of Myntdu River Basin

Hydrogeomorphological parameters of drainage network provide simple means, specially in mountainous and ungauged catchments to develop empirical rainfall-runoff relationships, synthetic hydrograph parameters and to develop regional Geomorphological Instantaneous Unit Hydrograph (GIUH). In this case study, a 1:50,000 scale Survey of India map of Myntdu river basin has been used. The map is digitised using Calcomp digitising tablet in AutoCad. The geomorphological parameters consisting of linear, areal and relief aspects of the drainage network of the basin have been worked out using the facilities of AutoCad and by developing some computer programs which can handle DXF files (ASCII format) of AutoCad.

Various methods of estimation of geomorphological parameters established by numerous investigators have been reviewed. The results of this review would be utilized in various hydrological studies now ongoing in the area in connection of a proposed hydroelectric power project. particularly the quantitative estimates of the geomorphological parameters for the basin would be utilised for the development of Geomorphological Instantaneous Unit Hydrograph for the basin.

2. Determination of Trace Elements in Ground Water of Greater Guwahati (Assam) Part-I

In groundwater, there are several sources of input of heavy and non-heavy metals and other chemicals which in very small quantities are required for good growth of plants and animals. However, when these reach higher concentrations, they cause pollution to aquatic life and through food chain to terrestrial animals and mankind. Among the metals present in higher quantity, the most problematic are mercury, lead, cadmium, arsenic, chromium, copper, zinc, sodium, manganese, iron, potassium, calcium, tin, etc. High concentrations of inorganic trace elements in irrigated soils and shallow groundwater pose a threat to agricultural production and the health of humans and animals.

Toxicity of a metal depends on its concentration which adversely affects any biological activity. Almost all the metals are toxic at higher concentrations; few of them are toxic in low quantity but few others are toxic even in traces e.g. lead. The presence of such metals in natural waters is a subject of serious concern. Natural water which contains high amount of metals and any toxic metals, affects public health to a great extent when it is used for drinking and bathing purposes.

The objective of these investigations is to provide a framework for evaluating trace-element concentrations in shallow ground water of Greater Guwahati. The study deals with the detection of trace elements in groundwater of Greater Guwahati for selected sampling points and to review the environmental impact of toxic elements.

3. Protection of Majuli: Problems and Remedies

Majuli the largest river island in the world with an area of about 1245 sq.km by old records (presently about 900 sq.km) has been undergoing large scale erosion by the Brahmaputra floods since the great earthquake of 1950. The unabated erosion has thrown out of gear every protection measure, displaced 75000 people, threatened existence of age old religious and socio-cultural epicenters (Satras) of 1.50 lakh odd mixed population of Assam and now challenges modern technology to understand it and suggest long lasting solution to this gigantic problem to save the great human heritage. Fury of the Brahmaputra flood is eroding Majuli in two ways; first engulfing large section of the land on the river banks along the direction of flow and the second is continuous collapse of the near vertical banks of the river. There were national and international technology missions to suggest ways and means to save the island. With size of Majuli island becoming smaller and smaller after every flood there is growing concern amongst the technocrats, bureaucrats, public representatives and the large population for protection of the island.

This review report examines the problems, reviews various activities undertaken to tackle it, examines various technical opinions, highlights certain recommendations to the multi-dimensional problem and suggests approaches for long term solution.

Other Activities :

During the year, 5 papers have been published/accepted for publication and participated in 5 training courses by the scientists and staff of the Regional Centre.

The Seventh Regional Coordination Committee Meeting could not take place due to unavoidable circumstances. The work program for 1997-98 was prepared and circulated for comments and is being implemented.

4.3 Western Himalayan Regional Centre, Jammu

The regional centre at Jammu was established in the year 1990. The states of J&K, Himachal and hilly parts of western UP constitute the western Himalayan region. The entire region is marked with steep mountains which largely influence the climate and weather conditions of north west India. The Himalayan mountains in 3 ranges run from Kashmir to the North eastern states. These include the greater, middle and outer Himalayas. The region receives rain and snow during winter and also the south west monsoon. The origin of some of the major river systems like Indus and Ganges lies in the western Himalayas.

The physiography, geology, climate and landuse pattern in western Himalayas have several hydrological problems. The thrust areas of studies and research at the regional centre which have been identified, include:

i. Snow and glacier melt modelling

ii. Flash floods during monsoon season

iii. Soil erosion and sedimentation in reservoirs.

iv. Effects of forest cutting and watershed management

v. Lake hydrology

vi. Water quality studies

vii. Network improvement and instrumentation

viii. Education and training of personnel

Good laboratory and field capabilities have been developed at the centre. These include remote sensing/GIS applications, water quality and soil laboratories. In the water quality lab. about 16 parameters such as conductivity, dissolved oxygen, biochemical oxygen demand, Ph, total dissolved

solids, temperature, turbidity etc. can be measured. The remote sensing applications lab. includes a FCC printer, digitizer and Erdas/GIS system. The soil lab. includes permeameters, neutron probes, tensiometers, sieve shakers and infiltrometers. An automatic weather station (since 1995) and a manual hydrometeorological observatory (since 1992) have been set up at Tissa (HP) as a part of representative basin studies.

During the year following studies were carried out :

1. Variation of Ground Water Quality in Jammu and Kathua District, J&K (1997-98)

This study was continued on similar lines as in the previous years. During this year, sampling were done at 25 sites in Jammu district and 15 sites in Kathua district. Water sampling was carried out for pre-monsoon and post-monsoon periods. Physico-chemical analysis (e.g. Temp., pH, EC, TDS, Hardness, Ca, Mg, Na, K, HCO_3,Cl, SO_4, NO_3, PO_4, F) of water samples was carried out in Water Quality Laboratory using standard methods. The suitability of water of the wells was evaluated for domestic and irrigation purposes. Classification of water were carried out using Piper's Trilinear and Willcox Diagrams. Principal Component Analysis of water quality parameters was also carried out.

2. Water Quality Monitoring and Evaluation of Mansar Lake, J&K (1997-98)

During this year, water samples were collected to monitor surface and depth wise variation in water quality of the lake. The sampling was done for pre-monsoon and post-monsoon period using standard water sampler. Various physico-chemical parameters were determined using standard methods to evaluate lake water quality and its fitness for domestic and irrigation purposes. Dissolved oxygen were also determined. Classification of water was carried out using Piper's Trilinear and Willcox Diagrams. Depth-wise temperature variation was also determined. The physico-chemical analysis reveals that lake water is good for drinking and irrigation purposes, though the human impact has increased the eutrophication in the lake.

Other Activities :

During the year, 9 papers have been published/accepted for publication and participated in 4 seminars/symposia/training courses by the scientists and staff of the Regional Centre.

Dr R Berndtsson, University of Lund, Sweden visited the centre as UNDP consultant during September 1997. He delivered lecture in the area of hydrometeorology. These lectures were attended by officers from State/Central Govt. organisations including University of Jammu and SKUAST.

The 8th meeting of the Regional Coordination Committee meeting could not be held due to unavoidable circumstances. The work programme was however prepared and is being implemented.

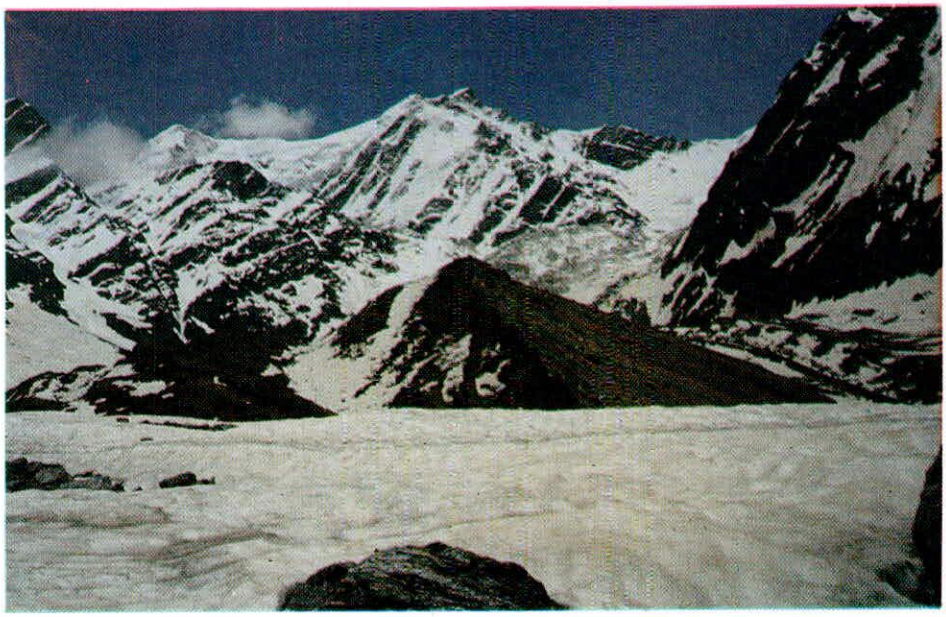
4.4 Ganga Plains North Regional Centre, Patna

The Ganga Plains North Regional Centre was opened at Patna in May 1991. The centre, has been provided with four acres of land by Government of Bihar in WALMI Complex in Patna. A few residential quarters have been constructed in the campus. The main building of the Centre is also nearly completed, however, office of the Centre is presently housed in two residential quarters as a temporary arrangement till the office building is completed in all respects.

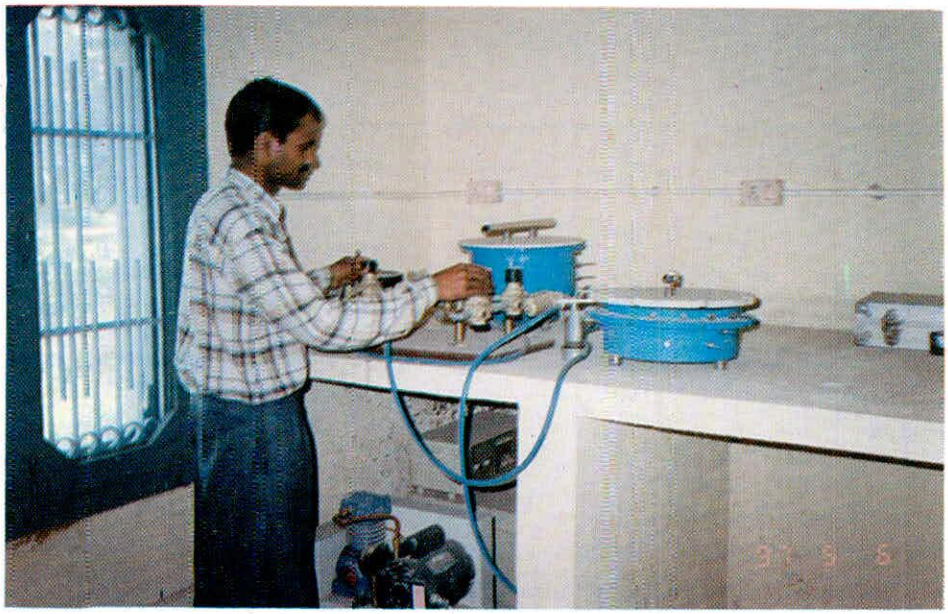
The Ganga Plains comprise of mainly UP, Bihar, MP and West Bengal besides other states in North India. All the important rivers in the region originate mainly from different mountain ranges of the Great Himalayas. The rivers are perennial in nature and bring enormous silt from their catchment areas because of natural activities such as land slides, soil erosion due to rainfall and other human activities.

The region frequently suffers from floods and at times also due to drought. Flood has been controlled to a great extent by taking recourse of an extensive network of embankment along different river courses. Sharda Sahayak Canals, Gandak Canals and Kosi Canals are important canals in the region. DVC is also located in the region. The important water projects are Gandak Project, Kosi Project and DVC Project. The area between the Great Himalayas and the river Ganga is flat. The water table is shallow. The flood embankments, canals, railway lines, roads etc. have disturbed the drainage system. This has aggravated the problem of flooding, drainage congestion and water logging. Nearly nine lakh hectares of land in Bihar is water logged and forty lakh hectares is flood prone. In Ganga plains there is hardly any location for having a dam. There is problem of erosion and shifting of river courses also. In West Bengal, there is special problem of sea erosion. Keeping all these issues in

FIELD EXPERIMENTAL STUDIES AT PATNA REGIONAL CENTRE



A VIEW OF DOKRIANI GLACIER IN GARHWAL HIMALAYAS, U.P.



SOIL SAMPLE ANALYSES USING PRESSURE PLATE APPARATUS AT JAMMU REGIONAL CENTRE

FIRST RCC MEETING OF GANGA PLAINS SOUTH REGIONAL CENTRE, SAGAR

view, this regional centre was established in Patna which is located in the middle of the region.

The Regional Coordination Committee has identified the following areas for study by GPRC in consultation with different Departments.

i. Representative basin study
ii. Hydrology water year book
iii. Reservoir sedimentation studies
iv. Hydrometeorological network design
v. Remote sensing application
vi. Drainage and water logging studies
vii. Flood plain mapping
viii. Reservoir water balance
ix. Erosion and sedimentation studies
x. Morphological studies.

Following studies have been completed during the year :

1. Contaminant Transport in Multi-Aquifer System - with reference to the Arsenic Pollution in West Bengal

It is well known that textural composition of soils vary in three cartesian planes from point to point. For that matter, most of the parameters characterizing solute transport in the unsaturated zone also vary both laterally and longitudinally. On the other hand, due to fracture or leakage in the aquifer that may occur due to soil textures or due to inhomogeneity in soil strata or due to the geological formation, contaminants in soil easily migrate from unsaturated zone to the confined/ saturated zone. The rate of migration in the initial period or at the beginning may be less, however, continuous pathways of constituents and their vertical and horizontal mixing may lead to serious pollution hazards in the saturated zone.

The problems of Arsenic pollution in ground water in West Bengal, in some parts, are also suspected to be propagated from unsaturated zone to the saturated zone. The degree of migration and rate of spreading in the saturated zone can be investigated through modelling technique. The present study is aimed:

i. to study the rate of transport pattern in unconfined zone, and their migration pathways confined zone;
ii. to study the spreading pattern in the confined zone for the given flow and well conditions.

MODFLOW and MT3D compatible with MODFLOW developed by USGS have been successfully used all over the World for modelling of ground water flow and transport behaviours both for unconfined and confined aquifers. These models have been developed using finite difference schemes and can simulate flow and transport of constituents in three dimensional case. These standard models have been applied in this case. The data for this study have been obtained from CGWB, Calcutta.

2. A Management Approach for Water Logging and Drainage Problems of Mokama Group of Tals

Problems of water logging and drainage in Mokama group of tals in Central Bihar, are a serious concern to the water resources planners. However, for its remedial measures though a number of attempts have been made in the form of scientific studies and as implementation of different schemes, however, no satisfactory solutions have been achieved so far. Reasons for the same are not well recorded. For carrying out a systematic study all information concerning; upto date efforts made for solving the problems of tal areas, and most of the hydrological information of tal region have been collected.

An area in the order of 0.106 million hectares remains inundated for a period of about five to six months in a year. During monsoon months, the water level of the river Ganga which is the outlet of tal waters maintains higher level than the submerged area. After recession of floods in Ganga, the areas get its opening for drying off. A number of tributaries also contribute their monsoon runoff to the tal areas. Due to this submergence, the agricultural return period (crop number) of the area could hardly be attained upto a limit of 1.0-1.25 times in a year. An effort is necessary to increase the agricultural return period of the area to a minimum of 2.0 to 2.5 with definite certainty. Such an effort should not disturb the ecology of the region.

The main objectives of this study were: i) to identify the reasons of water logging, ii) to develop a management model as a remedial measure. The methodology and data have been used as given below :

- hydrological parameters like, rainfall pattern, infiltration rate, evaporation rate, soil type, vegetation cover, drainage slope etc. will be studied,

- rainfall-runoff pattern of streams joining the tals will be studied,
- seepage rate from the Ganga and to the ground water will also be studied,
- using remote sensing data with the help of GIS pre-monsoon and post-monsoon scenarios, will be analysed,
- basic information obtained from the villagers in the form of questionnaire.
- the problem would be basically dealt as a water balance problem,
- a management model with objectives of minimization of water logged area under the constraints of check over of inflows from tributaries is being developed.

The study is in progress and is expected to be completed by the end of next year.

3. Determination of Hydraulic Conductivity of Soils in Central Bihar

Due to the restriction in use of surface water sources for various obvious reasons, the pressure on ground water sources is increasing day by day. As a result, there has been number of complaints of continuous depletion of ground water table in many places. True picture of ground water balances, can only be achieved when a water balance study and flow modelling of ground water is carried out.

To model the ground waterflow, the parameters like hydraulic conductivity which governs the flow phenomena and movement of water, is to be assigned as the basic input. The value of hydraulic conductivity can only be estimated from field observation/study. Guelph permeameter is one of the latest equipment for in-situ measurement of permeability of water through soil. The main objective of this study is to determine the hydraulic conductivity for different textures of soils and to quantify the errors involved in field measurement and laboratory method using ICW constant/variable head permeameter.

4. Hydrological Inventory of River Basins of South Bihar and Eastern U.P.

Hydrological data are the basic information for development and planning of water resources projects. It is most likely that various hydrological data and information which include; properties of basin, rainfall, runoff, and data on soil and land resources etc. are collected, however, these data are generally not available at one place. This is mainly due to the fact that a large number of central and state Government agencies are involved in collecting these hydrolgical data as per their need, and maintain records either in the form of manuscript or in magnetic tapes. For a comprehensive hydrological study, a good data-base which shape the hydrology of a river basin is necessary. On the other hand, delinking a parameter from other, a hydrolgical study can not be addressed. It is, therefore, necessary to put an effort for combining these scattered data at one place and examine the hydrological problems of a river basin.

The work for preparation of a "Hydrological Data Book for River Basins of South Bihar" and Eastern UP has been taken up with the following objectives :

i. compilation of hydrological data for river basins of South Bihar, and Eastern UP;
ii. Identification of hydrological problems for river basins of South Bihar and easter UP. The work is in progress.

Other Activities:

During the year, 11 papers have been published/accepted for publication and participated in 4 seminars/symposia/training courses by the scientists and staff of the Regional Centre.

The Regional Coordination Committee Meeting could not take place due to unavoidable circumstances. The work program for 1997-98 was prepared and circulated for comments, and is being implemented.

4.5 Deltaic Regional Centre, Kakinada

With a view to deal with the region specific hydrological problems in a better way, the 5th Regional Centre of NIH started functioning from 9th September, 1991 in the coastal city of Kakinada which is the headquarters of East Godavari District in Andhra Pradesh. The Regional Centre has been allotted 4.05 acres of land in Kakinada by the Andhra Pradesh State Government on long term lease basis. The activities of this regional centre pertain to studies and research in the eastern coastal and deltaic region of the country. The jurisdiction of the regional centre extends from Cauvery delta in Tamilnadu to coastal region of West Bengal covering partly the states of Tamilnadu, Andhra Pradesh, Orissa, West Bengal and the union Territory of Pondicherry.

Every year the highly populated coastal and deltaic region of the east coast of the country is subjected to the fury of nature in the form of floods and related problems. The major hydrological problems being faced in the region are flash floods due to intensive cyclonic storms in medium sized rivers catchments, drainage congestion of streams in the flat coastal plains and the associated problems of inundation and water-logging. In the tailend reaches of the deltas and along the coastal areas enormous growth and uncontrolled increase in aquaculture is disturbing the natural equilibrium of the sensitive environment. The lands are being dug upto 3 to 4 meters deep leading to landward development of salt water intrusion. The scarcity of drinking water is another growing problem as the water being collected in surface tanks for drinking purposes is turning into brackish water.

The following studies and research were envisaged in the work programme of the centre:

i. Representative basin studies
ii. Rainfall-runoff modelling
iii. Flood plain zoning
iv. Conjunctive use studies
v. Preparation of hydrological data year books
vi. Ground water development in coastal aquifers
vii. Morphometric studies of river catchments
viii. Total basin studies and drainage

The centre has established a Water Quality Lab having capabilities for estimating 20 physical, chemical parameters analysis i.e. volumetric analysis of groundwater/surface water samples. The laboratory is also having water level recorder, water samplers, turbidity meter, BOD incubator, UV-spectro photometer, flame photometer with Na and K filters, etc.

The Computer Centre has three personal computers (PC-386, PC-486, and one Pentium) with its accessories. ERDAS (Earth Resources Digital Analysis System) software is available for digital image processing of the remotely sensed data. A Calcomp Digitizer is provided for digitizing the maps. The Remote Sensing cell has pre-monsoon and post-monsoon IRS LISS II satellite imageries (FCC) on 1:250,000 scale of DRC Region for the year 1989. Light Table with co-ordinate measuring system and magnifying lenses are used for carrying out the visual interpretation studies.

The field investigation facilities include two sets of double ring infiltrometers to measure the infiltration rate of soil in the field, electric resistivity meter for measuring the resistivity of the soil, and two sets of current meters for measuring the velocity of the flow of the stream. To establish the hydrometeorological observatories in the representative basins, three sets of observatory equipment have been procured comprising of ordinary raingauge, automatic raingauge, pan evaporimeter, stevenson screen. A hydrometeorological observatory has been established in the deltaic Regional Centre site at Kakinada.

During the year, the Centre has completed the following studies :

1. Seasonal Changes in Groundwater Hydrochemistry of Kakinada Town, AP During the year 1997

The Deltaic Regional Centre of NIH has started the activity of monitoring of shallow groundwater levels and its quality in and around Kakinada town since 1994. In continuation of this program the detailed hydrochemistry of ground water of Kakinada town during the year 1997 is included in this report.

Total 161 groundwater samples were collected from 29 dug wells and 16 filter points during different seasons and analysed for its physical and chemical parameters. Further the monthly groundwater levels were also measured in dug wells. The groundwater table contour (with reference to MSL) were plotted for pre-monsoon (April 97) and post-monsoon (October 97) periods. The detailed hydrochemistry of dug wells and filter points are assessed through various classification (Stiff, Piper and US Salinity etc) and observed the seasonal changes. The hydrochemistry of the area shows that filter points are better than the dug wells for drinking water purposes. Further landuse/cover map of the study area was prepared on 1:50,000 scale using IRS 1B, LISS II FCC imageries. The impact of fertilizer/land use on groundwater quality was assessed through SO_4/Cl ratio and found that the quality of groundwater is being influenced by fertilizer use to some extent.

It was observed that the seasonal changes in water quality parameters are more predominant in dug wells than in filter points. Much variation of Total Dissolved Solids (TDS) values observed

between dug well and filter points located in same place. Further studies would be conducted to find the groundwater quality at different depths in the study area.

2. Conjunctive Use Studies in Pennar Delta Canal System : Conjunctive Use Modeling for Southern Channel Command Area

This study on conjunctive use modeling has been undertaken for the southern Channel command area (118 sq km) in the Pennar delta canal system in Andhra Pradesh. The study area is having poor network of observation wells to understand the groundwater level fluctuations in the command area. There are two OB wells recording monthly water levels under State Government's Groundwater Department, Relevant data and information at village level is used in the study.

The conjunctive use modeling at seasonal level, i.e., total area under canals during monsoon season and under wells during non-monsoon season is studied based on the water balance studies undertaken earlier for the study area. Since the area consists of a network of about 3250 filter points for agricultural use, an attempt was made to simulate the drawdown due to pumping of groundwater at a single well so that it can be interpreted for the rest. Finally top aquifer is simulated using a finite difference method at a grid level of 1 km x 1 km. Pumping at different nodes is derived based on the number of filter points and extent of geographical area served by the village falling with in the grid. The aquifer parameters are adopted as those used for water balance study.

3. Modelling of Flows at Vasishta Godavari River Mouth Using FESWMS

This study deals with simulation of the flow process over a reach 10 km in the Vasishta river mouth in the Godavari delta. A finite element surface water modelling system, FESWMS developed by USGS is implemented to model the reach. Since the Godavari at mouth is wide and shallow it is expected that the model may simulate the flows reasonably well. Unlike in an estuary, hydrodynamics may not be so dominant at the Godavari mouth as it drains an area more than half of deccan plateau.

The outcome of this two dimensional depth averaged modeling study is to simulate the water level and velocity distribution in the study reach for different tide conditions during the flood scenario in which there is lot of variation in river flows. The study is in progress.

4. Irrigation Water Management for Eastern Godavari Delta, AP

A study has been conducted to develop irrigation schedule for the Eastern Godavari Delta, AP. The present system of scheduling is the conventional procedure and a more scientific scheduling method is proposed so as to result in water saving in irrigation. An artificial Neural Network (ANN) model has been developed for forecasting the evapotranspiration. The results of the ANN model is compared with existing models. The output of this ANN model is then fed to the model CROPWAT, a model developed by FAO to develop the irrigation schedule. The final output of the model is the amount of irrigation to be applied to each field and the time of each irrigation. The water allocation to canal is also computed after developing the schedule. The ANN model has been employed to identify the minimum weather parameters required to forecast the evapotranspiration with least error, so as to enable the model to be used in areas where all the weather parameters are not being monitored.

5. Geomorphological Studies of Suddagedda Basin (Representative basin)

The geomorphology of Suddagedda representative basin has been studied. Quantitative descriptors of basin properties grouped under linear aspects, areal aspects and relief aspects of the basin are computed. These features are upstream of proposed gauging station at Gollaprolu in the basin. Further the landuse/cover, slope and drainage maps are prepared using IRS-1C digital data on 1:50,000 scale.

This information would be useful, particularly when hydrometeorological data are not available, and can be applied to ungauged catchments.

Other Activities :

During the year, 14 papers have been published/accepted for publication and participated in 6 training courses by the scientists and staff of the Regional Centre.

Dr J L Luick, National Tidal Facility, Adelade, Australia visited the Centre as UNDP consultant during September 1997. Interactions with various Government organisations, NGOs, academic

A VIEW OF SAGAR LAKE

AUTOMATIC WEATHER STATION INSTALLED AT SANTI ASHRAMAM IN SUDDAGEDDA REPRESENTATIVE BASIN, ANDHRA PRADESH

institutions ware arranged. A 3 day workshop on Coastal Hydrology was arranged at JNTU Engineering College, Kakinada. A field visit to Mangrove forest at Godavari mouth was also arranged.

The 8th Meeting of Regional Coordination Committee was held on November 19, 1997 at Chennai.

4.6 Ganga Plains South Regional Centre, Sagar

The Regional Centre, Sagar has started its functioning from 1st December 1995. This Centre has been named as Ganga Plains South Regional Centre of National Institute of Hydrology located at Sagar (MP) in a private rented building. This centre has been set up to carry out research studies in different aspects of hydrological problems of basins/sub-basins of north flowing rivers, namely Banas, Chambal, Kalisindh, Dhasan, Ken, Son and their tributaries, which are ultimately joining to river Ganga.

At the centre following studies are proposed to be conducted :

i. Typical hydrology year book
ii. Study to control water logging
iii. Regional formulae
iv. Flood plain zoning and flood routing
v. Reservoir water balance
vi. Representative basin study for Bundelkhand area
vii. River morphological studies
viii. Induced recharge studies
ix. Hydrological network design
x. Study of lakes
xi. Ground water development and conjunctive use studies
xii. Water availability studies in Bundelkhand region
xiii. Water quality network, monitoring and modelling studies.

The jurisdiction of Ganga Plains South Regional Centre covers major part of Bundelkhand region of Central India; which falls in northern part of Madhya Pradesh, Southern part of Uttar Pradesh and some part of the South East Rajasthan state. This region is rich in mineral resources, like limestone, diamonds, phosphorite, bauxite, dolomite, gypsum and building stones such as masonary stone, slab stone, granites and river sands etc.

Regional centre, Sagar and its area of jurisdiction falls under semi-arid to sub-tropical climate. This region regularly experiences severe drought conditions due to frequent failure of rains and poor agricultural yields. This region receives average annual rainfall of about 1173 mm. The ground water levels in this region vary from 3 to 8 meters during post monsoon and it goes very deep during summer season (March-June). The humidity during summer months decreases upto 11 to 13%. The irrigated area in this region may be about 5 to 6% only. The major portion of this region falls under rainfed agriculture. Most of the tributaries of major rivers in this region have no flow (or dry) after February. Also the major rivers like Son, Ken, Dhasan, Kalisindh, etc have very little flows during summer months. Also the major water storage structures/dams are lacking in this region.

The Regional Centre is well equipped with personal computers like one pentium, one PC-AT486 and one PC-AT386 for taking up various mathematical modelling studies in the field of hydrology and water resources. In addition, one small laboratory comprising of various instruments to carry out water quality measurements and to conduct field experiments related to soil-water interaction has been established at the centre. One automated weather station has also been installed at a suitable site near the office of Regional Centre, Sagar in order to collect various hydrometeorological real time data.

During the year the Centre has carried out studies on

1. Status Report on Sagar Lake

There are a number of major problems that the lakes, all over the world are facing. The Sagar lake is also, not an exception in this regard. Though, geographically the lake is small and situated in the region where normal annual rainfall is more than the national average, the shallower part of the lake generally dries up during summer season.This is due to very small catchment area contributing insufficient runoff water to the lake.The lack of vegetative cover in the catchment area causes severe

problem of sedimentation to the lake. The catchment of the lake is full of built-up areas, building stone querying, crop fields etc. With passage of time, inflow from these crop fields and a number of domestic and industrial effluents joining the lake have degraded its water quality to unusable extent. The yield of fish has also reduced to a great extent as abundance of Carnivorous and local minor fishes spoil the fish seed of major carps. Population residing around the lake is also found to be suffering from various diseases due to lake water. In nutshell, it can be said that the domestic use of lake water has ceased.

In this report, efforts are made to compile all possible published works on the Sagar lake at one place. This includes brief description of the historological and the geographical background of the lake, details of water quality analysis carried out in past, present position of the lake and various schemes proposed and implemented for the improvement of pathetic condition of the lake. A number of analytical studies have ben carried out on biological aspect of the Sagar lake. The general observations of these studies show a high trophic status and a high organic pollution level of the Sagar lake. Also, a number of proposals and schemes from various Government agencies have been offered for the renovation of the lake, but due to lack of public awareness as well as scientific approach the lake is still to get back its golden period. This report is a first step of the Regional Centre to understand the present condition of lake Sagar in order to plan and conduct the hydrological studies in future.

2. Statistical Analysis of Rainfall in Sagar Division

Sagar division comprises of five districts namely Sagar, Damoh, Panna, Tikamgarh and Chattarpur. The Sagar division has its economy mainly dependent on agriculture which in turn, relies on rainfall. Hence to understand the problem of rainfall particularly for identification of any trend or persistence in the rainfall series, a climatological study of rainfall in the Sagar division is carried out. Besides studying the statistical parameters, and cross correlation, other techniques like linear regression and polynomial regression have been applied to identify the presence of any trend.

The study indicated that, monthly rainfall series of July and August shows good correlation with the monsoon and annual rainfall series. The serial correlation was very poor; indicating absence of any persistence in the rainfall series of the region. Linear regression of monthly rainfall data shows falling trend at most of the places in Panna and Tikamgarh districts and shows rising trend at some places of Sagar, Damoh and Chattarpur districts. Polynomial regression of rainfall data has indicated non-linear trend in the seasonal and annual rainfall series at Raheli Jatara, Ajaygarh and Panna. The polynomial regression of non-monsoon rainfall series do not indicate any trend.

