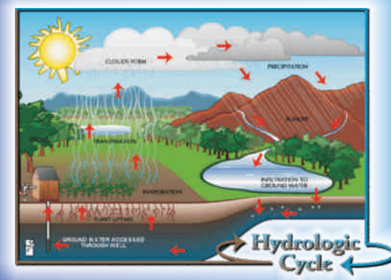
Issue 3 December 2011

Hydrology for People™



Newsletter of National Institute of Hydrology, Roorkee (India)

From Director's Desk

Water is the most important and perishable asset of our planet. On a global scale, we have only 0.75 percent accessible fresh water of the total water resources available on the earth. Our global economy, agricultural production, industrial growth, socio-economic structures, governance mechanisms and everyday life depends on this finite and vulnerable resource. In most parts of the world, including India, the water resources are under stress due to growing imbalance between the mounting demand for water and shrinking water reserve. In our country, the water table is falling due to intense ground water use, thus hampering our quest for the sustainable development. With increased prospects of feeding increased population in 2050, the industrial, individual and agricultural demand is expected to escalate dramatically. Also, the climate change is becoming a more and more important issue for growing water scarcity. This calls for awareness that water is very scare and valuable natural resource and that we need to initiate innovative technological and management changes. Thus, we have to go for a 'blue revolution' to achieve food security and prevent a serious water crisis in the future.

National Institute of Hydrology has been conducting the research in the field of hydrology and water resources, over the last three decades. Many purpose driven studies and strategic projects were carried out to solve the various need based problems touching almost every sphere of water resources development. With growing interest of managing water resources under the constant threat of climate change, the Institute is gearing-up to conquer the challenges and fulfil the needs of the country via demand driven strategic studies. The Institute is also pro-actively contributing to the knowledge dissemination, mass awareness and capacity building programmes.

R D Singh

Editorial

Drinking water supply in India, especially in rural areas, is a challenging situation. Sustainability of drinking water sources and schemes is a process which facilitates the existing/new drinking water supply projects to provide safe drinking water in adequate quantity, even during distress periods, through conjunctive use of groundwater, surface water and rain water harvesting. The main aim of providing sustainability in drinking water schemes is that such schemes will not slip back from universal access of safe drinking water to the community throughout the design period of schemes. Adoption of appropriate technology, revival of traditional systems, conjunctive use of surface and ground water, conservation, rain water harvesting and recharging of drinking water sources, are all considered integral component of achieving drinking water security.

Hydrology helps the drinking water supply schemes in meeting the minimum water quality standards and making the sources accessible at all times and in all situations. It is desirable that such projects need to be managed as locally as is reasonable so they are based on local demands and are sustainable. This requires sharing of resources and skills, including knowledge on the hydrology principles which is vital for long-term sustainability of the water availability (both in quantity and quality) in various community-led water supply schemes.

Publication of this newsletter is an attempt to rejuvenate the knowledge dissemination efforts of the Institute, with a flavour of 'connecting to the people'. The intent is to take the research findings to the community so that they are incited to develop interest in the scientific developments taking place in the country.

Your suggestions and feedback are welcome, and will help us in improving future issues!

V C Goyal

About National Institute of Hydrology

The National Institute of Hydrology (NIH), established in 1978 as an autonomus organization under Ministry of Water Resources (Government of India), is a premier R&D institute in the country to undertake, aid, promote and coordinate basic, applied and strategic research on all aspects of hydrology and water resources development. The Institute has its headquarters at Roorkee (Uttarakhand). To carry out field related research covering different regions of the country, the Institute has four Regional Centers located at Belgaum, Jammu, Kakinada and Sagar, and two Centres for Flood Management Studies at Guwahati in Hydrology, Water Quality, Soil Water, Remote Sensing & GIS Applications, Groundwater Modelling and Hydrological Instrumentation.

The Institute act as a center of excellence for transfer of technology, human resources development and institutional development in specialized areas of hydrology, and conducts user defined, demand-driven research through collaboration with relevant national and international organizations. The Institute vigorously pursues capacity development activities by organizing training programmes for field engineers, scientists and researchers, NGOs. NIH has so far completed more than 150 sponsored research and consultancy projects- the sponsors included Indian Army, PSUs, Planning Commission, National Productivity Council, State Government Departments, and central ministries of Science & Technology, Environment & Forests, Agriculture, Rural Development, etc. The Institute has undertaken a number of internationally funded projects, including those from UNDP, USAID, UNESCO, The World Bank, The Netherlands, Sweden, European Union. The Institute is presently participating in the World Bank funded Hydrology Project Phase-II.

Some of the significant contributions of NIH include studies for solution of real-life problems related to augmentation of water supply and water management in cities, glacier contribution in streamflow of Himalayan rivers for hydro-electric power projects, watershed development, water quality management plan for lakes, watershed development, storm water drainage network in cities, flood inundation mapping and flood risk zoning, and water quality assessment in major cities. The Institute is actively pursuing the IEC activities and mass awareness programmes of the Ministry of Water Resources. NIH works as a nodal centre of the Ministry for effective implementation of the National Water Mission.

Vision

Providing leadership in hydrologic research through effective R&D solutions for achieving sustainable development and self-reliance of the water sector in India

Mission

- Develop cost-effective techniques, procedures, software packages, field instrumentation, etc. for hydrological studies
- Study scenarios of water resource availability under varying hydrogeological, climatic, socio-cultural conditions through modelling techniques
- Assess impact of climate change on water resources and suggesting measures for mitigation, adaptation and resilience

- Propagate application of emerging technologies for water resources development and management
- Provide cost-effective R&D solutions to need-based water-related problems
- Provide reliable advice to the various stakeholders
- Empower community through capacity building and awareness on water resources development and conservation

