

**MINUTES OF THE
41ST MEETING OF WORKING GROUP OF NIH
HELD AT NIH, ROORKEE, DURING NOVEMBER 26-27, 2014**

The 41st meeting of the Working Group of NIH was held at NIH, Roorkee, during November 26-27, 2014 under the Chairmanship of Director, NIH. The list of the participants of the meeting is given in Annexure-I.

ITEM NO. 41.1: OPENING REMARKS BY THE CHAIRMAN

Dr Sharad K Jain, Director-in-charge, NIH & Chairman, WG welcomed the Working Group members and the Scientists of the Institute. After a round of introductions, the Chairman requested Dr V C Goyal, Member-Secretary, to take up the agenda of the meeting.

ITEM No. 41.2: CONFIRMATION OF THE MINUTES OF 40TH MEETING OF THE WORKING GROUP

The 40th meeting of the Working group was held during June 4-5, 2014. The minutes of the meeting were circulated to all the members and invitees vide letter No. RCMU/WG/NIH-10 dated July 7, 2014. Er. R.K. Khanna conveyed the following suggestions: (i) Training Course on EIA (ii) Taking up EIA studies by NIH and (iii) Certificate or PG Diploma Course on IWRM.

The members confirmed the Working Group minutes.

ITEM No. 41.3: ACTION TAKEN ON THE DECISIONS/RECOMMENDATIONS OF THE PREVIOUS WORKING GROUP MEETING

Dr V C Goyal gave a brief account of the actions taken on the recommendations/decisions of the 40th working group meeting.

ITEM No. 41.4: PRESENTATION AND DISCUSSION ON THE STATUS AND PROGRESS OF THE WORK PROGRAMME FOR THE YEAR 2014-15.

The Member-Secretary requested the respective Divisional Heads to present the progress of studies carried out during 2014-15. Accordingly, the progress of various studies and sponsored projects was presented by all Scientific Divisions on their turn during two day deliberations of the Working Group. The Division wise minutes of each study/project presented during the meeting are given below:

ENVIRONMENTAL HYDROLOGY DIVISION

S.No	Project Study, Study Team, Date of Start and Completion	Recommendation/Suggestion
Research Studies 2014-15		
1.	Water Quality Modelling using Soft Computing Techniques Study Team: Rama Mehta (PI), C. K. Jain and Anju Chowdhary Duration: 2 Years (06/14-03/16)	Results were appreciated by members. Dr. N.C. Ghosh suggested that the Water Quality Index should also be developed for other uses of water. Dr. V.K. Sharma, Director, GSI, Dehradun, suggested that sample locations presented in GIS map could be related with the soil and geology of that area.
2.	Himalayan River Water Quality Assessment in a Stretch from Gangotri to Haridwar. Study group: Rajesh Singh (PI) , C. K. Jain, M. K. Sharma, S. P. Rai , Renoj J. Thayyan, J. P. Patra Duration: 3 Years (07/14-06/17)	No comments.
Consultancy Project 2014-15		
1.	Water Safety Impact Assessment through Sanitary Improvement of India Mark 2 Hand Pumps in Moradabad Division, Uttar Pradesh Study team: C. K. Jain (PI), Babita Sharma, Rakesh Goyal and Dayanand UNICEF Lucknow, Amount: Rs. 12 lacs Duration: 6 months (10/14-03/15)	No comments.
Sponsored Projects 2014-15		
1.	Low Cost Technology for Purification of Arsenic and Microbes Contaminated Water using Nanotechnology Study team: Vijaya Aggarwala, IITR (PI) & Rama Mehta, NIH (Co-PI) Duration: 2 Years (04/14-03/16) DST Sponsored	No comments.
2.	Ionic Enrichment Dynamics of Glacial Sediment and Melt Water of Gangotri Glacier Study Team: M. K. Sharma (PI), C. K. Jain , Renoj Thayyan , Manohar Arora , Naresh Saini , Jatin Malhotra, Rakesh Goyal , Daya Nand Duration: 3 Years (04/14-03/17) DST Sponsored	Study was appreciated by member.

GROUND WATER HYDROLOGY DIVISION

Dr. Anupma Sharma, Scientist-D, presented an overview and progress of studies and activities carried out by the Division during the period June-November, 2014. She informed that out of 4 R&D studies approved for the year 2014-15, one is in-house study and 3 are sponsored continued studies of the year 2013-14. Out of the 3 sponsored studies, one study on 'Saph Pani' Project has been successfully completed, while 2 studies are being continued as in-house studies. The 'Saph Pani' Project was concluded in September, 2014 with organization of the International Conference at New Delhi.

The Division has proposed one training course to be organized in collaboration with DHI-India during 2014-15. As professional scientific activities, scientists of the Division have submitted/published a number of research papers in various journals/ conferences/ symposia, delivered lectures in various training courses and guided summer trainees during the period.

The study-wise progress reported and suggestions emerged are given below.

Project Ref. Code: NIH/GWD/NIH/13-14: Estimation of specific yield and storage coefficient of aquifers

Dr. Surjeet Singh (PI) presented the progress of the study and also demonstrated the software developed on the estimation of specific yield and storage coefficient. The work was appreciated by the Working Group Members as well as NIH Scientists. Dr. R.D. Deshpande suggested to include an option for the ranking of the suitable methods of specific yield estimation. Dr. S.N. Rai suggested preparing a professional paper for the scientific community on the developed software rather than preparing a study report. The professional paper can be in two parts (i) Part-1 should deal with unconfined aquifer, and (ii) Part-2 should deal with confined aquifer. Sh. S.K. Bhartya suggested to also explore suitable options of specific yield estimation for the hilly areas of Uttarakhand State. Dr. V.C. Goyal suggested to take 4-5 more months for value addition of this software.

An extension of four months was requested to make the software web-enabled which was approved by the WG Members.

Project Ref. Code: NIH/GWD/NIH/11-14: Managed Aquifer Recharge (MAR) and Aquifer Storage Recovery (ASR)

Mr. Sumant Kumar (PI) presented the progress of the study. It was informed that, the study as per requirement of the 'Saph Pani' project has been completed and the report has been submitted to the Saph Pani consortium.

Because of contains in hydrogeological formations, the feasibility of MAR in Raipur area has been found limited, while the Raipur city area has about 85 surface water bodies, which with some scientific approaches can be used to meet city's water supply. To work out a water management plan based on these water bodies, PI suggested continuing this study as an internal project till March, 2015. .

Project Ref. Code: Flow and Contaminant Transport Modeling of Riverbank Filtration.

Ms. Shashi Poonam Indwar, Scientist-B presented the progress made and work carried out in the study since April, 2014. She informed that model setup and its input data preparation using MODFLOW coupled with MT3D is in progress. It was also mentioned, because of her long leave, the completion of the study got delayed.

Project Ref. Code: NIH/GWD/INT/14-17: Management of Water Resources for Quantity and Quality in Yamuna-Hindon Inter-basin

Dr. Anupma Sharma (PI) presented the new study to be taken up for three years under collaboration with Dept. of Civil Engg., IIT Roorkee. Dr. N.C. Ghosh described the background of the study. The need for undertaking the comprehensive research study was also explained. Dr. S.N. Rai informed about related works carried out in different parts of the region by various other organizations which will be useful in the present study. Dr M.K. Sharma of NIH gave information about studies pertaining to water quality of River Hindon. PI informed that data from all such studies would be compiled for building up the historical database of the study area.

The work programme of the division for the year 2014-15 is given at annexure-I.

