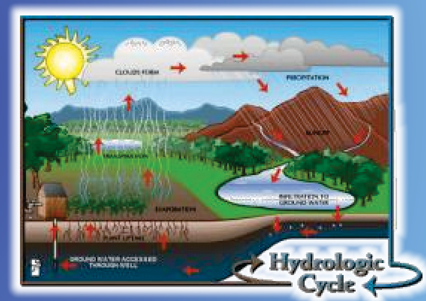
Issue 9, January, 2015

Hydrology for People™



Newsletter of National Institute of Hydrology, Roorkee (India)

From Director's Desk

Water at the land surface is a vital resource, both for human needs and for natural ecosystems. Society's growing water resource needs include hazard mitigation (floods, droughts, and landslides), agriculture and food production, human health, municipal and industrial supply, environmental quality, and sustainable development in a changing global environment. Desertification and drought are problems of global dimension that affect more than 900 million people in about 100 countries. Irrigation already accounts for more than 70% of freshwater withdrawn from lakes, rivers, and groundwater aquifers, and according to the UN's recent estimates, perhaps 80% of the additional food supplies required to feed the world's population in the next 30 years will depend on irrigation. Today, about one-third of world's population live in countries that are experiencing moderate to high water stress, that is, renewable freshwater availability is below 1700 cubic meters per person. 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 scarce 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 fulfill 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

Hydrologists are facing important, even fundamental, changes in the direction of hydrologic science. New tools, non-traditional datasets, and a better understanding of the connection between hydrology and the rest of the climate system are being developed just as society's needs for improved water management and hazards prediction are becoming critical. The application of new ideas and techniques to the difficult hydrologic problems of the future will require careful and visionary planning. In addition to new types of data, hydrologists are encountering a new intellectual paradigm that emphasizes connections between land surface hydrology and other components of the earth system. This coupling is now widely considered to be essential. It has already led to significant changes in the research and training foci for the discipline.

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. This is the time to make information related with water reach all nooks of the country. And, NIH fraternity is zestful enough to do its bit in this endeavour.

Response to the previous issues has been encouraging. 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 autonomous 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 Bhopal, and two Centres for Flood Management Studies at Guwahati and Patna in Hydrology, Water Quality, Soil Water, Remote Sensing & GIS Applications, Groundwater Modelling and Hydrological Instrumentation.

The Institute acts as a centre of excellence for the 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, researchers and 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 and 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

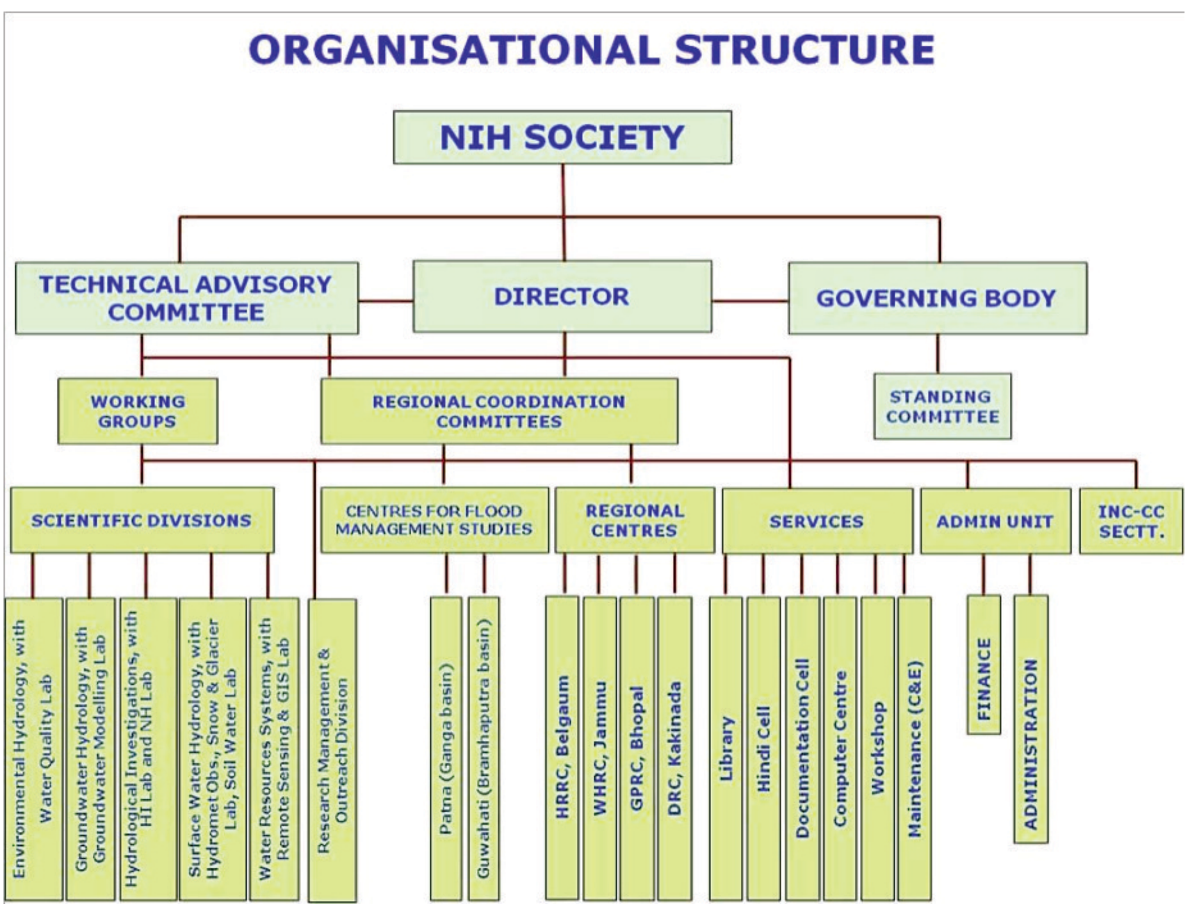
- Develop cost-effective techniques, procedures, software packages, field instrumentation, etc. for hydrological studies
- Study scenarios of water resource availability under varying hydro-geological, climatic, socio-cultural conditions through modelling techniques
- Assess impact of climate change 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 in 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

