

**MINUTES OF THE  
42<sup>ND</sup> MEETING OF WORKING GROUP OF NIH  
HELD AT NIH, ROORKEE, DURING MARCH 19-20, 2015**

The 42<sup>nd</sup> meeting of the Working Group of NIH was held at NIH, Roorkee, during March 19-20, 2015 under the Chairmanship of Director, NIH. The list of the participants of the meeting is given in Annexure-I.

**ITEM NO. 42.1: OPENING REMARKS BY THE CHAIRMAN**

Er R D Singh, Director, NIH & Chairman, WG welcomed the Working Group members and the Scientists of the Institute. The Chairman mentioned that the Institute has received many additional responsibilities from the Ministry of WR, RD & GR, namely- development of a Ganga Knowledge Centre; two pilot sites for demonstration of the wastewater treatment systems, including phytoremediation technique; and pilot demonstration of natural treatment techniques, such as Bank Filtration, at selected sites in the country.

A Memorandum of Understanding (MoU) was signed between National Institute of Hydrology (NIH) and Centre for Water Resources Development and Management (CWRDM), Kozhikode. The ED, CWRDM and the Director, NIH exchanged the MoU document.

The Chairman then requested the Working Group members to give their general observations, suggestions and remarks on the scientific activities of the Institute. These are summarized below:

<b>S N</b>	<b>Member</b>	<b>Suggestion(s)</b>
1	Dr N B N Prasad	<ul style="list-style-type: none"> <li>▪ Explore new, innovative ideas</li> <li>▪ Provide list of publications in the working group meeting agenda document</li> <li>▪ Mention name of funding agency and budget for sponsored projects</li> </ul>
2	Dr R Rangarajan	<ul style="list-style-type: none"> <li>▪ Intensity of rainfall should be considered for modelling</li> </ul>
3	Dr (Mrs) Surinder Kaur	<ul style="list-style-type: none"> <li>▪ Emphasize on water quality studies</li> </ul>
4	Dr S C R V Ishwakarma	<ul style="list-style-type: none"> <li>▪ Revisit published work, and highlight public-utility work</li> </ul>
5	Sri Kishore Kumar	<ul style="list-style-type: none"> <li>▪ Provide meta-data on NIH's website</li> </ul>
6	Dr R D Deshpande	<ul style="list-style-type: none"> <li>▪ EHD should explore plasma-based remediation techniques (contact Institute of Plasma Research, Ahmedabad)</li> <li>▪ Use SAT along with MAR</li> <li>▪ Improve presentations, focusing on results and time management</li> <li>▪ Visibility of research results through publication of edited books, etc.</li> </ul>

After taking the views of the members and their self-introduction, the Chairman asked the Member-Secretary to take up the agenda of the meeting.

**ITEM No. 42.2: CONFIRMATION OF THE MINUTES OF 41<sup>st</sup> MEETING OF THE WORKING GROUP**

The 41<sup>st</sup> meeting of the Working group was held during November 26-27, 2014. The minutes of the meeting were circulated to all the members and invitees vide letter No. RCMU/WG/NIH-10 dated December 10, 2014. No Comments were received. The members confirmed the Working Group minutes.

**ITEM No. 42.3: 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 41<sup>st</sup> working group meeting.

**ITEM Nos. 42.4 & 42.5: PRESENTATION AND DISCUSSION ON THE STATUS AND PROGRESS OF THE WORK PROGRAMME FOR THE YEAR 2014-15 AND FINALIZATION OF THE WORK PROGRAMME FOR THE YEAR 2015-16.**

The Member-Secretary requested the respective Divisional Heads to present the progress of studies carried out during 2014-15 and work programme for the year 2015-16. Accordingly, the progress of various studies and sponsored projects was presented by all Scientific Divisions on their turn during the 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.N.	Title of the Project/Study, Study Group & Duration	Recommendation/Suggestion
<b>Internal Studies</b>		
1.	<p>Water Quality Modeling using Soft Computing Techniques</p> <p>Study Group: Rama Mehta (PI), C. K. Jain, and Anju Chowdhary</p> <p><b>Duration: 2 Year (05/14-03/16)</b></p>	<p>Dr. N. B. N. Prasad (CWRDM) suggested that there must be some plasma based remediation.</p> <p>Dr. R.D. Deshpande suggested that the WQI should be done for heavy metals like Cadmium, Chromium, Zink etc. He also suggested that a software with all guidelines to calculate WQI like CCME guidelines must be developed by NIH itself.</p>
2.	<p>Himalayan River Water Quality Assessment in a Stretch from Gangotri to Haridwar</p> <p>Study Group: Rajesh Singh (PI), C. K. Jain, M. K. Sharma, S. P. Rai, Renoj J. Thayyan and J. P. Patra</p> <p>Duration: 3 Years (07/14-06/17)</p>	<p>Dr. S.K. Bartarya, WIHG, Dehradun suggested analysis of silica and plot Na+K conc. Vs Silica concentration for silicate weathering.</p> <p>Director, NIH suggested correlating the water quality parameters with flow.</p>
<b>Sponsored Projects</b>		
3.	<p>Low Cost Technology for Purification of Arsenic and Microbes Contaminated Water using Nanotechnology</p> <p>Study Group: Vijaya Aggarwala, IITR (PI), Rama Mehta, NIH (Co-PI)</p> <p><b>Duration: 2 Years (04/14-03/16)</b></p> <p>Sponsored by DST, New Delhi</p>	-
4.	<p>Ionic Enrichment Dynamics of Glacial Sediment and Melt water of Gangotri Glacier</p> <p>Study Group: M.K. Sharma (PI), C. K. Jain, Renoj Thayyan, Manohar Arora, Naresh Kumar, Jatin Malhotra, Rakesh Goyal and Dayanand</p> <p><b>Duration: 3 Years (04/14-03/17)</b></p> <p>Sponsored by DST, New Delhi</p>	-

**ENVIRONMENTAL HYDROLOGY DIVISION  
WORK PROGRAM FOR 2015-16**

<b>S.N.</b>	<b>Code</b>	<b>Study</b>	<b>Study Team</b>	<b>Duration</b>
<b>Internal Studies</b>				
1.	EH/2015/TS-1	Water Quality Modelling using Soft Computing Techniques	Rama Mehta (PI) C. K. Jain	<b>2 Years (05/14-05/16)</b>
2.	EH/2015/TS-2	Himalayan River Water Quality Assessment in a Stretch from Gangotri to Hardwar	Rajesh Singh (PI) C. K. Jain M. K. Sharma S. P. Rai Renoj J. Thayyan J. P. Patra	<b>3 Years (07/14-06/17)</b>
<b>Sponsored Projects</b>				
1.	EH/2015/SR-1	Ionic Enrichment Dynamics of Glacial Sediment and Melt water of Gangotri Glacier <b>(DST)</b>	M. K. Sharma (PI) C. K. Jain Renoj Thayyan Manohar Arora Naresh Saini Jatin Malhotra Rakesh Goyal Karan Jamwal	<b>3 Years (04/14-03/17)</b>
2.	EH/2015/SR-2	Low Cost Technology for Purification of Arsenic and Microbes Contaminated Water using Nanotechnology <b>(DST)</b>	Vijaya Aggarwala, IITR (PI) Rama Mehta, NIH (Co-PI)	<b>2 Years (04/14-03/16)</b>

## GROUND WATER HYDROLOGY DIVISION

Mr. C. P. Kumar, Scientist 'F' presented an overview and progress of studies and activities carried out by the division during the period December 2014 - March 2015. While presenting the technical activities carried out and progress made on different studies during last six months, he gave an account of scientific personnel available at the division and the sponsored projects being pursued by the Division. He informed that out of four R&D studies approved for the year 2014-15, one is in-house study and three are sponsored studies. The 'Saph Pani' project was concluded in September, 2014 with organization of the International Conference at New Delhi. Two out of the three sponsored studies are being continued as in-house studies. Three new studies have been proposed for the year 2015-16.

The division has organized one training course on "*Groundwater Modeling using MODFLOW and MIKE SHE*" during 2-6 February, 2015 in collaboration with DHI-India. As professional scientific activities, scientists of the division have submitted/published a number of research papers in various journals/conferences and delivered lectures in various training courses during the period.