Annexure-I

WORK PROGRAMME OF THE GROUND WATER HYDROLOGY DIVISION FOR THE YEAR 2014-15

S. No.	Project	Project Team	Duration & Status	Funding Source
1. NIH/GW D/NIH/13 -14	Estimation of specific yield and storage coefficient of aquifers	Surjeet Singh (PI) N.C. Ghosh (Co-PI) Sumant Kumar	1&1/2 year (04/13 – 10/14) Extension of 4 months up to March, 2015 was granted	NIH
Sponsored & HP-II Projects				
2. NIH/GW D/NIH/11 -14	Management of Aquifer Recharge (MAR) and Aquifer Storage Recovery (ASR)	Sumant Kumar (PI) Rajan Vatsa, N.C. Ghosh C.P. Kumar, Surjeet Singh, Sanjay Mittal	3 years (04/11 – 03/14) Status: . Etension up to March, 2015 was granted .	NIH (after September , 2014)
3.	Flow and Contaminant Transport Modeling of Riverbank Filtration	Shashi Poonam Indwar (PI), N.C. Ghosh Anupma Sharma, Rajan Vatsa	2 ½ years (04/12 – 09/14) Status: Extension up to September, 20/15 was granted	NIH (after September , 2014)
Proposed New Study				
4.	Ganges Aquifer management for Ecosystems services (GAMES)	Sharad Jain (PI), N.C. Ghosh, Sudhir Kumar, Sanjay Jain, M.K. Goel, Anupma Sharma, Surjeet Singh	1 year (01/06 – 31/05) Status: in progress.	IWMI, Hyderabad
5. NIH/GWD/ INT/14-17	Management of Water Resources for Quantity and Quality in Yamuna-Hindon Inter-basin	Anupma Sharma (PI) N. C. Ghosh & other NIH study team member Collaborating Institute; IIT Roorkee, CED	3 years (December, 2014 –Nov., 2017) Status : New	Initially by NIH, later on by sponsoring agency.

HYDROLOGICAL INVESTIGATIONS DIVISION

INTERNAL STUDIES:

1. **PROJECT REFERENCE CODE: NIH/HID/INT/2012-14/2:**

Title of the Study: Water Quality, Hydrogeology and Isotopic Investigations in SW Punjab

Dr. M. Someshwar Rao, PI of the project briefly explained the objectives of the project and responsibilities of NIH and collaborative partner, Punjab University, Chandigarh in executing the project. He then explained the work components accomplished by NIH and the results obtained by samples analysis at NIH, Roorkee. He explained the results through spatial distribution maps on EC, nitrate, fluorides, sulphates and $\delta^{18}\text{O}$ in groundwater etc. Using correlation plot between water quality and stable isotopes he explained the groundwater contamination arising due to anthropogenic and geogenic sources. He told that due to non-receiving of funds at the collaborative organization (Punjab University), the component of work in relating hydrogeology with water quality could not be completed by Punjab University. However, as NIH component of the project is completed the report will be submitted with the accomplished results. Dr Rao concluded the presentation by highlighting measures that can be taken up to overcome the contamination problems in the Bhatinda district of Punjab and informed completion of the project.

2. **PROJECT REFERENCE CODE: NIH/HID/INT/2013-15/1**

Title of the Study: Water Availability Studies for Sukhna Lake, Chandigarh

The study was presented by Dr. S. D. Khobragade, Sc-E and PI. He informed that the major objectives of the study are: (i) To study inflow regime of the lake, (ii) To study seepage losses from the lake, (iii) To analyze long term trends in rainfall and evaporation (iv) To study water availability in the lake.

Dr. Khobragae presented the analysis carried out so far and the results in details including the water balance of the years 2011-12, 2012-13. He discussed the relative significance of various factors in the water balance of the lake. He also presented the analysis of variation of the lake water levels to understand the possible impact of the check dams on inflow to the lake. Detailed analysis of the inflow and the runoff coefficients of the lake and their trend over the past 10 years was also presented. In the end Dr. Khobragade presented the results of the prediction of the water availability of the lake in the coming summer of 2015. He informed that as per the predictions, the lake shall be on the verge of drying on 1st July, 2015. Although, the lake shall have a significant water spread area, but the depth of the water shall be only about a feet. He further added that if the monsoon is significantly delayed, the lake may dry up during July 2015.

The working group noted progress of the study. No comments were received.

3. **PROJECT REFERENCE CODE: NIH/HID/INT/2013-15/2**

Title of the Study: Isotope Studies for the Identification of Different Aquifer Groups and their Dynamics in Upper Yamuna River Plains

Dr. Sudhir Kumar (PI) presented the progress of the work done carried out since the last meeting. He informed that the analysis of the noble gases for 12 samples has been completed from IAEA Vienna. The results on noble gases indicate that there is a good correlation between

the age of groundwater with built up of He in the groundwater. He further informed the working group that $^3\text{He}/^4\text{He}$ v/s Ne/He plot indicates that the source of helium in the groundwater is from continental crust.

Dr. Sudhir Kumar further informed that as the study is being funded by IAEA under the project "Integration of Isotope Hydrology in Aquifer Mapping Efforts in India: A Pilot Study of Upper Yamuna Plains", the sponsorer has requested that a deep borehole be drilled to verify the finding of the isotopic investigations. It is proposed to drill a deep well (upto 350 m) tapping all the three aquifer systems, and samples will be collected for isotopic analysis from each aquifer. He further informed that sampling work of deep groundwater shall start in the month of December 2014 and shall finish by February 2015. The samples shall be shipped to Netherland and Vienna for dating and noble gas analysis.

Dr. RD Deshpande suggested computing the noble gas temperature from the analysis of different noble gases.

Working group noted the progress of the work done under the study.

4. PROJECT REFERENCE CODE: NIH/HID/INT/2013-15/4

Title of the Study: Estimation of Radon Concentration in Waters and Identification of Paleo-groundwater in Part of Punjab Located in Satluj River Basin using Isotopes

Sh. S. K. Verma, the principal investigator of the study, presented the study before the members of the WG meeting. He mentioned about the objectives of the study along with the location of study area, brief methodology, action plan, achievement so far received for the study etc. He also mentioned that there were no comments or suggestions raised during the last working group meeting i.e. 40th meeting of working group.

While discussing the progress of the study, he informed that 1st objective of the study has been partially achieved. The groundwater samples collected from intermediate/deep tube wells from 5 districts located in the study area have been analysed for radon concentration. The radon concentrations monitored in these districts were found within the maximum permissible limit for drinking water as per the guide lines of WHO. A small part of the study area is left to be investigated for radon measurement which will be taken up during the next field trip. Sh. Verma further informed that in order to meet 2nd objective of the study, the analysis of environmental tritium in 39 groundwater samples which were collected during the field trips is in progress to identify the location for carbon dating.

The working group noted the progress of the study.

SPONSORED PROJECTS:

5. PROJECT REFERENCE CODE: NIH/HID/MOES/2012-15

Title of the Study: The Structure and Dynamics of Groundwater Systems in North-western India under Past, Present and Future Climates

Based on results of stable and radio-isotope, Dr. S. P. Rai presented the progress study. The main highlights of the presentation were the identification of recharge source of the shallow and deeper groundwater aquifer. On a query from Dr. R. D. Deshpande, Dr. S. P. Rai informed about the variation of tritium values in shallow aquifer 1 TU to 7 TU and deeper aquifer <3 TU.

Dr. S. K. Bartarya asked the source of groundwater level data and Dr. Rai replied that water level data have been collected from the CGWB and State Groundwater Department.