Thrust Areas

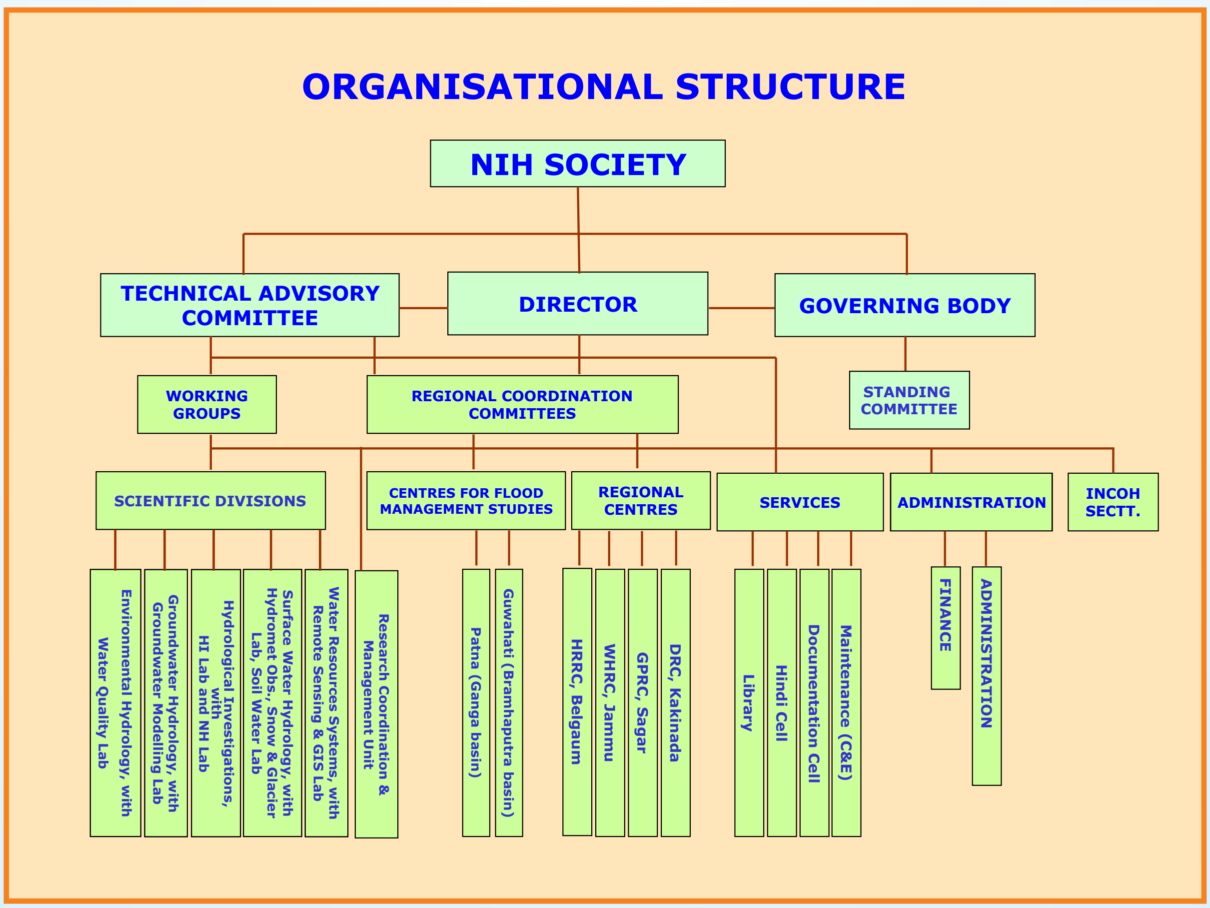
- Water Resources Planning and Management
- Ground Water Modeling and Management
- Flood and Drought Prediction and Management
- Snow and Glacier Melt Runoff Estimation
- Prediction of Discharge in Ungauged Basins
- Water Quality Assessment is specific areas
- Hydrology of Arid, Semi-arid, Coastal & Deltaic Zones
- Reservoir / Lake Sedimentation
- Impact of Climate Change on Water Resources
- Application of modern techniques to provide the solution to hydrological problems

Hydrology Primer

In India, most of the major and medium cities meet their needs for water by withdrawing it from the nearest river, lake or reservoir. Hydrologists help cities by collecting and analyzing the data needed to predict how much water is available from local supplies and whether it will be sufficient to meet the city's projected future needs. To accomplish this task, hydrologists study records of rainfall, snowpack depths, river flows, evapo-transpiration rates, possible transportations in the emergency that are collected and compiled by hydrologists/engineers in various government department/agencies.

Managing reservoirs can be quite complex, because they generally serve many purposes. Reservoirs increase the reliability of local water supplies. Hydrologists use topographic maps and aerial photographs to determine where the reservoir shorelines will be and to calculate reservoir depths and storage capacity. This work ensures that, even at maximum capacity, no highways, railroads or homes would be flooded.

Deciding how much water to release and how much to store depends upon the time of year, flow predictions for the next several months, and the needs of irrigators and cities as well as downstream water-users that rely on the reservoir. If the reservoir also is used for



recreation or for generation of hydroelectric power, those requirements must be considered. Decisions must be coordinated with other reservoir managers along the river. Hydrologists collect the necessary information, enter it into a computer, and run computer models to predict the results under various operating strategies. On the basis of these studies, reservoir managers can make the best decision for those involved.

The availability of surface water for drinking, cooking, swimming, industrial or other uses sometimes is restricted because of water pollution. Pollution can be merely an unsightly and inconvenient nuisance, or it can be an invisible, but deadly, threat to the health of people, plants and animals.

Water Related Facts

- The hydrologic cycle is a continuous process that exists on the earth by which the water from over and beneath the earth's surface (including the ocean) is transported to the atmosphere through the process of evaporation and evapo-transpiration from the vegetative cover and to the land surface through the process of rainfall and snowfall, and reaches to the surface and groundwater storages, and the ocean by means of the various path.
- The various phases of the hydrologic cycle may be short, or it may take millions of years. Water may be captured for millions of years in polar ice caps, groundwater reservoirs (aquifers) and in the sea.
- The hydrological cycle moves enormous quantities of water about the globe. However, much of the world's water has little potential for human use because 97.5% of all water on earth is saline water. Out of remaining 2.5% fresh water, most of which lies deep and frozen in Antarctica and Greenland, only about 0.26% flows in rivers, lakes and in the soils and shallow aquifers which can be readily used.
- Certain hydrological problems and weaknesses have affected a large number of water resources all over the world due to the effect of Climate Change due to Global Warming.
- In case of India, floods and droughts affect vast areas of the country, transcending state boundaries. One-sixth area of the country is drought-prone. Out of 40 million hectares of the flood prone area in the country, on an average, floods affect an area of around 7.5 million hectares per year.

Role of Hydrologist

Hydrology is the science that treats the waters of the earth, their occurrence, circulation, movement and distribution, their chemical and biological properties and their reaction with the environment, including their relation to living things. The domain of hydrology embraces the full life history of water on the earth.

- The hydrologist play very important role in solving water-related problems in society such as quantity, quality and water availability or basin water budgeting through application of the proper scientific knowledge and mathematical principles.
- The hydrologist studies the fundamental transport processes to be able to describe the quantity and quality of water as it moves through the hydrologic cycle (evaporation, precipitation, streamflow, infiltration, groundwater flow, and other components).
- Hydrologists assist public health officials in monitoring public water supplies to ensure that health standards are met. When pollution is discovered, environmental engineers work with hydrologists in devising the necessary sampling program. Water quality in estuaries, streams, rivers and lakes must be monitored, and the health of fish, plants and wildlife along their stretches surveyed. Related work concerns acid rain and its effects on aquatic life, and the behavior of toxic metals and organic chemicals in aquatic environments. Hydrologic and water quality mathematical models are developed and used by hydrologists for planning and management and predicting water quality effects of changed conditions. Simple analyses such as pH, turbidity, and oxygen content may be done by hydrologists in the field. Other chemical analyses require more sophisticated laboratory equipment.
- The engineering hydrologist, or water resources engineer, is involved in the planning, analysis, design, construction and operation of projects for the control, utilization, and management of water resources.
- He may also deal with the study concerning the municipal water supply, irrigation water supply and management, mitigation of floods and droughts, integrated watershed management, ground water recharge and solving reservoir sedimentation problems.
- Scientists and engineers in the field of hydrology may be involved both in the field investigation and office work.
- In the field investigation, they may collect basic hydrological, geological, meteorological and water quality data, sometimes from remote and rugged terrains with use of measuring instruments and equipments. While, in the office, they may do many jobs that includes the assessment of water quality in the laboratory, remote sensing data

processing and analysis using GIS, interpretation and analysis of field data, modelling studies for flood hazards mitigation, groundwater replenishment, water-logging problems, sea water intrusion, reservoir operations in the command area and assessment of their impacts on environment.