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

### Project Ref. Code: NIH/GWD/NIH/11-15: Managed Aquifer Recharge (MAR) and Aquifer Storage Recovery (ASR)

Mr. Sumant Kumar (PI) presented the study and explained about the analytical modeling and analyses of various hydrological, meteorological, hydro-geological and water quality parameters. Dr. Prasad asked about the connectivity of lakes with groundwater and his question was well answered based on the analyzed data. PI informed that, the study was under the framework of Saph Pani project and based on the study 3 technical reports have been published, treating Raipur as one of the case study.

### Project Ref. Code: EU-sponsored Project no. 282911: Flow and Contaminant Transport Modeling of Riverbank Filtration. - After October 2014 as internal study.

Ms. S.P. Indwar (PI) presented the study, "Flow and Contaminant Transport Modeling of Riverbank Filtration", its objectives, statement of the problem; water quality analyses results. The Conceptualization of the flow model has been completed and Steady-state modelling of flow path for monsoon (23.08.12) and post-monsoon (11.10.12) is completed. PI was advised to carry out the further data analysis of water quality and to model the bank filtrate travel-time using MODPATH and composition of extracted water in each Infiltration wells through ZONEBUDZET tools of Visual MODFLOW.

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

Dr. Anupma Sharma (PI) presented the progress of the study initiated in Dec. 2014 in the Yamuna-Hindon Inter-basin. Declining groundwater levels and presence of harmful contaminants in some portions of the shallow groundwater system were shown as the major issues that need to be addressed in the study area. The project budget was also presented. Dr. Prasad opined that the study objectives were complex given the time frame of the study. PI informed that existing data from different studies pertaining to various portions of the region was being utilized in the project in addition to the laboratory experiments and planned field surveys in the region.

**Project Ref. Code: NIH/GWD/NIH/15-18: Development of Website and e-Portal on “Mitigation and Remedy of Arsenic Menace in India”**

Mr. C. P. Kumar informed that Inter-Ministerial Group (IMG) on “Arsenic Mitigation” constituted by the Ministry of Water Resources, River Development & Ganga Rejuvenation, Government of India has desired that National Institute of Hydrology (NIH), Roorkee should take lead role on R & Ds activities related to “Arsenic Mitigation” as per the areas suggested by the ‘Core Committee’ on “Mitigation & Remedy of Arsenic Menace in India”. One of the recommendations by the ‘Core Committee’ is website and e-Portal development on Arsenic related matter for information dissemination as well as gathering responses and opinions. Mr. R. D. Singh, Chairman also informed about background for taking-up this task. Mr. Kumar further informed that NIC will be contacted to get the website/e-Portal designed by its empanelled vendors and also the domain name (gov.in) will be registered. Necessary hardware and software will be procured and the website is proposed to be hosted on a dedicated NIH server. However, Mr. Kishore Kumar suggested to consider hosting the website on NIC server in view of security concerns.

**Project Ref. Code: NIH/GWD/NIH/15-16: Diagnosis Survey and Selection of Suitable Sites for Development of Riverbank Filtration Demonstration Schemes in Different States**

Dr. Surjeet Singh (PI) made a presentation on river bank filtration study on diagnosis survey and selection of suitable sites. Dr. C. Rangarajan, NGR I inquired about the possibility of aquifer clogging which was well replied and Sh. R.D. Singh, Director, NIH inquired about the status of RBF project to be submitted to MoWR, RD & GR. No specific observations/comments were made.

**Project Ref. Code: NIH/GWD/NIH/15-16: Alternate Water Supply Management Strategies in Arsenic Affected/ Vulnerable Areas: Mapping of Arsenic Affected Zones/ Regions in Eastern U.P.**

Mr. Sumant Kumar (PI) presented the objectives, methodology and expected outputs of the proposed study. It was advised by Dr. Deshpande that objectives should be curtailed down and PI agreed upon that. PI informed that this study was undertaken in the light of the recommendations given by Inter-Ministerial Group (IMG) on “Arsenic Mitigation” constituted by Ministry of Water Resources, River development & Ganga Rejuvenation and Public Accounts Committee(PAC, eighth report, 16<sup>th</sup> Lok Sabha) on ‘Water Pollution in India’. It was informed that the proposed study will be a step forward in understanding the root causes and magnitude of arsenic contamination in eastern U.P. and for attaining sustainable supply of arsenic safe groundwater to affected areas.

The work program of the division recommended for the year 2015-16 is given below.

**GROUND WATER HYDROLOGY DIVISION  
WORK PROGRAM FOR 2015-16**

S. No.	Code	Study	Study Team	Duration & Status
1.	GWH/2015/TS-1	Flow and Contaminant Transport Modeling of Riverbank Filtration	Shashi P. Indwar (PI) N.C. Ghosh Anupma Sharma Rajan Vatsa	3 ½ years (04/12 – 09/15) Status: In progress
2.	GWH/2015/TS-2	Management of Water Resources for Quantity and Quality in Yamuna-Hindon Inter-basin	Anupma Sharma (PI) Deepak Kashyap, CED, IITR (Technical Advisor) N. C. Ghosh M K Sharma R.P. Singh Sumant Kumar Shashi P. Indwar	3 years (12/14 – 11/17) Status: In progress
3.	GWH/2015/TS-3	Development of Website and e-Portal on “Mitigation and Remedy of Arsenic Menace in India”	N. C. Ghosh (Coordinator) C. P. Kumar (PI) Anupma Sharma Shashi P. Indwar Sanjay Mittal	2.5 years (04/15 – 9/17) Status: New
4.	GWH/2015/TS-4	Diagnosis Survey and Selection of Suitable Sites for Development of Riverbank Filtration Demonstration Schemes in Different States	Surjeet Singh (PI) N.C. Ghosh C. P. Kumar Sumant Kumar Sanjay Mittal	1 year (04/15 – 3/16) Status: New
5.	GWH/2015/TS-5	Alternate Water Supply Management Strategies in Arsenic Affected/ Vulnerable Areas: Mapping of Arsenic Affected Zones/ Regions in Eastern U.P.	Sumant Kumar (PI) & Shashi P. Indwar (PI) N. C. Ghosh R. P. Singh Rajesh Singh S. L. Srivastava	1 year (04/15 – 3/16) Status: New

**HYDROLOGICAL INVESTIGATIONS DIVISION**

Dr. Sudhir Kumar, Scientist G and Head, presented an overview and progress of studies and activities carried out by the Hydrological Investigations Division during the year 2014-15. He informed that out of 8 internal R&D studies approved for the year 2014-15, 2 studies have been completed (out of which 1 study was completed till last working group meeting). Out of the 5 sponsored studies, one study on sponsored by BGS, UK has been successfully completed, while 4 studies are being continued. He further informed that the scientists of the division have also completed 5 consultancy projects, conducted 5 training programs / workshops and published more than 45 papers in Journals and conferences.

Dr. Sudhir Kumar informed that for the next year, i.e., 2015-16, 5 internal studies, 4 sponsored projects, and one consultancy project shall continue from the year 2014-15. Further, 2 new

internal studies and 1 sponsored project has been proposed for the year 2015-16. Also, many consultancy projects have been submitted by the scientists of the division and expected to be started during 2015-16

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

### **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**

Head, HI Division informed that the study was being conducted in collaboration with Punjab University, Chandigarh. He told that due to some administrative problems Punjab University could not complete the component of work assigned to it. However, as NIH component of the project was completed in September 2014 and presented in the 41<sup>st</sup> working group meeting. The study has been completed and the report is being prepared.

#### **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 study has been completed. He told that the major objectives of the study were: (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, and (iv) To study water availability in the lake. All the objectives have been achieved. However, he informed that the work related to trend analysis has been done based on trend line only and analysis based on statistical tests would be completed in next few days and would be included in the final report.

Dr. Khobragade presented the analysis carried out so far and the results in details including the water balance of different years including monsoon 2015. 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 and analysis of catchment requirement vis-a-vis cumulative number of check dams to demonstrate the possible impact of the check dams on inflow to the lake. He informed that since in the water balance approach seepage was determined indirectly, to confirm seepage losses from the lake a number of parameters such as piezometer water level variation, radon, stable isotopes, EC, pH and temperature were measured. He presented the results of these parameters to demonstrate seepage from the lake. However, he informed that long term data and further investigations are needed for detailed analysis of seepage. In the end Dr. Khobragade presented the various findings of the study.