The working group noted the progress of the study.

6. PROJECT REFERENCE CODE: NIH/HID/IAEA-1/2012-15

Title of the Study: The Use of Environmental Isotopes to Assess Sustainability of Intensively Exploited Aquifer Systems in North Eastern Parts of Punjab, India

Dr M. S. Rao, P. I. of the project explained depletion in water resources in the study area using falling water level data of Dholwaha reservoir (along with rainfall data). Using environmental tritium activity data for shallow and deep groundwater he told that shallow groundwater is getting poorly recharged in area falling diagonally along SE-NW zone in the study region. Along this zone, groundwater in shallow aquifer is about 20 years old and in the remaining region it is relatively young (about 10 years old). In the north of this zone, groundwater age is low due to modern recharge occurring from reservoirs of Kandi region whereas, in the southern side of this zone, modern recharge is occurring due to over pumping induced recharge from surface water sources (canal & rainfall). The deeper aquifer water is twice the age of shallow groundwater. In the deeper aquifer, groundwater is old towards river side (southern end towards river Satluj and western end towards river Beas). Stable isotope results show that shallow aquifer groundwater is formed from rainfall recharge all throughout the region except at few locations where recharge from canal is also seen. Isotopic data shows groundwater in deeper aquifer, in area close to the river Satluj, as water of canal origin. Since this water is old, it indicates a few decade old canal irrigated return flow water. PI Informed that the sampling and analysis will be continued for the premonsoon of 2015.

7. PROJECT REFERENCE CODE: NIH/HID/IAEA-2/2012-15

Title of the Study: Assessment of Baseflow and its Impact on Water Quality in the Part of Satluj River in India using Environmental Isotopes and Age Dating Techniques

Dr. S. P. Rai presented the progress of the study. He informed that rainfall, river, canal and groundwater samples were to collect from the study area and stable isotopes (δD and $\delta^{18}O$) radioactive isotope (3H) were measured. The results of the isotopes were presented in detail along with details of hydrogeological conditions. Dr. Rai also presented findings of surface water groundwater interaction of the study area. Results of modelling approach to assess the base flow component were also discussed.

The working group noted the progress of the study and appreciated the progress of the study.

8. PROJECT REFERENCE CODE: NIH/HID/BGS/2013-14

Title of the Study: Review of Groundwater Resources in the Indo-Gangetic Basin: A Case Study on Resilience of Groundwater in the Punjab to Withdrawal and Environmental Change

Dr M. S. Rao, PI of the project informed that the BGS funded project has two components; (i) preparing a review report by collating data from the published reports and (ii) groundwater dating using CFC & noble gas technique in Bist Doab region. For the review report, (i)

landuse/landcover data at 1:50,000 has been collected, (ii) 20 years district average pre-monsoon/post monsoon water level data of UP, Bihar, West Bengal and Assam has been collected and (iii) water quality data from CPCB has been collected. To accomplish the 2nd objective of the project, major ions analysis of groundwater of Bist Doab region was done NIH, Roorkee and heavy metals & trace metals were analyzed at BGS, UK. Groundwater samples were collected for CFC dating and these were analyzed at BGS, UK. The CFC dating results were also compared with the tritium dating results obtained in the IAEA-CRP project. The two results obtained by two different technique and conducted at two different laboratories grossly show agreement and internal consistency. Groundwater Age using CFC dating technique has provided mean age of shallow groundwater as 25 years (range: 15 – 48 years) and mean age of deep groundwater (> 100m depth) is 46 years (age range: 38-54 years). The results has shown that withdrawal of groundwater from deeper wells for irrigation and its subsequent transfer to shallow aquifer through irrigation return flow has resulted into mixing of shallow aquifer water by deeper aquifer water, thereby, isotopic and chemical mixing of the two waters in the shallow aquifer. Similar to environmental tritium results, the CFC dating has shown that deeper aquifers of the Bist Doab region are getting recharged mainly at Bhabhar region. The excessive groundwater withdrawal in the central Bist Doab region especially from deeper aquifers has induced enhanced flow of groundwater from recharge zones to the central Bist Doab region. The excessive withdrawal of groundwater from deeper aquifer has accelerated groundwater movement from shallow to deeper aquifer (recharge to deeper aquifer) at points wherever interaction between the two exists. The results of the report are presented in 4 publications (3 international conferences and 1 in international journal). Dr Rao informed successful completion of the project.

NEW STUDIES:

1. PROJECT REFERENCE CODE: NIH/HID/INT/2014-16/1

Title of the Study: Interaction between groundwater and seawater along the north east coast of India

Dr M. S. Rao as a PI of this new study informed that the study is taken up as a pilot project as per the suggestion of the Working Group. Dr Rao presented the objectives and methodology of the proposed new project and informed that this 2 years project (Jan 2015-Dec 2016) project will be executed through internal funds with budget of Rs. 5.0 lakhs. He informed that the interaction between groundwater and seawater in the parts of east coast will be examined through measurement of groundwater salinity (EC), stable isotope composition of groundwater and dissolved radon in groundwater. Dr Rao provided importance of the study and methodology to achieve the objectives of the study. Under the project, groundwater sampling will be conducted in pre & post monsoon periods and the collected data will be analyzed in NIH, Roorkee.

Approved Activity Schedule:

S. No.	Activities	Quarters							
		1	2	3	4	5	6	7	8
1.1	Review of literature	√	√	√					
1.2	Site selection & preparation of index map of the study area	√	√						
1.3	Collection and compilation of data	√	√						
1.4	Field work, sample collection and		√	√	√	√	√		

	analysis of water samples								
1.5	Data interpretation					√	√	√	
1.6	Project report & publications							√	√

Budget Details:

Sl. No.	Budget Head	Amount (lakhs)
1	Travel Expenditure (2-3 field work of aprox. 15 days each)	2.0 lakhs
2	Analytical charges, field & lab assistance	2.0 lakhs
3	Miscellaneous expenses	1.0 lakhs
	Total	5.0 lakhs

The project is envisaged to bring out map on submarine groundwater discharge/seawater intrusion for the study area and research publication based on the results. The Working Group approved the project programme and the budget.

Suggestion by Working Group members: Shri Niladri Naha informed that he may be contacted for data and in the field support for the above study. Dr Rao noted the suggestion of Shri Naha.

2. PROJECT REFERENCE CODE: NIH/HID/INT/2014-16/2

Title of the Study: Isotopic investigation of benchmark Himalayan glaciers

Dr M. S. Rao, PI of the project informed that the proposed study was submitted in the 40th Working Group of NIH with the title “Monitoring Isotopes in Air Moisture in Parts of Himalaya (Himachal Pradesh & Uttarakhand) for investigating the Cloud Condensation”. However, the title is modified in light of the following reason:

Under National Action Plan on Climate Change (NAPCC), Government of India launched a National Mission for Sustaining the Himalayan Eco-system (*NMSHE*). Of various objectives of the mission -NMSHE, one objective is to address Himalayan Glaciers and the associated hydrological consequences. To address this issue, DST, GoI, has asked NIH to submit a proposal to address “impact of water, snow and ice on Himalayan ecosystem”.

Considering the above recent developments and to fulfill the objective of the mission, it was decided to take up a pilot project to evaluate the feasibility of isotopes techniques for investigation of Himalayan glaciers. Accordingly, the previously submitted title of the project was modified as “Isotopic investigation of benchmark Himalayan glaciers”. The modified title directly addresses the glacial systems using isotopes.