International Decade for Action Water for Life 2005–2015

World Water Day, 22 March 2005, heralded the start of the International Decade for Action proclaimed by the United Nations General Assembly. 'Water for Life' calls for a coordinated response from the whole United Nations system. The timing is significant: the end of the action decade in 2015 is the target date for achievement of many of the Millennium Development Goals (MDGs). Those goals were amplified by the 2002 World Summit on Sustainable Development in the Johannesburg Plan of Implementation, which set the following target:

WATER FOR LIFE
2005-2015

HALVE, BY 2015, THE PROPORTION OF PEOPLE WITHOUT SUSTAINABLE ACCESS TO SAFE DRINKING WATER AND BASIC SANITATION.

Project Solving Real Life Problem

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

During 2006-07, a mass levels Jaundice due to influx of pollutants/bacteria in the drinking water have been reported in Shimla Town, India. After discussion with the officials of Himachal Pradesh, it was found that the assessment of impact of sewage effluent on drinking water sources of Shimla city is the real problem and needs to be assessed scientifically and thus, this study was taken by NIH as PDS under Hydrology Project Phase-II. The main objectives of this project were (a) analysis of hydrological, water quality, & basin characteristics of Shimla city, (b) assessment of water quality variables in drinking water sources and sewage effluent, (c) analysis of pollutant / source identification (location) of sewage influx in drinking water, (d) impact assessment of sewage effluent in drinking water source and (e) suggesting possible remedial measures for its removal and dissemination of knowledge and findings to field engineers and common people.

The drainage area of Shimla City, which consist of part of Satluj and Yamuna sub-basins. Two watersheds falls in Satluj river sub-basin, while one watershed fall in Yamuna river sub-basin. In this study, watershed characteristics are evaluated for problematic (Sanjauli - Malyana Zone) area of Shimla City lying under Yamuna basin using SWDES and ERDAS/ILWIS Software's. The dizitized sewer network map of the study area (Sanjauli - Malyana Zone) is shown in Fig. 1

Figure1: Sewer Network map of Study Area (Sanjauli - Malyana Zone)

Samples were collected for Pre & Post Monsoon period of 2010-11 from the: groundwater, surface water, WTP and STP at different locations (See pictures).Sampling and analysis for various physico chemical and bacteriological parameters (pH, EC, TDS, Ca, Mg, Na, K, HCO_3, Cl, SO_4, NO_3, PO_4, F, BOD, COD, total coliform, fecal coliform, etc.) of the study area were carried out. Drinking water quality data were analyzed on quarterly basis using standard methods (APHA, 1995). Verification for efficacy of sewerage network of Sanjauli - Malyana Zone had been carried out by using Bentley SewerCAD software. The salient conclusions and recommendations of this study are :

1. Sewerage network installed in Sanjauli Malyana region is sufficient for designed sewage load and elevation profile indicates smooth flow of sewage.
2. Figure1: Sewer Network map of Study Area (Sanjauli - Malyana Zone)
2. Contamination of natural stream supplying water to Ashwani Khud WTP is due to-poor connectivity of habitation with the sewerage network.
3. The groundwater of Shimla city was found to be of Ca-Mg-HCO_3 type having temporary hardness.
4. The important sources of contaminations of water resources reduced efficiency of Malyana STP.
5. The WTP needs modification to provide safe water.

6. It is recommended to install solids contact type Clarifier / Actiflow with an option for in built sludge recirculation in order to get rid of organics and microbes during pretreatment (Equipment cost – 15 Crores INR).
7. Septic tank system should be discouraged and sewerage facility should be provided.
8. Anoxic tank for removal of nitrate should be considered in order to reduce the nitrate concentration in drinking water supplied from Ashwani Khud WTP.
9. It is recommend to continuously recycle the settled sludge along with periodic removal of biomass from the system.
10. Proper operation of WTP & STP by its proper evaluation/ audit will minimize the disease outbreaks. This can be achieved by proper training of the operators and valuing their critical role.

Malyana Sewerage Treatment Plant (STP)

Ashwani Khud Water Treatment Plant (WTP)

Dhalli WTP

Spatial Variability of Ground Water Quality in Jammu, Kathua and Udhampur Districts, J&K (India)

Nowadays the concept of "safe ground water (GW)" for drinking and various other uses in the society is losing its merit due to haphazard growth of industries, intensive agricultural activities and other anthropogenic activities, which are causing GW pollution everywhere. Better planning & management of GW resource in any area requires a regular program of Ground Water Quality (GWQ) monitoring, which is a costly. Thus, the application of spatial variability (SV) of GWQ may be very useful for better planning & management of GW resource in any area. The SV can be useful for optimal design of GWQ monitoring network in an area and cost of sampling and analysis can also be drastically reduced. Therefore, this research work was undertaken to study spatial variability of groundwater quality in Kandi, Sirowal and Shiwalik areas of Jammu, Kathua and Udhampur Districts and to prioritize ground water quality parameters for regular monitoring in the study area. In this study, GWQ data having 12 WQ parameters (pH, EC, total hardness, calcium, magnesium, sodium, potassium, bicarbonate, chloride, nitrate, sulphate, phosphate, and fluoride) which is collected from 40 open wells a) for year 1995 by NIH/WHRC, and b) for year 2008 by CGWB Jammu were used for spatial variability analysis study. The location of sample collection sites, mean values of range for different water quality parameter and contour maps of GWQ data for 2008 are shown in the following figures.

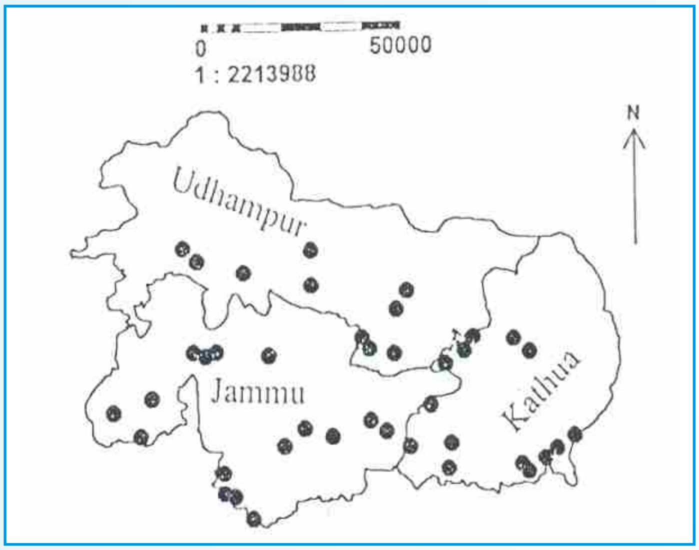


Figure: Location map of GWQ Monitoring Sites

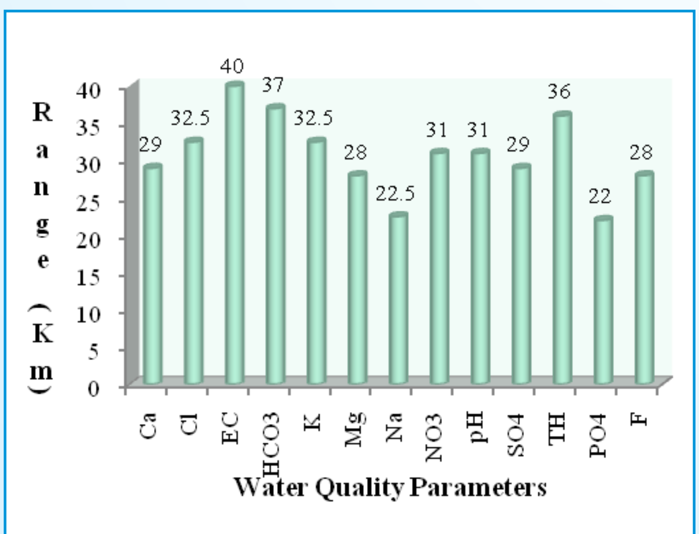


Figure: Mean values of ranges (Km) for different Ground water quality parameters in Jammu, Kathua and Udhampur Districts