From the decadal mean of annual rainfall series, it was seen that rainfall during the 1961-70 was low and it was high during 1971-80 and 1981-90 except at some places in Panna and Tikamgarh division.

3. Estimation of Runoff from Bewas River Basin Using SCS Curve Number Model

The Sagar city is facing acute shortage of municipal water supply especially during summer months, therefore, the Public Health Engineering Department (Government of Madhya Pradesh), Sagar has undertaken a project to augment the municipal water supply of the Sagar city by constructing a dam near Salaiya village in the Sagar block across Bewas river. The project envisages to construct a 1860 meters long and 25.5 meters high earthen dam to store 96 MCM water (gross). Therefore, a part of the Bewas river basin having outlet at dam site was selected for this study.

The United States Soil Conservation Service (SCS) has developed runoff curve number model, which is based on a non-linear rainfall-runoff relation that includes a variable called runoff curve number. This model involved relationship between landuse/land cover, hydrologic soil class (A,B,C and D) and runoff curve number of hydrologic soil cover complex, which is a function of soil type, land cover and antecedent moisture condition (AMC-I,II and III).

In the present study SCS curve number method is used to predict the discharge at dam site from the daily rainfall series in the Bewas basin. The ancillary data on landuse/land cover was interpreted from IRS 1B, LISS II imageries of the catchment area. ARC/INFO GIS package has been used as the core of the spatial database. The general relationships between the direct runoff and rainfall recorded at the four rain gauge stations in the

Bewas catchment area were also developed for all the three antecedent moisture conditions.

The discharge measured by the Public Health Engineering Department, Sagar and the direct runoff volume estimated using SCS curve number method was compared and monthly correlation coefficient were calculated. In general good correlation was found between the measured and estimated runoff volume.

4. Water Availability Study in Ken River Basin Using SCS Model and Remote Sensing Approach

Estimation of runoff from a natural catchment is essentially required for the planning, management and evaluation of the available water resources. Much hydrologic research has been directed at understanding the hydrologic processes involved with the gauged watershed and applying this knowledge to predict the runoff values needed for the efficient water resources development and management.

Simulation of rainfall-runoff process for ungauged catchments is one of the important areas of modern research. All the well established techniques like unit hydrograph technique, conceptual models and physically based modeling requires a certain amount of historical data for establishing various parameters. However, due to sparse gauging network available of the Indian catchments, particularly for small catchments, it becomes very difficult for such techniques to be directly applicable.

In the present study of water availability in Ken River Basin, SCS Curve Number model which is a widely used hydrological model for calculating direct runoff from ungauged catchments, has been applied for calculating the runoff using rainfall and curve number (CN). The SCS curve number is a quantitative description of the land use/land cover/ soil complex characteristics of a watershed.

The latest technique of satellite remote sensing provides a real time and a reasonably accurate information of the prevailing land use patterns at a faster rate and less tedious way as compared to the conventional methods. In this study various land use classes have been interpreted using the IRS, 1A, LISS-II satellite imageries. The large sub-basin of river Ken namely, Sonar and Bearma has been further sub-divided into smaller basins and the runoff for each of these sub-basins have been computed, after establishing their respective SCS curve numbers. The runoff from these smaller sub-basins were summed up, keeping in mind, the time lag, if any, and the discharges were predicted at the Garhakota G/D site on R. Sonar at the Gaisabad G/D site on river Bearma. These predicted runoff values at these gauging stations are quite in agreement with the available observed surface runoff, which implies that the sub-basin wise runoff estimation is satisfactory. Flow-duration curves have been prepared for each of these sub-basins, which will be helpful in assessing the dependable flows in each of the sub-basin.

Other Activities:

During the year, 3 papers have been published/accepted for publication and participated in 1 training course by the scientists and staff of the Regional Centre.

First Regional Coordination Committee meeting of the Centre was held on 23 January 1998 at Sagar.

5.0 Staff and Facilities

The Institute has 18 scientific divisions and 4 units of administration, finance, maintenance, and extension services. The Secretariate of Indian National Committee on Hydrology (INCOH) is also attached to the Institute. Besides these, the Institute also has six Regional Centres. During the sixth plan period (1980-85) the Institute had a sanctioned strength of 121 posts and 20 posts of INCOH (out of which only 14 posts were released). Out of the 173 posts sanctioned during the 7th plan (1985-90) only 157 posts were released. Thus out of these 314 posts only 292 posts have been released and remaining 22 posts have been abolished and 11 Group B, C and D posts have been upgraded by Ministry of Water Resources (MOWR). During the 8th plan (1992-97) 118 posts were provided in four schemes approved by the Standing Finance Committee of MOWR. However, out of 118 posts only 34 posts of scientists and 3 posts of Drivers have been released under 8th plan schemes, till 31st March 1998. Further, as per the Government of India's requirement for cut of 10% posts in sanctioned strength, out of 292 (Non Plan) posts, 9 posts have been abolished. The total sanctioned strength is thus 283 (non-plan) + 37 (plan) posts.

The status of staff as on 1.4.1997 and 31.3.1998 is given in Appendix X.

5.1 Scientists

During the year, the following scientists have joined the Institute.

1. Shri Tej Ram Nayak, Sc C
2. Dr Vijay Kumar, Sc C
3. Shri B Venkatesh, Sc C
4. Shri Nani Gopal Pandey, Sc B
5. Dr Imran Ali, Sc B
6. Shri Pankaj Mani, Sc B
7. Shri Niranjan Panigarhy, Sc B
8. Shri Purna Chandra Nayak, Sc B

During the year, the following have been promoted :

1. Shri Kamal Kumar, from Principal Research Assistant to Sc B
2. Shri A K Dwivedi, from Principal Research Assistant to Sc B
3. Shri M K Jose, from Principal Research Assistant to Sc B

At the end of the year (March 31, 1998) the Institute had 77 scientists.

The names and qualifications of scientists who are in position as on March 31, 1998 is given below :

DIRECTOR

S M Seth	B. E. (Civil Engg.); M.E. (Dam Design, Irrigation Engg. and Hydraulics), University of Roorkee, Roorkee; Ph.D., Victoria University, Manchester, UK

SCIENTISTS

G C Mishra	B.Sc. (Civil Engg.); M.E. (Soil Mechanics & Foundation Engg.), Indian Institute of Science, Bangalore; Ph.D., Indian Institute of Science, Bangalore.
P V Seethapathi (Presently on deputation to NERIWALM, Tezpur)	B.E. (Civil Engg.); M.Tech. (Dam Construction & Water Power Engg.); IIT Kharagpur; Ph.D., IIT Kharagpur.

K S Ramasastri	M.Sc. (Tech.) Meteorology & Oceanography; Ph.D., University of Roorkee, Roorkee
K K S Bhatia	B.E. (Civil Engg.); M.E. (Hydraulics & Hydraulic Structures), Birla Institute of Technology and Science, Pilani; Ph.D., IIT Bombay
A K Bhar	B.E. (Civil Engg.); M.E. (Hydrology), University of Roorkee, Roorkee; Ph.D., University of Roorkee
B Soni	B.Sc. (Ag.Engg.); M.Tech. (Soil & Water Conservation Engg.), IIT Kharagpur; Ph.D., IIT Kharagpur
B C Patwari	B.E. (Civil Engg.), M.E. (Water Resources Development), University of Roorkee, Roorkee
R D Singh	B.E. (Civil Engg.); M.E. (Civil Engg.), University of Roorkee, Roorkee; M.Sc. (Hydrology), Ireland
S K Jain	B.E. (Civil Engg.), M.Tech. (Hydraulics & Water Resources), IIT Kanpur; Ph.D., University of Roorkee, Roorkee
A B Palaniappan	B.E. (Civil Engg.); M.S. (Hydraulic Engg.), IIT Madras; Ph.D., University of Roorkee, Roorkee
V K Choubey	M.Sc. (Applied Geology); P.G. Diploma (Remote Sensing), IIT Bombay; Ph.D., Jawaharlal Nehru University, Delhi.
Bhishm Kumar	M.Sc. (Physics); Ph.D. (Physics), University of Roorkee, Roorkee.
S V N Rao	B.E. (Civil Engg.); M.Tech. (Hydraulics & Water Resources Engg.), KREC,Surathkal
N C Ghosh	B.E. (Civil Engg.); M.Tech. (Water Resources Engg.), IIT Kharagpur
Deepa Chalisgaonkar	B.E. (Electronics); M.E. (Computer Science), University of Roorkee, Roorkee
Avinash Agarwal (Presently on study leave)	B.Sc. (Agril.Engg.); M.Tech. (Irrigation Drainage), G.B. Pant Krishi Evam Praudyogic Vishwavidyalaya, Pant Nagar; M.S., University of Guelph, Canada
S K Singh	B.E. (Civil Engg.); M.E. (Hydraulics & Irrigation Engg.), University of Roorkee, Roorkee
C P Kumar	B.Sc. Engg. (Civil Engg.); M.E. (Hydraulics & Irrigation Engg.), University of Roorkee, Roorkee
Rakesh Kumar	B.E. (Civil Engg.); M.E. (Hydraulics & Irrigation Engg.), University of Roorkee, Roorkee
V C Goyal	M.Tech. (Applied Geophysics); Ph.D., University of Roorkee, Roorkee.
D S Rathore	B.E. (Civil Engg.); M.Tech. (Remote Sensing); IIT Bombay
P K Majumdar	B.E. (Civil Engg.); M.E. (Water Resources Development), University of Roorkee, Roorkee
Jai Vir Tyagi	B.Sc. (Agril Engg.); M.Tech. (Soil & Water Conservation Engg.), IIT Kharagpur
Sudhir Kumar	M.Tech. (Applied Geology); Ph.D., University of Roorkee, Roorkee
S K Mishra	B.E. (Civil Engg.); M.Tech. (Hydraulics & Water Resources), IIT Kanpur
Pratap Singh	M.Sc. (Physics); Ph.D., University of Roorkee, Roorkee
C K Jain	M.Sc. (Chemistry); Ph.D., University of Roorkee, Roorkee
R R Mehrotra	B.E. (Civil Engg.); M.E. (Hydrology), University of Roorkee, Roorkee

S K Jain	B.E. (Civil Engg.); M.E. (Soil Dynamics), University of Roorkee, Roorkee; M.Sc. (Hydrology), Ireland
Anil Kumar (Presently on study leave)	B.Tech. (Civil Engg.); M.E. (Hydraulics & Irrigation Engg.), University of Roorkee, Roorkee
V K Dwivedi	B.Sc. (Engg.); M.Tech. (Civil Engg.), IIT Kanpur; M.E. (Civil Engg.), University of Alberta, Canada
B Chakravorty	B.Sc. (Agri. Engg.); M.E. (Hydrology), University of Roorkee; M.S. (Hydrological Engg.); Delft
M K Goel	B.Sc. Engg (Civil); M.E. (Irrigation & Hydraulics), Punjab Engineering College, Chandigarh
Aditya Tyagi (Presently on study leave)	B.E. (Civil Engg.); M.E. (Environmental Engg.), University of Roorkee, Roorkee
A V Shetty	B.E. (Civil Engg.); M.Tech. (Hydraulics & Water Resources); Mangalore University, M.Sc. (Hydrology), Ireland
Ramakar Jha	B.Tech. (Agri. Engg); M.Tech. (Soil & Water Conservation Engg.), G.B. Pant Krishi Evam Praudyogic Vishwavidyalaya, Pant Nagar
M K Shukla (Presently on study leave)	B.Tech. (Agril. Engg.); M.Tech. (Soil & Water Conservation Engg.), JNKVV, Jabalpur
M K Jain	B.Tech. (Agril. Engg.); M.Tech. (Soil & Water Conservation Engg.), JNKVV, Jabalpur
Chandra Mohan T.	B.E. (Civil Engg.); M.Tech. (Hydraulic Engg.), University of Kerala
R P Pandey	B.Tech. (Agril. Engg.); M.Tech. (Soil & Water Conservation Engg.), JNKVV, Jabalpur
S V Vijayakumar	B.E. (Civil Engg.); M.Tech. (Hydraulics & Water Resources), Mangalore University
A K Lohani	B.Tech. (Agril. Engg.); M.Tech. (Water Resources Dev. & Management), IIT Kharagpur
Y R S Rao	B.E. (Civil Engg.); M.E. (Hydrology & Water Resources Engg.), Anna University, Madras
Vijay Kumar	B.Sc. (Agril. Engg.); M.Tech. (Water Resources Engg.), IIT Delhi; Ph.D., IIT Delhi
Tej Ram Nayak	B.E. (Civil), M.Tech. (WR), PG Diploma, IIRS, Dehradun
B Venkatesh	B.E. (Civil Engg.); M.Tech. (Hydraulics & Water Resources), Mangalore University
S K Goel (Presently on study leave)	B.E. (Civil Engg.); M.E. (Hydraulics & Irrigation Engg.), University of Roorkee, Roorkee
S D Khobragade	B.E. (Civil Engg.); M.Tech. (Water Resources Dev. & Management), IIT Kharagpur
Omkar	B.Tech. (Agril. Engg.); M.Tech. (Soil & Water Conservation Engg.), IIT Kharagpur
P K Bhunya	B.E. (Civil Engg.); M.Tech. (Water Resources Dev. & Management), IIT Kharagpur
S R Kumar	B.E. (Civil Engg.); M.E. (Water Resources), DAV Indore
A R Senthil Kumar	B.E. (Civil Engg.); M.E. (Hydrology & Water Resources Engg.), Anna University, Chennai
S K Verma	B.E. (Civil Engg.); M.E. (Hydraulics & Irrigation Engg.), University of Roorkee, Roorkee
Daya Ram (Presently on lien)	B.Tech. (Civil Engg.); M.E. (Environmental Engg.), University of Roorkee, Roorkee
V S Jayakanthan	B.E. (Civil Engg.); M.Tech. (Remote Sensing), Anna University, Chennai

R D Mehta	M.Sc. (Maths); M.Sc. (Hydrology), Ireland; Ph.D., University of Roorkee, Roorkee
Vemu Sreenivasulu	B.Tech. (Civil Engg.); M.Tech. (Water Resources Engg.), Regional Engineering College, Warangal.
Vivekanand Singh	B.Sc. Engg. (Civil Engg.); M.Tech. (Hydraulics and Water Resources), IIT Kanpur; Ph.D. (Hydraulics and Water Resources), IIT Kanpur
Archana Sarkar	B.E. (Civil Engg.); M.E. (Civil) - Computer Aided Design, University of Roorkee, Roorkee
P K Mahapatra	B.Sc. Engg. (Civil Engg.); M.Tech. (Hydraulics and Water Resources), IIT Kanpur
C Rangaraj	B.Tech. (Agril. Engg.); M.Tech. (Hydraulics and Water Resources), IISc. Bangalore
Shive Prakash Rai	M.Sc. (Geology); Ph.D. (Hydrogeology and Geomorphology), Kumaun University, Nainital
Jiweshwar Sinha	B.Sc. Engg. (Civil Engg.); M.Tech. (Hydraulics & Water Resources), IIT Kanpur
Sudheer K P	B.Tech. (Agril Engg.); M.Tech. (Soil and Water Conservation Engg.), IIT Kharagpur
B K Purendara	M.Sc. (Geology); Ph.D., Cochin University of Science and Technology
Hemant Singh	B.E. (Civil Engg.); M.E. (Hydraulics), University of Roorkee, Roorkee
R V Galkate	B.Tech. (Agril. Engg.); M.Tech. (Soil and Water Conservation Engg.), IIT Kharagpur
C. Chatterjee	B.Tech. (Agril. Engg.); M.Tech. (Soil and Water Conservation Engg.), IIT Kharagpur
Pankaj Mani	B.Sc. Engg. (Civil), M.E. (Civil) Remote Sensing Photogrammetic Engg., UOR, Roorkee
Niranjan Panigarhy	B.Sc. (Agril. Engg.), M.Tech. (WRDM), IIT Kharagpur
Imran Ali	B.Sc., M.Sc. (Chemistry), Ph.D. (Chemistry), University of Roorkee, Roorkee
Nani Gopal Pandey	B.Sc., M.E. (IWM), University of Roorkee, Roorkee
Kamal Kumar	B.Sc. (Civil), Bihar University.
A K Dwivedi	B.Sc., M.Sc. (Physics), M.E. (Hydrology), University of Roorkee, Roorkee
M K Jose	B.Sc., M.Sc. (Meteorology), University of Cochin
P C Nayak	B.Tech. (Civil), M.Tech. (WRE), IIT Kharagpur

Shri V K Jain, Deputy Director (Admn.), GB Pant University of Agriculture & Technology, Pantnagar, joined the Institue as Senior Administrative Officer on deputation basis on 1st May 1997 for a period of one year.

5.2 Scientific and Technical Staff

At the end of the year under report (31st March 1998) the Institute had 99 scientific and technical staff.

5.3 Other Supporting Personnel

At the end of the year (31st March 1998), the Institute had 83 other supporting personnel including one Documentation Officer and three Section Officers.Resignation/Reversion/Lien/ Deputation :

1. Dr P V Seethapathi, Sc F is on deputation as Director, NERIWALM (North Eastern Regional Institute and Water and Land Management), Tezpur, Assam wef 23.1.1998 for a period of three years.

2. Shri Daya Ram, Sc. B is on lien as Assistant Engineer, Public Works Department (PWD), Almora wef 1.9.1997 for a period of two years.

During the year, the following scientists resigned from the Institute :

1. Dr D K Agarwal, Sc C
2. Dr A K Kesari, Sc C
3. Shri Hemant Chowdhary, Sc C
4. Shri M V Rao, Sc B
5. Dr C Kesava Rao, Sc B

During the year the Institute lost a young dynamic scientist B, Dr Baldev Prasad in a train accident.

5.4 Awards and Higher Degrees

- Shri Vivekanand Singh, Sc B has been awarded Ph.D. degree from the Civil Engineering Department, IIT Kanpur
- Shri A K Dwivedi, Sc B has been awarded M.E. Hydrology from the Department of Hydrology, University of Roorkee, Roorkee
- Cash awards for those who rendered meritorious services among the Group B, C and D staff in the Institute were given on 15th August 1997 for the year 1996-97. The list of awardees is given in Appendix-XI.

b. Guidance of ME/M.Tech. dissertations/theses

- Dr S K Jain, Sc E and Mr M K Goel, Sc C guided a ME thesis on "GIS based Water Balance Study of Agricultural Land" of Shri R S Tiwari, WRDTC, University of Roorkee, Roorkee
- Dr Pratap Singh, Sc C guided a M.Tech. thesis on "Application of Passive Microwave Data for Snow Depth and Snow Extent Estimation in part of Himalayas" of Shri Soukhin Tarafdar, Department of Earth Sciences, University of Roorkee, Roorkee.
- Dr P V Seethapathi, Sc F guided two ME theses of Shri S Suresh and Shri B K Gupta of Department of Hydrology, University of Roorkee, Roorkee.
- Dr Bhishm Kumar, Sc E guided ME thesis on "Eutrophication Analysis of Lakes in Kumaun Regions" of Shri Wudneh Ayele, Department of Civil Engineering, University of Roorkee, Roorkee.
- Shri M K Jain, Sc C guided ME thesis on "Estimation of Temporal Variation of Sediment Yield Using GIS" of Shri Binyam Yoseph, Department of Civil Engineering, University of Roorkee.

5.5 Deputation Abroad

The following scientists were sent for training under UNDP Project on "Developing Capabilities for Hydrological Studies - IND/90/003" fellowship training programme:

- Shri R P Pandey, Sc C was deputed to Department of Civil & Environmental Engineering, San Diego State University, San Diego, USA from August 31 to January 1, 1998 for advance training in the area of Data Processing.
- Shri C P Kumar, Sc C was deputed to National Tidal Facility, The Flinders University of South Australia, Adelaide, Australia-5001 from December 31, 1997 to April 30, 1998 for advance training in the area of Deltaic Hydrology.
- Shri S D Khobragade, Sc B was deputed to Department of Water Resources Engineering, Lund University, Sweden from October 18, 1997 to February 17, 1998 for advance training in the area of Lake Hydrology.
- Shri D S Rathore, Sc C was deputed to Department of Land Information, Royal Melbourne Institute of Technology, Melbourne, Australia from December 31, 1997 to 14 April 1998 for advance training in the area of Remote Sensing.
- Dr (Mrs) Rama Mehta, Sc B was deputed to Department of Civil and Environmental Engineering, University of California, Davis, USA from December 31, 1997 to 14 April 1998 for advance training in the area of Mountain Hydrology.
- Shri S K Mishra, Sc C was deputed to Department of Civil Engineering, Louisiana State University, LA, USA from September 17, 1997 to January 17, 1998 for advance training in the area of Remote Sensing.
- Shri R Mehrotra, Sc C was deputed to Department of Civil and Environmental Engineering, University of California, Davis, USA from December 31, 1997 to April 30, 1998 for advance training in the area of Catchment Hydrology.

- Shri Rakesh Kumar,Sc C was deputed to Department of Civil and Environmental Engineering, University of California, Davis, USA from December 31, 1997 to April 30, 1998 for advance training in the area of Hydrometeorology.
- Shri S K Verma, Sc B was deputed to Department of Earth Sciences, University of Waterloo, Waterloo, Canada from October 31, 1997 to February 28, 1998 for advance training in the area of Nuclear Hydrology.
- Dr B K Purandara, Sc B was deputed to University of Idaho, USA from August 1 to December 1, 1997 for advance training in the area of Forest Hydrology.
- Shri V K Dwivedi, Sc C was deputed to Lund University, Sweden from October 18, 1997 to February 17, 1998 for advance training in the area of Lake Hydrology.
- Shri P K Bhunya, Sc B was deputed to Lund University, Sweden from October 18, 1997 to February 17, 1998 for advance training in the area of Catchment Hydrology.
- Shri S R Kumar, Sc B was deputed to Louisiana State University, USA from September 17, 1997 to January 17, 1998 for advance training in the area of Data Processing.
- Shri V S Jaykanthan, Sc B was deputed to National Research Institute, Sasktoon, Saasketchwan, Canada from September 6, 1997 to January 5, 1998 for advance training in the area of Remote Sensing.
- Dr Vijay Kumar, Sc C was deputed to National Tidal Facility, The Flinders University of South Australia, Adelaide, Australia-5001 from July 23 to November 23, 1997 for advance training in the area of Deltaic Hydrology.
- Dr Sudhir Kumar, Sc C was deputed to San Diego State University, USA from August 31, 1997 to January 1, 1998 for advance training in the area of Catchment Hydrology
- Dr C K Jain, Sc C was deputed to Department of Environmental Engineering, Manhattan College, New York, USA from September 17, 1997 to January 17, 1998 for advance training in the area of Environmental Hydrology.
- Dr V C Goyal, Sc C was deputed to US Department of Agriculture, ARS, Coshocton, Ohio, USA from October 31, 1997 to February 28, 1998 for advance training in the area of Hydrological Instrumentation.
- Shri S K Singh, Sc C was deputed to Univ. of Georgia, Athens, USA from December 31, 1997 to April 30, 1998 for advance training in the area of Lake Hydrology.

STUDY TOURS AND VISITS

1. Dr G C Mishra, Sc F was deputed to Centre for Water Research, Department of Environmental Engineering, University of Western Australia, Nedlands; CSIRO, Division for Water Resources, Perth Laboratory; CSIRO, Division of Water Resources, Canberra; School of Civil Engineering, The University of New South Wales Sydney; Australia from February 2-17, 1997 for study tour in the area of Catchment Hydrology.
2. Dr S M Seth, Director was deputed to Unesco, Paris, France to attend the meeting of Unesco Working Group on IHP V Project 5.1: Hydrological Processes in Arid and Semi-arid Zones from April 13-17, 1997.
3. Dr S M Seth, Director was deputed to Unesco, Paris, France, to attend the 25th Session of International Hydrology Programme from June 2-4, 1997.
4. Shri S K Jain, Sc C was deputed to Dublin, Ireland to attend the Conference on GIS IRELAND on October 21, 1997.
5. Dr S K Jain, Sc E was deputed to China, Australia from November 1-16, 1997 for study tour in the area of hydrology.
6. Dr B Soni, Sc E was deputed to Institute of Hydrology, Wallingford, UK; US Department of Agriculture, Washington DC; NASA Maryland; San Diego State University, San Diego, USA from November 23 to December 18, 1997 for study tour in the area of hydrology.
7. Shri N C Ghosh, Sc E was deputed to CSIRO Perth; The Flinders University, Adelaide; University of Wallongong, Wallongong; Australia from December 31, 1997 to January 14, 1998 for study tour in the area of Environmental Hydrology.

8. Dr Bhishm Kumar, Sc E was deputed to USGS Field Office, Menlow Park, San Francisco; Department of Earth Sciences, University of Arizona, Tucson; Columbia University, New York, USA from December 31, 1997 to January 14, 1998 for study tour in the area of Nuclear Hydrology.

9. Mrs Deepa Chalisgaonkar, Sc E was deputed to USGS Field Office, Menlow Park, San Francisco; Department of Biosciences, University of Arizona, Tucson; US Department of Agriculture, Arizona; Columbia University, New York; USA from December 31, 1997 to January 14, 1998 for study tour in the area of Hydrological Instrumentation.

10. Dr V K Choubey, Sc E was deputed to NASA, Maryland; Polytechnique University, New York; San Francisco State University, San Francisco, USA from December 31, 1997 to January 14, 1998 for study tour in the area of Remote Sensing.

11. Shri S V N Rao, Sc E was deputed to Austrlia from December 31, 1997 to January 14, 1998 for study tour in the area of Deltaic Hydrology.

5.6 Higher Studies

The following scientists and staff continued/ were deputed for higher studies on full-time/part-time basis :

1. Shri S K Goel, Sc B is pursuing Ph.D. degree in Agricultural Engineering - Hydrology at University of Idaho, USA (since 1.3.1993).

2. Shri Anil Kumar, Sc C is pursuing Ph.D. in Hydrological Response of a Watershed at Hongkong University of Science and Technology, Hongkong (since 28.9.1995).

4. Shri M K Shukla, Sc C is pursuing Ph.D. in Mathematical Modelling of the Salt Movement in Unsaturated Zone at University of Agriculture, Vienna, Austria (since 4.10.1995).

5. Shri S K Jain, Sc C was pursuing Post Graduate Studies in Hydrology in the University College, Galway, Ireland (since 23.9.1996). He has completed the course, obtained M.Sc. Hydrology degree and rejoined the Institute on 10 December 1997.

6. Shri Aditya Tyagi, Sc C is pursuing Ph.D. degree at Biosystems and Agricultural Engineering Department, Oklahoma State University, Oklahoma, USA (since 2.1.1998). He is on study leave wef. 2.1.98 to 1.1.2000.

7. Shri Avinash Agarwal, Scientist C is pursuing Ph.D. degree at GB Pant University of Agriculture and Technology, Pant Nagar (since 14.1.1998). He is on study leave wef 14.1.98 to 13.1.1999.

5.7 Laboratories

In the second phase of its development (1985-90), the Institute has embarked on a programme for carrying out field and laboratory oriented studies in addition to the computer based studies and research. The following six laboratories are operational at the Institute:-

- Water Quality Laboratory
- Remote Sensing Applications Laboratory
- Hydrologic and Instrumentation Laboratory
- Hydrological Investigations Laboratory
- Soil and Ground Water Laboratory
- Nuclear Hydrology Laboratory

Water Quality Laboratory

The Institute has a modern, well equipped laboratory to monitor physical, chemical and bacteriological parameters in various water bodies like rivers, lakes, aquifers, canals etc. At present, the laboratory has facilities and capabilities to determine about 70 parameters which include major and minor ions, trace elements, pesticides, organic compounds and bacteriological parameters, with different degree of accuracy.

The sophisticated equipment available in the laboratory include Atomic Absorption Spectrometer with FIAS, Gas Chromatograph with thermal conductivity, Flame ionization and electron capture detectors,, Flow Injection Analyzer and Total Organic Carbon Analyzer, Portable direct reading Environmental Laboratory.

In the year 1997-98, the hydro-chemical studies on Hindon river system were carried out. Adsorption of toxic metal ions were studied on the bed sediments to demonstrate the importance of coarser fraction of the sediments in controlling metal pollution. The studies were also carried out

on groundwater contamination in different regions. Trace element contamination studies were also taken up in the arsenic affected districts of West Bengal. The studies on non-point source pollution are under progress. Facilities of the Laboratory were also extended to regional centres and other Divisions of the Institute for their research and studies. The facilities of the laboratory are also being used for the analysis of water samples received from outside agencies.

Remote Sensing Applications Laboratory

The Remote Sensing Application laboratory is equipped with sophisticated instruments and software necessary to carry out visual and digital analysis of remotely sensed data. The task of modernisation of this laboratory initiated during 1996-97 was completed in this year. Upgrade of Integrated Land and Water Information System (ILWIS) 1.3 to WINDOWS based ILWIS 2.1 has been done. Also VGA based Earth Resources Data Analysis System (ERDAS) has been upgraded to WINDOWS based ERDAS IMAGINE 8.3.1 system under UNDP project. A five day training course on ERDAS Imagine was also organised to get all users of this system familiarized with the software. AO size colour image scanner was also installed in the laboratory. Facility for colour printing was also added in the laboratory by installing a laser colour printer capable of printing at 600 dpi in colour mode.

In the current year, ILWIS and ERDAS systems were used for various studies which include soil erosion assessment in Nagwa catchment in Bihar using GIS and kinematic wave theory, topography based rainfall-runoff modelling of Temur catchment in Narmada basin, application of TOPMODEL to Hemavati and Malaprabha basins. Besides these studies work is going on watershed studies in Tehri Garhwal, reservoir sedimentation studies etc.

Hydrological Instrumentation Laboratory

The Institute has a state of art instrumentation laboratory with modern electronic components for developing hydrologic instruments. Presently the laboratory is involved in development of following instruments:

a. Weighing Rain Gauge :

During the year 1997-98, the weighing rain gauge was further tested and the data compared with other available rain gauges in the Institute campus.

b. Weighing Snow Gauge

The snow gauge instrument, along with an imported ultrasonic snow height sensor, and IMD snow gauge were installed and tested at Dhanaulti (elevation 2400 m) in Western UP Hills, and tested for about three months during December 1997 to Feb. 1998.

c. Soil Moisture Instrument for Ground Water Recharge Studies

During the year 1997-98, a field set up for multi-electrode measurements was tested in the Institute's campus.

Hydrological Investigations Laboratory

The laboratory has many field equipment for carrying out a number of hydrological investigations. Some of the important equipment are infiltrometer, Guelph Permeameter, Tensiometer, Turbidity meter, Digital Thermometer, Altimeter, Water Samplers, Water Level Recorder and Current Meters. With the help of these equipment hydrological investigations were carried out in arsenic affected areas of Nadia district, West Bengal during the year 1997-98.

Soil and Ground Water Laboratory

The Soil and Ground Water Laboratory has capabilities for measurement of various hydrological soil and ground water parameters such as infiltration rate, soil density, soil suction head, soil moisture, hydraulic conductivity saturated as well as unsaturated, soil salinity and soil characteristics curve. During this year following equipments have been procured under UNDP project.

