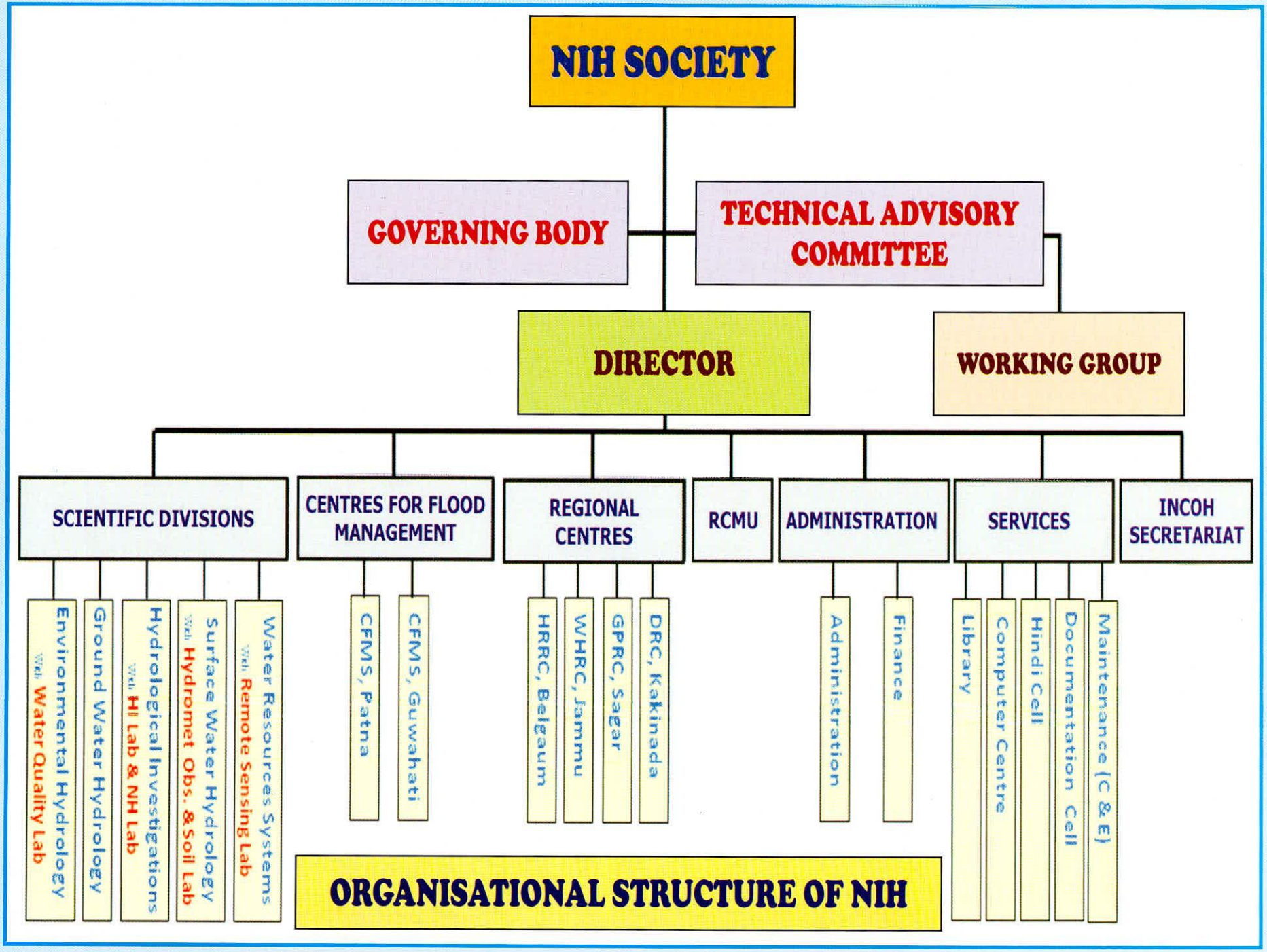

ORGANISATIONAL STRUCTURE OF NIH

Annual Report
2009-10

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National Institute of Hydrology

Jalvigyan Bhawan, Roorkee-247667

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DIRECTOR'S REPORT

It gives me immense pleasure to present the Annual Report of National Institute of Hydrology, Roorkee for the year 2009-2010 highlighting the achievements of the Institute during the year. Over the years, the Institute has grown as a centre of excellence and continues to pursue research activities in Hydrology with emphasis on technology transfer and demand driven, user-defined, strategic research. It has been the constant endeavor of the Institute to nurture a policy of description, prescription and demonstration through its research programs and scientific output.

During the year, there has been a significant growth in the activities of the Institute. Concerted efforts were made towards hazard-free, optimal and sustainable utilization of water resources and to conduct focused research in priority areas. Forty five research projects are under progress under five scientific themes. Application of advanced soft computing techniques such as ANN and fuzzy logic has been demonstrated in various facets of Hydrology. In general, there has been a greater emphasis on demand driven, user-defined and purpose driven research during the year.

The Institute has taken a lead role in the implementation of Hydrology Project, Phase II (HP-II) and is the nodal agency for the implementation of Decision Support System (Planning) for Integrated Water Resources Development and Management. The consultants (DHI, Denmark) have submitted the DSS (P) Needs Assessment Report and Model Conceptualization Report. The Institute has been working on seven Purpose Driven Studies (PDS) in association with State Implementing Agencies to address their specific hydrological problems. A number of trainings have been organized for capacity building for the states and central agencies under HP-II.

I am glad to mention that with the dedication and innovative ideas put forward by the scientists and hard work of the employees, the Institute has achieved commendable progress. I am confident that the Institute will take greater strides in achieving higher goals in the years to come. The Annual Report would provide a glimpse of the activities of the Institute and the contributions made by it in the field of Hydrology during the year. I hope and assure that the Institute will continue to attain higher levels of achievements in the years to come.

(R. D. Singh)
DIRECTOR

ACHIEVEMENTS AT A GLANCE

- The Institute has carried out 54 studies to fulfill its objectives. With the changing scenario in water sector, the Institute is focusing more on demand driven strategic research.
- The studies and research in the Institute have been carried out under five scientific themes at the headquarters at Roorkee, four Regional Centres located at Belgaum, Jammu, Kakinada and Sagar and two Centres for Flood Management Studies at Guwahati and Patna. At the headquarters, significant emphasis has been given on basic and applied research and user-defined research while at the Regional Centres, more emphasis has been given to field oriented research areas/problems.
- The studies and research carried out by the Institute have received national and international recognition and resulted in the publication of 3 books, 3 chapters in books and 172 research papers in national and international journals of repute and proceedings of various national and international conferences, seminars and symposia.
- The Institute has significantly contributed in the on-going second phase of World Bank funded Hydrology Project. A number of training workshops were conducted during the year under Institutional Strengthening Component. Under Vertical Extension Component, development of Decision Support System (Planning) for Integrated Water Resources Development and Management is under progress. The consultants (DHI, Denmark) have submitted the DSS (P) Needs Assessment Report and Model Conceptualization Report. Under Vertical Extension Component, seven Purpose Driven Studies (PDS) are also under progress in association with State Implementing Agencies to address their specific hydrological problems.
- As part of the technology transfer programme of the Institute, 26 training courses/workshops were organized during the year.
- During the year, the Institute also organized a National Symposium on "Climate Change and Water Resources in India (CCWRIN)" during November 18-19, 2009 at NIH Roorkee.

CHAPTER – 1

ABOUT THE INSTITUTE

The National Institute of Hydrology (NIH) is a Govt. of India Society under the Ministry of Water Resources and has been functioning as a premier research Institute in the area of hydrology and water resources in the country since December 1978. The Institute was established as an autonomous Society fully funded by the Ministry of Water Resources, Govt. of India with the following 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.

The organisational structure of the Institute consists of a Society, Governing Body, Standing Committee, Technical Advisory Committee, a Joint Working Group for five Scientific Divisions at the Headquarters, six Regional Coordination Committees for the six Regional Centres, and a Coordination Committee with the Indian Institute of Technology, Roorkee. The description of each component of the structure is presented in Chapter-2.

The Director of the Institute is the Principal Executive Officer of the Society and is appointed by the Govt. of India. The Institute has a team of 69 well qualified and trained scientists in addition to supporting scientific, technical and administrative staff.

The research activities of the Institute are being carried out in five Scientific Divisions at the Headquarters at Roorkee, two Centres for Flood Management Studies at Guwahati and Patna and four Regional Centres at Belgaum, Jammu, Kakinada and Sagar. The Institute's research and other technical activities are monitored and guided by the Technical Advisory Committee headed by the Chairman, Central Water Commission. Regional Coordination Committees (with Director, NIH as the Chairman) for four Regional Centres and two Centres for Flood Management Studies monitor and guide the research and technical activities at the respective Centres.

Keeping in view the requirements and need for hydrological research in the country for the future, the Technical Advisory Committee and Governing Body of the Institute has approved the areas of study and research for the XIth plan period (2007-2012). The annual technical work programs are formulated and considered by the Joint Working Group and the Technical Advisory Committee. As per the directions of the Technical Advisory Committee, significant efforts have been made to include basic and applied research as a part of regular work programme of the Scientific Divisions at Headquarters while at the Regional Centres and Centres for Flood Management Studies, more emphasis is being given to applied research and field oriented research problems.

During the year 2009-10, the scientists and scientific staff of the Institute have contributed significantly which has resulted in the publication of 172 research papers in reputed National/International Journals and proceedings of various National and International Conferences and Symposia organized in India and abroad. A large number of research projects under various thrust areas in hydrology have also been undertaken. The Institute is also assisting several Central and State Government organizations,

public sector undertakings and private institutions in the country in solving various complex and typical hydrological problems through sponsored and consultancy projects.

Under the technology transfer program of the Institute during the year 2009-10, the Institute organized 26 training courses and workshops at Roorkee and in the States.

The Institute has, in general, contributed significantly to water sector in the country through basic and applied research and field oriented research in various frontier areas of hydrology. The progress made during the year 2009-10 on various ongoing and newly initiated projects, and a brief account of academic and other activities along with the statement of accounts is presented in this report.

CHAPTER – 2

ORGANISATIONAL STRUCTURE

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. Ten Ministers-in-Charge of Irrigation and Water Resources in the States and ten eminent engineers & water resources experts are nominated by the President of the Society for a three years term. The membership of the Society as on March 31, 2010 is given in Appendix-I.

The 30th Annual General Meeting of the Society is scheduled to be held at Roorkee under the Chairmanship of the Union Minister for Water Resources & President of the Society on April 6, 2010. The Society will consider the Annual Report and audited statement of accounts of the Institute for the year 2008-2009 and will review the works carried out by the Institute during 2009-2010. The annual report and audited accounts for the year 2008-2009 and budget for the year 2010-2011 will be approved.

Governing Body

The Governing Body (GB) under the Chairmanship of the Secretary, Ministry of Water Resources, Government of India is the executive body of the Institute and 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 constitution of the Governing Body as on March 31, 2010 is given in Appendix-II.

During the year 2009-2010, the 70th meeting of the Governing Body was held at Roorkee on December 24, 2009. Several decisions relating to administrative and financial matters of the Institute were taken in the meeting. Annual report and audited accounts of the Institute for the year 2008-2009 were considered by the Governing Body and recommended for approval. The revised budget for 2009-2010 and budget proposals for 2010-2011 were also considered and recommended for consideration of the Society.

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 the Institute. The Standing Committee has the powers to consider 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 for its approval. The constitution of the Standing Committee is given in Appendix-III.

Technical Advisory Committee

The Technical Advisory Committee (TAC) under the Chairmanship of the Chairman, Central Water Commission, New Delhi carries out technical scrutiny of the research program of the Institute and recommends priority areas for studies and research. It is also responsible for carrying out technical scrutiny of the plans drawn up for five years and the individual schemes submitted for external assistance and expansion of the Institute. The constitution of TAC is given in Appendix-IV.

The 60th and 61st meetings of the TAC were held on April 28, 2009 and November 10, 2009 at Delhi. During the meetings, the TAC reviewed the progress of studies and research for the year 2008-09 and 2009-2010.

Working Groups

The Governing Body of the Institute has constituted three Working Groups namely Surface Water Group; Ground Water Group; and Hydrological Observation and Instrumentation Group under the Chairmanship of the Director, NIH to consider and to recommend to TAC on the program of studies to be taken up by various Scientific Divisions of the Institute and review the progress of work. Experts in specialized fields from various field organisations both from Central and State Governments and academic and research institutions are members of the Working Groups. Members of the Working Group are drawn from various Central and State Government Organisations, Universities and individual experts working in the field of hydrology and water resources. The constitutions of the Working Groups are given in Appendix-V. The technical reports prepared by the Scientific Divisions in various areas of hydrology are sent to the concerned members of the Working Group and other experts for their comments and suggestions.

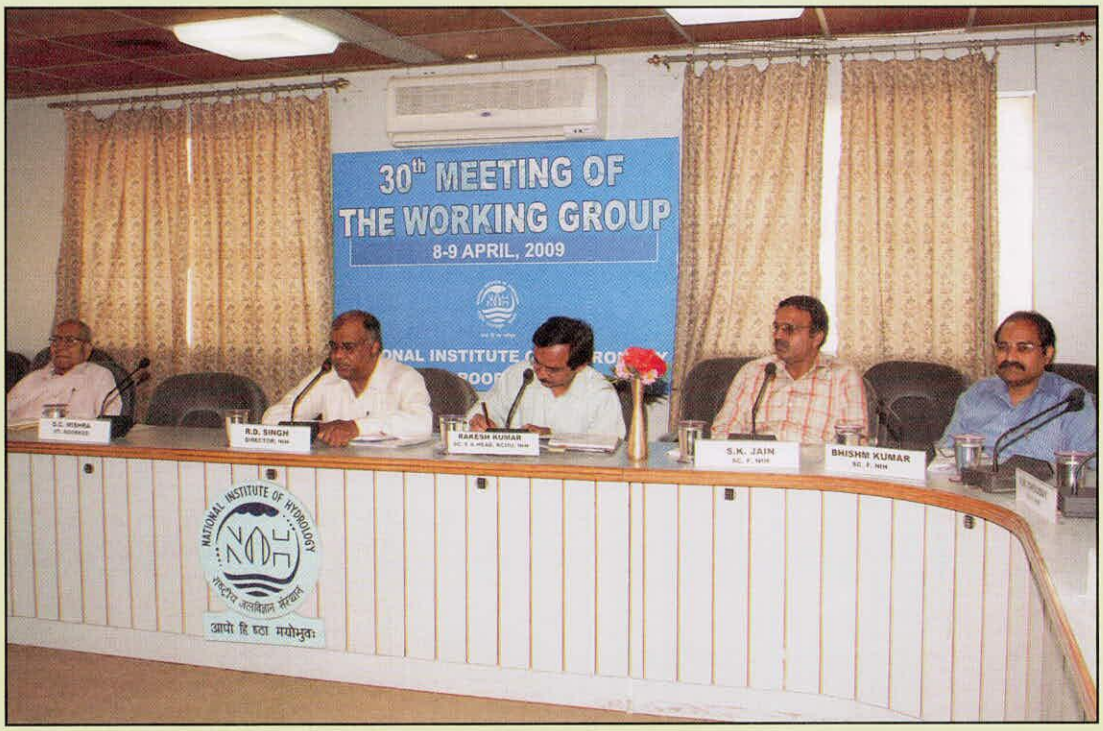
The 30th, 31st and 32nd Joint Working Group meetings were held on April 8-9, 2009; September 17-18, 2009 and March 4-5, 2010 at NIH, Roorkee.

Coordination Committee

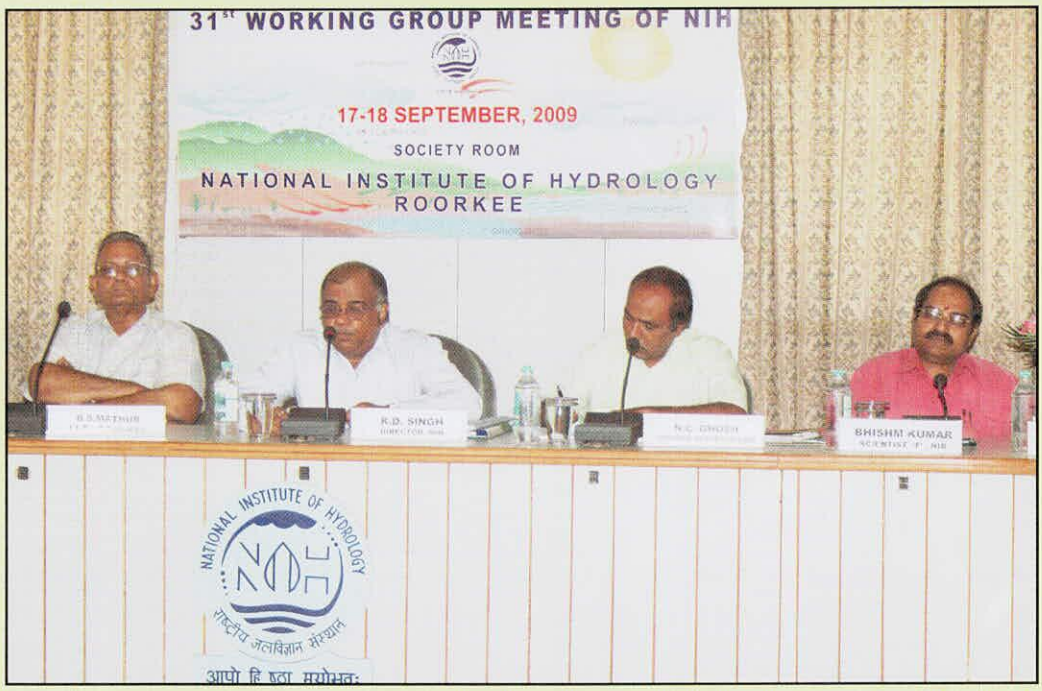
To ensure effective coordination between the Institute and the Indian Institute of Technology, Roorkee, a Coordination Committee has been constituted under the Chairmanship of Director, Indian Institute of Technology, Roorkee. This committee, besides ensuring effective coordination, also recommends the ways for increasing interaction between the two organisations so that the facilities and expertise of both the organisations are optimally utilized.

Scientific Divisions

Studies and research activities at the headquarters are carried out under the following five scientific Divisions. The divisions have undertaken various consultancy and sponsored research projects. As part of the technology transfer program of the Institute, various training courses/workshops have also been organized by the divisions.



Mr. R D Singh, Director NIH addressing the 30th meeting of the Working Group at Roorkee on April 8, 2009



Mr. R D Singh, Director NIH addressing the 31st meeting of the Working Group at Roorkee on September 17, 2009

1. Environmental Hydrology

The Vision of the Division: Environment is the source of life on the earth. It is the environment that provides food, clothes, shelter and other life supporting substances like water, air, sunlight etc to all the living beings. Recent faster growth of industrialization and urbanization has disturbed the natural balance of the environment and the result is un-sustainable process of growth and development. Consequently there is increased realization about the protection and conservation of environment and its invaluable components. The issues related to protection and conservation water resources are one of them required for benefit of society as well as for sustainability of life on this earth. A comprehensive understanding of the various hydrologic processes associated with environmental systems is pre-requisite for better planning, development and management of the water resources for the ultimate benefit of society. This Division aims to undertake, aid, promote and coordinate basic, applied and strategic research in the area of environmental hydrology contributing to sustainable water resources development and management. The thrust areas of research in the Division include the following: (i) Surface, ground & waste water quality monitoring and modeling, (ii) Natural and organic contaminants transport modeling, (iii) Integrated hydrological studies of lake ecosystems, (iv) Erosion and sedimentation studies, (v) Point and Non-point source pollution, (vi) Low cost treatment/remedial technologies, (vii) Environmental impact assessment studies, and (viii) Environmental flow requirement studies.

To pursuit the above research, the Division has a well-equipped Water Quality Laboratory having advanced state-of-the-art-equipment to identify and quantify various physical, chemical and bacteriological parameters of water samples. The laboratory is also equipped with advanced equipment to determine specific water quality constituents viz., trace elements, pesticides, Polynuclear Aromatic Hydrocarbons, organic compounds, etc.

R&D work engaged with: The Division is undertaking sponsored/ consultancy projects in the area of water quality assessment, urban water supply, environmental flow requirement as well as environmental impact assessment besides the

institute funded researched studies. Under technology transfer activities, the Division organizes activities viz., Seminar/Symposium/ Training Course/Workshop in the areas of water quality, lake hydrology & its management. The Division is also engaged in conducting field and laboratory based R&D work related monitoring, assessment and modeling of surface (lake/reservoir/river), ground water & waste water quality, environmental flow requirement and Purpose Driven Studies on impact of sewage effluent on drinking water quality of Shimla City. The Division has also been engaged in assessment of ground water quality in different Metropolitan/class-I cities of India.

Interactions with other organizations: In pursuits of various R&D activities, the Division has made interactions with CWC; CGWB; Central Pollution Control Board, New Delhi; Karnataka Power Corporation Ltd., Bangalore; Irrigation & Public Health Engineering Dept., Shimla; National Institute of Communicable Diseases, New Delhi, Ground Water Resources Development Corporation, Vadodara; IIT's, Tehri Hydroelectric Development Corporation, Tehri; ITRI, Lucknow. The Division has organized a collaborative training on "Water Quality and its Management" during November 9-13, 2009 with Central Soil & Materials Research Station, New Delhi. In this connection, interactions were made with CWC; CGWB, CPCB; IIT; CSMRS; NICD; JNU; WHO-India; New Delhi as guest faculty in the above training course. The Division has also providing technical services to various public and private agencies for analysis of water samples for various water quality parameters. These mainly include: Central Water Commission, Dehradun; CPWD, Roorkee; NTPC Limited, Tapovan, Joshimath, Distt. Chamoli; M/s Bharat Petroleum Corporation Ltd., Rooerkee/Landhora; M/s HMI Manufacturing Co., Roorkee; GPO, Dehradun; M/s Arrow Infra Limited, Haridwar; College of Engineering Roorkee, Roorkee; Uttaranchal Jal Sansthan, Nainital; Bhagirathi Research & Training Centre, Dhulkot, Dehradun; DHI (India), Pvt Ltd., New Delhi.

2. Ground Water Hydrology

The Vision of the Division: Providing efficient and effective methodologies and technologies for sustainable groundwater resources development and management are the vision of the division. Some of the emerging areas in the field of Groundwater Hydrology needing inputs to modern science include groundwater storage and resource estimation; groundwater modeling and management; coastal aquifer dynamics; surface water-groundwater interaction; hard-rock and karst hydrology; and impact of climate change on groundwater resources. Keeping in view of these thrust areas, the Ground Water Hydrology Division is pursuing the basic and applied researches pertaining to various aspects of groundwater hydrology such as; aquifer parameter estimation; aquifer responses due to untoward stresses; groundwater assessment, modelling and management; coastal groundwater dynamics; contaminant transport modelling; management of aquifer recharge; and impact of climate change on groundwater resources. The division has recently created a "Groundwater Modeling Unit" (GMU) with advanced state-of-art computational facilities and technologies required for groundwater assessment, modeling and management. The Unit comprises numerical groundwater modeling software such as MODFLOW, MIKE-SHE, ROCKWORKS, AquiferTest, AquaChem, etc. and other essential software such as those related to Geographical Information System (GIS), geological analysis, water quality analysis etc.

R&D work presently engaged with: The Ground Water Hydrology division is presently actively engaged in conducting field, laboratory and computer-based research studies and projects related to quantification of impact of rainwater harvesting on groundwater availability in Aravalli hills; impact of climate change on dynamic groundwater recharge in a drought prone area; study of rising groundwater table in Jodhpur city and to evolve a management plan to contain the rising trend; and coastal groundwater dynamics and management in the Saurashtra region, Gujarat. A vision document on "Mitigation and Remedy of

Ground Water Arsenic Menace in India" has been completed and published with the approval of the Ministry of Water Resources.

Interaction with other organizations: From time to time, the Ground Water Hydrology division receives demand for undertaking R & D and specific studies from different State Government departments and other organizations in areas related to groundwater. All those tasks help scientists to get exposed to real life problems. Depending upon the spareable time, on case-by-case basis, the division continues to work on demand driven assignments. The division is also involved in the activities of Hydrology Project, Phase-II including development of Decision Support System (Planning) and Purpose Driven Studies in coordination with state governement departments. As part of the technology transfer program of the Institute, the division organizes various training courses/workshops from time to time.

3. Hydrological Investigations

The Vision of the Division: The conventional hydrological data are collected by a number of State and Central Government organizations. However, some specific hydrological information/data may be needed to understand and suggest remedial measures for various hydrological problems. This may require the use of advanced techniques like isotope techniques, advanced instrumentation, remote sensing technique, etc. The Hydrological Investigation Division aim to study the surface water and ground water interaction, groundwater recharge due to rain and irrigation, identification of recharge zones of springs and measures to rejuvenate the dying springs in mountainous areas, integrated hydrological investigation of lakes, aquifer dynamics, seawater intrusion, evaluation of effectiveness of artificial recharge, hydrographs separation, leakage/seepage from water bodies etc. where problem encounter along with basic research related to various hydrological investigations. The Division also has two laboratories attached to it: i) Nuclear Hydrology Laboratory and ii) Hydrological Instrumentation Laboratory. The Nuclear Hydrology Laboratory has facilities to measure different types of radioactive and stable isotopes while Hydrological Instrumentation Laboratory has state of art hydrometeorological instruments for demonstration and measuring various hydrometeorological parameters.

R&D work presently engaged with: The Hydrological Investigations Division is presently actively engaged in conducting field and laboratory based research related to various hydrological investigations using conventional and isotopic techniques and hydrological instrumentation. The Division is presently involved in a number of national projects related to watershed management, surface water and groundwater interaction, isotopic signatures of groundwater, rivers, precipitation and air moisture in different parts of the country.

Interaction with other organizations: The Division is participating in a mega multi-institutional project on isotope finger printing of waters in India (IWIN) in which 14 different academic, state and central government field and R&D organizations are involved. The Division is also engaged in two purpose driven studies, – one on groundwater aquifer dynamics in Bist Doab, Punjab and other on groundwater management on over-exploited blocks in Karnataka where Punjab Regional Directorate Office of Central Groundwater Board and State Water Resources Department of Karnataka alongwith SSIT Tumkur are involved. Keeping in view the drinking water problem in mountainous part of Uttarakhand, the Division has taken a collaborative project on the identification of recharge zones of springs with G.B. Pant Institute of Himalayan Environment and Development, Almora. The division has also taken such studies in Uttarakhand independently with active support by Uttarakhand Jal Sansthan. In order to meet out the drinking water needs of Delhi, the Delhi Jal Board has sponsored a project to the Institute for the assessment of groundwater potential in Yamuna flood plain in Delhi where CGWB, Delhi and IIT, New Delhi are involved. The Division is also actively engaged in various hydrological investigations to solve the problems related to leakage, seepage from dams/reservoirs in Uttarakhand and in the mining areas in Rajasthan in

association of NTPC, NHPC and RSMML, Rajasthan.

4. Surface Water Hydrology

The Vision of the Division: Water is one of the most essential natural resources for sustaining life and it is likely to become critically scarce in the coming decades, due to continuous increase in its demands, rapid increase in population and expanding economy of the country. Variations in climatic characteristics both in space and time are responsible for uneven distribution of precipitation in India. This uneven distribution of the precipitation results in highly uneven distribution of available water resources both in space and time, which leads to floods and drought affecting vast areas of the country. The components of the hydrologic cycle are being affected because the hydrological processes are no longer stationary due to point and non-point changes taking place in the river basins. Hence, a comprehensive understanding of the various hydrologic processes associated with surface water hydrology is a pre-requisite for optimal planning, development and management of the water resources for sustainable development and well being of the society.

The thrust areas of research in the Division include the following: (i) Water availability analysis, flow duration curve analysis and environmental flow requirement studies, (ii) Flood estimation, (iii) Flood routing, (iv) Hydrological modeling, (v) Structural and non-structural measures of flood management, (vi) Urban hydrology, (vii) Watershed management studies for flood control, (viii) Sedimentation studies for flood control, (ix) Socio-economic aspects of flood disasters, (x) Drought mitigation and management, (xi) Impact of climate change on water resources.

The Surface Water Hydrology Division has a Soil and Ground Water Laboratory which is well equipped with state of the art equipments to study soil moisture, particle size, infiltration rate and other soil characteristics.

R&D work engaged with: The SW Division is actively pursuing the basic and applied research pertaining to various aspects of Surface Water Hydrology. It includes hydrology of extremes i.e. floods and droughts, flood forecasting, project hydrology, sedimentation modeling, monitoring and modeling of snow and glacier melt, watershed modeling, impact of climate change on water resources, applications of soft computing techniques in hydrology etc. Under technology transfer programme, the Division organizes various activities viz. Seminars/Symposia/Training Courses/Workshops in the area of surface water hydrology. The Division is also engaged in conducting field and laboratory based R&D work as well as in carrying out sponsored consultancy projects. The division is actively coordinating the activities of Hydrology Project Phase-II. The Scientists of the division are also involved in the development of DSS (P) and Purpose Driven Studies under HP-II.

Interactions with other organizations: In pursuance of various R&D activities, the Division has made interactions with CWC; CGWB; GFCC; IMD; IITM, NHPC; Central Pollution Control Board, New Delhi; DST, New Delhi; various State Water Resources Departments; IITs; Tehri Hydroelectric Development Corporation, Tehri; NEEPCO, New Delhi etc. The Division has been providing technical services to the various organizations.

5. Water Resources Systems

Vision of the Division: At present, India lacks indigenous software and tools for analysis of complex water systems. With the increase in water demands for various purposes, there is a need to identify optimum solutions for water resources development and utilization. The WRS division aims to contribute in the development of Decision Support System for integrated river basin planning and management. In addition, works have been initiated for development of independent tools for analysis of reservoirs, river basin planning, and operation of irrigation systems. Further, the existing hydrological information systems in India lack reliability, accessibility and timeliness. With the popularity of web as preferred media for information exchange, it is proposed to develop Web-based Water Resources Information System.

The division aims to develop user-friendly software to perform various computations required for hydrological analysis of a project. It is also planned to develop techniques for hydrological predictions in ungauged basins and investigate the applications of soft computing techniques (like Artificial Neural Networks, Genetic Algorithms, Fuzzy Logic Models etc.) for analysis of water resources systems. Further, it is also envisaged to use the remote sensing and GIS tools for solving various water resources problems.

R&D work presently engaged with: The WRS Division is presently actively participating in the development of Decision Support System for water resources planning and management. A few software, such as NIH_ReSyP (NIH_Reservoir Systems Package) and web-based information software are under development. Application of various models for river basin planning is being carried out and a purpose driven study under HP-II for predictions in ungauged basins is in progress. Various studies which use remote sensing data and GIS tools are also in progress.

Interaction with other organizations: The scientists of the Division are coordinating with Water Resources Departments of various States (Maharashtra, Gujarat, Orissa, and Kerala) for the database development for DSS applications and for PDS studies under HP-II. Few scientists of the division are members of the Climate Change Cell at NIH and are also interacting with Central Govt. Organizations like CWC and CGWB for various studies being carried out in this area. Scientists are also interacting with officials of Gujarat State (CDO), THDC, Rishikesh for solving their specific sponsored projects.

Centre for Flood Management Studies and Regional Centres

In order to deal with the specific hydrological problems in different regions of the country and for providing effective interaction with the States, the Institute has established following two Centre for Flood Management Studies and four Regional Centres.

1. Centre for Flood Management Studies, Guwahati

The Vision of the Centre: The North Eastern Regional Centre (NERC), Guwahati catering for the seven North-East states, Sikkim and parts of West Bengal (Teestha basin) was established in August 1988 at Guwahati and was working for various water resources problems of the region. Considering flood as the major problem in the region, Ministry of Water Resources, Government of India decided to focus the activities of the centre towards the problem of floods in the Brahmaputra basin and renamed it as "NIH Centre for Flood Management Studies". As per the action plan, the centre is to work in thrust areas of research like flood estimation and routing; structural/non-structural measures for flood management; iii) Integrated watershed management for flood control; iv) Hydrological data base management system; v) Drainage congestion and erosion problems; vi) Water quality problems; vii) Socio-economic aspect of flood disaster and; viii) Technology transfer. The centre has got long term ongoing program of representative basin studies and has since procured advanced software for flood studies and packages for GIS in which the scientists are trained/being trained. However, the centre needs reinforcement of manpower and other infrastructural facilities to address the huge water resources problems of the region, it should.

R&D work presently engaged with: The centre is presently engaged in modelling non-point source pollution, flash flood studies (Jiadhal Basin), Flood plain zoning/flood hazard mapping of rivers of Arunachal Pradesh, phytoremediation: a plant based technology to clean-up the environment and design of rain guage station network for Arunachal Pradesh. The centre has contributions in publishing a book, five papers in international journals, one paper in national journal, one paper in international conference and nine papers in national conferences. Moreover, it conducted one technology transfer activity and organized six mass awareness activities in different districts of Assam.

Interaction with other organizations: In connection of the centre`s activities, there have been continuous interaction with different state/central agencies, academic institutions like Brahmaputra Board, CWC, CGWB, IIT for base line information/data, research orientation, state water resource organizations for field logistics and existing data base, other academic institutions for technology transfer and mass awareness program. The centre also actively participated in the meetings of the Climate and Glacier Commission, Govt of Sikkim and submitted a modified chapter on 'Hydro-Meteorological Observations and Modelling of Glacierized Basins' for inclusion in the report of the Commission. The chapter includes details of meteorological parameters and discharge measurement techniques along with modelling basics and data requirements.

2. Centre for Flood Management Studies, Patna

The Vision of the Centre: The Centre is mainly focusing on flood related studies of the region covering eastern Uttar Pradesh, Bihar, Jharkhand and West Bengal. The broad objectives envisaged by the Centre are: (i) to undertake strategic and adaptive research activities related to flood management for the Ganga basin, (ii) to advise different Government organizations dealing with hydrology and water resources about the technological advancement in flood management and (iii) technology transfer activities about the advancement in flood management.

The Centre has been carrying out research in different aspects of flood management and other hydrological studies since its inception, as per the work programme approved by the Regional Coordination Committee (RCC) of the Centre. Over the years, the Scientists of the centre have developed the expertise to deal with various hydrological problem of the region. Some of the areas are: i) Flood estimation and flood forecasting: development of regional flood formulae for small catchments of Bihar and Jharkhand, flood estimation by GIS based GIUH approach for Ajay basin of Jharkhand, development of real-time flood forecasting model for Ajay basin, characteristics of short interval rainfall etc.; ii) Flood hazard mapping and flood risk zoning for a reach of river Ganga between Buxor to Mokama; iii) Study of shifting characteristics of river Ganga between Ara and Patna using remote Sensing data; iv) Water logging and drainage congestion studies for lower Gandak basin, development of management model for waterlogging and drainage congestion problem of Mokama group of Tals; v) Application of ANN techniques in flood forecasting; vi) Dam break analysis and flood inundation study of Mithon and Panchet dam; vii) Lab studies of the soils of Central Bihar; viii) Application of remote sensing and GIS in flood management; and x) Urban hydrology study of Patna etc.

R&D work presently engaged with : The centre is presently engaged in (i) Flood hazard mapping and flood risk zoning for a reach of river Ganga between Buxor to Mokama by using MIKE FLOOD software, (ii) Purpose driven study of Storm water management in Otteri Nullah sub basin, Chennai Corporation under HP-II and (iii) Shifting characteristics of river Kosi and Bagmati.

Interaction with other organizations: The centre is interacting with the Central Water Commission, Ganga Flood Control Commission and Water Resouces Department, Govt. of Bihar for obtaining hydrological data and sharing the outcome of the studies. As a part of technology transfer, training on state of art softwares like MIKE 11 and MIKE Flood are organized from time to time for WRD officials of Govt. of Bihar. The centre is engaged in one purpose driven studie – Storm water management in Otteri Nullah sub basin, Chennai Corporation for which the officials of State Ground and Surface Water Resources Data Centre, PWD, Govt. of Tamilnadu are associated.

3. Hard Rock Regional Centre, Belgaum

The Vision of the Regional Centre: About 67% of India is occupied by hard rock terrain. This region is frequently experience drought and at times flood. The ground water is one of the most depended water resources in the region. Over last decade, the usage of ground water has increased exponentially causing the lowering of water level.

On the other hand, increased anthropogenic activities in region has resulted in a dramatic changes in the land use and land cover. This has strongly affected the water availability of the region. These problems are further complicated by the changes observed in the rainfall and meteorological parameters over the region. In order to study the effect of these changes on the water availability of the hard rock region, the following are the thrust areas, viz., forest hydrology, groundwater, and water logging and salinity studies presently being focused. However, looking at the present and future need of the region, drought studies, urban hydrology and the impacts of climate change on water resources sector were added. Apart from this, technology transfer activities, extension services/mass awareness programmes, infrastructure development, improvement of laboratories and establishment of experimental watersheds/plots were given importance in the future plans of the Centre.

R&D work presently engaged with: The regional centre is actively involved in conducting field based studies for many years. In continuation of its previous efforts to generate the first hand data for inferring more insight into the problem, presently the regional centre is engaged in many research studies such as Basin Level Planning of Manimanla River Basin in Kerala, Estimation of Environmental Flow Requirement of Bhadra River in Karantaka and Assesment of Efficacy of Artificial Recharge Structure in augmenting the ground water in semi-arid zone of Karnataka.

Keeping in view of growing problem of water deficit in the region, which is compounded by the present problem of climate change, it is imperative to assess the possible impact of climate change on the water resources of the region. In order to meet this objective, a study has been proposed to carry out the analysis of climate change and its impact on the water availability in the Western Ghat region of India.

Interaction with other organizations: The Regional Centre collaboratively taken-up a Purpose Driven Study (PDS)) with Kerala Irrigation and Ground Water departments to assess the water quality over entire state. Also, a PDS study is being proposed along with Karnataka State Water Resource Development Organization for optimizing the Stream Gauge Network in Karnataka. In addition to these PDS studies, the regional Centre is actively engaged with the DST to study the impact of land cover changes on water balance component of forested watersheds in Western Ghats. The Following departments are regularly interactingf with the Regional Centre for conducting studies on hydrological problems of the region and for exchanging information and data: Karnataka Irrigation Department, APERL Hyderabd, Maharashtra Irrigation Department, Ground Water Department Tamilnadu, Institute of Water Studies Taramani, Chennai, University of Agricultural Sciences Dharwad, AP Irrigation Department, CWC Hyderabd, Ground Water Department Hyderabd, NRDMS Belgaum, CGWB, Department of Mines and Geology, GIT Belgaum, KLES CET Belgaum, KREC Mangalore, WALMI Dharwad, Karnataka University, Dharwar, SDMEC Dharwad. GSDA Pune, KPCL, etc.

4. Western Himalayan Regional Centre, Jammu

Vision of the Centre: In view of the hydrological problems in the western Himalayan region, it is envisaged to carry out the future studies in the areas of a) Assessment of impact of climate change on hydrological variables, b) Analysis and design of hydrological network, c) Long-term hydrological data generation in selected climatic regimes, d) Lake hydrology studies, e) Monitoring and modelling of hydrological characteristics of glaciers and change estimation of selected glaciers in distinct climatological regimes of western Himalayas, f) Snow cover monitoring and snowmelt modeling studies, g) Water quality studies, h) Prioritization of catchments for sedimentation treatment using GIS, i) Water resources management aspects in Kandi belt, j) Analysis of extreme hydrological events, and k) Technology transfer and mass awareness.

R&D work presently engaged with: Presently the R&D studies undergoing at the Centre include cryospheric system studies and runoff modeling of Ganglass catchment, Leh, Ladakh Range,

Glaciological studies of Phuche glacier, Ladakh Range, and Trend Analysis of Hydrological Variables in Western Himalayan Region – Phase I (Jammu & Kashmir). Considerable efforts are being made to study the hydrological characteristics of glaciers in the Ladakh region. Impact of climate change on the Himalayan glaciers is also being analyzed through glacier change studies. Further, studies are also in progress to estimate the trend of hydrological variables (say, rainfall, runoff etc.) in different parts of the region.

Interaction with other organizations: Active interaction has been made with the Irrigation and Flood Control Department, Jammu; Directorate of Environment and Remote Sensing, Jammu/Srinagar; different Departments of the Jammu University, Jammu; Geology Department of the Kashmir University, Srinagar; Ladakh Hill Council, Leh, Ladakh; and Agriculture Department, Hamirpur, H.P.

5. Deltaic Regional Centre, Kakinada

The vision of the Centre: East Coast is rich in water resources than the West Coast due to excess precipitation and a massive river runoff (river delta system). Approximately 25 km width of the east coast of India is vulnerable to the cyclones hazard and the risk is particularly severe at the mouths of rivers and estuaries. On an average, four severe cyclonic storms form in the Bay of Bengal every year. Due to cyclones and floods the coastal areas are frequently inundated, thus causing loss of crops, human lives etc. Groundwater problems are also significant in coastal areas apart from the surface water problems. The backwater through the streams and rivers, aquaculture practices, excessive pumping of groundwater are the main sources of salinity contamination in the shallow aquifers. Other than the salinity, the ground and surface water is also deteriorating due to industrial effluents, poorly treated sewage, irrigation return flows, and unsatisfactory household and community sanitary conditions. Therefore few thrust areas have been identified after interacting with various water resources agencies in the region. The main thrust areas are: Urban Hydrology, Real time flood Forecasting, Impact of climate change on river flows, Flash floods in ungauged basins, Sedimentation of reservoirs, point and non point groundwater source contamination, Saltwater intrusion modelling, Time series and Rainfall-Runoff modelling. The centre is also equipped with soil and water quality laboratory, GIS and Remote sensing tools and other hydrological software's for analyzing field problems.

R&D work presently engaged with: The deltaic regional centre is presently working on demand driven R&D studies referred by various state govt., departments. As a part of ongoing Hydrology Project II, purpose driven study titled "Urban hydrology of Chennai city" is initiated in collaboration with PWD, Govt. of Tamilnadu. This centre is also working on other projects titled Spatial and Temporal Hydrological Aspects on Water Resources of Kakinada City, Study on Pre and Post project Scenarios and IWRM under Pushkar Canal Command Area in Andhra Pradesh, Impact Assessment of Climate Change on hydrological regime in Sabari sub-basin, Godavari river system, status report on salinity ingress in the coastal Andhra Pradesh, Tamilnadu and Groundwater Modeling of Puri City, Orissa as referred by various govt., agencies.

Interaction with other organizations: The centre is actively participating in various review meetings of state water resources departments and also actively interacting with academic institutions like Andhra University, IIT Chennai, NIT Warangal, Agricultural University, Bapatla, NGRI on various capacities. Further, the centre is imparting training on SWDES and HYMOS software under ongoing Hydrology Project II. Various training workshops were organized by this centre on the request of various agencies on specialized topics. Expert opinions and guidance were also provided to Vizag steel plant, Reliance Energy, GMR groups etc.

6. Ganga Plains South Regional Centre, Sagar

The vision of the Regional Centre: The Jurisdiction of the GPSRC, Sagar is major part of Madhya Pradesh, southern part of Uttar Pradesh,

southeast Rajasthan, northern Chhattisgarh and south-west part of Bihar. The economy of these areas is primarily dependent on rainfed agriculture. The lack of appropriate water resource management, degraded watersheds, recurrent droughts, excessive soil erosion, groundwater depletion, deterioration of water quality and reduction of forest cover have given rise to inadequate water availability, reduced the crop yield and exacerbated poverty in this region. Under those circumstances; sustainable management of water resource including its quality is one of the key challenges in the R & D activities. The centre is thus aimed at to carry out its scientific researches to develop appropriate methods and methodologies for sustainable management of water resources and drought management in the drought prone regions under its jurisdiction. The centre has also focused its research studies in areas related to impacts of climate change on water resources in river basins in Central India.

R&D work presently engaged with: The Regional Centre is presently involved in conducting various in-house research studies and sponsored projects on drought management, river basin management, demand-supply analysis, reservoir sedimentation and management, command area management and catchment treatment plans using advanced hydrological techniques and softwares.

Interaction with other organizations: The Regional Centre has taken up drought management study on Bundelkhand region comprising of 13 districts covering Madhya Pradesh and Uttar Pradesh. The Centre is currently pursuing World Bank sponsored two purpose driven studies under Hydrology Project-II in collaboration with Water Resources Department, Govt. of Chhattisgarh, Raipur; out of which, One is on supply-demand analysis in Kharun river basin and the other one is on reservoir sedimentation in Kodar reservoir in Chhattisgarh. The Regional Centre is also involved in development of Decision Support System (DSS) for Madhya Pradesh state under Hydrology Project Phase II. The Centre is also involved in organizing training programs for officials of MP and Chhattisgarh state under the Institue's technology transfer activities. The activities of the centre follow a close interaction with state and different central agencies such as, CGWB, CWC, NCA, PHE, WALMI, etc.

Regional Coordination Committees

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

Experts from field organisations and academic Institutes of the region covered by the Regional Centre are members of the Regional Coordination Committee with Director, NIH as the Chairman. The constitution of six Regional Coordination Committees for six Regional Centres/CFMS is given in Appendix-VI. The details of meetings of RCC held during 2009-10 are given below:

Meetings of Regional Coordination Committees

S. No.	CFMS/Regional Centre	Date	Place of meeting
1.	Guwahati	June 18, 2009	Guwahati
2.	Patna	July 10, 2009	Patna
3.	Belgaum	August 20, 2009	Bangalore
4.	Jammu	May 19, 2009	Jammu
5.	Kakinada	July 13, 2009	Kakinada
6.	Sagar	July 27, 2009	Bhopal

Mr. R D Singh, Director NIH addressing the 19th meeting of the Regional Coordination Committee at WRDO, Bangalore on August 20, 2009

Indian National Committee on Hydrology

The Indian National Committee on Hydrology (INCOH), as one of its objectives, provides technical support to Ministry of Water Resources, Government of India (MoWR) in evaluating the R&D projects and studies for funding. The Institute has been providing secretarial assistance to the INCOH. The constitution of the INCOH is given in Appendix-VII. Till date, under INCOH, MoWR has granted financial support to sixty nine research projects under "Research Schemes Applied to River Valley Projects". Out of these, thirty five research projects have been completed successfully, twenty projects are on-going and fourteen projects related to groundwater have been transferred to Indian National Committee on Ground Water (INCGW), CGWB, New Delhi, as per directions received from MoWR.