The working group noted the progress of the study and appreciated the work done under the study. Dr. Deshpande suggested that the water balance results may be presented as normalised data. The study has been completed and report is being prepared

#### **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) informed that progress of the work done upto November, 2014 was presented in the last meeting wherein it was informed that analysis of the noble gases for 12 samples has been completed from IAEA Vienna and that the results



indicated a good correlation between the age of groundwater with built up of He in the groundwater. He further informed that the next phase of sampling has been started only recently and is still under progress. The results of analysis of the collected samples of this phase are yet to be obtained. Working group noted the progress of the work done under the study. No comments were received.

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

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

Sh. S. K. Verma, Sc. D and P.I. 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. 41<sup>st</sup> meeting of working group held during Nov. 26-27, 2014.

While discussing the progress of the study, he informed that 1<sup>st</sup> 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 analyzed for radon concentration. The radon concentrations monitored in these districts were found well below 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 2<sup>nd</sup> objective of the study, a total of 19 groundwater samples have been analyzed for environmental tritium in the laboratory and the analysis of environmental tritium in rest of the 20 groundwater samples is in progress to identify the location for carbon dating. The working group noted the progress of the study. No comments were received.

**5. 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 the study informed that the study is a new study. The objectives and methodology of the project were presented in the last meeting. The study was supposed to start from 1<sup>st</sup> January, 2015 but due to technical reasons it shall now be started as a new study from 1<sup>st</sup> April, 2015. The working group noted the progress of the study. No comments were received.

**6. 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 study, informed that the study was supposed to start from 1<sup>st</sup> January, 2015 but due to technical reasons it shall now be taken up as a new study from 1<sup>st</sup> April, 2015. The working group noted the progress of the study. No comments were received.

**7. 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 and PI. He informed that the objectives of the study are: (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 groundwater samples from the study region are being collected and 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. He further informed that the samples are also being collected and analyzed for stable isotope analyze to support and collaborate the results and the inferences of radon measurements.

Discussing the progress of the study he informed that samples have been collected (shallow depth= <50 m) from six locations and radon analysis has been completed. Other parameters such as pH, EC, and temperature have also been measured. Results indicate that the values of radon concentration in shallow groundwater samples is within the permissible limits as prescribed by USEPA (1991).

**SPONSORED PROJECTS:**

**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 had 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. 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 during September 2014.

**9. 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 details of the study area and it fall with the north western India and further pointed out that GRACE satellite data has been used for same area. Dr. S. K. Bartarya asked about the source water of groundwater in study area and Dr. Rai replied that findings of the study indicate about the recharge from local precipitation and recharge through the canals. The working group noted the progress of the study and appreciated the progress of the study.

10. **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 presented the progress of project. Dr Rao presented the 'Local Meteoric Lines' analyzed and developed for sites at Mukerian, Dasuya, Bolath, Bhaddi, Ropar, Kapurthala, Dholwaha and Maily using isotopic data of rainfall data measurements made for 2 years period. The LMWL displayed an unusual high slope ~10 for precipitation data at Mukerian. At other sites, the slopes of LMWL were in the range 7.5 to 8.5. The intercept of LMWL at these sites ranged from +5 to +15. During the study, isotopic fluctuation of reservoir water at Dholwaha and Maily dams were also compared with Bhakra reservoir water (measured on Satluj river at site Ropar). The comparison made over 2 years indicated altitude effect (depleted isotopic composition of Bhakra water  $\delta^{18}\text{O} = -10\%$ ) compared to Dholwaha and Maily dam water ( $\delta^{18}\text{O} = -3\%$ ) and impact of local effects (evaporation, local rainfall etc) in affecting the isotopic composition of the reservoir water. Being very large in size compared to Maily and Dholwaha dams, the isotopic composition of Bhakra reservoir water fluctuated over a narrow range (< 10%) compared to large fluctuation observed in isotopic values of – Dholwaha and Maily reservoir water (15%). The parameters - EC &  $\delta^{18}\text{O}$  of Bhakra water were found correlating positively indicating changes in  $\delta^{18}\text{O}$  value of Bhakra water as mainly due to evaporation effect. However, no specific relation was observed between EC and  $\delta^{18}\text{O}$  for Maily dam. In addition to isotopic investigations, groundwater level trend was also analyzed for over 20 sites for the period 1999 to 2009. The analysis indicated depleting groundwater conditions in more than 80% of the study region (the groundwater falling trend is not observed in the northern region and in area close to Ropar). The average groundwater fall rate in the region was ~1m/yr.

PI Informed that the sampling and analysis will be continued for the pre-monsoon and post-monsoon of 2015.

Dr R. D. Deshpande, member, Working Group suggested to re-confirm the isotopic slope of 10 for LMWL observed at Mukerian as the observed slope is un-usual and is not reported in the literature.

11. **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 ( $\delta\text{D}$  and  $\delta^{18}\text{O}$ ) radioactive isotope ( $^3\text{H}$ ) 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 and origin of groundwater of the study area. Results of modelling approach to assess the base flow component were also discussed. Dr. Rai also presented the chemical analysis of groundwater data and its interpretation for origin of groundwater. Dr. Rai showed that finding of chemistry also corroborated the isotope data. Dr. S. K. Bartarya suggested to analyse  $\text{SiO}_2$  if possible, which can help to understand silicate weathering pattern. The working group noted the progress of the study and appreciated the progress of the study.

**12. PROJECT REFERENCE CODE: NIH/HID/IAEA-3/2013-15**

**Title of the Study: Integration of Isotope Hydrology in Aquifer Mapping Efforts in India: A Pilot Study of Upper Yamuna Plains**

Dr. Sudhir Kumar (PI) informed that after the progress which was reported in the last meeting, next phase of sampling has been started only recently and is still under progress. The results of analysis of the collected samples of this phase are yet to be obtained. Working group noted the progress of the work done under the study. No comments were received.

**NEW STUDIES:**

**1. PROJECT REFERENCE CODE: NIH/HID/SPON/12-15**

**Title of the Study: Understanding of hydrological processes in Upper Ganga basin by using isotopic techniques**

Dr. S. P. Rai, PI, informed that this study is being proposed under the NMSHE project which is under the process of finalization by the Institute as a sponsored project by DST. The study would be started once the project is approved. The objectives of the proposed study would be : (i) Isotopic characterization of precipitation and identification of sources of vapour, (ii) Runoff generation processes in headwater region of Ganga using isotope and modeling (iii) Spatial and temporal variation of snow and glacier melt in Ganga and its major tributaries. (iv) Contribution of transient groundwater and its role in sustainable flow of Ganga and (v) Groundwater dynamics in mountainous area including identification of recharge sources and zones of major springs

**2. PROJECT REFERENCE CODE: NIH/HID/INT/2015-16/1**

**Title of the Project: Status Report on Rewalsar Lake, Himachal Pradesh**

Dr. Khobragade, PI, presented the study. He informed that this is a new study which is being proposed by the division. The proposed objectives of the study are : (i) To determine the environmental status of the lake (ii) To identify major problems of the lake (iii) To identify major management issues of the lake (iv) To review current research status and research needs for lake and (v) To review the data availability scenario and identify data gaps vis-a-vis identified research needs. He informed that the Rewalsar lake is significant from religious, cultural and tourism purposes but water quality degradation has been reported for the lake and due to pollution more than 700 lake fish died during May 2014. So in the first phase a status report is being proposed and based on the recommendations of the status report, of the lake, a full ledged study would be proposed in the future. He informed that the proposed budget of the study is 3.27 lakhs. While discussing the methodology, he informed that the envisaged objectives will be achieved through collection, processing and analysis of the available data, review of literature, field survey, interaction with management authorities and local people and collection and laboratory analysis for water sample/sediment samples for water quality and isotopic characteristics. Informing about the outcome of the study he told that the output of the study would be in the form of a comprehensive report wherein all data, maps, information and analysis would be included. The report would also contain major identified problems of the lake, current research status of the lake, identified data gaps. Major management issues related to the lake would be discussed and possible approaches to deal with them would be suggested.