Dr M. S. Rao, informed that the project is taken up as a pilot study to examine the feasibility of isotopes to investigate Himalayan glaciers using isotope and chemical analysis of glacial components. Technical support for field work will be taken up from Prof. AL Ramanathan, JNU, New Delhi. Prof. Ramanathan has agreed to provide glacial melt, snow-melt and shallow glacial core samples for the study with no financial support from NIH, Roorkee. The project will be completed in 2 years (January 2015 to December 2016) with budget of Rs. 5.0 lakhs from NIH internal funds. Dr Rao informed that for the pilot study, shallow glacial cores, melt-water and surface snow will be collected from glaciers of Uttarakhand, Himachal Pradesh and Ladakh

parts of Himalayas. The isotopic and chemical analysis will be done at NIH Roorkee. As per the availability of stations in the study area, meteorological data will be collected and as per availability of sites, air-moisture sampling units for isotopic analysis will be installed. Isotopic and chemical data will be suitably inter-compared to interpret glacial environment at this regions. The study is expected to (i) generate the isotope database on snow & glaciers in the Himalayan region at Uttarakhand, H.P. and Ladakh (ii) assess spatial variability in isotopic & chemical characteristic of glacial environment (iii) isotope based interpretation of accumulation and ablation process of these glaciers.

Approved Activity Schedule:

S. No.	Activities	Quarters							
		1	2	3	4	5	6	7	8
1.1	Review of literature	√	√	√	√				
1.2	Site selection & preparation of index map of the study area	√	√						
1.3	Collection and compilation of data	√	√						
1.4	Workshop & training programme	√				√			
1.5	Field work, sample collection and sample analysis		√	√	√	√	√		
1.6	Data interpretation					√	√	√	
1.7	Project report & publications							√	√

Budget Details:

Sl. No.	Budget Head	Amount (lakhs)
1	Travel Expenditure	2.0 lakhs
2	Analytical charges , field & lab assistance, minor instrument purchase	2.0 lakhs
3	Miscellaneous	1.0 lakhs
4	Total	5.0 lakhs

The working group approved the project and budget requirements without any specific recommendations or suggestions.

3. PROJECT REFERENCE CODE: NIH/HID/INT/2014-16/3

Title of the Study: Assessment of dissolved radon concentration for groundwater investigations in Haridwar

The study was presented by Sh. P. K. Garg, Scientist-B. He informed that temporal variation in dissolved radon concentration in groundwater may provide a new way to look into the aquifer system and recharge conditions. So the study has been undertaken with the objectives: (i) Mapping the spatial distribution and temporal fluctuation in radon levels in groundwater in Haridwar district, (ii) To investigate the effect seasonal groundwater levels fluctuations on fluctuation in radon levels. He told that the study will be conducted in the district Haridwar which is considered to be the major recharge zone spanned in the Bhabhar-Siwalik region and, the local recharge zones along the canal length and along the western bank of the river Solani. Discussing the methodology he informed that the groundwater samples from the study region

will be analyzed for radon concentration during pre and post monsoon seasons to generate the background radon concentration in the shallow aquifer, to investigate the recharge induced variation in radon concentration and to decipher change in radon concentration along the confined aquifer due to variation in radioactivity in the aquifer matrix. Samples will also be collected and analyzed for stable isotope analyze to support and collaborate the results and the inferences of radon measurements.

Activity Schedule:

S. No.	Activities	Quarter			
		1	2	3	4
1.1	Review of literature	√	√		
1.2	Site selection	√			
1.3	Collection and compilation of data		√		
1.4	Field work, sample collection and analysis of water samples	√	√	√	
	Data interpretation		√	√	
1.5	Project report & publications			√	√

Budget Details:

Sl. No.	Budget Head	Amount (lakhs)
1	Travel Expenditure	0.40 lakhs
2	Analytical charges , field & lab assistance, minor instrument purchase	0.25 lakhs
3	Miscellaneous	0.15 lakhs
4	Report Printing	0.20 Lakh
	Total	1.00 lakhs

The working group approved the project and budget requirements without any specific recommendations or suggestions.

REVISED WORK PROGRAMME OF HYDROLOGICAL INVESTIGATIONS DIVISION FOR THE YEAR 2014-2015

S. No.	Study	Team	Duration/ Status
INTERNAL STUDIES			
1.	Water Quality, Hydrogeology and Isotopic Investigations in SW Punjab	M. S. Rao (PI), C. P. Kumar Gopal Krishan	3 years (07/12-06/15) Completed Study

S. No.	Study	Team	Duration/ Status
2.	Water Availability Studies for Sukhna Lake, Chandigarh	S. D. Khobragade (PI) C. P. Kumar Sudhir Kumar A. R. Senthil Kumar P. K. Garg V. K. Agarwal	2 years (04/13-03/15) Continuing Study
3.	Isotopic Studies for the Identification of Different Aquifer Groups and their Dynamics in Upper Yamuna River Plains	Sudhir Kumar (PI) C. K. Jain S. P. Rai S. D. Khobragade P. K. Garg B. C. Joshi (CGWB, Lucknow) Tejdeep Singh (CGWB, Chandigarh)	2 years (07/13-06/15) Continuing Study
4.	Estimation of Radon Concentration in Waters and Identification of Paleogroundwater in Part of Punjab Located in Satluj River Basin using Isotopes	S. K. Verma (PI) S. P. Rai (Co-PI) M. S. Rao C. P. Kumar Mohar Singh	2 years (10/13-09/15) Continuing Study
5	Sub-marine Groundwater Discharge and Sea-water Intrusion in Coastal Aquifers of East Coast, India	M. S. Rao (PI)	2 years (06/14-05/16) Revised Study as given as S No. 7
6.	Monitoring Isotopes in Air Moisture in Parts of Himalayas (Himachal Pradesh & Uttarakhand) for investigating the Cloud Condensation	M. S. Rao (PI) C. P. Kumar Gopal Krishan	2 years (06/14-05/16) Revised Study as given as S No. 8
7.	Interaction between groundwater and seawater along the northern part of east coast of India	M. S. Rao (PI), Sudhir Kumar Pankaj Garg	2 years (01/15 - 12/16) New Study
8.	Isotopic investigation of benchmark Himalayan glaciers.	M. S. Rao (PI), Sudhir Kumar	2 years (01/15 - 12/16) New Study
9.	Assessment of dissolved radon concentration for groundwater investigations in Haridwar district	Pankaj Garg (PI), Sudhir Kumar, M. Someshwar Rao	1 year (01/15 – 12/15) New Study
SPONSORED PROJECTS			