In pursuance of its objectives of preparing and periodically updating the state-of-art reports on hydrology in the country, the secretariat has published thirty state-of-art reports on different topics so far. The secretariat also publishes the "Journal of Hydrological Research and Development" earlier named as Hydrology Review Journal entitled "Jalvigyan Sameeksha". Twenty three volumes (31 Nos.) of the Journal have been brought out so far on different focal themes. The Journal is being distributed to about 500 organizations in the country and abroad in order to disseminate and promote knowledge in the area of hydrology.

One of the major aims of the INCOH is to effectively coordinate and act as the focal point for the International Hydrological Programme (IHP) of UNESCO by organizing regional courses and workshops and carrying out R&D work on various Themes of IHP. The Committee is involved in the 7th phase of IHP (2008-2013) of UNESCO, which is devoted to water interaction with various systems emphasizing the need to solve social changes ahead and associated risks.

The 37th Meeting of INCOH is scheduled to

be held on April 8, 2010 at CWC, New Delhi under the Chairmanship of Chairman, CWC & Chairman, INCOH to discuss the various issues of INCOH.

The INCOH has discharged its role effectively during the last 29 years and it will continue to strive to achieve higher goals in the years to come.

INCOH ACTIVITIES HELD - UP TO 31st March 2010

S.No.	Activities	Up to 2009-2010
1.	Total R&D Projects funded	69
2.	R&D Projects completed	35
3.	R&D Projects On-going	20 projects are with INCOH & remaining 14 projects have been transferred to INCGW
4.	State of Art Reports	30
5.	Journal of Hydrological Research & Development (Jalvigyan Sameeksha)	31 (23 volumes)
6.	National Seminar/ Symposia sponsored	13

CHAPTER – 3

RESEARCH & DEVELOPMENT

During the year 2009-10, research and development activities at the Institute were carried out under the five scientific divisions at headquarters at Roorkee and four regional centres at Belgaum (Karnataka), Jammu (J&K), Kakinada (Andhra Pradesh), Sagar (Madhya Pradesh) and two Centre for Flood Management Studies (CFMS) at Guwahati (Assam), & Patna (Bihar).

The program of studies and research for the year 2009-10 of the Institute was deliberated at length in the Working Group meetings and then approved by the Technical Advisory Committee. The work programs of regional centres and CFMS were deliberated in their respective Regional Coordination Committee meetings as well as at Headquarters. Approved research program of the Institute and its regional centres for the year 2009-2010 is given in appendix-VIII. Brief description of some of the important studies carried out during the year 2009-10 is given below.

A. NIH INTERNAL FUNDED PROJECTS (COMPLETED)

1. Evaluation of water quality of rivers joining Tehri Reservoir and downstream of the reservoir

The main aim of the study was to examine the suitability of water of the rivers joining Tehri reservoir and downstream for various designated uses and to identify possible sources of pollution and assess the actual changes in river water quality. A reconnaissance field visit of Tehri reservoir and its joining rivers has been carried out and three water samples from reservoir (upstream, mid and downstream), one sample each from river Bhilangana at Ghansali and from river Bhagirathi at Dharasu, two downstream samples from Zero point and Koteshwar, 21 km downstream were collected in the month of December 2008, May 2009 and August 2009 and analysed for physico-chemical, bacteriological parameters and metal concentrations. Results revealed that all the physico-chemical parameters and heavy metals are found within the limit prescribed for drinking water by Bureau of Indian Standards (BIS, 1991). The concentration of almost all the water quality parameters were observed higher in summer season as compared to winter and monsoon season. Bacteriological contamination was observed in the river Bhagirathi and Bhilangana which may be attributed to runoff and washing off from the places of open defecation from bank in the catchment areas. Assessment of suitability of the river water for irrigation purpose is made on the basis of total soluble salts, SAR, RSC which revealed that the water is of good quality for irrigation purpose throughout the year as per recommended guidelines for evaluation of irrigation water quality.

2. Runoff and Sediment Modelling in a part of Brahmaputra River Basin using ANN

Gauge discharge and sediment discharge rating curves using Back propagation ANN have been developed for three important gauging sites of Brahmaputra River, viz, Pandu, Pancharatna, and Choulduaghat (Subansiri River). The results have been compared with conventional rating curve technique. Back propagation ANN models have been developed for simulation of rainfall-runoff and sediment-runoff process in the basin. The results of ANN simulation show a high degree of correlation between observed and simulated discharge as well as sediment concentration (Figure 2.1).

3. Hydrological Studies in a Forested Watershed in Uttarakhand

The project has been carried out in collaboration with Forest Training Academy (FTA), Govt. of Uttarakhand in a Sal forested watershed in Nainital District with the objectives to study the variation of soil-hydrological and environmental parameters viz. soil moisture

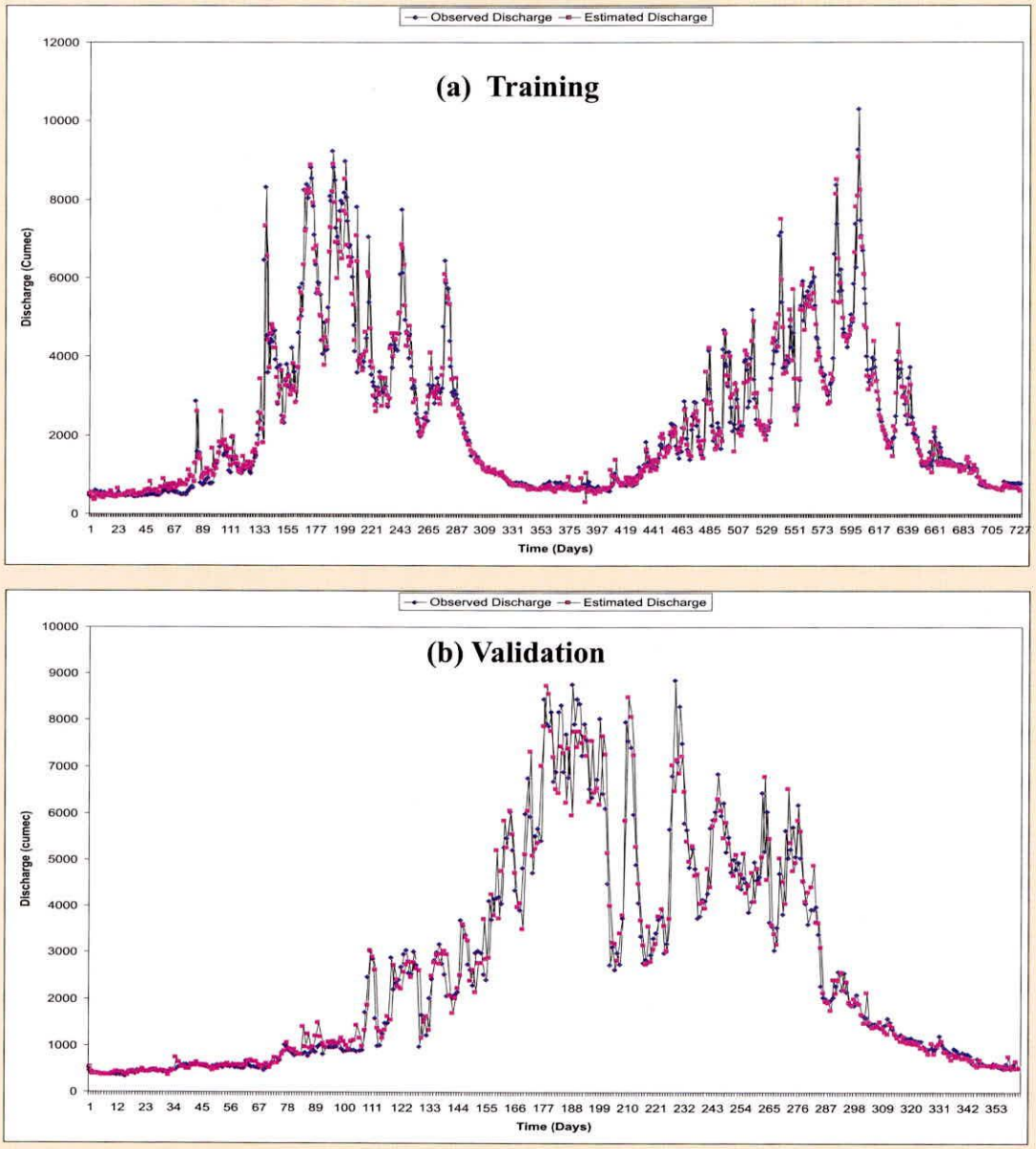


Figure 2.1: Comparative performance of observed discharge with estimated discharge using ANN model for Subansiri Basin

storage, light intensity and soil erosion under various micro-environments formed due to varying overhead canopy and their effect in terms of the variation in natural regeneration of Sal. For this purpose, the data on soil moisture, light intensity and Sal regeneration under different canopy densities, and rainfall, runoff and sediment load data at the watershed outlet were collected in the field using appropriate instruments. The analysis of data shows that the regeneration is better correlated with incidence of light intensity than the soil moisture storage. The higher regeneration under C1 canopy is mainly due to the higher incidence of light intensity despite lower levels of soil moisture in C1 canopy than in other canopies. The simulation by ANSWERS model shows that the soil erosion is higher in areas under C3 canopy than those under C1 and C2 canopies. The high soil erosion under C3

canopy contributes to uprooting and washing away of tender seedlings during their establishment stage in early monsoon season. This may be one of the reasons, among others, for poor regeneration under C3 canopy. The natural regeneration in Sal species is generally affected by the 'dying back phenomenon' which results in a very slow progress towards establishment of the seedlings.

4. Web-based River basin Information System for India

River basin management deals with technical, as well as socio-economic and ecological aspects and calls for an integrated approach. It involves planning and execution of measures to reduce environmental degradation and to ensure sustainable use of water, including water allocation, water user conflicts, monitoring, protection and rehabilitation of ecosystems. Basin wise information on rainfall, water availability, water resources projects, irrigation potential are useful inputs for planning and management. The main design objective of the package is to provide a common, integrated, and quantitative geo-spatial framework for providing the hydrological information of India over a variety of domains, from national to sub basin level. The themes of the package are topography, water facts, river basins, water resources utilization, climate and thematic maps. The package also includes information about water policy and constitutional provisions for water use. Several treaties (international and inter-state) have been signed in the past and water related disputes have been arisen. The details of these treaties and resolution disputes are also. Ancient literature such as The Vedas and The Upanisads also provide some meaningful information about weather prediction, drainage, water use etc. To make the user aware of the ancient methods and practices of hydrology the system includes a section for it. The option of e-learning has also been incorporated in this. The e-learning feature is very helpful as a reference hydrological book. It has a large number of figures and more than 600 definitions of various terminologies related to hydrology. Another important feature of the package is the option of online ET-computation using commonly used methods.

5. Hydrological impact of land-use changes in Humid Tropical Watersheds located In the Sahayadri Mountains

This study was carried out to understand the linkages between land-use/land-cover (LU/LC) changes and hydrological responses of catchments located in the Sahayadri (Western Ghats) mountain ranges, India. Virtually all the major rivers in southern India originate in the Sahayadri mountain ranges and provide water supplies to several million people living in the states of Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and Maharastra. However, the upland catchments of these rivers are rapidly undergoing a variety of changes in LU/LC due to intensive use, degradation, cultivation, afforestation and natural regeneration. Recent research and field observations in temperate regions of the world indicate that such land-use changes could have very significant and complex influences on different aspects of watershed functioning such as: changes in magnitudes and distribution of low flows and flood flows, modifications in natural groundwater recharge rates and groundwater supplies, and changes in soil erosion and sediment discharges.

Following are some of the important conclusions drawn from this study:

1. A water balance model such as ARNO, can be used to assess the impact of land cover changes on hydrologic regime.
2. The median flow does not show any impact of land cover changes. The major changes have been observed in high and low flows only.
3. It is observed that, when the entire watershed is under degraded forest, it can generate very high flows (Q_{10}). Also, the simulation show that, the stream will flow only for 35% of the time in a year.
4. The analysis shows that, a combination of acacia plantation and the forest, can induce an increasing trend of low flow (Q_{90}) and moderate the high flow (Q_{10}). The flow in the

stream can sustain for 85% to 90% of the time in the year.

The study indicates that the forest and acacia plantation can be a good combination to restore the hydrological regime in the watershed. However, from the point of view of bio-diversity, the acacia possess poor rating compared to natural forest.

6. Spatial and Temporal Hydrological Aspects for Water Resources Planning and Management of an Urban Area (Kakinada) along the Coastal Region

The objective of this study is to estimate 5, 15, 30 and 60 minute short duration rainfall in and around Kakinada urban settlement. To demonstrate the importance of spatial and temporal aspects of rainfall for urban hydrological studies including groundwater. To evaluate the impact of excess precipitation on urban drainage and deficit precipitation on urban water supply with specific attention to the management of surface water and groundwater. The results of the above study are as below:

- The 15-minute duration rainfall observed is about 50 mm at Kakinada (13 October 2005) and it is most intense 15-minute rainfall (20 cm/hour) so far observed.
- The heaviest intensity of rainfall observed in the study area for 1, 5, 10, 15, 30, 60 minutes duration in 2007 is 13.72, 11.28, 10.52, 8.33 7.37, 4.88 and in 2008 it is 15.24, 11.58, 9.14, 7.72, 6.55, 4.57 cm/hour respectively.
- Thus, the heaviest rainfall intensity for 1,5,10,15,30 and 60 minutes duration observed during the study is 15.24, 11.58, 10.52, 8.33 7.37 and 4.88 cm/hour respectively.

From the initial urban hydrological studies on short duration rainfall it is observed that during the intense storm of 30th Aug 2009 an intense rainfall of 20 cm/hr over 5 minutes; 16.5 cm/hr over 15 minutes; 11.5 cm/hr over 30 minutes durations occurred in the city. Also, it is noticed that rainfall intensities were higher for storms of short durations during the study period.

To understand the rainfall recharge characteristics of urban area, groundwater monitoring is undertaken for water levels and quality at 12 locations in the city.

- The groundwater table is at a depth of 1.5 to 3.5 m during pre monsoon and rise by 1 to 2 m by post monsoon.
- The wells located at discharge locations like Suryannarayana puram, Jagannaick pur, Toorangi and close to drains like LB Nagar, RR Nagar and those located in highly urban areas like Surya Rao peta (main road) are responding quickly to heavy precipitation and recording high water tables immediately.
- The change in EC of non-monsoon season of 2007-08 and monsoon season of 2008-09 indicates the influence of the impact of seasonal rainfall recharge.
- It is observed that the less rainfall of 2008 has resulted in high EC of groundwater during post-monsoon of 2008 in the eastern half of the city and is very high compared to the EC of post monsoon of 2007.

From the groundwater aspect of the analysis and results, it has been concluded that there is certain impact of urbanization on the shallow unconfined aquifer in Kakinada city. With the increasing draft from the aquifer in highly urbanized areas and less recharge to it from rainfall the dependability of the shallow aquifer is under threat. In areas like Gandhi Nagar, Madhura Nagar, Meher Nagar and Frazer pet on the west, north-west of city the situation is alarming. There is need to rejuvenate such aquifers using artificial recharge techniques to supplement the decreasing natural rainfall recharge to the aquifer for sustainable development of the water resources in the city.

7. Pre and Post Project Scenarios and IWRM of Pushkar Canal Command Area in Andhra Pradesh

There are number of ongoing projects in East Godavari District, Andhra Pradesh for irrigation purpose. After introduction of canal water there

was significant rise in groundwater table, which has led to adopt conjunctive use of surface and groundwater. Therefore, water management practices are to be planned scientifically in ongoing projects. The main objectives of the study are 1) Monitoring of groundwater quantity and quality, soil salinity and land use/land cover practices within the Pushkar canal command area before release of water. 2) Impact assessment of canal water on groundwater regime, changes in land use and land cover practices and conjunctive use of groundwater and surface water.

Groundwater samples were collected during December 2009 from about 40 locations in the study area of about 1000 km^2 with a command area of 752.35 km^2 spread in 139 villages of 14 Revenue mandals in East Godavari district of Andhra Pradesh. EC of ground water ranged from 253 to 3700 micro mhos/cm. The analysis of major cations and anions indicated that, there is a significant seasonal variation in the groundwater quality. The major groundwater quality type is Na-HCO_3. The general groundwater quality is suitable for drinking and irrigation purposes. However, the total hardness of groundwater varies between 113 to 855 ppm. This is mainly due to higher concentrations of Chloride and Sulphate.

8. Phytoremediation: A Plant Based Technology to Clean-up the Environment

Phytoremediation is an emerging technology that utilizes plants and the associated microorganisms to remove, transform or contain toxic chemicals located in soils, sediments, ground water, surface water and even in the atmosphere. Currently, phytoremediation is used for treating many classes of contaminants including petroleum hydrocarbons, chlorinated solvents, pesticides, explosives, heavy metals and radionuclides and landfill leachates. According to a recent report, approximately 80% of the polluted ground waters are within 20 m of the ground surface. This suggests that a significant number of sites are potentially suitable for low cost phytoremediation applications.

This cost-effective plant-based approach to remediation takes advantage of the remarkable ability of plants to concentrate elements and compounds from the environment and to metabolize various molecules in their tissues. In recent years, knowledge of the physiological and molecular mechanisms of phytoremediation began to emerge together with biological and engineering strategies designed to optimize and improve the technique further (Figure 8.1).

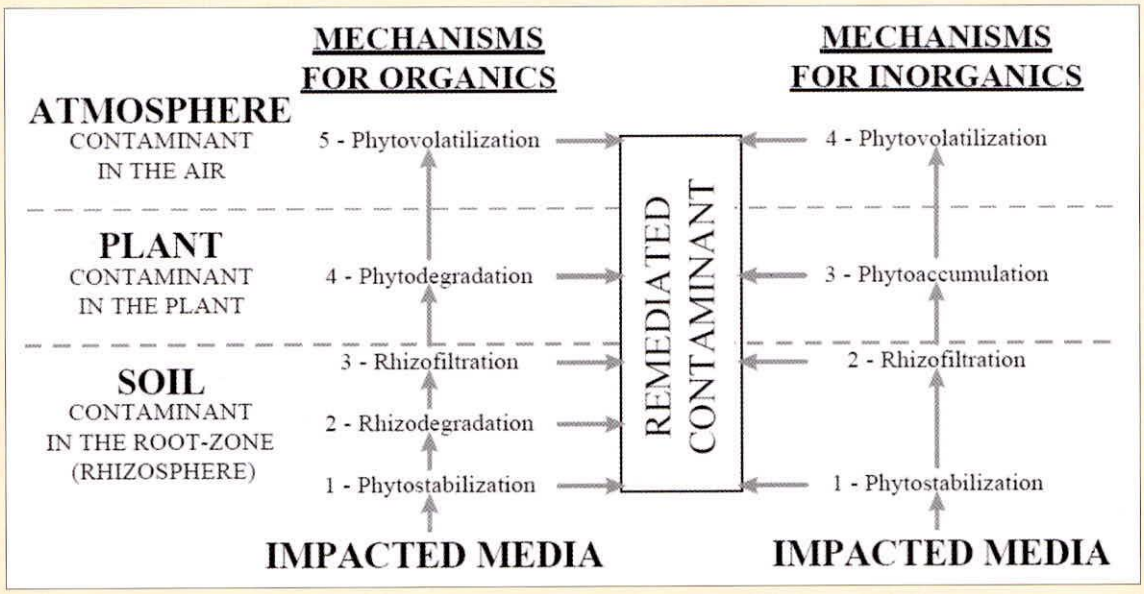


Figure 8.1: Contaminant fate in the soil-plant-atmosphere continuum

Phytoremediation has been studied extensively in research and small-scale demonstrations, but full scale applications are currently limited in number. However, some field trials confirmed the feasibility of using plants for environmental cleanup. This review concentrates on the most developed subsets of phytoremediation technology and on the biological mechanisms that make phytoremediation work. Further development and research in the area may lead to wider acceptance and use of phytoremediation at field level.

In this study an attempt has been made to evaluate the current progress and trends in the area of phytoremediation of organic substances and heavy metals to improve the technique further and to extend its use to clean up the environment. The report presents advantages and disadvantages of phytoremediation in comparison with available technologies for remediation. The technique has been claimed as an attractive alternative to other existing methods of remediation of soils and water. There is an immediate need to pursue both fundamental and applied research to extend the potential use of phytoremediation.

9. Design of Rain Gauge Station Network for Arunachal Pradesh

A hydrological network is an organised system for the collection of information of specific kinds such as precipitation, run off, water quality, sedimentation and climate parameters. The accuracy in the decision making in the water project design depends on how much reliable information is available for the region concerned. Having enough relevant and accurate hydrologic information reduces the chances of under-design or over-design and thus minimizes the economic losses, which leads to the overall increase in the benefit/ cost ratio.

Precipitation is the most basic data required for any water resources studies. Estimation of the number and location of the rain gauge stations which will provide sufficient information regarding rainfall falling over an area is referred to as raingauge network designing.

In the present study, the rain gauge network design for Arunachal Pradesh has been carried out. Daily rainfall data of at least 10 years were collected for existing 36 IMD raingauge stations distributed throughout the state. These rainfall data were analysed and wide spatial variation was found in one of the highest rainfall receiving hilly state of India. It was tried to model the variation by kriging method which was not quite successful due to lack of spatial correlation. Therefore, number of stations required to get sufficient accurate areal averages was determined by Coefficient of Variation method.

The number of raingauges required to estimate average rainfall with an error below 5% was found to be 310. However, considering this is a huge task to accomplish, 80 stations are recommended in the first phase which will bring down the error to below 10%. In the second phase, it can be increased to 120 (error 8%), then in the last phase to 220 (error below 6%). Beyond this point the rate of reduction of error with increase in number of raingauges becomes too low and it requires about a 100 stations to bring down the error from 6 to 5%, which cannot be considered economical.

10. Shifting characteristics of Kosi river

The river Kosi (also known as 'Sorrow of Bihar') is a tributary of the river Ganga. Nearly 80% of its catchment lies outside the country and the rest 20% lies in India. The river is famous for its peculiar nature of shifting courses. The river Kosi enters India with heavy silt load and high momentum. The portion of the catchment in India is almost flat and the river has the shifting characteristics. After entering India it travels for about 318.65 km in an alluvial plain, unloads the silt in the plains of Bihar and finally meets the river Ganges near Kursela. The river carries a mean annual discharge of 1,600 m^3/sec, with monsoon discharge 10 times the lean period discharge. Sediments load of Kosi is estimated at 120 m cu.m. As one course becomes higher than the possible adjacent paths, Kosi river shifts laterally. Shifting of Kosi from 1736 to 1964 was 112.6 km towards

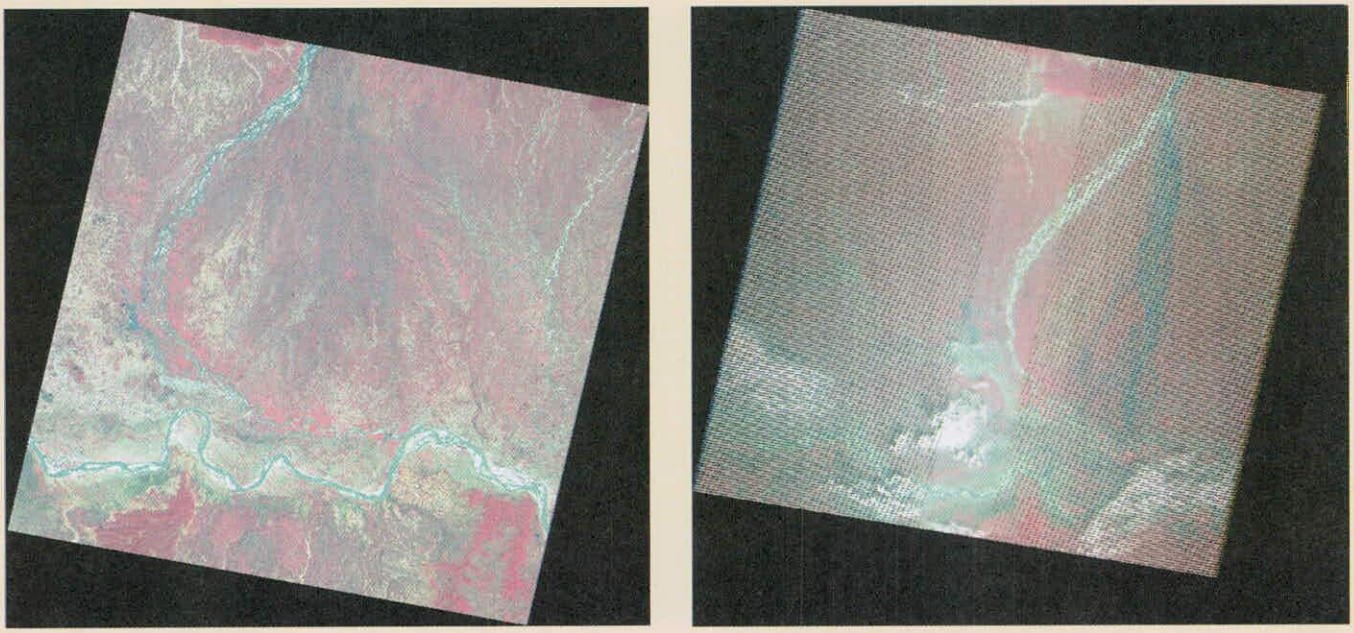
west. In the present study, shifting characteristic of Kosi river starting from the year of publication of SOI toposheet have been studied. The toposheets of 1936-38 on the scale of 1:250000 were used to generate the base level information (prior to construction of Kosi Barrage project in 1954). The Landsat, MSS and TM imageries at 5 years interval from 1972 onwards have been analyzed for marking the course of river Kosi at different times. The analysis indicates that there is different trend of shifting as the river flows from north to south. Two satellite imageries in a gap of 36 years are shown in Figure 10.1.

11. Shifting characteristics of Bagmati river

The river Bagmati originates in Nepal, 16 Km north east of Kathmandu. It enters India in Sitamarhi district of Bihar, nearly 2.5 km from Dheng railway station. In the middle reach the river Bagmati frequently changed it course and thus prominent shifting characteristics were observed. The Bagmati is a tributary of river Kosi and meets Kosi near Hayaghat. The study was taken with the objectives to (a) study of the shifting course of the river over a period of time using toposheets and satellite imageries (b) identify the critical locations along the river where major shifting has taken place and (c) study the shifting pattern of the river at the critical locations. In the study, the course of the river, along with the major roads, railways and important places is digitized from SOI toposheet. The digital analysis of satellite data of various dates was carried out to delineate the course of the river using the image processing software ERDAS Imagine. The shifting course of the river has been found from the image of 2009 with respect to the course of the river marked in the toposheet.

12. Shifting characteristics of Daha river

Daha river is one of the major tributary of Ghaghara river flowing in districts of Gopalganj and Siwan in Bihar. There are number of channels flowing in the flat terrain of North Bihar and interconnecting the major rivers particularly during monsson, Daha being one of them originating from river Gandak in north and flowing south to meet the river Ghaghara. The river morphology changes with time and is affected by river discharge, velocity, sediment load, sediment characteristics and the composition of bed and bank material apart from varied geological controls. Objectives of the studies include (a) study of the shifting course of



Kosi river 07 Nov, 1972 Kosi river 05 Nov, 2008

Figure 10.1: Satellite images of Kosi river in different years.

the river over a period of time using Survey of India toposheets (base data) and satellite imageries; (b) identification of the critical locations along the river where major shifting has taken place and (c) detailed study of the shifting characteristics of the river at the identified critical locations and also to identify the places which have been severely affected and the places which are likely to be affected in future. Survey of India toposheets have been used as the reference maps to study the shifting of the river course.

13. Development of a flood forecasting model for the Chenab Basin

River Chenab experiences significant floods during the monsoon season. There are some major projects on the river, such as Salal dam, Baglihar, and Dulhasti. On the directions of the Governing Body of NIH, this study was taken up to develop a flood forecasting model for the Chenab Basin. The objectives of the study were to implement snow-melt and rainfall-runoff models for the Chenab basin up to Akhnoor.

Different data layers of the Chenab basin (such as basin boundary, drainage network, DEM, elevation bands, hydro-meteorological network etc.) were generated in GIS. The drainage map of the basin was used to mark various sub-basins at Benzwar, Sirshi, Premnagar, Dhamkund, and Akhnoor as shown in Figure –13.1. Around 30 years of rainfall data at 20 sites and 13 years of discharge data at 10 sites were used. Using the daily data of rainfall stations, average daily rainfall has been worked out in different sub-basins for different flood events using the method of interpolation (moving surface) in ILWIS. Plots of daily rainfall and discharge at different stations suggests that most of the flood events in the Chenab basin are generated from rainfall storms mostly concentrated in the middle and lower reaches of the basin below Benzwar/Sirshi.

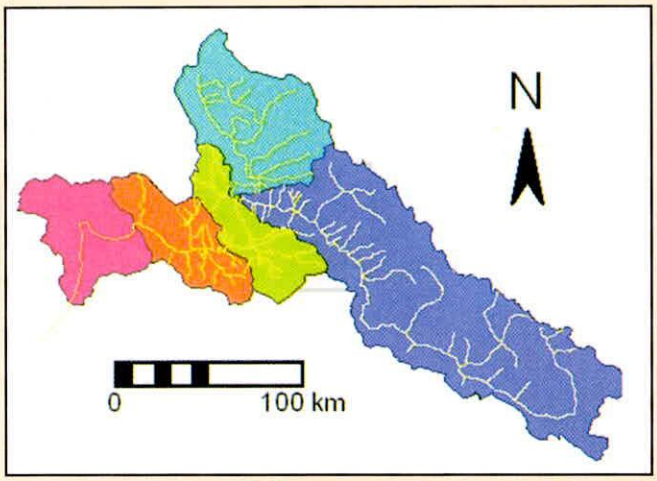


Figure – 13.1: Different sub-basins in Chenab River basin up to Akhnoor

In view of the status of availability of data and the factors responsible for generation of flood, WINSRM model was applied considering daily rainfall and discharge for sub-basin downstream of Benzwar/Sirshi up to Akhnoor. Model parameters were calibrated and validated to get the best match of observed and simulated flows at Akhnoor. The simulated and observed floods for the year 1997 are presented in Figure – 13.2.

The travel time of flood wave from Benzwar to Akhnoor is less than one day and hourly hydrological data were crucial for this study. So, available 3-hourly rainfall data and hourly discharge data of Akhnoor and Salal dam site for the flood event of year 2006 (September 1 – 6, 2006 were used to simulate flood using unit hydrograph for the sub-basin between Premnagar and Akhnoor (Area – 5043 km^2). Synthetic unit hydrograph (UH) was developed for this sub-basin. Using the 3-hourly rainfall of Salal station, the daily rainfall data of various stations (obtained from CWC) for the flood event (September 1 – 6, 2006) were disaggregated and 3-hourly average rainfall in the area was computed. Observed hourly flow at Akhnoor and Salal and estimated 3-hourly average rainfall are plotted in Figure – 13.3. This rainfall pattern was convoluted with the UH to get the simulated flood at Akhnoor. Simulated flood matches with the expected pattern of flow at Akhnoor to a considerable extent.

14. Estimation of Aerial and Volumetric Changes for Selected Glaciers in Jammu & Kashmir

The state of Jammu & Kashmir has around 5400 glaciers covering an area of 29213 km^2. This

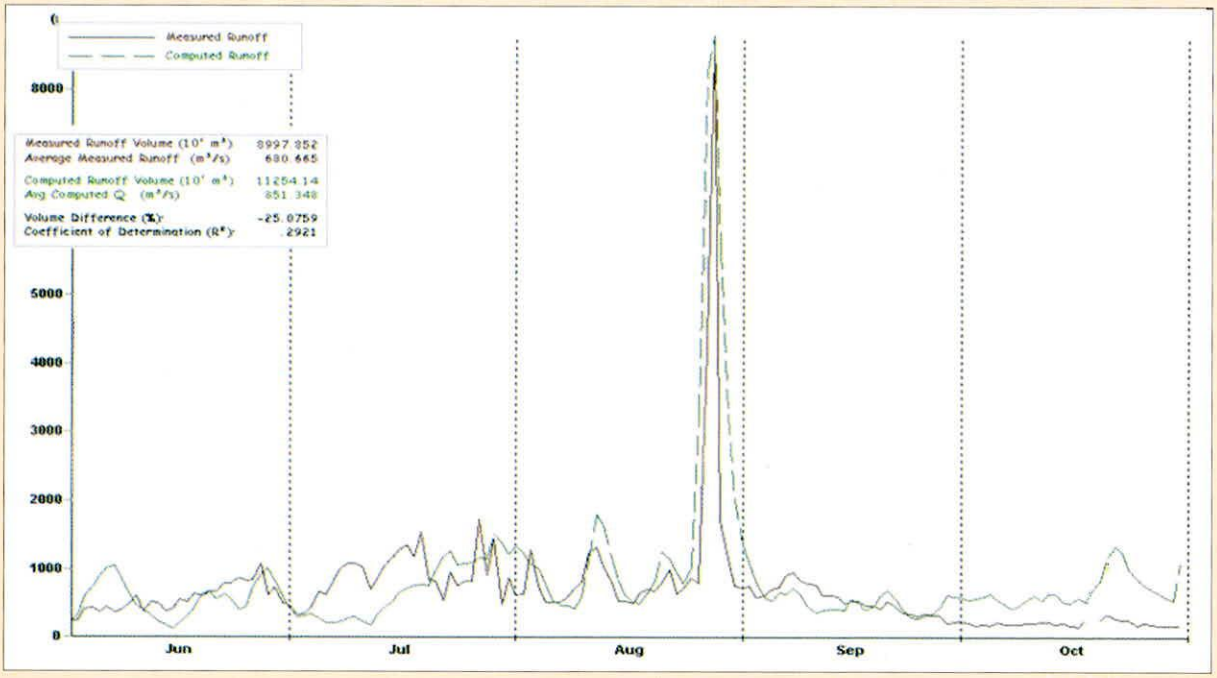


Figure – 13.2: Observed & simulated flow (using WINSRM) at Akhnoor in 1997

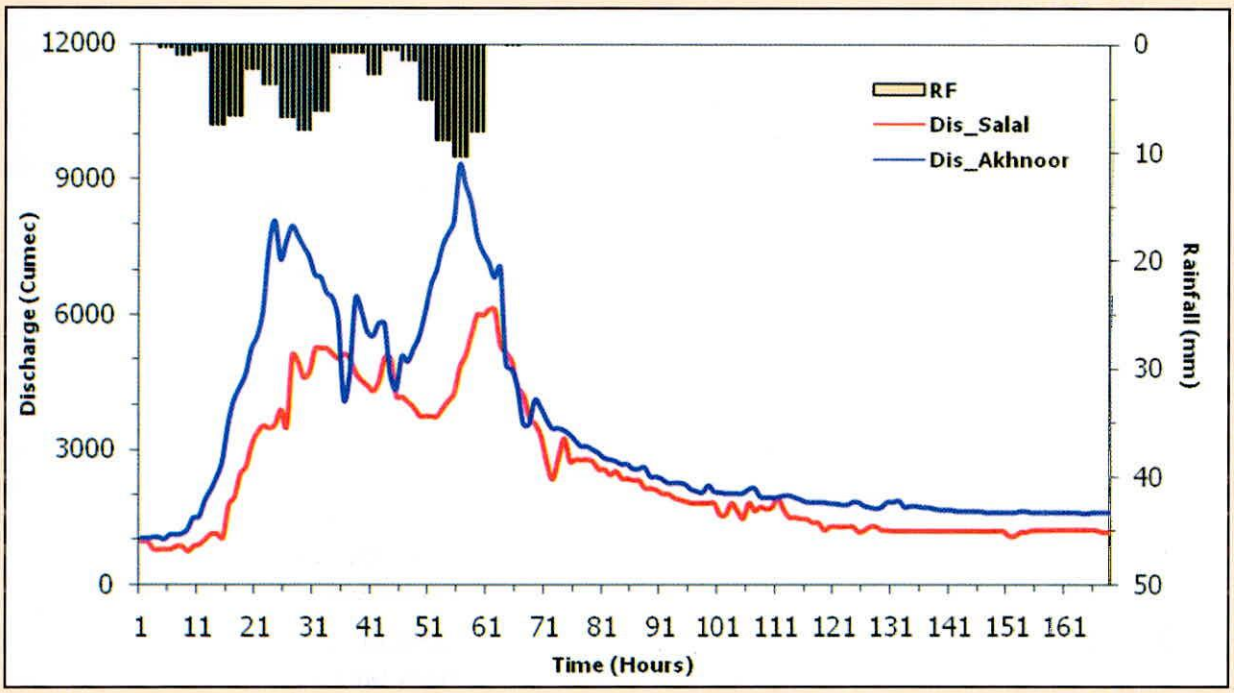


Figure – 13.3: Observed flow at Salal & Akhnoor and average basin rainfallduring September 1 – 6, 2006

constitutes around 56% of glaciers and about 78% glacier cover area of the Indian Himalayas. In the present study ten glaciers in the Ladakh Mountain range under the cold-arid glacio-hydrologic regime and two glaciers in the Zanskar range and seven glaciers in the Drass and Kashmir region of great Himalayan mountain range under the Alpine glacio-hydrological regime have been investigated. Change in the glacier length and area during the last three decades (27-34 years) have been investigated by topographic method using Survey of India toposheet and latest high resolution remote sensing imageries combined with extensive field survey during 2007 and 2008. Volume change is calculated by using glacier area-volume scaling relationship, calibrated for the Himalayan region. Specific mean mass balance of individual glaciers was deduced from cumulative volume change of the glaciers.

Following important conlusions have been drawn from the study:

1. In the Ladakh range, the lower extent of the glaciers is generally around 5200 m a.s.l., whereas, in the Kashmir region these are situated at much lower altitude with glacier snout reaching up to 3600 m a.s.l. The results of the present study suggest there is no 'altitude effect' on the glacier change in these two regions. The changes experienced in the glaciers of both the regions are similar as has been observed in the major glacier systems of world in different altitudes and latitudes.

2. Ladakh mountain range is characterised by small glaciers and the area of glaciers evaluated in the present study range from 0.022 – 1.164 km^2. The area of glaciers selected for the study in the Kashmir region ranged between 0.539 to 7.47 km^2. The percentage area change during the past 34 years in the Ladakh range vary from 6.5 to 100%. If we exclude the highly degrading smaller glaciers of Khardug La, the upper range of aerial change is 18.6%. In the Drass and Kashmir regions of the Great Himalayan range, change in the glacier ranged between 2.9 to 34.5%.

3. The recession rate of small glaciers in the Ladakh range is in the order of 0 to 4.5 m/yr, whereas for longer glaciers in the Kashmir region, recession rate is as high as 20 m/yr (Figure 14.1). The length change of these glaciers, small glaciers of Ladakh range and bigger glaciers of Great Himalayan range of Kashmir range between 0 to - 0.17. This observation suggests that the glaciers in the cold-arid system as well as in the Alpine glacio-hydrological regimes are may be changing at a comparable rate.

4. Absolute values of glacier volume change show the characteristics of distinct glacier regimes. Small glaciers of the Ladakh range have small melt component ranging from 0.13 x 106 m^3 to 7.16 x 106 m^3 of cumulative ice loss during 34 years study period. Glaciers in the Kashmir region showed higher range of melt out component ranging from 2.73 x 10^6 m^3 to 72.93 x 10^6 m^3, primarily reflecting the wide range of glacier size existing in the region. In percentage terms volume change of glaciers studied in the Ladakh region range between 8.7 to 100%. In the Kashmir region,

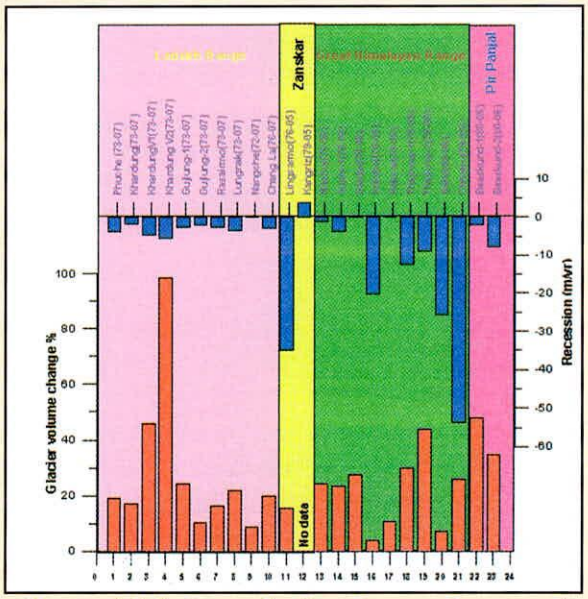


Figure-14.1: Length & volume change of selected glaciers in different mountain ranges of NWH region

the volume change of glaciers range between 4-43.7 % during 27 to 34 year study period.

5. Average specific mass balance calculated by the glaciological method ranged between -0.98 to -0.26 m w.e. yr^{-1}. Compared to this, the average specific mass balance derived from present study range from -0.50 m w.e. yr^{-1} for Galdar glacier to -0.04 m w.e. yr^{-1} for Nangche glacier. Evaluation of annual net balances of these glaciers in terms of percentage annual degradation with respect to the total glacier storage range between 0.15 to 1.62% and results suggests that the small glaciers are degrading at faster rate.

B. NIH INTERNAL FUNDED PROJECTS (ON-GOING)

Modelling of Pesticide Transport in Ground Water – a case study of Metropolitan City – Vadodara

Groundwater of Vadodara city is found to be contaminated with high concentration of Lindane. Therefore this study is being carried out with the objective to study and characterize the contaminant (pesticide) migration pattern in the ground water in space and time for prediction purposes. Water and waste water samples from open wells, tube wells and piezometeric wells maintained GWRDC, Gandhinagar and major drains were collected during June 2009 and February 2010. The collected samples were analysed for pesticides and organochloro pesticides. To understand the transport of pesticides in unsaturated zone, column experiments were conducted in laboratory. Pumping tests were also conducted in a large diameter well at Asoj, Vadadara Taluka and a bore well at village Dena, Harni, Vadadara Taluka to estimate the aquifer parameters viz; Field Permeability, Transmissibility, Specific Yield and Radius of influence. The daily rainfall data of Vadodara city for 18 years has been collected for modeling purpose. Identification of contaminant sources using chemographs of point sources and ground water at different locations is in progress.

Impact of Climate Change on Dynamic Groundwater System in a Drought Prone Area

The objectives of this study are to quantify the impacts of climate change on groundwater recharge in a part of Sonar basin, Madhya Pradesh and to simulate the groundwater levels and investigate the temporal response of the aquifer system to historic and future climate periods. The study involves basic data preparation using GIS, hydro-geological characterization of the study area and synthetic generation of daily values of precipitation, mean temperature, and solar radiation (using a weather generator). The groundwater recharge will be estimated based on the available precipitation and temperature records and anticipated changes to these parameters (using Visual HELP). Quantification of the spatially distributed recharge rates will be done using the climate data and spatial soil survey data. Finally the simulations of groundwater flow using each recharge data set will be done to evaluate the changes in groundwater flow and levels.

Surface Water and Groundwater Interaction at selected locations along River Yamuna in NCT, Delhi (Phase-II)

Generally, management of water resources is focused either on surface water or ground water, as if they were separate entities. As development of land and water resources increases, it is apparent that development of either of these resources affects the quantity and quality of the other. Nearly all surface-water features (streams, lakes, reservoirs, wetlands, and estuaries) interact with ground water. Due to the interaction, surface-water bodies may gain water and solutes from ground-water systems or vice versa. The withdrawal of water from streams can deplete ground water or conversely, abstraction of ground water can deplete water in streams, lakes, or wetlands.

In Palla area of Delhi about 90 wells have been installed to pump groundwater for municipal water supply. To study the impact of pumping on surface water groundwater interaction, a study was conducted by the Institute during 2007. In phase-2

the study is being further refined to confirm the conclusions drawn in the Phase-I. The objectives of the study are (1) To study the surface water and groundwater interaction along river Yamuna in the Palla area of Delhi, and (2) To study the extent of surface and groundwater interaction in the region.

Isotopic methods are being used to study the interaction of surface water with groundwater in the Palla area of NCT Delhi. A groundwater model shall also be developed to understand the extent of groundwater interaction, both with or without pumping wells in that area.

Water samples are being collected from 13 piezometers and, 3 tublewells, river and rainfall for isotopic analysis. The samples are being analysed for variation in $\delta^{18}O$ and δD with distance and with time. The variation in water level in the floodplain during and after the passage of flood is also being monitored.

Integrated Hydrological Investigations of Ropar Lake, Punjab

The study was taken up on the request of Punjab Council of Science and Technology with the aim to estimate the sedimentation rate in the Ropar Lake. The sedimentation rate in the lake is being studied using the isotope techniques. For this purpose a new Multichannel Spectrometer was purchased and installed in the sediment dating laboratory of HID Division of NIH during August 2009. Sediment cores have been collected from seven locations in the lake as well as from four locations in the lake bed along the shore of the lake during June and November 2009. The sediment cores have been cut into sediment samples. In total, 178 sediment samples consisting of 98 samples from the lake and 80 samples from the exposed lake bed along the shore have been collected. The samples are being analyzed for Cs-137 activity. Analysis of six cores have been (about 100 samples) completed. The results indicate that there is very little C-137 activity in the sediment samples. This could be because about 20 years back the area was flooded and the lake gates had to be opened, washing most of the sediments which means most of the sediments are of recent origin and hence are not showing the required Cs-137 peak. It has therefore been planned to carry out the analysis of samples for Pb-210 activity which would need an additional time of about two-three months.