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 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 paths.
- 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

- ❖ The hydrologist plays 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 estimate the volume of water stored underground by measuring water levels in local wells and by examining geologic records from well-drilling to determine the extent, depth and thickness of water-bearing sediments and rocks. Before an investment is made in full-sized wells, hydrologists may supervise the drilling of test wells. They note the depths at which water is encountered and collect samples of soils, rock and water for laboratory analyses. They may run a variety of geophysical tests on the completed hole, keeping and accurate log of their observations and test results. Hydrologists determine the most efficient pumping rate by monitoring the extent that water levels drop in the pumped well and in its nearest neighbors.
- ❖ 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

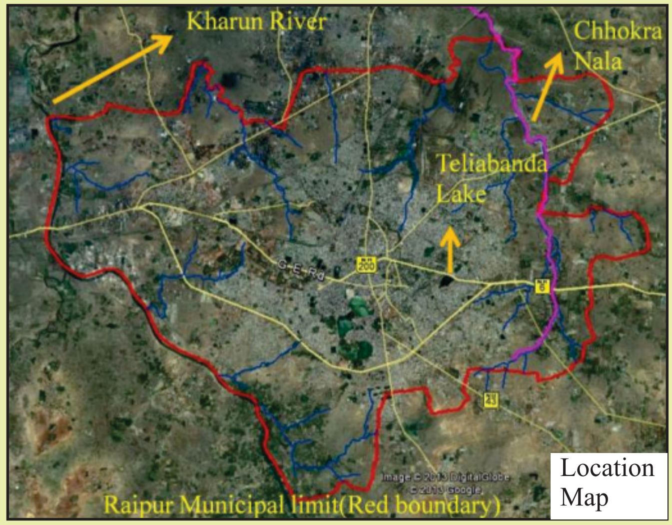
World Water Day, 22 March 2005, heralded the start of the International Decade for Action proclaimed by the United Nations General Assembly. 'Water for Life' calls for a coordinated response from the whole United Nations system. The timing is significant: the end of the action decade in 2015 is the target 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:

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

PROJECTS SOLVING REAL LIFE PROBLEM

Managed Aquifer Recharge (MAR) and Aquifer Storage Recovery (ASR)

The Study was a part of 'Saph Pani' project sponsored by European Union. The study was aimed to examine feasibility of MAR through a lake (Teliabandha Lake), of Raipur city, Chhatisgarh by conserving monsoon surface runoff and its water quality constituents. The Raipur city had 154 small and large water bodies, out of which 85 talabs are existing. The Teliabandha lake has spread area of 0.12 km^2 covers a catchment area of 1.14 km^2. The components of water balance equation were estimated by comprehensive analysis of hydrological and hydrogeological aspects of the selected lake which included analysis of rainfall-runoff, evaporation rate, lake water quality, lake geometry, aquifer characterization, parameters estimate, ambient groundwater level and quality. The semi-analytical mathematical model was developed to estimate unsteady groundwater recharge resulting from variable depth of water in the lake, influenced by time variant inflows and outflows. The recharge rates from the lake found very less, which ranged between 3.75 mm/day and 4.82 mm/day. The lake water quality indicated contamination by bacteriological parameters (viz. Fecal coliform and Total coliform), turbidity and



Location Map


Bathymetric Survey

COD, exceeding the permissible limit of drinking water standards (IS-10500:2012). Lake catchment possessed favourable hydrological and hydrogeological features except the geological stratum of massive limestone configuration, MAR-ASTR by additional engineered hydrological interventions has been found not viable because of restraining purification capacity of limestone formations.