S. No.	Study	Team	Duration/ Status
10.	The Structure and Dynamics of Groundwater Systems in Northwestern India under Past, Present and Future Climates	S. P. Rai (PI) M. S. Rao Surjeet Singh S. K. Verma C. P. Kumar Sudhir Kumar V. K. Agarwal Rajeev Gupta S. L. Srivastava Vishal Gupta Mohar Singh	3 years (06/12-05/15) Continuing Study
11.	The Use of Environmental Isotopes to Assess Sustainability of Intensively Exploited Aquifer Systems in North Eastern Parts of Punjab, India	M. S. Rao (PI) C. P. Kumar S. P. Rai	3 years (09/12-08/15) Continuing Study
12.	Assessment of Baseflow and its Impact on Water Quality in the Part of Satluj River in India using Environmental Isotopes and Age Dating Techniques	S. P. Rai (PI) R. V. Kale M. S. Rao C. P. Kumar Sudhir Kumar V. K. Agarwal Vishal Gupta Mohar Singh	3 years (10/12-09/15) Continuing Study
13.	Review of Groundwater Resources in the Indo-Gangetic Basin: A Case Study on Resilience of Groundwater in the Punjab to Withdrawal and Environmental Change	M. S. Rao (PI) C. P. Kumar Gopal Krishan	One year 8 months (02/13-09/14) Continuing Study
14.	Integration of Isotope Hydrology in Aquifer Mapping Efforts in India: A Pilot Study of Upper Yamuna Plains	Sudhir Kumar (PI) S. P. Rai S. D. Khobragade C. K. Jain P. K. Garg	2 years (05/13-04/15) Continuing Study
CONSULTANCY PROJECTS			
15.	Integrated Hydrological Investigations of Sukhna Lake, Chandigarh for its Conservation and Management	Suhas Khobragade (PI)	Initially 2 years (7/11-12/13) (extended upto 3/15)
16.	Hydrogeological Study for Dewatering of Jhamarkotra Mines, Distt. Udaipur	Sudhir Kumar (PI)	3 years (05/13-04/16) Continuing Study
17.	Impact Assessment of Ash Pond on the Groundwater Quality in the Surrounding Villages of NTPC Simhdri through Stable Isotopic Studies	Sudhir Kumar (PI)	1 year (07/13-06/14) Completed
18.	Isotopic Characterization of Groundwater of District Raigarh, Chhattisgarh	S. P. Rai (PI)	6 months (04/14-09/14) Extended till 3/15

S. No.	Study	Team	Duration/ Status
19.	Hydrogeological Studies for Ash Pond of 2 X 525 MW Maithon Power Limited and an Abandoned Coal Mine, District Dhanbad, Jharkhand	Sudhir Kumar (PI)	3 months (06/14-8/14) Extended till 12/14 Interim report submitted
20.	Possible impact of construction activities in Kansal area (Mohali, Punjab) on water flow to Sukhna lake in Chandigarh	Suhas Khobragade (PI)	2 months (9/14-11/14) Draft Report Submitted.

SURFACE WATER HYDROLOGY DIVISION

S.N.	Title of Project/Study, Study Team, Start/Completion Dates	Status and Recommendations/Suggestions
1.	<p>Sedimentation Studies for Pong Reservoir, Himachal Pradesh</p> <p>Team A. R. Senthil kumar Manohar Arora Suhas D Khobragade Avinash Agarwal and Sanjay Jain</p> <p>DOS: April 2012 DOC: March 2015</p>	<p>Dr. A. R. Senthil Kumar, PI of the project, presented the objectives, methodology and progress of the study for the period from June 2014 to November 2014 and overall progress in brief. The PI presented the development of sediment yield model for pong dam using ANN and the simulation of sediment yield for future 25, 50, 75 and 100 years using the generated series of rainfall and flow volume. The PI presented the uncertainty analysis of the rainfall and flow volume of 10%, 50% and 90% dependable series for future 25, 50, 75 and 100 years. The PI presented the determination of average simulated sediment yield using the sets of weights of ANN model by boots trap method and the dependable series of rainfall and flow volume. The PI also presented results on the computation of unit weight of sediment and consolidated unit weight of sediment in the reservoir by different methods such as particle size distribution of suspended sediment concentration, porosity of the settled sediment and hydrographic survey.</p>
2.	<p>Study Of Hydro-Meteorological Droughts For Chitrakoot Bundelkhand Region In India</p> <p>R.P. Pandey</p> <p>DOS: April 2012 DOC: March 2015</p>	<p>The Head, Surface Water Hydrology Division reported the progress of studies in brief and invited Dr R.P. Pandey, PI of the project, to presented details of activities and work carried out in respect of ongoing study for the period after last working group meeting held in May 2014. Dr Pandey presented the analysis and results based on past records of long-term meteorological data. He informed that the study site had faces acute drinking water shortages from time to time during summer months and this problem was very severe during drought years in the recent past i.e.</p>

		<p>2004-2008. The major objective of the study is to quantify water scarcity during droughts and to identify possible options for augmenting water supply and minimizing crop loss due to droughts. The PI further reported that the data processing & analysis and preparation of base maps, dryspell analysis and estimation of supplemental irrigation water requirement for dry-spell periods for kharif season, village-wise domestic drinking water demand assessment and water availability have been completed. It was informed that a new methodology has been devised and verifies for regular drought monitoring using rainfall data. The method has been compared with Standardized Precipitation Index (SPI) and Effective Drought Index (EDI). The method provides comparable assessment of onset of drought and its progression. Further, it was informed the villages have been grouped in to different clusters based on local topographic features, potential source of water supply, population, source-wise water availability, and magnitude of demand. It was reported that a comprehensive plan drinking water supply and supplemental irrigation water supply to kharif crop during dry spells has been and the same was presented for comments from the distinguished members of the Working Group. It was informed that the second Interim Report of this study has been submitted in June 2014. The final report is expected to be completed by the April 2014.</p>
3.	<p>Application of DSS (P) for Integrated Water Resources Development & Management</p> <p>Team</p> <p>A.K. Lohani, Surjeet Singh, Rahul Jaiswal, D K Sonkusale and Akilesh Verma</p> <p>DOS: April 2013 DOC: March 2015)</p>	<p>Dr. A K Lohani presented the background the DSS(P) activity completed under HP-II and objectives of the study. Dr Lohani mentioned that the DSS(P) software has been developed under HP-II and the same model is being applied in Arpa basin of Seonath river basin to demonstrate the capabilities of the DSS(P) model. Dr Lohani mentioned that the data has been collected from Chhattisgarh for the application of DSS(P) software. Dr Lohani asked that the names of Shri D.K. Sonkusale and Shri Akilesh Verma of Water Resources Department, Raipur may be included in the study group of this project. Members and the Chairman, of the working group have approved the inclusion of these officers in the study group. Dr Lohani further mentioned that the collected data has been computerized and a NAM rainfall-runoff model has been setup in Mike basin and Mike-11 RR. He further mentioned that as an academic exercise the NAM model results have been compared with the ANN model results. He informed that an interim report of this project on</p>

		rainfall-runoff modelling using NAM model has been submitted. Members of the working group appreciated the work.
4.	<p>Quantitative assessment of uncertainties in river discharge estimation</p> <p>Team</p> <p>Sanjay Kumar and Sharad Jain</p> <p>DOS: April 2013 DOC: March 2016</p>	<p>Dr. Sanjay Kumar presented the study on “Quantitative assessment of uncertainties in river discharge estimation”. He explained the background and objectives of the study and mentioned that study is a part of the systemic review of uncertainty clause of the ISO 9123 document. He explained the methodology based on ISO documents GUM (Guide to the expression of uncertainty in measurement), HUG (Hydrometric uncertainty guidance) and presented the progress made in the study. He mentioned that the working draft of the ISO 9123 was circulated to SC1 member bodies for call of experts. Accordingly the experts were nominated to review the draft ISO 9123 documents. He informed that the review comments have been received from experts and currently being resolved. He also mentioned that the revised draft ISO document will be considered in the ISO meeting scheduled during May 2015 in Tokyo. There were no comments from WG members</p>
5.	<p>Evaluation and modeling of hydrological support system for watersheds of Garhwal, Uttarakhand hills</p> <p>Team</p> <p>Avinash Agarwal, Manohar Arora and R K Nema</p> <p>DOS: November 2013 DOC: October 2016</p>	<p>Dr. Agarwal presented the study entitled “Evaluation and modeling of hydrological support system for watersheds of Garhwal, Uttarakhand hills”. Objective wise progress was presented. It was informed that rainfall-runoff-sediment model with using SWAT and CCH1D is in progress. Regarding rejuvenation of springs, it was concern of the house to use isotope techniques to exactly locate the points of recharge within the identified springshed. Working group accepted the study progress.</p>
6.	<p>Estimation of Water Balance for Integrated Water Resources Management in Yerrakalva Pilot Basin, A.P.</p> <p>Team:</p> <p>J.V.Tyagi and YRS Rao</p> <p>DOS: April 2014 DOC: March 2015</p>	<p>Dr. J.V. Tyagi presented the study and informed the house that NIH has taken up Pilot Basin Studies (PBS) for IWRM in Yerrakalva river basin in coastal Andhra Pradesh under 12th five-year plan program. The program involves detailed studies on various components of the hydrologic cycle including water balance study of the basin. The components of water balance of a basin are influenced by climate, the physical characteristics of the basin such as morphology, land use and soil. Therefore, understanding the relationship between these physical parameters and hydrological components are very essential for integrated</p>