Working Group approved the proposed study. No specific comments were received.

**3. PROJECT REFERENCE CODE: NIH/HID/INT/2015-18/1**

**Title of the Project: Lake-Groundwater Interaction Studies for Sukhna Lake, Chandigarh**

The study was presented by Dr. S. D. Khobragade, Scientist E. He informed that Sukhna Lake in Chandigarh faces water scarcity problems especially during the deficit rainfall years. No studies on the interaction of the lake with surrounding groundwater have been reported for the lake so far except for the preliminary investigations carried out by NIH. Studies on water balance carried out by NIH indicated that seepage may be a significant factor determining the water availability in the lake. As such studies on seepage was one of the major observation of the water availability studies on the lake carried out by the Institute. Therefore, the present study has been proposed with the major objective of understanding the lake-ground water interaction regime of the lake and to determine seepage losses from the lake. While discussing the methodology he informed that it is proposed install few piezometers in the vicinity of the lake as adequate ground water data are presently not available for the lake. Dr. Sudhir Kumar, Scientist-G & Head, HI Division informed that efforts would be made to model the lake-ground water interaction. Dr. Khobragade informed that the proposed budget of the study is 59.59 lakhs.

Working Group approved the proposed study. However, Dr. Prasad suggested that the first objective may be modified and identification of zones of lake-water interaction may be removed from the objectives as it would not be possible to establish such zones.

**HYDROLOGICAL INVESTIGATIONS DIVISION  
WORK PROGRAM FOR 2015-2016**

S. N.	Code	Study	Team	Duration/ Status
<b>Ongoing Internal Studies</b>				
1.	HI/2015/TS-1	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 CGWB, Lucknow CGWB, Chandigarh	<b>2 years</b> (07/13-06/15)
2.	HI/2015/TS-2	Estimation of Radon Concentration in Waters and Identification of Paleo-groundwater 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	<b>2 years</b> (10/13-09/15)
3.	HI/2015/TS-3	Interaction between groundwater and seawater along the northern part of east coast of India	M. S. Rao (PI), Sudhir Kumar Pankaj Garg	<b>2 years</b> (01/15 - 12/16)
4.	HI/2015/TS-4	Isotopic investigation of benchmark Himalayan glaciers.	M. S. Rao (PI) S.P. Rai, Sudhir Kumar Pankaj Garg	<b>2 years</b> (01/15 - 12/16)
5.	HI/2015/TS-5	Assessment of dissolved radon concentration for groundwater investigations in Haridwar district	Pankaj Garg (PI) Sudhir Kumar, M. Someshwar Rao	<b>1 year</b> (01/15 – 12/15)

S. N.	Code	Study	Team	Duration/ Status
<b>New Internal Studies</b>				
6.	HI/2015/TS-6	Status Report on Rewalsar Lake, Himachal Pradesh	SD Khobragade (PI) Sudhir Kumar, C. K. Jain	<b>1 year</b> (04/15 – 03/16)
7.	HI/2015/TS-7	Lake-Groundwater Interaction Studies for Sukhna Lake, Chandigarh	SD Khobragade (PI) Sudhir Kumar, Senthil Kumar, Pankaj Garg	<b>3 year</b> (04/15 – 03/18)
<b>Sponsored Projects</b>				
8.	HI/2015/SR-1	The Structure and Dynamics of Groundwater Systems in Northwestern India under Past, Present and Future Climates <b>(MoES)</b>	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	<b>3 years</b> (06/12-03/16) <b>Continuing Study</b>
9.	HI/2015/SR-2	The Use of Environmental Isotopes to Assess Sustainability of Intensively Exploited Aquifer Systems in North Eastern Parts of Punjab, India <b>(IAEA)</b>	M. S. Rao (PI) C. P. Kumar S. P. Rai	<b>3 years</b> (09/12-08/15) <b>Continuing Study</b>
10.	HI/2015/SR-3	Assessment of Baseflow and its Impact on Water Quality in the Part of Satluj River in India using Environmental Isotopes and Age Dating Techniques <b>(IAEA)</b>	S. P. Rai (PI) R. V. Kale M. S. Rao C. P. Kumar Sudhir Kumar V. K. Agarwal Vishal Gupta Mohar Singh	<b>3 years</b> (10/12-09/15) <b>Continuing Study</b>
11.	HI/2015/SR-4	Integration of Isotope Hydrology in Aquifer Mapping Efforts in India: A Pilot Study of Upper Yamuna Plains <b>(IAEA)</b>	Sudhir Kumar (PI) S. P. Rai S. D. Khobragade C. K. Jain P. K. Garg	<b>2 years</b> (05/13-04/15) <b>Continuing Study</b>
12.	HI/2015/SR-5	Understanding of hydrological processes in Upper Ganga basin by using isotopic techniques <b>(DST)</b>	Dr. S. P. Rai (PI) Dr. Sudhir Kumar Rajesh Singh S. D. Khobragade Dr. M. Arora Dr. R. J. Thayyen Sh. P. K. Garg	<b>5 years</b> (4/15 – 3/20) <b>New Study</b>

## 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><b>Team</b> A. R. Senthil kumar Manohar Arora Suhas D Khobragade Avinash Agarwal and Sanjay Jain DOS: April 2012 DOC: March 2015</p>	<p>Dr N B N Prasad suggested to derive the elevation-area-capacity table for every 5 and 10 years and observe any reduction in the rate of sedimentation in the reservoir after soil conservation practices in the catchment. Dr. R. D. Deshpande inquired about the contribution of sediment yield from small tributaries joining the reservoir, which was replied by the PI. The PI requested six months extension for the computation of elevation-area-capacity table for the consolidated sediment volume for each ensemble, which will present a range of elevation-area-capacity table. The Chairman granted the permission to compute the elevation-area-capacity tables and the present the whole result in the next working group meeting.</p>
2.	<p>Study of Hydro-Meteorological Droughts For Chitrakoot Bundelkhand Region In India</p> <p><b>R.P. Pandey</b> DOS: April 2012 DOC: March 2015</p>	<p>The Working Group was informed about the details of Simple Drought Index (SDI), a new method, devised and validated for regular drought monitoring using monthly rainfall data. It was reported that a comprehensive plan for augmenting drinking water supply and supplemental irrigation water supply to kharif crop during dry spells has been prepared.</p>
3.	<p>Application of DSS (P) for Integrated Water Resources Development &amp; Management</p> <p><b>Team</b> A.K. Lohani, Surjeet Singh, Rahul Jaiswal; D K Sonkusale and Akilesh Verma DOS: April 2013 DOC: March 2015)</p>	<p>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 crop water requirement data is not yet provided by the Water Resources Department, Raipur and therefore about six month extension may be granted to complete the study. Members and the Chairman, of the working group have approved the six month extension.</p>
4.	<p>Quantitative assessment of uncertainties in river discharge estimation</p> <p><b>Team</b> Sanjay Kumar and Sharad Jain DOS: April 2013 DOC: March 2016</p>	<p>Dr. Sanjay Kumar mentioned that review comments received from the nominated experts of member countries have been resolved and the draft was circulated to member bodies and national committees for further comments. Dr. Kumar informed that comments from member bodies/national committees are currently being resolved. The final draft would be placed in the ISO meeting scheduled during May 2015 in Tokyo. There were no comments from the WG members.</p>
5.	<p>Evaluation and modeling of hydrological support system</p>	<p>Dr. Agarwal informed that rainfall-runoff-sediment model with using SWAT and CCH1D is in progress. Working</p>