Integrated Water Resources Management of a Sub-Basin to Cope With Droughts

This study has been taken up in the Tons Basin, Madhya Pradehs, India. This area experiences recurrence of drought at an average frequency of once in 5 years. Huge economic losses and great suffering are often reported in the affected areas. Reduced agricultural production, mass migration and famine threat are major concern in the study area. The purpose of the study is to devise a water management plan for coping with water scarcity during drought. The specific objectives of this project are (a) to identification of strategic surface and groundwater resources to be used in drought situations, (c) to study alternative means for minimizing adverse impacts of droughts and (c) to devising integrated water management plan for minimizing water stress on crops, human and animal life during drought situation. The soil map, DEM, drainage map etc. has been prepared for the study area in Tons basin. Land use map and water availability maps are under preparation. A report on inventory of water resources in the basin has been prepared to assess strategic water resources for utilization during drought.

Modelling Snow Melt Runoff Using Fuzzy Logic Technique

Modeling of streamflow from a basin is based on transformation of incoming precipitation to outgoing streamflow by considering losses to the atmosphere, temporary storage, lag and attenuation. In most part of the world the seasonal short-term variation in streamflow reflects the variation in rainfall. But in higher latitude and altitudes where snowfall is predominant, runoff depends on heat available for snowmelt rather than the timing of precipitation. Hence, to understand the hydrological behavior and simulate the streamflow it is very important to model the snowmelt runoff. The Beas River is an important river of the Indus River system. The Beas basin up

to Pandoh dam is considered as the focus area of the present study. In this study fuzzy rule based approach will be applied to simulate snow melt runoff. An attempt is also being made to use the same input data in the fuzzy model as used by the conventional snow melt model. Furthermore, fuzzy models will also be developed with the inputs consisting of temperature, snow cover area, rainfall etc. Primary and secondary data processing including gap filling of the collected hydrological time series data has been carried out. Further various map layers for the study area have been prepared using GIS software. A hydrological model using fuzzy rule based method for the selected snow covered basin has been developed.

Monitoring and Modelling of Streamflow for the Gangotri Glacier

The field investigations were started in the last week of April 2009. but full fledged observations could be initiated in the last week of May 2009. The cross-section of river channel was determined at the site and observations are made continuously. The observations were carried till the end of the ablation season i.e. October first week. The Institute has been monitoring the hydro-meteorological parameters during the ablation season using conventional methods since last 8 years. This year an Automatic Weather Station (AWS) at the Meteorological Observatory near the snout of Gangotri Glacier has been installed by the Institute. The AWS will continuously record the observations of various hydro-meteorological parameters throughout the winter season at desired interval of time. The AWS has the following sensors: 1) Air temperature and relative humidity sensor; 2) Baraometric pressure sensor; 3) wind speed and direction sensor; 4)Albedometer; 5) Ultrasonic snow depth; 6) Net pyranometer; 7) Tipping bucket rain gauge; 8) Infra red snow surface temperature sensor. The flow and other meteorological data collected during the ablation period have been analysed.

Snow Melt Runoff Modelling in Sultej Basin

The objectives of the study are to simulate snow melt runoff using conceptual models SRM and SNOWMOD, develop an ANN model to simulate the snow melt runoff and compare the results of conceptual models with ANN model. Three layered feed forward structure is selected for the ANN model. The training of the model is done by back propagation algorithm. The performance of the model is evaluated by coefficient of correlation, root mean squared error, model efficiency and percentage error in peak flow estimation. Many combinations of temperature, rainfall, snowfall and discharge for Kalpa, Kaza, Namagia, Rackchham, Rampur are tried to develop the ANN model to simulate the discharge of river Sutlej at Rampur using the data from 1987 to 2000. The data from 1991 to 2000 is considered for the training of the model. The data from 1987 to 1990 is considered for the validation of the model. From the results, the combination with maximum, minimum temperature at all stations and discharge at Rampur is found to be the best model based on the performance indices during calibration as well as validation of the model. The results of ANN calibration indicates that the all range of discharge values are simulated fairly well. Whereas the medium and high range values of discharge are slightly deviating from the observed values during the validation of the model. To simulate the medium and high discharges in better way two separate ANN models are developed, one for low discharge and another for medium and high discharge using the input variable of best model as mentioned earlier with optimum model structure. The data from November to March are considered as low flow values and the data from April to October are considered as medium and high flow values. The ANN model for low discharge performed well except few values during calibration and validation. The ANN model for medium and high flow discharge during calibration performed better than the ANN model during validation. The performance of general ANN model is better than ANN models with low, medium and high flow values

Data Book of Hydro-meteorological Observatory 2001-2008

The objective of the study is to bring out the

data book for NIH hydro meteorological observatory for the years 2001-2008. National Institute of Hydrology commissioned a hydro-meteorological observatory in its campus in the year 1985. Since then, observations of maximum temperature, minimum temperature, relative humidity, pan evaporation, rainfall, wind speed, wind direction are made on daily basis. Earlier the data book has been prepared and published for the period up to 2000. Now it is planned to prepare the year book for the period from 2001-2008. The data processing software SWDES is being used to enter the data. The software SWDES has the facilities of processing the data, computing the statistical properties of data and generation of final report. The entry of the Data (temperature, rainfall, humidity on hourly basis) in SWDES is under progress. Three years of temperature and Humidity data has been entered till now.

Integrated Water Resources Management for Manimala River Basin, Central Kerala

Manimala river basin in Kerala, faces water shortage during non-monsoon season owing to steep topography and non-availability of mass storage structures. The demand for water resources has increased with population and subsequently affected the quality of the existing resources. Due to the existing water resources related problems, it is proposed that an integrated study has to be taken in this river basin to use the available resources in a better manner. The objectives of the project were identified as:

- To make a detailed study of the Manimala river basin to gain knowledge about the soil, land use, geology, meteorology and hydrology.
- To assess the adequacy of the existing gauge network to completely represent the hydrological characteristics of the basin.
- Collection and anlyses of the historical hydro-meteorological data.
- To assess the water demand under existing and future conditions.
- To estimate available water resources during average and drought years.
- To develop alternatives and strategies to manage the situations where water demand exceeds supply, considering both human and environmental needs.
- To evolve strategies to protect the water quality and its land related resources, while accommodating population growth, economic growth, and environmental protection.
- To identify existing and future water resource infrastructure needs and develop plans to address them.

The study is being carried out in collaboration with Kerala Irrigation Department.

Environmental Flow Requirements for Bhadra River in Karnataka

The objectives are as given below:

- review the current status of environmental flow estimation methods and examine the applicability in the Indian context
- Improving, demonstrating and evaluating the benefits of environmental management of stressed rivers
- Research into water regime — ecological dependence relationships and management of environmental water allocation in poorly understood aquatic ecosystems
- Research into holistic water budgets of river systems that encapsulate current temporal/spatial patterns of water distribution and probable changes to water availability with future land use and climate change.
- suggest the way forward in environmental flow assessment in India, which can be pursued to enhance environmental water research and policies

Brief Methodology :

- Detailed assessment, using primarily holistic

methodologies.

- Desktop assessment, using primarily ecologically relevant hydrological characteristics (indices) analysis of hydrological time series.
- Both types require observed or simulated flow time series representing unmodified (natural) flow regimes.

Assessment of Groundwater Vulnerability in the State of Kerala

Because of the high gradients of groundwater flow and aquifer proximity to the sea coast, the management of groundwater resources in the State of Kerala demands approaches based on results of scientific studies and action plans. Further, vulnerability of groundwater regimes to pollution needs to be addressed in a regional scale. Preparation of GW vulnerability maps for the region may help the State to protect its groundwater system. The objectives of the this tudy are: a) Assessment of current situation in terms of both quantity and quality, evaluation of basic reasons for GW depletion/deterioration; and b) To prepare groundwater vulnerability maps to facilitate GW planning and management.

Evaluation of Artificial Recharge Measures in North Karnataka

Artificial recharge measures are meant to address issues like, sustainable yield in over-exploitation aquifers, conserving excess surface water in underground storage, improving the quality of ground water through dilution, recycling sewage and waste water to remove impurities. Geological boundaries; hydraulic boundaries; inflow/ outflow; storage capacity; porosity; hydraulic conductivity/ transmissivity; natural springs; recharge sources; natural recharge; water balance; lithology; depth of the aquifer etc are some of the important parameters need to be considered in artificial recharging. Due to lack of understanding on the hydrogeological environment, many times the schemes fail to achieve the objectives of rejuvenating the aquifers. Therefore, a methodology need to be evolved in assessing artificial recharge potential and efficiency based on natural conditions and simulation results. The following parameters may be considered for the assessment: precipitation infiltration coefficient, specific yield, thickness of depleted aquifer, depth of groundwater, exploitation intensity and type of land use.

In North Karnataka, a semi-arid region, there are large numbers of artificial schemes in operation. The efficiency of these schemes are not known. Therefore, it is proposed to take up a pilot study in the Raibag, Mudhol area of Bijapur District of Karnataka to assess the efficacy of artificial recharge schemes in this region after conducting field survey of the region. For the purpose, the data of pre-project period has been collected and data monitoring after implementation of the schemes is going on.

Integrated Water Resources Management Plan for Catchment and Command of Benisagar and Rangawan Reservoirs in Madhya Pradesh

Integrated management of catchment and command area is one of the important prerequisite for efficient operation and getting maximum benefits from water resources projects. For this purpose, Benisagar and Rangawan irrigation projects of Chhatarpur district of M.P. have been selected. The Benisagar project is a medium multipurpose reservoir scheme, designed for irrigation and drinking water supply to historical city of Khajuraho. The Benisagar project comprises of an earthen dam constructed on river Khurar and a Beniganj weir on river Banne to feed the main dam. As a part of the work program of 2009-10, sediment study of Benisagar reservoir has been carried out using digital image analysis of remote sensing data. From the analysis, it has been observed that 7.34 Mm^3 of gross storages and 1.16 Mm^3 of dead storage of Benisagar reservoir have been lost in 38 years (1970-2008). The land use pattern of command areas of Benisagar and Rangawan reservoirs have also been determined by digital image classification. The potential evapotranspiration for different crops in the command areas of Benisagar and Rangawan have

been estimated using CROPWAT. The soil loss from Benisagar dam and Beniganj weir catchments has been estimated using USLE model. The average soil loss computed for Benisagar dam and Beniganj weir catchments are found to be 6.76 t/ha/yr and 5.82 t/ha/yr respectively. The detailed soil survey on seventeen sites in the command areas has been carried out for determination of soil properties including infiltration test, hydraulic conductivity, textural analysis, soil moisture curve, sp. gravity, dry density etc. The hydraulic conductivity in the command areas varies from 4.35×10^{-5} cm/sec to 0.011 cm/sec. The nutrient analysis of the soil samples of both commands indicated that soils are low to medium in organic carbon and phosphorus while very low in availability of potash. An awareness program on water conservation among the members of Water Users Association (WUA) of Benisagar and Rangawan reservoir projects has been organized. A sample survey for identification of problems in both the command has been initiated.

Water Resources Management Study for Drought Affected Bundelkhand Region

Water resources management in the arid and semiarid areas is a complex task, involving a large number of hydrologic, environmental and management factors that have to be considered in order to supply sufficient water and to ensure the minimum levels of environmental protection and quality of life. Droughts, so frequent in the semiarid areas, intensify these problems even more. Since they are unpredictable phenomena both in their occurrence and duration, prevision and preparation against droughts are key elements for minimizing their impact. The Bundelkhand region comprises thirteen districts, six districts of Madhya Pradesh (MP) namely Sagar, Damoh, Chhattarpur Tikamgarh, Panna and Datia and seven districts, namely Jhansi, Lalitpur, Jalaun, Hamirpur, Banda, Mahoba and Chitrakoot of Uttar Pradesh (UP). The region receives average annual rainfall of 800 to 900 mm, the rainfall pattern being erratic and uncertain. The Bundelkhand region is under constant water stress and is suffering from severe scarcity of water for agricultural and domestic use. Four years of continuous drought from year 2004 to 2007 and acute water and power shortage has badly affected the economy of the region and resulted in large-scale migration up to 36.95%. Management of water on scientific lines alongwith adoption of appropriate drought management strategies is therefore important for the well being of the people in the Bundelkhand region.

This study aims to evaluate the present and future demand and the efforts to manage water resources under drought conditions in Bundelkhand region falling in MP and UP. The study also aims to address the related issues and to develop proper guidelines, keeping in view the latest technologies and management practices available for these purposes.

During the year 2009-10, data pertaining to rainfall and agriculture has been collected from Jhansi, Lalitpur, Tikamgarh, Sagar and Chhattarpur districts.

Impact Assessment of Climate Change on Hydrological Regime in Sabari sub-basin, Godavari River System

In recent years, the occurrences of extreme events such as droughts and floods have been on the rise almost worldwide. Some researchers speculated that the variability of runoff and water resources is particularly higher for drier climates, e.g., a higher percent change in runoff resulting from a small change in precipitation and temperature in arid or semiarid regions like India. While India has about 16% of the global population, it only has 4% of total water resources, and many parts of India already face water scarcity. In these circumstances it is very important for water resources managers in India to know and prepare to deal with the effects of climate change on the changes of hydrological cycles and stream flow regimes. In this regard Sabari sub-basin of Godavari river has been selected to study the climate change in this region. The objective of the study is to i) Develop a rainfall-runoff model to analyze various scenario's due to climate change ii) Computation of evapo-transpiration (ET) from different types of vegetation using satellite data.

After the calibration and validation of the model different scenarios would be developed in the event of changes in the hydrological parameters due to climate change.

Present Status of Salinity Ingress in the Coastal Andhra Pradesh, Tamil Nadu and Prediction of Impact due to the Sea level rise in varying Climatic Conditions

One of the most important impacts of future climate changes on society will be the change in regional water availability. Further, reduction in the river flows and sediment at river mouths may aggravate erosion processes of coastal areas and sea level rise may leads to submergence of small islands and threat to coastal urban towns. The over-exploitation of groundwater may cause changes in groundwater flow pattern and salinity ingress along the coastal regions. The current project is an attempt to present the status of salinity ingress and assessment of sea level rise impact in the coastal regions in changed climatic conditions. The main objectives of the project are 1) Status of present groundwater salinity in the coastal regions 2) Mapping of coastal areas inundation due to sea level rise in changed climatic conditions 3) Probable changes in Hydrological regime of the most vulnerable areas in the coastal areas.

Recent reports of State and Central Ground Water Departments indicate that in coastal Tamilnadu, sea water intrusion problems are prevalent in Minjur area North of Chennai city. Southern part of Chennai city, Cuddalore Coast and in Tuticorn sea water intrusion was reported. In Vaippar and Gundar basin heavy pumping of sand dune aquifers results in upward movement (up-coning) of underlying saline water causing a permanent damage to the hydrological regime. In Coastal Andhra Pradesh, saline water occurs in tidal flats, mangrove swamps, back swamps. In the beach ridge, sand dune complex located close to the coast in Prakasam district, the water is fresh having EC of 280 µS/cm down to 18m depth and moderate fresh water upto a depth of 45 m bgl. Water is fresh up to a depth of 70m in the paleo channels in Godavari delta, while in Krishna delta the paleo channels hold fresh water up to a depth of 20 m only.

Groundwater Modeling and Surface Water - Groundwater Interactions in and around Puri City, Orissa

The importance of ground water is immeasurable and it is vitally important to both our environment and our water resources. Ground water is a great source of good quality water used for drinking and irrigation worldwide. It is the future source of clean water supply for future generations. The great thing about ground water is that it is a renewable source and will replenish itself with an adequate amount of precipitation. It is also cheaper to tap into than surface water which has to be treated to make it safe for human consumption. Surface water needs an infrastructure to move the water to where it is needed and a place to store it. Ground water just needs to be pumped to the surface. Rains and melting snow replenish aquifers of ground water; however water tables can be drastically reduced as the ground water is used by large population centers or used in heavy irrigation. Coastal city of Puri in Orissa state depends on groundwater and is now facing severe groundwater shortage. Water supply system in Puri is characterised by several problems. The water supply network coverage in the city is only 55%. Less than 25 % of households have domestic connections. As Puri is a city of high religious importance and heritage value, details of the Puri Jagannadh Temple, rituals, fairs and festivals and related aspects are covered extensively. It is reported that water levels in two wells are falling inside the Jaganatha Temple Puri, which is causing problem for temple activities. The probable causes need to be studied by undertaking modeling study of rainfall-recharge processes, surface water groundwater interactions and increasing demands due to urbanization at basin scale.

Modelling Non-point Source Pollution

The wide spread nature of Non-point Source pollution poses a complex problem for its assessment and management. Areal extent of its contamination increases the complexity and due to

this large volume of data is required for its assessment as compared to that for the typical point source pollution. Because of such high complexity, NPS pollution is assessed through modelling approach which combines hydrologic models with Remote Sensing (RS) and Geographic Information System (GIS) techniques. The Dikrong Watershed was selected for the study and details about the study area and rainfall-runoff data collected. The Dikrong River is one of the important north bank tributaries of Brahmaputra River. The river originates at an elevation of 2579 m at the border of Lower Subansiri district and East Kameng district of Arunachal Pradesh. The watershed of the Dikrong River covers an area of 1556 km^2, out of which 1278 km^2 falls in Arunachal Pradesh and rest in Assam. The total length of the Dikrong River is 145 km, out of which 113 km length is within Arunachal Pradesh and 32 km in Assam. During 2009-10, rainfall-runoff modelling part was carried out using distributed parameter model AvSWAT 2005. The model was calibrated and validated using the Manning's n parameter for overland and channel flows for periods June 2005 to July 2007 and September 2007 to September 2008, respectively. Calibration and validation results revealed that model was predicting daily surface runoff in terms of inflow to proposed Pare reservoir of PHEP (Pare Hydro-Electric Project) at Hoz satisfactorily.

Flash Flood Studies (Jiadhal Basin)

The flood and subsequent heavy sedimentation have for long been acting as a festering sore in the Jiadhal River Basin. The sedimentation is a part of the flood hazard that gives rise to a miserable situation particularly in the lower part extending from National Highway–52 to Ghilamara covering almost two–third of Assam part of the basin area. Sudden flood, huge sedimentation and frequent change of the river course have become a regular phenomenon in the river basin since the great earthquakes of 1950. The sudden reduction in the gradient of the river may be the prime cause of drastic reduction of flow velocity of the river causing massive sedimentation and aggradation of the riverbed. The flood hazard scenario in Jiadhal Basin is very critical. Large scale sedimentation in the river valley has made large areas of land sand casted and unfit for agriculture. Several villages have been completely eroded away leaving no trace of their existence in the river basin, while many other villages are partly affected by flood and sedimentation of Jiadhal River. Acute shortage of food and occurrence of diseases are often grim in this region during flood period. The aim of the study is to assess the flood in the study area to help the decision makers especially the government's department and developers to make proper plan for further development. In this study HEC-RAS/MIKE is being used to study the flash floods in Jiadhal River Basin.

Flood Plain Zoning/flood Hazard Mapping of Rivers of Arunachal Pradesh

Floodplains and regions near rivers, where social and economic activities take place due to their special conditions, are always in danger of inundation. Determining the amount of flood advance and its height with respect to ground surface elevations, and finding flood characteristics with different return periods (known as "flood zoning") have tremendous importance. Flood zoning is considered a prerequisite for sustainable development within the limits of flood prone rivers, because it determines the type of development, construction criteria, basis for the ecological and environmental effects, and the amount of investment risk. Hence, flood zoning provides a valuable tool to managers and planners.

Dikrong river basin of Arunachal Pradesh was selected as the study area on the request of Chief Engineer, Water Resources Department, Govt. of Arunachal Pradesh. For the digitization of contours, preparation of DEM, and other GIS related tasks, GIS software ArcGIS Desktop 9.3 was used. Preliminary analysis revealed that the floodplains for up to 100 year return flood of this river lies entirely in Assam near its confluence with Brahmaputra near the Sisapathar GD site. Therefore, the DEM was extended to include the downstream of the river in Assam and flood zoning

was done for 2, 5, 10, 20, 50 and 100 years return floods.

The differences in the inundated areas were not found to be varying much among these flood levels. The reason for such small differences in inundated areas due to different return period flood levels is that, the downstream part of the Dikrong basin, which lies in Assam and contains the entire floodplains, are part of the Brahmaputra river floodplain. But the upstream part of the basin, in and near the Arunachal Pradesh, is hilly and part of the Siwalik hills with sudden increase in elevation. The slope in this transitional portion of the basin is so steep that inundation area increases at a very slow rate with increase in inundation depth. Therefore, Arunachal Pradesh does not posses any serious threats from the flood of Dikrong river. However, land use in the part of the basin falling in Assam needs to be planned very carefully to avert serious losses as in this part, a 2 year return period flood inundates almost the same area as does a 100 year return period flood. That means a considerable area is flooded almost every alternate year.

PURPOSE DRIVEN STUDIES UNDER HP-II PROJECT

Impact of Sewage Effluent on Drinking Water Sources of Shimla city and Suggesting Ameliorative Measures

Mass level Jaundice was reported in Shimla Town during 2007. The cause of the disease was due to the influx of pollutants/bacteria in the drinking water. Therefore, a project has been initiated in collaboration with I&PHE, Shimla to study the impact of sewage effluent on drinking water sources of Shimla city. During the year, field investigations were made for reconnaissance survey as well as for water quality monitoring in Shimla City. Collection of surface water samples from open drains, STPs, and water supply source and water distribution points was carried out in the problem segment of the Shimla City. The water sample were analysed for physico-chemical and bacteriological parameters in the Water Quality Laboratory of NIH. A software (Bentley SewerCAD) was purchased for studying efficacy of existing sewage network in problem segment of the Shimla City. The work of digitizing the maps was also in progress. The data required to evaluate the efficacy of the existing sewer network by model is being is being collected by I&PHE.

Groundwater Dynamics of Bist-Doab, Area, Punjab, using Isotopes

The Project was started in June 2009 with the objectives of identification of groundwater recharge zones and recharge sources and modeling the groundwater conditions under the impact of landuse change.

Over the period 2009-2010, hydrogeological data was collected, literature was carried out, sample inventories were done and the collected samples were analyzed for their isotopic composition. From the analyzed data the following preliminary conclusion can be drawn:

1. The groundwater flow in shallow and deep aquifers is mainly in the direction diagonally along NE-SW direction.

2. Rivers Beas and Satluj show characteristic difference in their isotopic composition as detailed in the table below:

Isotopic Characteristic of Rivers Satluj and Beas

River	($\delta^{18}O$, δD) in ‰
Satluj	(-10.5, -75)
Beas	(-6.9, -45)

3. Isotopic data of river Satluj shows a very high base flow component in its discharge near the village Harike (confluence point of river Beas and Satluj).

4. Isotopic composition of groundwater in the Doab region closely match with the isotopic composition of local rain and Beas river water indicating these (local precipitation and river Beas) to be the recharge sources to the groundwater of the region (except in the active flood plain region of the river Satluj

and at few locations along the Doab Canal).

Groundwater Management in Over-exploited Blocks of Chitradurga and Tumkur districts of Karnataka

Today groundwater resources are exploited as a common pool resource in an open access framework by one and all. This has resulted in over exploitation of groundwater resources leading to falling groundwater levels and deterioration of groundwater quality. Now, realization is growing among hydrologists, hydro-geologists and socio-economic scientists that groundwater development and its management is key to poverty alleviation in developing countries, wherein large sections of rural population are illiterate and their livelihood support depends on low productive agriculture.

Keeping this in view a project has been initiated in Tumkur and Chitradurga Districts of Karnataka with the following broad objectives:

- To analyze groundwater productivity at specific study sites and an assessment of its contribution to rural livelihood improvement.
- To develop integrated understanding of hydrologic, social, economic, and institutional perspectives.
- To improve stakeholder engagement and community participation for developing a common vision, goal and partnership for managing Basin's groundwater resources.
- To identify anthropogenic interventions and evaluate their likely impact for effective groundwater management.
- To arrive at a model for management and regulation of identified over-exploited blocks on an operational basis.

The project would provide a holistic approach to promote maximum agricultural output and promote industrial growth while regulating groundwater exploitation on a sustainable basis both in terms of quality and quantity in each hydrologic unit (watershed). The scope of the study is expected to extend to other states with over-exploited blocks for replication.

During the year all historical data available with the Mines and Geology Department, Karnataka was collected. Various thematic layes, such as, drainage, landuse, soil, geology has been prepared in the GIS environment.

A Comprehensive Assessment of Water Quality Status of Kerala State

Various studies have reported that the pollution levels in the water bodies and drinking water sources of the State of Kerala have gone up at an alarming rate. Factors like unscientific waste disposal, lack of alacrity to protect the rivers and other water bodies and unplanned construction of toilets in areas of high density of population have led to the steady deterioration of water quality. However, necessary data on hydrologic and water quality status are not available for proper planning and management of the water resources. One of the objectives of the State water Policy is to undertake regular water quality upgradation programmes to maintain the quality of water in the major sources of water. The present project is being envisaged in this direction to identify the type of quality problems existing in different regions of the State, to develop quality indices and to evolve strategies to protect the existing water bodies by conducting public awareness programmes and by adopting appropriate preventive and remedial measures.

Objectives

- Periodic monitoring of water quality status for the whole State by Kerala Irrigation Department and Ground water Department, by selecting appropriate monitoring stations.
- Development of Water quality Index for surface water bodies and DRASTIC indices for groundwater resources.
- Identification of polluted and pollution prone areas after analyzing one year quality data.
- Conducting socio-economic survey to know the existing water quality problems based on hydrological and hydro-geological regimes.

- Intense monitoring for groundwater quality parameters including trace metals in selected blocks of Kerala. Different regions such as; coastal zone, category based on land cover and agriculture pattern, and urban areas; will be selected for the study.
- River quality monitoring for river Pamba, wherein severe pollution problem is reported; along the river course and riparian areas.
- Application of surface water quality models like Qual2E to understand the flow requirements for maintaining the river water quality under various scenarios.
- Development of strategy for water quality management; institutional capacity building; and conducting training and awareness programme.

Hydrological Assessment of Ungauged Catchments (Small Catchment) Mahanadi Sub-Basin

Recently, Govt. of India is taking up expansion of highways in a big way in the state. Therefore, there is always a need for engineers to arrive at a design flood for planning of culverts, bridges, road embankments etc. Such works require estimatimation of design return period flood, peak floods for different storm, and unit hydrographs of different durations. Most of these parameters are to be computed for flow contribution from small catchments that are ungauged, a standardized procedure of flood estimation, and regional formulae would be very much useful to the field engineers. Government of Orissa is initiating small to medium water harvesting structures and tanks for artificial recharge purpose mainly in southern part (Rushukulya catchment) prone to drought. For design of such structures, water availability studies are pre-requisite. A regional flow duration curve along with empirical regional formulae to estimate mean flow shall assist the field engineers in computing the design parameters for small-ungauged areas. In addition to these design and sanction of small projects in the state, which require design return period flood, unit hydrograph and water availability analysis gets delayed because of lack in data or due to lack of any standard procedures. Further the existing regional formulae for such design parameter estimation, if exists need to be updated and standardized with latest available data and methods.

For this study, Mahanadai, Rushukulya, and Brahmani catchments in state of Orissa have been selected. The objectives of the study are:

1. To calibrate and validate an event based model employing unit hydrograph approach to the available data of flood events for the gauged catchments in the region.
2. To identify few robust flood frequency distributions that may be used for the computation of return period flood for the gauged catchments in the region.
3. To develop regional flood formulae using statistical correlation of the observed peak characteristics with important catchment and storm characteristics, for the estimation of the peak, and time to peak for the ungauged catchments in the region.
4. To develop regional unit hydrograph, and regional flood frequency analysis procedures utilizing the available data and methodologies.
5. To develop methodology for the regionalization of the hydrological parameters for the computation of the water availability for the ungauged catchments in the region.

Storm Water Management in Cooum sub basin, Chennai Corporation, Chennai, Tamilnadu

The Otteri Nullah watershed in Cooum sub basin has been identified for storm water modeling studies within the Chennai Corporation after conducting technical consultations with user agencies at Chennai. The sub basin catchment area is about 30 km^2. The data pertaining to historical urban floods in the Chennai city was collected. The hourly rainfall data (IMD) for about 20 years in the Chennai was collected. The analysis of rainfall data

is completed. The 2 yr, 5 yr, 10 yr, 25yr, 50 yr, 75 yr and 100 yr return period of rainfall intensity in the study area are 50, 63, 72, 83, 91, 95 and 99 mm/hour respectively. The state of the art of urban hydrological studies carried out in India and elsewhere was collected. The storm water drainage network map, contour map etc. has been collected from Chennai Corporation, Chennai. The collection of other information like slopes of the drains and cross sections of storm water drains are under progress. The procurement of field instruments (rain gauges, water level recorders), remote sensing data and up gradation of GIS software is under progress. The conversion of AutoCad map files into GIS frame work is completed. The main objectives of the projects are Evaluation of existing storm water drainage network in the study area using mathematical model, to find out the inflow-outflow hydrograph at various outlets and the water surface profile along the drains, feasibility of improvement of the existing drainage network and additional network if possible to mitigate urban storm water flooding in the study area.

C. EXTERNAL PROJECT STUDIES (COMPLETED)

Project No.1

Title of the Project	**A Vision Document on "Mitigation and Remediation of Ground Water Arsenic Menace in India**
Sponsoring Agency	Ministry of Water Resources, GOI, New Delhi
Principal Investigator	Dr N C Ghosh, Sc F, NIH and Dr. S.K. Srivastava (CGWB
Duration	One Year (May 2008- April 2009)
Amount	Rs. 2.00 lakh

Occurrence of Arsenic in groundwater, in excess to the permissible limit of 50 µg/L in the Ganges-Brahmaputra fluvial plains in India covering seven states namely, West-Bengal, Jharkhand, Bihar, Uttar Pradesh (in flood plain of Ganga River); Assam and Manipur (in flood plain of Brahamaputra and Imphal rivers) and Chhattisgarh state (in Rajnandgaon village), has been described internationally as the World's biggest natural groundwater calamity to the mankind after Bangladesh..

Over the last 25 years, since the groundwater arsenic contamination first surfaced in the year 1983, a number of restorative and substituting measures coupled with action plans focusing mainly towards detailed investigations to understand the physiochemical process and mechanism, alternate arrangement to supply arsenic free water to the affected populace have been initiated mainly in West Bengal. Efforts have also been made in the development of devices for arsenic removal and their implementation at the field. While in other States, they are meager. Despite number of corrective and precautionary measures, the spread over of arsenic contamination in groundwater continues to grow and more new areas have been added to the list of contaminated area. The problem resolving issues, thus, seem to be partial and inadequate, that need to be strengthened by strategic scientific backing.

The document focuses mainly on: (i) up to date status of arsenic menace in India, (ii) state-of-the-art of scientific knowledgebase, understanding and technologies available from both national & international perspectives, (iii) technologies in place, (v) preventive and corrective measures taken so far and results thereof, (v) shortcomings, and possibility of employing success stories of one place to another region, (iv) further work to be undertaken, (vi) roadmap to achieve the targeted milestones, (vii) framework of activities to be taken up, etc. For figuring these concerns and issues, a total of ten different Chapters linking one to another are deliberated. Of which, first six chapters illustrate the knowledgebase, understanding, status , technologies available followed by a critical appraisal, while the other four chapters elaborate on further work required for achieving sustainable solution for arsenic menace, roadmap to achieve those along with an envisaged 'Plan of Actions' and

financial requirement to achieve those targeted tasks.

A framework of activities with an estimated financial target of Rs. 200 crores for a period of five years has been envisaged to resolve aesenic menance exposed in seven States in India. It is believed that the outcome of these scientific tasks will help building the strategy to mitigate and remove groundwater arsenic menace in India.

Project No.2

Title of the Project	Development of Non - linear Data Driven Models for Flood Forecasting for Indian Rivers
Sponsoring Agency	DST, New Delhi
Principal Investigator	Mr. P. C. Nayak, Sc. C
Duration	3 years (July 2006 to June 2009)
Amount	Rs. 5.02 Lakh

The critical dependence of human society on a reliable source of water and its needs for protection from floods and droughts, demands for engineering solutions to water-resources problems. A prediction of flood event is one of the most essential yet difficult hydrological tasks.

However, the presence of strong nonlinearities and feedbacks among the various hydrological processes in a basin makes river flow foreasting a complex task. In short, the major objective of the current work is to develop methods for improving the performance of the data driven models in the context of river flow forecasting. In the current study, seven data driven models (DDMs) (i.e. MLR, ANN, two types of Fuzzy and two types neurofuzzy, hybrid intelligent system) have been developed and applied for river flow and water level forecasting for Baitarani and Subarnarekha basins. From the analysis, it is found that hybrid intelligent system (HIS) is efficient in water level as well as river flow forecasting. HIS is a combination of neural network and fuzzy computing techniques. In the HIS, parameters are optimized using Levenberg-Marquardt algorithm. It is found that efficiency is more than 80% for higher lead time forecasting (12 hours) by HIS model. Similar result is found for Subarnarekha basin also.

Project No. 3

Title of the Project	Design Flood Estimation for Kameng Power House
Sponsoring Agency	North Eastern Electric Power Corporation Ltd. (NEEPCO)
Principal Investigator	Mr. Rakesh Kumar, Sc. F
Duration	1 ½ years (June 2008 – Dec. 2009)
Amount	Rs. 3,20,544/-

Design flood estimation studies have been carried out for estimation of probable maximum flood (PMF) and floods of various return periods for the Kameng power house. The study has been sponsored by North Eastern Electric Power Corporation Ltd. (NEEPCO). The Kameng H.E. Project, being taken up in the Arunachal Pradesh, is a run-of-the river scheme, diverting the water flow from the Bichom (tributary of the Kameng) and Tenga (tributary of the Bichom) rivers up to a maximum of 150 cumecs, for generating 600 MW of power, under a head of about 500 m. The Bichom river originates from the glacial ranges of the greater Himalayas at an altitude of around 7000 m. The river runs in southerly direction with very steep bed slope (average 1 in 60) till its own major tributary, Digien joins. After the confluence with Digien, the river flows in the south-easterly direction upto the point where the Tenga River meets the Bichom. The river, after the confluence of Bichom and Tenga, is known as the Kameng or Jia Bhareli and joins the Brahmaputra River. The catchments areas of Tenga, Bichom and Kameng are 1101, 3660 and 4274 km^2, respectively. The project contemplates construction of two diversion dams, one each across the Bichom and Tenga rivers. The respective maximum heights of

these dams are 75 m and 30 m. For Bichom dam, the diverted water will be carried to the power house, located on the right bank of the Kameng river via. 14 km long head race tunnel and an underground penstock system. The power house will be equipped with 4 units of 150 MW each. The Bichom dam is being designed as a concrete gravity dam, with a central spillway. The gross storage capacity of the reservoir behind the dam would be about 32 m cum. The dam will be constructed in moderate valley, with the length along the top of dam being about 225 m. The spillway is proposed to be equipped with 15 m high radial gates for passing the PMF without causing any risk to the safety of the dam. As the flood storage capacity in the reservoir is insignificant, no moderation of the inflow flood is assumed to take place. In the present study, PMF has been estimated for the Kameng Hydro Electric Project. For this purpose, the PMP value has been arrived at from isohyets available in the PMP Atlas of Eastern India. The HEC-HMS package has been used for estimation of PMF hydrograph. Floods of various return periods have also been estimated for the project site using the L-moments approach.

Project No. 4

Title of the Project	**Dating of water from CBM wells and nearby tube wells by isotopic method (^{3}H and ^{14}C)**
Sponsoring Agency	Reliance Industries Ltd., Ahmedabad
Principal Investigator	Dr. Sudhir Kumar, Sc. E2
Duration	Four months (June 2009 to October 2009)
Amount	Rs. 3 lakh

Coal Bed Methane (CBM), is a natural gas occurring in coal seams and is a relatively new source of energy in India. Large amount of groundwater is pumped alongwith the gas from CBM wells, especially in the early stages of production. This may create environmental problems by inducing recharge of water from the overlying leaky aquifers or surface water bodies through fractures and faults. The lowering of water table or drying of surface water bodied may impact the economic and social activities in the area. In view of the above, Reliance Industries Limited, Ahmadabad, awarded this consultancy project to National Institute of Hydrology, Roorkee with the objectives to know the water being produced from CBM wells is connate water from coal bed of Gondwana and is not connected to ground water of the area through Isotopic analysis of water (Preferably 3H and 14 C) from CBM wells and nearby tube wells.

The study was carried out in Sohagpur East and Sohagpur West blocks falling in Shahdol and Anuppur districts of Madhya.

The study indicated: (i) the groundwater present in the shallow and intermediate aquifers (30-75 m) is generated from the recent time precipitation; (ii) the groundwater pumped from deep CBM wells is older than that use for drinking from shallow water; and (iii) the uncorrected age of groundwater abstracted through the CBM wells is >20,000 yrs.

D. EXTERNAL PROJECT STUDIES (ON-GOING)

Project No.5

Title of the Project	**National Programme on Isotope Fingerprinting of Waters of India (IWIN)**
Sponsoring Agency	DST, New Delhi.
Principal Investigators	Dr Bhishm Kumar, Sc F andDr. M.S. Rao, Sc. C
Duration	5 years (2007-2012)
Amount	Rs. 54.65 lakh (There are total 14 collaborators under the IWIN project with separate budget)

A five year DST funded National Programme on Isotope Fingerprinting of Waters of India (IWIN) was initiated in July, 2007 with the objectives (i) identifying Regional/local water components in the local atmosphere, (ii) quantifying the partitioning of vapours into rain and re-partitioning of rain into various components as

evapo-transpiration, stream flow and groundwater, (iii) residence time of /water in different inland hydrological units, (iv) atmospheric/surface water/groundwater interaction on seasonal and spatial basis.

To achieve the objectives, atmospheric moisture, precipitation samples and groundwater samples are being collected at Roorkee (Uttarakhand) and Sagar (Madhya Pradesh) and the river Ganga (from Upper Ganga Canal) at Roorkee. The collected water samples are analyzed for δD, $\delta^{18}O$ and ^{3}H.

From the data analysis, the following 3-observations can be made:

1) The isotopic index of local vapours composition at mid-summer is about -5‰ (for ^{18}O).
2) Events of moist air inflow or rainfall are characterized by sudden depletion in isotopic values.
3) With the onset of monsoon moisture, isotopic composition of air-moisture continuously depletes and reaches to -30 ‰ indicating the total vapour of the region replaced by the monsoon vapour.
4) The onset of depleting isotopic trend indicates onset of monsoon and the date of change-over in the isotopic pattern from depleting to enrichment as the date of onset of monsoon withdrawal.
5) A positive correlation is observed between the isotopic variation in air moisture and the absolute humidity.
6) The isotopic variation in groundwater composition clearly indicates impact of canal seepage atleast a distance upto 1½ km across the canal length.

Work is also initiated to set-up two new stations at RC, Jammu and at RC, Kakinada to monitor change in isotopic composition of water vapour along the monsoon track from Kakinada near coast of Bay of Bengal to the northwest end at Jammu.

Project No. 6

Title of the Project	**Rainfall-runoff modeling and water availability estimation for Rehar River at Rihand Dam and selected sites in Benas and Mehar river**
Sponsoring Agency	Department of Alternate Hydro - energy Centre, IIT Roorkee for Central Electricity Authority
Principal Investigator	Dr. R. P. Pandey, Sc. E1
Duration	6-months (Dec-2009 –May 2010)
Amount	Rs.3.21 lacs

Rainfall-runoff modeling and water availability estimation are the components of the project on "Utilization of Rihand reservoir water up to designed MDDL and possibility of creating additional storage in the nearby catchments to meet requirements of thermal power plants". The study was taken up with the objectives to develop rainfall-runoff relationship and assess water availability in Benas, Gopad and Kanhar rivers. Rainfall records at various stations in study catchments and flow records at Benas river have been used to estimate water availability at two sites in Gopad and one site in Kanhar river. Rainfall and streamflow records of the sites were analysed for the period 1977-78 to 2005-06. 10-daily streamflow records for 30 years (June 1977- May 2006) were used in the study. Rainfall-runoff modeling and water availability analysed showed that both the basins have surface water availability during the monsoon season to supplement the requirement of water for thermal power plants around the Rihand reservoir.

Project No.7

Title of the Project	**Integrated Hydrological Study for Sustainable Development of two Hilly Watersheds in Uttaranchal.**
Sponsoring Agency	DST, New Delhi
Principal Investigator	Dr Avinash Agarwal , Sc. E2
Duration	5 years (July 2005-June 2010)
Amount	Rs. 48.0 lakhs

Department of Science & Technology, Govt. of India, initiated a network of projects on hydrological study of small watersheds, in different agro-ecological regions of the country with following as broad objectives.

- Detailed hydrological monitoring, collection of data at sub-watershed scale and creation of a centralized database for watershed for the benefit of the users
- Rainfall-runoff-sediment yield studies to develop strategies for conservation of soil and water resources
- Delineation of recharge and discharge zones of springs using nuclear techniques
- Water management planning for domestic use and crop production purposes
- Develop linkages with state line departments, local technical NGO's etc.
- To act as a hub for transfer of NRDMS technologies related to watershed management

The study area of this project lies in 'Western Himalaya' agro-ecological region of the Sub-humid Ecosystem at elevation of 720 m to 2350 m. Climate in this region is warm with air temperature 3°C to 35°C sub-humid to humid and per-humid with average annual rainfall 900 to 1200 mm. Total fifty numbers of springs are under observation for both the watersheds and daily spring flow discharge are being recorded. As for as possible all the available springs in the watersheds are being monitored. The construction of ten daily flow duration curves was done as per the procedure of Institute of Hydrology and reported in figure 1. The springs of Danda watershed indicated average discharge as 0.22 l/s yielding more than the springs of Chandrabhaga watershed with an average of 0.17 l/s.

The water balance for both the watershed was estimated by using equation based on method (ER, SCS) and (ER, FAO). In Chandrabhaga watershed the water balance indicated an unaccounted value may be as surplus of 340 mm at the end of the water year i.e. the month of May. In Danda watershed the water balance indicated an unaccounted value may be as deficit of 45 mm at the end of the water year i.e. the month of May.

Project No.8

Title of the Project	**Water Balance Studies of the Forested Watersheds, Western Ghats, India**
Sponsoring Agency	DST, New Delhi
Principal Investigator	Mr. B. Venkatesh, Sc. E1
Duration	3 yrs (2007-2010)
Amount	Rs. 12.00 Lakhs

Present research is undertaken to closely

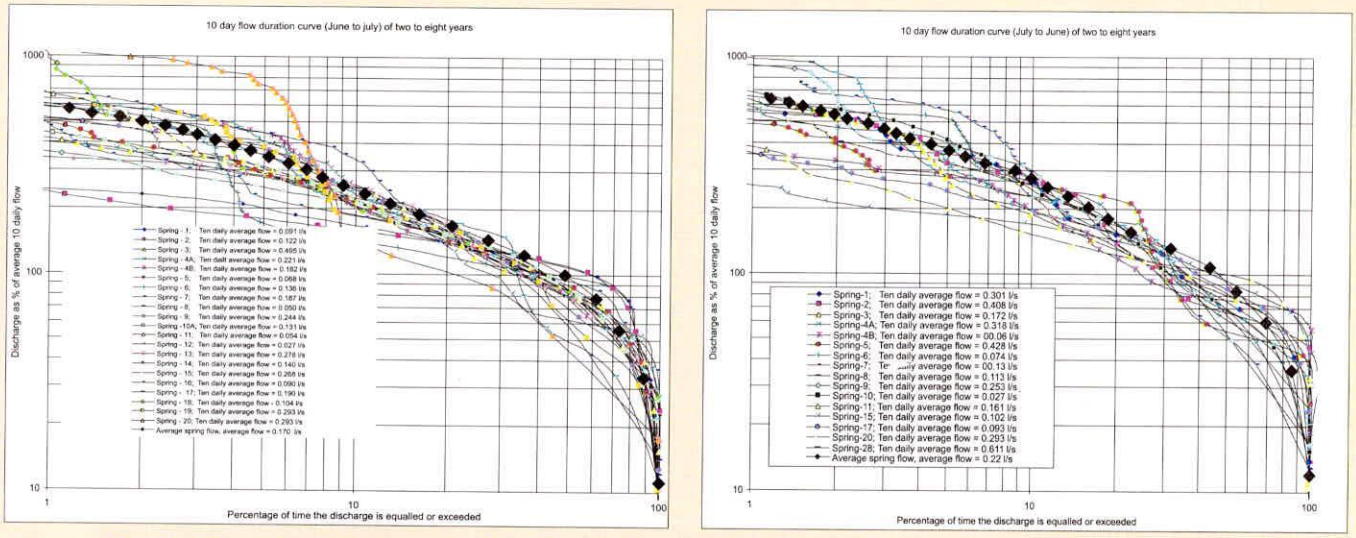


Fig. 1: Flow duration curve for the springs of Chandrabhaga and Danda watersheds.

examine the poorly understood link between water balance components-vegetative relationships through the different parts of the landscape in Western Ghats region. The study is being conducted in the North-Canara district of Karnataka. The area considered for study has been extensively planted with monoculture species (Acacia) on grass land and degraded land. The hydrological implications of such an extensive plantation have not been studied so far. Therefore objectives of the project are:

1. To understand the hydrological role of vegetation, and its relationship with the mean annual evapotranspiration;
2. To evaluate the impact of changing vegetation on groundwater recharge;
3. To develop water balance model that describes the effect of vegetation change on mean annual evapotranspiration and runoff.
4. To evaluate the impact of changing vegetation on erosion rates

Project No.9

Title of the Project	**Assessment of Ground Water Quality in 25 Class – I Cities of India, Sponsored by CPCB, Delhi**
Sponsoring Agency	Central Pollution Control Board, New Delhi
Principal Investigator	Dr V K Choubey, Sc F
Duration	2 yrs (2008-10)
Amount	Rs. 72.00 Lakhs

The Central Pollution Control Board (CPCB), Delhi has awarded the project study on 'Assessment of Ground Water Quality in 25 Class – I Cities of India'. In order to achieve the objectives of the study, thirty ground water samples from each of the Class – I Cities of Agaratala, Aizawl, Kohima, Shillong, Guwahati, Itanagar, Raipur, Bhubneshwar, Gangtok, Dehradun, Shimla and Jammu were collected during pre-and post monsoon season during 2009-10 from various abstraction sources used for drinking purpose at various depths covering extensively populated area, commercial, industrial, agricultural and residential colonies so as to obtain a good areal and vertical representation and were analysed for various water quality parameters, viz., physico-chemical and bacteriological parameters, heavy metals, pesticides and polynuclear aromatic hydrocarbons. The water quality data for pre- and post-monsoon seasons was processed as per BIS and WHO standards to examine the suitability of ground water for drinking purpose, ionic relationships were developed and water types identified. Spatial distribution maps were be prepared in the form of contour diagrams to identify degraded water quality zones. Suitability of ground water for irrigation purpose was assessed on the basis of total soluble salts, SAR, RSC and boron content. Classification of water was made using Piper trilinear diagram, Durov plots, Chadha's diagram, US Salinity Laboratory Classification and Gupta Classification.