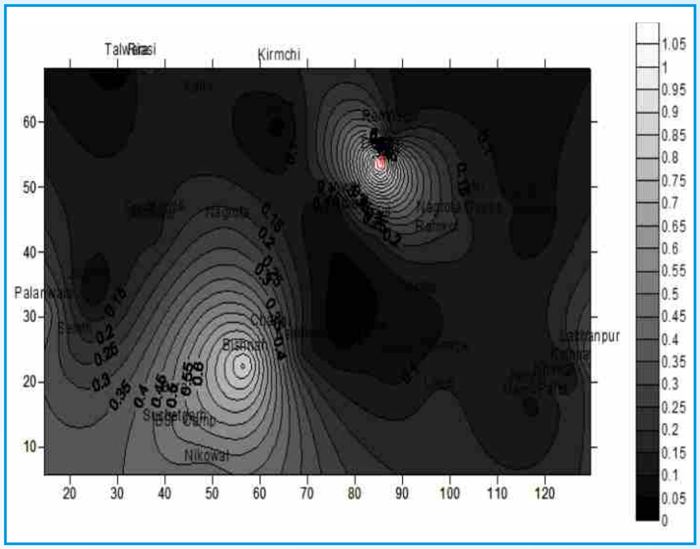


Fig. : Contour map of Fluoride for ground water quality data of Jammu, Kathua and Udhampur Districts (2008)

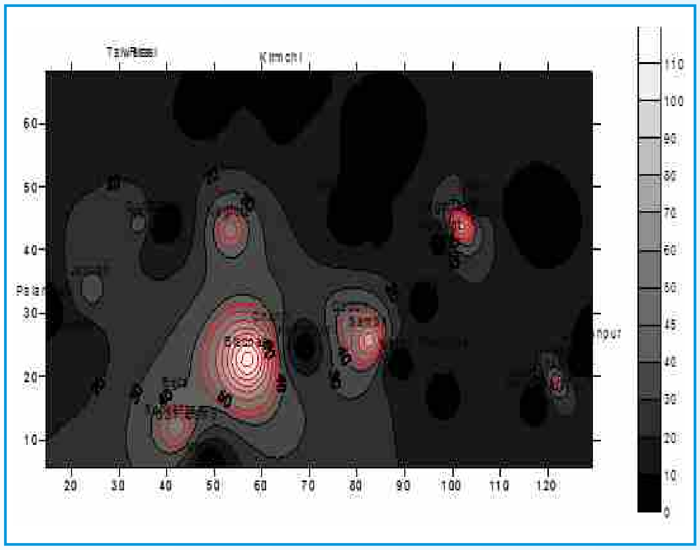


Fig. : Contour map of Nitrate for ground water quality data of Jammu, Kathua and Udhampur Districts (2008)

Assessment of Groundwater Resources & Development Potential of Yamuna Flood Plain, NCT, Delhi

The existing sources of water all over the country are under heavy stress to meet the gross water requirement for all uses of our people. However, there is a scope for improving the situation by optimizing the demand and supply requirements, ensuring judicious distribution and optimum consumption of appropriate quantity and type of water for a particular use. In National Capital Territory of Delhi, Delhi Jal Board (DJB) is responsible for supply of water to all the users. Due to limited availability of surface water and in general saline groundwater, DJB is not able to fully meet the municipal needs of the State. Therefore, to increase the supply of water, DJB is contemplating a scheme to extract groundwater from the Yamuna River Floodplain. A consultancy project was awarded to NIH, Roorkee with the objectives, (i) Estimation of groundwater resources in the Yamuna floodplains, (ii) Estimation of groundwater development potential in space and time through ground water simulation studies, (iii) Assessment of the impact of groundwater extraction from floodplains on hydrological regime, and (iv) Assessment of groundwater quality vis-a-vis availability of drinking water.

In this study, a four layer 3-dimensional groundwater model for the Yamuna Floodplain and adjoining area has been developed using Visual Modflow. All data related to river discharge and cross sections have been collected and incorporated into model (See figures 2 & 3). The subsurface layers have been defined using the lithological data. Model has been calibrated using the five year water level data collected from CGWB. The scenarios for recharge of Yamuna Floodplain at low, medium and high flood levels were developed. Impact of large scale pumping on groundwater and surface water regime also studied through groundwater modeling of the floodplain aquifer.

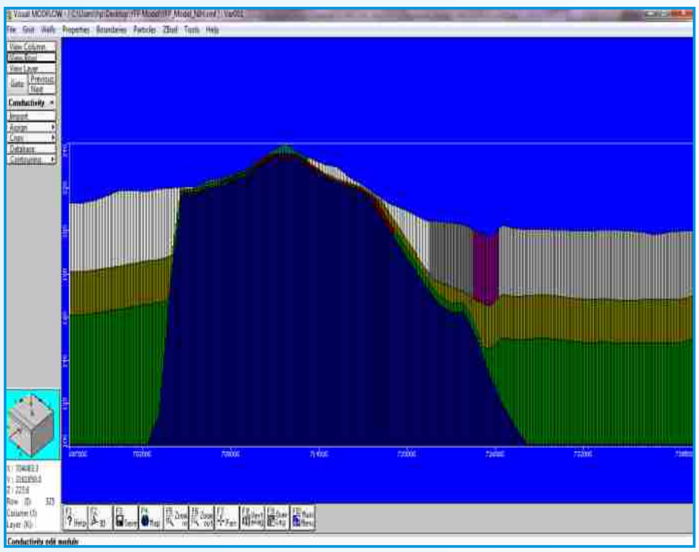


Figure 2 : Cross Section of the Model

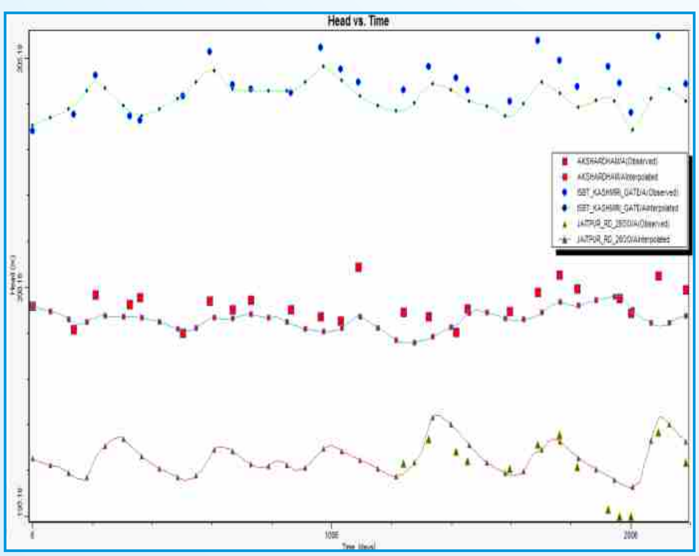


Figure 3 : Calibration of Model

Water availability study and supply-demand analysis in Kharun sub-basin of Seonath basin in Chhattisgarh state

Chhattisgarh, a newly born state is exploiting its water resources mainly for development of irrigation schemes, domestic supply and industrial supply. The state is facing the problem of water scarcity in rural as well as in urban areas to meet various water demands. Present PDS study deals with the problems of water scarcity being faced by Chhattisgarh state. It envisages the assessment of drought situation in the basin, rainfall runoff modeling, water availability assessment and study of supply demand scenario for the formulation of strategies for future water resources development and management in Kharun river basin.