	for watersheds of Garhwal, Uttarakhand hills <b>Team</b> Avinash Agarwal, Manohar Arora and R K Nema DOS: Nov 2013 DOC: Oct 2016	group accepted the study progress.
6.	Estimation of Water Balance for Integrated Water Resources Management in Yerrakalva Pilot Basin, A.P. <b>Team:</b> J.V.Tyagi and YRS Rao DOS: April 2014 DOC: March 2015	Dr. J.V. Tyagi informed that the required spatial database and attribute data tables for the model have been prepared and SWAT has been set up for the Yerrakalva basin. The model calibration is pending for want of the out flow data from the Yerrakalva reservoir. In view of this, Dr. Tyagi requested the Chairman to grant an extension of six months to complete the study. The Chairman approved the extension for the study up to up to 30 <sup>th</sup> September, 2015.
7.	Systematic treatment and analytical solutions for surges and bores in rectangular channels (research study) <b>Team:</b> S.K. Singh DOS: April 2014 DOC: March 2015	Dr. S. K. Singh informed that the study is complete and the report will be submitted by this month.
8.	Status Report on “Impact of Anthropogenic and Climate Change on Sediment Load of Rivers” <b>Team:</b> Archana Sarkar DOS: April 2014 DOC: March 2015	Mrs Archana Sarkar presented some of the findings of various research workers in the subject area. Working group members noted the progress of the study and appreciated the work.
9.	Study of Rainfall Patterns and Comparison of Rainfall Data from different Sources for Uttarakhand State <b>Team:</b> Archana Sarkar, N.K. Bhatnagar, Vaibhav Garg and Rakesh Kumar DOS: April 2014 DOC: March 2016	Mrs Archana Sarkar presented the progress of the study with results of trend analysis of historical rainfall data (annual, seasonal and monthly) by parametric and non-parametric methods for four rainfall stations two each in Kumoan and Garhwal regions. Mrs Sarkar informed to include the data comparison work through hydrological modeling and requested for an extension of the study by another six months, i.e., a new time frame of April 2014 to Sept 2017. Working group members agreed for the extension.
10.	Monitoring and modelling of streamflow for the Gangotri Glacier <b>Team:</b> Manohar Arora and	The PI presented the future GCM scenarios of GFDL GCM. He validated the past data with observed data and explained the reason for over estimation. The future RCM output of REGCM4.3 model for the RCP8.5 scenarios



	Rakesh Kumar DOS: May 2014 DOC: March 2017	were presented for 100 years. Dr Arora explained that these output will be considered while assessing the future water availability. No specific questions were asked by the experts.
11.	Effect of climate change on evaporation at point scale Team: Digambar Singh, A. R. Senthil kumar and Manohar Arora DOS: June 2014 DOC: March 2017	The PI reported that there was a slight decrease in rainfall during the considered period of analysis. There was a mild variation in temperature and humidity. The PI informed the house that high variability was observed in evaporation in the month of January from the analysis of recorded data. Highest value of the evaporation was observed in the month of May.
<b>NEW STUDIES</b>		
12.	Study of regional drought characteristics and long term changes in supplemental irrigation water requirement in Seonath Basin in Chhattisgarh  Dr. R.P. Pandey Dr. Rakesh Kumar DOS: April 2015 DOC: March 2017)	Dr R.P. Pandey presented a new study to be carried out in the Seonath basin in Chattisgarh state of India. The Director NIH and the Chairman Working Group suggested taking up a study in Bundelkhand region to study the possible impact of proposed Ken-Betwa interlinking project. He suggested to propose a project proposal on the above in the next working group meeting.
13.	Flood and Sediment studies in Himalayan basin using MIKE-11 Model  Dr. A.K. Lohani DOS: April 2015 DOC: March 2018	Dr. A. K. Lohani mentioned that the flood study is required to be carried out in the Himalayan basins so as to simulate the impact of flooding due to cloud burst. Furthermore, the Himalayan rivers carry very sedimentation load and therefore, scientific study of river sedimentation is also required to be carry out.
14.	Snowmelt Runoff Modelling and Study of the Impact of Climate Change in Sharda River Basin Team: Dr Achana Sarkar Er. T. Thomas Dr. Vaibhav Garg  DOS: April 2015 DOC: March 2018	Mrs. Archana Sarkar informed that the Institute has already carried out related studies for the Ganges basins mostly in the Garhwal Himalayas but the proposed study would be the first one for the Kumaon Himalayan River basin. Various scenarios of precipitation and temperature would be considered to study the impact of climate change on the hydrological regime of the study basin using GCM outputs.
15.	Generalization and parameter estimation of GEV distribution for flood analysis  Dr. S. K. Singh	Dr. S. K. Singh presented the study highlighting the intended objectives of the study. The GEV distribution as is widely used has two different forms (Type 2 and Type 3) as used in flood frequency analysis. It is intended to possibly unify both type 2 and type 3 GEV distributions in a single GEV and suggest both a simple and optimization method for estimation of its parameters with illustration on

	DOS: April 2015 DOC: March 2016	measured/ published data. This was well received during the discussion and no suggestions were received from the members at this stage.
16.	Analytical Solution for meeting of two surges or bores  Dr. S. K. Singh DOS: April 2015 DOC: March 2016	Dr. S. K. Singh presented the study highlighting the intended objectives of the study as developing analytical equations/solutions in case two surges or bores in rectangular channel intersection from opposite direction, avoiding the currently used iterative solution, with a systematic treatment of surges. An abrupt change in discharge or depth of flow causes a surge or bore in channels. This abrupt change may be due to a sudden opening or closure of gate, part-blockage of a channel due to landslide or tidal effect. This was well received with discussion and no suggestion from the members at this stage.

**SURFACE WATER HYDROLOGY DIVISION  
WORK PROGRAM FOR 2015-16**

S.N.	Code	Study	Study Team	Duration
<b>Ongoing Internal Studies</b>				
1.	SWH/2015/TS-1	Application of DSS (P) for Integrated Water Resources Development & Management	A.K. Lohani Surjeet Singh Rahul Jaiswal D K Sonkusale Akilesh Verma	2 years (April 2013 to Sept. 2015)
2.	SWH/2015/TS-2	Estimation of Water Balance for Integrated Water Resources Management in Yerrakalva Pilot Basin, A.P.	J.V.Tyagi YRS Rao,	1 year (April 2014 to Sept. 2015 )
3.	SWH/2015/TS-3	Study of Rainfall Patterns and Comparison of Rainfall Data from different Sources for Uttarakhand State	Archana Sarkar Vaibhav Garg, IIRS Rakesh Kumar N.K. Bhatnagar	2 years (April 2014 to Sept. 2017)
4.	SWH/2015/TS-4	Quantitative assessment of uncertainties in river discharge estimation	Sanjay Kumar Sharad Jain	3 Years (April 2013 to March 2016)
5.	SWH/2015/TS-5	Evaluation and modeling of hydrological support system for watersheds of Garhwal, Uttarakhand hills.	Avinash Agarwal Manohar Arora RK Nema	3 Years (Nov 2013 to Oct 2016)
6.	SWH/2015/TS-6	Effect of climate change on evaporation at point scale	Digambar Singh A. R. Senthil kumar Manohar Arora	3years (June 2014 to March 2017)
7.	SWH/2015/TS-7	Hydrological modelling, water availability analysis	J.P.Patra Rakesh Kumar Pankaj Mani	3years (April 2014 to March 2017)
<b>Ongoing Sponsored Projects</b>				
1.	SWH/2015/SR-1	Modeling of Gangotri Glacier melt runoff and simulation of stream flow variation under different climate scenarios	Manohar Arora Rakesh Kumar	3years (May 2014 to March 2017)
<b>New Internal Studies</b>				
1.	SWH/2015/TS-8	Flood and Sediment studies in Himalayan basin using MIKE-11 Model	A.K. Lohani	3 years (April 2015 to March 2018)
2.	SWH/2015/TS-9	Snowmelt Runoff Modelling and Study of the Impact of Climate Change in Sharda River Basin	Archana Sarkar T. Thomas Vaibhav Garg	3 years (April 2015 to March 2018)
3.	SWH/2015/TS-10	Study on effect of climate change on sediment yield to Pong reservoir	A. R. Senthil Kumar J. V. Tyagi Avinash Agarwal Suhas Khobragade Manohar Arora	3 years (April 2015 to March 2018)
4.	SWH/2015/TS-11	Study of regional drought characteristics and long term changes in supplemental irrigation water requirement in Seonath Basin in Chhattisgarh	R.P. Pandey Rakesh Kumar	2 years (April 2015 to March 2017)

## 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, sponsored & consultancy 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 of 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. MKG informed that, a number of modifications have been made in the model methodology and the source code for making it more practicable and realistic. Some of these include:

- a) Number of land use classes has been increased from 6 to 51 for more detailed representation.
- b) As suggested in last WG by Dr. Deshpande, option has been included to consider industrial demands separately and the same has been linked to city attributes.
- c) Date of commissioning of hydraulic structures has been included and in the long-term simulation, their effects are considered only after their commissioning.
- d) Variable GW development is now considered (it was constant initially).
- e) Baseflow computation now depends on the actual GW storage in upstream basin above a gauging site.
- f) Rather than considering constant human and cattle population, population growth is considered as per defined rate. For long-term simulation, revised population is estimated at the beginning of each year.
- g) In the command area of hydraulic structures, which are commissioned in intermediate stages during simulation, option has been included for considering the revised cropping pattern while computing irrigation demands.