1. Mettler moisture analyzer system LP-16
2. Pressure plate apparatus
3 Guelph-in-situ permeability
4. Soil sample ring kit model C
5. ICW Lab permeameter
6. Altimeter
7. Clinometer
8. Bearing compass
9. Microprocessor temperature meter
10. Height meter
11. pH meter

12 Sludge Blanket detector

13 Electric water level gauge

14. Multi volume pycnometer

15 Soil moisture sensor with meters

16. Electronic tensiometer with accessories

17. Tensiometer

The above equipment has been installed and demonstrated during this year. Inspite of routine works of the laboratory, the laboratory facilities have also been used in connection with following studies and sponsored projects.

1. Variation of soil moisture characteristics in a part of Hindon river catchment. Under this study mainly soil texture, soil moisture retention curve and in situ saturated hydraulic conductivity have been determined.

2. Temporal distribution of Dokriani glacier melt runoff and its relationship with meteorological parameters (project sponsored by DST). Under this study the soil texture has been determined using Master sizer.

3. Infiltration gallery in the bed of river Yamuna at Agra. Under this project soil texture, soil moisture retention curve, permeability by ICW permeameter and porosity have been determined.

4. Arsenic studies in the sub basin in parts of Nadia and North 24 Parganas Districts - West Bengal. In this project disturbed and undisturbed soil samples at 48 points have been collected. In situ saturated hydraulic conductivity at various points have also been measured.

Nuclear Hydrology Laboratory

The laboratory is equipped with the instruments such as Ultra Low Level Liquid Scintillation System, Normal Liquid Scintillation System, Multi channel Gamma Ray Spectrometer, Geolog Rate Meter, Neutron Moisture Probe, Neutron Moisture Density Probe, Ultrasonic Depth Indicator, Tritium Enrichment Unit facilities for tritium and carbon dating of ground water, CO_2 sample preparation lines, and Soil Moisture Extraction Unit. These equipments are being used for the field investigations and laboratory analysis for the study of soil moisture movement and estimation of recharge to groundwater, surface water and ground water interaction and lake studies using isotopes, etc.

During the period, a new high performance Germanium detector has been procured under UNDP project.This detector will be very helpful in the measurements of very low environmental Cs-137 and other gamma emitting radioactive elements. The end-use of this detector coupled with the available multi-channel Gamma ray spectrometer will be in estimating sedimentation rates in reservoirs and lakes. Further, many radioactive standards (in liquid and solid forms) have been procured which are essential for instrument calibrations.

The tritium enrichment unit in the laboratory has been made operational and the performance of the cells are being evaluated, which will be used in correcting the measured activity to the true activity of the enriched samples.

Utilising the aluminium pipes procured under the UNDP project and the density/moisture probe, a study on the soil moisture variability has also been initiated in the Hardwar District of Uttar Pradesh.

The Pb-210 dating of sediment samples collected from lake Naini at Nainital using the column-chromatography separation procedures and the ultra-low level liquid scintillation Beta counter is under progress. The estimated sediment age and the chemistry of the sediments will be used for reconstruction of the past lake environment.

During the year 1997-98, Dr R J Drimmie, UNDP consultant from University of Waterloo, Canada visited the Nuclear Hydrology Laboratory and reviewed the improved quality-control procedures and suggested further improvements.

5.8 Technical Facilities

The Institute has the following central technical facilities for use by the various scientific divisions :

i. Computer Centre

The computational facilities available in the Institute include a DEC-2000/300 Workstation. Recently one DEC-255/300 Alpha system has been installed.

In the current year, some Pentium based PCs have been purchased for the headquarters and the various regional centres. To increase the

computational capabilities, additional peripherals, viz, a colour printer DESKJET 690C, a colour scanner HP scanjet 4C, Laserjet printers 6P, multimedia kit etc have also been purchased. DEC 2000/300 server has also been connected with VSAT to provide internet facilities as well as E-mail facilities in the Institute. ARC/Info software has been installed on DEC-255/300 for GIS applications.

A number of PC based software, general purpose as well as hydrological, have been procured and training courses have been organised for various category of users.

The future plans for the expansion of the Computer Centre include procurement of a few PCs and software packages and network facilities for all PCs.

ii. Automated Weather Station

The Institute has an Automated Weather Station (AWS) procured from Australia under the second UNDP project. The AWS is installed in the Institute campus. The hydrometeorological data on rainfall, temperature, humidity, wind speed and direction, solar radiation, soil moisture and soil temperature are being recorded at an interval of 30 minutes. The data are automatically collected and are being used for further hydrometeorological and hydrological analysis.

iii. Workshop

For developing hydrologic instruments and for the maintenance of equipment, workshop plays an important role. The workshop not only helps in carrying out the works entrusted by the maintenance unit but also renders help to scientists in developing prototypes of automated hydrological instruments. During the year the workshop has been used for fabricating evaporimeter,current meter, solenoid valve and sediment sensor.

iv. Library

Realising the crucial role of upto-date library services for conducting high level R&D activities, the Institute since its inception has been in the continuous process of building a good technical library with latest publications in the area of hydrology and water resources.

It has been its endeavour to add modern hydrologic literature to its library. The Library has so far procured 9928 books on the various disciplines of hydrology and water resources, computers and electronics. Out of these 1406 books were transferred to the libraries at the Regional centres of NIH. Besides 3465 technical reports and technical papers were made available by other organisations. The library also has 442 manuals of computer software, 1975 maps,41 microfiche and 305 Indian and foreign standards. The library is subscribing to 34 Indian Journals and 40 Foreign Journals. Three of the Indian Journals are in Hindi. Some books in Hindi were also procured during the year.

5.9. Construction Works at Institute Headquarters and Regional Centres.

A. CONSTRUCTION WORKS AT ROORKEE

The construction activities at the main campus of the Institute and the staff colony of the Institute have progressed satisfactorily during the year. There has been some delay in taking up the construction of approach road to staff colony because of matter relating to provision of compensation to land owners whose land has come under the approach road. Recently, the Ministry has approved the purchase of land coming under the approach road and the concerned land owners have been asked to provide the details of their land ownership so that the process of purchase of land can be completed expeditiously in consultation with District Administration. A brief review of the progress of construction activities during the year is given below :

a. Works Completed during the year :

i. NIH Campus :

Wing - C of IInd Laboratory Block : The building is a two storeyed building with two lecture halls, seating space for scientists and staff and space for laboratory.

ii) NIH Staff Colony :

Internal Water Supply Network The work has been completed by M/s National Projects Construction Corporation Ltd.

b. Work in Progress and Schedule of Completion

i. NIH Campus :

- *Construction of Auditorium :*

The construction of an auditorium with a seating capacity of about 350 persons has been

entrusted to M/s National Projects Construction Corporation Ltd, (NPCC Ltd). The construction was started in May 1997 and the building is scheduled to be completed by December 1998. Presently 50% work has been completed.

ii. NIH Staff Colony :

❑ *Reception-cum-Guard Room-cum-Gate :*

The work was entrusted to University of Roorkee. However, because of some reasons, the Institute had requested the University of Roorkee to hand over the work to the Institute in incomplete position. The work has been handed over to NIH recently and now the work has been entrusted TO NPCC. The work has been started by NPCC and the expected date of completion is May 1998.

❑ *Sub-Station & Pump House :*

The work was entrusted to University of Roorkee, however, because of some reasons, the Institute had requested the University of Roorkee to hand over the work to the Institute in incomplete position. The work has been handed over to NIH recently and now the work has been entrusted to NPCC. The work has been started by NPCC and the expected date of completion is May 1998.

❑ *Two Blocks of Scientists B & C Residences (12 residences) :*

The work has been entrusted to M/s NPCC Ltd., in January 1997. About 90% work has been completed. The buildings are expected to be ready by April 30, 1998.

❑ *Raising of Boundary Wall :*

The existing boundary wall was constructed by the University of Roorkee. Keeping in view the security requirements of staff colony, it has been decided to raise and strengthen the existing boundary wall. The work has been entrusted to M/s NPCC Ltd. The Institute has received structural drawings which are being scrutinized. The work is expected to start in April 1998 and expected to be completed by August 1998.

Regular meetings are being held with the officers of University of Roorkee and M/s NPCC Ltd., Delhi for monitoring the progress of construction works. During the year 4 such meetings were held.

(B) CONSTRUCTION WORKS AT PATNA

The construction activities at Ganga Plains North Regional Centre (GPNRC) have been completed. These include two residences for senior scientists, 4 residences for middle and junior level scientists and an excellent office building. During the year some minor internal works were completed. The office has been shifted to Main Office Building.

(C) CONSTRUCTION WORKS AT KAKINADA

The construction works for the Regional Centre at Kakinada were entrusted to M/s NPCC Ltd., Southern Zone as a deposit work. So far, boundary wall and laboratory sheds (with three halls) have been completed and physically handed over. Presently, the laboratory sheds were being used to house the office of the Regional Centre also besides housing the laboratories. The construction of the Administrative Building is also completed. The land developmental activities, street lighting and construction of roads have also been entrusted to M/s NPCC Ltd., and these are 75% completed. It was expected that building would be ready for occupation by the end of December, 1997. However this was delayed due to some problems of Contractor. NPCC was requested to issue necessary orders for expeditious completion of all the works.

6.0 Consultancy and Sponsored Project

From the inception, besides regular R and D work, the Institute has been carrying out studies referred to it by the various State and Central Government organisations on consultancy basis. Their number has been kept under a reasonable limit with a view to provide more weightage to research activities. Some research projects were sponsored and funded by Government organisations. The list of consultancy/sponsored projects on which the Institute worked/and is working during the year is given in Appendix VI. During 1997-98, studies were carried out in the following consultancy/sponsored projects.

ON-GOING CONSULTANCY PROJECTS :

6.1 Study of Interaction of Surface and Groundwater for River Ganga from Narora to Kanpur

This consultancy project has been referred and sponsored by Investigation and Planning Division of Water Resources Department, UP. 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 lean flow period. The data required for the study have been supplied by the sponsoring agency. The mathematical model for interaction of river and multiple aquifer system has been formulated. The expression for computing the river resistance parameter has been derived. An interim report has been prepared and submitted to the Project Authorities. The study is under progress.

6.2 Hydrogeological Studies at Jhamarkotra Mines

This project has been referred by Rajasthan State Mines and Minerals Ltd. with the objective to carry out ground water modelling to suggest the network of pumping wells to achieve the required drawdown in the Jhamarkotra Mines area in Udaipur district of Rajasthan. The following aspects were proposed to be studied under the project :

(i) identification of source of recharge to the water bearing rockphosphate and ground water potential zones,

(ii) a total water management plan, design and the effective dewatering wells to achieve drawdown of 15 m per annum,

(iii) computer aided ground water model of the area,

(iv) regional effect of mine dewatering on groundwater regime in the area, and

(v) any remedial measures to stop/reduce water ingress to the pit.

During the last two years, the determination of distributed aquifer parameters using an optimization based numerical technique has been carried out. The source of water to the mines has been identified as rainfall recharge. The studies indicate that there is no sub-surface flow from adjoining area. Locations for installation of tubewell were suggested to RSSML. The tubewells have been found to be suitable for achieving drawdown of 15 m.

The study is under final stage and it is likely to be completed by 1998.

6.3 Indigenous Development of data logger and sensor unit for watershed hydrology

This project has been sponsored by National Land Use and Conservation Board, Division of Soil

Conservation, Ministry of Agriculture, Government of India. A data logger based on powerful micro controller 8031 has been developed with the external assistance of M/s MICRON , Roorkee. This data logger has the provision to use one raingauge having one tipping bucket system, one weighing system, one temperature sensor including solenoid valve; and one water level sensor based on optical shaft encoder technique and four suspended sediment-cum-flow velocity sensors. Provision has also been made to use solar penal for charging DC 12V, 24AH battery for the uninterrupted working of the data logger. The data of rainfall, water level/stage and suspended sediment can be stored in a memory module at preselected time interval and data can be transferred on to the PC directly in the field or it can be transferred to PC in the laboratory by replacing the memory module from the data logger. The development of the data logger has been completed and it is under testing.

The typical rainfall sensor, water level sensor and suspended sediment-cum-flow velocity sensors have been developed at NIH. Provisions have been made in the sensors as well as software to make the sensors fully automatic in order to remove all the manual errors.

The operating manuals of the sensors developed at NIH with the details of laboratory testing for submitting to the authority of Ministry of Agriculture, Government of India, New Delhi in March 1996. In view of the above, the presentation of the sensors and testing were made before the project authorities on 5th August 1997. After the presentation, it was decided that these sensors should be tested and compared with the imported/reputed Indian instruments in field.Therefore, these sensors and data loggers are to be installed at Indo-German Project site namely Arki in Himachal Pradesh in the first week of June 1998.

6.4 Hydrological Studies of Lake Naini, District Nainital

This project has been sponsored by the Directorate of Environment , Government of Uttar Pradesh, through Naini Lakes Development Authority, Nainital. The study of water balance, sedimentation rates/pattern, hydrodynamics and pollution aspects of Lake Naini were proposed to be carried out using conventional as well as advanced technique. The Institute has completed the study of water balance, sedimentation rate/ pattern and the estimation of useful lake life using isotope techniques. The hydrodynamics and pollution aspects of the lake are being studied. The following actions have also been taken :

i. An interim report-I covering various hydrological aspects of lake Naini including preliminary studies carried out was submitted to the Department of Environment, Government of UP, Lucknow in 1994.

ii. On the basis of the studies carried out in the year 1994-95, 1995-96 and 1996-97 an interim report-II was prepared covering the details of the progress of various studies and was submitted to the project authorities.

The hydrological water balance of Lake Naini has been computed using conventional as well as isotopic techniques. It has been found that the lake receives 47% of its total inflow as subsurface inflow, 25% from surface runoff and balance through the drains and direct precipitation. Pumping from the lake accounts for 47% of the total outflow and 33% by over flow and discharge from the sluice gates, the remaining is lost by the evaporation. The average residence time of lake water is 1.49 years.

The study of effect of sedimentation on the lake environment reveals that out of the total increase in surface outflow in the last 40 years, approx. 23% has been increased due to reduction in lake's capacity and 77% due to reduction in subsurface outflow as a consequence of a sedimentation.

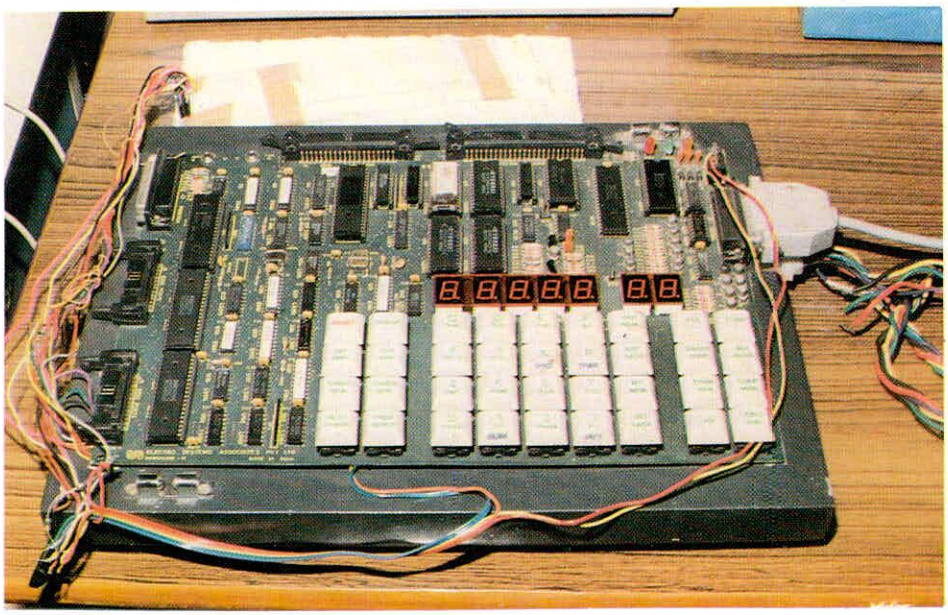
The water quality analysis of lake Naini indicates that the lake is phosphorus dominated and phosphorus & lead are the major pollutants. The eutriphication study of different lakes in Kumaun region indicated that lake Naini is the most eutrophied lake (hypereutrophic) out of all the five lakes.

The gist of the final report has been prepared and submitted to the Project authorities while, the draft of the final report is proposed to be submitted by the end of June 1998.

6.5 Temporal Distribution of Glacial melt runoff of Dokriani

Glaciermelt and its Relationship with Meteorological Parameters. The project is sponsored by Department of Science and Technology, Government of India. Glaciers and snow are reservoirs of fresh water and the melt from them

AUTOMATIC WEATHER STATION INSTALLED IN TEHRI WATERSHED, U.P.



FABRICATION OF INDIGENEOUS INSTRUMENT

DOKRIANI GLACIER DISCHARGE GAUGING SITE OF NIH ROORKEE,U.P.

FORMATION OF A SNOWBLOCK FOR DETERMINATION OF SNOWMELT FACTOR

reaches the Himalayan rivers during spring when the contribution from other sources is at its lowest. However, during summer the melt-rate increases and together with rain could cause flooding in some years. Also because of the unstable soil, steep slopes and high velocities of the flows the sediment carried by the melt streams is high and causes not only silting of the reservoirs downstream but is also known to damage the turbines of hydroelectric power stations. Study of the hydrological aspects of the glaciers and their melt is, therefore, very vital.

Though glaciers have been known as a source of water since long, very few studies on the hydrological aspects of the glaciers have been done. For the last ten years scientists in the Institute have been involved in studies of the hydrological aspects of glaciers.

The Institute is involved in carrying out detailed hydrological study of Dokriani glacier including determination of total melt water yield from this glacier and its distribution with time. It involves collection of the meteorological and hydrological data near the snout of the glacier for a period of 3 years during summer period. A standard hydrometeorological observatory equipped with all important meteorological parameters with rain gauges, evaporimeter, thermograph, hydrograph anemometer, wind vane and sunshine recorder has been set up at about 4000m altitude. Continuous monitoring of glacier melt runoff is made using an automatic water level recorder installed in 1995 at the gauging site near the snout. Suspended sediment samples were collected at specified timings. Storage and drainage characteristics of the glacier have been studied and are found very peculiar which produced a delaying effect on runoff generation. The melt water produce a delaying effect on runoff generation. The melt water yield from the glacier and its distribution with time has been determined. Relationships between glacier melt runoff and meteorological parameters are being established.

6.6 Development of Instruments for Automation of Irrigation Scheduling and Groundwater Recharge Monitoring Using Soil Moisture Measurements.

This project was sponsored by the Ministry of Agriculture, Government of India for development of an insitu instrument for soil moisture measurements.

Under this project, a prototype instrument was developed during the year. Further work is in progress for testing of the instrument under laboratory and field conditions.

6.7 Exploration of Construction of Infiltration Gallery Inside the Bed of River Yamuna at Agra

This project has been sponsored by Uttar Pradesh Jal Nigam, Agra. The city of Agra, with a population of more than one million, is situated on the right bank of river Yamuna. The drinking water supply to Agra city is mainly through water drawn from river Yamuna. The water of the river is highly polluted, which is also used as a receiving body for the waste water disposal from Delhi, Faridabad, Mathura and also from Agra itself.

Agra Jal Sansthan has a water works complex on the right bank of the river Yamuna, which draws water from the river through a channel. A huge amount of money for chemicals are spent to treat this polluted surface water to make it potable. Therefore, it has become necessary to tap good quality sub-surface water for drinking water supply. Most of the ground water present around Agra city is brackish in nature and is not good for drinking. Considering the brackish nature of groundwater and thin layers of aquifer intracalated with clay layers, only feasible way to get good quality water is by tapping the sub-surface water through radial collector wells/infiltration gallery in the bed of river Yamuna.

The objective of this project is to study the feasibility of construction of infiltration gallery in the river floodplain near both water works (existing and new) at Agra, to provide good quality sub-surface water from the bed of river Yamuna.

The first interim report has been prepared and submitted to the Project Authorities in Feb. 1997. Draft final report is in final stages of preparation.

6.8 Hydrological Studies of Myntdu Leska Catchment

On the request of Meghalaya State Electricity Board, Govt of Meghalaya a consultancy project on Hydrological Studies of Myntdu Leska catchment,

where the department had proposed a Hydro Electric project in 9th plan, was undertaken by the Institute. All available data were collected and a formal proposal with detailed terms and conditions was prepared and sent to Meghalaya State Electricity Board.

Preliminary frequency analysis was carried out with the available data. Further processing and analysis of data is in progress.

6.9 Integrated Hydrological Study (Instrumentation, Investigations and Modelling) for Sustainable Development and Management of Two Hilly Watersheds in U.P.

The Department of Science and Technology-sponsored project involves hydrological investigations in two small hilly watersheds located in Tehri-Garhwal District (UP), representative of the mountainous subhumid agro-ecological region in the Western Himalayas. Both these watersheds are of 1,000 ha area approx., and are about 10 kms apart. One of the watersheds has received treatment under watershed management scheme (operated by the UP Govt and local NGOs) whereas the other watershed is an untreated one, thereby making available an ideal set of paired watersheds. Some baseline data (mostly on socio-economic aspects) has already been collected under the previously operated scheme in these areas.

Using an integrated approach of hydrologic instrumentation, field investigations, and remote sensing and Geographical Information System (GIS), the project envisages to evolve appropriate model for integrated and sustainable development in the two watersheds. This would provide techniques and methodologies which could be used as a guide to the behaviours of other small mountainous watersheds where only basic hydrometeorological data might be available.

The specific objectives of the project include the following major indicators, besides being aimed as a pilot project for demonstration to the interested users (e.g. students, academicians, researchers, administrators, NGOs):

1. Erosion and sediment control strategies
2. Changes in land use and vegetative cover
3. Rainfall-runoff studies
4. Soil and water conservation (including springs rejuvenation) strategies
5. Hydrologic simulation modelling
6. Devise mechanism for people's participation in sustainable development of small watersheds.

The equipment installed in the watersheds during 1997 included

(i) Automated Weather Station; and

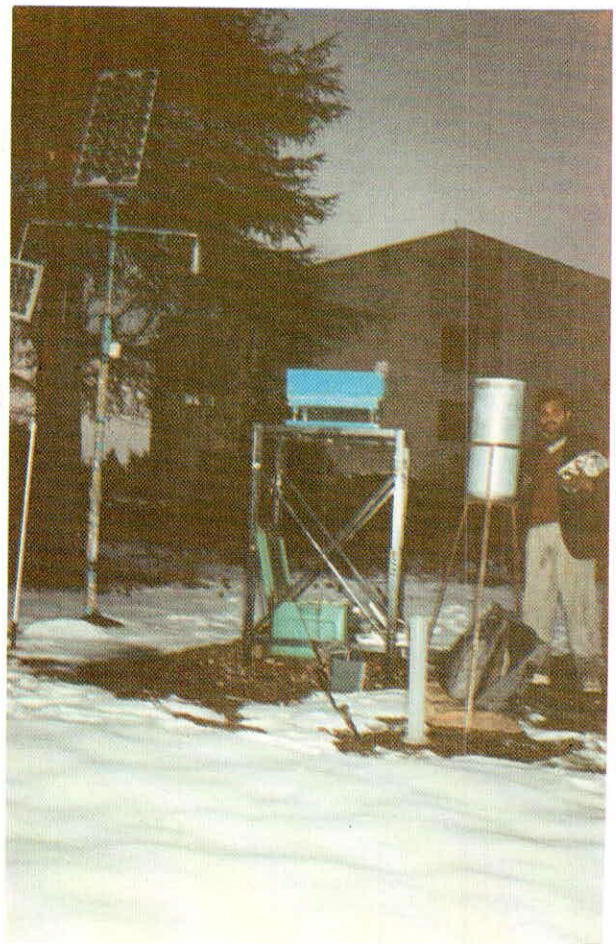
(ii) Tipping bucket rain gauges. Hydrometeorological data and maps were collected from available sources. Discharge measurements have been carried out for the springs in this area.

Yearly progress report has been submitted to the funding agency - DST, Government of India, New Delhi

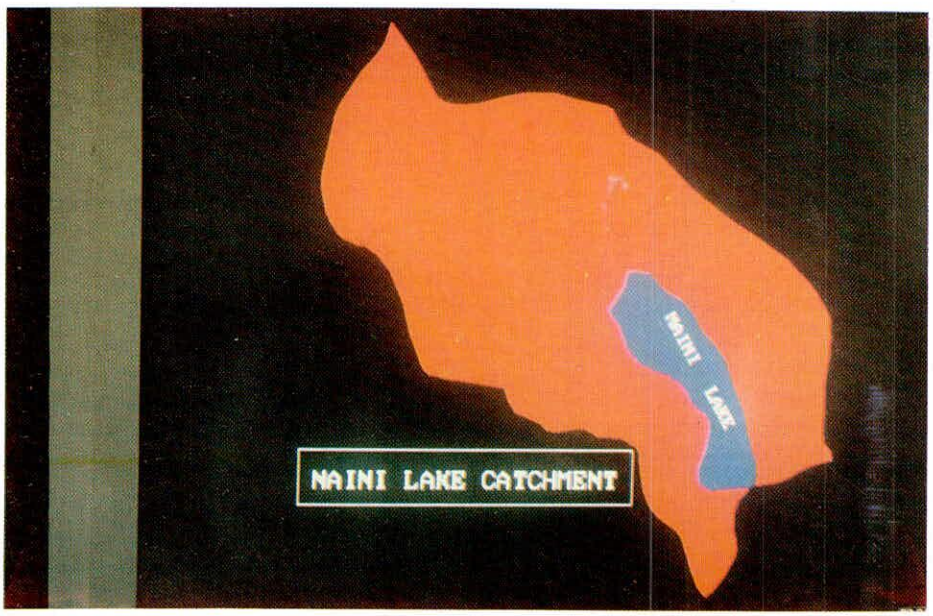
The Institute has retained its repute in scientific community by undertaking limited sponsored and consultancy studies having a bias towards basic and applied research.The objective of such schemes is not only to assist the funding agencies in solving their hydrological problems but also to update and modernize the existing techniques employed for planning, development and management of water resources resulting in efficient, effective and cost effective hydrologic and hydraulic design. The taking up of the above mentioned demand driven research studies has given the scientists an insight into field situations and problems.

INFILTRATION TEST IN PROGRESS IN NAINITAL LAKE CATCHMENT, UTTAR PRADESH

INSTALLATION AND TESTING OF WATER LEVEL, RAINFALL AND SEDIMENT SENSORS DEVELOPED BY THE INSTITUTE AT ARKI IN HIMACHAL PRADESH



TESTING OF WEIGHING SNOW GAUGE AT DHANAULTI IN U.P.



A MAP OF NAINI LAKE CATCHMENT UTTAR PRADESH BY REMOTE SENSING TECHNIQUE

7.0 International Collaboration

7.1 Developing Capabilities for Hydrological Studies UNDP Assisted Project

A project worth US $ 3.00 million titled, 'Developing Capabilities for Hydrological Studies' assisted by UNDP under the Third Country Programme was in operation in the Institute since November, 1991 with the following objectives:

i. To develop capabilities/facilities at the Institute for undertaking hydrological studies for optimal utilization of water resources in order to meet the growing demands of rising population of the country.

ii. To establish capacity and capability in NIH Regional Centres to undertake water balance studies in catchments with different water balance characteristics in three identified regions.

The project which started in November, 1991 was originally scheduled for a period of 5 years and was extended subsequently for the 6th year, and has been completed by 31st December, 1997 All scientists who went for their study tour/training abroad by the end of December, 1997 have also returned by 30th April, 1998.

The technical approach chalked out to achieve the objectives of the project was that the NIH would enhance its know-how and expertise in the specified areas of research and studies through:

- ⊙ Study tours abroad by senior scientists/officers to locate suitable consultants and institutions for training and technology transfer equipment.
- ⊙ To identify and procure state-of-art equipment to conduct studies in specified areas of hydrology.
- ⊙ To arrange for visits of consultants to train the scientists of the NIH
- ⊙ To depute scientists at junior levels for fellowship training in foreign countries.
- ⊙ To conduct research and studies in the identified areas.

The twelve areas of hydrology which have been strengthened the project are as follows :

i Hydrological Instrumentation
ii. Deltaic Hydrology
iii. Nuclear Hydrology
iv. Hydrometeorology
v. Lake Hydrology
vi. Catchment Hydrology
vii. Data processing and Analysis
viii. Snow Hydrology
ix Mountain Hydrology
x. Remote Sensing Applications.
xi. Environmental Hydrology
xii. Forest Hydrology

Besides, the following existing laboratories were also strengthened:

- ♦ Remote Sensing Laboratory
- ♦ Water Quality Laboratory
- ♦ Computer Centre
- ♦ Surface Water Laboratory
- ♦ Ground Water Laboratory

It was expected that once the project is completed, the Institute will possess trained scientists and capabilities for technology transfer

in identified areas. The expertise achieved by the Institute through the project will be disseminated to the various agencies associated with the responsibilities of water resources development in the respective region through the technology transfer programme of the Institute. In order to disseminate the information to user agencies, it was proposed to have an exclusive extension service division. This division will be able to carry out technology transfer programme in the form of workshops and short duration training courses, arrange lecture notes, document the same, transfer the computer models on to the PCs available with state/central agencies/ departments and facilitate the transfer of technology in an effective manner.

Visits of Consultants

The project had a provision of inviting consultants to train the scientists at the Institute and its regional centres in the different areas of hydrology. The purpose for inviting consultants was to provide guidance to the scientists in relevant areas and to identify suitable software preferably for use on personal computers and to develop mathematical models and software in the relevant area using Indian data and to advise the scientists with the development of low cost instruments. The consultants were identified by committee headed by Secretary, MOWR with Chairman, Central Water Commission and Director, NIH as members.

Forty three visits of consultants have been made in different areas. The area-wise list of consultants is given at Appendix XII-c. These consultants provided guidance in the studies being conducted at the Institute. They have implemented various software using Indian data. The technology transfer activities were also carried out.

Study Tours

The study tours of senior scientists was to organise for familiarization of research activities in different areas at selected centres of excellence abroad. The senior scientists were to identify consultants in different areas who could train the scientists of the Institute in different universities/ research organisations and to identify the latest equipment, software, books and journals etc. in the relevant areas.

The Project Director, Project Coordinators, Senior Scientists of the Institute and Senior Officers of Ministry of Water Resources visited developed countries like, USA, UK, Japan, Thailand, China, Hongkong, Canada, West Germany, France, Netherlands, Switzerland, Sweden, Thailand, and Australia. These visits involved discussions with experts in different areas of hydrology such as Catchment Hydrology, Hydrometeorology, Environmental Hydrology, Lake Hydrology, Data Processing, Forest Hydrology, Mountain Hydrology, Nuclear Hydrology, Remote Sensing and Hydrological Instrumentation. The list of Senior Scientists and Officers who visited abroad under the project is given at Appendix XII-b. These senior scientists identified the various places of training for the scientists, identified the probable consultants and visited various laboratories to identify the equipment for adopting the latest technology. The various software available in the relevant areas were also identified.