The Rainfall Runoff model was developed for Kharun river using observed flow data of Patherdihi G/d site having catchment area 2442 km2, using MIKE11 NAM model. The coefficient of determination (R2) value of model calibration and validation were observed as 0.858 and 0.764 respectively, which indicated the good agreement between the simulated and observed catchment runoff in terms of the peak flows with respect to timing, rate and volume (Figure 4). It could be concluded that model is capable to generate extended runoff time series in Kharun basin. The Efficiency Index was obtained as 81% which shows that the choice of the model parameters was relevant and the model was found simulating the stream flow with accuracy.

The flow regime in Kharun river is strongly influenced by regulation operations associated with water transfer from Ravishankarsagar reservoir to Kharun and its supply for various usages through the series of anicuts. The Kharun River Basin Model was developed in MIKE BASIN to generate the virgin or regulated flows at required locations (Figure 5). The water availability assessment in the river under regulated and non-regulated indicated that the Kharun river is originally a intermittent river having flow during monsoon season and 2-3 months thereafter. Under the natural virgin condition, the river has no flow during January to May at even at 60% probability. The river has sufficient annual water yield but due to lack of big storage structures, the water demands in the basin cannot be fulfilled by the river. The water supplemented from Ravishankarsagar reservoir and other sources to Kharun river is being supplied to Raipur city, railways and industrial area through the series of anicuts. Thus the river experiences flow throughout the year under regulated flow condition.

The water from Kharun river is being utilized mainly to meet domestic and industrial water demand, which are expected to be boost up in next few decades due to rapid population and industrial growth. The present domestic water demand of Raipur city is 41.28 MCM which will become 94.67 MCM by the year 2050-51. From the analysis of Ten-Daily Period flow volumes at various probability levels at Patherdihi, it was observed that, the quantity of water available in the river during lean period till the beginning of monsoon season is due to the water added from various sources to the river to meet its demands. From the supply-demand analysis it was observed that, when the water surplus volume becomes zero, the deficit begins and vice-versa. The river water deficit increases with increase in demand and increase in probability level of assured water supply. The development of future supply-demand scenarios, amount of water deficit at various probabilities is important for development and planning of water resources in Kharun river basin (Figure 6). It sets guidelines for addressing various issues such as demand management in the river basin, planning of water supply at appropriate level of probability, selection of flow volume of reasonable dependability and providing assured water supply to meet the total demands being fulfilled from the river.

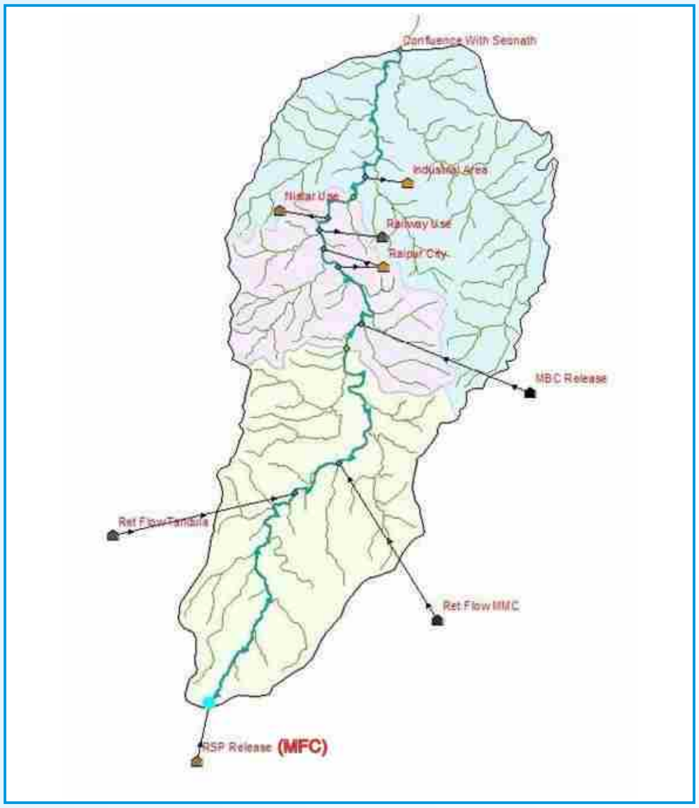
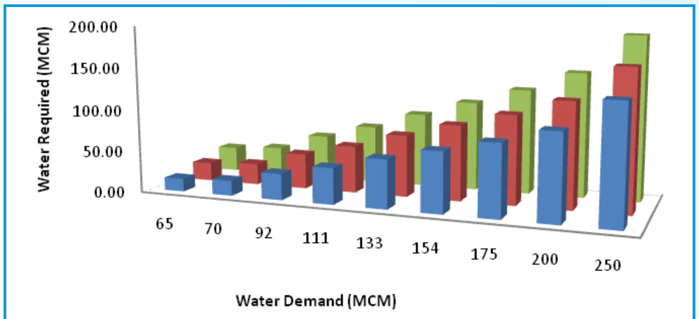


Figure 4: Schematics of Kharun River MIKE BASIN Model



	65	70	92	111	133	154	175	200	250
75%	15.41	18.13	31.33	43.12	57.97	71.60	85.24	101.86	137.75
90%	22.00	25.32	41.99	56.06	73.56	89.45	105.33	124.53	165.23
95%	29.71	33.67	52.94	68.94	88.38	106.49	124.91	148.00	193.76

Figure 6: Additional water supply required to meet the water deficit at various probability levels

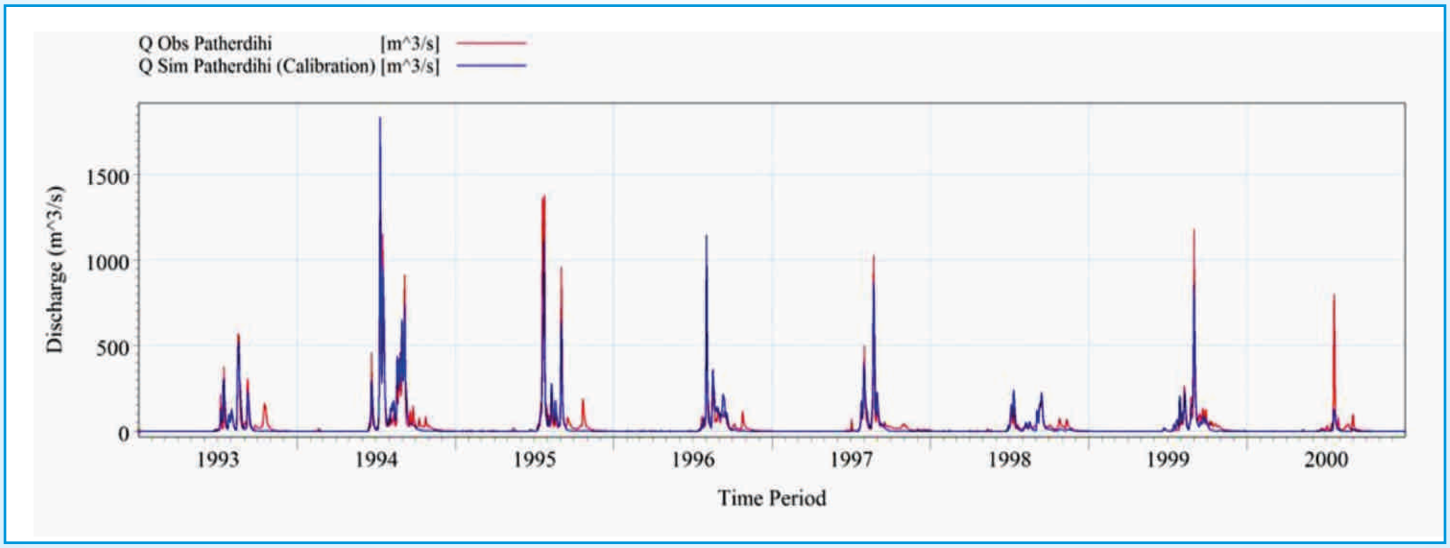


Figure 5: Comparison between observed and simulated discharge using MIKE11 NAM Rainfall Runoff Model