Since these modifications required changes in the input data, it was decided to first complete the model modifications and then develop the WINDOWS based forms for database preparation. The program development is nearing completion but interface development needs considerable time. MKG requested to increase the study period by 6 months which was agreed by the WG.

**PI: Dr. Sanjay K. Jain (SJ), Scientist “F”**

### ***1. Glacier change and glacier runoff variation in the upper Satluj river basin (Ongoing)***

Dr. Jain presented the objectives as well as the progress made so far. Three sub basins of Upper Satluj basin have been taken for this study. Dr. Jain presented the analysis of temperature and snow water equivalent data and explained correlation between these with glacier change. SJ informed that the data base preparation for snowmelt runoff modelling is under progress and presented the results of snow cover depletion. Dr. Deshpande asked whether snow and glacier mapping vis-à-vis aspect can be carried out. He also suggested that analysis related to trend in a time series may be carried out at different time step, say a decade instead of taking long-term linear trend. Dr. Bartarya informed that some of glacier studies in Baspa basin have been carried out which can also be reviewed. These suggestions were noted.

## **2. Modelling of Narmada Basin using GWAVA Model (Ongoing)**

SJ presented the status as well as the progress. He informed that entire Narmada basin will be considered in the present study, however, initial calibration will be carried out up to Hoshangabad in which three important storage structures are Bargi, Barna and Tawa reservoirs. Dr. Jain also informed about different processes and components of GWAVA model. A training workshop on the GWAVA model was conducted by experts from Centre of Ecology and Hydrology (CEH), United Kingdom during 02-05 March, 2015. Dr. Jain also presented different thematic maps/ model inputs prepared so far. Dr. Sharad Jain suggested inclusion of Madhya Pradesh Council of Science and Technology in the study. Dr. Deshpande suggested inclusion of tectonic features (differential pathways) in the model. Dr. Jain replied that if such feature is available in the GWAVA model, the same will be tried.

**PI: D. S. Rathore (DSR), Scientist “F”**

### **1. Decision Support System for Water Resources Planning in Upper Bhima basin, Maharashtra (Ongoing)**

The progress of the study was presented by DSR. For multi reservoir operation application, Khadakwasla reservoir complex was chosen. The complex has four reservoirs namely Khadakwasla, Temghar, Warasgaon and Panshet. Uptake of water for urban supply to Pune city and Mutha RBC is done from Khadakwasla reservoir. Hydro power generation is also done in Warasgaon and Panshet reservoirs. Simulations were done for FRL and 75% dependable reservoir water levels for varying demands. For 6% increased demands, reliability of supply reduced up to 86% and 73% for town and irrigation demands respectively. Probability of drought magnitude (SPI based) was estimated for monthly rainfall data. The probability varies from 40 to 70% for magnitude greater than one. Water quality model setup was elaborated. Availability of data for various pollutant sources, person-load were presented. Pollutant load temporal distribution was conceptualized as runoff based or uniform. Dr Deshpande inquired about differences in reliability of water supply to different users for a scenario. DSR informed that difference is due to different priority assigned to the users. Water allocation in any time step is based on priority. Water supply reliability will be higher for higher priority user. In this case, urban user is given first priority and irrigation user is assigned 2nd priority. Chairman pointed out that in reliability table, demand should also be written for clarity.

### **2. Web GIS based snow cover information system for Indus basin (Completed)**

In the study, snow cover mapping for Indus basin was completed for year 2007 to 2012 using MODIS data. NDSI and NIR bands were used from 8-day composite MOD09A1. FCC were visually inspected to identify cloud cover and for scenes with significant cloud cover, snow area of cloud free preceding and/or succeeding dates were used in snow statistics. Snow cover raster maps were processed to obtain snow polygons. The polygons were used in Geoserver based web application. Sub basin wise yearly variation in snow cover area during 1st September to 31st August was studied. There was significant snowfall in eastern part of Indus basins during September- November in many years. Visualization in web browser for snow cover maps in different days was demonstrated. Mr Kishor Kumar inquired about extending the application to other basins. Further, since web pages are created dynamically, i.e. server data being accessed by the application on user request, the security audit of the application will be needed. The audit may be done by empanelled agencies. It was informed that for extending the application to other basin, snow maps need to be generated from MODIS data and published in Geoserver. Further, links in HTML application need to be updated. Application is currently deployed on intranet. Dr. Sanjay Jain informed that security audit will be initiated prior to deploying the application on web.

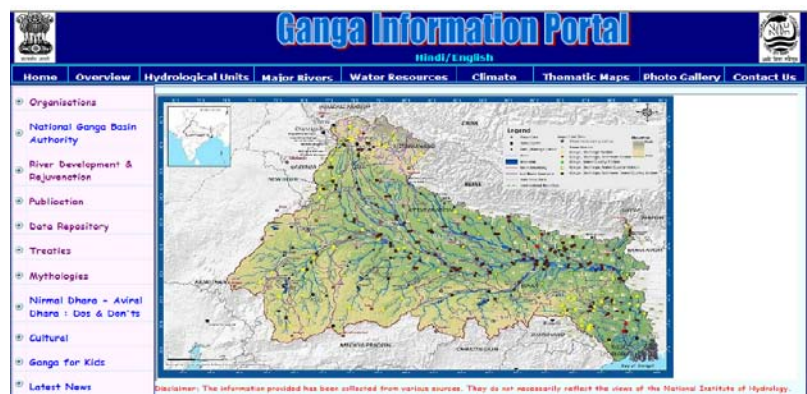
**PI: Deepa Chalisgaonkar (DC), Scientist “F”**

### **1. Assessment of Water Footprint of the National Capital Territory (NCT) of India (Completed)**

DC informed that the objective of this study is to estimate the water footprints of NCT Delhi from both a supply and consumption perspective by quantifying green, blue and grey water footprints. Additionally, the aim is to understand how the water resources of NCT Delhi are being utilized for water consumption. The methodology used in this study is largely based on earlier studies supported by Water Footprint Network ([www.waterfootprint.org](http://www.waterfootprint.org)) and the three components of water footprint have been computed for domestic, agriculture and industrial sector based on the data for the period 2006-2010 collected from various sources, published reports from various departments of government of NCT Delhi and from websites. The virtual water content related data is available at country level not at NCT Delhi level, so it is being used for NCT Delhi as well. Missing data has been assumed. As the computation of grey water footprint includes the amount of freshwater required for mixing pollutants and maintaining water quality according to agreed water quality standards, the water quality criterion of Central Pollution Control Board (‘C’ Class water) has been taken for the computation of dilution water requirement. For the computation of crop water requirement, CROPWAT software has been used and for the grey water component only the nitrogen fertilizer use has been incorporated. This means only the most critical pollutant with the greatest application rate is being considered. Virtual water import component has also being considered for the computation of agriculture water footprint as lot of agriculture related products are brought in Delhi for consumption. WG noted the progress of the study.

### **2. Development of Ganga Information Portal**

DC presented the proposed new study on development of Ganga Information Portal, which is envisaged to provide a unique platform comprising multisource data and information on Ganga basin. The major objective is to develop a knowledge/ information e-portal with exhaustive information on Ganga basin. Govt. of India is keen to clean rivers of India, beginning with Ganga and restore ‘Nirmal dhara’ and ‘Aviral dhara’. Recognizing the multi-sectoral, multi-dimensional and multi-stakeholder nature of information in the Ganga basin, the need is to develop a web-based platform where different types of data/ information (facts; publications; data; maps; photographs; etc.) related to Ganga basin is available at one place. ‘Ganga Information Portal’ (GIP) is a step in this direction. DC also presented the proposed framework of the portal.