Training of Scientists

The project had a provision of training of scientists C and B working at NIH Roorkee as well as at NIH, Regional Centres. The scientists who have been identified for training abroad were required to fulfill certain conditions stipulated. The scientists were asked to prepare status reports in the area of training and the training programmes of the scientists were drawn up. They received training at one or two places abroad during their training period which was of normally 4 calendar months. During the fellowship training scientists were required to work on specific area which was identified by the Institute in consultation with the training Institute. The scientists who were identified for training were sent for training in developed countries like USA, UK, France, Germany, Canada, Sweden, Australia in different identified areas. The scientists after returning from training prepared Training Report and are working in their area of training. The area-wise lists of scientists who went on training is given at Appendix XII-a.

Equipment

The project had a provision of procuring the state-of-the-art equipment which are not being manufactured in the country. The equipment procured under the project are given at Appendix XII-d. With the help of these equipment, various studies are being undertaken.

Achievements

i. Hydrological Instrumentation

The Hydrological Instrumentation Division was opened in the Institute and various studies are being conducted. One scientist went on training to USA and one study tour was performed in the area. Three visits of consultants were arranged. Various equipment like Automatic Weather Stations, Data Loggers, Precipitation Gauge and Accessories for developing certain hydrological instruments indigenously were procured. The equipment procured under the project are also being utilized for field studies.

ii. Deltaic Hydrology

Deltaic Hydrology is one of the important areas of Hydrology. A Regional Centre at Kakinada has already been established. One consultant from Australia visited the Institute in the area of Deltaic Hydrology. One senior scientist went to Australia on study tour and three scientists were trained in Australia and United Kingdom.

iii. Nuclear Hydrology.

Three consultants from University of Arizona, USA and Environmental Isotope Laboratory, University of Waterloo, Canada visited the Institute to guide the identified scientist. One study tour of the Divisional Head, Nuclear Hydrology Division to USA was performed and two scientists went on training to University of Paris, France and University of Waterloo, Canada respectively.

The various equipment like Normal Liquid Scintillation Counter, Quantulus Ultra Low level liquid Scintillation Counter, Neutron Moisture and Density Gauge, Geolog Rate Meter, High Performance Germanium Detector, Multi channel Gamma Ray Spectrometer, Sediment Corer, Coaxial Detector and various reference material were procured under the project. These equipment are being used in various studies.

iv. Hydrometeorology

Two scientists went on training to Colorado State University, and University of California in USA. One study tour was undertaken to Sweden and Switzerland. Three consultancy visits from University of Lund, Sweden and Colorado State University, USA were arranged.

v. Lake Hydrology

Lake Hydrology Division has been strengthened. Four scientists were sent on training to University of Lund, Sweden. One study tour of the Divisional Head of this division was arranged to Canada. Two consultants from university of Lund, Sweden and one from National Hydrology Research Institute, Canada visited the Institute under lake hydrology.

vi. Remote Sensing Applications

Four scientists were sent on training under this area to CSIRO, Australia; National Hydrology Research Institute, Canada, Louisiana State University, USA and RMIT, Australia. One study tour of the Divisional Head, Remote Sensing was arranged to Australia and four consultancy visits from USA and Canada were also arranged.

vii. Environmental Hydrology

The division was strengthened by arranging training of four scientists in Canada and USA, two to University of Waterloo,and one each to US Environmental Protection Agency, and University of Manhattan. Five consultants from USA, Canada, Australia and Sweden visited in this area. Two study tours of the Divisional Head of this division was arranged to Germany and Australia.

viii. Mountain and Snow Hydrology

The Mountain Hydrology Division of the Institute was strengthened by providing training of two scientists in the Mountain Hydrology in USA at University of Washington and University of California and training of one scientist in Snow hydrology at University of British Columbia, Canada. One study tour of a senior scientist was arranged to USA. Three consultants in Mountain Hydrology visited from Colorado State University, New Mexico State University, USA and Geographisches Institut Abteolung Hydrologie, Switzerland. Further three consultants from canada, USA and Switzerland visited the Institute in the area of Snow Hydrology.

Laboratories

The following existing laboratories have been strengthened :

- Remote Sensing Laboratory
- Water Quality Laboratory

- ❖ Computer Centre
- ❖ Surface Water Laboratory
- ❖ Ground Water Laboratory

a. Remote Sensing Laboratory

Equipment like ERDAS, Laser Colour Printer, Digital Curvimeter, Image Scanner and Digital Planimeter were procured. Various studies are being conducted by using these equipment.

b. Water Quality Laboratory

Equipment like Atomic Absorption Spectrometer, DREL/2000 Portable Laboratory have ben added to strengthen the Water Quality Laboratory. Various studies have been conducted by using these equipments.

c. Computer Centre

The following software packages were procured : VT 340 Console Terminal, RA 90 Disk Drive, Alpha Work Station 255/300, ARC/INFO 7.04 Digital Unix CD ROM, DEC 2000/300, and various software like TURBO C++++, Microsoft window 3.1, Quarto Pro, USDA Water Erosion Prediction Project, PASSSFA (Parameter Selection System for Streams in Frontal Areas, PUSE VER 1.04, Pagemaker V5.0, Aldus Freehand, HEC-1, HEC-2, HEC-5, HEC-RAS, FFA,STATs, COED, HEC-DSS, WRAP, F-PROT, MODFLOW, INTRANS-01, AQUASEA-03, TECHWORDS3-01, PLOTCHEM-01, SWIM-01, SUTRA-01, FLOTHRU-01, CTRANW-01, SOILPROP-01, WATERSHED, FLONET, SWIFTS, FLOWCAD, SEEP, Hydrological Application Soft, Pesion and Alpha Test, Muskingum, ICS CLARK, DINRETN, LINREG, SPIECHER, fiering, ls, suliv, asm step, HAR7SIM, SEEP/W, CTRAN/W, RETEC WMS(PWIN), MODRET, MODFLOWP, Hydrofind, Hydrofind Data Base, MS Office, MS Fortran, MS-VMS, TECPLOT+.

d. Surface Water Laboratory

The Surface Water Laboratory is under establishment and equipments like Electromagnetic Current Meter, 10AU Field Fluorometer, Ultrasonic Velocity Profile (UVP) have ben procured for this laboratory.

e. Ground Water Laboratory

The existing Soil and Ground water Laboratory has been strengthened by adding new equipment like Master Sizer-E System, Wide Range pF meter Model DIK-3400, Unsaturated permeameter Model DIK-4150, Metler Moisture Analyzer System, Multi Volume Pycnometer 1305, Soil Moisture Sensors with Meters, Electronic Tensiometer with Accessories, Pressure Plate Apparatus, Guelph Permeameter, Soil Sample Ring Kit Model 'C' ICW Lab Permeameter, Altimeter, Clinometer, Bearing Compass, Height Meter, Microprocessing Temp. meter, pH meter, Sludge Blanket Detector, Electronic Water Level Gauge, Spares for Mastersizers and other associated accessories have been procured. Several studies are being conducted using these equipment.

7.2 Hydrology Project

The main role of National Institute of Hydrology (NIH) in the 'Hydrology Project' is to strengthen and expand Institute's capabilities for training to serve the important training objectives in the Hydrology Project namely

(i) Data collection and processing procedures

(ii) Use of computers and software for water data management and

(iii) Skills in the use of specialised laboratory and field equipment.

Besides organising advanced computer courses for Data Base managers and Data Base supervisors, a major responsibility of the institute would be to provide training of trainers (TOT) in the required skills through short courses run at Roorkee and in the states. NIH would also advise the states on the content of the training courses which would be subsequently run in house by the state agencies. In addition, NIH would also organise courses for senior level officers from the states on selected specialised topics for application to field problems.

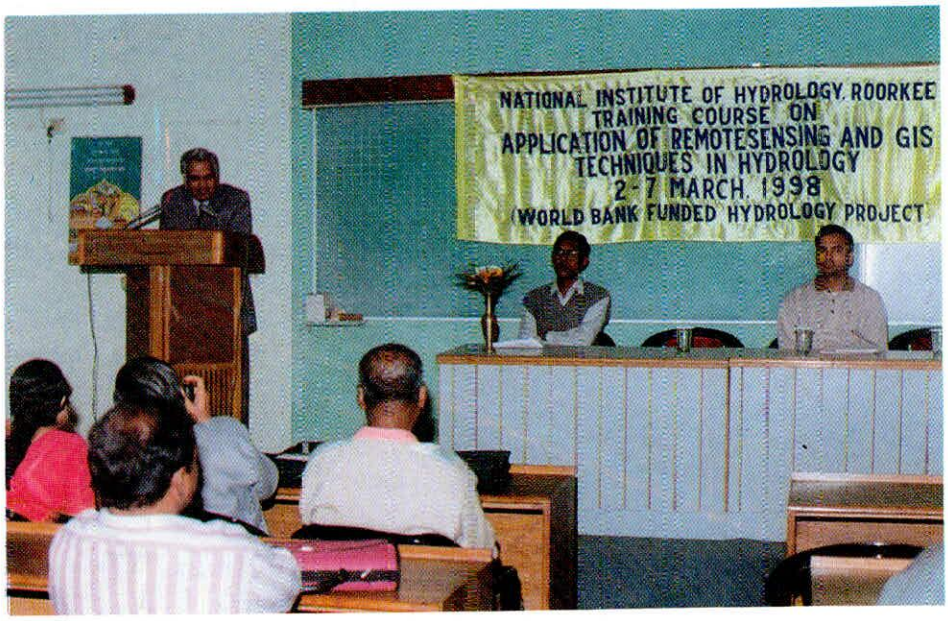
The following activities were envisaged to be undertaken by the National Institute of Hydrology under the Hydrology Project during the year 1997-98 :

i. Training of Officers of the participating agencies

ii. Undertaking demand driven research and development projects

iii. Training NIH scientists/scientific staff in courses organised by other agencies.

iv. Procurement of training equipment and field equipment



DIRECTOR, NIH INAUGURATING THE TRAINING COURSE ON "APPLICATION OF REMOTE SENSING AND GIS TECHNIQUES IN HYDROLOGY

FACULTY AND PARTICIPANTS OF TRAINING COURSE ON BASIC COMPUTER SKILLS

A brief review of these activities is given below :

i. Training of Officers of other Agencies:

The Institute has organised the following courses during 1997-98 :

S. No.	Title of Course	Period	Duration	No. of Participants
1.	Basic Computer Skills	15-25 Oct. 1997	Two weeks	11
2.	Application of Remote Sensing & GIS Techniques in Hydrology	2-7 Mar. 1998	One week	24

ii. Research and Development Projects :

Scientists of NIH visited the study areas in the states of Andhra Pradesh, Karnataka, Kerala, Maharashtra and Orissa and helped the states in the formulation of proposals for the following R&D projects for funding under the Hydrology Project:

S. No.	Title of R&D Project	State	Status
1.	Fresh Water-Saline Water inter relationships in the Multi-aquifer system of Krishna Delta	Andhra Pradesh	Approved
2.	Estimation of Irrigation Return Flow in the Lokapavani area of Krishnaraja Sagar Command	Karnataka	Proposal being finalised by NIH/DHV
3.	Joint Reservoir Operation Studies for Ujjani Reservoir in Bhima	Maharashtra	-do-
4.	Ground Water Modelling for Karamana River Basin	Kerala	Proposal being prepared
5.	Measures for Artificial Ground Water Recharge in Alluvial and hard rock areas.	Maharashtra	Proposal being prepared
6.	Conjunctive use studies Command Areas of Major Irrigation Projects.	Orissa	Proposal being prepared

Necessary action has been initiated for starting the work on the project "Fresh Water Saline Water inter-relationships in the Multi-aquifer system of Krishna Delta" which has already been approved by the Research and Development Evaluation Committee of Ministry of Water Resources, New Delhi.

iii. Training of NIH Scientists

Two scientists of NIH were trained in the Training of Trainers course on Hydrometery organised by CTU, Pune during September 1997 and December 1997.

iv. Procurement of Training and Field Equipment

Training (audio visual) equipment namely CRT video projector, slide projector and visual presenter have been procured.

The Institute has requested Central Water Commission to procure 3 packages of Type D computer along with related software. Similarly the Central Ground Water Board has been requested to procure software for ground water data management and compatible computer hardware. These two organisations have already invited international competitive bids for this purpose.

8.0 Technology Transfer and Mass Communication

One of the main objectives of the Institute is to transfer the developed/implemented technology. To achieve this objective, the Institute has been organising short duration workshops on various important topics of hydrology at Roorkee and in the States. The Institute is also organising national, regional and international courses, seminars and symposia. Dissemination of the methodologies developed at the Institute is also carried out through preparation of publications and circulation of these reports, manuals and publication of technical papers.

8.1 Organisation of Workshops

Dissemination of up-to-date technology to the user agencies is very necessary. Hence technology transfer activities form an important component of the Institute's activities besides publication and circulation of reports of studies and research. The Institute has been organising short duration workshops dealing with specific areas in hydrology for transfer of relevant theoretical background as well as methodologies including computer programmes to field engineers of central and state Government organisations in the country. The workshops on any new topic are first organised at Roorkee where the participants are given the complete course material including listing of computer programmes and they are provided with opportunities of working on the computer using field data. On specific requests and response from the concerned State organisations, the workshops are then organised in States. Such workshops on the flood frequency analysis, unit hydrograph techniques, design storm and design flood, processing and analysis of rainfall data, application of remote sensing techniques, and other topics of hydrology have been organised in a number of States. The Institute is continuing the technology transfer programme and adding new topics for organising short duration (five days) training workshops for the benefit of the States as in earlier years.

During the year, 8 workshops were organised in Karnataka, Andhra Pradesh and Roorkee. The details are given in Appendix XIV.

Field engineers, scientists and academicians from several central and state Government organisations, academic institutes participated in the workshops. The workshops/courses were well received and appreciated.

8.2 Organisation of Brain Storming Sessions

Brain Storming Session on "Hydrological Problems of Coastal Region"

A one day Brain Storming Session on "Hydrological Problems of Coastal Regions" was organised by the Deltaic Regional Centre of National Institute of Hydrology on April 23, 1997 at Chennai.

8.3 Publication of Newsletter

The Institute publishes a half-yearly Newsletter titled 'Jalvigyan Samachar'. This Newsletter contains abstracts of studies and research carried out by the Institute and information on the activities of the Institute. News items on the activities relating to hydrology and water resources from other organisations are also published. The newsletter is circulated to about 500 Central and State Government organisations and academic and research institutes dealing with hydrology and water resources.

8.4 State of Art Reports

In pursuance of its objectives to prepare and periodically update the state of art in different branches of hydrology and disseminating the same, the Indian National Committee on Hydrology which

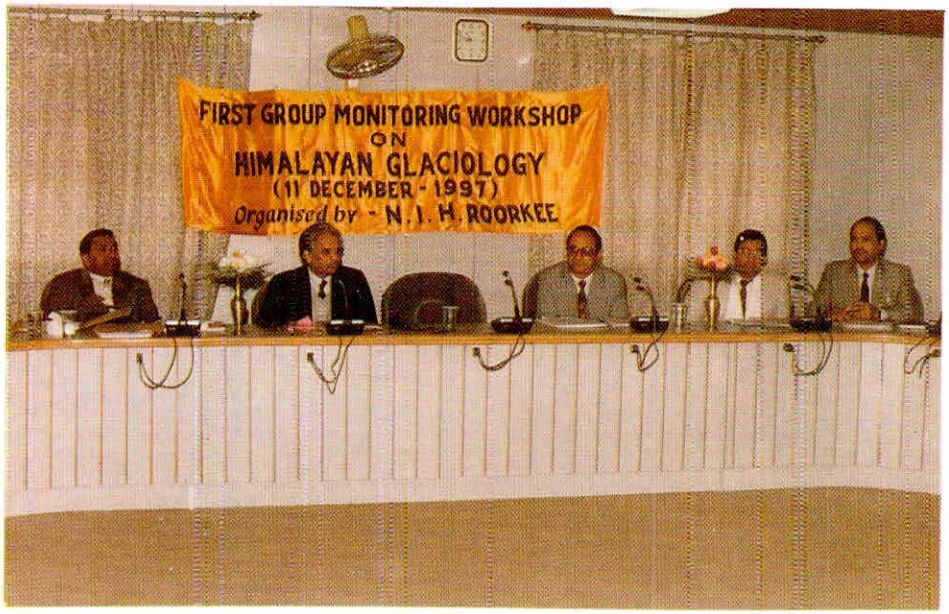
is attached to the Institute had taken up a programme of requesting experts to prepare state of art reports on various facets of hydrology. The topics and experts are identified by the Panels of INCOH and are recommended to INCOH for final decision. The status of various reports since inception of this activity is as below :

S.No.	Title of the State of Art Report
1.	Long Term Base Flow Studies
2.	How to Conduct River Surveys
3.	Current Status and Prospects of Rain-Water Harvesting
4.	Surface Drainage Aspects of Agricultural Areas
5.	Research in Soil and Water Conservation in India with Special Emphasis on Watershed Management
6.	Reservoir Sedimentation
7.	Natural Ground Water Recharge Estimation Methodologies in India
8.	Water Supply for Industrial and Domestic Use
9.	Real Time Reservoir Operation
10.	Wastewater Treatment with Aquatic Plants
11.	Prevention and Control of Soil Erosion
12.	Ground Water Pollution Studies in India
13.	Infiltration and its Simulation
14.	Surface Water Quality Modelling
15.	Integrated Planning of River Basin System and Management
16.	Impact of Siltation on the Useful Life of large Reservoirs
	Under Print during the year 1997-98 :
17.	Conjunctive Use of Surface and Ground Water
18.	Computation of Seepage
19.	Existing Methods of Collection of Sediment Data inIndian Streams/Rivers
20.	Frontier Areas of Research in Hydrometeorology
21.	Regionalisation of Hydrological Paramters
22.	Manual on Snow Clearance

DIRECTOR, NIH INAUGURATING THE TRAINING COURSE ON RESERVOIR OPERATION

BRAIN STORMING SESSION AT CHENNAI, TAMIL NADU

A VIEW OF DIAS DURING SEMINAR ON WATER RESOURCES MANAGEMENT OF NORTH BIHAR HELD AT MUZAFFARPUR



THE WORKSHOP ON HIMALAYAN GLACIOLOGY IN PROGRESS AT NIH, ROORKEE

WORKSHOP ON COASTAL HYDROLOGY AT KAKINADA, ANDHRA PRADESH

9.0 Hindi - Official Language

9.1 Progress in Use of Hindi

The Institue realizing the important role of use of Hindi in official dealings, has remained very active in use of Hindi. Also in accordance with the Official Language Policy, the annual programme of the Institute for the year 1997-98 was oriented to implement the various provisions stipulated thereunder with all dedication. As a first step in this direction, the Institute contributed significantly during the year towards the furtherance of the cherished objectives enshrined in the Constitution for implementation of the Official Language Policy i.e. most of the communications with Central and State Government Departments/ Offices located in region A and B were made in Hindi. Most of the official work of the Administration, Finance and Maintenance Branch of the Institute was also done in Hindi.

The Hindi cell of the Institute remained very active during the year. A number of activities were carried out by the Cell for implementing and promoting the use of Hindi language in various technical/administrative works. A versatile Hindi software "AKSHAR FOR WINDOWS" was procured by the Institute during the year. The staff of the Institute is being trained on the use of this software. Two workshops of one day duration were organised by the Hindi Cell for the administrative and clerical staff of the Institute in this regard. In one of the workshops, hands on training was given to the employees so that they get familiar with the use of the software on computer.

The most significant achievement during the year was the publication of bilingual (Hindi-English) "Jalvigyaneeya Paribhashayen" (Hydrological Definitions) by the Institute. It contains definitions of 460 most commonly used terms of Hydrology. These definitions were got reviewed by the senior officials of CWC before printing. This publication was prepared by the Hindi Cell.

The fourth issue of the annual publication "Pravahini" was brought out wherein articles in Hindi were contributed by the staff of the Institute. For increasing awareness among the masses about the various aspects of hydrological problems, pamphlets on different topics are prepared from time to time. A semi-technical pamphlet on "Floods and Drought" is being prepared.

9.2 Rajbhasha Karyanvayan Samiti

Various works related to the implementation and use of Hindi language were actively carried out in the Institute during the year. Four meetings of the Official Language Implementation Committee were held during the year. At these meetings important decisions regarding the implementation of Hindi in day to day official proceedings and activities and review of the progress of the ongoing activities in Hindi was taken up besides preparing the plan and program for future activities.

9.3 Publications in Hindi

The Institute brought out following publications in Hindi during the year :

a. Pravahini (Literary in-house annual magazine)

b. Hydrological Definitions - Bilingual publication containing definitions in Hindi and English of 460 most commonly used hydrological terms.

c. Annual Report - Hindi version of the Annual Report of the Institute for the year 1996-97.

Other publications, which are in progress of preparation in Hindi, include :

a. A pamphlet on 'Drought and Floods'

b. a Hydrology booklet for the students of class I to III

c. an observation manual for hydrometeorological data.

9.4 Hindi Week Celebrations

The Institute celebrated Hindi Week with great enthusiasm. Various programmes for the promotion of Hindi were organised in the Institute during the Hindi Week i.e. 08-16 September 1997. In the inaugural function, the message of the honourable Home Minister was also presented. Most of the employees of the Institute participated enthusiastically in the various activities during the week. An exhibition of Hindi books was also arranged on this occasion.

The Institute staff whole heartedly participated in various activities during the week which included essay writing, Hindi typing, Hindi quiz, Kavita Path and Debate Competitions etc. The topic of the essay competition was "Planning and Management of Water Resources in the 21st Century". Prizes to the winners of various competitions were distributed in the valedictory function.

A VIEW OF THE DIAS AT THE INAUGURAL FUNCTION OF HINDI WEEK CELEBRATION

10.0 Other Activities

10.1 Hydrology Terminology

The Hydrology Terminology prepared by the Institute in 1993-94, with 395 hydrological terms in eight Indian languages namely Bengali, Gujarati, Hindi, Kannada, Malayalam, Marathi, Tamil and Telugu was highly appreciated.. The pan Indian Terminology, for these hydrological terms was also prepared. The publication was circulated to varius organisations and received wide recognition.

Keeping in view, the popularity of the work, it was decided to extended the work by bringing out Hydrological Terminology-II. The work on second volume was initiated in the year 1995-96. For this volume, 605 terms were selected and their definitions were prepared. The terms, alongwith their definitions, were sent to the eight concerned states for obtaining their equivalents in respective state languages. Water Resources Departments of the concerned states have finalized the equivalents in their respective languages.

The concerned states were involved in the preparation of equivalents in regional languages. During the year 1995-96, the coining of equivalents in four languages viz., Hindi, Tamil, Marathi and Gujarati was completed. In the year 1996-97, the equivalents of hydrological terms in three more languages, Bengali, Kannada and Telugu were received. In the present year, work for preparing the equivalents in all the concerned regional languages was completed. The language experts of various languages were contacted for phonetic transliteration of the regional language terms in Roman and Devnagari script. The work is in its final stages.

10.2 Awards

NIH has instituted two awards for encouraging studies and research in hydrology and operational hydrology.

Through an endowment provided by M/s Hoysala Group of Companies, Bangalore, NIH has instituted an award in honour of Prof. Bharat Singh, former Vice-Chancellor, University of Roorkee. The BHARAT SINGH AWARD with a cash prize of Rs.10,000 is given biennially to engineers, technocrats and scientists for outstanding research work carried out in the area of hydrology and water resources. So far, the award has been given for the years 1987, 1989, 1991, 1993, 1995. The meetings of Judging Committees for National Hydrology Award (1996) and Bharat Singh Award (1997) could not be held during the year due to unavoidable reasons.

The Institute has also instituted another award known as 'The National Hydrology Award' which is given to eminent engineers, technologists and scientists working in the area of operational hydrology or those who have made significant contributions for promoting hydrology.

The list of awardees of both these awards is given below:

(A) National Hydrology Award - 1987

1.	Shri V B Patel Secretary (Water Supply) Govt. of Gujarat Gandhinagar	Gold Plated medal and a cash prize of Rs.4000/-	
2.	Shri K Sreeramakrishnaiah Officer on Special Duty Telugu Ganga Project Cuddapah-516 004 (AP)	Silver medal and a cash award of Rs.2000/-	
3.	Dr A Krishnan National Fellow (ICAR) University of Agriculture Science, Bangalore	Certificate of Merit and a cash prize of Rs.1000/-	

(B) National Hydrology Award - 1988

1.	Dr S M Seth Scientist F, NIH, Roorkee	FIRST AWARD	Rs. 4000/- and a plaque
2.	Shri R S Prasad Chief Engineer NWDA, New Delhi	SECOND AWARD	Rs. 2000/- and a plaque
3.	Shri A K Chakraborty Scientist SF and Head of WR Division, IIRS, Dehradun	Certificate of Merit and a cash prize of Rs.1000/-	
4.	Dr B S Thandaveswara Asstt. Professor Hydraulics & WR Engg., IIT Madras	Certificate of Merit and a cash prize of Rs.1000/-	

(C) National Hydrology Award - 1989

1.	Prof. Jaswant Singh Sher-e-Kashmir University of Agri. Sc. & Tech., Jammu	FIRST AWARD	Rs. 5000/- and a plaque
2.	Shri C P Sinha Bihar State Irrigation Commission, Patna	SECOND AWARD	Rs. 3000/- and a plaque

(D) National Hydrology Award - 1990

1.	Prof. S A Abbasi C.P.C. & B.E. Pondicherry -605 014	FIRST AWARD	Rs.5000/- and a plaque
2.	Dr K K S Bhatia Scientist F NIH Roorkee	SECOND AWARD	Jointly awarded Rs.3000/- and a plaque to each
3.	Dr P M Modak IIT Bombay- 400 076		

(E)	**National Hydrology Award - 1991**		
1.	Shri Prakash Bahadur	FIRST AWARD	Rs. 4000/- and a plaque
2.	Shri R S Saksena	SECOND AWARD	Rs. 2000/- and a plaque
(F)	**National Hydrology Award - 1992**		
1.	Dr Neelamraju Hanumantha Rao Indian Agricultural Research Institute, New Delhi	FIRST AWARD	Rs. 4000/- and a plaque (Operational Hydrology)
2.	Dr D V L Narasimha Rao B-1/399, First Floor, Janakpuri, New Delhi	SECOND AWARD	Rs. 2000/- and a plaque (Operational Hydrology)
(G)	**National Hydrology Award - 1993**		
1.	Dr V K Choubey Scientist E NIH, Roorkee	FIRST AWARD	Rs. 4000/- and a plaque (Operational Hydrology)
2.	Dr S N Rai National Geophysical Research Institute, Hyderabad	SECOND AWARD	Rs. 2000/- and a plaque (Operational Hydrology)
3.	Shri B P Singh Water Resources Dept., Patna	Certificate of Merit and a cash prize of Rs.1000/-	
(H)	**National Hydrology Award - 1994**		
1.	Shri Y V Dharma Rao	Award of Rs. 10,000/- and a plaque	

(A)	**Bharat Singh Award - 1987**	
1.	Shri J F Mistry	Jointly awarded the Bharat Singh Award (Rs.5000/-) each
2.	Dr B H Briz Kishore	
(B)	**Bharat Singh Award - 1989**	
1.	Dr R S Varshney	Jointly awarded the Bharat Singh Award (Rs.5000/-) each
2.	Shri V B Patel	
(C)	**Bharat Singh Award - 1991**	
	——NIL——	
(D)	**Bharat Singh Award - 1993**	
1.	Dr A S Chawla	Bharat Singh Award Rs.10,000/-
(E)	**Bharat Singh Award - 1995**	
1.	Dr Subhash Chander	Bharat Singh Award Rs.10,000/-

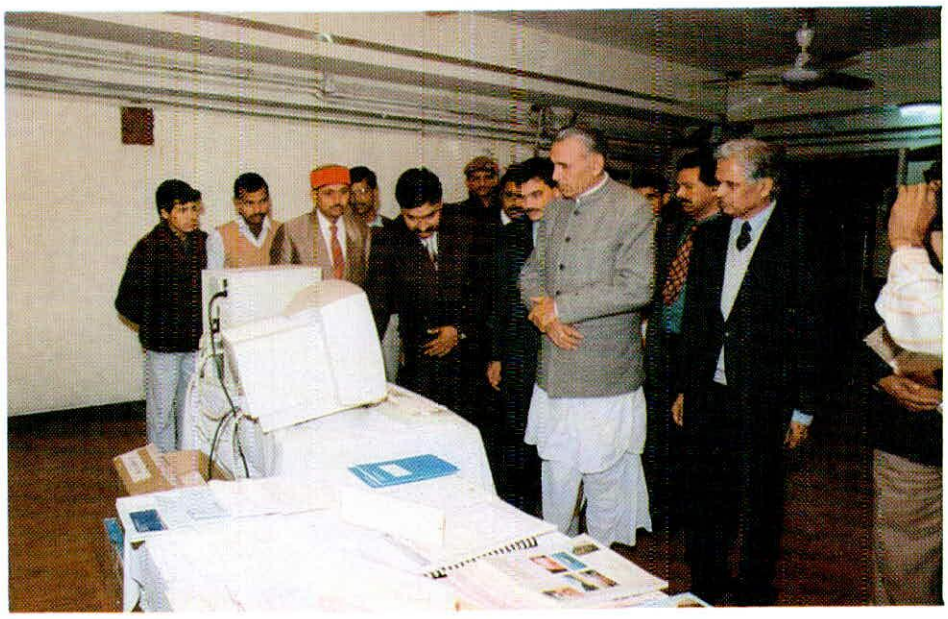
10.3 Distinguished Visitors

The following distinguished persons visited the Institute during the year in connection with meetings and interaction with the Institute.

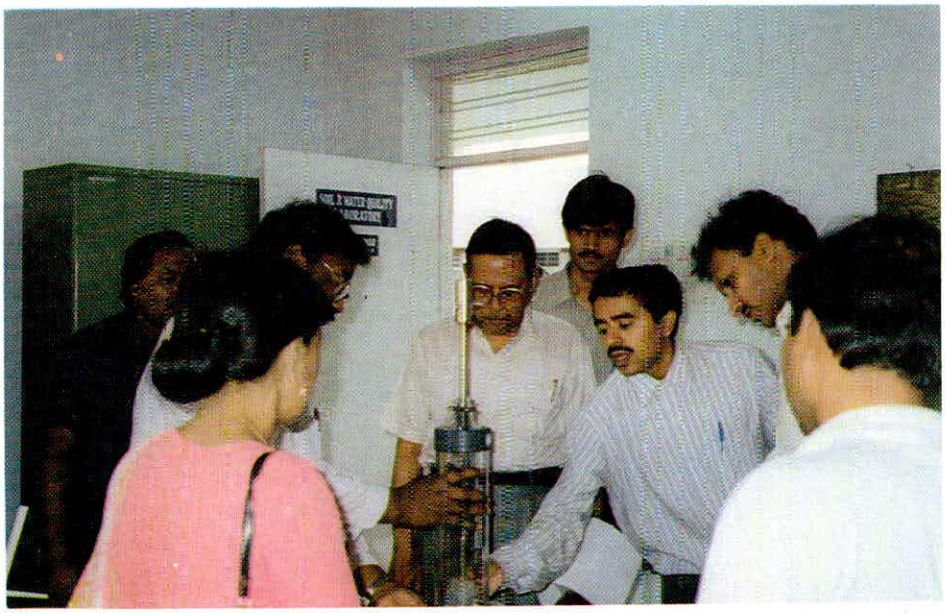
Name and Address	Date of visit	Remarks
Dr Peter F Friend Dept. of Earth Sciences University of Cambridge Cambridge CB2 3EQ, UK	10.5.97	Thank you for your advice.
Dr Ali Akbar Salehi Neyshaboury, Dept. of Civil Engg. Tarbiat Modares Univ., Tehran, Iran	1.6.97	Thank you for good arrangements for us and advice on scientific problems
Dr Zhra Isadpanah Dept. of Civil Engg. Tarbiat Modares Univ., Tehran, Iran	1.6.97	-do-
Shri A D Mohile Chairman Brahmaputra Board Guwahati	7.7.97	Visiting Roorkee and NIH is always a pleasure. The Director and scientists have spent much time in discussing possible areas of collaboration between NIH and the Board.
Dr James E Ball Water Research University of New South Wales, King Street Manly Vale, NSW 2093 Australia	20.6.97	Very pleasant accommodation. Laboratory People very helpful.
Dr L A Mandalia Unesco, 8 Poorvi Marg New Delhi-57	9.7.97	Very comfortable stay and helpful staff.
Dr T J Ward Prof. and Chairman Dept. of Civil Engg. New Mexico State Univ. Las Cruces New Mexico 88003 USA	9.7.97	This has been a memorable visit.
Dr R H Hawkins Prof. of Watershed Management, School of Renewable Natural Resources, Biological Sciences East, Univ. of Arizona, Tucson, AZ 85721 USA	9.7.97	Thanks for the hospitality.