		<p>water resources management and long term sustainability of water resources in the basin. Dr. Tyagi explained that the SWAT, one of the most recent models developed by the USDA, will be used to analyse and quantify the water balance of the Yerrakalva river basin. He informed that the observed data on rainfall, runoff has been collected and the base maps in GIS have been prepared. The progress of the study is as per the approved schedule. There were no comments on the study.</p>
7.	<p>Systematic treatment and analytical solutions for surges and bores in rectangular channels (research study)</p> <p>Team:</p> <p>S.K. Singh</p> <p>DOS: April 2014 DOC: March 2015</p>	<p>Dr. S. K. Singh presented the study highlighting the technical and innovative content of the study, which are the formulating nondimensional hydraulic force equation in a moving frame of reference for a systematic treatment of surges and bores in rectangular channels and, deriving its analytical solution. The positive surges and bores are characterized by increased depth of flow moving upstream or downstream and are formed due to sudden increase or decrease in discharge in the channel on account of sudden opening or closing of a gate, sudden tides, or sea wave of increased height. The derived analytical solutions help solve the concerning problems in a single step, avoiding the trial and error method currently being practised. The Chairman opined this type of basic research is also required and stressed that the application of the study is important and should be presented in the next meeting. Dr. Singh informed, few illustrative examples are complete and, distributed hard copy of it to the Chairman and the Members of the Working Group.</p>
8.	<p>Status Report on “Impact of Anthropogenic and Climate Change on Sediment Load of Rivers”</p> <p>Team:</p> <p>Archana Sarkar</p> <p>DOS: April 2014 DOC: March 2015</p>	<p>Mrs Archana Sarkar, PI of the study presented the background, objectives, methodology and expected deliverables of the new study. Mrs Sarkar informed that the sediment load of a river represents a key component of its hydrology, and in turn exerts an important influence on its aquatic ecology, its morphology and the exploitation of its water resources. She further informed the house that changes in the sediment loads of rivers can therefore have wide-ranging environmental and social and economic implications. She also informed about the growing evidence (reported by various authors for different rivers of the world) that the sediment loads of many rivers of the world, especially Asian rivers have changed significantly in recent years due to many reasons, including anthropogenic as well as climate change impact). Mrs Sarkar presented some of the findings of</p>

		various research workers in the subject area. Dr Deshpande from PRL, Ahmedabad enquired about the double mass curve plots of sediment yield. Mrs Sarkar explained about the double mass curve plots. Mrs Sarkar further informed about the work plan for the next two quarters. Working group members noted the progress of the study and appreciated the work.
9.	<p>Study of Rainfall Patterns and Comparison of Rainfall Data from different Sources for Uttarakhand State</p> <p>Team: Archana Sarkar, N.K. Bhatnagar, Vaibhav Garg and Rakesh Kumar</p> <p>DOS: April 2014 DOC: March 2016</p>	<p>Mrs Archana Sarkar, PI of the study presented the background, objectives, methodology and expected deliverables of the new study. Mrs Sarkar informed that the study area is the Uttarakhand State, often referred to as the "Land of the Gods" due to the many holy Hindu temples and pilgrimage centres found throughout the state which observed a massive flood disaster in June 2013. Mrs Sarkar informed the house that a good knowledge of local rainfall-regime is crucial for planning and management of domestic, urban as well as industrial water use, irrigation and crop practices besides forecasting and management of extreme events like floods and droughts. She further informed that in view of the recent flood disaster in the Uttarakhand state, it becomes all the more important to carry out a scientific analysis of the rainfall regime of the region. Mrs Sarkar also informed that a comparative accuracy assessment of various data sources of rainfall viz, Rain gauges, satellite sensors (TRMM), and high resolution gridded re-analysis rainfall (APHRODITE) is of prime importance as the rainfall data from these data sources are further provided to hydrological models to produce forecasts. Mrs Sarkar presented the progress of the study with preliminary results of trend analysis of historical rainfall data (annual and seasonal) by parametric and non-parametric methods for four rainfall stations two each in Kumaon and Garhwal regions. Dr Deshpande suggested to carry out the trend analysis for extreme events. Mrs Sarkar informed that the IMD guidelines would be followed to carry out the trend analysis work for extreme events. Working group members noted the progress of the study and appreciated the work.</p>
10.	<p>Monitoring and modelling of streamflow for the Gangotri Glacier</p> <p>Team:</p>	<p>Dr. Arora presented the progress of the study. He informed the house that the data collection for the ablation period of 2014 has been analyzed and the results were presented. He informed the house that the total volume of water from the glacier for the entire melt season was 853</p>

	<p>Manohar Arora and Rakesh Kumar DOS: May 2014 DOC: March 2017</p>	<p>MCM with the date of peak discharge on 15th July 2014. Dr R D Deshpande suggested some minor changes in the map of the study area. He was interested in knowing whether some noticeable changes have been observed in the discharge pattern. The PI replied that since it is a big glacier there is inter seasonal variability and no such noticeable changes have been observed. Dr N C Ghosh enquired about the trend line fitted in the graph of daily melt depth with daily mean temperature. The PI answered that the R² obtained for this was very poor therefore the mean monthly values of melt depth were plotted with the mean monthly temperature which resulted in significant improvement of R² values.</p>
11.	<p>Effect of climate change on evaporation at point scale</p> <p>Team: Digambar Singh, A. R. Senthil kumar and Manohar Arora</p> <p>DOS: June 2014 DOC: March 2017</p>	<p>Shri Digambar Singh, PI of the study, presented the objectives, methodology and progress of the study from June 2014 to Nov 2014. The PI, presented the computation of evaporation using the data of temperature, humidity and wind speed observed at the NIH observatory. The computed evaporation is computed with observed data of the pan evaporation and presented in graphical form. Dr. Anshuman asked the method of observation of evaporation data. The PI replied that the observation is made from the standard or class A pan (dia 1.22 m and depth 0.254 m, filled up to 0.180 m) evaporimeter installed at the observatory. Dr. N.C.Ghosh queried about the developer of empirical formula. The PI replied that it is taken from the text book “Engg. Hydrology” written by E.M.Wilson.</p>
12.	<p>Hydrological Modelling of Brahmani Baitarani River Basin using eWater Source Platform</p> <p>Team: J.P.Patra, Dr. Rakesh Kumar and Pankaj Mani</p> <p>DOS: April 2014 DOC: March 2017</p>	<p>Mr. Jagadish Prasad Patra, PI of the study presented the objectives, present state of art, brief description of study area and methodologies with progress made during last six months. There were no specific comments from the members.</p>

WATER RESOURCES SYSTEM DIVISION

Dr. Sharad K Jain, Sc. G and Head (WRS Div.), presented an overview of the division – scientific strength, the ongoing studies, technical publications and training courses organized. Following are the comments received from working group on the presentations of the various studies.