Project No.10

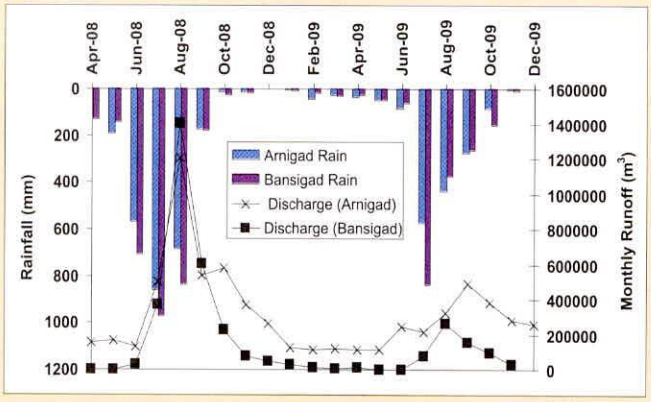
Title of the Project	**Impact Assessment of Landuse on the Hydrologic Regime in the Selected Micro - Watersheds in Lesser Himalayas, Uttarakhand**
Sponsoring Agency	Forest Research Institute, Dehradun
Principal Investigator	Dr S P Rai, Sc E1
Duration	5 yrs (2008-12)
Amount	Rs. 4.5 Lakh (FRI, Dehradun is also a collaborator under the project with separate budget)

The study is being carried out jointly with the Forest Research Institute, Dehradun. The main objective of the project is to study the impact of assess cover on the hydrological regime of a microwatershed. The quantity, timing and quality of water flowing from a watershed serve as sensitive indicators to understand the hydrological

response of a watershed. Two watersheds, in Lesser Himalaya near the Mussoorrie (Uttarakhand) have been selected to study the impacts of landuse on hydrological regime. These two watersheds are namely, Arnigad, covers an area of 2.99 km^2 under dense Oak forest and Bansigad, covers an area of 1.99 km^2 under degraded oak and pine mixed forest. The geomorphological features, geological set-up and meteorological conditions are almost identical in both the watersheds. Both the watersheds are equipped with the hydrometeorological equipments. To measure the discharge of both the watershed 120^0 'V' Notch and automatic water level stage recorder has been installed in both the watersheds for the continuous monitoring of stream discharge. Meteorological observatories have been installed near the outlet of each watershed for monitoring the rainfall, temperature, humidity and evaporation etc.

The average air temperature varies between 15.5^{0}C (minimum) and 25^{0}C (maximum) in degraded watershed and 18^{0}C to 22^{0}C in forested watershed. The evaporation rate varied from minimum 2.5 mm/day in rainy months to maximum 6 mm/day in summer months.

The continuous discharge and rainfall data have been recorded since June 2008 and onwards. Rainfall and runoff data are for the duration April 08 to Dec. 09 are shown in the figure. Rainfall and runoff data for a year from April 2008 to March 2009 have been analyzed in detailed for both micro-watershed. Discharge of stream from the Bansigad watershed (degraded forest cover) becomes negligible during summer months and maximum flow is recorded in the month of August at the rate of 0.59 m^3/sec. While, discharge from the Arnigad watershed (dense forest cover) was recorded minimum 0.06 m^3/sec in the month of June and maximum 0.55 m^3/sec in the month of August. The discharge decline slowly in Arnigad stream during post monsoon month while it decline at faster rate in Bansigad stream and stream dries up in summer months.



Rainfall-runoff relationship on monthly basis Arnigad and Bansigad micro-watershed

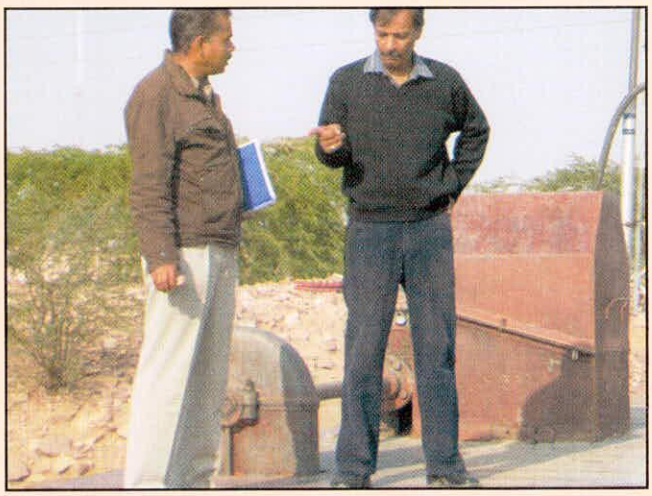
Total rainfall received during April 2008 to March 2009 in the micro-watersheds of Arnigad and Bansigad are 2905 mm and 2958 mm, which is generating runoff of 1627 mm and 1932 mm respectively. Seasonal and monthly variation of runoff from both the micro watersheds have been observed. During the monsoon period from June to September runoff is about 81% from Bansigad watershed and 60% from Arnigad watershed of total annual flow while both the watersheds receive about 86-88% of the total rainfall. The runoff from Bansigad watershed (Degraded watershed) is about 20% higher than the Arnigad watershed (Dense Forest Cover). The higher runoff from the Bansigad micro-watershed is due to less recharge of rainfall high overland flow in comparison of than that of Arnigad micro-watershed.

Flow during the post monsoon season is supported by subsurface flow in hilly watershed, popularly known as base flow of the stream. Contribution of subsurface flow is much higher in Arnigad catchments and stream emanating from the dense forest cover is generating 184 mm more runoff during the non rainy months. In degraded watershed of Bansigad, ground water storage is not enough to sustain the stream discharge throughout the year. Therefore, stream flow from Arnigad micro-watershed is perennial whereas stream generating from degraded forests of Bansigad is intermittent and it flows for 9 to 10 months only. It may be concluded that ground water recharging or infiltration is higher in dense forests.

Project No.11

Title of the Project	Problem of rising ground water level in Jodhpur City
Sponsoring Agency	Ground Water Department, Jodhpur
Principal Investigator	Dr. N.C. Ghosh, Sc. F
Duration	1 ½ years August 2009-February 2011
Amount	Rs. 24.52 Lakh

A sponsored project entitled "Problem of rising ground water level in Jodhpur City" was sponsored by Ground Water Department, Jodhpur in April 2009. The main objectives of the project are: (i) identification of cause(s) of rising ground water levels in Jodhpur city (ii) development of an effective and sustainable management plan for maintaining the water table of area at a safe level to avoid any negative impact on the civil structures and population of the area.



Collection of information on the Hathi Canal (Inflow to the Kailana Lake) under the Study -Problem of rising ground water level in Jodhpur city

During the period, the relevant data has been collected and analysed at NIH and an interim report based on the preliminary study has already been sent to the sponsoring agency in March 2010.

Project No.12

Title of the Project	Glaciological studies of Phuche Glacier, Ladakh Range, India
Sponsoring Agency	Department of Science & Tech. (DST), New Delhi
Principal Investigator	Dr. R. J. Thayyen, Sc. C
Duration	3years (Dec. 2009 to Dec.2012)
Amount	Rs.43 Lakh

The objectives of the study are

a) To generate data for glacier mass balance and runoff model:
   - Winter & Summer Mass Balance studies by glaciological method
   - Runoff measurements
   - Collection and standardisation of meteorological parameters by AWS
   - Mass Balance & Runoff modeling

b) To study the composition of stable isotopes $\delta^{18}O/D$ in the winter snow, summer snow/rainfall and separate snow, rain, groundwater and glacier melt components in the river flow and study its temporal and seasonal variations.

This is a DST project which has been sanctioned in December, 2009. Procurement of equipments in the project has been initiated. Change estimation study of the Phuche glacier has been completed by using topographic method to estimate the glacier during 1973-2007 period. Winter mass balance measurements will be carried out in May 2010. Snow samples will be collected for isotopic profiling.

LIST OF COMPLETED PROJECTS

S N	Title	Sponsoring Agency	PI	Duration	Amount Rs.	Status
1.	A Vision Document on "Mitigation and Remediation of Ground Water Arsenic Menace in India	Ministry of Water Resources, GOI, New Delhi	Dr N C Ghosh, Sc F, NIH and Dr. S.K. Srivastava (CGWB)	2008- April 2009	Rs. 2.00 lakh	Completed
2.	Development of Non-linear Data Driven Models for Flood Forecasting for Indian Rivers	DST, New Delhi	Mr. P. C. Nayak, Sc. C	3 years , July 2006 to June 2009	Rs. 5.02 Lacs	Completed
3.	Design Flood Estimation for Kameng Power House	North Eastern Electric Power Corporation Ltd. (NEEPCO)	Dr. Rakesh Kumar, Sc. F	1 ½ years (June 2008 – Dec. 2009)	Rs. 3,20,544/-	Completed
4.	Dating of water from CBM wells and nearby tube wells by isotopic method (^{3}H and ^{14}C)	Reliance Industries Ltd., Ahmedabad	Dr. Sudhir Kumar, Sc. E2	Four months (April 09 to July 09)	Rs. 3 lakh	Completed

ON-GOING EXTERNAL PROJECTS

S N	Title	Sponsoring Agency	PI	Duration	Amount	Status
5.	National Programme on Isotope Fingerprinting of Waters of India (IWIN):	DST, New Delhi.	Dr Bhishm Kumar, Sc. F, and Dr. M.S. Rao, Sc. C	5 years (2007-2012)	Rs. 54.65 lakh (Total 14 collaborators with separate budget)	On-going
6.	Rainfall-runoff modeling and water availability estimation for Rehar River at Rihand Dam and selected sites in Benas and Mehar river	Department of Alternate Hydro-energy Centre, IIT Roorkee for Central Electricity Authority	Dr. R. P. Pandey, Sc. E1	6-months (Dec-2009 – May 2010)	Rs.3.21 lacs	On-going
7.	Integrated Hydrological Study for Sustainable Development of two Hilly Watersheds in Uttaranchal.	DST, New Delhi	Dr Avinash Agarwal, Sc. E1	5 years (July 2005-June 2010)	Rs. 48.0 lakhs	On-going
8	Water Balance Studies of the Forested Watersheds, Western Ghats, India	DST, Govt. of India	Shri B. Venkatesh, Sc. E1	3 yrs	12.00 Lakhs	On-going

S N	Title	Sponsoring Agency	PI	Duration	Amount	Status
9	Assessment of ground water quality in 25 Class – I Cities of India	CPCB, Delhi	Dr. V K Choubey, Sc. F	2 year (2008-10)	Rs 72 lakhs	On-going
10	Impact assessment of Landuse on the Hydrologic Regime in the Selected Micro-watersheds in Lesser Himalayas, Uttarakhand, FRI, Dehradun.	Forest Research Institute, Dehradun	Dr S P Rai, Sc.E1	5 years (2008-12)	Rs.4.5 lakh (FRI, Dehradun is a collaborator with separate budget)	On-going
11	Problem of rising ground water level in Jodhpur City	Ground Water Department, Jodhpur	Dr. N.C. Ghosh, Sc. F	1 ½ years April 2009 - Sept. 2011	Rs. 24.52 Lakh	On-going
12	Glaciological studies of Phuche Glacier, Ladakh Range, India	Department of Science & Technology (DST)	Dr. R.J. Thayyen, Sc. C	3 years	43.0 Lakh	On-going

CHAPTER – 3.B

HYDROLOGY PROJECT - II

KEY ACHIEVEMENTS UNDER HYDROLOGY PROJECT-II

The National Institute of Hydrology, Roorkee has been entrusted important tasks under World Bank funded Hydrology Project Phase-II (HP-II). Eight Central Agencies (MOWR, NIH, CWC, CGWB, CWPRS, CPCB, IMD and BBMB) and thirteen States (Andhra Pradesh, Gujarat, Maharashtra, Karnataka, Kerala, Madhya Pradesh, Chattisgarh, Orissa, Tamil Nadu, Himachal Pradesh, Goa, Pondicherry and Punjab) are participating in the Project. As a follow up to HP-I; HP-II has activities under three major components viz. (i) Institutional Strengthening, (ii) Vertical Extension and (iii) Horizontal Expansion. For achieving the tasks entrusted to it the Institute has a final allocation of Rs. 50.68 crores. The Institute has been actively engaged to achieve the assigned targets within stipulated time frame under the above components. To ensure proper management of HP-II activities the Institute has designated a Nodal Officer, Training Coordinator and Procurement Officer for HP-II. A HP-II Cell is also operational at the Institute with seven redeployed scientists and staffs to manage various activities of the HP-II.

The Institute has conducted thirty seven training programs since inception of the project on the specialized topics of hydrology, data processing software SWDES & HYMOS and demand driven trainings for the State and Central implementing Agencies. The training and office equipments have also been procured to further strengthen these activities.

The Institute is the nodal agency for the development of Decision Support System (Planning) for Integrated Water Resources Development and Management to be implemented in six Central and nine States Agencies. To develop the DSS (P), Consultants have been hired through International Competitive Bidding (ICB) under World Bank Procurement guidelines. The contract for the DSS (P) consultancy was signed on 15th November, 2008 between NIH (Client) and DHI, Denmark (Consultants) at Roorkee. Since then DSS (P) Consultants have been working as per the scheduled tasks in the contract document and submitted the Inception Report, DSS (P) Needs Assessment Report (NAR) and DSS (P) Model Conceptualization Report to NIH. The inception report provides a comprehensive road map for the development of the DSS (P) consultancy during the project period. The DSS (P) needs of the States in their identified basins were assessed by the Consultants during their visits to various States and the same have been compiled in one main NAR and nine State specific NARs of the respective States. Based on the DSS (P) need assessment of the States the task of DSS (P) model conceptualization has been completed. The outcomes of these reports were deliberated with the Implementing Agencies (IAs) in workshops organized by NIH and Consultants. The observations and comments of various IAs during the workshops were recorded and incorporated in the final reports. The review committee (having representation from MOWR, NIH, CWC and CGWB) has reviewed the final reports. A DSS (P) Working Group comprising of twenty scientists has also been constituted, and is associated with the DSS (P) Consultants for proper implementation of DSS (P) software in the DSS (P) implementing Agencies.

The Purpose Driven Studies (PDS) is another subcomponent under the vertical component wherein the Institute is actively participating with State and Central Agencies in carrying out eleven PDS. The PCS and World Bank have approved of four Surface Water (SW) and three Ground Water (GW) PDS of NIH. Apart from these, the Institute is associated in carrying out four other PDS with the States and Central Agencies. The project staff has been appointed for carrying out these PDS and the procurement of various software, goods and equipments has been finalized for these studies. The PIs of the PDS have conducted field visits to the study areas and collected relevant data and information from the concerned States Agency and the PDS are in progress.

CHAPTER – 4

INITIATIVES IN THE NORTH-EAST REGION

The North Eastern Regional Centre (NERC) of NIH, Guwahati catering for the seven North-East states, Sikkim and parts of West Bengal (Teestha basin), was established in August, 1988 at Guwahati and was working for various water resources problems of the region. Since its inception, the centre has been actively interacting with various water resources organizations in the states covered under the region and carrying out its studies and activities within the frame work of recommendations of the Regional Coordination Committee in the areas of representative basin study, water quality study, remote sensing application, floods, watershed Management etc.

Considering flood as the major problem in the region, Ministry of Water Resources, Govt. of India decided to rededicate the centre towards service of the region and renamed it as "NIH Centre for Flood Management Studies". The centre was formally opened/inaugurated on September 27, 2001 by the then Hon'ble Minister of State for Water Resources, Govt. of India and the then Secretary, Govt. of India, Water Resources. As per the action plan, the centre works in different areas addressing the various hydrological and water resources problems of the North-East Region.

During the year, following studies have been undertaken: i) Modelling non-point source pollution; ii) Flash flood studies (Jiadhal Basin); iii) Flood plain zoning/flood hazard mapping of rivers of Arunachal Pradesh; iv) Phytoremediation: A plant based technology to clean-up the environment; and v) Design of rain guage station network for Arunachal Pradesh.

Long Term Studies

Dudhnai river sub-basin, situated in Meghalaya and Assam, was selected for long term representative basin studies. The study was undertaken in the representative basin, regarded to be a model for larger hydrologically similar basins, for long term fundamental research and experimenting all hydrological procedures with a view to extrapolate or interpolate the results to other hydrologically similar basins.

Basic maps of the basin have been prepared, existing data collected and some long-range data are being collected. An observatory has also been setup and equipment installed and maintained in Sarangma within this basin and data being collected since last 10 years by this Centre. Several rounds of basin investigations for soil, infiltration, water quality, hydraulic conductivity etc. are completed and soil map on 1:50,000 scale prepared. Six technical reports and two ME dissertations have been completed so far on the representative basin. The basin monitoring through the observatory is continuing.

Technology Transfer

The Scientists of the centre have been actively involved for wider dissemination and exchange of information to the scientific community and general public of the region.

NIH Centre for Flood Management Studies, Guwahati organized a two days Training Workshop on 'Flood Management in North East Region' during March 23-24, 2010 at Greenwood Resort, Khanapara, Guwahati for the practicing engineers

Chief Guest delivering Inaugural Address in the Training Workshop on Flood Management in North East Region on March 23, 2010 at Guwahati

of the North-East region. The workshop was aimed to provide valuable update of knowledge to engineers for solving real field problems related to flood management, as the North-East region with

7th Meeting of Regional Coordination Committee of CFMS, Guwahati on June 18, 2009

vast water resources potential and associated management problems really needs effective scientific understanding and technological knowhow to tackle the problems of flood and erosion in the region.

In addition to the Scientists of CFMS, Guwahati, the lectures were delivered by various other experts from Regional Meteorological Centre, Assam Engineering College, Central Water Commission and IIT-Guwahati. Total 17 persons belonging to different organizations from the North-East region participated in the workshop.

Most of participants felt that the Training Workshop was very well organized, covered almost all the important topics and it was very useful for updating the knowledge with recent technological advances. However, some participants were of the opinion that such workshops may be organized for larger duration and may be made more practical/problem-oriented with some exercises/ tutorials.

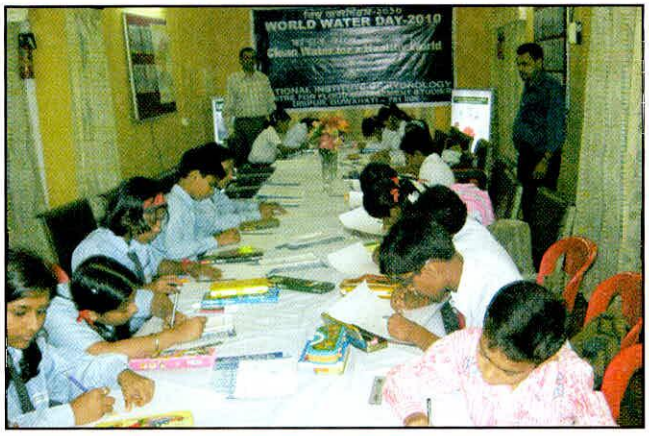
Mass Awareness Programme

The Centre has organized following Mass Awareness Programmes during 2009-10:

Mass Awareness Programme on Flood Management at Dakshin Kamrup College, Mirza on 12th December, 2009 Organized by CFMS, Guwahati

S.No.	Mass Awareness Programme	Place	Date
1.	Stage Drama UPANAYAN on the theme Flood Management	Mirza (District Kamrup)	12th Dec. 2009
2.	Mass Awareness Programme on Water Conservation	Changsari (District Kamrup)	21st Dec. 2009
3.	Mass Awareness Programme on Climate Change & Global Warming	Nasatra (District Barpeta)	29th Dec. 2009
4.	Participation in Assam International Trade Fair through distribution of pamphlets	Guwahati (District Kamrup)	8th Feb. 2010
5.	Celebration of World Water Day on the theme Clean Water for a Healthy World	Guwahati (District Kamrup)	22nd March 2010

Mass Awareness Programme on Water Conservation at Saraighat College, Changsari on December 21, 2009 Organized by CFMS, Guwahati



Drawing Competition on the Occasion of World Water Day – 2010 at CFMS, Guwahati

Organization of Water Resources Day

The Centre actively participated in organization of 24th Water Resources Day on the theme 'Shared Water–Shared Opportunities' with a Technical Seminar on the theme on May 29, 2009 organized by The Institution of Engineers (India), Assam State Centre, Guwahati.

Participation in Sikkim Glacier Commission

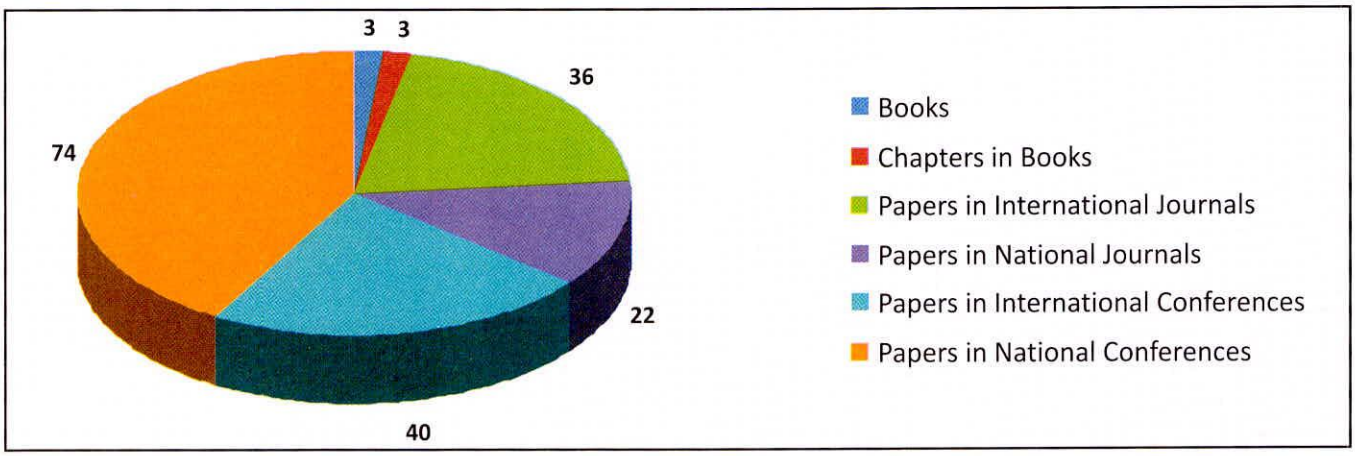
The Govt. of Sikkim has constituted a Commission to study the state of glaciers and its impact on water system in Sikkim and to suggest measures for modern scientific and technological interventions and actions required on human resource generations, training and management that would cater to glaciology and related environmental management. The Centre has actively participated in the meetings of the Commission and submitted a modified chapter on 'Hydro-Meteorological Observations and Modelling of Glacierized Basins' for inclusion in the report of the Commission. The chapter includes details of meteorological parameters and discharge measurement techniques along with modelling basics and data requirements.

CHAPTER – 5

PUBLICATIONS AND TECHNOLOGY TRANSFER

A. Publications

During the year 2009-10, a number of publications in different forms were brought out by the Institute and the same is presented below. The list of publications is given in Appendix-IX.



B. Technology Transfer

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 organizing short duration workshops dealing with specialized areas in hydrology for transfer of relevant theoretical background as well as methodologies including computer programs to field engineers of Central and State Government organisations in the country.

During the year 2009-10, following training courses and workshops were organized:

SN	Training Courses and Workshops organised	Period	Venue	Duration (weeks)	Course Coordinator	No. of Trainees/Participants	Man weeks
1.	Workshop to Discuss the Findings of Climate Change Studies Carried Out under MoWR Action Plan on Climate Change	July 31, 2009	New Delhi	1 day	Dr. A.K. Lohani	55	11
2.	DSS Needs Assessment Workshop	August 05 - 06, 2009	New Delhi	2 days	DSS (P) Consultants (Under HP-II)	60	24
3.	Hydrological Modelling	September 14-18, 2009	NIH, Roorkee	1 week	Dr A.K. Lohani,	22	22
4.	Training Workshop on Project Hydrology	September 21-24, 2009	DRC, Kakinada	4 day	Dr Y R S Rao	26	21

SN	Training Courses and Workshops organised	Period	Venue	Duration (weeks)	Course Coordinator	No. of Trainees/Participants	Man weeks
5.	Training Course on SWDES/HYMOS Software	Sept. 24,25, 28,29,30 and October 1, 2009	Goa	6 days	Dr A.K. Lohani,	35	42
6.	Training Course on Artificial Groundwater Recharge & Aquifer Management	October 5-10, 2009.	Kolkata	6 days	Dr Surjeet Singh	30	36
7.	Rainfall Runoff and River Basin Modelling	October 19-23, 2009	NIH, Roorkee	1 week	DSS (P) Consultants (Under HP-II)	25	25
8.	Rainfall Runoff and River Basin Modelling for Five States & Central Agencies	October 26, November 6, 2009	NIH, Roorkee	2 weeks	DSS (P) Consultants (Under HP-II)	24	48
9.	Training Course on Hydrologic Studies for Major and Medium Irrigation Projects fo r 20 officers of Irrigation and CAD Department, AP.	October 26 – November 6, 2009	NIH Roorkee	12 days	Dr Vijay Kumar	20	48
10.	Training Course on "Water Quality and its Management" in the collaboration of Central Soil and Materials Research Station (CSMRS) , New Delhi	November 9-13, 2009	CSMRS, New Delhi	1 week	Dr V K Choubey	30	30
11.	Rainfall Runoff and River Basin Modelling for Four States & Central Agencies	November 9-20, 2009	NIH, Roorkee	12 days	DSS (P) Consultants (Under HP-II)	25	60
12.	DSS(P) for Decision Makers	November 11, 2009	New Delhi	1	DSS (P) Consultants (HP-II)	71	14
13.	Training Course on Groundwater Assessment Modelling and Management	November 16-20, 2009	NIH RC Belgaum	1 week	Dr M K Jose	30	30
14.	Two days All India Workshop on Flood Risk Management' organsied by NIH, Roorkee and Institution of Engineers(I), Roorkee Local center	November 26-27, 2009	Roorkee	2 days	Dr A K Lohani	16	6

SN	Training Courses and Workshops organised	Period	Venue	Duration (weeks)	Course Coordinator	No. of Trainees/Participants	Man weeks
15.	Training Course on Data Processing and Validation using SWDES & HYMOS Software	November 30-December 4, 2009	Nasik	1 week	Dr A.K. Lohani, (Under HP-II)	18	18
16.	Training workshop on Coastal Hydrology (Organized in collaboration with Andhra University, Vishakapatnam)	December 22-26, 2009	DRC, Kakinada	1 week	Dr Y R S Rao	25	25
17.	Workshop on DSS(P) Model Conceptualization	January 7, 2010	New Delhi	1	DSS(P) Consultants	72	14
18.	Flood Management	January 18-22, 2010	WALMI, Anand	1 week	Dr. Rakesh Kumar	31	31
19.	Training course on Hydrological Analysis in Ungauged Catchments: Special Reference to Flood Estimations. (Und er HP -II Project)	January 18 – 22, 2010	NIH Roorkee	1 week	Dr P K Bhunya	17	17
20.	Rainfall Runoff and River Basin Modelling	January 25 – February 5, 2010	NWA, Pune	12 days	DSS(P) Consultants	24	57
21.	Training Workshop on SWDES and/or HYMOS	February 3-6, 2010	WALMI, Anand	4 days	Dr A.K. Lohani, (Under HP-II)	24	19
22.	Rainfall Runoff and River Basin Modelling	February 08 - 19, 2010	NIH, Roorkee	12 days	DSS(P) Consultants	24	57
23.	Training Workshop on SWDES and/or HYMOS	February 09-12, 2010	Shimla	4 days	Dr A.K. Lohani, (Under HP-II)	38	30
24.	Training course on Remote sensing and GIS Applications in Water Resources Management (under HPII)	March 8-12, 2010	NIH Roorkee	1 week	Dr Sanjay Kumar Jain	16	16
25.	Training Workshop on Flood Management in North-East Region	March 23-24, 2010	Guwahati	2 days	Shri B C Patwari/Dr C K Jain	17	7

SN	Training Courses and Workshops organised	Period	Venue	Duration (weeks)	Course Coordinator	No. of Trainees/Participants	Man weeks
26.	Two days workshop on Applications of Downscaling Techniques for Climate Change Studies in Water Resources	March 25-26, 2010	NIH Roorkee	2 days	Dr Sanjay Kumar Jain	16	6
27.	Two days National **Symposium** on Climate Change and Water Resources in India (CCWRIN)	November 18-19, 2009	NIH Roorkee	2 days	Dr Sanjay Kumar Jain/Dr A K Lohani	150	

Address by Chief Guest Mr. P Rama Raju, Chief Engineer in Inaugural function on Training Workshop on "Project Hydrology" conducted at Deltaic Regional Centre, Kakinada on September 21-24, 2009

HP-II Training Programme on "Groundwater Assessment Modeling and Management" on November 16-20, 2009 at Belgaum

Mass Awareness Programmes

Topic	Period	Venue
Stage Drama UPANAYAN on the theme Flood Management	December 12, 2009	Mirza (District Kamrup)
Mass Awareness Programme on Water Conservation	December 21, 2009	Changsari (District Kamrup)
Mass Awareness Programme on Climate Change and Global Warming	December 29, 2009	Nasatra (District Barpeta)
Participation in Assam International Trade Fair through distribution of pamphlets	February 8, 2010	Guwahati (District Kamrup)
Mass Awareness on Water Resources and Environment (Organized in collaboration with Science Vision (NGO), Kakinada)	February 25-26, 2010	DRC, Kakinada

Topic	Period	Venue
Mass Awareness Training Program on "Rainwater Harvesting"	March 3, 2010	Khurai, Sagar District
Conducted an awareness programme on "Water Conservation".	March 5, 2010	Bharatesh High School, Basavan Kudachi, Belgaum
Mass Awareness Training Program on "Water Conservation and Rainwater Harvesting"	March 17, 2010	Khajuraho, Chhattarpur district
Celebration of World Water Day on the theme Clean Water for a Healthy World	March 22, 2010	Guwahati (District Kamrup)
World Water Day (Organized in collaboration with Sristi foundation (NGO), Kakinada)	March 22, 2010	Krishi Bhawan, Kakinada
Mass Awareness on Groundwater and Rainwater (Organized in collaboration with Srishti foundation (NGO), Kakinada)	March 22, 2010	Krishi Bhawan, Kakinada
Celebrated "World Water Day 2010" on "Clean Water for Good Health and Preventing Water -borne Diseases" and "Water Resources Management with Special Emphasis on Water Quality".	March 22, 2010.	at KLE S College of Engineering, Belgaum

Mass Awareness Programme on Water Conservation on March 5, 2010, Belgaum

NIH Regional Centre, Sagar organized Mass Awareness Program on Water Conservation and Rain Water Harvesting at Khajuraho (Chhatarpur district) on March 17, 2010

CHAPTER – 6

INFRASTRUCTURE

Besides excellent information and communication facilities and sensitive support base, the Institute has well-equipped laboratories with state-of-art monitoring and analytical instruments powered by a top-of-the-line team of scientists and supporting scientific and technical staff. Sophisticated and well equipped laboratories are one of the major necessities for research and development. Water quality, remote sensing and GIS, nuclear techniques, hydrological investigations and instrumentation, soil characterization etc. are some of the investigations which are used in various research studies. They provide a superbly-equipped, dynamic and broad-based research environment. Keeping this in view, the following six laboratories have been established at the Institute.

1. Nuclear Hydrology Laboratory

The Nuclear Hydrology laboratory is well equipped with the instruments such as Normal Level Liquid Scintillation Spectrometer, Ultra Low Level Liquid Scintillation Spectrometer (Quantulus), Multichannel Gamma Ray Spectrometer, Geolog Rate Meter, Neutron Moisture and Density Probe, Ultrasonic Depth Indicator, Tritium Enrichment Units, facilities for tritium and carbon dating of ground water, CO_2 sample preparation lines, CO_2 absorption line, Soil Moisture Extraction Units and Liquid Nitrogen Plant etc. In addition, the laboratory has Continuous Flow Stable Isotope Ratio Mass Spectrometer (CFIRMS) with Elemental Analyser (EA) for measuring D, ^{13}C, ^{15}N, ^{18}O, ^{34}S & ^{37}Cl in water and solids and Dual Inlet Isotope Ratio Mass Spectrometer for measuring D and ^{18}O in waters. These instruments are being used for field investigations and laboratory analysis for the study of soil moisture movement and estimation of recharge to groundwater, surface water and groundwater interaction, lakes studies, groundwater dating and identification of recharge sources and zones of deeper aquifers and springs.

The facilities of the laboratory were extended to Regional Centres and other Divisions of the Institute for completing their studies. The facilities of the laboratory were also extended for the analysis of water and sediment samples received from various other departments/agencies like BARC, Mumbai; Indian Institute of Technology, Mumbai; Indian Institute of Technology, Roorkee; PRL, Ahmedabad; NGRI, Hyderabad; Nuclear Research Laboratory, IARI, Delhi; Anna University, Chennai and CWRDM, Kozhikode etc.

Water Samples Analyzed : More than 8750 water samples (precipitation, rivers, springs, air moisture and groundwater) were collected/received under various hydrological studies being carried out by the Division, other Divisions, Regional Centres and were got analysed for deuterium (D), and Oxygen-18 (D) and C-13 on DIIRMS and CFIRMS at the Nuclear Hydrology Laboratory.

More than 300 samples were collected, out of which 221 got distilled and then enriched for environmental ^{3}H dating. A total of 308 water samples could be analyzed for environmental tritium. Radio carbon dating was carried out for 15 groundwater samples. A total of 88 sediment samples were analyzed using MCA.

2. Remote Sensing and GIS Laboratory

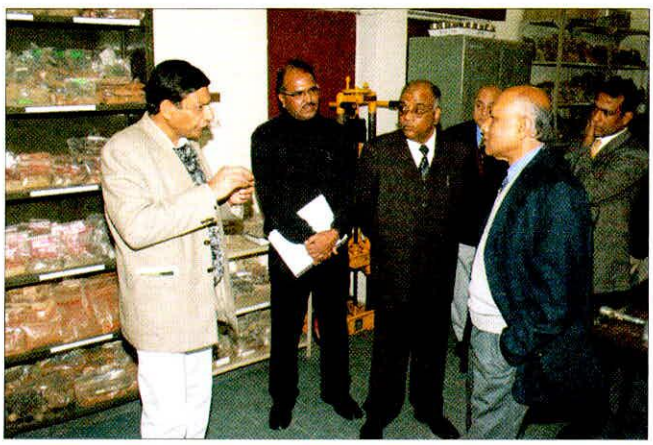
The applications of remote sensing and Geographic Information System (GIS) play a rapidly increasing role in the field of hydrology and water resources development. Space is the ideal vantage point from which to make primary observations through which plethora of useful information can be derived for input for the various hydrological studies. There is now a wealth of information available from a wide variety of satellites, each using different parts of the electromagnetic spectrum as their means of making their measurements.

The space borne mutli-spectral data enable generating timely, reliable and cost effective information on various natural resources, namely surface water, ground water, landuse/cover, soil, forest cover and various environmental hazards, viz waterlogging, salinity and alkalinity, soil erosion by water etc. For many hydrological applications, remote sensing data alone are not sufficient and need to be merged with data from other sources. GIS technology provides suitable alternative for efficient management and analysis of large and complex databases. Multitude of spatially related data concerning topography, geomorphology climatology etc. along with satellite derived information can be appropriately integrated in GIS environment.

For carrying out studies and research on various aspects of hydrology and water resources using remote sensing and GIS techniques, Institute is having Remote Sensing and GIS Laboratory. Softwares and peripherals available in the laboratory include-Software: ArcGIS, ERDAS IMAGINE, ILWIS, ENVI, R2V:Raster to Vector conversion software; Peripherals: A0 WIDECOME Image Scanner, A0 CALCOM Digitizer, Laser Colour Printer etc.

3. Soil and Ground Water Laboratory

The Soil and Ground Water Laboratory has capabilities for laboratory and field measurement of various soil hydrological, physical and vegetation optical properties. The major capabilities include determination of soil particle size distribution for textural analysis, permeability, porosity, infiltration, soil density, soil moisture at different suction for determination of the soil moisture characteristic curves, saturated hydraulic conductivity, sorptivity and matrix flux potential of soils, in-situ soil moisture, soil salinity, measurement of trace elements, leaf area index, foliage and other canopy measurements in command area etc. using various advanced instruments. Major instruments available in the laboratory include Pressure Plate Apparatus, Soil Particle Size Analyzer, Guelph In-situ Permeameter, TDR Soil Moisture Probe, ICW Lab Permeameter, Multi Volume Pycnometer, Infrared Soil Moisture Balance, Digital pH & Conductivity meter, Constant Head Permeameter, Falling Head Permeameter, Electromagnatic Sieve Shaker, Hydrometer Kit, Tensiometers, Double Ring Infiltrometers, Plant Canopy Analyser and UV Visible Spectrophotometer. In addition to routine work of the laboratory analysis, the laboratory is providing services in the field for collecting samples, conducting in-situ measurement of various parameters and for field surveys relating to the studies taken up by various divisions including the sponsored/ consultancy projects.



Visit of Mr. U. N. Panjiar, Secretary, Ministry of Water Resources, Govt. of India, New Delhi to Soil and Ground Water Laboratory

4. Water Quality Laboratory

The Water Quality Laboratory is well-equipped with state-of-art equipment to identify and quantify physical, chemical and bacteriological parameters in various water bodies like rivers, lakes, reservoirs, wells, aquifers, canals etc. The laboratory has facilities and capabilities to determine about 100 water quality constituents including major and minor ions, trace elements, pesticides, Polynuclear Aromatic Hydrocarbons, organic compounds and bacteriological parameters. During the year 2009-10, samples collected by the division for different studies were analyzed. In addition, water samples of outside agencies (including public and private) were also analyzed.

The major equipment available in the laboratory are: (i) Ion Chromatograph, (ii) Atomic Absorption Spectrometer, (iii) Total Organic Carbon Analyzer, (iv) Gas Chromatograph, (v) Flow Injection Analyzer, (vi) UV-VIS Spectrophotometer, (vii) Ion Analyzer, (viii) Mercury Analyzer, (ix) Flame Photometer, (x) Portable Environmental Laboratory, (xi) Digesdahl Digestion Apparatus, (xii) COD Reactor, and (xiii) Water Purification System, (xiv) Research microscope, etc.

5. Snow & Glacier Laboratory and Hydro-meteorological Observatory

The Meteorological observatory at NIH campus has been operational since 1985. The instruments operational are: (i) ordinary rain gauge, (ii) autographic rain gauge (siphon) (iii) max and min thermometer, (iv) dry and wet bulb thermometer, (v) thermograph, (vi) hydrograph, (vii) anemometer, (viii) pan evaporimeter. The readings of various meteorological parameters are taken from the instruments on daily basis at 08:30 am. The data collected at NIH campus have been supplied to various research organizations, state government departments and research scholars on their requests. A weather display unit has been installed at the main building for display of current and recorded weather parameters for the general public.

National Institute of hydrology has been carrying out hydrological studies since 1999 on Gangotri Glacier, which is one of the biggest glaciers of Himalayas. The field investigation for the year 2009 started in the first week of May 2009. The monitoring of Gangotri Glacier was carried out with the help of conventional meteorological instruments and AWS (Automatic Weather Station). In order to make accurate streamflow observations, the cross section of the river channel was determined at the gauging site and observations were made continuously. A graduated staff gauge was installed in the stilling well at the right bank of the river for observations of water level fluctuations. Manual observations were made for water level during the day and night time. For the continuous observation an automatic water level recorder was also installed. For measurement of discharge, velocity-area method was used to estimate flow in the river. Wooden floats were used to compute the velocity of flow and time travelled by the floats was determined with the help of stopwatch. For accuracy in velocity, the readings were repeated at least three times and an average value was adopted for further computations. For suspended sediment studies water samples were scooped directly from the channel at the sampling site in a pre cleaned polyethylene bottle (500 ml) twice a day (0830 and 1730 hours). The samples were collected from the stream at about mid-depth, filtered at the site using Whatman-40 ash less filter paper and packed properly. The sets of samples were transported to the laboratory of the Institute for further analysis.

6. Hydrological Instrumentation Laboratory

Hydrological Instrumentation Laboratory caters to the instrumentation needs of the Institute. It provides infrastructure for routine servicing of hydrological instruments. The laboratory has necessary state-of-art instruments for hydro-meteorological monitoring under specific projects. Also, Resistivity Meter (Terrameter) and EM Conductivity instruments are available for conducting geophysical surveys as required in hydrogeological studies. The capabilities and facilities of the laboratory are briefly outlined below.

Capabilities: Indigenous development of hydrologic instruments; Hydro-meteorological monitoring; Geophysical investigations; and Capacity building programs.

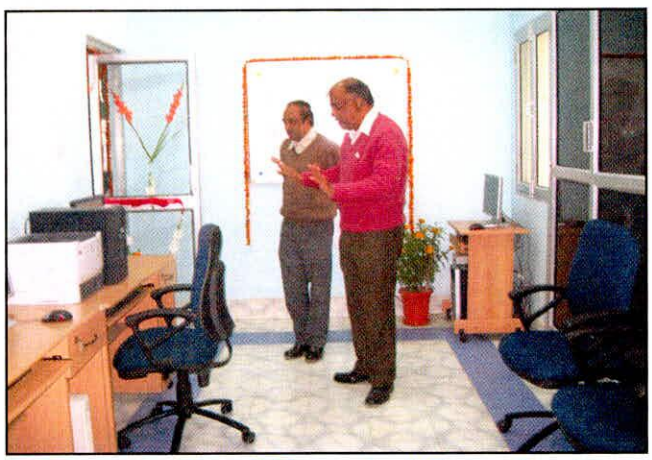
Equipment/Facilities: Terrameter (SAS 4000 ABEM); EM 34-3 & 34-3XL Conductivity Meter (Geonics); Automated Weather Station; Weighing Snow Gauge; Weighing Rain Gauge; Automatic Water Level Recorder; Tipping Bucket Rain Gauges with Event Logger; Water Current Meter with Digital Readout; and Soil Moisture Sensors with Digital Readout.

The laboratory has successfully conducted field investigations under several projects, e.g. watershed hydrology studies in Uttarakhand, and

geophysical surveys for location of suitable tubewell sites around Roorkee. Weighing Rain Gauge, developed at the laboratory, was used for automated collection of rainfall data from a forested watershed near Haldwani (Uttarakhand).

Numerical Groundwater Modelling Unit

To encourage an efficient working environment and to sort out the computational complexities faced while undertaking groundwater studies, the need for creating a "Numerical Groundwater Modelling Unit" has been realized. A comprehensive computational facility was required to be developed at one location to meet out the increasing complexities of groundwater problems instead of scattered and individual-based single computational software facilities. Therefore, a Numerical Groundwater Modelling Unit (NGMU) has been established in the Ground Water Hydrology Division in January, 2010. The NGMU is aimed at to provide excellent computational facilities to deal with issues related to groundwater. The unit possesses state-of-art computational technology required for groundwater assessment, modeling and management. The state-of-art technology, in addition to latest computational and printing facilities is comprised of worldwide acceptable numerical groundwater modeling software such as MODFLOW, FEFLOW, MikeSHE etc, and other essential softwares related to Geographical Information System, geological analysis, water quality analysis etc.



Inauguration of Numerical Groundwater Modelling Unit

Library

Realizing the crucial role of up-to-date information services for conducting high level R&D activities, the Institute since its inception has been in the continuous process of building and updating 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. In the year 2009-10, 522 new books and 163 technical reports have been added to the collection of the library. The total collection of the library has reached upto 20,936 publications, comprising 11389 books, 2925 bound periodicals, 5239 technical reports, 306 Indian and foreign standards, 1036 technical papers/ reprints and 41 microfiches. The library is currently subscribing 29 Indian and 24 foreign periodicals. Out of them, online versions of 7 international periodicals are also available in addition to their print versions. Seven periodicals are in Hindi. In addition to the Institute employees, library's resources are being utilised widely by users from other organizations.