Dr C A Madramootoo McGill University, Montreal, Canada	12.8.97	Thanks for a very kind visit.
Dr J Niemczynowicz Associate Professor Dept. of Water Resources Engg. University of Lund Box 11B, S-22100 Lund Sweden	13.8.97	Nice people, difficult working conditions.
Dr A J Wojcik Technical Officer, Hydrology Section Dept. of Water Engg. School of Civil Engg. Univ. of New South Wales Sydney 2052, Australia	14.8.97	My first visit to India and I shall not forget. Thanks.
Dr J L Luick National Tidal Facility The Flinders University of SA Post Box 2100 Adelaide 5001 Australia	12.9.97	Wonderful hospitality. Lovely time.Thanks.
Dr U Maniak Technical University of Braunschweig, 38106 Braunschweig,Germany	19.9.97	Thank you for everything.
Dr R J Drimmie Manager, Environmental Isotope Laboratory, University of Waterloo Waterloo, Ontario N2L 3G1,Canada	19.9.97	–
Dr J V Bonta Research Hydraulic Engr. USDA-ARS, North Appalachian, Experimental Watershed PO Box 478 Coshocton OH 43812, USA	23.9.97	Thanks for hospitality. Keep working to improve Indian conditions.
Dr S N Ghosh Prof. Department of Civil Engg. IIT Kharagpur	26.9.97	
Prof. R D Verma 119/209 Mansarovar, Agrawal Farm, Jaipur 302 020	26.9.97	I am glad to interact with the scientists of NIH.
Dr N V Pundarikanthan Director, Centre for Water Resources Dev. & Management, Anna Univ. Chennai	26.9.97	Very good in treatment

Dr R Berndtsson Department of Water Resources Engg. Lund University Box 118, S-22100 Lund, Sweden	26.9.97	It is pleasure always to visit NIH and learn more by very useful interaction.
Dr B Sevruk Geographisches Institut Abteolung Hydrologie, ETH Winterhurerstr. 190 CH-8057 Zurich Switzerland	26.9.97	–
Dr T Prasad Director Centre for Water Resources Patna	26.9.97	
Dr G S Dhillon Chief Engr (Retd.) 533 Sector 10 D Chandigarh	27.9.97	
Shri I D Garg Chief Engineer (Hydrology) Central Water Commission New Delhi	27.9.97	
Dr G Kite Hydrological and Aquatic Sciences Div. National Hydrology Research Institute 11, Innovation Blvd Saskatoon, Saskatchewan S7N 3HS, Canada	28.9.97	
Dr Natalia V Penkova State Hydrological Institute, Second Line 23, St. Petersburg 199053 Russia	7.10.97	–
Dr E A McBean Consulting Engrs. Conestoga Rovers and Associates Ltd. 615 Colby Drive Waterloo,Ontario Canada N2V 1C2	31.10.97	Very enjoyable and productive visit.
Prof. T V Pillai Space Age Foundation Staiplon Villa Shimla-1	25.11.97	–



HON'BLE SHRI SIS RAM OLA, UNION MINISTER FOR WATER RESOURCES VISITING THE NIH EXHIBITION



DIRECTOR, WALMI, BIHAR VISITING REGIONAL CENTRE LABORATORY AT NIH, REGIONAL CENTRE, PATNA

Dr A Gudard Institute of Hydrology UK	5.12.97	I look forward to further cooperation.
Dr M N Kaul Dept. of Geography Jammu University Jammu (J&K)	11.12.97	–
Dr A K Tangri Remote Sensing Application Centre, UP Lucknow	11.12.97	–
Maj. Gen. S S Sharma Snow and Avalanche Studies Establishment, Chandigarh	12.12.97	–
Dr B D Acharya Jt. Advisor, Govt. of India, Dept of Sc.& Tech. New Delhi-16	12.12.97	
Lt.Col.(Dr) M N Kulkarni Survey of India 17 EC Road, Dehradun	12.12.97	Excellent institute.
Shri B Lal Deputy Director General India Meteorological Dept. New Delhi	12.12.97	
Shri S K Benerjee Superintending Engr.(HOC) Central Water Commission Dehradun	12.12.97	A very pleasant experience.
Delegation from Mongolia (Mr D Enkhtuja, Mr D Tsengelmao, Mr R Onon, Mr Righu Gautam,etc) Roads Development Project Ulaanbaatar, Mongolia	4.2.98	Good place to know
Visit of trainee officers from Indian Institute of Remote Sensing, Dehradun	6.2.98	–
Visit of trainee officers from Dept. of Continuing Education, University of Roorkee, Roorkee	9.2.98	–

Shri Avinash Chander Director (Engg) National Projects Construction Co. Ltd 67-68, Sector 25 Faridabad	20.2.98	–
Shri M M Kapoor Additional GM NPCC Ltd 67-68, Sector 25 Faridabad	20.2.98	–
Shri D D Taneja Retd. Chief Engineer The World Bank 333-D Defence Colony New Delhi	5.3.98	Come across excellent work, most knowledgeable and dedicated scientists.
Dr B U Nayak Director Central Water and Power Research Station,(CWPRS) Khadakwasla Pune-411024	12.3.98	Excellent work is being done in hydrology at NIH.
Shri V K Kulkarni Jt. Director CWPRS, Pune-24	12.3.98	It was very nice visiting this Institution again.

10.4 List of Experts Contacted for Comments on Institute Technical Reports.

The Institute highly appreciates the kind gestures of following experts who spared their valuable time by offering comments on Institute technical reports:

1. **Director**
   Snow & Avalanche Study Establishment,
   DBRL Range, PO: Ramgarh,
   Dist. Punchkula, Haryana

2. **Dr D S Upadhyay**
   Director, India Meteorological Department,
   Mausam Bhavan, Lodhi Road
   New Delhi-110 003

3. **Director**
   Glaciology Division,
   Geological Survey of India,
   Northern Region Lucknow, UP

4. **Chairman**
   Central Pollution Control Board
   Parivesh Bhavan, East Arjun Nagar, Shahdara
   Delhi -110 032

5. **Head**
   Department of Geology
   Indira Gandhi Government Engineering
   College Sagar (MP)

6. **Director**
   Central Soil and Water Conservation Training and Research Institute, 218 Kaulagarh Road
   Dehradun-248 195

7. **Dr K D Sharma**
   Central Arid Zone Research Institute
   Industrial Area,
   Jodhpur-342 003 Rajasthan

8. **Dr S Vedula**
   Professor, Civil Engineering Department
   Indian Institute of Science
   Bangalore-560 012

9. **Dr N K Goel**
Associate Professor
Department of Hydrology
University of Roorkee
Roorkee-247 667

10. **Dr Arun Kumar**
Professor, Civil Engineering Department
Delhi College of Engineering
Delhi

11. **Dr K G Ranga Raju**
Professor, Civil Engineering Department
University of Roorkee
Roorkee-247 667

12. **Chief Engineer (Floods, RM)**
Central Water Commission
Sewa Bhavan, R K Puram
New Delhi-110 066

13. **Dr S.B. Murthy**
Professor, Civil Engineering Department
Indian Institute of Technology
Kanpur-208 016

14. **Dr R K Tripathy**
Secretary, PHED
Irrigation Department
Calcutta-700 001

15. **Dr R D Verma**
Former Professor
M R Engineering College
Jaipur

16. **Director**
National Geophysical Research Institute
Uppal Road
Hyderabad-500 007

17. **Dr A S Chawla**
Former Professor WRDTC
University of Roorkee
Roorkee-247667

18. **Dr B S Mathur**
Professor, Department of Hydrology
University of Roorkee
Roorkee -247 667

19. **Shri A D Mohile**
Chairman
Brahmaputra Board
Basishtha,
Guwahati-781 028 Assam

20. **Dr D S Bhargava**
Professor,
Civil Engineering Department
University of Roorkee
Roorkee- 247 667

21. **Dr Arvind Kumar**
Professor (Environment),
Civil Engg. Department
University of Roorkee
Roorkee-247 667

22. **Director**
National Environmental Engineering Research Institute, Nehru Marg
Nagpur- 440 020

23. **Professor S A Abbasi**
Director
Centre for Pollution Control &
Biowaste Energy
Pondicherry University (Central)
Pondicherry

24. **Dr V Subramaniyam**
School of Environmental Sciences
Jawahar Lal Nehru University
New Delhi

25. **Director**
Central Ground Water Board
Northern Region
B-1/7, Mohil Bhavan, Mahanagar Extension
Lucknow- 226 006

26. **Chairman**
Central Ground Water Board
Jam Nagar House, Man Singh Road
New Delhi-110 001

27. **Director**
Central Soil Salinity Research Institute
Karnal-132 001 Haryana

10.5 Qaumi Ekta Week

The week from 19-25 November 1997 was celebrated as Qaumi Ekta Week by the Institute. Keeping in view the objectives of this i.e. to foster the spirit of patriotism and national integration, on 19 November 1997 the National Integration pledge was administered by Director NIH to all staff of the Institute.

The Martyrs Day was celebrated by the employees of the Institute on January 30, 1997. Institute paid homage to the martyrs of the nation.

10.6 Recreation Club

NIH Recreation Club was very active during the year. It had organised number of social, literary and recreational activities. Some of these are described below :

- Annual sports Meet for the employees was organised in June 1997.
- A Sampradyak Pakhwara was organised in August 1997.
- The prizes of the sports activities were given by the Director on 15 August 1997 to the employees.
- Vishwakarma Pooja was organised on 17 September 1997.
- A Deepawali Mela was organised in October 1997 in NIH campus which was a grand success.
- The Blood Group identification and general check up of the employees and families of the employees was organised in October 1997 on the occasion of Deepawali Fete. The medical check was done by Dr Sudhir Chowdhary, MD and Dr (Mrs) Madhulika, MD.
- Public awareness pamphlet entitled, "Jal, Jalvigyan evam Rashtriya Jalvigyan Sansthan." was prepared and distributed to the general public. The other brochures on hydrology were also distributed to the general public regarding water conservation and water quality.

11.0 Finance and Accounts

During the year under review, Ministry of Water Resources, Government of India provided an amount of Rs.261.00 lakhs and Rs.244.00 lakhs as Grant-in-Aid to the Institute under Plan and Non-Plan heads respectively. The actual total expenditure during the year under review after taking into account the amount carried forward from the previous year was Rs.5,05,70,229.51 (Rs.2,61,35,476.71 under Plan and Rs.2,44,34,752.80 under Non-Plan). The accounts were audited by M/s Hemant Arora & Co., Roorkee. The Auditor's report alongwith audited accounts is given at Appendix XV.

An addition of Rs.1,75,57,173.61 has been made to the fixed and current assets of the Institute during the year as under :

ASSET FUND ACCOUNT

Sc A	Increase in fixed assets		(+)	1,52,32,021.50
Sc B	Decrease in Works in Progress		(-)	47,83,000.00
Sc C	Increase in Deposits		(+)	-
Sc D	Increase in Advances		(+)	66,27,807.11
Sc F	Increase in Prepaid		(+)	9,83,447.00
	Sub Total			1,80,60,275.61
Less :				
Sc G	Increase in Deposits			-
Sc E	Increase in Liability	5,03,102.00		
	Sub Total	5,03,102.00	(-)	5,03,102.00
	Total increase in assets fund A/c			1,75,57,173.61
(a)	Increase in Current Assets Fund			71,08,152.11
(b)	Increase in Fixed Assets Fund			1,04,49,021.50

12.0 Acknowledgements

With the learned guidance and thoughtful directions from the President of the Society, the Chairman, Governing Body, the Chairman, Technical Advisory Committee, the Chairman, Standing Committee and the Members of the Society, Governing Body and Technical Advisory Committee, the Institute has made some remarkable progress in all spheres of hydrology. The support and cooperation received from UNDP, UNESCO, World Bank and Department of Economic Affairs is gratefully acknowledged. The Institute records its appreciation to Officers of the Ministry of Water Resources for their active cooperation and help. Central Water Commission, University of Roorkee, Central Ground Water Board, India Meteorological Department, and several other Central and State Government organisations provided all help and guidance. Various significant achievements of the Institute during the year under report would not have been possible without their help. The Institute also thankfully acknowledges the advice and cooperation received from Members of the Working Groups, Regional Coordination Committees, the eminent scientists and engineers from various academic and research organisations.

Hydrology being a field oriented science, the role of states is very important. The Institute is thankful to various State Government organisations for providing crucial hydrologic data and for inviting the Institute for organising short duration workshops in the States for the benefit of their in-service engineers and technical personnel. The Institute also place on record its appreciation to various Central and State Government organisations and public sector undertakings who have provided the Institute with an opportunity to contribute effectively in solution of various real life problems through consultancy and sponsorship.

Director also records his appreciation for the devotion, hard work, enthusiasm and initiative exhibited by the scientists and the staff of the Institute without which the present growth and achievement would not have been possible.

13.0

Appendices

Appendix-I

NATIONAL INSTITUTE OF HYDROLOGY SOCIETY

PRESIDENT : Union Minister
: for Water Resources
: Government of India
: New Delhi

VICE PRESIDENT : Minister of State
: for Water Resources
Government of India
New Delhi

MEMBERS

Minister in Charge
of Irrigation
Govt. of Haryana
Panchkula

Minister in Charge
of PWD & Irrigation
Govt. of J&K
Jammu

Minister in Charge
of Irrigation
Govt. of Uttar Pradesh
Lucknow

Minister in Charge
of Water Resources
Govt. of Bihar
Patna

Minister in Charge
of Irrigation
Govt. of Assam
Guwahati

Minister in Charge
of Irrigation
Govt. of Manipur
Imphal

Minister in Charge
of Irrigation & Water Resources
Govt. of Gujarat
Gandhinagar

Minister in Charge
of Irrigation
Govt. of Rajasthan
Jaipur

Minister in Charge
of PWD & Irrigation
Govt. of Karnataka
Bangalore

Minister in Charge
of Irrigation
Govt. of Kerala
Thiruvananthapuram

Member (Irrigation)
Planning Commission
New Delhi

Dr Pande B B Lal
Principal,
Madan Mohan Malviya Engineering College
Gorakhpur (UP)

Shri A K Bhargava
Chief Engineer (Retd.)
3 Ta 56, Jawahar Nagar
Jaipur

Prof. C P Sinha
Professor & Head, CED
North Eastern Regional Institute
of Science and Technology
Nirjuli, Itanagar (Arunachal Pradesh)

Dr Ram Singh
Village : Sri Amar Pura (Gidde Ki Dhani)
Post office : Kithana
P.S. : Chirawa
Distt. Jhunjhunu (Rajasthan)

Director
Central Soil and Water Conservation
Training & Research Institute
218 Kaulagarh Road
Dehradun

Secretary to Govt. of India
Ministry of Water Resources
New Delhi

Secretary to Govt.of India
Ministry of Science and Technology
New Delhi

Secretary to Govt.of India
Ministry of Urban Development
New Delhi

Secretary to Govt.of India
Planning Commission
New Delhi

Chairman
Central Water Commission
New Delhi

Vice Chancellor
University of Roorkee
Roorkee

Dr T Gangadharaiah
Professor,
Dept. of Civil Engg. IIT
Kanpur

Dr N V Pundarikanthan
Centre for Water Resources,
Anna Univ.,
Chennai

Dr P B S Sarma
Director,
Water Technology Centre
IARI, Pusa
New Delhi

Dr C D Thatte
Secretary General
ICID, 48 Nyaya Marg
Chanakyapuri
New Delhi

Dr N K Tyagi
Director
Central Soil Salinity
Research Institute
Karnal (Haryana)

Secretary to Govt. of India
Ministry of Energy
New Delhi

Secretary to Govt. of India
Ministry of Agriculture and Cooperation
New Delhi

Secretary to Govt. of India
Ministry of Environment and Forests,
New Delhi

Additional Secretary to Govt. of India
Ministry of Water Resources
New Delhi

Financial Advisor and Joint Secretary
Ministry of Water Resources
New Delhi

Member (D&R)
Central Water Commission
New Delhi

Chairman
Central Electricity Authority
New Delhi

Director General
India Meteorological Department
New Delhi

Chairman
Central Pollution Control Board
New Delhi

Joint Secretary (Admn.)
Government of India,
Ministry of Water Resources
New Delhi

Commissioner (ER)
Govt.of India
Ministry of Water Resources
New Delhi

Chief Engineer,
Hydrology Studies Organisation (HSO),
Central Water Commission
New Delhi

Chairman
Central Ground Water Board,
Faridabad

Director General
Geological Survey of India,
Calcutta

Director (R&D), Central Water Commission, (A representative of Indian National Committee on Hydrology (INCOH), nominated by Chairman, INCOH

Commissioner (PP)
Govt. of India
Ministry of Water Resources
New Delhi

Commissioner (PR)
Government of India
Ministry of Water Resources
New Delhi

Member Secretary

Director
National Institute of Hydrology
Roorkee

This constitution was approved by the Society of NIH at its Special General Meeting held on 16th November, 1995 and as per rules 10 Ministers and experts were changed in 1997.

Appendix-II

GOVERNING BODY

CHAIRMAN	:	Secretary to Government of India Ministry of Water Resources, New Delhi
VICE-CHAIRMAN	:	Vice-Chancellor University of Roorkee, Roorkee
MEMBER SECRETARY	:	Director National Institute of Hydrology, Roorkee

MEMBERS

Advisor (Irrigation & CAD)
Planning Commission Yojna Bhawan
New Delhi

Additional Secretary (WR)
Ministry of Water Resources
New Delhi

Secretary (Irrigation)
Govt. of Uttar Pradesh,
Lucknow

Representative of Govt. of Karnataka
not below the rank of
Chief Engineer

Representative of Government of Bihar,
not below the rank
of Chief Engineer

Representative of
Government of Madhya Pradesh,
not below the rank of Chief Engineer

Chairman
Central Water Commission New Delhi or
Member (D&R), CWC as his alternate

Financial Advisor and Joint Secretary (Finance)
Ministry of Water Resources,
New Delhi

Representative of Govt. of Assam
not below the rank of
Chief Engineer

Representative of Govt of Jammu & Kashmir
not below the rank of
Chief Engineer

Representative of Government of Andhra Pradesh
not below the rank
of Chief Engineer

This constitution was approved by the Society of NIH at its Special General Meeting held on 16th November, 1995.

Appendix-III

TECHNICAL ADVISORY COMMITTEE

1.	Chairman, Central Water Commission	Chairman
2.	Member (D&R), Central Water Commission	Member
3.	Chief Engineer, Hydrology Studies Organisation (HSO), Central Water Commission	Member
4.	Director, National Institute of Hydrology	Member
5.	Chairman, Central Ground Water Board	Member
6.	Representative of India Meteorological Dept.	Member
7.	A Professor of University of Roorkee, Roorkee	Member
8.	A Professor engaged in research in water resources areas from one of the IITs	Member
9.	A Professor engaged in research in water resources areas from one of the State Universities	Member
10.	Director of one of the Water Technology Centres	Member
11.	Expert of Hydrology in Individual capacity	Member
12.	Expert of Hydrology in Individual capacity	Member
13.	Head of one of the State Hydrology cells	Member
14.	Expert from Non-Government Scientific Organisation in the field of Hydrology	Member
15.	Scientist F, National Institute of Hydrology, (to be nominated by Director, National Institute of Hydrology)	Member

Note :

Members at Sr.No. 8 to 14 will be nominated by the Chairman, Governing Body for a period of three years.

This constitution was approved by the Society of NIH at its Special General Meeting held on 16th November, 1995.

Appendix-IV (1/3)

WORKING GROUPS

CONSTITUTION OF WORKING GROUP FOR SURFACE WATER

(This Group Comprises of Surface Water Analysis and Modelling, Flood Studies, Hydrologic Design, Mountain Hydrology, Atmospheric Land Surface Process Modelling, Watershed Development, and Water Resources System divisions)

Chairman :

1. Director, National Institute of Hydrology

Members :

2. Chief Engineer (Hydrology)/Director (Hydrology RS), Central Water Commission
3. Chief Engineer (BPMO)/Director (Reservoir operation), Central Water Commission
4. Nominee of India Meteorological Department
5. Nominee of National Water Development Agency
6. Nominee of Central Soil and Water Conservation Research and Training Institute, Dehra Dun
7. Nominee of Indian Institute of Technology,Delhi
8. Nominee of University of Roorkee
9. Nominee of Irrigation Department, Uttar Pradesh
10. Nominee of Irrigation Department, Gujarat
11. Nominee of Centre for Water Resources Development & Management, Kozhikode, Kerala
12. Nominee of National Centre for Medium Range Forecasting, New Delhi
13. Nominee of Indian Institute of Tropical Meteorology,Pune
14. Dr S Vedula, Indian Institute of Science, Bangalore

Convener :

15. Scientist F, NIH (to be nominated by Director,NIH)

Appendix-IV (2/3)

WORKING GROUPS

CONSTITUTION OF WORKING GROUP FOR GROUND WATER

(This Group Comprises of Groundwater Assessment, Drainage, Groundwater Modelling & Conjunctive Use, Drought Studies, Environmental Hydrology, and Lake Hydrology divisions)

Chairman :

1. Director, National Institute of Hydrology

Members :

2. Nominee of Central Ground Water Board
3. Nominee of Groundwater Department, Andhra Pradesh
4. Nominee of Groundwater Department, Gujarat
5. Nominee of Groundwater Department, Uttar Pradesh
6. Nominee of NABARD
7. Director (Water management),Central Water Commission, New Delhi
8. Nominee of National Geophysical Research Institute, Hyderabad
9. Nominee of Department of Environment, New Delhi
10. Nominee of Central Pollution Control Board, New Delhi
11. Nominee of U P Department of Environment, Lucknow
12. Nominee of Central Arid Zone Research Institute, Jodhpur
13. Nominee of Central Soil Salinity Research Institute, Karnal
14. Nominee of University of Roorkee, Roorkee
15. Dr R D Verma, Former Professor, M R Engineering College, Jaipur

Convener :

16. Scientist F, NIH (to be nominated by Director, NIH)

Appendix-IV (3/3)

WORKING GROUPS

CONSTITUTION OF WORKING GROUP FOR HYDROLOGICAL OBSERVATION AND INSTRUMENTATION

(This Group Comprises of Hydrological Investigation, Hydrological Information System, Nuclear Hydrology, Hydrological Instrumentation, and Remote Sensing Applications divisions)

Chairman :

1. Director, National Institute of Hydrology

Members :

2. Nominee of Central Water and Power Research Station, Pune
3. Chief Engineer (RM)/Director (R&D), Central Water Commission, New Delhi
4. Nominee of Space Applications Centre, Ahmedabad
5. Nominee of India Meteorological Department, Delhi
6. Nominee of Indian Institute of Remote Sensing, Dehra Dun
7. Nominee of A P Engineering Research Lab., Hyderabad
8. Nominee of U P Irrigation Research Institute, Roorkee
9. Nominee of Bhaba Atomic Research Centre, Bombay
10. Dr B P Singh, Nuclear Science Centre, New Delhi

Convener :

11. Scientist F, NIH (to be nominated by Director, NIH)

Appendix-V

CONSTITUTION OF REGIONAL COORDINATION COMMITTEE OF NIH REGIONAL CENTRES

1. DECCAN HARD ROCK REGIONAL CENTRE, BELGAUM

Chairman

Director, NIH

Members

1. Deputy Director General (Agrometeorology), India Meteorology Department, Pune
2. Chief Engineer, Central Water Commission, Hyderabad
3. Director, Central Ground Water Board, Bangalore
4. Chief Engineer, AP Irrigation Deptt., Hyderabad
5. Chief Engineer, WRDO, Karnataka Irrigation Department, Bangalore
6. Chief Engineer, Maharashtra Irrigation Department, Pune
7. Professor, Soil Science, Agriculture University, Dharwar
8. Chief Engineer (Groundwater), Tamilnadu

Member Secretary

Head, Regional Centre

* In the absence of Director, NIH, his nominee not below the rank of Sc. F will chair the meeting of RCC.

2. NORTH EASTERN REGIONAL CENTRE, GUWAHATI

Chairman

Director, NIH

Members

1. General Manager, Brahmaputra Board, Guwahati
2. Chief Engineer, Assam Irrigation Deptt., Guwahati

3. Chief Engineer, West Bengal Irrigation Dept., Calcutta
4. Chief Engineer, Mizoram Irrigation Dept., Tripura
5. Advisor (I, FC&WS), North Eastern Council, Shillong
6. Chief Engineer, Central Water Commission, Shillong
7. Director, NE Region, Central Ground Water Board, Guwahati
8. Prof. M M Das, Assam Engineering College, Guwahati

Member Secretary

Head, Regional Centre

* In the absence of Director, NIH, his nominee not below the rank of Sc. F will chair the meeting of RCC.

3. WESTERN HIMALAYAN REGIONAL CENTRE, JAMMU

Chairman

Director, NIH

Members

1. Chief Engineer, Jammu & Kashmir Irrigation & Flood Control Department, Jammu
2. Chief Engineer, HP Irrigation Deptt., Shimla
3. Chief Engineer (WR), UP Irrigation Deptt., Lucknow
4. Representative of Forest Research Institute, Dehradun
5. Director, SASE, Manali
6. Joint Commissioner (Indus), MOWR, New Delhi
7. Representative of CWC to be nominated by Chairman, CWC
8. Prof. M N Kaul, Deptt. of Geography, University of Jammu, Jammu

Member Secretary

Head, Regional Centre

* In the absence of Director, NIH, his nominee not below the rank of Sc. F will chair the meeting of RCC.

4. DELTAIC REGIONAL CENTRE, KAKINADA

Chairman

Director, NIH

Members

1. Chief Engineer, Andhra Pradesh Irrigation Department, Hyderabad
2. Chief Engineer, Orissa Irrigation Deptt., Bhubaneswar

3. Chief Engineer, Govt of Tamilnadu or his nominee
4. Professor of Engineering College, Kakinada to be nominated by the Principal Kakinada Engineering College
5. Director, Centre for Water Resources, Anna University, Madras
6. Director, State Ground Water Board, Hyderabad
7. Representative of NRSA, Hyderabad to be nominated by Director, NRSA
8. Director, Water Technology Centre, Bhubaneswar

Member Secretary

Head, Regional Centre

* In the absence of Director, NIH, his nominee not below the rank of Sc. F will chair the meeting of RCC

5. GANGA PLAINS NORTH REGIONAL CENTRE, PATNA

Chairman

Director, NIH

Members

1. Chief Engineer, Central Water Commission, Patna
2. Chief Engineer, DVC, Maithon
3. Representative of Chairman, GFCC, Patna
4. Director, (Hydromet), IMD, Patna
5. Chief Engineer (Irrigation and Waterways), Calcutta
6. Chief Engineer & Director, WALMI, Patna
7. Chief Engineer (WR), UP Irrigation Deptt., Lucknow
8. Chief Engineer (Monitoring), Water Resources Department, Bihar

Member Secretary

Head, Regional Centre

* In the absence of Director, NIH, his nominee not below the rank of Sc. F will chair the meeting of RCC.

6. GANGA PLAINS SOUTH REGIONAL CENTRE, SAGAR

Chairman

Director, NIH

Members

1. Chief Engineer or his Nominee, Ganga Basin Irrigation Department, Rewa, MP
2. Chief Engineer or his Nominee, Ground Water Survey, Water Resources Department, Bhopal, MP

3. Director or his Nominee, MP State Remote Sensing Centre, Bhopal, MP
4. Director or his Nominee, Central Ground Water Board, BP Arera Colony, Bhopal, MP
5. Chief Engineer or his Nominee, Central Water Commission, Jaipur, Rajasthan
6. Chief Engineer or his Nominee, CDO, BODHI, Bhopal, MP
7. Professor, Indira Gandhi Govt. Engg. College, Sagar (MP) [to be nominated by Principal of College]
8. Chief Engineer or his Nominee, Rajasthan Irrigation Department (located at Kota).

Member-Secretary

Head, Regional Centre

* In the absence of Director, NIH, his nominee not below the rank of Sc. F will chair the meeting of RCC.

Appendix-VI

CONSULTANCY/SPONSORED PROJECTS ON WHICH THE INSTITUTE WORKED/AND IS WORKING DURING THE YEAR 1997-98

	Title of the Project	Sponsoring Authority	Duration	Date of start	Principal Investigator(s)	Status	Remarks
1.	Surface Water and Ground Water Interaction along river Ganga from Narora to Kanpur	Investigation & Planning Dev. of Water Resources Dept., Govt. of UP	2 yrs	March 1989	Dr G C Mishra, Sc F	On Going	1. An interim report has been submitted in March 1994. 2. Some data have been supplied by sponsors. However, because of non-availability of data which are to be supplied by sponsors the work is delayed.
2.	Hydrological Studies at Jhamarkotra Mines.	Rajasthan State Mines and Minerals	2 yrs	April 1995	Dr G C Mishra, Sc F	On Going	1. An interim report has been submitted and the final report is being prepared
3.	Indigenous Development of Data Logger and Sensor Unit for Watershed Hydrology	Min. of Agriculture, Govt. of India, New Delhi	1 yr	April 1994	Dr Bhishm Kumar, Sc E	On Going	1. The equipment developed under the Project are being tested at Indo-German Watershed Project site Arky in Himachal Pradesh 2. Likely to be completed by December 1998.
4.	Hydrological Studies of Lake Naini, District Nainital, UP	Dept. of Env., Govt. of Uttar Pradesh (through Nainital Lake Special Area Development Authority)	3 yrs	July 1993	Dr Bhishm Kumar, Sc E	On Going	1. Scope of the Project has been changed by the funding agency. 2. Draft of the final report has been finalised.