PI: Dr. M. K. Goel, Scientist “F”

Study title: *NIH_Basin* – A WINDOWS based model for water resources assessment in a river basin (Ongoing)

Dr. M. K. Goel (MKG) presented the progress for the study. He informed that envisaged objectives of the study included modifications in the modeling methodology and development of WINDOWS interface (named as *NIH_Basin* – *NIH_Basin-Simulation*) of the model. Since the last working group meeting, a number of modifications have been made in the FORTRAN program of the model which include: a) incorporation of EAC tables for a reservoir (3 options), b) incorporation of rule-curve based operation analysis (for hydropower, irrigation, and domestic supply including environmental flows) for reservoir systems, c) incorporation of hydropower simulation analysis (with eight different options for supply of releases for various purposes through power plant), and d) simplification of groundwater representation in the model. MKG explained the two modes of model application: monthly and continuous simulation. For application of the model to larger basins, dimensions in the model for sub-basins, cities, hydraulic structures, rainfall stations, and river segments have been significantly increased. Various existing options in the model have been preserved and new modifications have been added as additional options.

In WINDOWS interface of the model, various data input forms have been developed in Visual BASIC environment. He presented some forms for the data entry. It was informed that forms will be finalized after completing model modifications as input requirements are getting revised with increased options.

Dr. R. D. Deshpande (RDD) suggested for the inclusion of industrial demands separately. MKG replied that at present the same is clubbed with the domestic demand but it is possible and preferable to give industrial demand a separate identity in the model. Further, RDD enquired about the model availability after its development. MKG informed that it is planned to put the model on NIH website for download and wider usage. Dr. S. C. R. Vishwakarma (SCRV) enquired whether the model is applicable in Himalayan basins? MKG informed that as yet, snow melt has not been included in the model and it can be used for the rainfall areas only. However, snowmelt can be calculated separately (through another model) and given as an input series for a specified downstream river segment. For this purpose, option is provided in the model to attach daily import/export time series with any river segment. In response to a query from Dr. S. K. Mittal (SKM), MKG confirmed that irrigated and rain-fed areas are treated separately in the model methodology.

PI: Dr. Sanjay K. Jain, Scientist “F”

Study title: Glacier change and glacier runoff variation in the upper Satluj river basin (Ongoing)

Dr. Sanjay K Jain presented the objectives of the study as well as the progress made so far. He informed that three sub basins of Upper Satluj basin have been taken for this study. Glacier change detection in all three sub basins has been carried out using temporal satellite data. The meteorological and discharge data have been collected. Dr. Jain presented the analysis of temperature and snow water equivalent data and explained correlation between these with glacier change. Dr. Ritesh Arya asked about the glacier change in different period of the study. Dr. Jain said that change is almost uniform but in recent years there is less change. He also said that the retreat is comparable with the other studies carried out in the region. Dr. Bartarya asked about the comparison of glacier retreat of western Himalayan and central Himalayan region. Dr. Jain said that as per the literature and a study carried out for Gangotri glacier the retreat in central Himalayan region is less and has reduced in recent years. Dr. S K Mittal asked about the software used and whether RADARSAT data has been used in the study. Dr. Jain replied that ERDAS image processing software has been used and no RADARSAT data have been used. He said that the possibility of using RADARSAT will be explored.

PI: D. S. Rathore, Scientist “F”

Study titles:

- 1. Decision Support System for Water Resources Planning in Upper Bhima basin, Maharashtra**
- 2. Web GIS based snow cover information system for Indus basin (Ongoing)**

The progress of the study on DSS for water resources planning in Upper Bhima basin was presented by Mr D.S. Rathore. Study area was described and information on availability of the data was presented. Mula, Mutha and Ghod are main tributaries. Information on Taluka wise gross crop area and livestock population, district wise N and P- Fertilizer are available and these will be used for non-point pollution load estimation for watersheds. Daily discharge data, meteorological data and reservoir performance data are available and utilized for hydrological modelling in catchments. Water quality data were available at six sites on Mutha and Bhima rivers. Lumped conceptual model NAM in Mike Hydro was used for rainfall runoff simulation in 24 sub basins (14 head water and 10 intermediate). Models setup is in progress for simulating water allocation of Khadakwasla reservoir complex and Mutha RBC command, and for water quality simulation of Bhima basin. RDD asked regarding outcomes from the study that may be of interest to water resources manager and whether location of water purification facilities may be identified through study. Mr Rathore replied that among many uses, typically simulating water allocation in post monsoon period may be of interest to water managers. Further, through model locating suitable site for facilities may not be possible, but water quality in the river network may be simulated.

The progress of the study on Web GIS based snow cover information for Indus basin was presented by Mr D.S. Rathore. The objective of the study is to develop snow delineation methodology and to publish snow cover maps on web/ intranet using Web GIS software. During the period of review, MODIS Aqua data for 2010- 12 were downloaded. Snow mapping was done by using 8-day composite MODIS data using NDSI and NIR bands. Cloud scenes were

identified by visually inspecting FCC using QGIS software. The information will be used to modify snow statistics at sub basin level. Statistics from cloud free preceding and/ or succeeding scene will be used for that of clouded scene. Snow cover statistics for years 2007-08 to 2011- 12, and median snow cover were presented for sub basins. Snow accumulation was visible in post monsoon period of September to December and its relation to snow availability in ablation period could be seen in temporal snow statistics. Mr Ritesh Arya stated that the graph indicates that this phenomenon is visible in Indus basin as well. Mr Rathore affirmed this and informed that though in all basin snow is accumulating in these months, but in general the phenomena is more pronounced in Satluj basin.

PI: D. Chalisgaonkar, Scientist “F”

Study title: Assessment of Water Footprint of the National Capital Territory (NCT) of India (Ongoing)

Mrs. Deepa informed that the objective of this study is to estimate the water footprints of NCT Delhi by quantifying green, blue and grey water footprints and the methodology used in this study is largely based on earlier studies supported by Water Footprint Network. She also informed that in the present study, the previous methodologies are integrated and upgraded where possible and the water footprint of NCT Delhi is being assessed for three major sectors i.e. domestic, agriculture and industrial. She informed that the assessment of the domestic water footprint has been done as a first step during 2013-14. It has been done by computing the environmental pressure exerted by the population of NCT Delhi in terms of the water it uses directly and indirectly. The assessment of agriculture water footprint has been taken up and industrial water footprint will be assessed in the next step. For the computation of crop water requirement, CROPWAT software is being used. It uses precipitation data, crop growth inputs, and soil data to calculate crop water requirements. After all yields and variables in the CROPWAT program are accounted for, the blue and green water footprints can be determined. Dr Anshuman suggested including supply-chain perspective in the assessment. He also suggested to define the boundaries for the assessment and differentiate between water demand and use. Mrs Deepa replied that two levels of water consumption in supply chain are being considered and the boundaries of the study will be separately indicated. Working group noted the progress of the study.

PI: Dr. Renoj J Thayyen, Scientist “D”

Dr Renoj presented three studies.