Communication and Telephones

The telephone facilities in the Institute have been provided mainly with a digital EPABX-256 Port (Make: Coral Telecom), as per agreement signed between NIH and BSNL on 31-03-2009 initially for a period of five years. The telephone services at the residences of the Scientists residing in the New Teacher Hostel (within IIT Campus) have also been connected with this digital exchange. The telephone facilities provided to officials through the existing digital EPABX-256 include any or all, of the following facilities depending upon the functional requirements of the individual officer/staff: i) Intercom facility, ii) Incoming call facility, iii) Outgoing local call facility, iv) Outgoing local mobile facility, v) Outgoing STD call facility.

In this EPABX, free intercom facility has been provided to all extensions for dialing within the complex by a short 3 digit number (XYZ). All extensions have been connected through existing

EPABX offering Direct Inward Dialing/Direct Outward Dialing (DID/DOD) facility through 249-XYZ for incoming call facility, outgoing local call facility, outgoing local mobile facility and outgoing STD call facility. 244 telephone connections/ extensions are operating satisfactorily through existing EPABX. Also, 100 caller ID phones (Make: Beetle) have been replaced in lieu of old telephone sets during the year. Two line cordless speaker phones (Make: Panasonic) have been provided to the Divisional Heads. Two Desktop PC's (P-IV) and one Laser jet printer have been purchased in the Communication and Telephone Cell for existing EPABX and performing related works. In addition, at present 26 BSNL land line telephone connections are working in different divisions, offices and NIH colony. 11 sets of Plan (1+1) are functioning in the institute with Divisional Heads/SAO/INCOH, etc. Four BSNL landline connections are being used as FAX lines in the office of Director, Sr. Administrative Officer, INCOH Secretariat and HP-II Project, respectively. A small EPABX (1+ 4) is also working in the Director's office.

Computer Centre

The Computer Centre is responsible for providing computing, networking, internet and email facilities to Scientists and Staff at the Institute. Computing has become an essential tool for almost all scientific research. At NIH, computers are extensively used both in scientific computation as well as in preparation and publication of scientific reports and papers. Computers of latest configuration are available in the Institute for conducting complex hydrological analyses and modeling studies. Internet and email facilities are routinely utilized for accessing scientific literature as well as for correspondence. The Institute also uses computers for processing of administrative and accounting data. The centre procures and provides maintenance to computers and related peripherals available with the Scientists and Staff.

The local area network (LAN) provides interconnectivity between the computers in different building blocks of the campus. The network comprises of switches in various blocks and UTP connections to individual machines. The LAN is connected to Internet by a 50 Mbps leased line link from BSNL. VSAT connectivity from ERNET India also exists for email communication. A centralized server receives and stores/forwards emails to respective users. A dedicated web server (www.nih.ernet.in) provides a platform for hosting institute information, research publications, important announcements, tender notices etc. and some useful hydrology related information. To maintain the integrity and security of Institute's network, a firewall restricts access from outside to machines within the LAN. All the facilities existing at the Computer Centre are upgraded from time to time to meet the evolving standards of Information Technology.

Workshop

The Institute Workshop plays a significant role in developing and fabricating instruments, as well as for repair and maintenance of different types of equipment. At present, the workshop has a lathe machine, power saw machine, drilling machine, cutting-cum-punching machine, welding machine and various related smaller machines. Some of the important works carried out by the Workshop during the year 2009-10 are as follows:

i) Development of Depth water sampler (mechanical and electronic).

ii) Fabrication and installation of two low cost Storm Water Samplers for Arnigarh and Bansigarh watersheds.

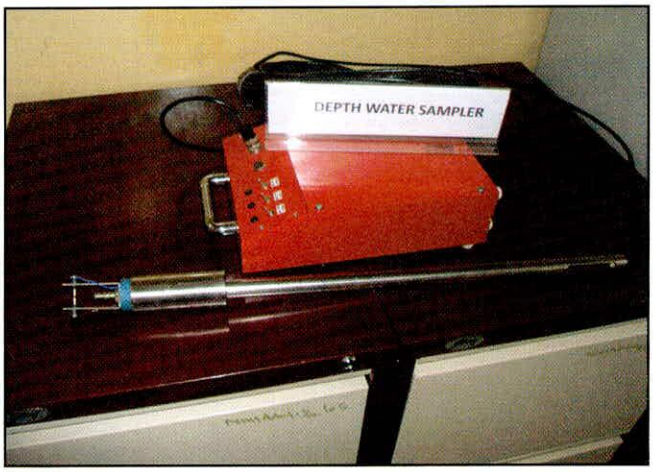
iii) Fabrication of Metal stands for the Air Moisture Collection Units of HI Division.

iv) Fabrication of wheel type steel frame for Tritium Cell Units of Nuclear Hydrology Laboratory.

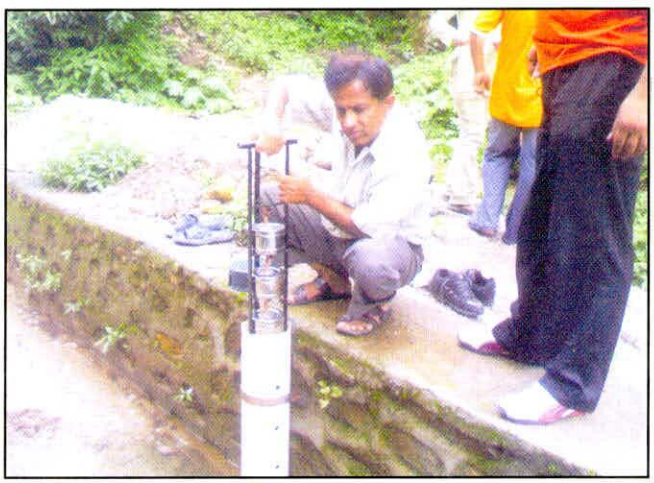
v) Design and fabrication of New Trolley (small) for old Quantlus Machine of Nuclear Hydrology Laboratory.

vi) Design and fabrication of Special trolly for New Quantlus Machine of Nuclear Hydrology Laboratory.

Depth Water Sampler (mechanical)



Depth Water Sampler (electronic)



Low cost storm water sampler and its installation at Arnigarh and Bansigarh watersheds

vii) Fabrication of Three New Steel Heavy Duty Trolleys for Maintenance Division and A. C. Section.

viii) Fabrication of two racks for sample holders for Nuclear Hydrology Laboratory.

Besides these major works, a number of other important works were also carried out, such as repair of rain gauges and hygrometer for Mountain Hydrology Division, fabrication of New Line of CO_2 for Nuclear Hydrology Laboratory, repair of NIH Sign Boards, fabrication of fuel tank locking arrangement for Sub-Station at NIH headquarters, assistance in repair of generator set and tube well of NIH, repair and welding of panel boards of Sub-Station at NIH staff colony, etc.

Construction Activities

During the year 2009-10, several renovation works of the Institute have been entrusted to CPWD, Dehradun. The completed works are as follows:

1. Renovation of existing VIP Guest House and extension of Dining Hall
2. Renovation of rear site entrance lobby of main administrative building
3. Renovation of Director's Office

CHAPTER – 7

HINDI - OFFICIAL LANGUAGE

In pursuance of Official Language policy of the Government and with a view to speed up propagation and development of Official Language Hindi and to accelerate its progressive use in official business, National Institute of Hydrology remained active in organizing various activities in Hindi during the year 2009-2010. Besides the day-to-day routine administrative, technical and scientific work, the following Hindi activities were organized in the Institute with utmost motivation and encouragement.

Official Language Implementation Committee Meeting

During the year 2009-2010, the 48th and 49th Meetings of Rajbhasha Karyanvayan Samiti (OLIC) were held on 27th August, 2009 and 31st March, 2010 respectively in which besides reviewing ongoing progress of Hindi, several decisions to enhance the use of Official Language Hindi in Office business were taken.

Hindi Week Celebrations

In order to propagate the use of Hindi and to encourage the employees to make use of Hindi in their official work, the Institute organised Hindi Week during 14-18 September, 2009. During the week, various Hindi activities were held in the Institute such as Essay, Noting/Drafting, Typing, Shorthand, Quiz, Debate and Poem recitation competitions. Those performed well in the competitions were awarded in the valedictory function held on 18th September, 2009.

Hindi Workshop

In order to acquaint the employees of NIH with Official Language policy of the Government and to remove their hesitation towards the use of Hindi in their day-to-day official work, a Hindi workshop on the topic "Rajbhasha Neeti and Hindi Software-Unicode" was organized at NIH on 12th March, 2010. TOLIC Hardwar provided faculty for the above workshop. Forty-five employees attended the workshop and received training.

Annual Hindi Magazine "Pravahini"

Institute's Annual Hindi magazine "Pravahini" comprising of Hindi articles of Employees of NIH and their family members was brought out. The magazine was released by the Chief Guest of Hindi Week-2009 on 18 September, 2009.

Organization of Workshop for Rural Women

With a view to disseminate the knowledge of water quality, conservation and its related issues and to make the rural women aware of various aspects of water, a workshop on the topic "Jal evam Jal Sanrakshan" was organized for the rural women of Safipur , Roorkee on 6th November, 2009. As many as 56 women and 38 school children participated in the workshop. Entire proceedings of the workshop were held in Hindi only.

Annual Report 2008-2009

Annual Report of NIH for the year 2008-2009 was simultaneously brought out in Hindi during the month of December 2009 – January 2010.

Town Official Language Implementation Committee, Haridwar

The Institute has regularly been taking part in the various activities being organized by TOLIC, Haridwar. The Institute participated in the following activities of TOLIC during the year 2009-2010.

- Five employees of the Institute participated in the 8th half yearly meeting of TOLIC, Haridwar held on 29th July, 2009 at IIT, Roorkee.
- Two employees of the Institute participated in the 9th half yearly meeting of TOLIC, Haridwar held on 22 January, 2010 at BHEL,

Hardwar.

- Three employees of NIH attended the Rajbhasha Co-ordination meet held on 18th February, 2010 at BHEL, Haridwar.

Participation of NIH employees in Hindi Computer Training Workshop

Twenty employees of NIH attended the Hindi workshop organized by IIT, Roorkee on the topic "Computer and Hindi" during 23-24 April, 2009.

Participation in Rajbhasha Sammelan evam Puraskar Vitrana Samaroh

Three employees of the Institute attended the Rajbhasha Sammelan evam Puraskar Vitran Samaroh (Rashtriya Rajdhani Kshetra Delhi evam Uttar Kshetra) held on 08 January, 2010 at ONGC, Dehradun.

CHAPTER – 8
STAFF NEWS

At the end of the year 2009-10, the Institute had a team of 69 scientists (including Director, NIH), 86 supporting scientific and technical staff, and 78 other supporting personnel. The position of staff as on 1.4.2009 and 31.3.2010 is given in Appendix-X.

List of N.I.H. Scientists as on March 31, 2010

Name of Division/ Regional Centre	Sr. No.	Name	Designation	Email address	Area of Specialisation
	1.	Shri R. D. Singh	**Director**	rdsingh@nih.ernet.in	Surface Water Hydrology including Flood Hydrology Hydrologic Design and Hydrologic Modelling
Environmental Hydrology Division	2.	Dr. V.K. Choubey*	Scientist 'F'	vkc@nih.ernet.in	Remote Sensing of Lakes & Reservoirs, Sedimentation, Water Quality
	3.	Shri Omkar Singh*	Scientist 'E1'	omkar@nih.ernet.in	Lake Hydrology, Soil & Water Quality Investigations & Assessment
	4.	Shri D.G. Durbude*	Scientist 'C'	dgdurbude@yahoo.com	Rainfall-Runoff Modelling (Long Term Simulation of Daily Stream Flow)
	5.	Dr. M.K. Sharma*	Scientist 'C'	mks@nih.ernet.in	Surface and Ground water quality, Pollutant transport
Ground Water Hydrology Division	6.	Dr. N.C. Ghosh*	Scientist 'F'	ncg@nih.ernet.in	Contaminant hydrology, Groundwater hydrology and hydraulics and Groundwater Modeling (Flow & Contaminant transport)
	7.	Shri C.P. Kumar*	Scientist 'F'	cpk@nih.ernet.in	Assessment of Groundwater Potential, Saline Water Intrusion in Coastal Aquifers and Modelling of Groundwater Flow and Contaminant Transport.
	8.	Dr.(Km) Anupma Sharma*	Scientist 'C'	anupma@nih.ernet.in	Numerical Groundwater flow and solute transport modeling
	9.	Dr. Surjeet Singh*	Scientist 'C'	surjeet@nih.ernet.in	Ground Water Modeling, Water Quality and Lake Studies
	10.	Shri A K Dwivedi*	Scientist 'C'	akd@nih.ernet.in	Analysis of Hydrometero-logical data, DSS for planning water resources & real time DSS and Ground water pollution studies
	11.	Shri Rajan Vatsa+	Scientist B	rvatsa@nih.ernet.in	Groundwater hydrology

Hydrological Investigation Division	12.	Dr. Bhishm Kumar*	Scientist 'F'	bk@nih.ernet.in	Isotope Hydrological Investigations Regarding Ground Water and Surface Water
	13.	Dr. Sudhir Kumar*	Scientist 'E2'	skumar@nih.ernet.in	Ground Water Hydrology/Modelling Isotope Hydrology Hydrological Investigations
	14.	Dr. S.P. Rai*	Scientist 'E1'	spr@nih.ernet.in	Watershed Hydrology Isotope Hydrology investigations regarding surface water and ground water
	15.	Shri S.D. Khobragade*	Scientist 'E1'	suhas@nih.ernet.in	Lake Hydrology, Evaporation/ ET, Sedimentation using isotope techniques
	16.	Dr. M.S. Rao*	Scientist 'C'	somesh@nih.ernet.in	Sediment dating (Luminescence dating), groundwater dating (tritium & 14c) isotope hydrology
	17.	Shri S.K. Verma*	Scientist 'C'	skverma@nih.ernet.in	Hydrological Investigation regarding ground & surface water using Isotopes
	18.	Shri P.K. Garg+	Scientist 'B'	pkgarg@nih.ernet.in	Water Resources Systems
Surface Water Hydrology Division	19.	Dr Avinash Agarwal*	Scientist 'E2'	avinash@nih.ernet.in	Watershed Hydrology Runoff Sediment Yield Modelling A.N.N. Modelling
	20.	Dr. Jaiveer Tyagi*	Scientist 'E2'	tyagi@nih.ernet.in	Watershed Hydrology Rainfall-Runoff Sediment Yield Modelling Catchment Area Treatment Planning & evaluation
	21.	Dr. R.P. Pandey*	Scientist 'E1'	rpp@nih.ernet.in	Drought and Climate, Water availability assessment, Drought vulnerability Assessment, Soil & Water Conservation Design of drainage system.
	22.	Dr. A.K. Lohani*	Scientist 'E1'	lohani@nih.ernet.in	Surface Water Hydrology including rainfall-runoff modelling, flood forecasting design flood estimation and application of soft computing techniques of ANN and Fuzzy Logic
	23.	Shri A.R. Senthil Kumar*	Scientist 'E1'	arsk@nih.ernet.in	Surface Water Hydrology including rainfall-runoff modelling, reservoir operation studies, real time flood forecasting using ANN Sedimentation modelling in reservoirs, application of GIS in rainfall-runoff modelling
	24.	Dr Sanjay Kumar*	Scientist 'C'	sk@nih.ernet.in	Remote Sensing & GIS applications in Reservoir sedimentation, Snow mapping & modelling water-logging, Morphology Soil Erosion

	25.	Smt. Archana Sarkar*	Scientist 'C'	archana@nih.ernet.in	Surface water hydrology (Hydrological Modelling)
	26.	Dr. Manohar Arora*	Scientist 'C'	arora@nih.ernet.in	Surface water hydrology
	27.	Shri Digamber Singh+	Scientist 'B'	dsingh@nih.ernet.in	Agriculture Hydrology and Lakes
Water Resources System Division	28.	Dr. V.C.Goyal*	Scientist 'F'	vcg@nih.ernet.in	Hydrologic instrumentation, watershed hydrology, water technologies, project management, societal issues
	29.	Dr. S.K. Singh*	Scientist 'F'	sksingh@nih.ernet.in	Analytical and Numerical Modelling of Ground Water Water Quality Modelling Unit Hydrograph and Linear Systems Parameter Estimation & Optimization
	30.	Dr. Sanjay K. Jain*	Scientist 'E2'	sjain@nih.ernet.in	Remote Sensing & GIS applications in Reservoir sedimentation, Snow mapping & modelling waterlogging, Morphology Soil Erosion
	31.	Dr. M.K. Goel*	Scientist 'E2'	mkg@nih.ernet.in	Water resources systems, Reservoir operations, Irrigation Water Management River basin planning & Mngt.
	32.	Shri D.S. Rathore*	Scientist 'E2'	dsr@nih.ernet.in	Remote sensing, GIS, hydrological modeling, decision support system
	33.	Smt. Deepa Chalisgaonkar*	Scientist 'E1'	deepa@nih.ernet.in	Hydro Informatics I.T.
	34.	Dr. Vijay Kumar*	Scientist 'E1'	vijay@nih.ernet.in	Water Resources Systems
	35.	Dr. P.K. Bhu nya*	Scientist 'E1'	pkb@nih.ernet.in	Predictions in ungauged watersheds
	36.	Dr. (Smt.) Rama Devi Mehta*	Scientist 'C'	rama@nih.ernet.in	Reservoir operation, Soft computing techniques
Research Coordination & Management Unit	37.	Dr. Rakesh Kumar*	Scientist 'F'	rakesh@nih.ernet.in	Surface Water Hydrology, Design Flood Estimation, Rainfall-Runoff Modelling Flood Management
Hard Rock Regional Centre, Belgaum	38.	Shri B.Venkatesh	Scientist 'E1'	bvenki30@yahoo.com	Forest Hydrology, Rainfall-runoff Modeling, Flood Frequency analysis
	39.	Dr. Chandra Mohan T.*	Scientist 'E1'	cmohant@yahoo.com	Rainfall-runoff Modeling, Erosion and Sediment Transport Modeling
	40.	Dr. B.K. Purandra*	Scientist 'E1'	purandarabk@yahoo.com	Ground Water Quality & Environmental Geochemistry, Forest Hydrology, Hydro-geology

	41.	Dr M K Jose*	Scientist 'C'	mathewkjose @yahoo.com	Groundwater Hydrology and Modeling, Surface Water Data Processing
Centre for Flood Management Studies, Guwahati	42.	Shri B.C. Patwari*	Scientist 'F'	nercnih@yahoo.com	Water resources development and management, Forest hydrology
	43.	Dr. C.K. Jain*	Scientist 'F'	ckj_1959@yahoo.co.in	Water quality & environment, Point and non-point source pollution, Adsorption kinetics & water-sediment systems, Ground water quality and aquifer contamination, low cost treatment & remediation technology
	44.	Shri S.R. Kumar*	Scientist 'E1'	-	Hydrological data processing, Ground water quality, Crop water requirement
Western Himalayan Regional Centre, Jammu	45.	Dr Renoj J Thayyen	Scientist 'C'	whrcnih@ yahoo.com	Glaciology and Mountain Hydrology
Deltaic Regional Centre, Kakinada	46.	Dr. Y.R.S. Rao*	Scientist 'E2'	Yrs_rao@ yahoo.com	Groundwater quality modeling, Rainfall-Runoff modeling, GIS, Remote sensing & ANN applications
	47.	Shri S.V.Vijaykumar*	Scientist 'E1'	vijayakumar@nih.ernet.in	Hydrology of deltas; Urban Hydrology; Water Conservation and Artificial Recharge
	48.	Shri V.S. Jayakanthan*	Scientist 'E1'	Vsj68@yahoo.com	Remote sensing and GIS for hydrological applications, Advanced Image processing
	49.	Dr. P.C. Nayak*	Scientist 'C'	nayakpc@ yahoo.co.in	Rainfall-runoff modeling, application of hybrid intelligent system to hydrologic modeling, stochastic hydrology
	50.	Shri B. Krishna*	Scientist 'C'	Krishna_b123 @rediffmail.com	Surface water modeling, Hydrological Time series modeling, Applications of soft computing tools
Centre for Flood Management Studies for Ganga Basin, Patna	51.	Shri B. Chakraborty*	Scientist 'E2'	biswajitnih@ gmail.com	Waterlogging and drainage congestion, Groundwater modeling
	52.	Shri Pankaj Mani	Scientist 'C'	mailofpmani @yahoo.com	Remote Sensing & GIS, Dambreak analysis.
	53.	Shri N.Gopal Pandey*	Scientist 'C'	ngpandey@ gmail.com	Soil water relationship, Remote Sensing & GIS
	54.	Shri R Venkataraman	Scientist 'B'	Venkataraman a_1973@yahoo.co.in	Urban hydrology, Remote Sensing & GIS.

South Ganga Plains Regional Centre, Sagar	55.	Shri R.V. Galkate	Scientist 'C'	rgalkate@yahoo.co.in	Drought assessment and management, River basin management and Soil and water conservation
	56.	Shri T. Thomas*	Scientist 'C'	thomas_sagar@rediffmail.com	Hydrological modeling, Climate Change and Watershed management
	57.	Shri R K Jaiswal+	Scientist 'B'	rkjaiswal_sagar@yahoo.co.in	Reservoir sedimentation, Rainfall runoff modeling, Watershed management

Note *= Assessment Promotee; += Promotee from Group B to Group A

Scientists on Deputation/Lien

58	Dr S K Jain, Sc. F	Professor, IIT, Roorkee
59	Dr. Ramakar Jha, Sc. E1	Professor, NIT, Durgapur
60	Shri Tej Ram Nayak, Sc. E1	Director (Hydrology), Narmada Control Authority, Indore
61	Dr A Bandhopadhyaya, Sc. 'B	Assistant Professor, IIT, Kharagpur

Scientists on Study Leave/EOL and submitted their resignations

62	Dr. R. R. Mehrotra	Scientist 'E1'
63	Shri P.K. Majumdar	Scientist 'E1'
64	Dr. Anil Kumar	Scientist 'C'
65	Dr. Aditya Tyagi	Scientist 'C'
66	Dr. M.K. Shukla	Scientist 'C'
67	Shri A.V. Shetty	Scientist 'C'
68	Dr. S.K. Goyal	Scientist 'B'
69	Dr. Rm. Nachiappan	Scientist 'B'

Resignation

1. Dr V K Dwivedi, Scientist E1
2. Dr N Panigrahi, Scientist C

Awards

- Sri Pankaj Mani Scientist 'C' and Sri Biswajit Chakraborty, Scientist 'E2' received 'The Sir Arthur Cotton Memorial Award' of the Institution of Engineers (India) for their paper entitled 'Dam break flood simulation for Maithon and Panchet dams using NWS DAMBRK model and inundation mapping' on December 11, 2009.

Cash Awards for Group B, C and D Staff

Cash awards for those who rendered meritorious services among the Group B, C and D staff in the Institute were given on 15th August, 2009 for the year 2008-09. The list of awardees is given below:

Group	Name and Designation	Category	Award (Rs.)
Group B	Shri Sanjay Mittal, Sr. Research Assistant	Technical	1,000.00
-do-	Shri Sandeep Kumar, Personal Assistant	Non-Technical	1,000.00
Group C	Shri Hussain Khan, Technician Grade-I	Technical	500.00
-do-	Shri N K Lakhera, Technician Grade-II	Technical	500.00
-do-	Smt Alka Rani, Upper Division Clerk	Non-Technical	500.00
-do-	Shri Daulat Ram, Stenographer	Non-Technical	500.00
Group D	Shri Satya Prakash, Attendant	Technical	300.00
-do-	Shri Ashok Kumar, Attendant	Technical	300.00
-do-	Shri Vijay Kumar, Messenger (Senior Grade)	Non-Technical	300.00
-do-	Shri Hari Das, Messenger	Non-Technical	300.00

Guidance of ME/M.Tech./Ph.D. Thesis

Supervisor	Details of Thesis
Shri R.D. Singh, Director	Ph.D. degree of Shri A.R. Senthil Kumar in Civil Engineering Deptt., IIT-Roorkee on "Optimal operation of multipurpose reservoir system"– Thesis submitted.
	Ph.D. degree of Smt. Archana Sarkar at IIT Roorkee on "Modelling Flood Flows and Sediment Yield in a part of Brahmaputra River Basin" – in progress.
	Ph.D. Thesis of Shri L N Thakural, Department of WRDM, IIT, Roorkee on "Snowmelt runoff estimation" – in progress.
Dr. Bhishm Kumar, Sc. 'F'	Ph.D. thesis of Shri A. Vardharajan, V. T. University, Belgaum on "Identification of salinity zones and recharge sources of aquifers in Ghatprabha Command" - in progress.
	Ph.D. thesis of Shri T. Vijay, Dept of Geophysics, Andhra University on "Evaluation of groundwater quality in coastal urban and agricultural regions near Kakinada" – in progress.
Dr. N.C. Ghosh, Sc.'F'	Ph.D. thesis of Shri Shakir Ali, Dept. of Hydrology, IIT, Roorkee on "Study of artificial Groundwater recharge from a pond in a small watershed" – Completed.
Dr. C. K. Jain, Sc. 'F'	Ph.D. Thesis of Km. Deepali, Gurukul Kangri University, Hardwar on the topic "Bioremediation of soil and groundwater contaminated with metal ions"– Degree awarded.
	Ph.D. Thesis of Km. Rashmi Yadav, Gurukul Kangri University, Hardwar on the topic "Environmental fate and phyto-remediation of metal ions" – Degree awarded.
	Ph.D. Thesis of Smt. Beena Prasad, Garhwal University, Srinagar on the topic "Groundwater quality under urban influence" – in progress.

	Ph.D. thesis of Sri. B. C. Patwary, Guwahati University, Guwahati on "Studies on Hydrological Processes and Non-point Source Pollution in a Hilly Watershed of North East India" – in progress.
Dr. Sanjay K. Jain, Sc E2 & Dr. J.V. Tyagi, Sc 'E2'	M. Tech. thesis of Shri Vishal Singh, Allahabad Agricultural Institute, Allahabad, on "Application of SWAT model for estimation of runoff and sediment in a mountainous basin" – completed.
Dr. Sanjay K. Jain, Sc. 'E2'	M. Tech. thesis on Snowmelt runoff modeling in Chenab basin using remote sensing and GIS", Department of Hydrology, IIT, Roorkee. (Completed in June 2009)
Dr. Sudhir Kumar, Sc. 'E2'	Ph.D. Thesis of Shri Santosh Rangrao Yadav, Department of Hydrology, IIT, Roorkee on "Sustainable Development of Water resources in Parts of Dehradun District, Uttaranchal" – in progress.
	Ph.D. Thesis of Shri Lekh Raj, Department of Earth Sciences, IIT Roorkee on "Remote Sensing and GIS Application in Groundwater Exploration and Vulnerability Assessment" – in progress.
	Ph.D. thesis of Sh. Arvind Singh, Department of Earth Sciences, IIT Roorkee on "Groundwater Assessment, recharge and pollut ion potential in hard rock areas of Karnataka"- in progress.
Dr R.P. Pandey, Sc. 'E1'	M. Tech. (Water Resources Management) thesis of Shri Dinesh Regmi, Dept of Water Resources Development and Management, IIT, Roorkee, on "Performance evaluation of selected tank irrigation projects in Kshipra Basin" – Degree awarded in 2009.
	M. Tech. (Water Resources Management) thesis of Shri Mahesh Prasad Tharu, Dept of Water Resources Development and Management, IIT, Roorkee , on "Estimation of water availability a nd utilization in small watershed of Kshipra Basin" –Degree awarded in 2009.
	Ph.D (Hydrology) thesis of Shri Vinit Jain, Department of Hydrology, IIT , Roorkee, on "Long term hydrological appraisal using distributed modeling", - under progress.
	M. Tech (Hydrology) thesis of Shri R P Shah, Department of Hydrology, IIT, Roorkee on "Assessment of drought severity in Kshipra Basin" - under progress.
Dr S P Rai, Sc. 'E1'	Ph.D. thesis of Ms. Nuzhat-Ul-Qayoom Qazi, FRI, Dehradun, on " Hydrological Response of M icro-Watersheds under dense and degraded Oak Forest, Garhwal Himalaya, Uttarakhand" - in progress.
Dr P K Bhunya, Sc. 'E1'	M.Tech. thesis of Shri M.K. Meena , IIT, Roorkee on " Flow in semi -confined aquifer" – in progress.
	Ph.D. Thesis of Ms. Cinthia M Falck, Lund University, Sweden on "Stochastic analysis" – in progress.
	M.Tech. thesis of Ms. Kuldeep Kanchan , IIT, Kharagpur on " Design flood for gauged and ungauged locations in the Mahanadi river basin by interpolation methods" – completed in 2010.

Dr. B.K. Purandara, Sc. 'E1'	Ph.D. Thesis of Shri N Varadarajan, Vishveswaraya Technological University, Belgaum, Karnataka on "Groundwater quality" – in progress.
Dr. Mathew K Jose, Sc. 'C'	Ph.D. Thesis of Shri Shobha Ram, IIT , Roorkee on "Groundwater Modeling" – completed.
Dr M.K. Sharma, Sc. 'C'	Ph.D. thesis of Km. Preetika Shukla, Kanya Gurukul Mahavidyalaya, Gurukul Kangri Vishwavidyalaya, Hardwar on "Studies on adsorption kinetics of defluoridation using low cost adsorbent" – in progress.
	Ph.D. Thesis of Km. Shikha Chamoli, Deptt. of Zoology and Env. Sc., Gurukul Kangri Vishwavidtalaya, Hardwar on the topic 'Studies on Organochloro pesticidal residue in Ganga water and its bioaccumulation in certain aquatic biota from Hardwar to Bijnor' - in progress.

Following scientists/staff of the Institute have registered for Ph.D degree

S. No	Name and Designation	Title of the Ph.D. thesis	Department/ University	Status
1.	Mr. Rakesh Kumar, Sc. F	Regional flood frequency estimation in India	Dept. of Hydrology, IIT, Roorkee	Completed
2.	Mr Shobha Ram, PRA	Analysis of Border Strip Irrigation and Estimation of Infiltration Parameters	Civil Engg. Dept., IIT Roorkee	Completed
3.	Mr. S D Khobra-gade, Sc. E1	Studies On Evaporation From Open Water Surfaces In Tropical Climate	Civil Engg. Dept., IIT, Roorkee	Thesis submitted
4.	Mr. A R Senthil Kumar, Sc E1	Evaluation of sediment yield and reservoir operation for Bhakra dam".	Civil Engg. Dept., IIT Roorkee	Thesis submitted
5.	Mr. B C Patwari, Sc. F	Studies on Hydrological Provesses and Non-point Source Pollution in a Hilly Watershed of North East India.	Guwahati University	On Going
6.	Mr. S V Vijaya Kumar, Sc. E1	Management Practices For Artificial Recharge	Dept. of Geo–Engg., Andhra Univ. Visakhapatnam	On Going
7.	Mr B Venkatesh, Sc E1		NIT, Surathkal, Karnataka	On Going
8.	Mr V S Jayakanthan, Sc E1	Recent Image Processing Techniques for Hydrological Applications	Anna University, Chennai	On Going
9.	Smt Archana Sarkar, Sc C	Runoff and Sediment Modeling in a part of the Brahmaputra River Basin	IIT, Roorkee	On Going
10.	Mr D G Durbude, Sc C	Long Term Hydrologic Simulation of Stream Flow	Dept. of Hydrology, IIT, Roorkee	On Going
11.	Mr N Vardarajan, SRA	Identification of salinity zone in aquifer of Ghataprbha command area, Kamataka	VTU, Belgaum, Katnataka	On Going
12.	Mr L N Thakural, SRA	Streamflow Modeling And Impact Of Climate Change In A Himalayan Basin	WRDM, IIT Roorkee	On Going
13.	Smt. Beena Prasad, RA	Ground Water Quality Under Urban Influence	HNB GU, Srinagar, Uttarakhand	On Going

Retirement of Staff

Shri Roshan Lal, Security Guard

CHAPTER – 9

WELFARE OF WOMEN EMPLOYEES

As per the directives of the Govt. of India, a committee was constituted in the year 1997 vide 6/18/97-NIH(Admn.) dated November 25, 1997 to look into the complaints of women employees working in the Institute. The members of the committee included lady employees of Group A, B and C category in the Institute. Section Officer (Admn.) is the Member Secretary. The terms of reference of the committee are as follows:

i) To receive complaints on incidents of sexual harassment in workplace in the Institute.

ii) To investigate all issues related with such complaints and report to Director for taking proper action against the offender(s).

iii) Evolve suitable mechanism for non-recurrence of such events and prevention of sexual harassment of women employees in workplace.

At present the constitution of the Committee is as follows:

1.	Dr. (Smt.) Rama Devi. Mehta, Sc.C	...	Chairperson
2.	Smt. Mahima Gupta, P.A.	...	Member
3.	Sri. N. K. Bhatnagar, SRA	...	Member
4.	Smt. Beena Prashad, JRA	...	Member
5.	Sri. A. P. Chamoli, SAO	...	Member Secretary

No case of harassment or complaint was received by the committee during the year 2009-2010.

CHAPTER – 10

WELFARE OF SC/ST AND OBC EMPLOYEES

The Institute is following reservation in vacancies to SC/ST, and OBC employees as per the Govt. of India instructions. Accordingly, separate rosters for direct recruitment and promotions are being maintained in the Institute. Liaison Officers for SC/ST, and OBC employees have been functioning in the Institute effectively. Action for filling up the vacant posts of reserved category has been taken for filling by candidates from respective groups.

During the year, the Liaison Officers ensured that due compliance is taken of various reservation orders and benefits admissible to SC/ST, and OBC employees in the Institute. The rosters maintained in the Institute were scrutinized from time to time and the reports and returns were submitted to the MOWR at regular intervals as specified. Proposals received for de-reservation of posts were scrutinized and certified after due satisfaction with reference to availability of SC/ST candidates, necessity of filling up by other candidates, etc. SC/ST, and OBC candidates were allowed to meet the Liaison Officer in connection with their queries and grievances related to appointment, promotion, etc.

The group-wise staff strength of the Institute indicating posts of SC/ST, and OBC category during the year is given below:

	TOTAL	Schedule Caste	Schedule Tribe	Other Backward Classes
GROUP A	70	09	02	07
GROUP B	69	11	-	-
GROUP C	94	28	-	01
TOTAL	233	48	02	08

CHAPTER – 11

WELFARE OF PERSONS WITH DISABILITIES

For effective implementation of the Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995; the Institute is following reservation in vacancies for the persons with disabilities as per the Government of India instructions. Accordingly, the Institute is maintaining separate 100 point reservation roster register in the prescribed format for determining/effective reservation for the disabled – one each for Group A posts filled by direct recruitment, Group B posts filled by direct recruitment, Group C posts filled by direct recruitment, Group C posts by promotion. Each roster has cycles of 100 points and each cycle of 100 points have been divided into three blocks comprising the following posts: 1st Block : point No. 1 to point No. 33; 2nd Block : point No. 34 to point No. 66; 3rd Block : point No. 67 to point No. 100.

Points 1, 34 and 67 of the roster have been earmarked reserved for persons with disabilities – one point for each of three categories of disabilities.

Liaison Officers for persons with disabilities have been functioning in the Institute effectively.

Relaxation in upper age limit for persons with disabilities have been given by this Institute (a) by ten years in case of direct recruitment to Group C posts, (b) by five year in case of direct recruitment to Group A and Group B posts where recruitment is made otherwise than through open competitive examination; and (c) by ten years in case of direct recruitment to Group A and Group B posts through open competitive examination.

During the year, the Liaison Officers ensured that due compliance is taken of various reservation orders and benefit admissible to persons for disabilities in the Institute. The rosters maintained in the Institute were scrutinized from time to time and the reports and returns were submitted to the MOWR at regular intervals as specified. The group-wise staff strength of the Institute indicating posts of disabled persons category during the year is given below:

	TOTAL staff strength	Persons with Disabilities		
		Visually Handicapped	Hearing Handicapped	Orthopedically Handicapped
GROUP A	70	01	-	-
GROUP B	69	-	-	01
GROUP C	94	-	-	01
TOTAL	233	01	-	02

The amount released and the amount utilized during the year 2009-10 under various schemes for the benefit of persons with disabilities, is nil.

CHAPTER – 12

VIGILANCE

Under the jurisdiction of Central Vigilance Commission (CVC), a part-time Chief Vigilance officer is appointed to look after the vigilance matters in the Institute and its Regional Centers. During the year 2009-2010, Dr. R.P. Pandey, Scientist E-1 looked after the duties of Chief Vigilance Officer in the Institute.

On the direction of CVC and Ministry of Water Resources (MoWR). Govt. of India, several actions and initiatives were taken up during the year 2009-2010 for maintaining preventive vigilance in the Institute. As a compulsory requirement for Group A and B for filing the Annual Property Returns, Chief Vigilance Officer collected the returns and issued the receipts to the concerned for reflecting in their Annual Confidential Reports. The Annual Property Returns submitted by the officers were checked and verified by the Chief Vigilance officer. Inspection of Cash with Institute Cashier, Various sections/divisions and Regional Centers of the Institute were conducted up by the Vigilance Cell of the Institute. The Director NIH, Sr. Administrative Officer, Finance Officer and other officers have been made up-dated with the instructions of CVC and MoWR from time to time for making the rules and procedures more transparent in the Institute.

All the pending vigilance cases have been disposed. Specific instructions of the Secretary, Water Resources regarding e-governance are being pursued with the Head of the Institution for compliance and transparent functioning of the Institute.

Vigilance Awareness Week (VAW-2009) were observed during November 3-7, 2009 at HQ Roorkee and at Regional Centres of the Institute at Belgaum (Karnataka), Jammu (J&K), Kakinada (Andhra Pradesh), Sagar (Madhya Pradesh) and Centers for Flood Management Studies at Patna (Bihar and Guwahati (Assam). During Vigilance Awareness Week (VAW), a pledge was administered to all the Employees of the Institute by the Director, NIH at HQ Roorkee and by the Heads/Officer in-charges at the respective Regional Centers. The messages from the President of India, Prime Minister, Vice-President and Central Vigilance Commission were displayed at the Notice Board of the Institute and at the main entrance of the Institute and halls/auditorium etc. where Vigilance Awareness Activities were conducted. Various slogans in English and in Hindi were displayed on the Charts at the entrance and exit gate of the main administrative building of the Institute at HQ as well as at the Regional Centres. The various competitions regarding Preventive Vigilance, anti-corruption etc. were organized at NIH Roorkee during Vigilance Awareness Week. At HQ Roorkee, essay writing competitions were organized for the employees of the Institute on the topic "Impact of Materialism on Corruption" and for the children of employees on the topic "Causes and Remedies of Corruption". A debate competition for students of about 31 prestigious Schools of Roorkee town was organized on the topic "Youth in politics may possibly lead to control corruption". There was very good response and a healthy competition was held. The Scientists, officers and staff of the Institute including teachers from various schools witnessed the gathering of this competition.

At Deccan Hard Rock Regional Centre of the Institute at Belgaum, the pledge was administered to all the Scientists & Staff. An elocution competition on "How Self vigilance can help in checking corruption" for high school students from various schools in Belgaum was organized. 13 students from 6 schools took part in the competition. Elocution Competition was conducted in Hindi and English mediums. Prizes were distributed to the winners in each category.

Posters highlighting anti-corruption slogans were displayed in the premises of Western Himalayan Regional Centre, Jammu. The pledge

was administered to the staff by the Head of the Regional Centre.

At Deltaic Regional Centre, Kakinada, the pledge was administered to the staff and officers by the Head of the Centre and he delivered a brief talk regarding the importance of the Vigilance Awareness Week – 2009, and harmful & evil effects of the corruptions were highlighted. Other scientists have also spoken on this occasion. Banners were displayed in the campus with anti-corruption slogans. An essay writing competition was organized and an Elocution Competition was also conducted on the topic of "Corruption: Evil of the Society". Total 100 students participated from 15 schools in Kakinada. Teachers and parents discussed the importance of VAW-2009 on this occasion.

At Ganga Plains South Regional Centre of the Institute at Sagar (Madhya Predesh), all the employees took pledge in English and Hindi on 3rd November, 2009. A big banner was displayed at the main entrance of the office building during the entire week. Slogans depicting the evil effects of corruption have been pasted in and around the office premises. A debate was organized on "Corruption and Community". All the employees at regional centre participated in the debate. On the closing day of Vigilance Awareness Week, messages of President of India and CVC were read.

At centre for Flood Management Studies, Patna, the observance of the week commenced with the pledge taken in Hindi as well as in English on 3rd November, 2009. Discussions were held highlighting the harmful effects of corruption and the way to make the system more transparent. Also, posters, highlighting anti-corruption, slogans were displayed at the Centre for awareness.

At CFMS Guwahati, the pledge was administered to all officers and employees on 3rd November 2009 at 11.00 hrs. Poster, banner, anti-corruption slogans etc. were displayed in and around the office complex.

On 6th November, 2009, a valedictory function was organized at HQ, Roorkee in the auditorium of the Institute. Director NIH, distributed token prizes to the winners of various competitions organized during the VAW-09. The Chief Vigilance Officer gave a brief account of various activities organized during the week.

Vigilance Cell of the Institute is consistently making efforts in bringing transparency in matter regarding electronic publication of tenders in Institute website, purchase tenders and other administrative and financial matters etc. The progress of activities of vigilance cell is reported to CVO, MoWR regularly.

Children participated in Essay writing and Poster making competition during VAW-2009.

Distribution of certificates to the winners of various competitions organized during Vigilance Awareness Week-2009

Judging Team, audience and participants of debate competition during Vigilance Awareness Week-2009

CHAPTER – 13

RIGHT TO INFORMATION (RTI) ACT

Right to Information Act is an act to provide for setting out the practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, the constitution of a Central Information Commission and State Information Commissions and for matters connected therewith or incidental thereto.

Section 5 of the Act makes it incumbent upon every public authority to designate Public Information Officers (PIO) whose duty is to deal with requests for information. A provision has been made in the legislation that such a Public Information Officer can seek assistance of any other officer in the public authority; and, in that eventuality, the latter shall come to be regarded as a de-facto Public Information Officer. Some of these de-facto Public Information Officers would, under the internal procedures, be actually taking a decision on an information request which, in turn, would be communicated to the applicant through the designated Public Information Officer. In the event of the request being rejected, etc., the act casts an obligation upon the designated PIO to communicate to the applicant the particulars of the appellate authority also. Having regard to the above, all the public authorities have to designate their appellate authorities in accordance with the provisions of section 19(1).

Section (25) of the Act provides that the Central Information Commission shall monitor the implementation of the Act by public authorities under the Central Government and prepare an annual report which shall be laid before each House Of Parliament. For the purpose of compilation of the Report, the Commission would require certain statistical information from the various public authorities under the jurisdiction of Ministries/Departments. The public authorities under the administrative control or associated with your Ministry may be suitably apprised of the provisions in this section so that action may be taken by them to compile the statistics from the date the Act comes into operation as would enable the Commission to prepare its Annual Report.

The name, designation and address of the appellate authority, PIO, and APIOs for head quarter and the regional centres (as mentioned in para 3 above) are given under right to information menu in NIH website i.e. www:// nih.ernet.in.

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ADDRESSES AND CONTACT DETAILS OF PUBLIC INFORMATION OFFICERS FOR NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE (UA) AND THE SPHERE OF WORK HANDLED BY THE PIOs AND APIOs

Addresses of the PIOs/ APIOs	*Sphere of Work*
Appellate Authority **Dr N C Ghosh** Scientist F National Institute of Hydrology, Roorkee-247 667 (UK) Ph.: 01332-272718 , Fax: 01332-272123, E-mail: ncg@nih.ernet.in	Appellate Authority For all the cases pertaining to NIH and its Centres
Public Information Officer **Dr. Suhas Khobragade** Scientist-E1, National Institute of Hydrology, Roorkee-247 667 (UK) Ph.:01332-249220, Fax: 01332-272123, E-mail:suhas@nih.ernet.in	Overall Co-ordination for regional centres and HQ at Roorkee
Assistant Public Information Officers	
Mrs. Archana Sarkar Scientist C National Institute of Hydrology, Roorkee-247 667 (UK) Ph.: 01332-249231, Fax:01332-272123, E-mail:archana@nih.ernet.in	Matters related to administration
Shri B C Patwary Scientist-F & Head, Centre for Flood Management Studies(Brahmaputra Basin), National Institute of Hydrology, Sapta Sahid Path, G S Road, Mathura Nagar, Dispur, Guwahati-781 006 (Assam) Ph.: 0361-2331150, 2264255; Fax: 0361-2228823 E-mail : nercnih@yahoo.com	Matters specific to NE-region
Shri B Chakraborty Scientist E2 & Head, Centre for Flood Management Studies (Ganga Basin), National Institute of Hydrology, WALMI Complex, Khagaul, P.O - Phulwari Sharif, Patna-801 505 (Bihar) Ph. : 0612-1452219; Fax: 0612-245227 E-mail : nihp@satyam.net.in	Matters specific to Bihar, Jharkhand and West Bengal

Dr Y R S Rao Scientist E2 & Head, Deltaic Regional Centre, National Institute of Hydrology, Siddarth Nagar, Kakinada -533 003 (Andhra Pradesh) Ph. : 0884-237 2254; Fax: 0884-235 0054 E-mail : nihr@ego.ap.nic.in	Matters specific to AP, Orissa, TN
Shri B Venkatesh Scientist E1 & Head, Hard Rock Regional Centre, National Institute of Hydrology, Plot No-11, 1st Main, Second Cross, Hanuman Nagar, Race Course Belgaum -590 001 (Karnataka) Ph. : 0831-244 7714; Fax: 0831-244 7269 E-mail : nihhrrc@sancharnet.in, Bvenki30@yahoo.com	Matters specific to Karnataka, Kerala , Pondicherry and Maharashtra
Dr. Renoj J Thayyen Scientist C & Incharge, Western Himalayan Regional Centre, National Institute of Hydrology, Opp. Military Hospital, Satwari, Jammu Cantt. - 180 003 (J & K) Ph. : 0191-2432 619; Fax: 0191-2450 117 E-mail: whrcnih@snacharnet.in	Matters specific to J & K, Punjab, HP
Shri R V Galkate Scientist C & Incharge, Ganga Plains South Regional Centre, National Institute of Hydrology, 278, Manorama Colony, Sagar-470 001 (Madhya Pradesh) Ph. : 07582-237347; Fax: 07582-237943 E-mail : nihrcs@sancharnet.in	Matters specific to MP, parts of WB

CHAPTER – 14

WORLD WATER DAY

World Water Day is celebrated every year on 22nd March in order to focus international attention on the importance of freshwater and to take concrete steps for the sustainable management of freshwater resources. Initiated by the United Nations, World Water Day invites countries all over the world to implement UN recommendations and evolve useful strategies to tackle the current global water crisis that is even more serious than the economic meltdown.