Trend and variability analysis of Rainfall and Temperature in Himalayan region

The changing climatic conditions and warming up of environment has major impact on the water resources and agricultural sectors, and overall economy of the nation. Due to intensification of hydrological cycle, drastic and oppressive change in hydrologic parameters (like precipitation, evaporation and streamflow) have occurred which substantially influences the flow regimes. It is being observed that among the different influential atmospheric variables, temperature has a significant and direct effect upon nearly all hydrologic variables. A small shift in climatic pattern owing to escalating air temperature and changing precipitation is likely to affect mountainous river networks. Moreover, warmer climate leads to the spatio-temporal variation in snow cover distribution and melt runoff from snow and glacier significantly (in different scales) which in turn will affect the water supplies in these regions. However, recent research studies by scientific community evince the well established global climatic change around the world and the effects of this alteration on regional and basin scale still needs to be probed.

The trend describes the long smooth movement of the variable lasting over the span of observations, ignoring the short term fluctuations. The study is envisaged to understand the behavior of climate in Himalayan terrain of India which can be utilized for proper planning and management. Most of the studies regarding climate change only seek to detect potential trends or fluctuations in the long term mean of climatic signals, but the study of variability changes and extreme event behaviour is also essential. In the present trend and variability changes in climatic variables namely temperature and rainfall has been carried out in Himalayan region covering western,

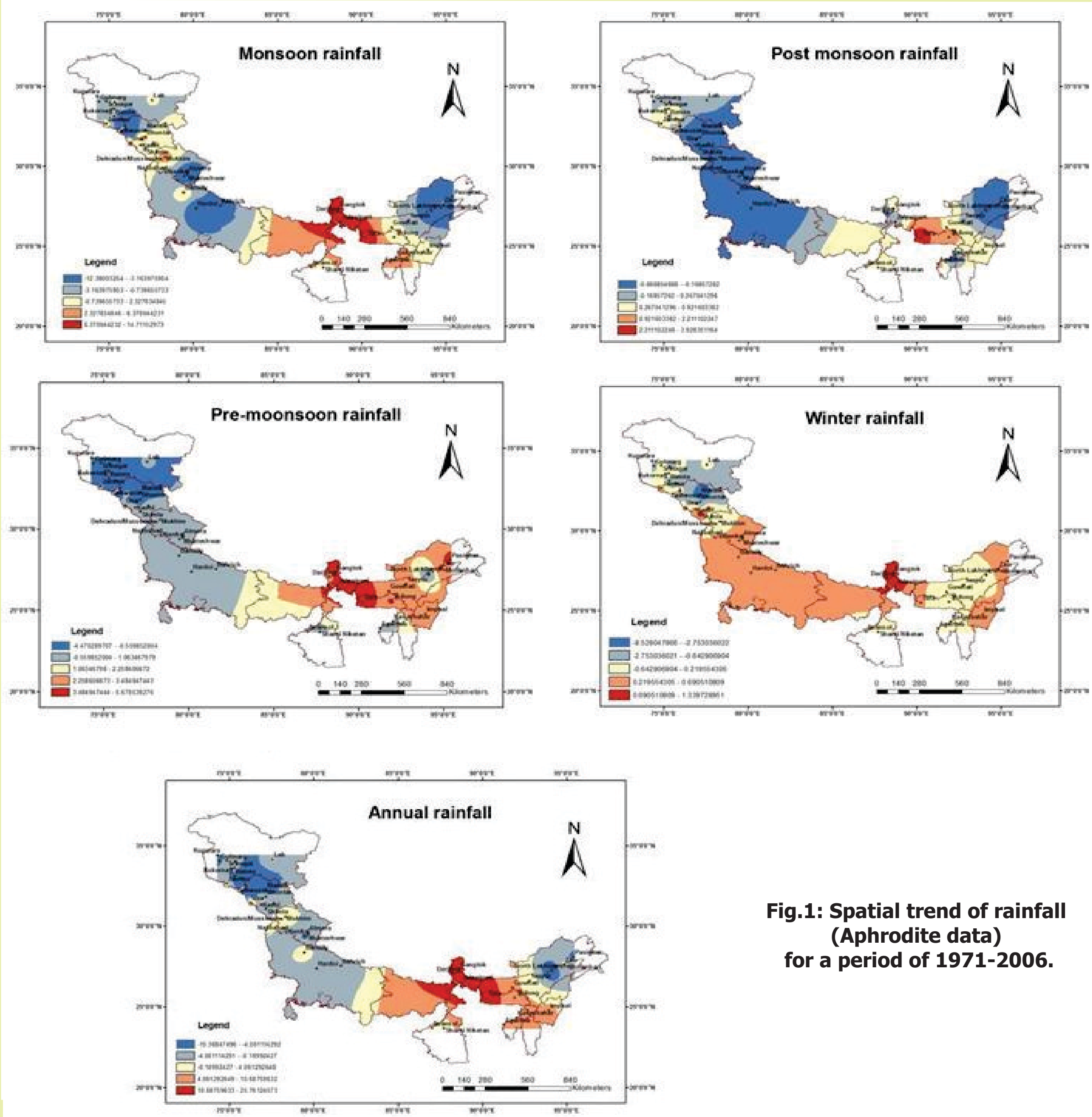


Fig.1: Spatial trend of rainfall (Aphrodite data) for a period of 1971-2006.

central and Himalayan regions in India. The parametric (linear regression) and non-parametric parametric (Mann-Kendall test and Sen's estimator of slope) approaches have been used to determine the trends on seasonal and annual scale in these meteorological variables. The trend analysis for rainfall data derived from Aphrodite has also been carried out for number of stations located in the Himalayan region.