Acid Mine Drainage in Coal Mining Areas of Meghalaya

Acid Mine Drainage (AMD) is recognized as one of the most serious environmental problem in the mining industry. The problem of acid mine drainage has been present since mining activity began thousands of years ago. Mining activity has disrupted the hydrology of mining areas so badly that it is extremely difficult to predict where water would eventually re-emerge. Acid mine drainage can have severe impacts to aquatic resources, can stunt terrestrial plant growth and harm wetlands, contaminate ground water, raise water treatment costs and damage concrete and metal structures. Therefore, coal-mining operations must meet strict environmental regulations concerning mining techniques and treatment practices.

This report summarizes water quality of rivers and streams in the coal mining areas of Jaintia Hills Districts of Meghalaya and discusses some of the associated problems including adverse impacts on aquatic biota. Some of the most common treatment and containment mechanisms are listed and briefly described in the report. A few environmental management strategies that can be useful in mitigation of the environmental problems and rehabilitation of degraded ecosystems of the area have also been suggested.

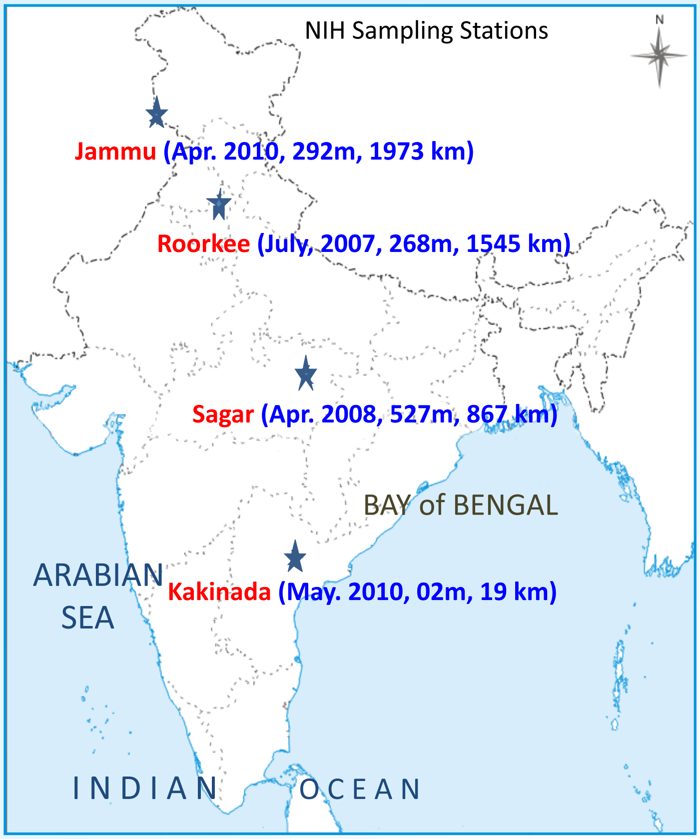
National Programme on Isotope Fingerprinting of Waters of India (IWIN)

The scientists at NIH has undertaken this dynamic research project of national and international importance to address the onset and withdrawal of monsoon and its regional dynamics along with other participating central agencies viz., A.U., CGWB, CPCB, CRIDA, CWRDM, IIT-Khargpur, IMD, NGRI, NIO, NRL-IARI and PRL. Samples are collected by NIH from 7 sites (Roorkee, Sagar, Jammu, Kakinada, Tezpur, Kanpur and Manali) and member organizations collect samples from 85 sites all over India. The location map of the NIH-IWIN sample collection sites is shown in the following figure.

The isotopic correlation among the IWIN sampling stations Roorkee, Sagar, Jammu and Kakinada were shown with special emphasis on the correlation between Roorkee and Sagar. Three more sampling stations at Tezpur University, Assam, IIT-Kanpur and Manali have also been established for collection of Ground Level Vapour (GLV) samples. A total of 1154 samples were collected from April, 2011 to September, 2011 from Roorkee, Sagar, Kakinada, Jammu, Tezpur, Kakinada, Kanpur and Manali and out of which 650 number of samples have been analysed. These include GLV, rainwater, groundwater and river water. Using GLV – isotopic time series data (2007-11). The significance of the isotopic composition of GLV in identifying arrival and departure of monsoon and shown its significance in monitoring the climate change which is also reflected in the change in winter temperature and reduction in sustaining the maximum temperature. To extend the objective of study from ground based to vertical profile (500-1000m), balloon based new experiments was recently initiated.

Environmental flows in river basins: a case study of Bhadra River

The Bhadra river originates in the Western Ghats range, and flows east across the Deccan plateau, joined by its tributaries the Somavahini, Thadabehalla, and Odirayanahalla. The river flows through the Bhadra Wild life sanctuary. A dam was built across the river near Lakkavalli. The Bhadra meets the Tunga river at Koodli, a small town near Shimoga. The combined river continues east as the Tungabhadra, a major tributary of



IWIN Sampling Locations Map

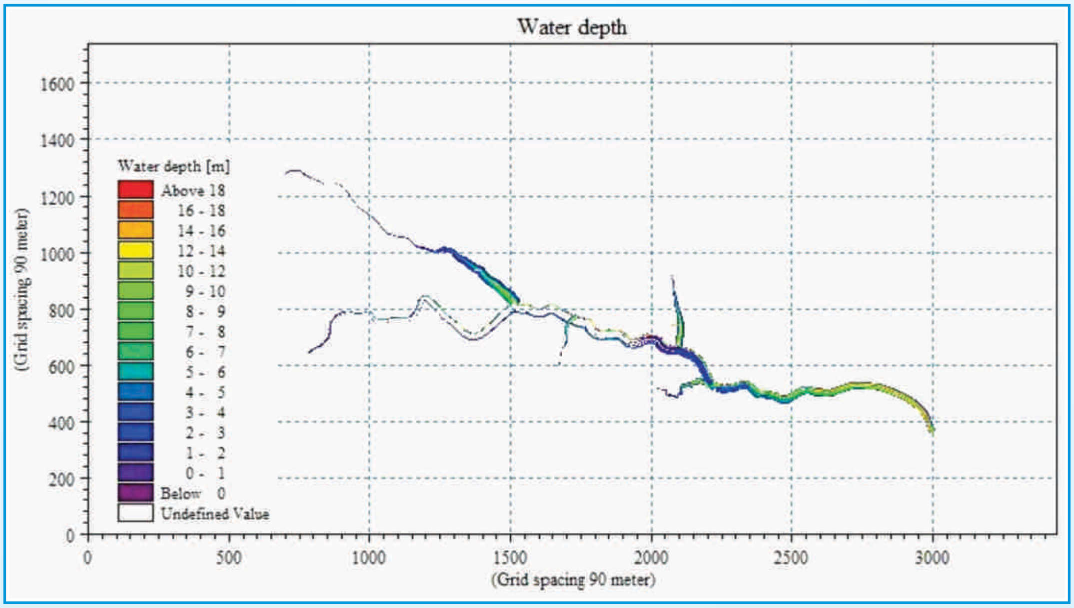
the river Krishna, which empties into the Bay of Bengal.