World Water Day was celebrated at NIH Roorkee on March 22, 2010. The celebrations started with a colloquium of school students on the theme of "Clean water for a healthy world". A short film was screened highlighting the importance of water conservation, efficient water management and improved water quality. A "Hydrology and Water Resources Information System for India" package was launched on the occasion.

Dr R C Trivedi, former Additional Director, Central Pollution Control Board, New Delhi, delivered an expert lecture on the theme of Water Quality. Dr Trivedi emphasized on the growing concern of quality of available water and the increasing gap between wastewater generated and treated, which needs urgent intervention before it is too late and becomes unmanageable.

This year's celebration was planned with active participation of stakeholders, such as water resources professionals, NGOs, members of line departments and local institutions, farmers, industrialists, media persons, etc. For this purpose, a round-table discussion was organized with the objective to bring all stakeholders together to discuss the various issues related to water quality. About 30 participants from various organizations like National Institute of Hydrology, Central Ground Water Board, Indian Institute of Technology, Central Building Research Institute, Irrigation Department, Uttarakhand Environmental Protection & Pollution Control Board, Uttarakhand Jal Sansthan, Channel Mountain, discussed various issues of water quality and its sustainability. Dr N C Ghosh and Dr M K Goel conducted the discussions with stakeholders. Dr V C Goyal planned and managed this year's World Water Day celebrations at Roorkee. In order to make the public aware about various facts regarding the availability of water, information was prepared and circulated through local classified publication. The activities organized on World Water Day-2010 were covered by a number of daily newspapers. The World Water Day-2010 was also celebrated at the Regional Centres of National Institute of Hydrology.

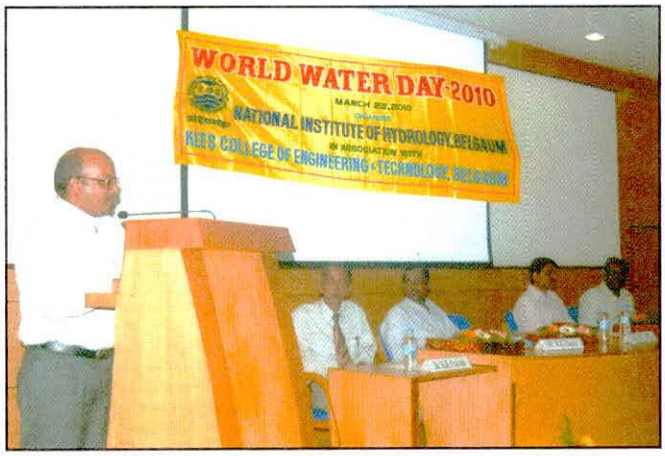
World Water Day-2010: Main Event at NIH Roorkee

Brainstorming Session during
World Water Day-2010 at NIH Roorkee

Prize Winners at World Water Day-2010
at NIH Roorkee

School children in Drawing competition on
World Water Day, March 22, 2010 at
Regional Centre, Sagar

Dr. Y R Satyaji Rao addressing the gathering
in connection with World Water Day-2010
conducted at DRC, Kakinada



World Water Day 2010 on March 22, 2010
at Belgaum

World Water Day on 22 March, 2010
at Patna

CHAPTER – 15

FINANCE AND ACCOUNTS

During the year under review, Ministry of Water Resources, Government of India provided an amount of Rs.830.16 lakhs and Rs.1004.05 lakhs as Grant-in-aid to the Institute under Plan and Non-plan respectively. The actual total expenditure during the year under review after taking into account the amount carried forward from the previous year is Rs.828.63 lakhs under Plan and Rs.1004.51 lakhs under Non-Plan. The accounts were audited by M/s Awasthi Prakash & Associates, Roorkee. The auditor's report along with audited accounts is given at Appendix XI.

CHAPTER – 16

ACKNOWLEDGEMENT

The Institute has made remarkable contributions in all aspects of hydrological research with the learned guidance and thoughtful directions from the President, Vice-President and members of the Society; the Chairman, Governing Body; the Chairman, Technical Advisory Committee; the Chairman, Standing Committee; and the members of the Governing Body and Technical Advisory Committee. The Institute places on record its gratitude to these authorities. The support and cooperation received from UNESCO is gratefully acknowledged. The Institute records its appreciation to the officers of the Ministry of Water Resources for their cooperation and help. Department of Science and Technology, Central Water Commission, Indian Institute of Technology, Roorkee, Central Ground Water Board, India Meteorological Department, Central Pollution Control Board and several other Central and State Government organisations provided help, guidance and cooperation. Various significant achievements of the Institute during the year under report would not have been possible without their help. The Institute also gratefully acknowledges the advice and cooperation received from Members of the Working Groups, Regional Coordination Committees, and the eminent scientists and engineers from various academic and research organisations.

Hydrology being a field oriented, multi-disciplinary science, the role of States is very important. The Institute is thankful to various State Government organisations for providing crucial hydrological data for carrying out collaborative studies and for inviting the Institute for organizing short duration workshops in the States for the benefit of their in-service engineers and technical personnel. The Institute also wishes to place on record its appreciation to various Central and State Government organisations and public sector undertakings for providing the Institute with an opportunity to contribute effectively in seeking the solution of various real life problems through consultancy and sponsored projects.

Director also records his appreciation for the devotion, hard work, enthusiasm and initiative exhibited by the scientists and the staff of the Institute because of which the present growth and achievement of the Institute became possible and the Institute achieved recognition not only at the national level but international level also.

APPENDICES

APPENDIX- I

N.I.H. SOCIETY

1	**PRESIDENT** **Union Minister for Water Resources** **Government of India, New Delhi**		
2	**VICE-PRESIDENT** **Minister of State for Water Resources** **Government of India, New Delhi**		
	MEMBERS		
3.	Member (Irrigation), Planning Commission, New Delhi	4	Minister-in-Charge of Irrigation, Govt. of Haryana
5	Minister-in-Charge of Irrigation, Govt. of Punjab	6	Minister-in-Charge of Irrigation, Govt. of Uttarakhand
7	Minister-in-Charge of Irrigation, Govt. of Nagaland	8	Minister-in-Charge of Irrigation, Govt. of Jharkhand
9	Minister-in-Charge of Irrigation, Govt. of West Bengal	10	Minister-in-Charge of Irrigation, Govt. of Karnataka
11	Minister-in-Charge of Irrigation, Govt. of Kerala	12	Minister-in-Charge of Irrigation, Govt. of Maharashtra
13	Minister-in-Charge of Irrigation, Govt. of Madhya Pradesh	14	Director, Indian Institute of Technology, Roorkee
15	Chairman, Tarun Bharat Sangh, Alwar	16	Secretary General, International Commission on Irrigation & Drainage (ICID), New Delhi
17	Chairman, Ganga Flood Control Commission (GFCC), Patna	18	Dr C D Thatte, Ex-Secretary (WR), Pune
19	Dr. B S Mathur, Professor (Retd.), IIT, Roorkee	20	Prof. Subhash Chander, Professor (Retd.), IIT, Delhi
21	Shri Vijay Pratap Saha, Chairman, South Asia Forum for Energy Efficiency, New Delhi	22	Dr. T Prasad, Professor (Retd.), Bihar College of Engineering, Patna
23	Prof. A K Sharma Indian Institute of Technology, Guwahati	24	Shri H C S Bery, Chief Engineer (Retd.), Punjab Irrigation Department, Chandigarh
25	Secretary to Govt. of India, Ministry of Water Resources, New Delhi	26	Secretary to Govt. of India, Department of Science & Technology, New Delhi.
27	Secretary to Govt. of India, Ministry of Agriculture & Co-operation, New Delhi.	28	Secretary to Govt. of India, Ministry of Energy New Delhi

29	Secretary to Govt. of India, Department of Expenditure, Ministry of Finance or his nominee, New Delhi.	30	Secretary to Govt. of India, Ministry of Urban Development, Govt. of India New Delhi
31.	Secretary to Govt. of India, Planning Commission, New Delhi	32.	Secretary to Govt. of India, Ministry of Environment & Forests, New Delhi
33.	Secretary to Govt. of India Rural Drinking Water Supply, New Delhi.	34.	Chairman, Central Water Commission, New Delhi.
35.	Additional Secretary to Govt. of India, Ministry of Water Resources, New Delhi.	36.	Member (D&R), Central Water Commission, New Delhi.
37.	Chief Engineer, Hydrology Studies Organisation (HSO) Central Water Commission, New Delhi.	38.	Chairman, Central Electricity Authority, New Delhi.
39.	Chairman, Central Ground Water Board, Faridabad, Haryana	40.	Director General, India Meteorological Department, New Delhi.
41.	Director General, Geological Survey of India, Kolkata.	42.	Chairman, Central Pollution Control Board, New Delhi.
43.	Director (R&D), Ministry of Water Resources, Representative of Indian National Committee on Hydrology (INCOH) nominated by Chairman, INCOH	44.	Joint Secretary (Administration), Ministry of Water Resources, Govt. of India, New Delhi.
45.	Commissioner (ER), Ministry of Water Resources, Govt. of India, New Delhi.	46.	Commissioner (PP), Ministry of Water Resources, Govt. of India, New Delhi.
47.	Commissioner (PR), Ministry of Water Resources, Govt. of India, New Delhi.		
48.	**Member Secretary** Director, National Institute of Hydrology, Roorkee		

This constitution was approved by the Society of NIH at its Special General Meeting held on 13th December 2002 and as per rules 10 Ministers and experts were changed on 24th December, 2003; 22nd November, 2006 and (15 January, 2010/9 February, 2010)

APPENDIX- II

GOVERNING BODY

1.	**Chairman** **Secretary to Govt. of India,** **Ministry of Water Resources, New Delhi**		
2.	**Vice-Chairman** **Director** **Indian Institute of Technology, Roorkee**		
	MEMBERS		
3.	Financial Advisor & Joint Secretary (Finance), Ministry of Water Resources, New Delhi	4.	Representative of Planning Commission Not below the rank of Joint Secretary Planning Commission, Yojna Bhawan, New Delhi
5.	Representative of Department of Science & Technology, Ministry of Science & Technology, (Not below the rank of Joint Secretary/Advisor, New Delhi.	6.	Chairman Central Water Commission, New Delhi. (Or Member (D&R), CWC, as his alternate)
7.	Additional Secretary (WR) Govt. of India, Ministry of Water Resources, New Delhi.	8.	Representative of Ministry of Urban Development, Govt. of India (Not below the rank of Joint Secretary/Joint Advisor, New Delhi.
9.	Representative of Ministry of Environment & Forests, Govt. of India (Not below the rank of Joint Secretary/Joint Advisor, New Delhi.	10.	Representative of Govt. of Assam Not below the rank of Chief Engineer
11.	Representative of Govt. of Karnataka Not below the rank of Chief Engineer	12.	Representative of Govt. of Jammu & Kashmir Not below the rank of Chief Engineer
13.	Secretary (Irrigation) Govt. of Uttar Pradesh, Lucknow.	14.	Secretary (Irrigation) Govt. of Uttaranchal, Dehradun.
15.	Representative of Govt. of Bihar Not below the rank of Chief Engineer	16.	Representative of Govt. of Andhra Pradesh Not below the rank of Chief Engineer
17.	Representative of Govt. of Madhya Pradesh Not below the rank of Chief Engineer		
18.	**Member Secretary** Director, National Institute of Hydrology, Roorkee		

This constitution was approved by the Society of NIH at its Special General Meeting held on 13th December, 2002.

APPENDIX - III

STANDING COMMITTEE

1.	Additional Secretary to Government of India, Ministry of Water Resources, New Delhi	**Chairman**
2.	Financial Advisor and Joint Secretary (Finance), Ministry of Water Resources, New Delhi	Member
3.	Joint Secretary (Admn.), Ministry of Water Resources, New Delhi	Member
4.	Commissioner (PP), Ministry of Water Resources, New Delhi	Member
5.	Director, National Institute of Hydrology, Roorkee	**Member-Secretary**

APPENDIX - IV

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 Department	Member
7.	A Professor of Indian Institute of Technology, Roorkee	Member
8.	A Professor engaged in research in water resources area from any one of the other six Indian Institute of Technology (IITs)	Member
9.	A Professor engaged in research in water resources area 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 Organization in the field of Hydrology	Member
15.	Commissioner (PP), Ministry of Water Resources	Member
16.	Scientist F, National Institute of Hydrology, (to be nominated by Director, National Institute of Hydrology)	Member

Note: Members at S. No. 7 to 14 are 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 13th December, 2002.

APPENDIX - V

WORKING GROUPS

I. SURFACE WATER GROUP

Chairman : Director, National Institute of Hydrology, Roorkee

Members:

1. Chief Engineer (Hydrology)/Director (Hydrology RS), Central Water Commission, New Delhi
2. Chief Engineer (BPMO)/Director (Reservoir Operation), Central Water Commission, New Delhi
3. Nominee of India Meteorological Department, New Delhi
4. Nominee of National Water Development Agency, New Delhi
5. Nominee of Central Soil and Water Conservation Research and Training Institute, Dehradun
6. Nominee of Indian Institute of Technology, Delhi
7. Nominee of Indian Institute of Technology, Roorkee
8. Nominee of Irrigation Department, Uttar Pradesh
9. Nominee of Irrigation Department, Gujarat
10. Nominee of Centre for Water Resources Development & Management, Kozhikode, Kerala
11. Dr. P. B. S. Sarma, Retd. Director, WTC, New Delhi

Convener: Scientist 'F', NIH (to be nominated by Director, NIH)

II. GROUND WATER GROUP

Chairman: Director, National Institute of Hydrology, Roorkee

Members:

1. Nominee of Central Ground Water Board
2. Chief Engineer, State Surface Water and Ground Water Data Centre, Chennai, Tamil Nadu
3. Nominee of Ground Water Department, Gujarat
4. Nominee of Ground Water Department, Uttar Pradesh
5. Nominee of National Geophysical Research Institute, Hyderabad
6. Nominee of Central Pollution Control Board, New Delhi
7. General Manager, Jal Sansthan, Uttaranchal Government, Dehradun
8. Chief Engineer (Irrigation), Rajasthan Irrigation Department, Jaipur
9. Nominee of Central Soil Salinity Research Institute, Karnal
10. Nominee of Indian Institute of Technology, Roorkee
11. Dr. G. C. Mishra, Professor, WRDTC, Indian Institute of Technology, Roorkee
12. Dr. R. D. Verma, Former Professor, M R Engineering College, Jaipur

Convener: Scientist 'F', NIH (to be nominated by Director, NIH)

III. HYDROLOGICAL OBSERVATION AND INSTRUMENTATION GROUP

Chairman: Director, National Institute of Hydrology, Roorkee

Members:

1. Nominee of Central Water and Power Research Station, Pune
2. Chief Engineer (RM)/Director (R&D), Central Water Commission, New Delhi
3. Nominee of Space Applications Centre, Ahmedabad
4. Nominee of India Meteorological Department, New Delhi
5. Nominee of Indian Institute of Remote Sensing, Dehradun
6. Nominee of AP Engineering Research Laboratory, Hyderabad
7. Nominee of UP Irrigation Research Institute, Roorkee
8. Nominee of Bhaba Atomic Research Centre, Mumbai
9. Dr. B. P. Singh, Nuclear Science Centre, New Delhi
10. Dr. P. K. Garg, Indian Institute of Technology, Roorkee
11. Representative of Director, CSIO, Chandigarh (not below the rank of Sc. 'F')

Convener: Scientist F, NIH (to be nominated by Director, NIH)

APPENDIX - VI

REGIONAL COORDINATION COMMITTEES

1. DECCAN HARD ROCK REGIONAL CENTRE, BELGAUM

Chairman: Director, National Institute of Hydrology, Roorkee

Members:

1. Director, State Ground Water Department, Hyderabad
2. Chief Engineer, Central Water Commission, Hyderabad
3. Director, Central Ground Water Board, Bangalore
4. Chief Engineer and Director, A. P. Engineering Research Laboratory, Hyderabad
5. Chief Engineer, WRDO, Karnataka Irrigation Department, Bangalore
6. Director, Ground Water Survey and Development Agency, Pune
7. Professor, Soil Science, Agriculture University, Dharwad
8. Chief Engineer, State Surface Water and Ground Water Resources Data Centre, Water Resources Organization, Chennai

Member Secretary: Head, Regional Centre

2. CENTRE FOR FLOOD MANAGEMENT STUDIES, GUWAHATI

Chairman: Director, National Institute of Hydrology, Roorkee

Members:

1. General Manager, Brahmaputra Board, Basistha, Guwahati
2. Chief Engineer (Water Resources), Assam Irrigation Department, Guwahati
3. Chief Engineer, Irrigation & Waterways Directorate, Govt. of W.B., Kolkata
4. A Professor, IIT, Guwahati. (to be nominated by Director, IIT, Guwahati)
5. Advisor (IFC&WSM), North Eastern Council Sectt., Shillong, Meghalaya
6. Chief Engineer (B & B Basin), Central Water Commission, Maranatha, Shillong
7. Director, Central Ground Water Board, NE Circle, Guwahati
8. Chief Engineer, Irrigation & Flood Control, Arunachal Pradesh, Itanagar.

Member Secretary : Head, Regional Centre

3. WESTERN HIMALAYAN REGIONAL CENTRE, JAMMU

Chairman : Director, National Institute of Hydrology, Roorkee

Members:

1. Chief Engineer, J&K Irrigation & Flood Control Department, Jammu
2. Representative of Engineer-in-Chief, Irrigation Department, Himachal Pradesh (not below the rank of Chief Engineer)
3. Representative of Engineer-in-Chief, Irrigation Department, Uttarakhand (not below the rank of Chief Engineer)
4. Regional Director, CGWB, Jammu
5. Representative of Director, Snow & Avalanche Study Esstt., Panchkula (not below the rank of Deputy Director)
6. Representative of Commissioner (Indus), (not below the rank of Joint Commissioner)
7. Chief Engineer(Indus), Central Water Commission, Chandigarh or his representative (not below the rank of Director)
8. A Professor from National Institute of Technology, Hamirpur (to be nominated by Principal, NIT, Hamirpur)
9. Representative of Director, G.B. Pant Institute of Himalayan Environment and Development, Almora (not below the rank of Deputy Director)
10. Deputy Director, Department of Agriculture, Govt. of H.P., Hamirpur

Member Secretary : Head, Regional Centre

4. DELTAIC REGIONAL CENTRE, KAKINADA

Chairman: Director, National Institute of Hydrology, Roorkee

Members:

1. Chief Engineer (Hydrology), Andhra Pradesh Irrigation Department, Hyderabad

2. Engineer-in-Chief, Orissa Irrigation Department, Bhubaneswar
3. Chief Engineer, State Surface Water and Ground Water Data Centre, Water Resources Organization, Chennai
4. Professor of IIT, Chennai (to be nominated by Director, IIT, Chennai)
5. Director, Centre for Water Resources, Anna University, Chennai
6. Director, State Ground Water Department, Hyderabad
7. Representative of NRSA, Hyderabad to be nominated by Director, NRSA
8. Director, A.P. Engineering Research Laboratory, Himayatsagar, Hyderabad
9. Chief Engineer, Irrigation and Waterways Department, Govt. of West Bengal
10. Chief Engineer & Director, GWS&I, Department of Water Resources, Bhubaneswar, Orissa

Member Secretary: Head, Regional Centre

5. CENTRE FOR FLOOD MANAGEMENT STUDIES, PATNA

Chairman: Director, National Institute of Hydrology, Roorkee

Members:

1. Chief Engineer, Central Water Commission, Patna
2. Chief Engineer (Civil), DVC, Maithon
3. Representative of Chairman, GFCC, Patna (not below the rank of Director)
4. Director (Hydromet), India Meteorological Department, Patna
5. Chief Engineer (Irrigation and Waterways), Kolkata
6. Chief Engineer & Director, WALMI, Patna
7. Chief Engineer (WR), Uttar Pradesh Irrigation Department, Lucknow
8. Chief Engineer (Monitoring), Water Resources Department, Patna, Bihar
9. Director, Centre for Water Resources Studies, Bihar College of Engineering, Patna

Member Secretary: Head, Regional Centre

6. GANGA PLAINS SOUTH REGIONAL CENTRE, SAGAR

Chairman: Director, National Institute of Hydrology, Roorkee

Members:

1. Chief Engineer, Dhasan Ken Basin, Water Resources Department, Sagar, MP
2. Representative of Ground Water Survey, Water Resources Department, MP (not below the rank of SE)
3. Regional Director, CGWB, Bhopal
4. Chief Engineer, Yamuna Basin, CWC, New Delhi
5. Chief Engineer, CDO, BODHI, Bhopal
6. Chief Engineer, Betwa Basin, Water Resources Department, Bhopal, MP
7. A Professor of MACT, Bhopal (to be nominated by Principal, MACT, Bhopal)
8. Chief Engineer and Director, Irrigation Management and Training Institute, Irrigation Department, Kota, Rajasthan

Member Secretary: Head, Regional Centre

Note: In the absence of Director, NIH, his nominee not below the rank of Scientist F will chair the meeting of RCC.

APPENDIX - VII

INDIAN NATIONAL COMMITTEE ON HYDROLOGY

List of 05 permanent Members of INCOH
(as per Letter No. 15/1/2001-R&D/ Dated 5th September, 2008)

1.	Chairman, CWC, Central Water Commission, Sewa Bhawan, R.K.Puram, New Delhi - 110 066	**Chairman**
2.	Shri R.D. Singh, Director, National Institute of Hydrology Roorkee – 247667	Member
3.	Chief Engineer (HSO), Central Water Commission, Sewa Bhawan, R.K.Puram, New Delhi – 110 066	Member
4.	Member (SML), Research Committee (GW), Central Ground Water Board (CGWB), A2-W3, Curzon Road Barracks, K.G.Marg, New Delhi - 110 001	Member
5.	Director General (Meteorology), Indian Meteorological Deptt., Mausam Bhawan, Lodhi Road, New Delhi – 110 003	Member

List of 11 Nominated Members of INCOH For a Period of 3 years
(as per Letter No. 33/2/2002-R&D/ Dated 5th September, 2008)

1.	Brig. P. Mathur , Joint Director, Snow & Avalanche Study Establishment (SASE), Research & Development Centre, 37-A, Chandigarh – 160036	Member
2.	Dr. Nityanand Singh, Sc. 'F' and Head Climatology , Hydrology Division Indian Institute of Tropical Meteorology (IITM), Dr. Homi Bhabha Road, Pashan, Pune – 411008	Member
3.	Chief Engineer, Water Resources Department Assam, Chandmari, Guwahati – 3	Member
4.	Engineer in Chief, Government of Uttrakhand, Irrigation & Power Department, Sachivalaya, Subhash Road, Dehradun-248001 (U.K.)	Member
5.	Sri Kuldeep Singh Takshi, Chief Engineer (R) –cum-Director Irrigation & Power Research Institute (IPRI), Punjab, Amritsar – 143001	Member
6.	Director, Institute of Hydraulics & Hydrology, Poondi, Tamilnadu – 602023	Member
7.	Dr. Sanjay K. Jain, Secretary, Indian Association of Hydrologists (IAH) National Institute of Hydrology, Roorkee-247667	Member
8.	Dr. K. Srinivasan, Professor, Environmental & Water Resources Engineering, Department of Civil Engineering, Indian Institute of Technology Madras, Chennai – 600036	Member
9.	Prof. N.K. Goel, Professor, Department of Hydrology, Indian Institute of Technology, Roorkee-247667	Member
10	Director (R&D), MoWR, PP Wing, R&D Division, Ist Floor, Wing 4, West Block-I, R.K.Puram, Sewa Bhawan, New Delhi –11006	Member
11	Shri Rakesh Kumar, Scientist 'F' , Indian National Committee on Hydrology National Institute Hydrology, Roorkee-247667	**Member Secretary**

APPENDIX - VIII

SCIENTIFIC STUDIES

WORK PROGRAMME OF NIH (HQ) FOR THE YEAR 2009-10

1. WORK PROGRAMME OF ENVIRONMENTAL HYDROLOGY DIVISION FOR THE YEAR 2009-10

Study No.	Title of the study	Study team	Duration	Funding
1. NIH/EHD/ NIH/ 06-08	Hydrological Studies for Restoration of the Renuka Lake, District Sirmaur (HP)	Omkar Singh V.K. Choubey, R. Jha, S.D. Khobragade M.K. Sharma, S. P. Rai	3 Years (04/06-03/09)	NIH
2. NIH/EHD/ NIH/ 07-10	Modelling of Pesticide Transport in Ground Water – a case study of Metropolitan City – Vadodara	M. K. Sharma, S.V.N. Rao	3 Years (10/07– 09/10)	NIH
3. NIH/EHD/ NIH/ 08-09	Evaluation of water quality of rivers joining Tehri Reservoir and downstream of the reservoir	M K Sharma, V K Choubey	1 Year (09/08 – 08/09)	NIH)
4. NIH/EHD/ CPCB/ 08-10	Assessment of ground water quality in Class – 1 cities in India (CPCB sponsored project)	V.K. Choubey M.K. Sharma	2 Years (10/08 – 09/10)	CPCB
5. NIH/EHD/ NIH/ 09-13	Impact of sewage effluent on drinking water sources of Shimla city and suggesting ameliorative measures	V.K. Choubey Omkar Singh M.K. Sharma	4 Years (4/09- 3/13)	PDS under HP-II

2. WORK PROGRAMME OF GROUND WATER HYDROLOGY DIVISION FOR THE YEAR 2009-10

Study No.	Title of the study	Study team	Duration	Funding
1.NIH/GWD/ NIH/07-10	Quantification of impact of rainwater harvesting on groundwater availability in Aravalli Hills.	Anupma Sharma , N C Ghosh, C P Kumar, Sudhir Kumar, Rajan Vatsa	3 years (04/07 – 03/10)	NIH
2. NIH/GWD/ NIH/08-09/	Vision document on "Mitig ation and Remediation of Ground Water Arsenic Menace in India	N C Ghosh (NIH) S K Srivastava (CGWB)	8 months (09/08 – 04/09)	NIH
3. NIH/GWD/ NIH/09-12/	Impact of Climate Change on Dynamic Groundwater Recharge in a Drought Prone area	Surjeet Singh, C. P. Kumar, Anupma Sharma, Rajan Vatsa	3 years (04/09 – 03/12)	NIH

3. WORK PROGRAMME OF HYDROLOGICAL INVESTIGATIONS DIVISION FOR THE YEAR 2009-10

Study No.	Title of the study	Study team	Duration	Funding
NIH/HID/UY RB/06-08	SW and GW Interaction at Selecte d Locations Along River Yamuna in NCT, Delhi: Phase-II	Sudhir Kumar, M. S. Rao, P. K. Garg	3 yrs (4/09 – 3/12)	NIH
NIH/HID/DST /07-12	National programme on isotope fingerprinting of waters of India (IWIN)	M.S. Rao, B. Kumar, Sudhir Kumar, S.P. Rai, S.K. Verma, Pankaj Garg	5 yrs (7/07 –6/12)	DST
NIH/HID/FRI/ 08-13	Impact Assessment of Landuse on the Hydrologic Regime in the selected Micro-watersheds in Lesser Himalayas, Uttarakahand	S.P. Rai, Bhishm Kumar, J.V. Tyagi	5 years (4/08 – 3/13)	FRI
NIH/HID/HP-II/08-10	Groundwater Dynamics of Bist-Doab Area, Punjab Using Isotopes	M.S. Rao, Bhishm Kumar, Sudhir Kumar S. K. Verma, Pankaj Garg + Officials of CGWB	4 years (10/08-3/12)	PDS under HP-II
NIH/HID/HP-II/08-13	Groundwater Management in Over-Exploited Blocks of Chitradurga and Tumkur Districts of Karnataka	Sudhir Kumar, JV Tyagi, Vijay Kumar, B.K. Purandara, S.P. Rai, M.S. Rao	4 years (10/08-3/12)	PDS under HP-II
NIH/HID/INC ID/08-11	Estimation of irrigation return flow and stream flow regeneration in parts of the selected canal command areas	M S Rao, Bhishm Kumar, S. K. Verma, Pankaj Garg	2 years from the date of approval from INCID	INCID (approval awaited)
NIH/HID/INC ID/09-12	Integrated Hydrological Investigations of Ropar Lake, Punjab	S.D.Khobragade, B. Kumar, N.C.Ghosh, Sudhir Kumar, S.P. Rai, M.S. Rao, S.K. Verma, Pankaj Garg, MK Sharma	3 years (04/09-03/12)	NIH

4. WORK PROGRAMME OF SURFACE WATER HYDROLOGY DIVISION FOR THE YEAR 2009-10

Study No.	Title of the study	Study team	Duration	Funding
1.NIH/SWD/ NIH/08-12	Study on integrated water resources management of sub -basin to cope with droughts	R.P. Pandey Ravi V. Galkate Surjeet Singh L.N. Thakaral	4 years (12/08 – 11/12)	NIH
2.NIH/SWD/ NIH/09-11	Snow melt runoff modeling using fuzzy logic	A.K. Lohani Sanjay K. Jain Rakesh Kumar	2 years (04/09 – 03/11)	NIH
3.NIH/SWD/ NIH/08-	Monitoring and modelling of streamflow for the Gangotri Glacier	Manohar Arora Rakesh Kumar	Long term	NIH
4.NIH/SWD/ NIH/09-11	Environmental flow requirement for river ganga at lohari nagpala power project site (Phase-II)	Manohar Arora R.D. Singh Rakesh Kumar	2 years (04/09-03/11)	NIH

5.NIH/SWD/ NIH/09-12	Snow melt runoff modelling in Sultej basin	A. R. Senthil Kumar, Manohar Arora Avinash Agarwal, D. S. Rathore Digambar Singh	3 years (04/09– 03/12)	NIH
6.NIH/SWD/ NIH/07-10	Runoff and Sediment Modelling in a part of Brahmaputra River Basin using ANN	Archana Sarkar R D Singh Nayan Sarma	3 years (04/07– 03/10)	NIH
7.NIH/SWD/ NIH/05-10	Integrated Hydrological Stu dy for Sustainable Development of two Hilly Watersheds in Uttaranchal	Avinash Agarwal R P Pandy S P Rai S K Singh	5 years (04/05-03/10)	DST
8.NIH/SWD/ NIH/07-10	Hydrological studies in a forested watershed in Uttarakhand	J.V. Tyagi Rakesh Kumar D. Singh	3 years (04/07 – 03/10)	NIH & FTA
9.NIH/SWD/ NIH/09-11	Data book- hydro-meteorological observatory 2001-2008	Digambar Singh A. R. Senthil kumar, Manohar Arora	2 years (04/09– 03/11)	NIH

5. WORK PROGRAMME OF WATER RESOURCES SYSTEMS DIVISION FOR THE YEAR 2009-10

Study No.	Title of the study	Study team	Duration	Funding
1.NIH/W RSD/NIH/ 07-12	Decision Support System (Planning) for Integrated Water Resources Development and Management	Rakesh Kumar, A K Lohani, D Chalisgaonkar, C P Kumar, M K Goel, Vijay Kumar, R P Pandey, P K Bhunya, Sanjay Kumar, A Sharma	5 Years (04/07– 03/12)	PDS under HP-II
2.NIH/W RSD/NIH/ 09-12	Use of Remote Sensing in soil moisture and water balance – case study of Solani catchment: Phase-II	Sanjay K. Jain, J.V. Tyagi, IIRS Dehradun	3 Years 04/09– 03/12)	NIH
3.NIH/W RSD/HP-II/08-12	Integrated approach for modeling snowmelt runoff and effect of climate change in Beas basin	Sanjay K. Jain Sharad K. Jain Vijay Kumar Manmohan K. Goel	4 Years (04/08– 03/12)	PDS under HP-II
4.NIH/W RSD/HP-II/09-12	Hydrological Assessment of Ungauged Catchments (small catchment)	Pradeep Kumar Bhunya Rakesh Kumar, Sharad. K. Jain, D S Rathore , P C Nayak, Niranjan Panigrahy, Sanjay Kumar, Director (Hydrology and W.R. Planning-I), Govt. of Orissa	4 Years (07/08– 06/12)	PDS under HP-II
5.NIH/W RSD/HP-II/09-13	Assessment of Effects of Sedimentation on the Capacity/ Life of Bhakra Reservoir (Gobind Sagar) on River Satluj and Pong Reservoir on River Beas	Sanjay K. Jain, D. S. Rathore, J. V. Tyagi, Sharad K. Jain, Rama D. Mehta, Director (Regulation), BBMB.	2 Years (04/09– 03/11)	PDS under HP-II (BBMB)
6.NIH/W RSD/NIH/ 08-10	Web-based River Basin Information System for India	Deepa Chalisgaonkar S K Jain D S Rathore N Panigrahy	2 years 04/08– 03/10)	NIH

WORK PROGRAMME OF NIH REGIONAL CENTRES AND CFMS FOR THE YEAR 2009-10

A. HARD ROCK REGION CENTRE, BELGAUM

Study No.	Title of the study	Study team	Duration	Funding
1. NIH/ HRRC/06-09/1	Hydrological impact of land -use changes in humid tropical water sehds located in the Sahayadri Mountains	B. Venkatesh & B.K. Purandra	05/06 to 04/09 (3 years)	NIH
2. NIH/ HRRC/08-11/1	Integrated water resource management for Manimala River basin, central Kerala	Chandramohan, B. Venkatesh, N. Varadarajan, and a person from Kerala Irrigaiton Department	07/08 to 06/11 (3 years)	NIH
3. NIH/ HRRC/08-11/2	Environmental flow requirements for Bhadra basin in Karnataka	B.K. Purandra, Chandramohan, M.K. Jose, N. Varadarajan and a persons each from WRDO and Mines and Geology	07/08 to 06/11 (3 years)	NIH
4. NIH/ HRRC/08-11/3	Assessment of groundwater vulnerability in the state of Kerala	M.K. Jose B.K. Purandara Chandra Kumar and a person from Kerala State Ground Water Depart.	07/08 to 06/11 (3 years)	NIH
5. NIH/ HRRC/08-10/4	Evaluation of artificial recharge measures in North Karnataka	M.K. Jose B.K. Purandara, Chandramohan, Chandra Kumar & a Person from Dept. of Mines and Geology	07/08 to 06/10 (2 years)	NIH
6. NIH/ HRRC/08-10/5	A Comprehensive Assessment of Water Qual ity Status of Kerala State (Purpose Driven Study under HP II)	B. K. Purandara, T. Chandramohan,	07/08-06/11	Under HP II (PDS)

B. WESTERN HIMALAYAN REGIONAL CENTRE, JAMMU

1. NIH/ WHRC/08-10/3	Trend analysis of hydrological variables in western Himalayan region - Phase I (J & K)	M. K. Goel R. J. Thayyen Vijay Kumar Sharad K. Jain	4/08-3/10 (2 years)	NIH
2. NIH/ WHRC/09-13/2	Cryospheric system studies and runoff modeling of Ganglass catchment, Leh, Ladakh Range	R. J. Thayyen M. K. Goel S.P Rai Bhishm Kumar	6/09- 5/13 (5 years)	DST

C. GANGA PLAINS SOUTH REGIONAL CENTRE, SAGAR

1. NIH/ GPSRC/NIH/08 -11/1	Integrated water resources management plan for catchment and command of Benisagar and Rangawan reservoirs in Madhya Pradesh.	R.K. Jaiswal, T. Thomas, R. V. Galkate,	07/08 to 06/11 (3 years)	NIH
2. NIH/ GPSRC/NIH/09 -13/1	Water resources management study for drought affected Bundelkhand region.	Sh. R.V. Galkate Sh. T. Thomas Sh. R.K.Jaiswal Dr. N.C. Ghosh	4 years (August 09 to July 2013)	NIH

D. DELTAIC REGIONAL CENTRE, KAKINADA

1. NIH/DRC// 05-09/1	A study on spatial and temporal hydrological aspects for water resources planning and management of an urban area (Kakinada) along the coastal region	S.V.Vijaya Kumar and B Krishna	04/05 – 03/09 (4 years)	NIH
2. NIH/DRC// 08-10/1	Study on pre and post project scenarios and IWRM under Pushkar Canal Command Area in Andhra Pradesh.	S.V. Vijaya Kumar, Y.R. Satyaji Rao, V.S. Jayakanthan, P.C.Nayak, B. Krishna, Bhishm Kumar	04/08 – 03/10 (2 years)	NIH
3. NIH/DRC// 08-12/2	Storm water management in Cooum sub basin, Chennai Corporation, Chennai, Tamilnadu	Y.R. Satyaji Rao, S.V. Vijaya Kumar, Bhishm Kumar , V.S. Jeyakanthan, B.Krishna P.C.Nayak	06/08 – 03/12 (4 years)	Under HP II (PDS)
4. NIH/DRC// 09-12/1.	Impact Assessment of Climate Change on hydrological regime in Sabari sub -basin, Godavari river system	V.S. Jeyakanthan, Sc'E1' (PI) Dr. S.K. Jain, Sc'E2' Dr. P.C. Nayak, Sc'C' B. Krishna, Sc 'C'	07/09 –03/11 (2 years)	NIH
5. NIH/DRC// 09-11/2	Present status of salinity ingress in the coastal Andhra Pradesh, Tamilnadu and prediction of Impact due to the sea level rise in varying climatic conditions	B. Krishna, Sc'C' (PI) Dr.Y. R Satyaji Rao, Sc'E2' Dr. Bhishm Kumar, Scientist 'F'	07/09 – 03/11 (2years)	NIH
6. NIH/DRC// 09-09/2	Groundwater Modelling and surface water - groundwater interactions in and around Puri City, Orissa	Dr.P.C. Nayak, Sc 'C' (PI) Sh. S.V. Vijaya Kumar, Sc' - E1' Dr. Bhishm Kumar, Sc- 'F'	July 2009 – March 2011	NIH

E. CENTRE FOR FLOOD MANAGEMENT STUDIES, GUWAHATI

1.	Modelling non-point source pollution	C. K. Jain, A. Bandyo - padhyay, B. C. Patwary and Aditi Bhadra, (NERIST)	05/08-03/11 (3 Years)	NIH
2.	Flash Flood Studies (Jiadhal Basin)	S. R. Kumar Rakesh Kumar Pankaj Mani & Brahmaputra Board	06/07-05/09 (2 Years) Extended for 1 year (2009-10)	NIH
3.	Flood plain zoning/flood hazard mapping of rivers of Arunachal Pradesh	A. Bandyopadhyay D. S. Rathore B. C. Patwary	06/07-05/10 (3 Years)	NIH
4. NIH/CFMS-G/09-10	Phytoremediation: A plant based technology to clean-up the environment	C. K. Jain N. C. Ghosh B. C. Patwary	1 Year (4/09-3/10)	NIH
5. NIH/CFMS-G/09-10	Design of rainguage station network for Arunachal Pradesh	A. Bandyopadhyay B. C. Patwary	1 Year (4/09-3/10)	NIH

F. CENTRE FOR FLOOD MANAGEMENT STUDIES, PATNA

1. NIH/ CFMS-P/08-09/1	Shifting characteristics of Kosi river	Biswajit Chakravorty, Pankaj Mani, N. G. Pandey, R. Venkata Ramana	10/08- 09/09 (1 year)	NIH
2. NIH/ CFMS-P/08-09/2	Shifting characteristics of Bagmati river	N. G. Pandey, R. Venkata Ramana, Biswajit Chakravorty, Pankaj Mani	10/08- 09/09 (1 year)	NIH
3. NIH/ CFMS-P/08-09/3	Shifting characteristics of Daha river	Pankaj Mani, Biswajit Chakravorty, N. G. Pandey, R. Venkata Ramana	10/08- 09/09 (1 year)	NIH

APPENDIX - IX

LIST OF PUBLICATIONS

A. Books Published

1.	Lohani, A.K. and Jain, Sanjay (Editors), 'Flood Risk Managemet' Proceedings of the Workshop on Flood Risk Management, Jointly Organised by The Institution of Engineers (India) Roorkee Local Centre and National Institute of Hydrology, Roorkee, November 26-27, 2009.
2.	Ojha, C.S.P., Berndtsson, R., Bhunya, P.K. (Authors), "Engineering Hydrology (Second Ed.)", by Oxford University Press, (Revised ISBN-10:0-19-569461-9), 2009.
3.	Patwary, B.C., Deb Krori, K.G., Jain, C.K., Kakati, N. and Misra, A.K. (Editors), Proc. Seminar on Shared Water – Shared Opportunities, The Institution of Engineers (India), Assam State Centre, Guwahati, 30 May, 2009.

B. Chapters in Books

1.	Jain, S.K., Sharma,B.R., Zahid, A., Jin, M., Shreshtha, J.L., Kumar, Vijay, Rai, S.P., J.Hu, Y. Luo, and D. Sharma, "A comparative analysis of the hydrogeology of the Indus-Gangetic and Yellow River basins", In: Aditi Mukherji, Karen G. Villholth, Bharat R. Sharma, Jinxia Wang (Eds), Groundwater Governance in the Indo-Gangetic and Yellow River Basins Realities and Challenges, Francis and Taylor, USA, 2009.
2.	Kumar, Bhishm and Rai, S.P., "Groundwater resource and management in mountainous region", In: Mountain People and Environment, a publication of Soil Conservation Society of India, New Delhi, 2009.
3.	Kumar, U. Saravana and Kumar, Bhishm, "Isotope Limnology-Some Indian Case Studies" In: Horizons in Earth Science Research, Chapter-9, Volume 1: ISBN: 978-1-60741-221-2: Editor: Benjamin Veress and Jozsi Szigethy, Nova Science Publishers, Inc, 2009.