5.	Temporal Distribution of Dokriani Glacier Runoff and its relation-ship with Meteorological Parameters	DST, New Delhi	3 yrs	April 1995	Dr Pratap Singh, Sc.C	On Going	1. Extension given by Project Authorities upto March 1999. 2. The data are being collected for the year 1998. 3. The progress report has been sent to DST.
6.	Dev. of Instruments for Automation of Irrigation Scheduling and Groundwater Recharge Monitoring using Soil Moisture Measurements	Min. of Agriculture, Govt. of India, New Delhi	2 yrs	April 1994	Dr Vikas Goyal, Sc C	On Going	1. Extension granted upto September 1998. 2. Final modification in instrument design is being carried out.
7.	Exploration of Construction of Infiltration Gallery Inside Bed of River Yamuna at Agra	U.P.Jal Nigam	1 yr. & 3 months	August 1996	Dr G C Mishra, Sc F	On Going	1. An interim report has been submitted in 1997 and the study is in progress. 2. Final draft report for one the of water works site has been submitted in 1998. 3. Draft report for the new water works is under preparation.
8.	Hydrology of Myntdu Leska Hydro-Electric Project in Meghalaya	Meghalaya State Electricity Board, Shillong	1 yr	December 1996	Dr B C Patwari, Sc E	On Going	1. Preliminary analysis has been taken up pending the release of first instalment.
9.	Integrated Hydrological study for Sustainable Development and Management of two Hilly Water-shed in UP.	DST, New Delhi	5 yrs	March 1997	Dr Vikas Goyal, Sc C	On Going	1. The watersheds have been partially instrumented. 2. Some GIS and remote sensing studies taken up. 3. Yearly report has been submitted.

Appendix-VII

ORGANISATIONS TO WHOM PUBLICATIONS OF NIH WERE SENT DURING 1997-98

1. Water Resources Department, Government of Madhya Pradesh, Bhopal.
2. Ground Water Department, Government of Andhra Pradesh, Govt. Offices Complex, Tank Bund Road, Hyderabad
3. Garhwal University, Dept of Geophysics, Srinagar (Garhwal)
4. Regional Engineering College, Civil Engineering Dept, Kurukshetra
5. Punjab Agricultural University, Ludhiana
6. Centre of Study in Resources Engineering, IIT Mumbai
7. Himalayan Ganga Division, Central Water Commission, Sewak Ashram Road, Dehradun
8. Irrigation and Drainage Engineering Division, GB Pant University of Agriculture and Technology, Pantnagar
9. Chief Engineer, Irrigation Dept., Government of Assam, Chandmari , Guwahati
10. Engineer in Chief, Irrigation and CAD Dept, Govt of Andhra Pradesh, Errum Manzil, Hyderabad
11. Chief Engineer, J&K Irrigation and Flood Control Dept., Jammu
12. Secretary (Irrigation), Govt of Uttar Pradesh, Sachivalaya, Lucknow
13. Engineer in Chief, Water Resources Development Organisation, Ananda Rao Circle, Bangalore
14. Chief Engineer, Water Resources Department, Government of Bihar, Patna
15. Chief Engineer (Research), Water Resources Department, Arera Colony, Bhopal
16. Director General, International Commission on Irrigation and Drainage,Chanakyapuri, New Delhi
17. Hydrology (RS) Directorate, Central Water Commission, R K Puram, New Delhi
18. Department of Applied Mechanics, IIT Delhi
19. Director, Centre for Pollution Control and Biowaste Energy, Pondicherry University, Pondicherry
20. Snow and Avalanche Studies Establishment, Manali
21. Central Soil Salinity Research Institute, Regional Research Station, WALMI Campus, Anand
22. Water Technology Centre, Indian Agricultural Research Institute, New Delhi
23. Chief Engineer (D&R), Water Resources Dept., Govt of Orissa, Bhubaneswar
24. Ganga Flood Control Commission,Govt. of India, Sinchai Bhavan, Patna

25. Cauvery Technical Cell, PWD, Pantheon Road, Egmore, Chennai
26. Chief Engineer (Planning Formulation), Water Resources Organisation, Chepauk, Chennai
27. Member (SM&L), Central Ground Water Board, Faridabad
28. Department of Civil Engineering, IIT Kharagpur
29. Directorate of Water Management Research, WALMI Complex, Patna
30. Central Scientific Instruments Organisation, Sector 30, Chandigarh
31. Isotope Division, Bhaba Atomic Research Centre , Mumbai
32. National Institute of Oceanography, Dona Paule , Goa
33. National Geophysical Research Institute, Uppal Road, Hyderabad
34. Director, Indian Institute of Technology, Kanpur
35. India Meteorological Department, Mausam Bhavan, Lodi Road, New Delhi
36. Indian Institute of Tropical Meteorology, Pashan, Pune
37. Central Arid Zone Research Institute, Heavy Industrial Area, Jodhpur
38. GB Pant Institute of Himalayan Environment and Development, Kosi, Almora
39. Space Applications Centre, Jodhpur Tekkra, Ahmedabad
40. National Remote Sensing Agency, Balanagar, Hyderabad
41. Indian Institute of Technology, Powai, Mumbai
42. Geological Survey of India, Jawaharlal Nehru Road, Calcutta
43. Wadia Institute of Himalayan Geology, General Mahadev Singh Road, Dehradun
44. Snow and Avalanche Study Establishment, DBRL Range, Ramgarh, PO Ramgarh, Distt. Punchkula (Haryana)
45. Research Design and Standards Organisation, Manak Nagar, Lucknow
46. Director, Indian Institute of Technology, Kharagpur
47. ICAR Research Complex for North Eastern Hills Region, Kedar Lodge, Jawai Road, Shillong
48. Narmada Control Authority, Vijay Nagar, Indore
49. Indian National Committee on Irrigation and Drainage, Chanakyapuri, New Delhi
50. National Water Development Agency, Community Centre, Saket, New Delhi
51. Indian Institute of Technology, Hauz Khas, New Delhi
52. Indian Institute of Technology, Chennai
53. Central Water and Power Research Station, PO Khadakwasla Pune
54. Director, Central Soil Water Conservation Research & Training Institute, Kaulagarh Road, Dehradun
55. Central Soils and Materials Research Station, Hauz Khas, New Delhi
56. Forest Research Institute, PO New Forest, Dehradun
57. Central Soil Salinity Research Institute, Karnal
58. Tata Energy Research Institute, Darbai Seth Block, India Habitat Centre, Lodhi Road, New Delhi
59. Physical Research Laboratory , Navarangpura, Ahmedabad
60. National Environmental Engineering Research Institute, Nehru Marg, Nagpur

Appendix-VIII.A

SCIENTIFIC AND TECHNICAL STUDIES CARRIED OUT DURING 1997-98

I. WATER RESOURCES SYSTEM DIVISION

1. Optimization of operation of a reservoir - a case study
2. Hydrological modelling using GIS
3. Calibration of a catchment model using genetic algorithm
4. Reservoir sedimentation study for Ukai dam using satellite data

II. WATERSHED DEVELOPMENT DIVISION

1. Effect of soil and water conservation measures on hydrological regime
2. Watershed development in India - a status report
3. Soil erosion and sediment yield modelling using kinematic wave in GIS environment
4. Watershed modelling with GIS based distributed unit hydrograph approach

III. MOUNTAIN HYDROLOGY DIVISION

1. Sensitivity analysis of melt due to temperature and precipitation
2. Development of relationship between glacier melt runoff and meteorological parameters

IV. FLOOD STUDIES DIVISION

1. Effect of non-hydrostatic pressure distribution on dam break flood movement
2. Applicability of NWS DAMBRK model under different river geometry conditions
3. Flow on a plain due to breach of a stream bank
4. Hydrological aspects of the flood disaster management
5. Erosion on a river island
6. One-dimensional modelling of branched free surface flow

V. SURFACE WATER ANALYSIS AND MODELLING DIVISION

1. Development of software modules for processing of streamflow data and related water quality data
2. Development of expert system for unit hydrograph analysis

3. Rainfall-runoff modelling for Morel catchment in Rajasthan
4. Study of impact of periodicity in rainfall records on the water availability estimates

VI. ATMOSPHERIC LAND SURFACE PROCESS MODELLING DIVISION

1. Physiographic modelling of heterogeneity to construct an equivalent homogeneous land surface

VII. HYDROLOGIC DESIGN DIVISION

1. Sensitivity analysis of hydrologic parameters on flood hydrograph
2. Regional flood frequency analysis using 'L' moments

VIII. GROUND WATER ASSESSMENT DIVISION

1. Estimation of ground water potential using soil moisture balance approach
2. Assessment of irrigation return flow
3. Variation of soil moisture characteristics in a part of Hindon river catchment
4. Modelling of arsenic transport in ground water : methodology development

IX. GROUND WATER MODELLING AND CONJUNCTIVE USE

1. Effect of geological set-ups of confining/semi-confining layer on seepage from a large water body
2. Effect of the eccentricity of fracture in the confining layer with respect to the recharge source on seepage from lake beds
3. Groundwater modelling of central Godavari delta for salt water intrusion (part I) - finalisation of network design of piezometers and data collection.
4. Review of artificial recharge practices
5. Development of optimization model for conjunctive use of surface and ground water in Pennar river basin (in collaboration with deltaic regional centre of NIH at Kakinada).
6. Stream aquifer interaction in multilayered system.

X. DRAINAGE DIVISION

1. Overland flow modelling for urban catchment considering random roughness coefficients and irregular land surface
2. Unsteady flow to sub surface drains considering saturated and unsaturated flow condition
3. Reclamation of Sodic soil

XI. DROUGHT STUDIES DIVISION

1. Drought studies for Kalahandi district in Orissa
2. Hydrological considerations for rainwater harvesting in arid and semi arid regions
3. Development of regional low flow relationships

XII. ENVIRONMENTAL HYDROLOGY DIVISION

1. Adsorption of metal ions (Cadmium) on sediments
2. Temperature dependence of BOD and its constants

3. Identification of water quality monitoring sites on river Khshipra
4. Trace determination of pesticides by Gas Chromotography
5. Arsenic pollution in ground water of selected districts in West Bengal
6. Ground water quality monitoring and evaluation in one/two basins under regional centres.
7. Salinity modelling of ground water in Hardwar district

XIII. LAKE HYDROLOGY DIVISION

1. Systematic procedure for the water balance computation of the lakes
2. Hydrodynamic processes in lakes

XIV. HYDROLOGICAL INSTRUMENTATION

1. Field testing of weighing type rain gauge and snow gauge
2. Hydrological instrumentation setup for small watershed studies

XV. REMOTE SENSING APPLICATIONS

1. Hydrological land use mapping in Narmada basin from Jabalpur to Hoshangabad
2. Flood studies in Satluj/Sone basin

XVI. HYDROLOGICAL INVESTIGATION

1. Hydrological soil classification in small watershed in Bikaner district of Rajasthan
2. Guidelines for hydrological investigation in a small watershed

XVII. HYDROLOGICAL INFORMATION SYSTEM

1. Preparation of a typical hydrological data book
2. Recent technical literature relevant to hydrological problems in India

XVIII. NUCLEAR HYDROLOGY

1. Study of measurement of age of groundwater in some selected areas (well suggested by CGWB and Saraswati river from Haryana to Rann of Kutch)
2. Study of soil moisture variation and recharge to groundwater in Hindon river basin using tritium tagging technique and neutron probe

SCIENTIFIC AND TECHNICAL STUDIES CARRIED OUT BY REGIONAL CENTRES DURING 1997-98

I. HARD ROCK REGIONAL CENTRE, BELGAUM

1. Conjunctive use studies in typical problem areas
2. Study of failure of open wells
3. Modelling of estuaries
4. Measurement of soil properties
5. Tank studies
6. Ground water quality studies
7. Ground water modelling studies
8. Development of regional flood formulae

II. NORTH-EASTERN REGIONAL CENTRE, GUWAHATI

1. Calculation of water surface profiles for typical sites
2. Ground water quality studies
3. Flood plain mapping studies
4. Soil classification of typical basins
5. Soil and water conservation studies in hilly areas
6. Hydrogeomorphological studies in typical basins

III. WESTERN-HIMALAYAN REGIONAL CENTRE, JAMMU

1. Development of rating curve
2. Ground water quality studies
3. Lake water quality studies
4. Land use mapping studies
5. Micro watershed studies
6. Soil physico chemical analysis of typical catchments
7. Study of erosion in islands

IV. GANGA PLAINS REGIONAL CENTRE, PATNA

1. Contaminant Transport in multi-aquifer system
2. Management approach for water logging and drainage problems of Mokama Tal
3. Determination of hydraulic conductivity of soils in Central Bihar
4. Hydrological inventory of South Bihar River basins
5. Hydrologic inventory of river basins in U.P.

V. DELTAIC REGIONAL CENTRE, KAKINADA

1. Daily rainfall-runoff modelling studies
2. Conjunctive use studies in typical command areas

3. Analysis of surface runoff and baseflow
4. Estimation of infiltration rates in the representative basins
5. Preparation of typical hydrological data books
6. Ground water quality monitoring studies

VI. GANGA PLAINS SOUTH REGIONAL CENTRE, SAGAR

1. Ground water balance of a typical district
2. Ground water quality studies
3. Water balance studies for river basins.

Appendix-VIII.B

LIST OF PUBLICATIONS

Based on the studies and research conducted at the Institute, results are being brought out in the form of publications under different categories: Technical Reports (TR), Technical Notes (TN), Review Notes (RN), Case Studies (CS), Applied Research (AR), Documentation of Programmes (DP), Manuals (M), Status Reports (SR), Basic Research (BR), Users Manual (UM) and State-of-Art Reports (SA). These reports are printed in 200-300 copies each and circulated to various State and Central Government organisations including educational and research Institutes. This activity is undertaken as a part of transfer of technology and dissemination of information.

LIST OF PRICED PUBLICATIONS

1.	National Symposium on Hydrology, 15-18 Dec., 1987, NIH Roorkee (India), Proceedings Vol.1 & Vol.2, 1987	Rs.	400.00
2.	International Seminar, Hydrology of Extremes : (Floods and Low Flows); 1-3 December, 1988, Roorkee (India) organised by NIH Roorkee, sponsored by UNESCO and INCOH, cosponsored by IAHS, IAHR and IWRS Proceedings 503 pp, 1988	Rs. US $	500.00/ 35.00
3.	Regional Course on Project Hydrology : Course Material NIH, Roorkee (India) 499 pp, 1991	Rs.	400.00
4.	Hydrological Developments in India Since Independence : A Contribution to Hydrological Sciences 440 pp, Hard Copy, 1992	Rs. US $	400.00/ 30.00
5.	International Symposium on Hydrology of Mountainous Areas, 28-30 May, 1992 Shimla (India) organised by NIH Roorkee, sponsored by UNESCO and cosponsored by IWRS Proceedings : 635 pp, 1992	Rs. US $	600.00/ 40.00
6.	Workshop on Flood Routing and Flood Forecasting : Course Material NIH, Roorkee (India) 221 pp, 1992	Rs.	250.00
7.	Workshop on Flood Estimation by Unit Hydrograph Techniques : Course Material NIH, Roorkee (India) 262 pp, 1992	Rs.	300.00

8.	Workshop on Reservoir Operation : Course Material NIH, Roorkee (India) 124 pp, 1993	Rs.	200.00
9.	National Workshop on Advances in Hydrological Instrumentation, 25-26 October, 1994, NIH Roorkee (India) Proceedings, Allied Publishers, New Delhi.		
10.	National Symposium on Hydrology and Water Resources (in Hindi), 15-16 Dec.1995, NIH, Roorkee (India) Proceedings 498 pp, 1995	Rs.	250.00
11.	Software on Unit Hydrograph Applications for Flood Estimation, developed by NIH, Roorkee (India), 1996.	Rs.	1000.00
12.	Software for Reservoir Analysis Developed by NIH, 1997	Rs.	1000.00

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1. Information Brochure of National Institute of Hydrology - 1995
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2. Water - Nature's Wonder Hydrologic Cycle
3. Influence of Deforestation and Afforestation on various Hydrological Parameters
4. Control Evaporation - Save Water
5. Water Quality Conservation
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9. Water Yield From Snow and Glaciers
10. Hydrological Influences of Forests
11. Hydrological Influences of Land Use Changes
12. Sediment Yield From Different Land Uses

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2. Jal Stuti
3. Jal Sanrakshan ke liye kuchh kam ki batein
4. Jal Sanrakshan - kya karein aur kya nahi karein
5. Vashpan Rokein Jal Bachayen
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8. Prakaran Adhyayno ke Saransh
9. Sukha Kya-Kyon-Kaise

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2. Hydrological Terminology - I (1992)
3. Drainage Manual (1996)
4. Jalvigyaniye Paribhashain (Hindi - English), (1998)

WATER SCIENCE SERIES

1. Snow and Glaciers and their Contribution to India's Water Resources (1992)
2. Evaporation from Water Bodies and Its Control (1992)
3. Infiltration and Ground Water Recharge (1992)
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362	TN	107	Representative basin studies: Baira Nalla sub catchment- H.P. Part-I: Preliminary report
363	TN	108	Loktak lake studies - Part I
364	TN	110	Parameterization of hydrological processes-evaporation and evapotranspiration
365	TN	111	Data acquisition systems (DAS) for hydrological measurements
366	TN	112	A study on waterlogging and drainage problems in Gandak river system, Bihar
367	TN	113	Thermal regime of lakes
368	TN	114	Hydrological data book for Narmada basin (upto Bargi Dam) 1981-90
369	TR	1	Cause of negative outflow in Muskingum Method
370	TR	2	Suitability of power transformation based Gumbel EV-1 distribution for flood frequency analysis
371	TR	3	Storage in confined aquifer with flowing artesian well
372	TR	4	Statistical analysis of rainfall in Belgaum district, Karnataka
373	TR	5	Ecosystem simulation submodels flora and fauna
374	TR	6	Water quality modelling of rivers
375	TR	7	Use of personal computer for preparation of reports
376	TR	8	Water balance of a reservoir
377	TR	9	Some studies on plotting position formulae for Gumble EV-1 distribution
378	TR	10	Determination of reach transmissivity under various hydrologic boundary conditions
379	TR	11	Study of parameters affecting base flow
380	TR	12	Field measurement of soil moisture movement in ponding condition

381	TR	13	Development of a variable parameter simplified hydraulic flood routing model for rectangular channels
382	TR	14	Estimating Evaporation losses from lakes and reservoirs
383	TR	15	Mathematical modelling of moving storms
384	TR	16	Overland flow modelling
385	TR	17	Simple techniques for forecasting of monsoon rainfall and runoff and application to Mahanadi river at Hirakud
386	TR	18	Assessment of recharge from various sources to an aquifer and assessment of aquifer yield
387	TR	19	Recharge from large depression storage
388	TR	20	Identification of Hydroenvironmental indices
389	TR	21	Development of a variable parameter simplified hydraulic flood routing model for trapezoidal channels
390	TR	22	Leaching requirement of agricultural land and study of movement of salts
391	TR	23	Determination of aquifer recharge for varying river stages
392	TR	25	Surface fitting of ground water table by means of least square approach
393	TR	27	Comparison of some variable parameter simplified hydraulic flood routing models
394	TR	28	Study of soil erosion for different land use and vegetal covers using universal soil loss equation
395	TR	29	Estimation of soil moisture variation using resistivity technique
396	TR	30	Study of soil moisture movement during rainfall by Green and Ampt equation and comparison of the study by numerical model
397	TR	31	Estimation of ground water recharge due to rainfall by statistical method
398	TR	33	Establishment of rating curve under shifting control
399	TR	34	Development of dimensionless flood hydrographs from Machhu Dam-II failure using Dambrk model
400	TR	35	Analysis of trends and periodicities of rainfall of some districts in east Rajasthan
401	TR	36	Comparative study of different parameter estimation techniques for EV-1 distribution
402	TR	37	Systems approach to optimize conjunctive use of surface and groundwater
403	TR	38	Statistical analysis of low flow in typical river basin to investigation drought characteristics
404	TR	39	Study of spectral reflectance characteristics of various ground features around Roorkee area including Doon valley
405	TR	40	Mapping of salt affected areas of district Aligarh by remote sensing
406	TR	41	Development of dimensionless hydrographs for storm sewers using Kinematic wave routing techniques
407	TR	42	Monthly streamflow simulation for Mahanadi basin using HEC-4 model
408	TR	43	Forecasting of monsoon runoff using data from specific basins
409	TR	44	Application of Kinematic cascade model @Kingen@ for flow computation in a hilly catchment

410	TR	45	Distribution of precipitation with elevation
411	TR	48	Type curves for multiaquifer well
412	TR	49	Retention of groundwater recharge beneath a spreading basin
413	TR	50	Groundwater quality variations in Saharanpur district (UP)
414	TR	51	Watershed characteristics of ONG sub basin
415	TR	52	Geoelectrical techniques for study of soil moisture variations
416	TR	53	Hydrological year book Hemavathy subbasin year 1985-86
417	TR	54	Application of HEC-2 programme for water surface profile determination
418	TR	56	Flood plain mapping of river Ganga between Raoli and Narora using multi temporal satellite data
419	TR	57	Remote sensing applications for sedimentation studies in reservoirs
420	TR	58	Hydrological network design for Narmada basin
421	TR	59	Regional flood frequency analysis for Godavari basin sub-zone(3F)
422	TR	63	Geomorphological characteristics of western ghats region Part-I Upper Krishna basin
423	TR	67	Monitoring of groundwater pollution from sewage wastes in Bhadrabad, Hardwar (UP)
424	TR	68	Simulation of daily runoff of two sub basins of river Krishna using Tank model
425	TR	69	Effect of surface water ground water interaction on routing characteristics
426	TR	72	Flood plain zoning for downstream area of Machhu Dam-II
427	TR	75	Study of spring and hydrologic modelling of spring flow
428	TR	79	Effect of tributary junction on routing characteristics
429	TR	80	Application of flood routing procedure incorporating lateral inflow
430	TR	81	Field investigations in Kolar sub basin of river Narmada
431	TR	82	Laboratory analysis of soil samples from Kolar sub basin of river
432	TR	84	Snowmelt modelling in Beas basin
433	TR	85	Hydrological studies carried out on Kolhai glacier (J&K)
434	TR	86	Interaction of large water bodies with aquifer
435	TR	87	Analysis of flow to a dug well in hard rock area in an unconfined aquifer by Cell theory
436	TR	89	Hydrological studies of Parda Spring in Nainital
437	TR	96	Comparison of some routing techniques
438	TR	97	The effect of Measurement errors on design flood estimation by flood frequency analysis
439	TR	99	Geomorphology of Kolar Sub Basin for Hydrological Studies
440	TR	100	Temperature Lapse Rate Study in Satluj Catchment
441	TR	104	Development of moisture prediction model
442	TR	106	Hydrological Investigations on Chhota Shigri Glacier (H.P.)

443	TR	116	Number of observation wells and their locations for an aquifer test in different geohydrological conditions
444	TR	119	Prediction of Evaporation Losses from Shallow Water Table using a Numerical Model
445	TR	121	Development of Drought Response Plan - Water Availability
446	TR	122	Performance evaluation of Percolation Tanks
447	TR	127	Geomorphological characteristics of western ghats Part III : Hemavati Basin upto Sakleshpur
448	TR	130	Estimation of hydrological soil parameters for Malaprabha and Ghataprabha subbasins
449	TR	131	Hydrological Aspects of the River Tawi
450	TR	132	Rainfall Characteristics in North East India
451	TR	133	Some hydrological Aspects of Brahmaputra River
452	TR	134	Low Flow Forecasting using Statistical Approach
453	TR	137	Guidelines for application of Musking Cunge method of flood routing
454	TR	138	Geomorphology of Sabarmati Basin upto Dharoi
455	TR	139	Application of Macro-scale atmospheric and land surface process hydrologic modelling system
456	TR	140	Current status of Methodology for ground water assessment in the country in different regions
457	TR	141	Mathematical Modelling of Flow from a group of Springs
458	TR	142	Estimation of ground water recharge due to rainfall by modelling of soil moisture movement
459	TR	143	Status of Water Logging, Soil Salinity and Alkalinity in India
460	TR	144	Intercomparison of urban watershed models
461	TR	147	Stochastic Modelling of water quality using Data for River Yamuna
462	TR	148	Effect of Waste Disposals on Quality of Water of River Kali (UP)
463	TR	149	Hydrological year book Malaprabha sub-basin
464	TR	150	Study of Stream-aquifer interaction along river Ganges between Hardwar and Narora using Isotope Techniques
465	TR	151	Hydrological year book Ghataprabha sub-basin
466	TR	155	Development of Data acquisition system (DAS) Instrumentation
467	TR	157	Numerical modelling of GW for Bulandshahar area
468	TR	158	Soil salinisation and reclamation in command areas
469	TR	159	Geographic information system using ILWIS
470	TR	161	Hydrological network for Tawi - J&K
471	TR	163	Infiltration studies in Jammu region
472	TR	164	Sedimentation of reservoir using remote sensing techniques (Tungabhadra)
473	TR	166	Groundwater Balance Study in Central Godavari Delta of Andhra Pradesh (Part-I) Processing and analysis of data
474	TR	170	Hydrological Studies on Dokriani Glacier in Garhwal Himalayas

475	TR	173	Geomorphological studies of Bagmati Basin of Kosi river system
476	TR	174	Hydrological data book Punpun Sub basin (1974-90)
477	TR	175	Evaluation and design of raingauge net work in Burhi Gandak Sub- basin
478	TR	177	Streamflow simulation of satluj river using UBC watershed model
479	TR	178	Representative Basin Studies in Malaprabha and Ghataprabha basins
480	TR	179	Application of rainflo model on Malaprabha catchment upstream of Khanapur
481	TR	180	Evaluation of precipitation gauge density in Punpun catchment of Ganga river system
482	TR/BR	106	Catchment routing using kinematic wave approach
483	TR/BR	107	Effect of orography on precipitation distribution in the Chenab basin
484	TR/BR	108	Effects of errors in annual maximum peak floods on flood frequency estimates
485	TR/BR	109	Development of hydrological drought index based on dynamic groundwater storage
486	TR/BR	110	Semi-pervious stream and aquifer interaction
487	TR/BR	111	Soil moisture simulation by improved numerical method
488	TR/BR	112	Forecasting of low flows for river Narmada at Mortakka
489	TR/BR	113	Excess rainfall and direct surface runoff modelling using geo- morphological characteristics
490	TR/BR	115	Time series analysis of springflow
491	TR/BR	116	Determination of specific yield in the zone of water table fluctuation
492	TR/BR	117	Effect of downstream boundary conditions on the propagation characteristics of the Dam Break Flood
493	TR/BR	117	Regional flood frequency analysis for sub-Himalayan Region
494	TR/BR	118	A runoff model for snow dominated catchment in greater Himalayas
495	TR/BR	119	Groundwater balance before introduction of irrigation in the canal command area
496	TR/BR	120	Effect of water table depth on recharge due to rainfall
497	TR/BR	121	Assessment of recharge from partially penetrating in fluent stream
498	TR/BR	122	Parameter determination in semipervious stream - aquifer system
499	TR/BR	123	Modelling of spring flow in different geohydrological conditions
500	TR/BR	124	Effect of urbanisation on runoff hydrograph
501	TR/BR	125	Runoff modeling using SCS method
502	TR/BR	126	Development of disaggregation techniques
503	TR/BR	127	Uncertainty analysis of dissolved oxygen model
504	TR/BR	128	Prediction of longitudinal dispersion coefficient for natural stream
505	TR/BR	129	Development of flood control regulation policy
506	TR/BR	130	Identification of aquifer parameters in Narmada basin
507	TR/BR	131	Real-time flow forecasting
508	TR/BR	132	Derivation of GIUH for small catchments of Upper Narmada and Tapi sub-zone (subzone 3C) - Part I
509	TR/BR	133	Regional flood frequency analysis for upper Narmada and Tapi subzone - 3C

510	TR/BR	134	Development of regional flood formula for Mahanadi subzone-(3D)
511	TR/BR	135	Development of a weighing type rain gauge (WRG)
512	TR/BR	136	Development of hydrological drought index based on reservoir level
513	TR/BR	137	Development of model for simulation of flows of non-monsoon season
514	TR/BR	138	Surface water-ground water interaction due to pumping near a recharge boundary
515	TR/BR	139	Flow towards a partially penetrating large-diameter well
516	TR/BR	140	Interaction of multilayer aquifer system with static water body
517	TR/BR	141	Impact of sewage waste disposal on soil strata and ground water quality
518	TR/BR	142	Evaporation from layered soils in the presence of a water table
519	TR/BR	143	Multiobjective optimization of operation of a dam
520	TR/BR	144	Shallow wave propagation characteristics in open channels
521	TR/BR	145	Study of 2-dimensional flow behaviour of river using FESWMS - 2DH model
522	TR/BR	146	Modelling surface runoff from micro-watersheds
523	TR/BR	147	Development of an empirical formula for approximate Dam Break flood estimation
524	TR/BR	148	Regional low flow analysis using morphological factors for Upper Narmada
525	TR/BR	1/96-97	Adsorption of lead and zinc ions on sediments
526	TR/BR	2/96-97	Development of a conceptual model for snow, glacier and rainfed catchments
527	TR/BR	3/96-97	Effect of discontinuous aquitard on the seepage from a static water body
528	TR/BR	4/96-97	Metal pollution assessment through aquatic sediments
529	TR/BR	5/96-97	Assessment of probability distribution of dissolved oxygen
530	TR/BR	6/96-97	Automated mapping of snow cover using IRS 1C data
531	TR/BR	7/96-97	Parameter characterization for solute transport in groundwater
532	UM	1	Tyson weber ground water flow model
533	UM	2	Frequency analysis
534	UM	3	Multiple linear regression
535	UM	4	Polynomial regression
536	UM	5	Rating curve analysis
537	UM	6	Preparation of working table
538	UM	7	Finite element aquifer flow model
539	UM	8	Unit hydrograph derivation
540	UM	9	Model parameter evaluation using catchment characteristics
541	UM	10	Muskingum cunge routing procedure
542	UM	11	Hydrologic flood routing

543	UM	13	Kalinin-Milyukov method of flood routing
544	UM	14	Application of tank model for daily runoff analysis
545	UM	15	Application of tank model for flood analysis
546	UM	16	Storage yield analysis
547	UM	17	Optimum reservoir operation using dynamic programming
548	UM	18	A flood control operation of a reservoir
549	UM	19	Flood frequency analysis on a microcomputer with basic language
550	UM	20	Mass curve analysis and sequent peak algorithm
551	UM	21	Generation of hydrological graphs using computer graphics
552	UM	22	Graphical representation of information related with floods
553	UM	24	Technique for flood frequency analysis
554	UM	25	Unit hydrograph analysis
555	UM	26	Physico chemical analysis of water and wastewater
556	UM	27	Graphical representation of flow duration curve
557	UM	28	Hydrologic channel routing with graphics
558	UM	29	Reservoir routing with graphical representation
559	UM	30	Data storage and retrieval system on personal computer
560	UM	32	Power transformation technique in basic for flood frequency Analysis
561	UM	36	Processing and analysis of rainfall data
562	UM	39	Event based distributed rainfall runoff model
563	UM	40	Determination of Trace Elements by Atomic Spectrometry
564	UM	41	Biosphere atmosphere transfer scheme
565	UM	42	Comprehensive data requirement for NWS DAMBRK model with selected examples
566	UM	43	The computerization facilities for technical literature
567	UM	44	User's manual for design of drainage system for steady and unsteady state
568	UM	45	Disaggregation techniques user's manual
569	UM	46	A model for simulation of multireservoir system for conservation operation
570	UM	47	A data storage processing and retrieval system for hydrological data
571	UM	48	Software Package No.1: Unit hydrograph applications for flood estimation
572	UM	49	User's Manual for estimation of seepage from a canal
573	UM	1/96-97	Software for reservoir analysis (SRA)

Appendix-IX

PAPERS PUBLISHED/ACCEPTED FOR PUBLICATION DURING THE YEAR

1. INTERNATIONAL JOURNALS

A. PUBLISHED

Bhar A K and G C Mishra, "One dimensional springflow model for time variant recharge", Hydrological Science Journal, IAHS, Vol.42(3), June 1997.