**PI: Dr. Renoj J Thayyen (RJT), Scientist “D”**

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

Main objective of this project is to evaluate the winter and summer mass balance of the Phuche glacier. RJT informed that the Phuche glacier experienced negative mass balance during 2013-2014 mass balance year. Progress made on analysing the energy balance data to achieve the mass balance modelling was also presented. No specific suggestions were received.

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

This project is aimed to evaluate the catchment scale hydrologic processes of the cold-arid regime. RJT informed about the establishment of a new discharge station at Gonpa near Leh to monitor round the clock discharge of the perennial stretch of the stream. Studies on permafrost thaw in the catchment continued during the reporting period. Electrical conductivity and discharge showed clear inverse relationship between the two during the peak discharge month of July and August which changed to in phase relationship in the month of September suggesting ground ice melt contribution. There were no specific suggestions/ comments from any member.

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

This project is executed in coordination with border Roads Organisation (BRO) at km 150 of Durbuk—DBO axis. The project was initiated in January 2015. RJT informed that the Radar Water Level Recorder has been already installed to monitor the water level at km 150. It has been a challenging task to raise a cantilever structure with a 10m long arm. RJT informed that steps for procurement of AWS will be initiated soon. No specific suggestions were received for this project.

**PI: Shri L N Thakural (LNT), Scientist “B”**

***1. Trend and variability analysis of Rainfall and Temperature in Himalayan region (Completed)***

The objectives of the study were 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 were applied to determine the trends in the time series data of these meteorological variables. The trend analysis on seasonal and annual scale carried out for the rainfall using APHRODITE data during the last quarter along with overall results for the entire Himalayan region were presented in the meeting. No specific suggestions were received for this project.

***2. Study of Hydrological Changes in selected watersheds in view of Climate Change in India (New)***

PI of the study (LNT) presented the background, objectives, methodology and the expected deliverables of the new study and informed that this 3 years (2015 to 2018) project will be executed through internal funds. It was informed that probable climate change and its perilous impact on the hydrologic system poses a threat to global fresh water resources and aquatic ecosystems worldwide. These changes are not uniform and vary from place to place or region to region. Thus, the present study intend to assess the hydrological changes in watersheds located in different parts of India under changing environment for proper planning and management of water resources. It was also informed that four watersheds will be selected from four different climatic regions of India mainly depending upon the data availability, easy accessibility and having different usage classes (Land use/Land cover). It was decided that one

watershed will be studied in association with CWRDM, Kerala, under the MOU signed between NIH and CWRDM.

**PI: Shri P. K. Mishra (PKM), Scientist “B”**

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

PKM presented the progress made in the study since inception as well as during last six months (November '14-March '15). PKM presented the objective-wise progress made in the study. Shri Mishra presented the future rainfall and temperature downscaled from HadCM3 A2 and HadCM3 B2 GCM data utilizing SDSM model for the KBK region. The study has been carried out using SDSM tool version 4.2.9. Further, to assess the water availability and utilization, input data for two basins viz. Tel basin (sub-basin to Mahanadi basin) and Sarbari basin (sub-basin to Godavari basin) is under preparation to run Soil and Water Assessment Tool (SWAT) model. Mr. Mishra requested to extend the study by 12 months which was agreed by the WG.

**PI: Shri M. K. Nema (MKN), Scientist “B”**

**1. Variability of the Hydro-climatic variables in Punjab Plains of lower Satluj (Ongoing)**

The progress of the study was presented by MKN. During the presentation no specific comments were made by any member. However, Dr. Rangarajan Ramaswamy, Chief Scientist, NGRI suggested to modify the tabular representation of groundwater data. Suggestion shall be followed in the future presentations.

**2. Hydrological Processes and Characterization of Lesser Himalayan Catchments**

MKN presented the progress of the study, which is experimental in nature and requires setting up instruments in the proposed watersheds. Dr. Sharad K Jain, Sc 'G' & Head WRSD, suggested that the stream gauging structure be constructed before the monsoon so that the flow data of the monsoon season can be collected. Mr. Nema replied that initiatives have already been taken to implement the gauging structure before monsoon.

**PI: Shri P. K. Agarwal, Scientist “B”**

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

The progress of the study was presented by Shri Tanveer Ahmad, Scientist B & Co-PI. He informed that SRTM DEM has been downloaded and the study area and drainage network have been generated with the help of the same. Preparation of land use map & Soil map are nearing completion. Some meteorological data has been collected. Database preparation for running SWAT is under progress. No specific comments were received.



**WATER RESOURCES SYSTEMS DIVISION  
WORK PROGRAM FOR 2015-2016**

SN	Code	Study	Study Team	Duration
<b>Ongoing Internal Studies</b>				
1.	WRS/2015/TS-1	NIH_Basin – A WINDOWS based model for water resources assessment in a river basin	M. K. Goel Deepa Chalisgaonkar Sharad K. Jain Prabhash K. Mishra	3 Years (04/13-03/16)
2.	WRS/2015/TS-2	Assessing climate change impact across KBK region of Odisha	P. K. Mishra Sharad K. Jain Sanjay K. Jain	3 Years (04/13-03/16)
3.	WRS/2015/TS-3	Glacier change and glacier runoff variation in the upper Satluj river basin	Sanjay K. Jain Sharad K. Jain Renoj J. Thayyen	2.5 Years (10/13-03/16)
4.	WRS/2015/TS-4	Variability of the Hydro-climatic variables in Punjab Plains of Lower Satluj	M. K. Nema Sharad K. Jain	2 Years (11/13-10/15)
5.	WRS/2015/TS-5	Catchment scale evaluation of cold-arid cryospheric system Hydrology, Gangglass catchment, Ladakh	Renoj J. Thayyen S. P. Rai Sanjay K Jain Sudhir Kumar	3 years (04/14-03/17)
6.	WRS/2015/TS-6	Hydrologic Modelling of a part of Satluj Basin using SWAT Model	P. K. Agarwal Sharad K. Jain M. K. Goel Sanjay K. Jain M. K. Nema Tanveer Ahmed	2 -3/4 Years (06/14-3/17)
7.	WRS/2015/TS-7	Decision Support System for Water Resources Planning in Upper Bhima basin, Maharashtra	D. S. Rathore M. K. Goel, R.P. Pandey Sanjay Kumar Surjeet Singh	2 years (07/14-06/16)
8.	WRS/2015/TS-8	Modeling of Narmada basin by using the GWAVA model	Sanjay K. Jain Sharad K. Jain T. Thomas (RC-Bhopal) P. K. Mishra P. K. Agarwal M. K. Nema	2.25 years Dec. 2014 – Mar 2017
9.	WRS/2015/TS-9	Runoff modeling of Shyok River, Karakorum Range	Renoj J.Thayyen Sanjay K.Jain	3 years Dec-2014 to Nov-2017
10.	WRS/2015/TS-10	Hydrological process and characterization of Lesser Himalayan Catchments	M. K. Nema Sharad K. Jain Sanjay K. Jain Renoj J.Thayyen P. K. Mishra P. K. Agarwal	5 Years 12/14-12/19
<b>Ongoing Sponsored Studies</b>				
1.	WRS/2015/SR-1	Glaciological studies of Phuuche Glacier, Ladakh Range, India (DST)	Renoj J. Thayyen M K Goel S P Rai	5 Years 1/10-06/15

2.	WRS/2015/SR-2	Assessment of Environmental flow for Himalayan River (MOES)	Sharad K. Jain Pradeep Kumar P. K. Agarwal P. K. Mishra	1 Year 07/14-07/15
<b>New Internal Studies</b>				
1.	WRS/2015/TS-11	Development of Ganga Information Portal	Deepa Chalisgaonkar Sharad K. Jain D. S. Rathore Sanjay K. Jain Sudhir Kumar P. K. Mishra P. K. Agarwal M. K. Nema Furquan Ullah	3 years (04/15-03/18)
2.	WRS/2015/TS-12	Study of Hydrological Changes in selected watersheds in view of Climate Change in India	L. N. Thakural D. S. Rathore Surjeet Singh Tanveer Ahmed Sanjay K. Jain Sharad K. Jain	3 years (04/15-03/18)