Long-term trends and their magnitude for these climatic variables have been determined both at annual and seasonal time scale. For investigation of changes in meteorological variables, a year was divided into four principal seasons namely Pre-monsoon (March to May), Monsoon season (June to September), Post-monsoon (October to November) and Winter season (December to February). For better comprehension and visual interpretation of the observed trends, first of all seasonal and annual anomalies of temperature, rainfall and stream discharge for each station were computed with reference to the mean of the respective variable for the available records. Further, these anomalies were plotted against time and the trend was examined by fitting the linear regression line. The linear trend value represented by the slope of the simple least square regression provided the rate of rise/fall in the variable. Thereafter, Mann–Kendall (MK) test has been used for identification and to test the statistical significance of trend at confidence interval of 95%, prior to which data series of all the variables were checked for presence of auto-correlation. The Sen's estimator of slope (SE) was then applied to estimate the magnitude of the trend over the study period. The SE was applied to verify the outcomes of simple regression analysis. The spatial trends of rainfall for the three Himalayan region using Aphrodite data for a period of 36 years both at seasonal and annual scales are shown in Fig. 1. The investigation for the different Himalayan regions is discussed below.

Western Himalayan Region

Annual Scale: Indicating decreasing trend in rainfall at all the stations except at Jammu, Mandi and Una.

Seasonal Scale: Monsoon rainfall is also found to decrease almost at all stations except Bhuntar, Jammu and Una. Winter rainfall is significantly decreasing at Manali. Pre-monsoon indicates a rising trend at Dharamsala, Kasol, Rampur, Shimla and Una.

North-East Himalayan Region

Annual Scale: Indicating rising trend in annual rainfall at ten stations Agartala, Asansol, Guwhati, Imphal, Jalpaguri, kaliashahar, Shanti Niketan, Shillong, Tura , Ziro and at other stations it is decreasing

Seasonal Scale: Monsoon rainfall indicates rising trend at Gangtok, Jalpaiguri, Kaliashahar,Shanti Niketan, Shillong, Tura. Pre-monsoon rainfall is found to be rising at all stations except at North-Lakhimpur

Central Himalayan Region

Annual Scale: Rainfall indicates a decreasing trend at majority of stations.

Seasonal Scale: Monsoon rainfall indicates a rising trend at stations namely Bareilly, Mukhim. Pre-monsoon rainfall is found to be increasing at all the stations. Winter rainfall is found to be increasing almost at all stations in all the Himalayan regions.

Majority of stations in the Himalayan region are indicating increasing trend at annual and in winter season in maximum, minimum and average temperature.

Thus, Trend and variability technique is very supportive for the evaluation of spatial-temporal variation and trends in meteorological variables and helpful for future prospective in various sectors such as water resources, agriculture and irrigation for better planning and management as associated with real world.

Web GIS based snow cover information system for Indus basin

Himalaya has largest glacier cover outside the polar region on earth. Total present glacier cover in world is 14.7 million sq. km which was 46 million sq. km at the time of peak glaciations. Glacier area outside polar region is mere 0.7 million sq. km. Glacier cover in Himalaya is 23000 sq. km. Transient snow seasonally changes in extent and volume. During accumulation period, snow water equivalent and snow areal extent increases. Accumulated transient snow gradually melts during melt season. In western and Central Himalaya mostly western disturbances and monsoon are main causes affecting largely upper and lower latitudes respectively. Snowfall mostly occur in monsoon, post monsoon and winter season. Pre monsoon season also to some extent sees snowfall activities. Snow melt starts at the end of winter and continues well in to monsoon. Snow accumulation and depletion leads to changes in snow extent, which is used as state variables in snow melt runoff models, latter is monitored using satellite remotely sensed data. In particular, MODIS data on boards Terra and Aqua satellites, part of NASA International Earth Observation Systems, are highly useful in monitoring snow due to high repeat period and moderate resolution. Open source software were utilized here in processing satellite remotely sensed data for extracting snow cover maps and preparing application for disseminating maps on internet/ intranet.