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Appendix-X

POSITION OF STAFF AGAINST SANCTIONED STRENGTH AS ON 1.04.1997 AND 31.3.1998

S.No.	Post	As on 1.04.1997	As on 31.3.1998
GROUP - A			
1.	Director	1	1
2.	Scientist F	2	2
3.	Scientist E	7	7
4.	Scientist C	20	22
5.	Senior Administrative Officer	-	1
6.	Finance Officer	-	-
7.	Scientist B	44	45
8.	Assistant Engineer	-	-
	Sub total	74	78
GROUP - B			
1.	Documentation Officer	1	1
2.	Section Officer	2	3
3.	Principal Research Assistant	3	3
4.	Senior Personal Assistant	1	1
5.	Senior Research Assistant	22	18
6.	Senior Technician Asst.(Library)	1	1
7.	Senior Hindi Translator	-	-
8.	Junior Engineer (Senior Grade)	1	2
9.	Senior Technician	-	1
10.	Superintendent	1	3
11.	Stenographer Grade-I	1	1
12.	Stenographer Grade-II	7	7
	Sub total	42	41

S.No.	Post	As on 1.04.1997	As on 31.3.1998
GROUP - C			
1.	Draftsman Grade-I	1	1
2.	Research Assistant	20	17
3.	Technical Assistant (Library)	-	1
4.	Junior Engineer	1	1
5.	Technician Grade-I	1	1
6.	Draftsman Grade-II	1	1
7.	Technician Grade-II	12	10
8.	Stenographer Grade-III	9	10
9.	Upper Division Clerk	5	5
10.	Draftsman Grade-III	2	2
11.	Junior Research Assistant	6	7
12.	Receptionist	1	1
13.	Technician Grade-III	11	9
14.	Lower Division Clerk	14	13
15.	Driver (Grade-II)	2	2
16.	Driver (Ordinary Grade)	6	6
	Sub total	92	87
GRADE - D			
1.	Mali (Senior Grade)	1	1
2.	Safai Karmachari (Senior Grade)	1	1
3.	Attendant	16	16
4.	Messenger	22	23
5.	Chowkidar	7	7
6.	Mali	3	3
7.	Safai Karmachari	3	3
	Sub total	53	54
	GRAND TOTAL	**261**	**259**

Appendix-XI

LIST OF AWARDEES UNDER SCHEME OF CASH AWARDS FOR GROUP B C AND D STAFF FOR THE YEAR 1996-97

SN.	Name and Designation	Tech./Non-tech	Amount Rs.
Group B:			
1.	Shri T Vijay, Senior Research Assistant	Technical	500
2.	Shri A S Mehra, Stenographer Gr.II	Non-technical	500
Group C:			
1.	Shri N Varadarajan, Research Assistant	Technical	300
2.	Shri Hussain Khan, Technician Gr. II	Technical	300
3.	Shri Sandeep Kumar, Stenographer Grade III	Non-technical	300
4.	Shri P V K Nair, Upper Division Clerk	Non-technical	300
Group D:			
1.	Shri Ved Pal, Attendant	Technical	200
2.	Shri Iftkhar-ul-hassan, Attendant	Technical	200
3.	Shri Hari Das, Messenger	Non-technical	200
4.	Shri Rakesh Kumar, Safai Karamchari (Sr.Gr.)	Non-technical	200

Appendix-XII (A)

PARTICULARS WITH REGARD TO TRAINING PROGRMME UNDER THE UNDP PROJECT : "DEVELOPING CAPABILITIES FOR HYDROLOGICAL STUDIES"

S. N.	Name	Area of Training	Country	Period of Training From	To
1.	Dr Divya	Hydrometeorology	USA	12.02.92	12.06.92
2.	Dr Pratap Singh	Snow Hydrology	Canada	12.02.92	14.06.92
3.	Shri S V N Rao	Forest Hydrology	USA	01.12.92	31.03.93
4.	Sh Chandra Mohan	Data Processing	USA	14.01.93	14.05.93
5.	Shri Ramakar Jha	Data Processing	USA	14.01.93	14.05.93
6.	Dr Bhishm Kumar	Nuclear Hydrology	France	31.01.93	01.06.93
7.	Shri M K Goel	Remote Sensing	USA	04.10.93	04.02.94
8.	Dr V K Choubey	Remote Sensing	Australia	30.11.93	30.03.94
9.	Sh M K Jain	Mountain Hydrology	USA	01.01.94	30.04.94
10.	Shri Aditya Tyagi	Environmental Hyd.	Canada	16.01.94	16.05.94
11.	Shri A V Shetty	Catchment Hydrology	USA	20.01.94	20.05.94
12.	Shri N C Ghosh	Environmental Hyd.	USA	08.05.94	07.09.94
13.	Shri A K Lohani	Data Processing	USA	02.09.94	01.01.95
14.	Shri Y R S Rao	Data Processing	USA	01.02.95	31.05.95
15.	Sh SV Vijaykumar	Deltaic Hydrology	UK	19.02.95	18.06.95
16.	Sh J V Tyagi	Catchment Hydrology	UK	05.11.95	05.03.96
17.	Sh B Venkatesh	Catchment Hydrology	UK	05.11.95	05.03.96
18.	Sh P K Majumdar	Environmental Hyd.	Canada	09.10.95	08.02.96
19.	Sh Omkar	Forest Hydrology	USA	29.09.96	29.01.97

S. N.	Name	Area of Training	Country	Period of Training From	To
20.	Sh AR Senthil Kumar	Data Processing	Germany	22.10.96	22.02.97
21.	Shri Vijay Kumar	Deltaic Hydrology	Australia	23.7.97	23.11.97
22.	Dr B K Purandara	Forest Hydrology	USA	1.8.97	1.12.97
23.	Shri R P Pandey	Data Processing	USA	31.8.97	1.1.98
24.	Dr Sudhir Kumar	Catchment Hydrology	USA	31.8.97	1.1.98
25.	Sh VS Jayakanthan	Remote Sensing	Canada	6.9.97	5.1.98
26.	Shri S R Kumar	Data Processing	USA	17.9.97	17.1.98
27.	Dr C K Jain	Environmental Hyd.	USA	17.9.97	17.1.98
28.	Shri S K Mishra	Remote Sensing	USA	17.9.97	17.1.98
29.	Shri P K Bhunya	Catchment Hydrology	Sweden	18.10.97	17.2.98
30.	Sh SK Khobragade	Lake Hydrology	Sweden	18.10.97	17.2.98
31.	Shri V K Dwivedi	Lake Hydrology	Sweden	18.10.97	17.2.98
32.	Shri S K Verma	Nuclear Hydrology	Canada	31.10.97	28.2.98
33.	Dr V C Goyal	Hydrological Instrumentation	USA	31.10.97	28.2.98
34.	Shri Rakesh Kumar	Hydrometeorology	USA	31.12.97	30.4.98
35.	Shri D S Rathore	Remote Sensing	Australia	31.12.97	14.4.98
36.	Dr R D Mehta	Mountain Hydrology	USA	31.12.97	14.4.98
37.	Shri R Mehrotra	Catchment Hydrology	USA	31.12.97	30.4.98
38.	Shri C P Kumar	Deltaic Hydrology	Australia	31.12.97	30.4.98
39.	Shri S K Singh	Lake Hydrology	USA	31.12.97	30.4.98

Total man months : 155
Man months utilised : 155
Balance man month : Nil

Appendix-XII (B)

PARTICULARS WITH REGARD TO STUDY TOURS UNDER THE UNDP PROJECT:"DEVELOPING CAPABILITIES FOR HYDROLOGICAL STUDIES"

S. N.	Name	Area of Study Tour	Country	Period	
				From	To
1.	Dr S Chandra	Project Director	USA	02.11.91	16.11.91
2.	Shri B C Patwari	Forest Hydrology	USA	11.04.93	26.04.93
3.	Shri R D Singh	Data Processing	USA	02.05.93	17.05.93
4.	Dr AB Palaniappan	Mountain Hydrology	USA	04.10.93	22.10.93
5.	Shri A K Bhar	Lake Hydrology	Canada	12.10.93	28.10.93
6.	Dr S M Seth	Project Coordinator (RC Comp)	Japan, Thailand, Australia	16.10.93	04.11.93
7.	Dr PV Seethapathi	Project Coordinator (HQ Comp)	USA, UK Germany, Canada, France, Netherlands	16.04.94	19.05.94
8.	Dr K S Ramasastri	Hydrometeorology	Sweden Switzerland	23.04.94	10.05.94
9.	Dr K K S Bhatia	Environmental Hyd.	Germany	10.05.94	25.05.94
10.	Dr S M Seth	Project Coordinator (RC Comp)	China	25.05.94	01.06.94
11.	Dr S M Seth	Project Coordinator	UK, Switzerland, Netherlands	15.09.96 29.09.96	18.09.96 & 6.10.96
12.	Dr G C Mishra,	Catchment Hyd.	Australia	2.2.97	17.2.97
13.	Shri Arun Kumar Additional Secretary, MOWR	Hydrology	China, Australia	01.11.97	16.11.97

S. N.	Name	Area of Study Tour	Country	Period	
				From	To
14.	Dr S K Jain,	Hydrology	China, Australia	01.11.97	16.11.97
15.	Dr B Soni,	Hydrology	UK, USA	23.11.97	08.12.97
16.	Sh Shailendra Pandey, Financial Advisor, MOWR	Hydrology	UK, USA	23.11.97	08.12.97
17.	Shri N C Ghosh,	Env. Hydrology	Australia	31.12.97	14.1.98
18.	Dr Bhishm Kumar	Nuclear Hydrology	USA	31.12.97	14.1.98
19.	Mrs Deepa Chalisgaonkar	Hydrological Instrumentation	USA	31.12.97	14.1.98
20.	Dr. V K Choubey	Remote Sensing	USA	31.12.97	14.1.98
21.	Shri S V N Rao	Deltaic Hydrology	Australia	31.12.97	14.1.98

Total man month :	12.0
Man months utilized :	11.0
Balance man month :	1.0

Appendix-XII (C)

PARTICULARS WITH REGARD TO CONSULTANTS UNDER THE UNDP PROJECT : "DEVELOPING CAPABILITIES FOR HYDROLOGICAL STUDIES"

S. N.	Name	Area of Consultancy	Country	Period	
				From	To
1.	Dr G H Belt	Forest Hydrology	Univ. of Idaho, USA	26.11.91	20.12.91
2.	Dr W P James	Data Processing	Texas A&M Univ., USA	16.12.91	19.01.92
3.	Dr V M Ponce	Catchment Hyd.	San Diago State University, USA	28.12.91	24.01.92
4.	Dr P F Ffolliot	Forest Hydrology	Univ. of Arizona, USA	19.08.92	18.09.92
5.	Dr M M Fogel	Catchment Hydrology	Univ. of Arizona, USA	20.08.92	16.09.92
6.	Dr K Seidel	Snow Hydrology	ETH, Institute for Communication Technique, Switzerland	03.10.92	03.11.92
7.	Dr J Balek	Catchment Hydrology	ENEX Consultancy, Czech Republic	17.11.92	12.12.92
8.	Dr M C Quick	Snow Hydrology	Univ. of British Columbia, Canada	17.04.93	17.05.93
9.	Dr K N Brooks	Forest Hydrology	Univ. of Minnesota, USA	02.09.93	26.09.93
10.	Dr E T Engman	Remote Sensing	NASA Goddard Space Flight Centre, USA	09.09.93	16.09.93
11.	Dr J Balek	Catchment Hydrology	ENEX Consultancy Czech Republic	20.11.93	19.12.93
12.	Dr E A McBean	Environmental Hyd.	Univ. of Waterloo, Canada	22.11.93	21.12.93
13.	Dr V M Ponce	Catchment Hydrology	San Diago State University, USA	29.11.93	02.01.94
14.	Dr L Bengtsson	Lake Hydrology	Univ. of Lund, Sweden	02.12.93	22.12.93
15.	Dr W P James	Data Processing	Texas A&M Univ., USA	13.12.93	15.01.94

S. N.	Name	Area of Consultancy	Country	Period From	Period To
16.	Dr J Ramirez	Hydrometeorology	Colorado State University, USA	28.12.93	24.01.94
17.	Dr I Cordery	Data Processing	Univ. of New South Wales, Australia	09.11.94	09.12.94
18.	Dr E T Engman	Remote Sensing	NSA Goddard Space Flight Centre, USA	02.03.95	18.03.95
19.	Dr R Larsson	Lake Hydrology	Univ. of Lund, Sweden	16.05.95	15.06.95
20.	Dr R Berndtsson	Hydrometeorology	Univ. of Lund, Sweden	30.07.95	03.09.95
21.	Dr D Speers	Snow Hydrology	US Army Corps of Engineers, USA	01.09.95	01.10.95
22.	Dr U Maniak	Catchment Hydrology	Technical University, Braunschweig, Germany	01.09.95	30.09.95
23.	Dr G Kite	Remote Sensing	National Hydrology Research Institute, Canada	11.11.95	09.12.95
24.	Dr A Long	Nuclear Hydrology	Univ. of Arizona, USA	15.11.95	15.12.95
25.	Dr J V Bonta	Hyd. Instrumentation	USDA-ARS, USA	24.11.95	22.12.95
26.	Dr C T Haan	Data Processing	Oklahoma State University, USA	10.01.96	09.02.96
27.	Dr R Wurbs	Data Processing	Texas A&M Univ., USA	17.06.96	16.07.96
28.	Dr Lee MacDonald	Mountain Hyd.	Colorado State University USA	17.07.96	16.08.96
29.	Dr R Drimmie	Nuclear Hydrology	Univ. of Waterloo, Canada	01.09.96	30.09.96
30.	Dr B C Kenney	Lake Hydrology	National Hydrology Research Institute, Canada	23.10.96	22.11.96
31.	Dr James E Ball	Env. Hydrology	Univ. of New South Wales, Australia	20.06.97	09.07.97
32.	Dr R H Hawkins	Data Processing	Univ. of Arizona, USA	04.07.97	03.08.97
33.	Dr T J Ward	Mountain Hydrology	New Mexico State University, USA	04.07.97	03.08.97
34.	Dr A Wojcik	Hyd. Instrumentation	Univ. of New South Wales, Australia	14.07.97	15.08.97
35.	Dr J Niemczynowicz	Env. Hydrology	Univ. of Lund, Sweden	18.07.97	15.08.97
36.	Dr J Luick	Deltaic Hydrology	National Tidal Facility Australia	01.09.97	30.09.97

S. N.	Name	Area of Consultancy	Country	Period From	Period To
37.	Dr B Sevruk	Mountain Hyd.	Geographisches Institute Abteolung Hydrologie, ETH, Switzerland	01.09.97	30.09.97
38.	Dr J V Bonta	Hyd. Instrumentation	USDA-ARS, USA	10.09.97	23.09.97
39.	Dr R Berndtsson	Hydrometeorology	Univ. of Lund, Sweden	15.09.97	01.10.97
40.	Dr U Maniak	Catchment Hydrology	Technical University Braunschweig, Germany	15.09.97	30.09.97
41.	Dr R Drimmie	Nuclear Hydrology	University of Waterloo, Canada	15.09.97	30.09.97
42.	Dr G Kite	Remote Sensing	National Hydrology Research Institute, Canada	19.09.97	01.10.97
43.	Dr E A McBean	Env. Hydrology	Conesstoga Rovers & Associates Ltd., Canada	17.10.97	1.11.97

Total man months of consultancy : 40.0

Appendix-XII (D)

PARTICULARS WITH REGARD TO EQUIPMENT PROCURED UNDER THE UNDP PROJECT:"DEVELOPING CAPABILITIES FOR HYDROLOGICAL STUDIES"

S.No.	Name of the Equipment
GROUND WATER AND SOIL WATER EQUIPMENT :	
1.	Permeameter
2.	Pocket Altimeter
3.	Clinometer
4.	Bearing Compass
5.	Digital Thermometer Height Meter (3)
6.	Water Level Indicator (1)
7.	Precipitation Snow Gauge (1)
8.	Guelph Permeameter (3)
9.	Tensiometer (3)
10.	Guelph Permeameter (2)
11.	Tensiometer (2)
12.	Sample Ring Kit
13.	Unsaturated Permeameter
14.	Wide Range pH meter
15	Master Sizer + Accessories
16	Mettler Moisture Analyser
17.	Check Valve (8)
18.	Unloader Valve (8)
19.	Soil Sample Ring Kit
20.	Permeameter
21.	Guelph Permeameter
22.	Tensiometer
23	Spares for Mastersizer
24.	Tensiocorder
25.	Spares for Master Sizer
26.	Multi Volume Pycnometer

S.No.	Name of the Equipment
COMPUTER AND GIS EQUIPMENT :	
1.	Colour Contact Printer
2.	Image Processing System
3.	Intelligent Desktop
4.	Computer Spares
5.	Computer Spares
6.	Computer Spares
7.	Computer Upgrades
8.	Image Processing System (3)
9.	Application Software Package
10.	Computer Upgrades
11.	Computer upgrades+network
12.	Boundary Element Package
13.	Computer accessories
14.	ARC/INFO Package
15.	Hydrofind Package
16.	Laser Colour Printer
17.	Digital Planimeter
18.	Digital Cartometer
19.	Colour Image Scanner
20.	ERDAS Upgrades
21.	Software
HYDROLOGICAL INVESTIGATION EQUIPMENT :	
1.	Evaporation Recorder
2.	Pygmy Current Meter
3.	Digital Current Meter

S.No.	Name of the Equipment
4.	Standard Water Sampler (4)
5.	Plastic Water Sampler (6)
6.	Pocket Altimeter (2)
7.	Clinometer (2)
8.	Bearing Compass (2)
9.	Digital Thermometer (2)
10.	Height Meter (2)
11.	Water Level Indicator (5)
12.	Evapor. Recorder (1)
13.	Pygmy Current Meter (5)
14.	Digital Current Meter (2)
15.	Automatic Weather Station (4) with installation material
16.	Pygmy Current Meter
17.	Mini Current Meter
18	Electronic Analytical Balance
19.	Pocket Altimeter Clinomter
21.	Bearing Compass
22.	Height Meter
23.	Water Level Gauge
24.	CR 10 Data logger
25.	Automated Weather Stations
26.	Total Precipitation Gauge
27.	Books; Maintenance Contract
28.	DS-51 Package
29.	Eagle 3.0-3.2
30.	CR-10 Data logger
31.	PK Keil electronic
32.	Automatic Weather Station; Spares for AWS
33.	Data Logger and Accessories

WATER QUALITY EQUIPMENT :

1.	Atomic Absorption Spetrometer
2.	Portable pH Meter (3)
3.	Portable Turbidity Meter (3)
4.	Standard Water Sampler (3)
5.	Plastic Water Sampler (1)
6.	pH Determin. Set (3)
7.	Electronic Balance(2)
8.	Portable pH Meter (2)
9.	Portable Turbidity Meter (2)
10.	Water Testing Kit
11.	Accessories for Atomic Absorption Spectrometer
12.	Electronic Balance
13.	portable pH Meter
14.	pH Determin. Set
15.	Water Sampling Kit

NUCLEAR HYDROLOGY EQUIPMENT :

1.	Neutron Probe (3)
2.	Liquid Scintillation Counter
3.	Core Sampler + Accessories
4.	Accessories for Liquid Scintillation Counter
5.	Spare for EG&G
6.	Spares for Neutron Probe
7.	SRM Standards
8.	PGT Model Coxial Detector
9.	Gamma Ray Spectrometer

SURFACE WATER EQUIPMENT :

1.	Fluorometer
2..	UVP Monitor
3.	Electromagnetic Flow Meter with E-30
4.	Wave Height Meter
5.	Profile Indicator
6.	Silt Measuring Inst.
7.	Ultrasonic High Concentration Meter
8.	Wave Height Gauge
9.	Velocity Meter

Appendix-XIII

PARTICIPATION IN SEMINARS, SYMPOSIA, CONFERENCES AND COURSES

S M Seth, Director attended the National Meet on S&T Inputs for Water Resources Management held on April 9, 1997 at IIT, Delhi

S M Seth, Director; B C Patwary, Sc E; N C Ghosh, Sc E;J V Tyagi, Sc C; Y R S Rao, Sc B attended the 8th National Symposium on Coastal Hydrology held on April 11-12, 1997 at Jadavpur University, Calcutta.

S V N Rao, Sc E; S V Vijaykumar, Sc C; Y R S Rao, Sc B;,T Thomas, SRA; U V N Rao, SRA attended the Brain Storming Session on Hydrological Problems of East Coastal Region held on April 23, 1997 at Chennai.

B C Patwary, Sc E and V K Dwivedi, Sc C attended Conference on Hydropower Development, Issues, Challenges and Opportunities held on April 24-25, 1997 at Guwahati.

S V Vijaykumar, Sc C attended the National Conference on Conjunctive use of Surface and Sub-Surface Waters - the Management and Assessment held on April 26-27, 1997 at Bhopal.

N C Ghosh, Sc E; B Chakravorty, Sc C; R Jha, Sc C; A K Lohani, Sc C; C Chatterjee, Sc B; and R K Jaiswal, SRA attended the Seminar on Water Management of North Bihar, held on April 27, 1997 at MIT, Muzzaffarpur, Bihar

S M Seth, Director attended the National Seminar on Future R&D efforts in Water Resources Engineering and Management held on May 1-2, 1997 at DST Delhi.

B C Patwary, Sc E attended Seminar on Water and Water Resources Management in NE India held on May 6-7, 1997 at Shillong.

S M Seth, Director attended the Workshop on the Methodology in Functioning of Central Ground Water Authority held on May 8, 1997 at CGWB, New Delhi.

B C Patwary, Sc E delivered lecture at Training Course on Watershed Management in NE Region held on May 8, 1997 at NERIWALM, Tezpur.

S M Seth, Director attended the Unesco Working Group on IHPV Project 5.1 : Workshop on Hydrologic Processes in Arid and Semi Arid Regions held on April 13-17, 1997 at Paris, France.

C P Kumar, Sc C attended the AICTE sponsored Short Term Course on Advance Computing with Object Oriented Approach held on May 26 -June 6, 1997 at Department of Mathematics, IIT Kharagpur.

S M Seth, Director attended the 25th Session of International Hydrology Programme Bureau Meeting held on June 2-4, 1997 at Paris, France.

A K Lohani, Sc C; Y R S Rao, Sc B attended the International Conference on Remote Sensing and GIS held on 18-21 June, 1997 at Hyderabad.

R D Singh, Sc E; delivered lectures and Vivekanand Sc. B; attended the course on Assessment of Ground Water Resources at Basin Scale using Water Balance and Modelling Approaches held on July 22 - Aug 7, 1997 at Department of Continuing Education, University of Roorkee, Roorkee.

P K Majumdar, Sc attended Report releasing Seminar on Conjunctive Use of Surface and Groundwater in Ghataprabha Command area using MODFLOW held in August 1997 at Belgaum.

V Sreenivasulu, Sc B attended Training Course on Geographic Information System in Water Resources management held during August 4-November 28, 1997 at Indian Institute of Remote Sensing, Dehradun.

S K Singh, Sc C attended the International Seminar on Monsoon Meteorology and Water Resources Hydrology held on August 15-17, 1997 at Andhra University, Visakhapatnam

Y R S Rao, Sc B attended National Conf. on Emerging Trends in the Development of Sustainable Ground Water Resources held on August 27-28, 1997 at Hyderabad.

Rama Mehta (Smt.), Sc B attended the Training Course on Basic Computer Skills (World Bank aided Hydrology Project) held on September 15-26, 1997 at NIH Roorkee.

S K Singh, Sc C attended the Conference on Deep Drilling of Ground Water Exploration in Ganga Basin held on September 18-19, 1997 at Lucknow.

G C Mishra, Sc F; K S Ramasastri, Sc F; Dr. K K S Bhatia, Sc. F; A B Palaniappan, Sc E; S K Jain, Sc E; Bhishm Kumar, Sc E; Pratap Singh, Sc C; M K Jain, Sc C; B Venkatesh,Sc C; S K Singh, Sc C; P K Mahapatra, Sc B; A R Senthil Kumar, Sc B; Omkar, Sc B; P K Agarwal, SRA attended the International Symposium on Emerging Trends in Hydrology held on September 25-27, 1997 at Department of Hydrology, UOR, Roorkee.

S Prakash, Sc B attended Fourth Glaciology Training Course held during September 20 - October 18, 1997 at Glaciology Division and Training Institute, Geological Survey of India, Lucknow.

B C Patwary, Sc E attended All India Seminar on Development of River Transport System in NE Region held on September 29, 1997 at IEI, Assam State Centre, Guwahati.

B C Patwary, Sc E delived lectures at Training Course on Planning, Design and Operation of Minor Irrigation Scheme held on October 20-24, 1997 at NERIWALM, Tezpur.

S K Jain, Sc C attended Conference on GIS on October 21, 1998 at Dublin, Ireland.

A K Lohani, Sc C attended the Second Intl. R&D Conference held on "Water and Energy", October 21-24, 1997 at Vadodara.

B C Patwary, Sc E and Pankaj Mani, Sc B delivered lectures at Training course on Watershed Management held on October 21-25, 1997 at Panchayat and Rural Development Department, Guwahati.

Kamal Kumar, Sc B and R K Jaiswal, SRA attended Training course on Remote Sensing Technology and Application through Visual Interpretation and Digital Analysis held during November 3, 1997 to January

1, 1998 at National Remote Sensing Agency, Hyderabad

B C Patwary, Sc E attended Seminar on Energy and Energy Resources Management in NE India held on November 26-27, 1997 at Guwahati.

M K Jain, Sc C attended DST sponsored User Interaction Workshop on Hydrology of Small Watersheds held on December 10-14, 1997 at CAZRI, Jodhpur.

Dr. Pratap Singh, Sc E delivered a lecture on Snowmelt runoff forecasting on January 1, 1998 at Indian Institute of Remote Sensing, Dehradun.

B C Patwary, Sc E delivered lectures at Training Course on Hydrological Investigation and Data Analysis held on January 4-9, 1998 at NERIWALM, Tezpur.

S M Seth, Director attended the International Conference on Water Quality and Its Management held on March 1-3, 1998 at New Delhi

J V Tyagi, Sc C; S V Vijaykumar, Sc C attended the Training Course on Application of Remote Sensing and GIS Techniques in Hydrology held on March 2-7, 1998 at NIH Roorkee.

S M Seth, Director; R D Singh, Sc E and S K Mishra, Sc C attended the International Conference on Hydrology of Ungauged Streams in Hilly Regions for Small Hydro Power Development held on March 9-10, 1998 at New Delhi.

Appendix-XIV

LIST OF WORKSHOPS/TRAINING COURSES ETC ORGANISED DURING 1997-98

SN	Topic	Time Schedule	Place	Number of Participants
1.	Urban Hydrology	7-9 July, 1997	Roorkee	15
2.	Hydrological Data Processing and Analysis for Mountainous Catchments	23-25 July, 1997	Belgaum	24
3.	New Approaches to Water Management towards Sustainable Solutions	4-6 Aug.,1997	Roorkee	22
4.	Hydrological Instrumentation data Collection, Storage and Processing	6-8 Aug.,1997	Roorkee	20
5.	Catchment Hydrology	22-24 Sept., 1997	Belgaum	10
6.	Coastal Hydrology	22-24 Sept., 1997	Kakinada	20
7.	* Basic Computer Skills	15-25 Oct., 1997	Roorkee	11
8.	* Application of Remote Sensing and GIS Techniques in Hydrology	2-7 March, 1998	Roorkee	24

* Training Courses under Hydrology Project

Appendix-XV

Audited Statement of Accounts

Hemant Arora & Co.
Chartered Accounts

22, Civil Lines, **Roorkee - 247 667**
• Tel : (01332) 72683, 73343 • Fax : 01332 - 77272
E-mail : harora@del.3.vsnl.net.in

AUDITOR'S REPORT

We have audited the Balance sheet of NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE as at 31st March, 1998 and also the annexed Income & Expenditure Account and the Receipts and Payments Account for the year ended on that date and report that :-

1. We have checked the accounts of the society from the books and vouchers producted and the information and explanations given to us, in which are incorporated the returns from Regional Centres not visited by us.
2. We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the furpose of our audit.
3. The Balance Sheet, The Income & Expenditure Account and The Receipts & Payments Account dealt with by the report are in agreement with the books of account.

In our opinion and to the best of our information and according to the explanations given to us, the statements together with Schedules A to G attached and read with Schedule 'H' of Notes on accounts and subject to comments reported in annexure attached to this report, give a true and fair view :

i) In the case of the Balance Sheet of the state of affairs of the society as at March 31st 1998.

ii) In the case of the Income & Expenditure Account of the SURPLUS for the year ended on that date.

iii) In the case of the Receipts & payments Account of the transactions for the Year ended on that date.

Seal

Place : Roorkee
Dated : 08 Oct. 1998

For Hemant Arora & Co.
Chartered Accountants

Sd/-

Hement K. Arora
Partner

ANNEXURE REFERRED TO AND FORMING PART OF OUR REPORT OF EVEN DATE

1. Only one common account is being maintained for Plan Fund, Non Plan Fund and Hydrology Project.
2. Bank charges debited by Bank amounting to Rs 6,474/- during F.Y. 97-98 have not been recorded in the books of accounts during the year.
3. Rent, Rates and Taxes amounting to Rs. 55,083/- debited to Plan Fund relate to Hydrology Project since adjusted during F.Y. 98-99.