This study utilizes, the secondary data pertaining to climatology, general features, water quality which were collected from the existing literature and also from various academic institution which conducted studies. Inflow and out flow data of Bhadra reservoir was collected from WRDO, Bangalore. Field investigations were also carried out along the stretch of the Bhadra river downstream of Bhadravathi town to understand the ecological and hydrological impact. Surface water samples from the river and Ground water samples around Bhadravathi town were collected. Dissolved Oxygen (DO) and Biochemical Demand (BOD) were monitored in the field. Laboratory analysis was carried out to determine major cations and anions. DO, pH and temperature were determined in the field and BOD5 was determined in the laboratory. Using the collected samples, the analysis was carried out as per the Standard Methods for examination of water and wastewater (APHA, 1992). The flow rate at each point was measured using a float method and measured cross-sectional area of flow.

Maintaining the minimum flow is a pre-requisite to keep the ecological balance as a part of river basin management. In this study, Tenant Method was adopted for the assessment of environmental flows. The present study analyses the state of water quality (in terms of DO- BOD) in the Bhadra sub-basin by using QUAL2K Model of USEP. The results obtained through the modeling helped to understand the ecological conditions existing in the river basin.

Flood inundation mapping and risk assessment in a reach of river Ganga using MIKE FLOOD.

The River Ganga between Buxor to Hathidah (Rajendra Bridge) for a length of 251.2 km has been taken up for the purpose of flood inundation mapping. In this stretch, the major tributaries joining the river on its left bank are Ghaghara and Gandak while Sone and Punpun joins on right bank. The lengths of tributaries from their



Water depth for 2-yr return period flood respective gauging sites to the confluence with river Ganga have been considered for developing the model. The study has been taken up with the objectives to i) prepare flood inundation maps for the river reach, ii) prepare flood hazard maps for the river reach, iii) prepare flood risk zone maps, iv) predict flood inundation and flood hazard areas for various stages of river flow and v) predict the flood risks associated with different return periods of flooding.

From the satellite data, the flow path of river Ganga and its tributaries are delineated while the river cross sections observed by CWC is used for developing 1-D flow model. The DEM prepared from Survey of India toposheets of 1:50,000 scale and is used for generating bathymetry for 2-D model. The coupled model is used for estimating the inundation corresponding to flood of various return periods.

Hydrology Project Phase - II

NIH is the nodal agency for the development of Decision Support System (Planning) for Integrated Water Resources Development and Management to be implemented in 6 Central and 9 States Agencies under HP-II. The DSS(P) consultants are working on development and implementation of the Generic DSS(P) software for the "Upper Bhima" pilot basin in Maharashtra.

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 11 PDS. The Institute has conducted 52 training programs/ workshops 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.

Important information about water related websites / Portals

Bhuvan Beta - Gateway to Indian Earth Observation

A Geoportal of Indian Space Research Organisation Showcasing Indian Imaging Capabilities in Multi-sensor, Multi-platform and Multi-temporal domain. This Earth browser gives a gateway to explore and discover virtual earth in 3D space with specific emphasis on Indian Region.

- Bhuvan evinces Indian Imaging capabilities
- Portrays Rich Thematic Information towards Societal applications
- Experience OGC web services enabling interoperability
- Robust API for ease of development and integration
- Interactive 3D modeling and guided tours
  http://bhuvan.nrsc.gov.in/bhuvan/home

Global Water Partnership

They support integrated water resources management programmes by collaboration, at their request, with governments and existing networks and by forging new collaborative arrangements.
http://www.gwpforum.org/

Hillslope and Watershed Hydrology Lab, Oregon State University

Conducts research on the hydrologic cycle, particularly runoff generation processes in diverse watersheds. Includes publications and presentations, information about opportunities for students, and related links.
http://www.cof.orst.edu/cof/fe/watershd/

Asian Water Scientist Network

Includes a directory of water scientists in Asia and worldwide listings of upcoming conferences of possible interest. http://members.tripod.com/awsn/

Water History

Articles explore prehistoric and historic water projects worldwide. http://www.waterhistory.org/

World Water Conservation

Reports on the status of water supply and water-saving measures at various locations around the world.
http://worldwaterconservation.com/

Mass Awareness Programme

Organized a mass awareness programme on "Sustainable Water Management and Water Quality Problem" and demonstrated the water quality testing and carried out the water testing of the village ground water samples at Junior High School, Village Kherajat on Oct. 3, 2011

Publications in Journals

Venkatesh.B., Lakshman Nandagiri., Purandara, B.K., V.B. Reddy "Soil Water Fluxes under different land Covers – A Case Study from Western Ghats, India", International Journal of Earth Sciences and Engineering, 4(2), 268-278.

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Kale, R. Vittal, "Green-Ampt Infiltration Models for varied Field Conditions: A Revisit", Water Resources Management, Springer, pp.1-32, doi:10.1007/s11269-011-9868-0.

Jeyakanthan, V.S. and Sanjeevi, S., "Reservoir capacity estimation of Singoor reservoir, India, by pre-pixel and sub-pixel processing of multi-date satellite images" Geo-Carto International, Vol.26, No.4, pp.305-320.

Ojha, C. S. P., S. D. Khobragade and A. J. Adeloye (2011), "Estimating Air vapour pressure in a semi arid region using FAO-56 methodology" J. Irrigation and Drainage Engg. ASCE., Vol. 137, No. 8, August 2011, pp. 491-500.

Rao, Y R Satyaji, B. Krishna and P.C. Nayak (2011), "Time series modeling in Water Resources Planning and Management". Int. Jr. of Earth Sciences and Engineering, Vol.4, No.6 SPL, Oct.2011.

Bhunya, P.K, S N Panda, and M K Goel. Synthetic Unit Hydrograph Methods: A Critical Review. The Open Hydrology Journal, Bentham Science, vol-5, 1-8, BSP-TOHYDJ-2009-4, 2011

Purandara, B.K., Venaktesh.B., and Choubey, V.K., "Sediment transport and sedimentation in a coastal ecosystem- a case study", Journal of Materials and Geoenvironment, 58(3), 289-302.

Jain, Sanjay K., Thakural, L.N., Singh, R.D., Lohani. A.K. and Mishra, S.K., "Snow cover depletion under changed climate with the help of remote sensing and temperature data", Natural Hazards, VO.58, No.3, 891-094, 2011.

Jain, Sanjay K., Goswami, A., and Saraf, A.K., "Assessment of snowmelt runoff using remote sensing and effect of climate change on runoff", Water Resources Management, Vol.24, No.9, 1763-1777, 2011.

KS Kasiviswanathan, RSR Pandian, S Sarravanan and Avinash Agarwal (2011). Genetic programming approach on evaporation losses and its effect on climate change for Vaipar basin. International Journal of Computer Science Issues, Vol. 8, Issue 5, No 2, September 2011.