## RESEARCH MANAGEMENT AND OUTREACH DIVISION (RMOD)

SN	Title of Project/Study, Study Team	Status and Recommendations/Suggestions
1.	Participatory development of structure for IWRM Framework in identified sub-basins under Pilot Basin Studies (PBS) program <b>Team:</b> V C Goyal (PI), Omkar Singh and R V Kale DOS: July 2014, DOC: June 2015	The study was presented by Dr. V.C. Goyal (PI). There were no any comments in this study.
2.	Customization of WEAP model for application in Ur river watershed in Tikamgarh district of Bundelkhand region. <b>(Under TIFAC Project)</b> <b>Team:</b> R V Kale (PI), T Thomas- RC Bhopal, Jyoti Patil, Rajesh Agarwal, DOS: Apr 2014, DOC: Sep 2015	The study was presented by Dr. R.V. Kale (PI). There is no any specific comment. However, Mrs. S. Kaur, IMD opinioned that it should have better option when application of WEAP model may have carried out initially for a gauged basin.
3.	Water conservation and management in Ibrahimpur Masahi village of Hardwar district (Uttarakhand) <b>Team:</b> Omkar Singh, V.C. Goyal, C.K. Jain, and Rajesh Singh DOS: Apr 2013, DOC: March 2015	The study was presented by Er. Omkar Singh (PI). The PI requested for one year extension to perform relevant tasks of this study and WG agreed. However, the Chairman suggested to utilize the boat facility for bathymetric survey of ponds in the villages. The PI noted the suggestions for compliance.
4.	WEAP Model set up for four sub-basins under Pilot Basin Studies (PBS) Programme, jointly with the RCs/CFMSs  <b>NIH HQs:</b> V C Goyal (PBS Leader), Jyoti Patil and R V Kale <b>Co-investigators from NIH RCs/CFMSs:</b> Chandramohan T (RC-Belgaum), Y R S Rao (RC-Kakinada), T R Nayak (RC-Bhopal), B Chakravorty (CFMS-Patna) DOS: Apr 2015, DOC: Mar 2016 <b>(New study)</b>	The study was presented by Dr. Jyoti Patil. There is no any specific comment. However, the duration of this study may be increased from 1 year to 2 years.

**RESEARCH MANAGEMENT AND OUTREACH DIVISION**

**WORK PROGRAM FOR 2015-2016**

SN	Code	Title of Project/Study, Study Team	Duration
<b>Ongoing Internal Study</b>			
1.	RMO/2015/TS-1	Participatory development of structure for IWRM Framework in identified sub-basins under Pilot Basin Studies (PBS) program <b>Team:</b> V C Goyal (PI), Omkar Singh and R V Kale	DOS: July 2014 DOC: June 2015
2.	RMO/2015/TS-2	Water Conservation and Management in Ibrahimpur Masahi Village of Hardwar District (Uttarakhand) <b>Team:</b> Omkar Singh, V.C. Goyal, C.K. Jain, and Rajesh Singh	DOS: Apr 2013 DOC: March 2016
<b>New Internal Study</b>			
3.	RMO/2015/TS-3	WEAP Model set up for four sub-basins under Pilot Basin Studies (PBS) Programme, jointly with the RCs/CFMSs <b>NIH HQs:</b> V C Goyal (PBS Leader), Jyoti Patil and R V Kale <b>Co-investigators from NIH RCs/CFMSs:</b> Chandramohan T (RC-Belgaum), Y R S Rao (RC-Kakinada), T R Nayak (RC-Bhopal), B Chakravorty (CFMS-Patna)	DOS: Apr 2015 DOC: Mar 2017
<b>Sponsored Project</b>			
1.	RMO/2015/SR-1	Customization of WEAP model for application in Ur river watershed in Tikamgarh district of Bundelkhand region. <b>(Under TIFAC Project)</b> <b>Team:</b> R V Kale (PI), T Thomas- RC Bhopal, Jyoti Patil, Rajesh Agarwal	DOS: Apr 2014 DOC: Sep 2015 <b>(Ongoing study)</b>

**Proposed Technical Transfer & Outreach Activities during 2015-2016**

SN	Code	Activity
1	RMO/2015/OR-1	Outreach activities (IITF-2015, IWW, other exhibitions)
2	RMO/2015/TW-1	5-day Workshop on "Citizen science in hydrology and water resources"
3	RMO/2015/TW-2	Orientation training of newly appointed scientists
4	RMO/2015/OR-2	Science-Policy interface, IPR issues, and technical meetings
5	RMO/2015/OR-3	Establishment of "Water Activity Centre"
6	RMO/2015/LCU	Operational expenses of LCU-Delhi

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 who attended the 42<sup>nd</sup> WG meeting**

1.	Er. R.D. Singh, Director, NIH	Chairman
2.	Dr. S.K. Bartarya, WIHG, Dehradun	Member
3.	Dr. (Mrs.) Surinder Kaur, DDGM(H), IMD, New Delhi	Member
4.	Dr. S C R Vishvakarma, Sc.F, GBPIHED, Almora	Member
5.	Dr. R D Deshpande, Sc.SF, PRL, Ahmedabad	Member
6.	Dr. R.Rangarajan, Sc.G, CSIR-NGRI, Hyderabad	Member
7.	Dr. N.B. Narasimha Prasad, Ex. Director, CWRDM. Kozhikode	Member
8.	Dr. Kishore Kumar, Sr. Tech. Director, NIC, New Delhi	Member
9.	Dr. S.K. Jain, Sc. G & Head WRS Division, NIH	Member
10.	Dr. Rakesh Kumar, Sc. G & Head SWH Division, NIH	Member
11.	Dr. Sudhir Kumar, Sc. G & Head HI Division, NIH	Member
12.	Dr. V C Goyal, Sc. F & Head, RMO Division, NIH	Member-Secretary

**Scientists from National Institute of Hydrology, Roorkee**

	<b>EH Division</b>		<b>SWH Division</b>
1	Dr. R.D. Mehta, Sc.D	18	Dr. J.V. Tyagi, Sc.G
2	Dr. M.K. Sharma, Sc.D	19	Dr. Avinash Agarwal, Sc.F
3	Dr. Rajesh Singh, Sc.B	20	Dr. S.K. Singh, Sc.F
	<b>GWH Division</b>	21	Dr. R.P. Pandey, Sc.F
4	Er. C.P. Kumar, Sc.F	22	Dr. A.K. Lohani, Sc.F
5	Dr. Anupama Sharma, Sc.D	23	Dr.A R Senthil Kumar, Sc.D
6	Dr. Surjeet Singh, Sc.D	24	Dr. Sanjay Kumar, Sc.D
7	Sh.Rajan Vatsa, Sc.B	25	Dr (Mrs) Archana Sarkar, Sc.D
8	Sh. Sumant Kumar, Sc.B	26	Dr. Manohar Arora, Sc.D
9	Mrs. Shashi Poonam, Sc.B	27	Sh. Digamber Singh, Sc.B
	<b>HI Division</b>	28	Sh. J.P. Patra, Sc.B
10	Dr.Suhas Khobragade, Sc.E		<b>WRS Division</b>
11	Dr. S.P. Rai, Sc.D	29	Smt. D.Chalosgaonkar, Sc.F
12	Dr. M.S. Rao, Sc.D	30	Dr. Sanjay Jain, Sc.F
13	Sh. S.K. Verma, Sc.D	31	Dr. M.K. Goel, Sc.F
14	Sh. P.K. Garg, Sc.B	32	Er. D. S. Rathore, Sc. F
	<b>RMO Division</b>	33	Dr. Renoj J. Thayyen, Sc.D
15	Er. Omkar Singh, Sc.E	34	Sh. L.N. Thakural, Sc.B
16	Dr. Ravindra Vitthal Kale, Sc.B	35	Sh. Manish Nema, Sc.B
17	Dr (Mrs) Jyoti P. Patil, Sc.B	36	Sh. P.K. Mishra, Sc.B
		37	Sh. Tanveer Ahmad, Sc.B
		38	Sh. P.K. Agrawal, Sc.B