C. Research Papers Published in International Journals

1.	Arora, M., Rathore, D.S., Singh, R.D., Kumar, Rakesh and Kumar, A., "Estimation of melt contribution in River Bhagirathi and River Dhauli Ganga at Loharinag Pala and Tapovan Vishnugad sites", International Journal of Water Resources and Protection, II, 636-643, 2010.
2.	Avinash Agarwal, R.K. Rai, Alka Upadhyay, "Forecasting of runoff and sediment yield using artificial neural networks", Journal of Water Resource and Protection, (1), 304-312, 2009
3.	Bandyopadhyay, A., Bhadra, A., Raghuwanshi, N.S. and Singh, R., "Temporal trends in estimates of reference evapotranspiration over India", ASCE J. Hydrologic Engineering, 14(5), 508-515, 2009.
4.	Bhadra, A., Bandyopadhyay, A., Singh, R. and Raghuwanshi, N.S., "Rainfall-runoff modeling: Comparison of two approaches with different data requirements", Water Resources Management, 24, 37-62, 2010.
5.	Bhunya, P.K, N. Panigrahy, R Kumar and Ronny Berndtsson, "Development of a Regional Non-Dimensional Return Period Flood Model", J of Water Resources Management, Springer, UK., 4 (7), *2010.*
6.	Bhunya, P.K, R.D.Singh, Rakesh Kumar and Ronny Berndtsson, "Flood analysis using Negative Binomial and Generalized Pareto models in Partial Duration Series (PDS): at site analysis". Water Resources Res. (Ref No-2009WR008287), 2009.
7.	Bhunya, P.K, S K Jain, P. K. Singh, and S.K. Mishra, "A Simple Conceptual Model of Sediment Yield", J of Water Resources Management, Springer, UK., 4(8), *2010.*

8.	Chandramohan, T , Balchand, A. N., and Samson Mathew, "Discharge and Sediment Transport in the Tropical Rivers of Kerala, India and Their Controlling Factors", Asian Journal of Water, Environment and Pollution, 6(4), 1-9, 2010.
9.	Choudhary, Preetam, Joyanto Routh, Govind J. Chakrapani and Bhishm Kumar, "Biogeochemical records of paleoenvironmental changes in Nainital Lake, Kumaun Himalayas, India", J. of Paleolimnology, DOI 10.1007/s10933-009-9306-y, 42, 771-586; 2009.
10.	Jain, C.K., Bandyopadhyay, A. and Bhadra, A., "Assessment of ground water quality for drinking purpose, District Nainital, Uttarakhand, India", Environmental Monitoring and Assessment, (DOI: 10.1007/s10661-009-1031-5), 2009.
11.	Jain, C.K., Gurunadha Rao, V.V.S., Prakash, B.A., Mahesh Kumar, K.and Yoshida, M., "Metal fractionation study on bed sediments of Hussainsagar Lake, Hyderabad, India", Environmental Monitoring and Assessment, (DOI: 10.1007/s10661-009-0984-8), 2009.
12.	Jain, S.K., N. Panigrahy, V.Kumar and P.K.Bhunya, "Algorithms for Computerized Estimation of Thiessen Weights", *Journal of Computing in Civil Engineering, ASCE, 23(4), 239-247, August, 2009.*
13.	Jain, Sanjay K., R. Keshri, A. Goswami, A. Sarkar and A. Chaudhary, Identification of drought vulnerable areas using NOAA AVHRR Data, International Journal of Remote Sensing, 1366-5901, 30(10), 2653–2668, 2009.
14.	Jain, Sanjay K., Tyagi, J., and Singh Vishal. "Simulation of Runoff and Sediment yield for a Himalayan Watershed Using SWAT Model" J. of Water Resource and Protection, Scientific Research, 2(3), 267-281, 2010.
15.	Jaiswal, R.K., Thomas, T., Ghosh, N.C., Galkate, R.V., and Singh, S., "GIUH based regional rainfall-runoff modeling for un-gauged watersheds in Bundelkhand region of Madhya Pradesh, India", International Journal of Water Resources and Environmental Management, 1(1), 117-131, 2009.
16.	Jaiswal, R.K., Thomas, T.,Galkate R.V., Singh, S., and Nayak, T.R., "Assessment of sedimentation in Ravishankar Sagar reservoir using digital image processing", International Journal of Environmental Research and Development, 3(4), 1238-1245, 2009.
17.	Kumar, Vijay and Jain, S.K., "Trends in seasonal and annual rainfall and rainy days in Kashmir valley in the last century", Quaternary International-The Journal of the International Union for Quaternary Research, 212, 64-69, 2010.
18.	Mehta, Rama and Jain S.K., "Neuro-Fuzzy Inference Model For Stage-Discharge Relationship", International Journal of Water Resources and Environment Systems (IJWREM), 1(1), 81-95., January 2010.
19.	Nayak, P. C., "Explaining Internal Behavior in a Fuzzy If-Then Rule-Based Flood-Forecasting Model" Journal of Hydrologic Engineering, 15(1), 20-28, 2010.
20.	Partha, Pratim Adhikari, H. Chandrasekharan, Debashis Chakrborty, Bhishm Kumar and B. R. Yadav, "Statistical approaches for hydrochemical characterization of groundwater in west Delhi, India" J. of Environmental Monitoring and assessment, DOI 10, 1007/s100661-08-0376-5,154:41-52, 2009.
21.	Purandara, B.K., Venkatesh, B. and Choubey, V.K., "Estimation of Ground water Recharge under different land covers". International Journal, Materials and Geo-environment (published from Slovenia), 57(2), 181-194, June 2010.
22.	Purandara, B.K., Venkatesh, B. and Veerabasawant Reddy, "Impact of Afforestation in dry deciduous Zones of Karnataka – A Case study". Int. Journal Eco. Env. & Cons 15(2), 213-216, 2009.
23.	Pandey, R.P., Ashish Pandey, Ravi Galkate, Hi-Ryong Byun and B.C. Mal, "Integrating Hydro-meteorological and Physiographic Factors for Assessment of Vulnerability to Drought, Water Resources Management", Springer Publishers, Published on line DOI: 10.1007/s11269-010-9653-5., 2010.
24.	Rao, Y.R.S., Keshari, A.K., and Gosain, A.K., "Evaluation of regional groundwater quality using PCA and geostatistics in the urban coastal aquifer, East Coast of India". International Journal of Environmental and Waste Management, 5(1/2), 163-180, 2010.

25.	Sharma, M.K., Jain, C.K., Singhal, D.C. and Choubey, V.K., "Kinetics of sorption of Lead on bed sediments of river Hindon, India", Environmental Monitoring and Assessment, 157, 11-21, 2009
26.	Singh, S., Ghosh, N.C., Pandey, R.P., Galkate, R.V., Thomas, T. and Jaiswal, R.K., "Numerical Solution of 1D Boussinesq Equation for Water Table Fluctuation between Drains in Response to Recharge and ET in A Sloping Aquifer", International Journal of Ecological Economics & Statistics (IJEES), Vol. 14 (S09), 50-59, 2009.
27.	Singh, S.K., "Generalized analytical solutions for groundwater head in a horizontal aquifer in the presence of subsurface drains", Jour. Of Irrigation and Drainage Engg., ASCE, 295-302, May-June 2009.
28.	Singh, S. K., "A simple method for quick estimation of leaky aquifer parameters" Journal of Irrigation and Drainage Engineering, ASCE, published online, 2009.
29.	Singh, S. K., (2009). "Diagnostic curves for identifying leaky aquifer parameters with or without aquitard storage" Journal of Irrigation and Drainage Engineering, ASCE, 136(1), Jan/Feb 2010.
30.	Singh, S. K., "Drawdown due to pumping a partially penetrating large diameter well using MODFLOW." Journal of Irrigation and Drainage Engineering, ASCE, 135(3), 388-392, 2009.
31.	Singh, S.K., "Flow depletion induced by pumping well from stream perpendicularly intersecting impermeable/recharge boundary", Jour. Of Irrigation and Drainage Engg., ASCE, 499-504, July-August 2009.
32.	Singh, S. K., "Time-base as an invertible function of the parameters of gamma unit hydrograph" Journal of Irrigation and Drainage Engineering, ASCE, 135(6), Nov/Dec 2009.
33.	Sukhija, B.S., D. V. Reddy, and P. Nagabhushanam, Bhishm Kumar, "Significant Temporal Changes in ^{14}C in Dissolved Inorganic Carbon of Groundwater Related to Reservoir-triggered Seismicity", Seismological Research Letters, 81(2), doi: 10.1785/gssrl.81.2.218, March, 2010.
34.	Thayyen, R. J. and Gergan, J. T. "Role of glaciers in watershed hydrology: a preliminary study of a Himalayan catchment", The Cryosphere, 4, 115-128, 2010.
35.	Thomas, T., Ghosh, N.C., Jaiswal, R.K., Galkate, R.V. and Singh, S. (2009). "Influence of special heterogeneity of soil and land use on infiltration and hydraulic conductivity-case studies", International Journal of Water Resources and Environmental Management, 1(1), 67-78, 2009.
36.	Vijay Kumar, Sharad K Jain, "Trends in seasonal and annual rainfall and rainy days in Kashmir valley in the last century", Quaternary International-The Journal of the International Union for Quaternary Research, 212, 64-69, 2010.

D. Research Papers Published in National Journals

37.	Bhadra, A. and Bandyopadhyay, A., "Development of an ANN model for runoff prediction", J. Indian Water Resources Society, 29(4), 46-53, 2009.
38.	Chakraborty, B. and Ghosh, N.C., "Modelling of groundwater transport in arsenic affected groundwater in Nadia and North 24-Paraganas districts of West Bengal", Journal of Indian Society for Applied Geochemistry, 2010.
39.	Chandramohan, T and Balchand, A. N., "Sediment Yield Characteristics of a Tropical River basin". IUP Journal Hyderabad, 2010.
40.	Choubey, V.K., Singh, Omkar and Srivastava, S.L., "Study of Hydrological Soil Properties of Salt Affected Areas Around Gohana, Haryana", e-Journal Earth Science India, 2(3), 211-223, 2009.
41.	Jhajharia, D. Ali, Md. I., Deb Berma, S., Durbude, D. G., and R. Kumar, "Assessing reference evapotranspiration by temperature-based methods for humid regions of Assam", Journal of Indian Water Resources Society, Roorkee, 29(2), 1, 2009.
42.	Misra D., Thomas Oommen, Avinash Agarwal, Surendra K., Mishra, Anita M. Thompson, "Application and analysis of support vector machine based simulation for runoff and sediment yield", J. of Biosystems engineering 103, 527-535, 2009.

43.	Kumar, Bhishm, M.S. Rao, S. V. Navada, S. K. Verma and Swati Shrivastava, "Evaluation of effectiveness of artificial recharge measures in parts of Maharastra using environmental isotopes", Current Science, 97(9), 1321-1330, 2009.
44.	Kumar, Bhishm, U. K. Singh and Rao, M.S., "Isotope Hydrology in India", Hydrology Journal, 31(3-4), 45-79, 2009.
45.	Purandara, B.K. and Shivapur, A. V., "Sediment Observation in River basin: A case study", ICFAI University Journal of Soil and Water Sciences, II (4), November 2009.
46.	Rai, S.P., Bhishm Kumar and Singh, Pratap, "Estimation of contribution of southwest monsoon rain to Bhagirathi River near Gaumukh, western Himalayas, India using Oxygen-18 isotope", Current Science, 97 (2), 240-245, 2009.
47.	Sarkar Archana, Raju, M. M. and Kumar A., "Sediment Runoff Modelling using Artificial Neural Networks", Journal of Indian Water Resources Society (IWRS), January 2010.
48.	Sharma S.K., G,S.Rajput, S.Tignath and R.P.Pandey, "Morphometric Analysis and Prioritization of a Watershed using GIS". Jour. of Indian Water Resources Society (IWRS), January 2010.
49.	Sharma, Anupma and N.C. Ghosh, 'Groundwater Quality Modelling and Management', Journal of Applied Geochemistry, April, 2009.
50.	Sharma, M.K. and Choubey, V.K., "Ground Water Quality Study of District Jaipur with special reference to Suitability for Irrigation Purpose, Journal of Indian Association for Environmental Management, 36(1), 8-16, 2009.
51.	Shivapur, A.V., Venktesh.B., and Mulangi R.H., "Yield studies on Neersagar Reservoir and its catchment", Jour. of Earth Science and Engineering, CAFET-INNOVA Publications, Hyderabad, 2009.
52.	Singh, Omkar, Kumar, V., Rai S.P. and Choubey, V.K., Principal Component Analysis of Groundwater Quality and Assessing Impact of Chemical Fertilizers in the Kandi Belt of Jammu Region (J&K), J. of Environmental Sciences, III(2), 33-43, May 2009.
53.	Singh, R.D., Manohar Arora and Rakesh Kumar, 'Climate change impact on water resources in India', Mausam (Diamond Jubilee Volume, 2009), 91-100, 2009.
54.	Thomas, T., Jaiswal, R.K., Galkate, R. and Singh, S. (2009). "Estimation of revised capacity in Shetrunji reservoir using remote sensing & GIS", Journal of Indian Water Resources Society, 29, 8-14, July 2009.
55.	Varadarajan, N., Purandara, B.K. and Bhishm kumar, "Assessment of Ground water Characteristics in Ghataprabha Command Area, Karnataka, India", Journal of Environmental Science and Engineering, NEERI, Nagpur, India, 2010.
56.	Venkata Ramana R., Chakravorty, B., Pandey, N.G and Mani,P, "Development of Intensity Duration Frequency Curves using L-moment and GIS technique", Journal of Applied Hydrology, Department of Geophysics, Andhra University, Visakhapatnam in XXI(1&2), 2008
57.	Venkata Ramana R., Chakraborty, B., Pandey, N.G and Mani,P, "Intensity Duration Frequency Relationship for Short Duration Rainfall", Hydrology Journal of Indian Association of Hydrologist (IAH), 2010.
58.	Venkatesh, B. and Purandara, B.K., "Application of TOPMODEL to Barchinala Catchment", Journal of Soil and Water Sciences, The ICFAI University Press, 2(3), 7-24, 2009.

E. Research Papers in International Conferences

59.	Bandyopadhyay, A., Raghuwanshi, N.S. and Singh, R., "Development of monthly net irrigation requirement maps for India", International Conference on Food Security and Environmental Sustainability (FSES-2009), IIT, Kharagpur, December 17-19, 2009. (Proceedings published on CD).

60.	Bhatnagar, N.K. and Lohani, A.K. "Impact of Climate Change on Water Resources of South Asia; special focus on India", Proceedings 3rd International Conference on Hydrology and Watershed Management with Focal Theme on Climate Change – water food and environmental security (ICHWAM), JNTU, Hyderabad, February 3-6, 2010.
61.	Bhishm Kumar and Rai, S.P., "Sedimentation rate and pattern in Dal Lake of Jammu and Kashmir, India using radiometric dating techniques", International Conf. on 3rd International Perspective on Current & Future State of Water Resources & the Environment organized by Indian Institute of Technology Madras (IITM), Chennai, India, January 5-7, 2010.
62.	Bhishm Kumar, S. P. Rai, Gopal Krishna and Rawat, Y.S., "Identification of recharge zones and sources of springs in mountainous region using isotopes: A case study from Uttarakhand State", International Workshop on Source, Treatment & Distribution of Drinking Water organized by Cooperation Centre for Riverbank Filtration (CCRBF) & Uttarakhand State Council for Science & Technology (UCOST) in Dehradun, 14-15 September, 2009.
63.	Bhunya, P.K., C S P Ojha, R. D. Singh and Pierre Hubert, "A Relook at the Simulation Methods in Hydrological Analysis", 8th IAHS scientific assembly and 37th IAH conference, Ref-4461 (Poster), Hyderabad, September 8-12, 2009.
64.	Bobba, A.G., Chambers, P. Satyaji Rao, Y R, Mondal, N.C. and Nagabhatla, N., "Prediction of nutrients discharge from Krishna delta to Coast". 3rd International Conference on Hydrology and Watershed Management with Focal Theme on Climate Change – water food and environmental security (ICHWAM), JNTU, Hyderabad, I, 1-9, February 3-6, 2010.
65.	Chakraborty, B. and Pandey, N.G., "Managing Waterlogging in Lower Gandak Basin of India by Conjunctive Use" International conference on Food Security and Environmental Sustainability (FSES 2009), IIT Kharagpur, December 17-19, 2009. (Proceedings published on CD).
66.	Durbude, D.G. and Jain M.K., "An Investigation of Soil Moisture Accounting in Long Term Hydrologic Simulation Models Based on SCS-CN Concept", Proceedings of International Conference on Food Security and Environmental Sustainability (FSES) IIT Kharagpur, December 17-19, 2009.
67.	Galkate R.V., Thomas, T., Pandey, R.P., Singh, S. and Jaiswal, R.K., "Drought study in Chhindwara district of Madhya Pradesh, India", 3rd International Conference on Hydrology and Watershed Management with Focal Theme on Climate Change – water food and environmental security (ICHWAM), JNTU, Hyderabad, 267-276, February 3-6, 2010.
68.	Galkate, R.V., Thomas, T., Jaiswal, R.K., Singh, S., Ghosh, N.C. and Nayak, T.R., "Water resources management plan for Naoradehi Wildlife Sanctuary", International Conference on Food Security and Environmental Sustainability (FSES-2009), IIT, Kharagpur, December 17-19, 2009. (Proceedings published on CD).
69.	Goel, M. K., "Some recent observations in the western Himalayan region", International Workshop on "Climate change and water resources in South Asia" organized by UNESCO, Columbia University, and Delhi Technical University, N. Delhi, August 8-10, 2009,
70.	Jaiswal, R.K., Galkate, R.V., Thomas, T., Ghosh, N.C. and Singh, S., "Remote Sensing & GIS based assessment of revised capacities in reservoirs of central India", 3rd International Conference on Hydrology and Watershed Management with Focal Theme on Climate Change – water food and environmental security (ICHWAM), JNTU, Hyderabad, 1093-1102, February 3-6, 2010.
71.	Jaiswal, R.K., Thomas, T., Galkate, R.V., Singh, S. and Ghosh, N.C., "Surface and groundwater resources development in basaltic region of Madhya Pradesh, India- A case study, International Conference on Food Security and Environmental Sustainability (FSES-2009), IIT, Kharagpur, December 17-19, 2009. (Proceedings published on CD).
72.	Khobragade, S. D., Ojha, C.S.P., Senthil Kumar, A. R., and Singh, R.D., "Estimating vapour pressure from temperature and humidity data using ANN technique", Third International Conference on "Hydrology and Watershed Management" (ICHWAM-2010), Organised by the Centre For Water Resources, Institute of Science & Technology, JNTU, Hyderabad, India, February 3-6, 2010.

73.	Khobragade, S.D., C.S.P. Ojha & R. D. Singh, "Possible impact of global warming on future evaporation rates from lakes in Udaipur, India", Third International Conference on "Hydrology and Watershed Management" (ICHWAM-2010), Organised by the Centre For Water Resources, Institute of Science & Technology, JNTU, Hyderabad, India, February 3-6, 2010.
74.	Krishna, B., and Satyaji Rao, Y.R., "Assessment of water availability for the changed rainfall pattern", Third international conference on "Hydrology and watershed management" I, 453-461, JNTU, Hyderabad, February 3-6, 2010.
75.	Kumar, Vijay, Anandha Kumar, K. J., Goel, M. K., and Das, P. "Groundwater flow modelling in a canal command of Haryana State, India", Proceedings of the Joint IAHS & IAH Symposium, Hyderabad, India, September 2009 and IAHS Publ. 329, 254 – 263, 2009.
76.	Kumar Rakesh "Assessment to vulnerability to drought", Satellite data training workshop on drought", University of Tokyo Campus, Tokyo, Japan, 17-18 December 2009.
77.	Kumar Rakesh "Flood hazard modeling and flood risk assessment", International Workshop on application and validation of Global Flood Alert System (GFAS), organized by International Centre for Water Hazard and Risk Management (ICHARM) under the auspices of UNESCO, Tsukuba, Japan, 3-7 August, 2009.
78.	Lohani, A.K., Rakesh Kumar, R.D. Singh, "Applications of Soft Computing Techniques in Hydrological Modelling, International Conference on "Food Security and Environmental Sustainability (FSES-2009)", IIT, Kharagpur, December 17-19, 2009. (Proceedings published on CD).
79.	Lohani, A.K., Rakesh Kumar, S.K. Jain, "Framework of Decision Support System for Water Resources Planning and Management", International Conference on "Food Security and Environmental Sustainability (FSES-2009)", IIT, Kharagpur, December 17-19, 2009. (Proceedings published on CD).
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81.	Mehta, Rama and Kumar Vipin, "Hybrid Subtractive Clustering Technique For Estimation of Ground Water Table", 4th Indian International Conference on Artificial Intelligence (IICAI-09), Tumkur, Karnataka State, India, December 16-18, 2009.
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149.	Rasheed, K., Muhammad Shafeeque, Chandramohan, T. and Balchand, A.N., "Exposition on the decadal fluvial dynamics of Central Kerala waterways", Proceedings of 22nd Kerala Science Congress, , KFRI, Peechi, pp.387-388, 28-31 January, 2010.
150.	Rathore D.S. and Tanveer Ahmed, "Basin and river network delineation using GLOBE digital elevation model", Regional Workshop on Water management and Hydrochemistry in Uttarakhand, CGWB, Dehradun. Uttarakhand. February 18- 19, 2010.
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153.	Rathore D.S., Sharad Kumar Jain, Yatveer Singh, P.K. Agarwal, Tanveer Ahmed, "Basin and river network delineation using SRTM digital elevation model", National Symposium on Climate Change and Water Resources in India, IAH, Roorkee. November 18-19, 2009.
154.	Rathore, D.S., M Arora, R D Singh, G Gupta and A Dheeman, " Snow and Ice mapping in Bhagirathi basin up to Loharinag Pala using remote sensing", Proceedings of National Symposium on "Climate change and water resources in India", IAH at NIH Roorkee, pp. 78 -79, 18-19 November, 2009.
155.	Sarkar, Archana, Sharma, N., Garg, R.D. and Arora, M., "River Channel Changes of the Brahmaputra in India using Geospatial techniques", Proceedings of National Symposium on "Climate Change and Water Resources in India (CCWRIN)", organized by Indian Association of Hydrologist, NIH Roorkee, November 18-19, 2009.
156.	Sharma, M K, Choubey, V K and Singh, R D, "Ground water quality status of Doon Valley, Dehradun and Hardwar district of Uttarakhand state", Abstract Volume, Regional Workshop on "Water Management & Hydrochemistry in Uttarakhand" organised by Central Ground Water Board, Uttaranchal Region, Dehradun, pp54, 18-19 February, 2010.
157.	Sharma, M.K., Singh, R.D. and Choubey, V.K., "Groundwater Quality in NCT, Delhi" National Conference on "Management of Water, Air, Noise, Solid Waste and Plastic Waste during Commonwealth Games at New Delhi", organised by IDC Foundation, New Delhi, 6-7 November, 2009.
158.	Singh, Omkar, Choubey, V.K., "Assessment of Ground Water Pollution in Haridwar District, Uttarakhand using PCA", Paper presented in Regional Workshop on "Water Management & Hydrochemistry in Uttarakhand", organised by Central Ground Water Board, Uttaranchal Region, Dehradun, 18-19 February, 2010.
159.	Singh, R. D. and Kumar, C. P., "Impact of Climate Change on Groundwater Resources", Proceedings of 2nd National Ground Water Congress, New Delhi, 332-350, 22 March, 2010.
160.	Singh, R.D. and Singh, S., "Groundwater Management & Its Quality", Workshop on Water management and Hydrochemistry in Uttarakhand, organized by CGWB, Dehradun, 18-19 February, 2010.
161.	Singh, S. and Kumar, C.P., "Assessment of Groundwater Recharge and Flow Simulation to Study the Impact of Climate Change", Workshop on "Ground Water Resources Estimation" organized by CGWB and IIT New Delhi, at New Delhi, February 23-24, 2010.
162.	Thayyen R. J., "Defining 'Himalayan catchment' for better understanding of climate change impact on Himalayan glaciers and river flows", National Symposium on Climate Change and water resources, NIH, Roorkee, 18-19 November, 2009.
163.	Thayyen R. J., Goel, M. K. and Kumar, N., "Some recent observations on Glacier change in the Western Himalaya", Workshop on Impact of Climate Change on water resources in India, CSMRS, Delhi, 21 July 2009.
164.	Thayyen, R. J., "Climate change impact on cryospheric systems of Jammu & Kashmir", Workshop on Roof top rainwater harvesting and Spring recharge, CGWB, Jammu, 10 February, 2010.

165.	Thayyen, R. J.. "Deciphering the message of changing cryosphere of Jammu & Kashmir", Invited lecture in "Brainstorming session on water: Present and future" organized by the Himalayan Ecological Research foundation, Jammu University, 22 March, 2010.
166.	Tyagi, J V., Kumar, Rakesh and Singh, R.D. "Soil Moisture Monitoring and its Importance in On-Farm Water Management", paper presented in Workshop on Water Management and Hydro-Chemistry in Uttarakhand, CGWB, Dehradun, February 18-19, 2010.
167.	Tyagi, J.V., Kumar, R., and Singh, R.D. "A Review of Technological Options for Improved Agricultural Productivity per Drop of Water", 44th ISAE Annual Convention & Symposium, New Delhi, January 28-30, 2010.
168.	Varadaraju, S., Hanumanthappa and Venkatesh, B., "Suitablity of coastal soil water for Brakishwater Shrimp Culture along Udupi District Karnataka State", Proceedings of National Symposium on "Climate Change and Water Resources in India (CCWRIN)", organized by Indian Association of Hydrologist, NIH Roorkee, November 18-19, 2009.
169.	Venkatesh, B. and Chandrakumar S., "Development of base flow indices for rivers of Western Ghats of Karnataka State", ", Proceedings of National Symposium on "Climate Change and Water Resources in India (CCWRIN)", organized by Indian Association of Hydrologist, NIH Roorkee, November 18-19, 2009.
170.	Venkatesh, B., Lakshman Nandagiri, Purandara, B.K. and Reddy, V.B., "Variability of soil hydrologic characteristics under different land covers – a case study from Sahayadri mountains, India", Proceedings of National Seminar on Sustainable Water Resources Management", Organised by NITK, Surathkal, 2009.
171.	Vijaya Kumar, S.V., Mohan Rangan, D., Rao, U.V.N. and Rao. P.R., "Short duration rainfall analysis for Kakinada city", National Conference on Sustainable Water Resources Management and Impact of Climate Change, BITS-Pillani, Hyderabad, pp 207-216, March 5-6, 2010.
172.	Vijaya Kumar, S.V., Rao, P.R., Rao, U.V.N. and Vijaya. T., "Impact of Urbanization on Shallow Aquifer of Kakinada City", National Seminar on Conservation of Lakes and Water Resources", MPUAT, Udaipur, Rajasthan, February 19-20, 2010.

APPENDIX - X

POSITION OF STAFF

S.N.	Group	Post	As on 1.4.2009	As on 31.3.2010
1.	A	Director	01	01
2.	A	Scientist F	01	01
3.	A	Scientist E1	08	07
4.	A	Scientist C	20	19
5.	A	Senior Administrative Officer	01	01
6.	A	Finance Officer	0	0
7.	A	Scientist B	41	41
		Sub Total	**72**	**70**
8.	B	Documentation Officer	01	01
9.	B	Section Officer	03	03
10.	B	Private Secretary	01	01
11.	B	Principal Research Assistant	05	05
12.	B	Senior Research Assistant	18	18
13.	B	Asstt.Library Information Officer	01	01
14.	B	Senior Hindi Translator	01	01
15.	B	Junior Engineer (Senior Grade)	02	03
16.	B	Senior Technician	01	07
17.	B	Superintendent	03	03
18.	B	Personal Assistant	12	12
19.	B	Draftsman Grade-I	02	02
20.	B	Research Assistant	10	10
21.	B	Library and Information Asstt.	01	01
22.	B	Junior Engineer	01	-
23.	B	Technician Grade-I	06	-
24.	B	Staff Car Driver (Special Grade)	01	01
		Sub-Total	**69**	**69**
25.	C	Draftsman Grade-II	02	02
26.	C	Technician Grade-II	08	08
27.	C	Stenographer Grade-III	05	05
28.	C	Upper Division Clerk	10	10
29.	C	Receptionist	01	01
30.	C	Technician Grade-III	05	05
31.	C	Lower Division Clerk	06	06
32.	C	Staff Car Driver Grade-I	02	02
33.	C	Staff Car Diver (Grade-II)	03	03
34.	C	Driver (Ordinary grade)	04	04
35.	C	Attendant (Senior Grade)	15	15
36.	C	Messenger (Sr. Grade)	22	22
37.	C	Security Guard	05	03
38.	C	Mali (Sr. Grade)	04	04
39.	C	Safai Karamchari (Sr. Grade)	04	04
		Sub total	**96**	**94**
		GRAND TOTAL	**237**	**233**

APPENDIX - XI

AUDITED STATEMENT OF ACCOUNTS

AUDITED STATEMENT OF ACCOUNTS

Awasthi Prakash & Associates
CHARTERED ACCOUNTANTS
16, CIVIL LINES, ROORKEE- 247 667 Distt.: Haridwar (U.K.) INDIA
Ph.: 91-1332-272852, Fax: 274831, E-mail: shalini@accountant.com

AUDITORS' REPORT

The Governing Body,
National Institute of Hydrology,
Roorkee

We have audited the attached Balance Sheet of NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE as at 31st March, 2010 and also the Income & Expenditure Account and the Receipts & Payments Account for the year ended on that date annexed thereto. These financial statements are responsibility of the management. Our responsibility is to express an opinion on this financial statement based on our audit.

We conducted our audit in accordance with the auditing standards generally accepted in India. Those Standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosure in the financial statement. An audit also includes assessing the accounting principles used and significant estimate made by management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion.

We report that:-

1.0 Projects

As per the instructions of the Secretary, Ministry of Water Resources, the Hydrology Project and IEC Projects have to be incorporated in the Plan Expenditures. The fund of the IEC Grant was received in the bank account of Plan funds. However the Hydrology Project is a separate project, aided by the World Bank and separate account is opened for it.

2.0 TA Advance, LTC Advance, Pay Advance and Advance to firm
(Non Plan).

A) TA Advance of Rs. 94,613, is old and outstanding and not settled till 31.3.2010. LTC Advance of Rs. 36,075, outstanding and is not settled till 31.3.2010.

(Plan).
TA Advance around Rs. 6,55,236.00 outstanding and is not settled till 31.3.2010. Advance to Firm of Rs. 33,63,660 is outstanding and is not settled till 31.3.2010.

3.0 We further report that,

1. We have obtained all the information and explanation which, to the best of our knowledge and belief were necessary for the purpose of our audit.
2. Subject to the qualifications stated above, in our opinion, proper books of accounts as required by law have been kept by the society so far as appears from our examination of those books.

AWASTHI PRAKASH & ASSOCIATES ROORKEE Chartered Accountants

Awasthi Prakash & Associates
CHARTERED ACCOUNTANTS
16, CIVIL LINES, ROORKEE- 247 667 Distt.: Haridwar (U.K.) INDIA
Ph.: 91-1332-272852, Fax: 274831, E-mail: shalini@accountant.com

In our opinion and to the best of our information and according to the explanation given to us, Statement together with schedule 1 to 23 attached and read with Schedule 24 of notes on accounts to this report give a true & fair view:

i) In case of Balance Sheet, of the state of affairs of the society as at March 31st, 2010
(ii) In case of Income & Expenditure a/c of the society, of the excess of Income over Expenditure for the year ended on that date.
(iii) In the case of Receipt & Payment a/c of the transactions for the year Ended on that date.

FOR AWASTHI PRAKASH & ASSOCIATES
Chartered Accountants

AWASTHI PRAKASH & ASSOCIATES ROORKEE Chartered Accountants

SHALINI PRAKASH
PARTNER
M. No. 077102

PLACE: ROORKEE
DATE: 31.08.2010

Awasthi Prakash & Associates
CHARTERED ACCOUNTANTS
16, CIVIL LINES, ROORKEE- 247 667 Distt.: Haridwar (U.K.) INDIA
Ph.: 91-1332-272852, Fax: 274831, E-mail: shalini@accountant.com

UTILISATION CERTIFICATE

Certified that the National Institute of Hydrology, Roorkee has utilised the Grants-in-aid detailed hereunder during the Financial Year 2009-2010 and the same has been verified with reference to accounting records maintained by the Institute and has been found to be correct:

PARTICULARS	R&D(PLAN)	IEC	HP-II	NON-PLAN	TOTAL
Opening Balance (as on 01.04.2009)					
a) at NIH Headquarters	798.74		3,483,809.00	13,701.92	3,498,309.66
b) at R.C.Belgaum	34,023.09			29,696.80	63,719.89
c) at R.C.Guwahati	47,846.18			7,777.00	55,623.18
d) at R.C. Jammu	19,437.67			588.36	20,026.03
e) at R.C. Kakinada	17,708.36			13,069.00	30,777.36
f) at R.C. Patna	17,900.92			15,746.00	33,646.92
g) at R.C. Sagar	17,651.25			9,776.47	27,427.72
TOTAL	**155,366.21**	-	**3,483,809.00**	**90,355.55**	**3,729,530.76**
Grants-in-aid received from MOWR, New Delhi	**83,016,000.00**	**7,900,000.00**	**98,100,000.00**	**100,405,000.00**	**289,421,000.00**
TOTAL	**83,171,366.21**	**7,900,000.00**	**101,583,809.00**	**100,495,355.55**	**293,150,530.76**
Less: Payment (Net of Miscellaneous receipts such as Savings Bank Interest etc.)	82,863,775.00	7,887,129.00	93,682,730.00	100,451,243.25	284,884,877.25
Closing Balance (as on 31.03.2010)					
a) at NIH Headquarters	231,498.92	12,871.00	7,901,079.00	12,456.67	8,157,905.59
b) at R.C. Belgaum	6,266.09			5,138.80	11,404.89
c) at R.C. Guwahati	29,100.00			5,000.00	34,100.00
e) at R.C. Jammu	16,362.67			4,956.36	21,319.03
d) at R.C. Kakinada	9,019.36			3,198.00	12,217.36
e) at R.C. Patna	5,343.92			8,362.00	13,705.92
g) at R.C. Sagar	10,000.25			5,000.47	15,000.72
TOTAL	**307,591.21**	**12,871.00**	**7,901,079.00**	**44,112.30**	**8,265,653.51**

FOR AWASTHI PRAKASH & ASSOCIATES
CHARATERED ACCOUNTANT

PLACE : ROORKEE
DATE : 31-08-2010

[D.P. SINGH]
FINANCE OFFICER

[R.D. SINGH]
DIRECTOR

Director
National Institute of Hydrology
Roorkee

SHALINI PRAKASH
PARTNER
M.NO. 077102

AWASTHI PRAKASH & ASSOCIATES ROORKEE Chartered Accountants

NATIONAL INSTITUTE OF HYDROLOGY (PLAN & NON PLAN), ROORKEE

BALANCE SHEET AS ON 31.03.2010

PARTICULARS	SCH.	Plan-R&D	IEC	HP-II	NON-PLAN	TOTAL	PREV. YEAR
CAPITAL FUND AND LIABILITIES							
CORPUS/CAPITAL FUND	1	-	-	-	-	-	-
RESERVES AND SURPLUS	2	170,224,243.39	12,871.00	15,378,793.00	(103,988,470.70)	81,627,436.69	61,921,085.33
EARMARKED/ENDOWMENT FUNDS	3	-	-	-	-	-	-
SECURED LOANS AND BORROWINGS	4	-	-	-	-	-	-
UNSECURED LOANS AND BORROWINGS	5	-	-	-	-	-	-
DEFERRED CREDIT LIABILITIES	6	-	-	-	-	-	-
CURRENT LIABILITIES AND PROVISIONS	7	2,755,174.00	-	9,500.00	109,791,373.00	112,556,047.00	99,883,023.00
			-	-		-	
TOTAL		**172,979,417.39**	**12,871.00**	**15,388,293.00**	**5,802,902.30**	**194,183,483.69**	**161,804,108.33**
			-	-			
ASSETS			-	-			
FIXED ASSETS	8	114,866,893.18	-	7,406,414.00	-	122,273,307.18	97,886,244.57
INVESTMENTS - EARMARKED/ENDOWMENT FUNDS	9	-	-	-	-	-	-
INVESTMENTS - OTHERS	10	-	-	-	-	-	-
CURRENT ASSETS, LOANS, ADVANCES ETC.	11	58,112,524.21	12,871.00	7,981,879.00	5,802,902.30	71,910,176.51	63,917,863.76
MISCELLANEOUS EXPENDITURE			-	-		-	-
(to the extent not written off or adjusted)			-	-		-	-
			-	-		-	
TOTAL		**172,979,417.39**	**12,871.00**	**15,388,293.00**	**5,802,902.30**	**194,183,483.69**	**161,804,108.33**
SIGNIFICANT ACCOUNTING POLICIES	23						

(D.P. SINGH)
FINANCE OFFICER

PLACE : ROORKEE
DATE : 31-08-2010

(R.D. SINGH)
DIRECTOR

Director
National Institute of Hydrology
Roorkee

AWASTHI PRAKASH & ASSOCIATES ROORKEE Chartered Accountants

FOR AWASTHI PRAKASH & ASSOCIATES
CHARTERED ACCOUNTANTS

SHALINI PRAKASH
PARTNER
M.NO. 077102

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED : 31-03-2010

PARTICULARS	SCH.	CURRENT YEAR					PREV. YEAR
		PLAN			NON-PLAN	TOTAL	
		R&D	IEC	HP-II			
INCOME							
Income from Sales/Services	12	-	-	-	-	-	2,691,860.00
Grants/Subsidies	13	83,016,000.00	7,900,000.00	98,100,000.00	100,405,000.00	289,421,000.00	158,600,000.00
Fees/Subscriptions	14	-			-	-	-
Income from Investments (Income on Invest. From earmarked/endow. Funds transferred to Funds)	15	-	-	-	-	-	-
Income from Royalty, Publications etc.	16	279,000.00	-	-	-	279,000.00	597,485.00
Interest Earned	17	345,071.00	-	566,182.00	306,069.00	1,217,322.00	5,830,545.00
Other Income	18	133,268.15	-	-	5,306,499.75	5,439,767.90	437,373.00
Increase/Decrease in stock of Finished goods and work-in-progress	19	-			-	-	-
TOTAL (A)		**83,773,339.15**	**7,900,000.00**	**98,666,182.00**	**106,017,568.75**	**296,357,089.90**	**168,157,263.00**
EXPENDITUREE							
Establishment Expenses	20	18,017,477.00	-	-	120,299,849.00	138,317,326.00	126,581,919.00
Other Administrative Expenses etc.	21	22,063,696.00	7,887,129.00	88,571,467.00	722,965.00	119,245,257.00	20,021,429.00
Expenditure on Grants, Subsidies etc.	22	-			-	-	-
Depreciation	8	24,372,233.54	-	1,809,578.00	-	26,181,811.54	15,423,234.25
TOTAL (B)		**64,453,406.54**	**7,887,129.00**	**90,381,045.00**	**121,022,814.00**	**283,744,394.54**	**162,026,582.25**
Balance being excess of Income over Expenditure (A-B)		**19,319,932.61**	**12,871.00**	**8,285,137.00**	**(15,005,245.25)**	**12,612,695.36**	**6,130,680.75**
Less:- Deductions in respcet of prior period adjustment		-	-	-	-	-	3,937,143.00
Add:- Additions in respect of prior period adjustment		-	-	-	-	-	3,165,428.00
Transfer to Special Reserve (Specify each)		-	-	-	-	-	-
Transfer to/from General Reserve		**19,319,932.61**	**12,871.00**	**8,285,137.00**	**(15,005,245.25)**	**12,612,695.36**	**5,358,965.75**
BALANCE BEING SURPLUS/(DEFICIT) CARRIED TO CORPUS/CAPITAL FUND							
SIGNIFICANT ACCOUNTING POLICIES	23						
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	24						

FOR AWASTHI PRAKASH & ASSOCIATES
CHARTERED ACCOUNTANTS

PLACE: ROORKEE
DATE : 31-08-2010

(D.P. SINGH)
FINANCE OFFICER

(R.D. SINGH)
DIRECTOR

Director
National Institute of Hydrology
Roorkee

AWASTHI PRAKASH & ASSOCIATES
ROORKEE
Chartered Accountants

SHALINI PRAKASH
PARTNER
M.NO. 077102

AUDITED STATEMENT OF ACCOUNTS

NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

RECEIPT AND PAYMENT ACCOUNTS FOR THE YEAR ENDING 31ST MARCH, 2010

PREVIOUS YEAR	RECEIPTS	PLAN			NON-PLAN	TOTAL	PREVIOUS YEAR	PAYMENTS	PLAN			NON-PLAN	TOTAL
		R&D	IEC	HP					R&D	IEC	HP		
6,020.66	1. OPENING BALANCE	798.71	-	3,483,809.00	13,701.92	3,498,309.66		1. EST. EXPENSES					
399,378.10	Opening Balance with RCs	134,567.47	-	-	76,653.63	231,221.10	82,672,242.00	(a) Pay & Allowances	9,060,091.00	-	-	85,035,146.00	94,095,237.00
	2. GRANTS RECEIVED						1,577,358.00	(b) Medical	125,690.00	-	-	1,588,567.00	1,714,257.00
158,600,000.00	(a) From MOWR, Govt. of India	83,016,000.00	7,900,000.00	98,100,000.00	100,405,000.00	289,421,000.00	2,271,303.00	© Travel	2,486,163.00	-	-	2,949,246.00	5,435,409.00
2,911,860.00	(b) From other sources	-	-	-	-	-	821,666.00	(d) L.S. & Pension Contribution		-	-	-	-
	3. INTEREST RECEIVED						3,775,408.00	(e) Employer's Contribution	1,461,612.00	-	-	13,490,168.00	14,951,720.00
367,038.00	(a) On Bank Accounts/other interest	320,015.00	-	566,025.00	121,876.00	1,007,916.00	20,102.00	(f) Honorarium & Others	1,000.00	-	-	63,128.00	64,128.00
133,751.00	(b) On Advances	6,059.00	-	-	144,075.00	150,134.00	172,680.00	(g) Advances to Employees	89,898.00	-	59,500.00	620,743.00	770,141.00
5,163,561.00	© On CPF Balances	-	-	-	-	-		2. CAPITAL EXPENSES		-			-
28,491.00	(d) Interest received from RCs	-	-	-	-	-	19,367.00	(a) Furniture & Fixture	3,118,555.00	-	-	-	3,118,555.00
					-			(b)Computer	20,138,246.00	-	1,856,813.00		21,995,059.00
	4. RECOV. OF ADVANCES						691,991.00	(c) Library Books/Journals	148,702.00	-		-	148,702.00
696,727.00	(a) From Employees	-	-	162,192.00	992,707.00	1,154,899.00	9,979,448.00	(d) Equipment	9,811,244.00	-	505,597.00	-	10,316,841.00
-	(b) From Firms	-	-	-	-	-	0.00	(e) Construction	323,956.00	-		-	323,956.00
		-	-	-	-	-		(f) Vehicle	-	-	3,757,825.00	-	3,757,825.00
-	© Deptt. Advance	-		146,427.00	-	146,427.00		3. OFFICE EXPENSES		-			-
-	(d) L.C. from IOB	-	-	-	-	-	2,970,660.00	(a) Misc.	2,194,481.00	-	77,713,003.00	3,021,135.00	82,928,622.00
237,208.00	(e) LC with SBI	2,559,700.00	-	-	-	2,559,700.00	0.00	(b)Wages	6,094,482.00	-			6,094,482.00
	5. OTHER RECEIPT	-	-	-	-		158,631.00	(c) Publication of Tech. Reports	415,539.00	-			415,539.00
330,129.00	(a) Misc. Receipt	-	-	157.00	847,643.00	847,800.00	543,653.00	(d) Workshop/Seminar & Conf.	902,738.00	-		-	902,738.00
2,200.00	(b) Sale of old Assets	123,000.00	-	-	-	123,000.00	963,277.00	(e) Other Misc.	315,137.00	-	10,652,993.00		10,968,130.00
88,370.00	(c) Licence Fee	-	-	-	82,333.00	82,333.00	5,081,078.00	(f) Maintenance	6,316,618.00	-		368,917.00	6,685,535.00
-	(d) Remittances	-	-	-	-	-		4. OTHER ADVANCES		-			-
-	(e) Receipts by RCs	-	-	-	-	-	1,783,183.00	(a) Departmental Advance	1,191,000.00	-	21,300.00	47,552.00	1,359,852.00
13,846.00	(f) Tender cost	10,308.00	-	-	-	10,308.00	48,453,696.00	(b) Advances to Firms	2,605,195.00	-	-	12,816.00	2,618,011.00
974,000.00	(g) EMD Received	(343,000.00)	-	-	-	(343,000.00)	45,422.00	© Permanent Adv./Imprest	38,261.00	-	-		38,261.00
5,000.00	(h) Deposits received by NIH	-	-	-	5,000.00	5,000.00	5,546,048.00	(d) Expenses of RC.	4,996,848.00	-	-	14,998.00	5,011,846.00
-	(i) Duties & Taxes	-	-	-	-	-	499,440.00	(e) Payment to Creditors	717,298.00	-	-	9,100.00	726,398.00
	(j)Registration fee training Course	279,000.00	-	-	-	279,000.00		(f) Advance to CPWD	11,021,602.00	-	-	-	11,021,602.00
	(k) Consultancy	-	-	-	4,592,608.75	4,592,608.75		(g) Advances to HP	9,500.00	-	-	-	9,500.00
347,485.00	(l) Staff Imprest	-	-	-	-	-		5. OTHER EXPENSES		-	-	-	-
-	(k) Recovery from staff	-	-	-	13,970.00	13,970.00	1,383,716.00	(a) Prepaid Expences	1,934,768.00	-	-	-	1,934,768.00
-	(l) NIH Plan	-	-	9,500.00	-	9,500.00	628,134.00	(b) Outstanding expenses Paid	-	-	-	-	-
-							31,060.00	(c)Remittances	-	-	-	-	-
								(d) Mass Advertising campaign	-	7,887,129.00	-	-	7,887,129.00
-							14,500.66	Closing Balance HQ	231,198.92	12,871.00	7,901,079.00	12,456.67	8,157,905.59
-							231,221.10	Closing Balance with RCs	76,092.29			31,655.63	107,747.92
170,335,284.76		86,126,448.21	7,900,000.00	102,468,110.00	107,295,568.30	303,790,126.51	170,335,284.76		86,126,448.21	7,900,000.00	102,468,110.00	107,295,568.30	303,790,126.51

(D.P. SINGH)
FINANCE OFFICER

(R.D. SINGH)
DIRECTOR
Director
National Institute of Hydrology
Roorkee

FOR AWASTHI PRAKASH & ASSOCIATES
CHARTERED ACCOUNTANTS
(SHALINI PRAKASH)
PARTNER
M. NO:-077102

SCHEDULE - 1 : CORPUS/CAPITAL FUND

PARTICULARS	CURRENT YEAR					PREV. YEAR
	PLAN-R&D	IEC	HP-II	NON-PLAN	TOTAL	
Balance as at the beginning of the year Corpus/Capital Fund	-	-	-	-	-	-
(Add (Deletion) : during the year	-	-	-	-	-	-
TOTAL	-	-	-	-	-	-

SCHEDULE - 2 : RESERVES AND SURPLUS	CURRENT YEAR					PREV. YEAR
	PLAN-R&D	IEC	HP-II	NON-PLAN	TOTAL	
1. Capital Reserve :						
As per last Account	281,337,838.64	-	-	-	281,337,838.64	281,337,838.64
Addition during the year	-	-	-	-	-	-
Less: Deductions during the year	-	-	-	-	-	-
		-	-			
2. Revaluation Reserve :		-	-			
As per last Account	-	-	-	-	-	-
Addition during the year	-	-	-	-	-	-
Less: Deductions during the year	-	-	-	-	-	-
		-	-			
3. Special Reserve :		-	-			
As per last Account	435503.00	-	-	-	435,503.00	435,503.00
Addition during the year	-	-	-	-	-	-
Less: Deductions during the year	-	-	-	-	-	-
4. General Reserve :						
As per last Account	(130,869,030.86)		7,093,656.00	(88,983,225.45)	(212,758,600.31)	(225,211,222.06)
Addition during the year	19,319,932.61	12,871.00	8,285,137.00	(15,005,245.25)	12,612,695.36	5,258,965.75
Less: Deductions during the year	-			-	-	-
TOTAL	170,224,243.39	12,871.00	15,378,793.00	(103,988,470.70)	81,627,436.69	61,921,085.33

AWASTHI PRAKASH & ASSOCIATES ROORKEE Chartered Accountants

SCHEDULE - 3 : EARMARKED/ENDOWMENT FUNDS

	PLAN-R&D	IEC	HP-II	NON-PLAN	TOTAL	PREV. YEAR
a) Opening Balance of the Funds						
b) Addition to the Funds:						
I. Donations/grants						
ii. Income from Investments made on account of funds						
iii. Other additions (specify nature)						
TOTAL (a+b)						
c) Utilisation/Expenditure towards objectives of funds						
I. Capital Expenditure						
- Fixed Assets						
- Others						
Total						
ii. Revene Expenditure						
- Salaries, Wages and allowances etc.						
- Rent						
- Other Administrative expenses						
Total						
TOTAL ©						
NET BALANCE AS AT THE YEAR - END (a+b-c)						

NIL

Notes

1) Disclosures shall be made under relevant heads based on conditions attaching to the grants.