Also at : 1 Tyagi Road, **Dehradun - 248 001** • Tel : (0135) 626795 • Fax : 627795

Hemant Arora & Co.
Chartered Accounts

22, Civil Lines, **Roorkee - 247 667**
• Tel : (01332) 72683, 73343 • Fax : 01332 - 77272
E-mail : harora@del.3.vsnl.net.in

UTILISATION CERTIFICATE

Certified that the National Institute of Hydrology, Roorkee has utilised the amount detailed hereunder received for the World Bank funded Hydrology Project during the financial year 1997-98 and the same has been verified with reference to accounting records maintained by the Institute and has been found to be correct :

Particulars	Amount (Rs.)
Opening Balance (as on 1.4.97)	38,04,772.00
Amount Received from Ministry of Water Resources, New Delhi under "Hydrology Project"	-
Total	38,04,772.00
Less : Expenditure Incurred	37,92,809.00
Closing Balance (as on 31.3.98)	11,963.00

Sd/-

(RAJESH CHADHA)
FINANCE OFFICER

Sd/-

(S.M. Seth)
DIRECTOR

Hemant Arora & Co.
Chartered Accountants

Sd/-

(HEMANT K ARORA)
Partner

Place : Roorkee
Dated : Oct. 8, 1998

Also at : 1 Tyagi Road, **Dehradun - 248 001** • Tel : (0135) 626795 • Fax : 627795

Hemant Arora & Co.
Chartered Accounts

22, Civil Lines, **Roorkee - 247 667**
• Tel : (01332) 72683, 73343 • Fax : 01332 - 77272
E-mail : harora@del.3.vsnl.net.in

UTILISATION CERTIFICATE

Certified that the National Institute of Hydrology, Roorkee has utilised the Grant-in-aid as detailed hereunder during the financial year 1997-98 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 Balance (as on 01.04.1997)	35,476.71	34,752.80	70,229.51
Grant in aid received from Ministry of Water Resources, N.Delhi.	2,61,00,000.00	2,44,00,000.00	5,05,00,000.00
Total	2,61,35,476.71	2,44,34,752.80	5,05,70,229.51
Less Payment	2,61,21,658.00	2,44,16,422.31	5,05,38,080.31
Closing balance as on 31.03.1998	13,818.71	18,330.49	32,149.20

Sd/-

(RAJESH CHADHA)
FINANCE OFFICER

Sd/-

(S.M. Seth)
DIRECTOR

Hemant Arora & Co.
Chartered Accountants

Sd/-

(HEMANT K ARORA)
Partner

Place : Roorkee
Dated : Oct. 8, 1998

Also at : 1 Tyagi Road, **Dehradun - 248 001** • Tel : (0135) 626795 • Fax : 627795

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE (U.P.)
INCOME AND EXPENDITURE ACCOUNTS FOR THE YEAR ENDING 31ST MARCH, 1998

PREVIOUS YEARS (Rs.)	EXPENDITURE	CURRENT YEAR (Rs.) PLAN	NON-PLAN	TOTAL	PREVIOUS YEAR(Rs.)	INCOME	CURRENT YEAR (Rs.) PLAN	NON-PLAN	TOTAL
1,71,47,766.00	SALARIES,WAGES AND ALLOWANCES	21,70,111.00	2,19,60,879.00	2,41,30,990.00	1,72,343.00	INTEREST ON SAVINGS/DEPOSITS	6,077.77	2,60,309.13	2,66,386.90
8,06,376.10	TRAVELLING AND CONVEYANCE	7,89,025.00	76,177.00	8,65,202.00					
5,08,813.47	ELECT./WATER & GEN.RUN.COST	6,42,074.95	1,18,014.00	7,60,088.95	3,69,116.00	MISCELLANEOUS RECEIPTS	-	6,76,509.00	6,76,509.00
3,42,389.19	PRINTING AND STATIONERY	5,15,100.75	51,819.00	5,66,919.75					
9,89,355.50	POSTAGE,TELEPHONE & TELEX	11,39,481.75	76,535.20	12,16,016.95	26,223.00	INTEREST ON ADVANCE	-	22,096.00	22,096.00
2,39,351.00	SEMINAR/WORKSHOP/TRG. COURSES	3,27,240.00	8,000.00	3,35,240.00					
					-	INTEREST ON CPF BALANCES	-	5,794.00	5,794.00
1,29,649.00	ADVERTISEMENT	74,988.00	-	74,988.00					
1,75,474.00	PRINTING OF TECHNICAL BOOKS	6,46,856.00	-	6,46,856.00					
4,85,993.37	MISCELLANEOUS	4,66,449.68	1,07,916.60	5,74,366.28	-	LICENCE FEE	-	1,254.00	1,254.00
4,58,131.66	REPAIR & MAINT OF VEHICLE	2,16,315.70	2,62,237.00	4,78,552.70					
22,34,678.10	REPAIR & MAINT. (OTHERS)	11,72,525.97	63,824.00	12,36,349.97	2,44,91,275.19	TRANSFERRED FROM GIA ACCOUNT TO MEET EXPENDITURE FOR THE	88,85,801.03	2,40,95,105.67	3,29,80,906.70
18,796.00	INTEREST TO CPF	21,978.00	-	21,978.00		YEAR			
5,24,694.00	EMPLOYER'S CONTRIBUTION OF CPF	1,43,426.00	22,73,964.00	24,17,390.00					

8,37,099.80	RUNNING COST OF LAB./COMPUTER	3,13,402.00	3,772.00	3,17,174.00					
1,60,390.00	RENT,RATES AND TAXES	2,52,904.00	57,930.00	3,10,834.00					
2,50,58,957.19	TOTAL	88,91,878.80	2,50,61,067.80	3,39,52,946.60	2,50,58,957.19	TOTAL	88,91,878.80	2,50,61,067.80	3,39,52,946.60

Sd/-

(RAJESH CHADHA)
FINANCE OFFICER

Sd/-

(S.M. SETH)
DIRECTOR

As per our separate report of even date.
HEMANT ARORA & CO.
CHARTERED ACCOUNTANTS

Sd/-

(HEMANT K. ARORA)
(PARTNER)

Place : Rorkee
Dated : Oct.8, 1998

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE (U.P.)
BALANCE SHEET AS AT 31ST MARCH, 1998

PREVIOUS YEAR (Rs.)	FUND AND LIABILITIES	CURRENT YEAR (Rs.)		PREVIOUS YEAR (Rs.)	ASSETS	CURRENT YEAR (Rs.)
	UNSPENT BALANCE				FIXED ASSETS (AT COST)	
66,533.50	OPENING BALANCE	70,229.51		11,71,51,398.71	(AS PER SCHEDULE 'A')	14,69,38,556.21
4,23,00,000.00	Add: (a) GIA FROM GOI,MOWR,N.Delhi	5,05,00,000.00				
	Less: (a) AMOUNT TRANSFERRED TO					
1,05,55,759.89	CURRENT ASSETS FUNDS	71,08,152.11			BUILDING WORKS IN PROGRESS	
	(b) AMOUNT TRANSFERRED TO			47,83,000.00	(AS PER SCHEDULE 'B')	
72,49,268.91	FIXED ASSETS FUNDS	1,04,49,021.50				
	(c) AMOUNT TRANSFERRED TO					
2,44,91,275.19	INCOME & EXPENDITURE	3,29,80,906.70			DEPOSITS	
				1,28,220.00	(AS PER SCHEDULE 'C')	1,28,220.00
70,229.51	CLOSING BALANCE	32,149.20	32,149.20			
	FIXED ASSETS CAPITAL FUND				LOAN AND ADVANCES	
				5,25,36,465.06	(AS PER SCHEDULE 'D')	5,91,64,272.17
11,46,85,129.80	OPENING BALANCE	12,19,34,398.71				
72,49,268.91	Add: TRANSFERRED FROM GIA	1,04,49,021.50				
-	Add: TRANSFER FROM PROJECTS	1,45,55,136.00				
12,19,34,398.71	SUB TOTAL	14,69,38,556.21	14,69,38,556.21			
				4,29,138.00	PRE PAID EXPENSES (AS PER SCHEDULE 'F')	14,12,585.00
	CURRENT LIABILITIES					
	LIABILITIES FOR EXPENSES					
6,52,087.00	(AS PER SCHEDULE 'E')	11,55,189.00				
	DEPOSITS			70,229.51	BANK BALANCES WITH STATE BANK	32,149.20
3,000.00	(AS PER SCHEDULE 'G')	3,000.00			OF INDIA	
6,55,087.00	SUB TOTAL	11,58,189.00	11,58,189.00			

	CURRENT ASSETS FUNDS					
4,18,82,976.17	OPENING BALANCE	5,24,38,736.06				
1,05,55,759.89	Add : TRANSFERRED FROM GIA	71,08,152.11				
5,24,38,736.06	SUB TOTAL	5,95,46,888.17	5,95,46,888.17			
17,50,98,451.28	TOTAL		20,76,75,782.58	17,50,98,451.28	TOTAL	20,76,75,782.58

Note: Schedules 'A' to 'H' form integral part of this Balance sheet.

Sd/-

(RAJESH CHADHA)
FINANCE OFFICER

Sd/-

(S.M. SETH)
DIRECTOR

As per our separate report of even date.
HEMANT ARORA & CO.
CHARTERED ACCOUNTANTS

Sd/-

(HEMANT K. ARORA)
(PARTNER)

Place : Rorkee
Dated : Oct.8, 1998

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE (U.P.)
RECEIPTS AND PAYMENTS ACCOUNTS FOR THE YEAR ENDING ON 31ST MARCH, 1998

PREVIOUS YEARS (Rs.)	RECEIPTS	CURRENT YEAR (Rs.)			PREVIOUS YEAR	PAYMENTS	CURRENT YEAR (Rs.)		
		PLAN	NON-PLAN	TOTAL			PLAN	NON-PLAN	TOTAL
66,533.50	OPENING BALANCE	35,476.71	34,752.80	70,229.51	1,70,30,806.00	SALARIES,WAGES AND ALLOWANCES	18,64,824.00	2,17,97,689.00	2,36,62,513.00
					5,79,452.00	TRAVELLING AND CONVEYANCE	5,13,905.00	1,94,348.00	7,08,253.00
					3,89,433.00	ELECTRICITY & WATER CHARGES	3,91,774.00	1,24,916.00	5,16,690.00
					81,536.00	PRINTING AND STATIONERY	3,25,474.00	49,494.00	3,74,968.00
					5,93,964.70	POSTAGE TELEPHONE & TELEX	8,18,602.00	52,011.20	8,70,613.20
4,23,00,000.00	GIA RECEIVED FROM GOI/MOWR/ND	2,61,00,000.00	2,44,00,000.00	5,05,00,000.00	1,29,649.00	ADVERTISEMENT	55,746.00	-	55,746.00
					1,75,474.00	PRINTING OF TECHNICAL BOOKS	5,15,396.00	-	5,15,396.00
					31,31,973.00	REGIONAL CENTRES	29,84,085.00	96,560.23	30,80,645.23
					2,24,945.00	MISCELLANEOUS	95,272.00	1,19,982.00	2,15,254.00
					1,75,652.00	REPAIR & MAINTENANCE OF VEHICLE	3,798.00	1,80,780.00	1,84,578.00
1,72,343.00	INTEREST FROM BANKS	-	2,56,289.12	2,56,289.12	8,80,967.00	REPAIR & MAINTENANCE OTHERS	16,34,206.00	12,789.00	16,46,995.00
					5,43,490.00	INTEREST OF CPF/CPF-CONTRIBUTION	1,65,404.00	18,18,170.00	19,83,574.00
					5,15,890.00	FURNITURE AND FIXTURE	3,47,241.00	-	3,47,241.00
					98,066.00	OFFICE EQUIPMENT	2,73,119.00	-	2,73,119.00
3,65,454.00	MISCELLANEOUS RECEIPTS	-	6,76,509.00	6,76,509.00	9,33,060.00	LIBRARY BOOKS/JOURNALS	8,66,753.00	-	8,66,753.00
64,85,446.71	REFUND FROM UOR, ROORKEE	67,05,711.00	-	67,05,711.00	20,04,998.00	MACHINERY/LAB.EQUIPMENT/ COMPUTER	26,65,798.00	-	26,65,798.00
					51,463.00	RENT,RATES AND TAXES	-	57,330.00	57,330.00
24,113.00	INTEREST ON ADVANCES	-	22,096.00	22,096.00		-			
					2,42,159.00	BUILDING AND BULK SERVICES	1,51,664.00	-	1,51,664.00
3,42,411.00	RECOVERIES OF ADV.TO EMPLOYEES	-	3,14,442.00	3,14,442.00	4,65,263.00	RUNNING COST OF LAB./COMPUTER	1,71,088.00	3,772.00	1,74,860.00
1,294.00	REMITTANCE	-	2,434.00	2,434.00	67,77,407.00	ADVANCES TO FIRMS	14,63,885.00	23,220.00	14,87,105.00
-	LICENCE FEE	-	1,254.00	1,254.00	8,20,053.00	DEPT.ADV./ADV.TO DIV.HEADS	7,95,469.00	1,44,425.00	9,39,894.00
-	REFUND FROM FIRMS	2,12,665.00	-	2,12,665.00	4,88,665.00	ADVANCES TO EMPLOYEES	-	10,13,960.00	10,13,960.00
					10,000.00	SEMINAR AND CONFERENCES	17,626.00	-	17,626.00
					1,33,43,000.00	ADVANCE TO N.P.C.C & OTHER	1,67,70,000.00	-	1,67,70,000.00
						CONSTRUCTION AGENCY GENERATOR	1,48,905.00	-	1,48,905.00
					70,229.51	CLOSSING BALANCE	13,818.71	18,330.49	32,149.20
4,97,57,595.21	TOTAL	3,30,53,852.71	2,57,07,776.92	5,87,61,629.63	4,97,57,595.21	TOTAL	3,30,53,852.71	2,57,07,776.92	5,87,61,629.63

Sd/-

(RAJESH CHADHA)
FINANCE OFFICER

Sd/-

(S.M. SETH)
DIRECTOR

As per our separate report of even date.
HEMANT ARORA & CO.
CHARTERED ACCOUNTANTS

Sd/-

(HEMANT K. ARORA)
(PARTNER)

Place : Rorkee
Dated : Oct.8, 1998

Schedule - A

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

Fixed Assets as on 31st March 1998

Sl. No.	Particulars	Cost as on 01.04.97	Additions during the year	Assets transferred from Projects*	Sale Adjustment during the year	Total Balance as on 31.03.98
1.	Building	4,73,64,206.47	76,12,202.00 **	-	-	5,49,76,408.47
2.	Land for colony	12,34,222.50	-	-	-	12,34,222.50
3.	Furniture & Fixtures	70,99,994.57	5,17,120.00	-	-	76,17,114.57
4.	Office equip.	75,18,241.68	4,73,158.50	-	-	79,91,400.18
5.	Computer Mach.	1,84,69,188.80	29,55,182.00	-	-	2,14,24,370.80
6.	Vehicle	25,67,623.25	-	-	-	25,67,623.25
7.	Library Books	72,79,070.07	11,77,530.00	-	-	84,56,600.07
8.	Machinery & Equipment	2,42,53,797.37	21,52,191.00	1,45,55,136.00	-	4,09,61,124.37
9.	Generator Set	13,65,054.00	3,44,638.00	-	-	17,09,692.00
Total		11,71,51,398.71	1,52,32,021.50	1,45,55,136.00	-	14,69,38,556.21
Previous Year 31.03.1997		10,99,02,129.80	72,49,268.91	-	-	11,71,51,398.71

* Assets transferred from UNDP WAMATRA and SHE Model Projects.

** Including transfer of capital work in progress from 1996-97.

Schedule - B

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

Building Works in Progress as on 31st March, 1998

Sl. No.	Particulars	Amount as on 01.04.1997	Additions during the year	Adjustment during the year	Amount as on 31st March 1998
1.	UOR, Roorkee	47,83,000.00	-	47,83,000.00	-

Schedule - C

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

Deposits as on 31.03.1998 (Made by NIH with outside parties)

Sl.No.	Particulars	Amount (Rs.)		
		Plan	Non Plan	Total
1.	Security deposits for Gas Cylinders	1,900.00	350.00	2,250.00
2.	Deposits to UPSEB for sub station	-	8,480.00	8,480.00
3.	Security deposits for Telex	-	10,000.00	10,000.00
4.	Deposits with SAIL Gaziabad for steel	15,000.00	-	15,000.00
5.	SDO (Telegraph) for telephones	-	13,800.00	13,800.00
6.	Security deposits for telephone at RC Belgaum	8,000.00	-	8,000.00
7.	Distt. G.M. Telecom for telephone connection at Guwahati	8,000.00	-	8,000.00
8.	M/s Deepti Gas Agency Guwahati	500.00	530.00	1,030.00
9.	Accounts Officer (Tel)	6,000.00	-	6,000.00
10.	A.O.(Tel) Patna	16,950.00	-	16,950.00
11.	A.O.(Tel) Kakinada	11,710.00	-	11,710.00
12.	SDO (Tel.) Sagar	12,000.00	-	12,000.00
13.	R.C. Jammu	15,000.00	-	15,000.00
Total		95,060.00	33,160.00	1,28,220.00
Previous Year 31.3.1997		95,060.00	33,160.00	1,28,220.00

Schedule - D

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

Current Assets, Loans and Advances as on 31.03.1998

Sl.No.	Particulars	Amount (Rs.)		
		Plan	Non Plan	Total
1.	Advances to Firms	63,26,002.00	84,380.00	64,10,382.00
2.	Advances to Employees			
	a) Cycle Advance	-	1,652.00	1,652.00
	b) Festival Advances	-	79,920.00	79,920.00
	c) Fan Advance	-	-	-
	d) Scooter/car Advances	-	4,14,250.00	4,14,250.00
	e) LTC Advances	-	1,00,036.00	1,00,036.00
	f) TA Advances	1,47,562.00	24,138.00	1,71,700.00
	g) Departmental Adv.	77,499.00	1,600.00	79,099.00
	h) Pay Advances	-	9,650.00	9,650.00
	i) Adv. to Div. Head	2,000.00	-	2,000.00
	j) House Building Adv.	-	19,27,831.00	19,27,831.00
	k) Medical Advances	1,000.00	1,000.00	2,000.00
	Sub Total (2)	2,28,061.00	25,60,077.00	27,88,138.00
3.	Advances for Construction			
	a) UOR, Roorkee	13,27,972.65	-	13,27,972.65
	b) Ex.Engr.Const.Div. CPWD, New Delhi	12,50,000.00	-	12,50,000.00
	c) Supdt. of works, PWD, DVC, Hardwar	2,07,000.00	-	2,07,000.00
	d) Ex.Engr.Elect.Div. Roorkee	35,12,154.00	-	35,12,154.00
	e) WALMI, Patna	59,21,604.00	-	59,21,604.00
	f) NPCC, Kakinada	98,50,000.00	-	98,50,000.00
	g) NPCC Headquarters	2,72,63,000.00	-	2,72,63,000.00
	Sub-Total (3)	4,93,31,730.65	-	4,93,31,730.65
4.	Amount transferred to RCs.			
	a) Belgaum	5,055.65	8,522.80	13,578.45
	b) Guwahati	77,061.98	-	77,061.98
	c) Jammu	5,340.00	1,576.36	6,916.36
	d) Patna	4,58,920.35	-	4,58,920.35
	e) Kakinada	22,096.62	-	22,096.62
	f) Sagar	38,038.75	17,409.01	55,447.76
	Sub Total (4)	6,06,513.35	27,508.17	6,34,021.52
	Total (1 to 4)	5,64,92,307.00	26,71,965.17	5,91,64,272.17
Previous Year (31.03.1997)		5,05,75,748.60	19,60,716.46	5,25,36,465.06

Schedule - E

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

Outstanding expenses as on 31.03.1998

Sl.No.	Particulars	Amount (Rs.)		
		Plan	Non Plan	Total
I.	Establishment			
	D.A.Arrear	-	1,02,669.00	1,02,669.00
	Medical Expenses	-	48,259.00	48,259.00
	Honorarium	-	17,245.00	17,245.00
	CPF Contribution	-	4,50,000.00	4,50,000.00
	Leave Salary Contr.	-	17,456.00	17,456.00
II.	O.E.			
	Telephone	1,03,479.00	-	1,03,479.00
	Payment for Professional charges	-	8,500.00	8,500.00
	Advertisement	16,682.00	-	16,682.00
	Running Cost of Lab.	20,099.00	-	20,099.00
	Printing of Tech. Books	1,31,460.00	-	1,31,460.00
III.	Capital			
	Books	2,29,716.00	-	2,29,716.00
	Journal	5,896.00	-	5,896.00
IV.	Recoveries from salary			
	NIH/GSLI/FP &			
	House rent/Elect.	-	3,728.00	3,728.00
	Total	5,07,332.00	6,47,857.00	11,55,189.00
	Previous year (31.03.1997)	4,02,747.00	2,49,340.00	6,52,087.00

Schedule - F

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

Prepaid expenses as on 31.03.1998

Sl.No.	Particulars	Amount (Rs.)		
		Plan	Non Plan	Total
1.	Journals	4,79,122.00	-	4,79,122.00
2.	Maintenance of office equipments	15,000.00	-	15,000.00
3.	Maintenance of Computer	5,68,463.00	-	5,68,463.00
4.	Maintenance of Auxiliary equipments	3,50,000.00	-	3,50,000.00
	Total	14,12,585.00	-	14,12,585.00
	Previous year (31.03.1997)	4,29,138.00	-	4,29,138.00

Schedule - G

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

Deposits as on 31.03.1998 (made by outside parties with NIH)

Sl.No.	Particulars	Amount (Rs.)		
		Plan	Non Plan	Total
1.	For Canteen	-	3,000.00	3,000.00
	Total	-	3,000.00	3,000.00
	Previous year (31.03.1997)	-	3,000.00	3,000.00

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE
ASSET FUND ACCOUNT

				Amounts (Rs.)
Sch.A	Increase in fixed assets			1,52,32,021.50
Sch B	Decrease in Works in Progress Building		(-)	47,83,000.00
Sch C	Increase in Deposits			-
Sch D	Increase in Advances			66,27,807.11
Sch F	Increase in Prepaid			9,83,447.00
	Sub Total			1,80,60,275.61
Less:				
Sch G	Increase in Deposits			-
Sch E	Increase in Liability	5,03,102.00		
	Sub Total	5,03,102.00	(-)	5,03,102.00
	Total (i.e. amount transferred to asset fund A/c)			1,75,57,173.61
(a)	Transfer to Current Assets Fund			71,08,152.11
(b)	Transfer to Fixed Assets Fund			1,04,49,021.50

Hemant Arora & Co.
Chartered Accounts

22, Civil Lines, **Roorkee - 247 667**
• Tel : (01332) 72683, 73343 • Fax : 01332 - 77272
E-mail : harora@del.3.vsnl.net.in

Schedule - H

NATIONAL INSTITUTE OF HYDROLOGY - ROORKEE ACCOUNTING POLICIES AND NOTES ON ACCOUNTS AS ON 31st MARCH, 1998

A. SIGNIFICANT ACCOUNTING POLICIES :

1) **Accounting Conventions :** The Accompanying financial statements have been prepared in accordance with the mandatory accounting standards issued by the Institute of Chartered Accountants of India under the historical cost convention, with revenue recognised on receipt basis and expenses accounted for on accrual basis.

   The cost reflected in these statements are not adjusted to reflect the impact of the changing value in purchasing power of money.

2) **Project Accounts :** Independent Project Accounts against funds provided by Independent bodies are maintained separately and are therefore not incorporated in the above statements.

3) **Regional Centres :** Accounts for regional centres are incorporated in the main accounts on the basis of returns received at Head Quarter, and balances if any, are shown under advances.

4) **Fixed Assets :**

   i) Fixed Assets are carried at cost of acquisition or construction and includes freight, duties, taxes and incidental expenses related to such acquisition. None of the fixed assets have been revalued during the year.

   ii) Land at Kakinada and at Patna are in possession of the Institute but are pending legal transfer from the State Governments. Superstructure has been built by the Institute out of its funds.

   iii) The society is maintaining proper records to show full particulars including quantitative details and situation of its fixed assets after adjusting the overall cost of acquisition/ construction.

   iv) Fixed Assets acquired under independent project namely UNDP, WAMATRA & SHE MODEL have been transferred to Fixed Assets and are incorporated in the above statements.

5) **Depreciation :** Depreciation has not been provided on fixed assets as per past practice.

Also at : 1 Tyagi Road, **Dehradun - 248 001** • Tel : (0135) 626795 • Fax : 627795

Hemant Arora & Co.
Chartered Accounts
22, Civil Lines, **Roorkee - 247 667**
• Tel : (01332) 72683, 73343 • Fax : 01332 - 77272
E-mail : harora@del.3.vsnl.net.in

6) **Inventories :** Stock of Institute's research publications and technical books and consumable stores are not valued in accounts as per past practice and the total expenditure is treated as utilisation of funds.

7) **Revenue Recognition :** Revenue grant has been taken in Income & Expenditure Account whereas Capital Grant has been taken directly to Fixed Assets Capital Fund in Balance Sheet.

B. NOTES :

8) **Fixed Assets Capital Fund :**

i) Fixed Assets Capital Fund represents the cost of fixed assets as on 31st March, 1998 including amount of Fixed Assets transferred from Independent Project Accounts namely UNDP, WAMATRA & SHE MODEL.

ii) Current Assets, Loans and Advances as on 31st March, 1998 are pending confirmation from parties.

C. GENERAL

The society is registered under Societies Registration Act 1860 vide Certificate No. 4738/78-79 Renewal no. 858/1995 File No. I-50232 valid upto 16-12-1999.

Seal

Place : Roorkee
Dated : 08 Oct. 1998

For **Hemant Arora & Co.**
Chartered Accountants

Sd/-

Hement K. Arora
Partner

Also at : 1 Tyagi Road, **Dehradun - 248 001** • Tel : (0135) 626795 • Fax : 627795

NATIONAL INSTITUTE OF HYDROLOGY
MAJOR LABORATORY FACILITIES AT ROORKEE

CAPABILITIES

COMPUTER CENTRE

- Analysis of hydrological data
- Data storage & retrieval system
- Development of mathematical models
- Development of softwares
- Implementation & application of softwares developed elsewhere
- Management information system

GROUND WATER

- Infiltration rate measurement
- In-situ soil density measurement
- Soil density measurements
- Soil sample collection

HYDROLOGICAL INSTRUMENTATION

- Collection, transmission and processing of hydromet data
- Design & development of various hydromet instruments and data acquisition system for field measurement

HYDROLOGICAL INVESTIGATION

- Flow/discharge measurement
- Infiltration rate measurement
- Measurement of water level in wells
- Water sampling from rivers, lakes etc.

NUCLEAR HYDROLOGY

- C-14/H-3 dating of ground water
- Discharge of rivers
- Ground water velocity measurements
- Leakage/seepage detection from dam/ reservoir
- Environmental tritium enrichment
- Recharge to ground water
- Soil moisture measurement
- Sedimentation in water bodies

REMOTE SENSING APPLICATIONS

- Groundwater zonation mapping, flood plain mapping, land use, salinity, sedimentation, snow cover mapping, soil erosion, visual and digital image processing for water quality, water logging etc.

SOIL WATER

- Determination of soil moisture characteristic curves (0.1 to 15 bar)
- Determination of soil suction (0 to 0.85 bar)
- In-situ soil moisture measurement
- In-situ soil salinity measurement
- Permeability measurement
- Sampling in soft & hard soil
- Sedimentation/wet mechanical analysis of soil

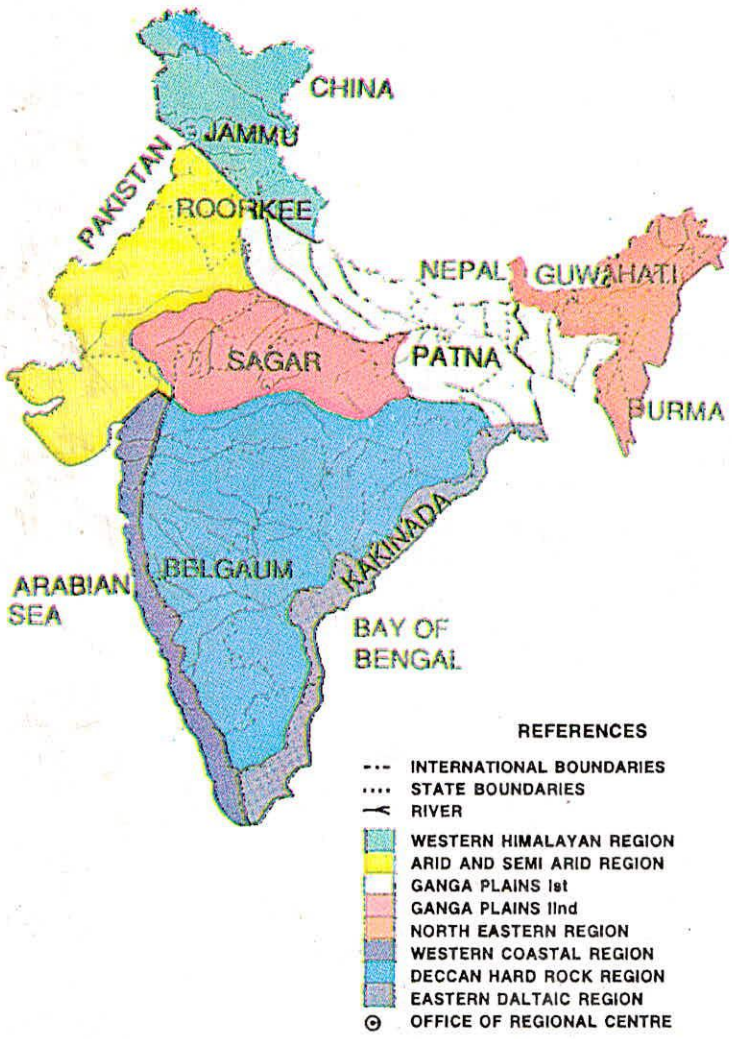
WATER QUALITY

- Analysis of organic carbon, inorganic carbon, total carbon
- Analysis of pesticides & other organic compounds
- Bacteriological analysis
- Digeistion of BOD & COD samples
- Field measurement of pH, conductivity, anions and trace elements

In addition, Regional Centres of NIH at different locations are well equipped to carry out computer, laboratory and field oriented studies relating to

- Hydrological modelling & analysis
- Digital image processing and GIS
- Ground water exploration
- Hydro-meteorology
- Remote sensing applications
- Soil moisture measurements
- Soil sampling & analysis
- Water quality

REGIONAL CENTRES OF NATIONAL INSTITUTE OF HYDROLOGY



NIH REGIONAL CENTRES

Hard Rock Regional Centre
National Institute of Hydrology
Plot No. 11, 1st Main, 2nd Cross,
Hanuman Nagar, Race Course
Belgaum - 590 001 (Karnataka)
Phone : 0831-451514
Fax : 0831-426222

North-Eastern Regional Centre
National Institute of Hydrology
Jalvihar, Chitra Lekha Lane
Usha Nagar, Dispur - 781 006
Guwahati, Assam
Phone : 0361-563153
Fax : 0361-563691

Western Himalayan Regional Centre
National Institute of Hydrology
Irrigation & Flood Control Complex
Belicharana, Satwari
Jammu Cantt - 180 003 (J. & K.)
Phone : 0191-432619
Fax : 0191-450117

Ganga Plains North Regional Centre
National Institute of Hydrology
WALMI Complex, Khagaul
P.O. Phulwari Sharif
Patna - 801 505 (Bihar)
Phone : 0612-452219, 452227
Fax : 0612-452227, 225192

Deltaic Regional Centre
National Institute of Hydrology
Siddartha Nagar, Vakalpudi Road
Kakinada - 533 003
(Andhra Pradesh)
Phone : 0884-72254, 62254
Fax : 0884-63272

Ganga Plains South Regional Centre
National Institute of Hydrology
278, Manorama Colony
Sagar - 470 000 (M.P.)
Phone : 07582-21943

For further information please contact :

Director
National Institute of Hydrology
Jal Vigyan Bhawan, Roorkee - 247 667 (U.P.)
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