SRTM 90 m data were used for delineation of sub basins, namely Indus, Jhelum, Punch, Chenab, Ravi, Beas and Satluj. The basin area within India was extracted. MOD09A1 data for years 2007 to 2012 were utilized for delineating snow cover areas using NDSI and MODIS band 2. Thresholds for ratio and band were 0.4 and 11% respectively. FCC were prepared using MODIS bands 2, 4 and 6. The FCC were visually interpreted to note sub basin wise cloud, ice cloud and percent of snow area obscured by them. Large snowfall event was in general manifested in terms of large changes in snow area, except during peak of snow cover. The large change in snow cover area was noted from FCC. Snow cover area delineated from scenes with cloudy conditions and statistics thereof are generally erroneous. Statistics for snow cover, in case of large cloud cover obscuring snow cover area, was determined through interpolation from statistics of adjacent date images, with clear sky or less cloud obscured conditions. In case of occurrence of large changes in snow area, the snow areas were duplicated from adjacent prior or later dates. Snow cover increases were observed in all seasons, namely monsoon, post monsoon, winter and pre monsoon. September month observed large snowfall event in several basins. Post monsoon and winter season saw large snow cover increases up to February. In pre monsoon season, at most one large event was observed. Maximum median snow cover occurred in first fortnight of February, thereafter snow cover depleted. Snow cover COV from median snow cover was large in post monsoon period and early period of winter. Rest of the seasons observed small COV. Snow depletion curves had at most one large aberration. Small basins had exponential depletion curves, whereas large basin had parabolic curves. This may be due to late start of melting at higher elevation in latter basins. Snow cover in years 2007-2012 for Satluj basin and web GIS application for Indus sub basins are shown in Fig. 1 and 2 respectively.

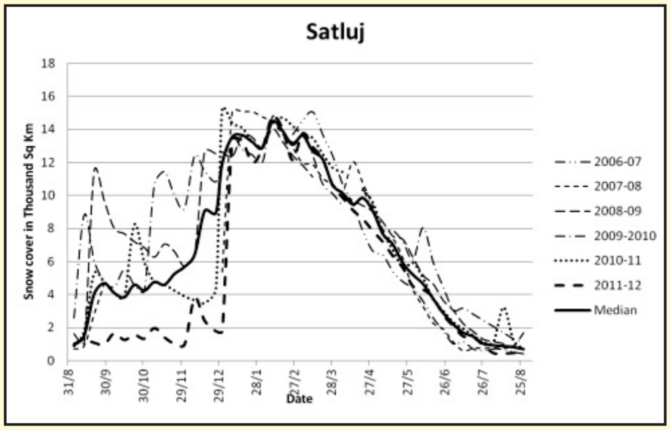


Fig. 1: Snow cover in satluj basin 2007-2012

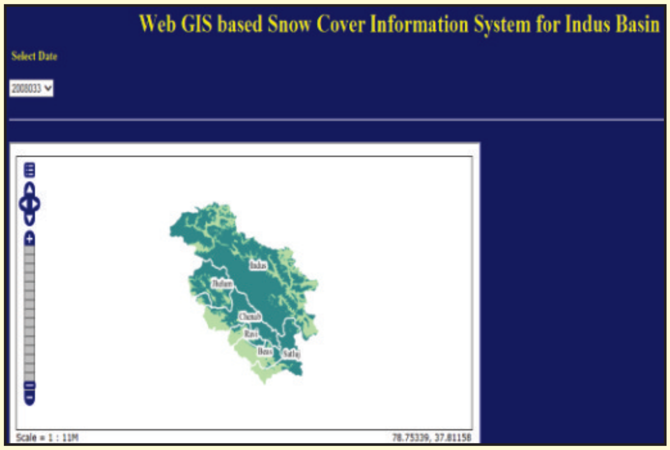


Fig. 2: Web GIS application for Indus basin

Hydrological study of Water Availability & drinking water supply to the people of Medininagar, Daltongung, Jharkhand

A proposal to study the feasibility of construction of a weir on North Koel river near Daltonganj for supply of drinking water to people of Medininagar, Daltongunj was received from Water Resources Department, Government of Jharkhand. In this context, the hydrological study for water availability and flow analysis was envisages with the objectives of (i) water availability study, (ii) to study the impact of construction of weir on flooding and (iii) to estimate the period of surface water availability due