2) Plan Funds received froim the Central/State Governments are to be shown as separate Funds and not to be mixed up with any other Funds

AWASTHI PRAKASH & ASSOCIATES ROORKEE Chartered Accountants

SCHEDULE - 4 : SECURED LOANS AND BORROWINGS :

	PLAN-R&D IEC	HP-II	NON-PLAN	PREVIOUS YEAR
1. Central Government				
2. State Government (Specify)				
3. Financial Institutions				
(a) Term Loans				
(b) Interest accrued and due				
4. Banks :				
(a) Term Loans				
- Interest accrued and due				
(b) Other Loans (specify)				
- Interest accrued and due				
5. Other Institutions and Agencies				
6. Debentures and Bonds				
7. Other (Specify)				
TOTAL				

NIL

Note : Amounts due within one year

AWASTHI PRAKASH & ASSOCIATES Chartered Accountants ROORKEE

SCHEDULE - 5 : UNSECURED LOANS AND BORROWINGS :

	PLAN	IEC	HP-II	NON-PLAN	PREVIOUS YEAR
1. Central Government					
2. State Government (Specify)					
3. Financial Institutions					
4. Banks :					
(a) Term Loans					
(b) Other Loans (specify)					
5. Other Institutions and Agencies					
6. Debentures and Bonds					
7. Fixed Deposits					
8. Others (Specify)					
TOTAL					
Note: Amounts due within one year					

NIL

SCHEDULE - 6 : DEFERRED CREDIT LIABILITIES :

	PLAN	NON-PLAN	PREVIOUS YEAR
(a) Acceptances secured by hypothecation of capital equipment and other assets			
(b) Others			
TOTAL			
Note : Amounts due within one year			

NIL

AWASTHI PRAKASH & CO. Chartered Accountants ROORKEE

SCHEDULE - 7 : CURRENT LIABILITIES AND PROVISIONS :

PARTICULARS	CURRENT YEAR					PREV. YEAR
	PLAN-R&D	IEC	HP-II	NON-PLAN	TOTAL	
A. CURRENT LIABILITIES :						
1. Sundry Creditors :						
(a) For Capital Goods (As per List 'I')	-	-	-	-	-	712,208.00
(b) Others	-			-	-	-
2. Deposit received	-		9,500.00	10,000.00	19,500.00	15,000.00
3. Outstanding Expenses (As per List 'II')	1,124,601.00			5,951,321.00	7,075,922.00	10,323,973.00
4. Earnest Money Deposit	781,000.00	-		-	781,000.00	1,124,000.00
5. Retention Money witheld	849,573.00			-	849,573.00	2,345,871.00
TOTAL (A)	**2,755,174.00**	**-**	**9,500.00**	**5,961,321.00**	**8,725,995.00**	**14,521,052.00**
B. PROVISIONS :						
1. For Taxation	-			-	-	-
2. Gratuity	-			65,182,658.00	65,182,658.00	54,360,289.00
3. Superannuation/Pension	-			-	-	-
4. Accumulated Leave Encashment	-			38,647,394.00	38,647,394.00	31,001,682.00
5. Trade Warranties/Claim	-			-	-	-
6. Others (Specify)	-			-	-	-
					-	
TOTAL (B)	**-**			**103,830,052.00**	**103,830,052.00**	**85,361,971.00**
TOTAL (A+B)	**2,755,174.00**	**-**	**9,500.00**	**109,791,373.00**	**112,556,047.00**	**99,883,023.00**

Annexures to Schedule - 7

	CURRENT YEAR					PREV. YEAR
	PLAN-R&D	IEC	HP-II	NON-PLAN	TOTAL	
List-'I' CAPITAL						
Library Journals	-	-	-	-	-	-
Library Books	-	-	-	-	-	-
Furniture & Fixture	-	-	-	-	-	-
Lab. & Field Equipment	-	-	-	-	-	511,488.00
Computer Centre	-	-	-	-	-	200,720.00
Buildings	-	-	-	-	-	
Communication	-	-	-	-	-	
Auxilliary Equipment	-	-	-	-	-	-
Office Equipment	-	-	-	-	-	-
TOTAL	**-**		**-**	**-**	**-**	**712,208.00**

AWASTHI PRAKASH & ASSOCIATES ROORKEE Chartered Accountants

Annexures to Schedule - 7

	CURRENT YEAR					PREV. YEAR
	PLAN-R&D	IEC	HP-II	NON-PLAN	TOTAL	
List-'II'						
(a) ESTABLISHMENT						
Dearness Allowances (DA (Arrear)	-	-	-	-	-	-
Salary	-	-	-	-	-	-
Medical Claims	-	-	-	-	-	180,287.00
HRA				-	-	-
Leave Salary & Pension Contribution	-	-	-	-	-	-
Employer's contribution to CPF	-	-	-	4,960,000.00	4,960,000.00	8,460,776.00
Intt. On Employee's own Subscription	-	-	-	-	-	-
Intt. On Employer's Contribution	-	-	-	-	-	-
Bonus Payable	-	-	-	450,000.00	450,000.00	459,382.00
Honorarium	98,150.00	-	-	-	98,150.00	55,000.00
T.A. Claims		-	-	-	-	46,490.00
T.A. Claims (Foreign)	-	-	-	-	-	-
Wages	667,017.00	-	-	-	667,017.00	114,477.00
Reimbursement of Tuition Fee	-	-	-	467,147.00	467,147.00	541,272.00
O.T.A.	-	-	-	36,452.00	36,452.00	73,308.00
TOTAL Rs. (a)	**765,167.00**	**-**	**-**	**5,913,599.00**	**6,678,766.00**	**9,930,992.00**
(b) OFFICE EXPENSES						
Elect/Water charges & Running cost of DG Set	51,083.00	-	-	-	51,083.00	176,905.00
Stationary & Printing	10,143.00	-	-	-	10,143.00	-
Telephone	61,074.00	-	-	5,752.00	66,826.00	54,974.00
Rent, Rates & Taxes	32,020.00	-	-	-	32,020.00	30,700.00
Advertisement	-	-	-	-	-	-
Running cost of Computer/Lab.	-	-	-	-	-	-
T.A. to Non-officials	-	-	-	-	-	-
Professional & Other Services	-	-	-	-	-	-
Newspapers/Periodicals	-	-	-	-	-	15,772.00
Printing of Technical Report	26,350.00	-	-	-	26,350.00	-
Misc. Expenses	-	-	-	-	-	8,000.00
Audit Fee Payable	-	-	-	18,000.00	18,000.00	-
	-	-	-	-		-

TOTAL Rs. (b)	**180,670.00**	**-**	**-**	**23,752.00**	**204,422.00**	**286,351.00**
(c) MAINTENANCE						
Furniture & Fixture	-	-	-	-	-	-
Computer Centre	75,975.00	-	-	-	75,975.00	76,604.00
Communication System	-	-	-	-	-	-
Buildings & Bulk Services	80,200.00	-	-	-	80,200.00	-
Office Equipment	-	-	-	-	-	-
P.O.L.	22,589.00	-	-	-	22,589.00	30,026.00
TOTAL Rs. (c)	**178,764.00**	**-**	**-**	**-**	**178,764.00**	**106,630.00**

Annexures to Schedule - 7

	CURRENT YEAR					**PREV. YEAR**
	PLAN-R&D	**IEC**	**HP-II**	**NON-PLAN**	**TOTAL**	
(d) RECOVERIES FROM SALARY						
Benovalent Fund	-	-	-	-	-	-
House Rent (IIT Roorkee)	-	-	-	-	-	-
Elect. Charges (IIT Roorkee)	-	-	-	783.00	783.00	-
C.P.F. Recovery	-	-	-	7,637.00	7,637.00	-
NIH GSLI	-	-	-	-	-	-
NIH GSLI Final Payment	-	-	-	-	-	-
Cycle Advance - Excess Recovered	-	-	-	-	-	-
Festival Advance- Excess Recovered	-	-	-	-	-	-
Scootar Advance - Excess Recovered	-	-	-	-	-	-
Mobile Phone Recovery	-	-	-	5,550.00	5,550.00	-
TOTAL Rs. (d)	**-**			**13,970.00**	**13,970.00**	**-**
TOTAL Rs. (a)+(b)+(c)+(d)	**1,124,601.00**	**-**	**-**	**5,951,321.00**	**7,075,922.00**	**10,323,973.00**

NATIONAL INSTITUTE OF HYDROLOGY

SCHEDULE-8 : FIXED ASSETS :

	GROSS BLOCK						DEPRECIATION				NET BLOCK	
Descriptions	COST AS ON 01.04.2009	Additions Before 01.10.09	Additions After 01.10.09	Deductions During the Year	Cost as on 31-03-2010	Rate of Depreciation	At the Beginning of the year	For the Year	Deductions During the Year	Value as at 31-03-2010	As on 31-03-2010	As on 31-03-2009
A. FIXED ASSETS												
Furniture & Fixture	11107497.95	-	2738394.00	-	13845891.95	10%	8780324.84	365269.16	-	9145594.00	4700297.95	2327173.11
Library Books	6453311.07	89001.00	53230.00	-	6595542.07	15%	5643115.10	138871.80	-	5781986.90	813555.17	810195.97
Library Journals	17108016.00	1369577.00	12748.00	-	18490341.00	15%	10681343.10	1170393.59	-	11851736.69	6638604.32	6426672.90
Maps & Imagery	6797201.00	108000.00	310100.00	-	7215301.00	15%	4692936.04	355097.24	-	5048033.28	2167267.72	2104264.96
Lab & Field Equipment	89507189.87	66936.00	9859922.00	-	99434047.87	15%	65551735.91	4342852.64	-	69894588.55	29539459.32	23955453.96
Auxillary Equipments	4481135.50	214299.00	449640.00	-	5145074.50	15%	3726956.90	178994.64	-	3905951.54	1239122.96	754178.60
Communications System	728789.00	-	1865.00	-	730654.00	15%	608857.59	18129.59	-	626987.18	103666.82	119931.41
Vehicle	4214670.65	-	-	-	4214670.65	15%	3518699.67	104395.65	-	3623095.32	591575.33	695970.98
Office Equipment	14339723.18	715950.00	1813545.00	765008.00	16104210.18	15%	10776869.56	754322.12	764213.15	10766978.53	5337231.65	3562853.62
Computer Centre	31765560.80	10684660.00	11970365.00	2295063.00	52125522.80	60%	26343983.28	11734366.21	-	38078349.49	14047173.31	5421577.52
Building	125244299.12	-	1762817.00	-	127007116.12	10%	75510486.79	5061522.08	-	80572008.87	46435107.25	49733812.33
Electrical Fixture & Fittings	3410154.00	85556.00	723828.00	-	4219538.00	15%	3254217.25	90511.01	-	3344728.26	874809.74	155936.75
Land for Colony	1743990.50	-	-	-	1743990.50	0%	-	-	-	-	1743990.50	1743990.50
Bulk Services	-	-	-	-	0.00	0%	-	-	-	-	-	-
Generator Set	1709692.00	-	618307.00	-	2327999.00	15%	1635460.06	57507.82	-	1692967.88	635031.12	74231.94
Work in Progress	-	-	-	-	-	0%	-	-	-	-	-	-
TOTAL	**318611230.64**	**13333979.00**	**30314761.00**	**3060071.00**	**359199899.64**		**220724986.09**	**24372233.54**	**764213.15**	**244333006.48**	**114866893.16**	**97886244.55**

SCHEDULE OF FIXED ASSETS AS ON 31ST MARCH 2010

HYDROLOGY PROJECT-II

DESCRIPTIONS	GROSS BLOCK				DEPRECIATION				NET BLOCK	
	Op.Bal as on 1.4.2009	NetAdditions till 30.09.09	Net Additions after 30.9.09	Cl.Bal as on 31.03.10	Opening Dep	Rate of Dep	Dep during the year	Total Dep	WDV as on 31.3.2010	WDV as on 31.3.2009
A. FIXED ASSETS :										
FURNITURE & FIXTURE	-	-	-	-	-	10.00%	-	-	-	-
EQUIPMENTS	1267421.00	-	505597.00	1773018.00	227480.80	15.00%	181999.00	409479.80	1363538.00	1039940.20
VEHICLE	-	-	3757825.00	3757825.00	-	15.00%	281837.00	281837.00	3475988.00	-
OFFICE EQUIPMENT	72758.00	-		72758.00	10913.70	15.00%	9277.00	20190.70	52567.00	61844.30
COMPUTER	5767152.00	-	1856813.00	7623965.00	3773179.60	60.00%	1336465.00	5109644.60	2514320.00	1993972.40
GENERATOR SET	-	-		-	-	15.00%	-	-	-	-
TOTAL	**7107331.00**	**-**	**6120235.00**	**13227566.00**	**4011574.10**		**1809578.00**	**5821152.10**	**7406413.00**	**3095756.90**

SCHEDULE - 9 : INVESTMENTS FROM EARMARKED/ENDOWMENT FUNDS

	PLAN	IEC	HP-II	NON-PLAN	TOTAL	PREV. TOTAL
1. In Government Securities						
2. Other approved Securities						
3. Shares						
4. Debentures and Bonds						
5. Subsidiaries and Joint Ventures						
6. Other (to be specified)						
TOTAL						

NIL

SCHEDULE - 10 : INVESTMENTS - OTHERS

	PLAN	IEC	HP-II	NON-PLAN	TOTAL	PREV. TOTAL
1. In Government Securities						
2. Other approved Securities						
3. Shares						
4. Debentures and Bond						
5. Subsidiaries and Joint Ventures						
6. Others (to be specified)						
TOTAL						

NIL

AWASTHI PRAKASH & ASSOCIATES ROORKEE Chartered Accountants

SCHEDULE - 11 : CURRENT ASSETS, LOANS, ADVANCES ETC.

PARTICULARS	CURRENT YEAR					PREV. TOTAL
	PLAN-R&D	IEC	HP-II	NON PLAN	TOTAL	
A. CURRENT ASSETS :						
1. Inventories :						
a) Stores and Spares	-	-	-	-	-	-
2. Sundry Debtors :		-	-		-	
a) Debts Outstanding for a period exceeding six months	-	-	-	-	-	-
b) Others	-	-	-	-	-	-
3. Cash balances in hand (including cheques/drafts and imprest)		-	-		-	
a) Imprest with Officers	-	-	-	-	-	-
4. Bank Balances :		-	-		-	
a) With Scheduled Banks:	-	-	-		-	
- On Savings Bank Accounts at	-	-	-	-	-	-
Headquarter	231,498.92	12,871.00	7,901,079.00	12,456.67	8,157,905.59	14,500.66
Cash & Bank Balance with Regional Centre (As per List 'I')	76,092.29	-	-	31,655.63	107,747.92	231,221.10
LC with IOB	-	-	-	-	-	1,380,979.00
LC with SBI	5,321,104.00	-	-	-	5,321,104.00	11,270,024.00
TOTAL (A)	5,628,695.21	12,871.00	7,901,079.00	44,112.30	13,586,757.51	12,896,724.76
B. LOANS, ADVANCES AND OTHER ASSETS						
1. Loans						
a) Staff (as per list 'II')	655,236.00	-	59,500.00	5,733,940.00	6,448,676.00	6,725,395.00
b) Others - Departmental Advances (as per list 'III')	370,040.00	-	21,300.00	1,690.00	393,030.00	302,843.00
					-	
2. Advances & other amounts recoverable in cash or in kind or for value to be received:					-	
a) Staff Imprest A/c	-	-	-	-	-	-
b) Advances to Firms	3,363,660.00	-	-	-	3,363,660.00	6,155,625.00
c) Advances for Constructions (As per list 'IV')	45,805,925.00	-	-	-	45,805,925.00	36,068,800.00
d) Pre-paid Expenses (As per list 'V')	1,934,768.00	-	-	-	1,934,768.00	1,383,716.00
e) Deposits (As per list 'VI')	354,200.00	-	-	23,160.00	377,360.00	384,760.00
TOTAL (B)	52,483,829.00	-	80,800.00	5,758,790.00	58,323,419.00	51,021,139.00
TOTAL (A+B)	58,112,524.21	12,871.00	7,981,879.00	5,802,902.30	71,910,176.51	63,917,863.76

AWASTHI PRAKASH & ASSOCIATES Chartered Accountants ROORKEE

Annexures to Schedule - 11						
PARTICULARS						
	CURRENT YEAR					PREV. TOTAL
List 'I' Cash & Bank Balance with Regional Centre	PLAN-R&D	IEC	HP-II	NON-PLAN	TOTAL	
RC Belgaum	6,266.09	-	-	5,138.80	11,404.89	63,719.89
RC Gauwhati	29,100.00	-	-	5,000.00	34,100.00	55,623.18
RC Jammu	16,362.67	-	-	4,956.36	21,319.03	20,026.03
RC Kakinara	9,019.36	-	-	3,198.00	12,217.36	30,777.36
RC Patna	5,343.92	-	-	8,362.00	13,705.92	33,646.92
RC Sagar	10,000.25	-	-	5,000.47	15,000.72	27,427.72
Total	**76,092.29**	**-**	**-**	**31,655.63**	**107,747.92**	**231,221.10**
List 'II' Staff						
Fan Advance	-	-	-	-	-	300.00
Festival Advance	-	-	-	99,900.00	99,900.00	85,800.00
Scooter/Car Advance	-	-	-	-	-	16,885.00
Interest Accrued on Scooter Advance	-	-	-	29,004.00	29,004.00	88,923.00
Cycle Advance	-	-	-	20,243.00	20,243.00	20,450.00
House Building Advance	-	-	-	1,781,665.00	1,781,665.00	2,366,696.00
Interest Accrued on House Building Advance	-	-	-	3,065,797.00	3,065,797.00	3,204,044.00
Medical Advance	-	-	-	-	-	152,000.00
L.T.C. Advance	-	-	59,500.00	642,718.00	702,218.00	36,075.00
T.A. Advance for HP Project	9,500.00			-		
T.A. Advance	645,736.00	-	-	94,613.00	740,349.00	747,072.00
Pay Advance	-	-	-	-	-	7,150.00
Total	**655,236.00**	**-**	**59,500.00**	**5,733,940.00**	**6,448,676.00**	**6,725,395.00**
List 'III' Others - Departmental Advances						
Departmental Advances	370,040.00	-	21,300.00	1,690.00	393,030.00	302,843.00
Advaces to Divisional Head	-	-	-	-	-	-
Total	**370,040.00**	**-**	**21,300.00**	**1,690.00**	**393,030.00**	**302,843.00**
List 'IV' Advances for Constructions						
WALMI, Patna	-	-	-	-	-	206,775.00
EE, CPWD, Dehradun	45,805,925.00	-	-	-	45,805,925.00	35,862,025.00
EE, PCD-II, C.P.W.D., Patna	-	-	-	-	-	-
Total	**45,805,925.00**	**-**	**-**	**-**	**45,805,925.00**	**36,068,800.00**

AWASTHI PRAKASH & ASSOCIATES Chartered Accountants ROORKEE

Annexures to Schedule - 11

List 'V' Pre-paid Expenses

PARTICULARS	CURRENT YEAR					PREV. TOTAL
	PLAN-R&D	IEC	HP-II	NON-PLAN	TOTAL	
Maint. Of Office Equipment	-	-	-	-	-	14,139.00
Library Journal	1,934,768.00	-	-	-	1,934,768.00	1,369,577.00
Rent, Rates & Taxes	-	-	-	-	-	-
Maint. Of Communication	-	-	-	-	-	-
Maint. Of Computer	-	-	-	-	-	-
Total	**1,934,768.00**	-	-	-	**1,934,768.00**	**1,383,716.00**
List 'VI' Deposits						
Security Deposits for Gas Gylinders	3,300.00	-	-	350.00	3,650.00	2,250.00
Deposits to UPSEB for Sub-Station	-	-	-	8,480.00	8,480.00	8,480.00
Security Deposits for Telex	-	-	-	-	-	10,000.00
Deposits with SAIL, Ghaziabad for Steel	-	-	-	-	-	-
SDO (Telegraph) for Telephones	16,000.00	-	-	13,800.00	29,800.00	29,800.00
Security Deposits for Telephones at RC Belgaum	21,100.00	-	-	-	21,100.00	21,100.00
D.G.M. Telecom for Telephones at Guwahati	10,000.00	-	-	-	10,000.00	10,000.00
Deepti Gas Agency, Guwahati	500.00	-	-	530.00	1,030.00	1,030.00
Accounts Officer (Tel), Jammu	2,880.00	-	-	-	2,880.00	2,880.00
Accounts Officer (Tel.), Patna	16,950.00	-	-	-	16,950.00	16,950.00
Accounts Officer (Tel.P, Kakinada	11,710.00	-	-	-	11,710.00	11,710.00
SDO (Tel), Sagar	12,000.00	-	-	-	12,000.00	12,000.00
R.C. Sagar	15,000.00	-	-	-	15,000.00	15,000.00
A.P. State Elect. Board, Kakinada	80,950.00	-	-	-	80,950.00	80,950.00
Accounts Officer (Tel.) Roorkee	5,600.00	-	-	-	5,600.00	5,600.00
Deposits made by NIH to outside Parties	30,010.00	-	-	-	30,010.00	30,010.00
Security deposit from gangotri project	25,000.00	-	-	-	25,000.00	25,000.00
E.E. UPCL, Roorkee for staff colony	102,000.00	-	-	-	102,000.00	102,000.00
BSNL, Kakinada	1,200.00	-	-	-	1,200.00	
		-	-	-	-	
Total	**354,200.00**	-	-	**23,160.00**	**377,360.00**	**384,760.00**

SCHEDULE - 12 : INCOME FROM SALES/SERVICES

PARTICULARS	CURRENT YEAR					PREVIOUS YEAR
	PLAN-R&D	IEC	HP-II	NON-PLAN	TOTAL	
1) Income from Services						
(a) Water Testing Charges	ALL ENTRIES SHOWN IN SCHEDULE 18, AS IT IS A SIMILAR SCHEDULE					
(b) Overhead Charges						
© Miscellaneous Receipt						
2) Others						
(a) Sale of Tender Documents						
(b) Guest House Receipts						
(c) Sale of Old assets						
TOTAL	0.00					

SCHEDULE - 13 : GRANTS/SUBSIDIES
(Irrevocable Grants & Subsidies Received)

PARTICULARS	CURRENT YEAR					PREVIOUS YEAR
	PLAN (R&D)	IEC	HP II	NON-PLAN	TOTAL	
1) Grant from MOWR, Govt. of India	83,016,000.00	7,900,000.00	98,100,000.00	100,405,000.00	289,421,000.00	158,600,000.00
TOTAL	83,016,000.00	7,900,000.00	98,100,000.00	100,405,000.00	289,421,000.00	158,600,000.00

SCHEDULE - 14 : FEES/SUBSCRIPTIONS

	PLAN	IEC	HP-II	NON-PLAN	TOTAL	PREV. YEAR
1) Entrance Fees						
2) Annual Fees/Subscriptions						
3) Seminar/Program Fees				NIL		
4) Consultancy Fees						
5) Others (Specify)						
TOTAL	-	-	-	-	-	-

AWASTHI PRAKASH ★ ROORKEE ★ Chartered Accountants

SCHEDULE - 15 : INCOME FROM INVESTMENTS

(Income on Investment from Earmarked/Endowment Funds transferred to Funds)

	INVESTMENT FROM EARMARKED FUND						INVESTMENT - OTHERS					
	PLAN	IEC	HP-II	NON-PLAN	TOTAL	PREV. YEAR	PLAN	IEC	HP-II	NON-PLAN	TOTAL	PREV. YEAR
1) Interest												
a) On Govt.Securities												
b) Other Bonds/Debentures												
2) Dividends												
a) On Shares												
b) On Mutual Fund Securities												
3) Rents												
4) Others (Specify)												
TOTAL												
TRANSFERRED TO EARMARKED/ENDOWMENT FUNDS												

NIL

AWASTHI PRAKASH & ASSOCIATES
ROORKEE
Chartered Accountants

SCHEDULE - 16 : INCOME FROM OTHER SOURCES

PARTICULARS	CURRENT YEAR					PREV. YEAR
	PLAN-R&D	IEC	HP-II	NON-PLAN	TOTAL	
1) Grants received for Seminar & Courses	-			-	-	250,000.00
2) Income from Publications	-				-	-
3) Registration fee for training course	279,000.00				279,000.00	347,485.00
					-	-
TOTAL	279,000.00			-	279,000.00	597,485.00

SCHEDULE - 17 : INTEREST EARNED

PARTICULARS	CURRENT YEAR					PREV. YEAR
	PLAN-R&D	IEC	HP-II	NON-PLAN	TOTAL	
1) On Term Deposits with Scheduled Bank	-				-	-
2) On Savings Accounts	338,539.00		566,182.00	121,876.00	1,026,597.00	405,511.00
3) On Loans						
(a) Employees/Staff	-	-	-	-	-	1,001.00
4) on NIH P.F. balances	-	-	-	-	-	5,163,561.00
5) Interest accrued on the house building advanc	-	-	-	184,193.00	184,193.00	258,432.00
6) Interest accrued on scooter advance	-	-	-	-	-	2,040.00
7) Interest on Intt. Bearing Advance	6,532.00	-	-		6,532.00	-
TOTAL	**345,071.00**	**-**	**566,182.00**	**306,069.00**	**1,217,322.00**	**5,830,545.00**
Note : Tax deducted at source to be indicated.						

AWASTHI PRAKASH & ASSOCIATES
ROORKEE
Chartered Accountants

SCHEDULE 18 : OTHER INCOME

PARTICULARS	CURRENT YEAR					PREV. YEAR
	PLAN- R&D	IEC	HP-II	NON PLAN	TOTAL	
1) Profit on Sale/disposal of Assets :						
a) Sales of old computers	0.00			0.00	-	0.00
b) Sale of office equipment	122205.15			0.00	122,205.15	0.00
2) Miscellaneous Income					-	
a) Misc. Receipt	755.00			631,558.00	632,313.00	334,957.00
b) Tender cost	10,308.00			-	10,308.00	13,846.00
c) Licence Fee	0.00			82,333.00	82,333.00	88,570.00
d) Guest House Receipts	-			-	-	0.00
3) Income from Consultancy/ Overhead Charges				4,592,608.75	4,592,608.75	2,691,860.00
TOTAL	133,268.15			5,306,499.75	5,439,767.90	3,129,233.00

SCHEDULE 20 : ESTABLISHMENT EXPENSES

PARTICULARS	CURRENT YEAR					PREV. YEAR
	PLAN- R&D	IEC	HP-II	NON PLAN	TOTAL	
(a) Pay & Allowances	9,420,212.00	-	-	87,267,653.00	96,687,865.00	76,823,669.00
(b) Bonus	10,362.00	-	-	450,000.00	460,362.00	780,009.00
(c) Medical	125,690.00	-	-	1,478,402.00	1,604,092.00	1,813,960.00
(d) Leave Salary & Pension Contribution	-	-	-	-	-	115,589.00
(e) Employer's Contribution CPF	771,183.00	-	-	5,493,136.00	6,264,319.00	6,424,027.00
+Contribution towards shortfall in Intt. On CPF (Annexure 1)	690,429.00	-	-	4,278,365.00	4,968,794.00	6,308,937.00
(f) Honorarium & Others	106,650.00	-	-	8,128.00	114,778.00	83,302.00
(g) Leave Encashment	-	-	-	9,379,528.00	9,379,528.00	6,112,255.00
(h) Wages	6,892,951.00	-	-	1,200.00	6,894,151.00	5,243,391.00
(i) Gratuity	-	-	-	11,943,437.00	11,943,437.00	22,876,780.00
TOTAL	18,017,477.00	-	-	120,299,849.00	138,317,326.00	126,581,919.00

(Annexure 1 to SCHEDULE 20 :

PARTICULARS	CURRENT YEAR					PREV. YEAR
	PLAN – R&D	IEC	HP-II	NON-PLAN	TOTAL	
(a) On CPF on Employees own subscription	338,866.00	-	-	3,404,731.00	3,743,597.00	2,610,608.00
(b) On CPF on Employer's contribution	351,563.00	-		4,665,213.00	5,016,776.00	3,698,329.00
TOTAL (a+b)	690,429.00	-		8,069,944.00	8,760,373.00	6,308,937.00
(c) Less : Interest Received on CPF Investments				3,791,579.00	3,791,579.00	-
TOTAL (a+b-c)	690,429.00	-	-	4,278,365.00	4,968,794.00	6,308,937.00

SCHEDULE 0.00 19 : INCREASE/(DECREASE) IN STOCK OF FINISHED GOODS & WORK IN PROGRESS

PARTICULARS	CURRENT YEAR					PREV. YEAR
	PLAN– R&D	IEC	HP-II	NON PLAN	TOTAL	
a) Closing Stock						
Finished Goods						
Work in Progress						
b) Less: Opening Stock						
0.00 Finished Goods						
0.00 Work0.00in0.00Progress						
NET INCREASE/(DECREASE) [a-b]	-	-	-	-	-	-

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ROORKEE
Chartered Accountants

SCHEDULE - 21 : OTHER ADMINISTRATIVE EXPENSES ETC.

PARTICULARS	CURRENT YEAR					PREV. YEAR
	PLAN- R&D	IEC	HP-II	NON-PLAN	TOTAL	
OFFICE EXPENSES :(A)						
(1) Elect./Water charges & Generator Running Cost	2,844,712.00	-	-	34,020.00	2,878,732.00	2,426,600.00
(2) Stationery & Printing	523,259.00	-	-	72,428.00	595,687.00	610,686.00
(3) Postage	86,268.00	-	-	-	86,268.00	136,138.00
(4) Telephone	1,253,419.00	-	-	79,855.00	1,333,274.00	937,552.00
(5) Rent, Rates & Taxes	924,107.00	-	-	-	924,107.00	782,102.00
(6) Liveries	48,321.00	-	-	21,625.00	69,946.00	67,726.00
(7) Hospitality Expenses	141,746.00	-	-	2,957.00	144,703.00	203,093.00
(8) Advertisement	739,432.00	-	-	-	739,432.00	24,735.00
(9) Running cost of Lab./Computer	1,749,421.00	-	-	15,800.00	1,765,221.00	813,852.00
(10) Publication (Printing of Tech. Reports)	441,889.00	-	-	-	441,889.00	158,631.00
(11) Training Courses/Workshops	714,110.00	-	701,151.00	-	1,415,261.00	1,327,406.00
(12) Seminar & Conference	4,330,419.00	-	-	-	4,330,419.00	1,056,522.00
(13) Project (INCOH Proposal)	-	-	-	-	-	-
(14) Payment for Professional & Other Services	52,326.00	-	76,924,848.00	1,100.00	76,978,274.00	50,795.00
(15) T.A. to Candidates	-	-	-	-	-	11,459.00
(16) T.A. to Non-Officials	503,179.00	-	-	-	503,179.00	870,953.00
(17) Reimbursement of Membership Fee	-	-	-	-	-	-
(18) Newspapers/Periodicals	4,773.00	-	-	83,979.00	88,752.00	112,401.00
(19) Sundry Expenses	594,389.00	-	-	-	594,389.00	443,384.00
(20) Travelling Expenses	3,031,856.00	-	-	146,376.00	3,178,232.00	2,751,226.00
(21) Field expenses	353,288.00	-	-	-	353,288.00	172,197.00
(22) VAT Charges	-	-	-	-	-	3,557.00
(23) Bank Charges	37,796.00	-	1,410.00	15,455.00	54,661.00	51,343.00
(24) Mass Communication Expenses.	-	7,887,129.00	-	-	7,887,129.00	-
(25) Operating Expenses	-	-	10,944,058.00	-	10,944,058.00	-
(26) Prior Period Exp.	-	-	-	-	-	-
(27) Audit Fees	-	-	-	18,000.00	18,000.00	-
TOTAL (A)	**18,374,710.00**	**7,887,129.00**	**88,571,467.00**	**491,595.00**	**115,324,901.00**	**13,012,358.00**

MAINTENANCE EXPENSES (B)						
(1) Lab./Workshop Equipment	217,386.00	-	-	-	217,386.00	204,154.00
(2) Auxilliary Equipment	37,630.00	-	-	-	37,630.00	1,250.00
(3) A.C.Plant		-	-	-	-	6,250.00
(4) Communications	5,831.00	-	-		5,831.00	93,270.00
(5) Generator Set	147,309.00	-	-	25,109.00	172,418.00	19,734.00
(6) Other Aux. Equipment		-	-	-	-	8,000.00
(7) Computer Centre	659,717.00	-	-	600.00	660,317.00	3,765,471.00
(8) Buildings & Bulk Services	1,548,232.00	-	-	14,433.00	1,562,665.00	1,356,594.00
(9) Office Equipment	308,279.00	-	-	80,787.00	389,066.00	567,663.00
(10)Furniture & Fixture	5,170.00	-	-	-	5,170.00	13,397.00
(11)Vehicle Petrol	533,022.00	-	-	10,930.00	543,952.00	583,108.00
(12)Vehicle other than Petrol	226,410.00	-	-	99,511.00	325,921.00	320,180.00
(13) Library Books	-	-	-	-	-	[illegible],000.00
TOTAL (B)	**3,688,986.00**	**-**	**-**	**231,370.00**	**3,920,356.00**	**7[illegible]9,071.00**
TOTAL (A+B)	**22,063,696.00**	**7,887,129.00**	**88,571,467.00**	**722,965.00**	**119,245,257.00**	**20,021,429.00**

SCHEDULE - 22 : EXPENDITURE ON GRANTS, SUBSIDIES ETC.

PARTICULARS	CURRENT YEAR					PREV. YEAR
	PLAN	IEC	HP-II	NON-PLAN	TOTAL	
(a) Grants given to Institutions/Organisations	NIL					
(b) Subsidies given to Institutions/Organisations						
TOTAL	-	-	-	-	-	-

NATIONAL INSTITUTE OF HYDROLOGY
CIVIL LINES,
ROORKEE.-247667

SCHEDULE 23

SIGNIFICANT ACCOUNTING POLICIES FORMING A PART OF BALANCE SHEET AS AT MARCH 31ST, 2010 AND INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED MARCH 31ST, 2010

1. **GENERAL**

The Financial Statements have been prepared under the historical cost convention, on the accrual basis of accounting and in accordance with generally accepted accounting principles.

2. **REVENUE RECOGNITION**

All income and expenditure items having material bearing on the financial statements are recognized on accrual basis.

3. **FIXED ASSETS**

i. Fixed Assets are stated at cost less accumulated depreciation.

ii. Fixed Assets are stated at cost of acquisition inclusive of all incidental expenses related thereto.

iii. Fixed Assets received by way of non-monetary grants (other than towards the Corpus Fund), are capitalized at values stated, by corresponding credit to Capital Reserve.

4. **DEPRECIATION**

i. Depreciation on fixed assets has been provided on written down value methods in accordance with the rates prescribed in the Income Tax Rules, 1962.

ii. In respect of additions to/deductions from fixed assets during the year, depreciation is considered on pro-rata basis.

iii. In case of HP II project, Electric Equipments of Rs. 1, 58,830 & Computer of Rs.13, 89,873 purchased as on 31st march. Hence Depreciation has not been charged

iv. In case of Plan accounts also, Office Equipments of Rs. 313520.00, Furniture of Rs.87357.00 and computer of Rs.478160 were not put to use during the FY, hence depreciation not provided on such assets.

5. **RETIREMENT AND DISPOSAL OF ASSETS.**

i. Profits on sale of assets are accounted for on completion of sale thereof.

6. **GOVERNMENT GRANTS**

i. Government grants of the nature of contribution towards capital cost of setting up projects are treated as Capital Reserve.

ii. Grants in respect of specific fixed assets acquired are shown as a deduction from the cost of the related assets.

AWASTHI PRAKASH & ASSOCIATES ROORKEE Chartered Accountants

7. **EMPLOYEES BENEFITS**

i. The cost of providing benefit i.e. gratuity is determined by the NIH, as per the rules applicable to the Central Government, which is slightly different from the calculation as prescribed by The Payment of Gratuity Act 1972.

ii. Other Long Term Employee Benefit viz. Leave Encashment is recognised as an expense in the income & expenditure account as and when it accrues. The liability is determined by the NIH, as per the rules applicable to the Central Government.

iii. Payments made to Contributory Provident Fund are charges as an expense as they fall due.

SCHEDULE-24

NOTES TO ACCOUNTS

1. Security deposit for Telex of Rs.10000.00 is adjusted by the BSNL, Haridwar according to a letter received by them. Hence the same has been added to Telephone Expenses.
2. Pay Advance of Rs. 7,150.00, is very old and since the recovery is doubtful, we have added the said amount to Miscellaneous Expenses.
3. Advance to Firm amounting to Rs.27, 857.00 is also very old. The vendor is not traceable, and transferred to POL Expenses.
4. The Journal Voucher's for the Regional Centers are prepared on 31st March 2010, at HO-NIH, Roorkee. In the case of the acquisition of fixed assets, we have taken the actual purchase date for calculation of depreciation.
5. Advance of Rs.2, 06,775.00 to EE Walmi Patna is added by us to the building account, as the building was completed long back, and is used by the RC-Patna since then. According to the HO staff, despite continuous reminders, the completion certificate is not provided by Walmi.
6. NIH is having two LC accounts. One is with IOB & other with SBI. The opening balances of these LC's contain figures which should have been adjusted till date, as the asset has been received and 100% payment made to the vendors. In the case of LC with IOB, the balance amounting to Rs.13, 80,979.00, outstanding since 2005-06, is adjusted with Retention money from vendors.

   In the case of LC with SBI-the opening balance of Rs. 1,15,319.00 is outstanding since FY 2005-06, is also adjusted with Retention money from vendors.
7. The Amount of **Provision of Gratuity and Leave Encashment** is as follows:-

PARTICULARS	GRATUITY	LEAVE ENCASHMENT
Opening Balance as on 01.04.2009	5,43,60,289.00	3,10,01,682.00
Less:- Paid during the Year	11,21,068.00	17,33,816.00
Add:- Provision for the Year	1,19,43,437.00	93,79,528.00
Closing Balance as on 31.3.2010	6,51,82,658.00	3,86,47,394.00

8. The Sale of Fixed Assets amounted to Rs. 1,23,000.00. The WDV of the assets was R. 794.85, hence Rs. 1,22,205.15 credited to Income & Expenditure account.

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NOTE ON AUDITOR'S REPORT

1.0	No comments.
2.0	**NON-PLAN** Transfer TA advance was given to a deputationist. Inspite of the several reminders, the adjustment has not been received from his parent department. The LTC advance was given in the month of March, 2010 which has been adjusted in the current financial year as per the LTC rules. **PLAN** An advance of Rs.1.5 lakhs was given to the employees for the Vidhan Sabha Election duty which has not been settled so far. NIH is persuing district administration for the early settlement of the advance. Rs.1.75 lakhs was given to the employees for Lok Sabha Election duty The TA advance for Lok Shabha Election duty has been settled during the current financial year. TA advance which was given in the month of Feb./March,2010 to the employees of Headquarters/Regional Centres of the Institute has been settled during current financial year according to rules and regulation . The advance to firms was given in the month of Feb/March,2010 which are being adjusted in the current financial year. So far most of the advances have been settled during the current financial year.

NATIONAL INSTITUTE OF HYDROLOGY

MAJOR LABORATORY FACILITIES AT ROORKEE

HYDROLOGICAL INSTRUMENTATION

- Collection, transmission and processing of Hydrometeorological data.
- Design & development of Hydro-meteorological instruments and data acquisition system.
- Flow/discharge measurement
- Infiltration rate measurement
- Measurement of water level in wells
- Water sampling from rivers, lakes etc.

NUCLEAR HYDROLOGY

- $^{14}C/^{3}H$ dating of ground water
- Sediment dating using $^{137}Cs/\ ^{210}Pb$
- Discharge of rivers
- Ground water velocity measurements
- Leakage / seepage detection from dam / reservoir
- Environmental tritium enrichment
- Recharge to ground water
- Soil moisture measurement
- Stable isotopic measurements (D, ^{13}C, ^{15}N, ^{16}O, ^{34}S)
- Identification of recharge sources and recharge zones

REMOTE SENSING APPLICATIONS

- Visual and digital image processing
- Ground water zonation mapping
- Flood plain mapping
- Land use mapping
- Soil erosion and sedimentation studies
- Snow cover mapping
- Salinity and water logging mapping

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
- Permeability measurement
- Particle size analysis of soil
- Infiltration rate measurement
- Soil density measurements

WATER QUALITY

- Analysis of organic carbon, inorganic carbon, total carbon
- Analysis of pesticides & organic compounds
- Bacteriological analysis
- Digestion of BOD & COD samples
- Field measurement of pH, conductivity, and anions
- Analysis of trace elements.

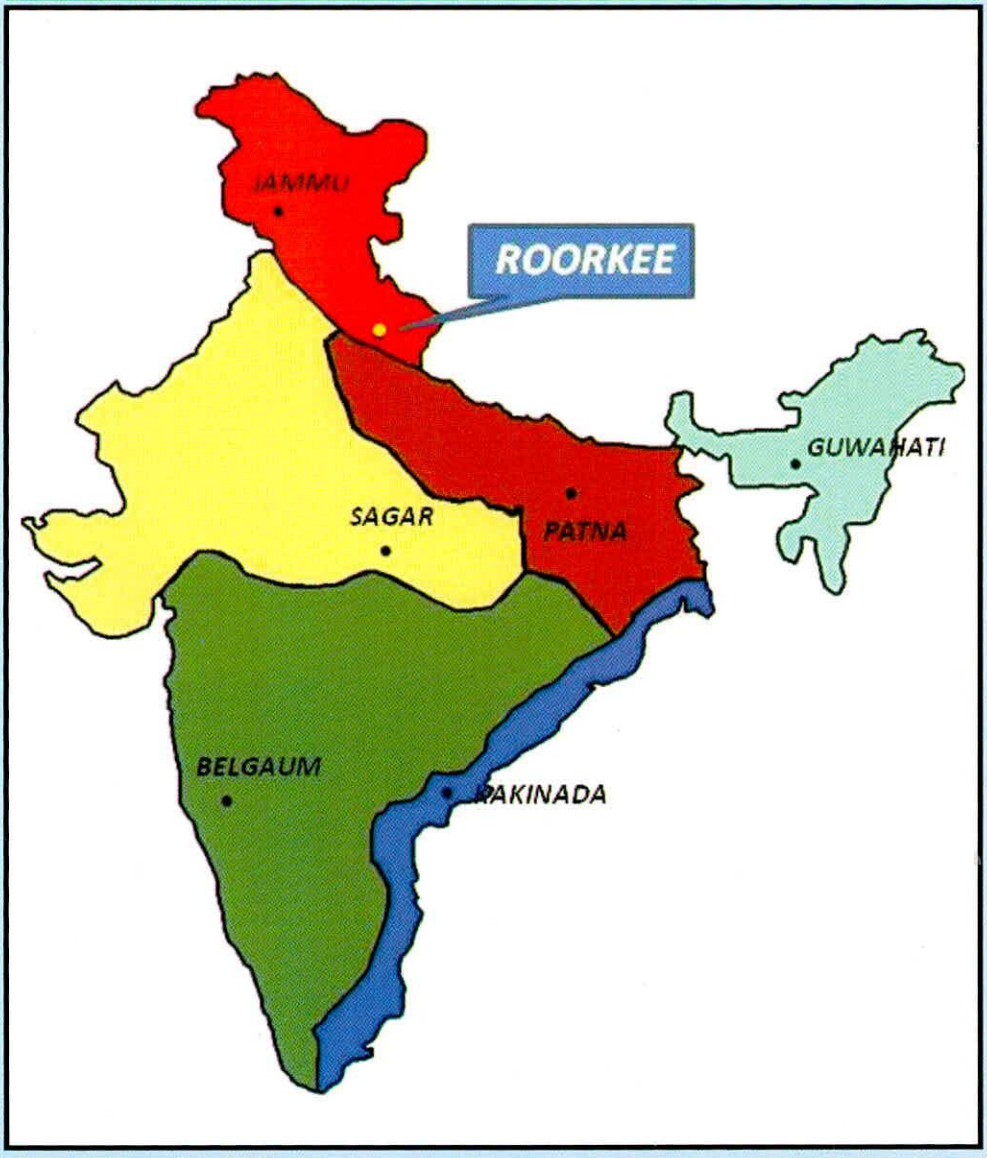
SNOW AND GLACIER LABORATORY

- Streamflow measurement in high altitude regions
- Analysis of snow cover
- Degree-day factors for snow and ice-melt
- Assessment of suspended sediment concentration
- Modelling of streamflow and snowfed rivers
- Hydrological investigations on glaciers

FACILITIES AT REGIONAL CENTRES

- Hydrological modeling & analysis
- Digital image processing and GIS
- Groundwater exploration
- Hydrometeorology
- Remote sensing application
- Soil moisture measurements
- Soil sampling & analysis
- Water Quality

REGIONAL CENTRES OF NATIONAL INSTITUTE OF HYDROLOGY



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