Archana Sarkar, R. D. Garg, Nayan Sharma, " RS-GIS Based Assessment of River Dynamics of Brahmaputra River in India", Journal of Water Resources and Protection (JWARP), Vol.4, N0.2, pp63-72.

Organization of Workshops / Training Courses/Seminar/ Symposia

S.No.	Topic of Training/ Workshop /Symposia	Date & Duration	Venue
1.	Hydrology for Drinking Water Sector Professionals	July 25-26, 2011	Roorkee
2.	Hydrological Processes in an Ungauged Catchment	July 25-29, 2011	Roorkee
3.	DSS Customization Workshop – I	Aug. 5, 2011	New Delhi
4.	Water Quality and its Management	Sept. 12-14, 2011	Shimla
5.	Project Hydrology	Sept. 12-16, 2011	Belgaum
6.	Storm Water Management in Urban Areas	Sept.21-23, 2011	Kakinada
7.	Glaciers and Water Resources in the Cold-arid Systems of Ladakh region	Sept., 27, 2011	Leh
8.	Drought Monitoring & Management	Oct.31-Nov.4, 2011	Roorkee
9.	Surface Water Data Entry System using SWDES	Nov.16-19, 2011	Goa
10.	DSS Customization Workshop II	Nov.25, 2011	New Delhi
11.	DSS(P) workshop on DSS customization for Orissa, M.P. and Karnataka	Nov.25, 2011	New Delhi
12.	Application of NIH_ReSyp software for the field engineers	Nov.28-Dec.2, 2011	Roorkee
13.	Integrated Water Resources Management Strategy for Water Scarce Bundelkhand Region in India	Dec. 6-7, 2011	Roorkee
14.	Water quality Monitoring, Network Design, Sampling, Analysis & Quality Assurance	Dec. 6-10, 2011	Roorkee
15.	Jal Sansadhanon ke prabhandan me naveentam taknekon ka upyog (in Hindi)	Dec.16-17, 2011	Roorkee
16.	SWDES (Surface Water Data Entry Software)	Dec. 20, 2011	Kakinada
17.	Isotope Hydrology	Dec. 19-24, 2011	Roorkee

Invited Lectures and Important Meetings

[From 1st-July 2011 to 31st Dec. 2011]

Sl. No.	Date	Meeting – Subject	Place
1.	6.6.2011	38th main meeting of the Indian National Committee on Hydrology (INCOH)	New Delhi
2.	24.6.2011	"Dialogue Initiation Meet" on Mitigation and Remedy of Groundwater Arsenic Menace in India	New Delhi
3.	4.7.2011	Meeting of Committee of MoWR constituted for identification of priority areas for research in the field of Water Resources on "Promoting PPP in R&D and Clean Energy" under PM's council on Trade and Industry	New Delhi
4.	7.7.2011	Guest Lecture in Joint Training Program for IAS, IPS and IFS officers at Indira Gandhi National Forest Academy	Dehradun
5.	15.7.2011	10th meeting of the Regional Coordination Committee (RCC) of South Ganga Plain Regional Centre of NIH, Sagar	Bhopal
6.	22.7.2011	Briefing meeting before the Standing Committee on Water Resources by representatives of MoWR and NIH in connection with examination of 'Working of National Institute of Hydrology' at Parliament House Annexe Meeting reg. 12 Five Year Plan (2012-17)	New Delhi
7.	5.8.2011	Workshop on 'DSS(P) software customization' under HP-II	New Delhi
8.	12.8.2011	Drafting Committee meeting for National Water Policy	New Delhi
9.	17.8.2011	2nd meeting of MoWR constituted for identification of priority areas for research in the field of WR on "Promoting PPP in R&D and clean Energy' under PM's council on Trade and Industry	New Delhi
10.	19.8.2011	8th R & D Session of INCOH at CWC	New Delhi
11.	22-23.8.2011	Inaugural ceremony of ASEM (Asia Europe Meeting) Water Research and Development Centre, the first Academic and Development Committee meeting and seminar on Asia-European Water Resources Cooperation	Changsha, China
12.	14.9.2011	6th meeting of Review Committee for DSS(P) at State Data Centre, WRD, under HP-II	Raipur (Chattisgarh)
13.	27.9.2011	2nd meeting of the Steering Committee on Water Resources and Sanitation for the formulation of 12th Five Year Plan (2012-17) under the Chairmanship of Dr. Mihir Shah, Member (WR), Planning Commission	New Delhi
14.	29.9.2011	Meeting of Working Group on Water Database Development and Management set up by Planning Commission for the XII Five Year Plan (2012-2017)	New Delhi
15.	3.10.2011	Meeting of 12th Five Year Plan Proposals of MoWR under the Chairmanship of Secretary (WR)	New Delhi
16.	31.10.2011	Meeting of National Water Mission – Assessment of Impact of Climate Change on Water Resources	New Delhi
17.	3-4.11.2011	Saph Pani Workshop on 'Enhancement of natural water systems and treatment methods for safe and sustainable water supply in India'	New Delhi
18.	27.12.2011	Meeting of Inter-Sectoral Advisory Group for Goal-I: Comprehensive Water Data Base in Public Domain and Assessment of Impact of Climate Change on Water Resources	New Delhi

Institute's Important Meetings

1. 64th Meeting of Technical Advisory Committee (TAC), held at CWC, New Delhi on June 1, 2011

Technical Advisory Committee Meeting (June 1 , 2011)

2. 35th Working Group Meeting, held at Roorkee during Oct. 11-12, 2011.

Working Model of "Water Cycle" at IITF-2011

Working Group Meeting (Oct. 11-12, 2011)

NIH at India International Trade Fair - 2011

Events Organized

S.NO.	Programme/Event	Date	Venue
1.	Vigilance Awareness Week-2011	Oct.31-Nov.5, 2011	Roorkee
2.	33rd NIH Foundation Day	Dec 16-17, 2011	Roorkee

Foundation Day Celebrations (Dec 16-17, 2011)

Recruitment

1. Ms. Sashi Poonam Indwar, Sc.B joined in GW Div. on 25.11.2011.

Retirement

1. Sh. Ragubir Singh, Junior Security Guard
2. Sh. S.P. Modi, U.D.C.
3. Sh. D.P. Singh, Finance Officer

Exhibition

NIH participated in the 31st India International Trade Fair-2011 at Pragati Maidan, New Delhi, during Nov 14-27, 2011.

Upcoming Events

- Water Resources Management in Changing Environment (WARMICE-2012), Feb. 8-9, 2012, at NIH, Roorkee
- Three day training course on "Hydrological Investigations for conservation and Management of Lakes" March 26-28, 2012 at NIH, Roorkee
- One day training course on "Bank Filtration for Sustainable Drinking Water Supply in India", under the 'Saph Pani' on April 13, 2012, Vigyan Bhawan, New Delhi.

Editor
Dr V C Goyal, Head, Research Coordination & Management Unit
Assistance by
Dr Ravindra Kale, Scientist 'B'
Sri Rajesh Agarwal, RA

We Will Appreciate Your Guest Articles!
You can share your knowledge with others on topics highlighting 'water resources for community benefits' by contributing an article to the Guest Article Column. For more information, please contact: Dr V C Goyal, vcg@nih.ernet.in or vcgoyal@yahoo.com

National Institute of Hydrology
Roorkee - 247 667 (Uttarakhand, India)
Phone: +91-1332-272106
Fax: +91-1332-272123
www.nih.ernet.in