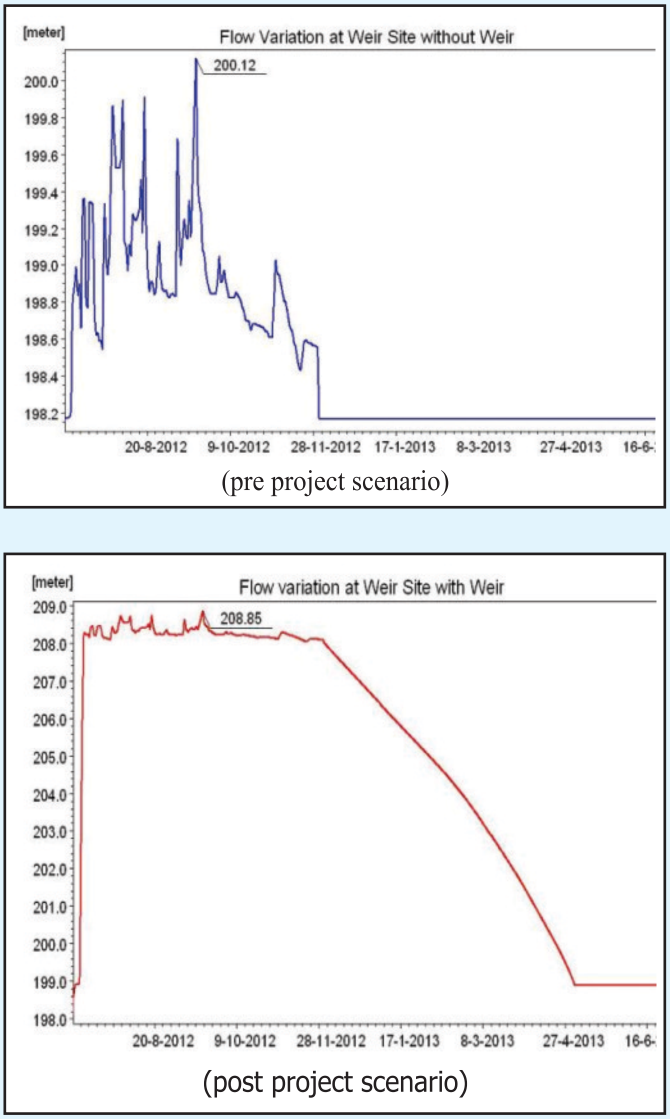


Fig. 1: Maximum flood level for 2012 flood

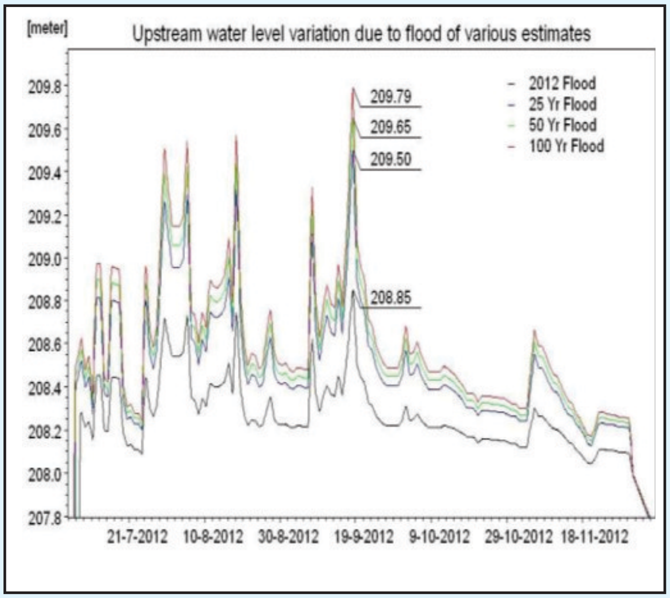


Fig. 2: Maximum flood level for various flood

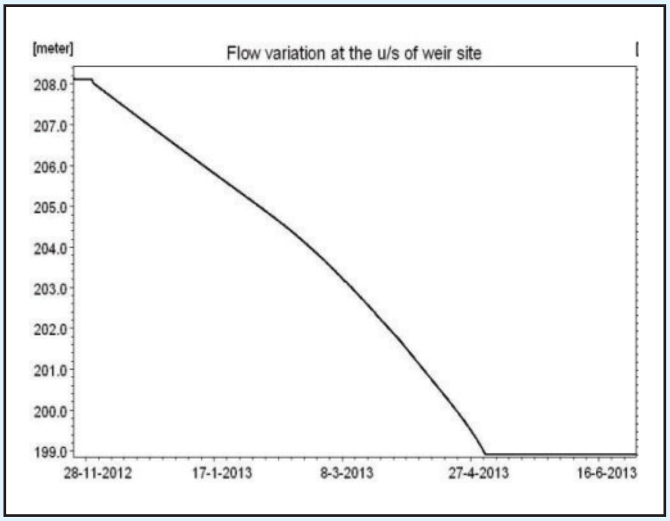


Fig. 3: flow depletion upstream of weir site

Photo 1: Daltonganj proposed weir site on the river bed of North Koel river

Photo 2: Coarseness of sand of the North Koel river

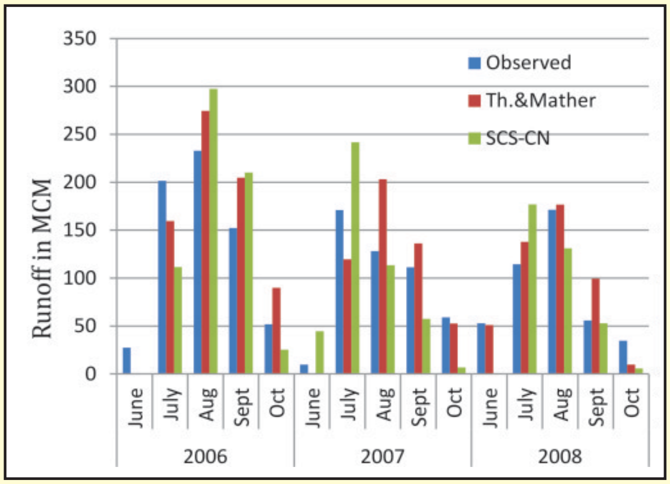
to weir. The flow in the North Koel river, in a stretch of 20 km from Daltonganj road bridge (GD site) has been developed using MIKE 11 program. The weir across the North Koel river (1000 m) wide and with top level of 208 m is introduced at the location of Genda Kheda. The model is run for the flow of 1999, 2000 and 2012 and also for various design flood estimates and the upstream inundation has been estimated. The river flow being seasonal, seepage analysis has been carried out to compute the depletion curve and thus to estimate the availability of water upstream of weir during non-rainy season. The river flow analysis shows that the construction of weir raises the flood level by 0.85 m for the observed flow of the year 2012 causing additional inundation near the township. In the region where the seepage loss and evaporation losses are very significant, the project is evaluated to be infeasible through tapping of surface water. Hence, alternative source of sustainable water supply schemes like river bank infiltration should be considered.