1. Glaciological studies of Phuiche Glacier, Ladakh Range (Ongoing- Sponsored)

Dr. N.C. Ghosh suggested that future research may look into the relationship between Positive Degree Days and energy balance of glacial systems in the cold-arid climate. RJT agreed to this point and mentioned that monitoring of soil heat flux is needed for such study and will be taken up during next phase of the project.

A member queried how the snowfall during May and June could retard the glacial melt as suggested in the study as it is widely seen that snowfall during May -June period generally lead to increased discharge in the stream. RJT explained that the May - June snowfall on glacier occur over the winter snow pack which further reduced the snow pack albedo leading to prolonged stay of snow over the glacier ice leading to retarded glacier melt. However, the snow

falling in May-June over non-glacial lower reaches melts faster, resulting into higher discharge in the streams.

2. Cryospheric system studies and runoff modeling of Ganglass catchment, Leh, Ladakh Range (Ongoing)

No specific suggestions/ comments from any Working Group Members.

3. Runoff modeling of Shyok River, Karakorum Range (New)

Mr. Ritesh Arya said that the proposed bridge by Border Roads Organisation (BRO) is an important bridge for the supply to the forward post in a very difficult terrain. He appreciated the NIH effort to set up a discharge station in this area.

PI: Shri L N Thakural, Scientist “B”

Study Title: Trend and variability analysis of Rainfall and Temperature in Himalayan region (Ongoing)

The study was presented by Sh. L. N. Thakural. The objectives of the study are to create the database for Rainfall and Temperature variables for the Himalayan region and to carry out statistical analysis to detect trend and variability in these variables in the Himalayan region, India. The parametric (Linear regression) and non-parametric (Mann-Kendall and Sen’s estimator of Slope) approaches are being used to determine the trends in the time series data of these meteorological variables. During the presentation, trend analysis of rainfall and temperature data for the Himalayan region was presented. RDD mentioned that this study for the Himalayan region will be useful. Moreover, he suggested that the rainfall intensity may also be considered and attempts be made to determine regional patterns. Dr. Naha and Dr. Vishvakarma offered to provide data on rainfall & temperature of some stations. The same will be collected by Mr Thakural and analyzed.

PI: Shri P. K. Mishra, Scientist “B”

Study title: Assessing Climate Change Impact across KBK (Kalahandi- Bolangir-Koraput) region of Odisha (Ongoing)

The status of the study was presented by Shri P.K. Mishra on behalf of his team. He informed about the progress made in the study since inception as well as during last six months (June’14- November ‘14). Shri Mishra presented the results for the 2nd objective of the study, i.e. to analyze the future climate in the region based on downscaled GCM data. He informed that future rainfall for the region has been generated based on downscaled HadCM3 A2 and HadCM3 B2 GCM data utilizing SDSM model. The study has been carried out using SDSM tool version 4.2.9.

RDD suggested to find the physiographic relationship for the trends observed for rainfall and temperature for the KBK region. Dr. Sharad K. Jain, Head, WRS Division also suggested to ponder on the trend findings and if possible, present findings. Mr. Mishra compiled the same and gave a brief presentation next day highlighting the possible impact of slopes and land cover. Another suggestion of RDD to find the relationship between the trend and atmospheric air temperature for the region will be explored based on data availability.

Shri Mishra ended the presentation informing the next course of actions analyzing downscaled GCM data for temperature using different models and running Soil and Water Assessment Tools (SWAT) for the Tel basin during the next six months.

PI: Shri M. K. Nema, Scientist “B”

Study titles:

- 1. Variability of the Hydro-climatic variables in Punjab Plains of lower Satluj (Ongoing)**
- 2. Hydrological Processes and Characterization of Lesser Himalayan Catchments**

For the ongoing study on variability of the hydro-climatic variables in Punjab plains of lower Satluj, no specific comments were made during the presentation. Dr. Renoj Thayyen suggested to examine the monsoonal cyclic effect on the trend of rainfall and temperature series.

While, presenting the proposed new study, Dr. NC Ghosh, suggested to modify the title of the study orienting towards its objectives. Accordingly, the new title of the study is proposed as “Hydrological Processes and Characterization in Lesser Himalayan Catchments”. Dr. S.K. Bartarya (WIHG) suggested that while inter-comparing the various results from two different watersheds, the size and geologic condition of them should be proportionate. Dr. J.V. Tyagi suggested to take care of interception loss measurements in the proposed study.

PI: Shri P. K. Agarwal, Scientist “B”

Study title: Hydrologic Modelling of a part of Satluj Basin using SWAT Model (Ongoing)

The status and progress of the study was presented by Shri P.K. Agarwal, Scientist B. Shri Agarwal presented the DEM, drainage network, land use map prepared from landsat data, and soil map prepared for the study area. He informed that classification of the soil map as well as landuse map is in progress.

No specific comments were received on the study. However, Dr Anshuman, suggested ground truth verification of the data.

RESEARCH MANAGEMENT AND OUTREACH DIVISION (RMOD)

S.N.	Title of Project/Study, Study Team, Start/Completion Dates	Status and Recommendations/Suggestions
1.	<p>Pilot Basin Studies (PBS) at six identified sites, jointly with the RCs and CFMSs (Joint Study)</p> <p>NIH HQs: V C Goyal (Leader), Omkar Singh, R V Kale</p> <p>NIH RCs/CFMSs: RC-Belgaum, RC-Jammu, RC-Kakinada, RC-Sagar, CFMS-Guwahati, CFMS-Patna DOS: Apr 2012; DOC: Mar 2015</p>	No comments
2.	<p>Water Conservation and Management in Ibrahimpur Masahi Village of Hardwar District (Uttarakhand)</p> <p>Team: Omkar Singh, V.C. Goyal and C.K. Jain, J.V. Tyagi and Sanjay K. Jain DOS: Apr 2013; DOC: March 2015</p>	Er. Anshuman (TERI University) wanted to know about water conservation measures being adopted in the study. The PI responded to his query. Dr. V.C. Goyal, Head, RMOD, also supplemented.
3.	<p>Participatory development of structure for IWRM Framework in identified sub-basins under Pilot Basin Studies (PBS) program (New Study)</p> <p>Team: V C Goyal (PI), Omkar Singh and R V Kale DOS: July 2014 DOC: June 2015</p>	No comments
4.	<p>Customization of WEAP model for application in Ur river watershed in Tikamgarh district of Bundelkhand region. (Under TIFAC Project)</p> <p>Team: R V Kale (PI), T Thomas- RC Bhopal, Jyoti Patil, Rajesh Agarwal DOS: Apr 2014 DOC: Sep 2015</p>	Er. Anshuman (TERI University) wanted to know about different scenarios considered for planning & decision making in agriculture water management. The PI responded to his query. Er. Anshuman was keen in this study and offered PI to provide his relevant research publications.

Dr. V C Goyal thanked the members for their valuable contributions during deliberations in the Working Group meeting.

The meeting ended with vote of thanks to the Chair.

ANNEXURE-I**List of Working Group Members attended the 41th WG meeting**

1.	Er. R.D. Singh, Director, NIH	Chairman
2.	Dr. V K Sharma, Director, GSI, State Unit-Uttarakhand, Dehradun	Member
3.	Dr. S.K. Bartarya, WIHG, Dehradun	Member
4.	Dr. S.K. Mittal, Chief Scientist, CSIO, Chandigarh	Member
5.	Dr. S C R Vishvakarma, Sc.F, GBPIHED, Almora	Member
6.	Sh. Niladri Naha, State Water Invest. Dir., Kolkata	Member
7.	Dr. R D Deshpande, Sc.SF, PRL, Ahmedabad	Member
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