GIS Based Water Balance Study of Bina River Basin

(Under Pilot Basin Studies: IWRM in Bina River Basin in Bundelkhand Region in M. P.)

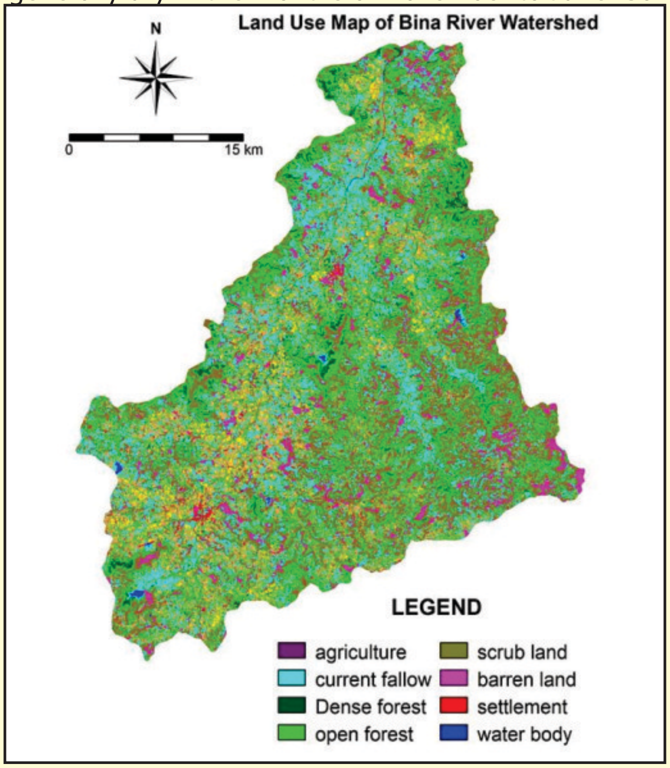
Bina river is a major tributary of River Betwa in Bundelkhand region of Madhya Pradesh, which originate from Begumganj block of Raisen district and traverse through Rahatgarh, Khurai and Bina blocks in Sagar district before confluence with river Betwa near Basoda town in Vidisha district. The water demand in the basin has increased drastically in recent years due to domestic water supplies to Rahatgarh, Khurai and Bina town; railways requirement at Bina Railway Junction and industrial supplies for Bina Refinery and JP Power project beside irrigation from the river by direct pumping. A water resources project, "Bina Complex- Irrigation and Multipurpose Project" has been proposed to meet these demands.

In the present study, an attempt has been made to compute the total volumetric runoff through the water balance of Bina river sub-basin, a tributary of Betwa river basin in Madhya Pradesh, using the Thornthwaite and Mather model. For the purpose of computation of peak flow and total runoff estimation, the SCS-CN method developed by soil conservation services (SCS) has also been applied to accomplish the above stated



objective. The input parameters to the SCS-CN model and Water Balance model, i.e. landuse, soil texture, and hydro-meteorological data have been computed with the help of remote sensing and GIS techniques. Three years daily/monthly rainfall and runoff data from the year 2006 to 2008 have been used for evaluation of the model performance.

The yearly potential evapotranspiration (PET) in the Bina river watershed was estimated to be 1229 mm. The actual evapotranspiration depends on the available soil moisture, viz. the duration and quantity of rainfall. The total runoff in the basin is about 45.5% of the total rainfall, which is high due to rocky & hilly terrain. The study reveals that the streams are generally dry in the months of November to June. Soil



moisture recharge takes place during July, however July, August, September & October months are the period of water surplus.

It is very obvious to have an idea about the water availability and water requirements for efficient use of water in a river basin. Therefore, water balance method is an important tool to provide quantitative information on water availability and water requirements. Further, the knowledge of availability of total water and peak flow are the major design criteria of any water resource structure, which becomes a difficult task for the ungauged catchments. Bina Complex Project: A multi-purpose irrigation and hydro-power project to be constructed in Bina River basin at the study site is under consideration. Therefore, the Water Resource Department, Govt. of M.P. is the direct beneficiary of this study.

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Workshop/ Conference/ Symposium attended by the Scientists/ Staff

S.No.	Name of the Seminar/Conference/Workshop	Date	Place
1.	Workshop on GW Modeling of GAMES	31-Jul-14	New Delhi
2.	जलवायु परिवर्तन, मानसून परिवर्तिता एवं पूर्वानुमान तथा जलवायु सेवाए: वैज्ञानिक दृष्टिकोण	जुलाई 30-31 2014	पुणे
3.	One week monsoon school on "Urban Floods"	Aug.4-9, 2014	Bangalore
4.	Workshop on Challenges and Opportunities in Interdisciplinary Water Research	Aug. 25, 2014	IIT Bombay
5.	Challenges and Barriers in Hydropower Development	Sept.18-19, 2014	Shimla
6.	Round-Table on Development of DSS for Water Resources	Sept.29-30, 2014	MERI Campus, Nashik
7.	IAMG International Conference on "Geostatistical and Geospatial approaches for the characterization of natural resources in the environment: Challenges, processes and Strategies	Oct.17-20, 2014	New Delhi

8.	4th International Conference of "Hydrology and Watershed Management with a Focal theme on Ecosystem Resilience- Rural and Urban Water (ICHWAM)	Oct.29-Nov.1, 2014	Hyderabad
9.	National Conference on Himalayan Glaciology (NCHG-2014)	Oct.30-31, 2014	Shimla
10.	National Conference on "Emerging Technology Trends in Agricultural Engineering (ETTAE 2014)	Nov.7-9, 2014	Nirjuli, Itanagar, A.P.
11.	19th International Conference on Hydraulics, Water Resources & Environmental Engineering (HYDRO-2014 International)	Dec.18-20, 2014	NIT, Bhopal
12.	National Conference on Emerging Trends in Water Quantity and Quality Management (ETWQQM-2014)	Dec.19-20, 2014	Jaipur
13.	Workshop on Science Academics' Lecture workshop on Climate Change	Dec.26-17, 2014	Pantnagar

Organization of Workshops/ Training Courses/ Seminar/ Symposia

S.No.	Name of the Seminar/Conference/Workshop	Date	Place
1.	Water Quality and its Management	Sept. 1-5, 2014	Roorkee
2.	Groundwater Management	Sept. 25, 2014	Belgaum
3.	Int. conf. on Natural Treatment Systems for Safe and Sustainable Water Supply in India: Results from the "Saph Pani Project"	18-19 Sep 2014	New Delhi
4.	Training Programme on Remote Sensing, GIS and Geospatial Techniques in Water Resources Management	22-27 Sept., 2014	Patna
5.	Training Programme on 'Monitoring & Analysis Non-point source of Pollution (NPS) – Agriculture in a Riverine System	Oct 13-15, 2014	Roorkee

6.	Brainstorming session on "Assessment of impact of flood on river bank filtration sites in Uttarakhand".	18 Oct 2014	Roorkee
7.	State level Geospatial Education & Training Workshop on "Management of Water Resources, Glaciers and Climate Change with special reference to Uttarakhand"	Nov. 1-3, 2014	Roorkee
8.	Training Program "Stress Management & Naturopathy"	Nov.6-7, 2014	Roorkee
9.	Training Course on 'ILBM Approach for Conservation and Management of Lakes"	Nov. 10_14, 2014	Roorkee
10.	Training Course on 'GIS applications in Watershed Management'	Nov. 17-21, 2014	Roorkee
11.	Flood Risk Mitigation & Management	19-21 Nov., 2014	Roorkee
12.	Training Course on "Advanced Soft Computing Applications in Hydrology & its Application	27 Nov.-2 Dec., 2014	Roorkee
13.	Training program on 'Advanced Instrumentation Technique and Preventive Maintenance	Dec.8-10, 2014	Roorkee
14.	Brain Storming Session on R&D needs on Ganga River to ensure Aviral and Nirmal Dhara	16 Dec., 2014	Roorkee
15.	Workshop for Hindi language and its applications	Dec.18, 2014	Roorkee
16.	19th International Conference on Hydraulics, Water Resources, Coastal & Environmental Engineering (HYDRO-2014 International) in collaboration with MANIT, Bhopal	18-20 Dec., 2014	Bhopal
17.	National Conference on Emerging Trends in Water Quality and Quality Management (in collaboration with Purnima University, Jaipur)	19-20 Dec., 2014	Jaipur

Mass Awareness

S.No.	Activities	Organised by & Date
1.	Hindi Sapthah	Sept.14, 2014, Belgaum
2.	Cleaniness Drive	Sept.25-30, 2014, Patna
3.	Vigilance Awareness Week	Oct.27-31, 2014, Roorkee
4.	Water Conservation for Teachers	Dec.6, 2014, Roorkee
5.	Ganga Cleaning and Rejuvenation (Abiral and Nirmal Dhara)	Dec. 16, 2014, Roorkee & Regional Centres

Other News

Institute Important Meetings

1. 67th TAC meeting, held on 15th July, 2014 at CWC, New Delhi.
2. 41st Working Group Meeting, held at Roorkee during 26-27 Nov., 2014.
3. 37th Foundation Day, held on 16 Dec., 2014 at NIH, Roorkee.

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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

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