

**MINUTES OF THE
48TH MEETING OF WORKING GROUP OF NIH
HELD AT NIH, ROORKEE, DURING 2-3 MAY 2019**

The meeting was held under the Chairmanship of Dr. S K Jain, Director, NIH. The list of participants of the meeting is given in Annexure-I.

ITEM NO. 48.1: OPENING REMARKS BY THE CHAIRMAN

Chairman, WG, welcomed the WG members and the Scientists of NIH. He informed about the Foundation Day celebration of NIH in December 2018 and the special publications prepared by NIH. He mentioned about a NIH publication entitled 'Climate change and its impacts on water resources of India'. He requested the members to suggest topics for such publications in key areas, and indicate their willingness to collaborate with NIH in this endeavour. He informed about the organization of a conference in Hindi in December 2019, and requested the members to actively participate in it. Also, he desired frequent interaction of NIH scientists with the WG members on specific studies.

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

S N	Member	Suggestion(s)
1.	Sh. Wasim Ahmed	▪ Collaboration with NIH on spring rejuvenation program
2.	Dr. K V Singh	▪ Site tour of WG members on ongoing/completed studies
3.	Dr. R D Deshpande	<ul style="list-style-type: none"> ▪ Objectives of some studies not carefully formulated ▪ Preparation of PPTs needs improvement ▪ Not all studies need to be presented in every meeting ▪ All NIH scientists should be present during the deliberations ▪ Data interpretation workshops should be organized among NIH groups with participation of concerned WG member(s) ▪ NIH may plan a new program on Hydromatics ▪ NIH may bring out a report on 'Hydrologic processes in Himalayas' ▪ NIH may organize an International Symposium on 'Advances in Hydrologic Research'
4.	Dr. S P Aggarwal	▪ NIH's may contribute more to solve real world water problems
5.	Dr. R K Goyal	<ul style="list-style-type: none"> ▪ Need for time management in presenting studies ▪ Overlap of scientists in many studies ▪ Mentioned ICAR's guidelines on scientists involvement in studies
6.	Dr. Man Singh	▪ Emphasised on data availability
7.	Prof. A K Saraf	▪ Change detection is an important consideration in many studies
8.	Prof. M L Kansal	▪ Requested for active participation in Roorkee Water Conclave 2020
9.	Dr. S S Grewal	<ul style="list-style-type: none"> ▪ Water recharge and allocation planning in industrial belt of Aravalli hills ▪ Drying of springs in Shiwaliks and Arvallis ▪ Lesser number of studies should be presented ▪ Pond rejuvenation work to be widely publicized
10.	Dr. Kaushal K. Garg	▪ Collaborative work with NIH on watershed interventions

		<ul style="list-style-type: none"> ▪ Consider Ecosystem Services as part of hydrology studies ▪ While working out climate change scenarios, include landuse changes along with precipitation and temperature
11.	Prof. Ramakar Jha	<ul style="list-style-type: none"> ▪ Prepare e-books ▪ Work for patents ▪ Sponsored projects need not be presented in detail
12.	Prof. A P Dimri	<ul style="list-style-type: none"> ▪ Establishment of High Performance Computing Centre ▪ Avoid duplication of studies among Divisions of NIH ▪ Organize workshop on ‘Statistical interpretation of hydrologic data’ ▪ Organize national workshop on ‘Rejuvenation of village ponds’ ▪ Plan new programs on ‘Hydrology for atmosphere-land-underground’ and ‘Hydrologic regimes of India’ ▪ Understanding of processes is important while selecting a model ▪ Highlight societal aspects of NIH’s work
13.	Dr. Sadhana Malhotra	<ul style="list-style-type: none"> ▪ Success stories need to be documented and disseminated ▪ Presentation skills need improvement
14.	Sh. Sudhindra Mohan Sharma	<ul style="list-style-type: none"> ▪ More training programs for field engineers ▪ More interaction with industry
15.	Dr. Anil Guatam	<ul style="list-style-type: none"> ▪ Collaboration with NIH on spring rejuvenation program

Next, the Chairman asked the Member-Secretary to take up the agenda.

ITEM No. 48.2: CONFIRMATION OF THE MINUTES OF 47th MEETING OF THE WORKING GROUP

The 47th meeting of the Working group was held during 23-24 October 2018. The minutes of the meeting were circulated to all the members and invitees vide letter No. RMOD/WG/NIH-10 dated 04 December 2018. The members confirmed the minutes of the 47th Working Group meeting.

ITEM No. 48.3: 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 47th working group meeting.

ITEM Nos. 48.4 & 48.5: PRESENTATION AND DISCUSSION ON THE STATUS AND PROGRESS OF THE WORK PROGRAMME FOR YEAR 2018-19 AND FINALIZATION OF THE WORK PROGRAMME FOR YEAR 2019-20.

The Member-Secretary requested the respective Divisional Heads to present the progress of studies carried out during 2018-19 and proposed work program for the year 2019-20. Accordingly, the progress of various studies and sponsored projects was presented by all Scientific Divisions during the two day deliberations of the Working Group. The Division wise minutes of each study/project presented during the meeting are given next.

ENVIRONMENTAL HYDROLOGY DIVISION

Dr. J.V. Tyagi, Scientist 'G' & Head of EHD presented a brief overview of the Division including scientific manpower, status of studies, consultancy projects, publications, and technology transfer activities. Thereafter the scientists of the Division presented the progress of their studies and the comments/suggestions received from the Working Group members are summarized below.

Progress of Work Program for 2018-19

SN	Study	Recommendations/Comments
Internal Studies (Continuing)		
1.	<p>Development of Habitat Suitability Curves for the Aquatic Species of Western Himalayan Streams and Assessment of Environmental Flows</p> <p>Study Group: Pradeep Kumar (PI) and C. K. Jain Duration: 3 Years (04/16-05/19)</p>	<p>Dr. Pradeep Kumar presented the study and there were no comments.</p>
2.	<p>Impact of Climate Change on Runoff and Sediment Yield for Puthimari Tributary of River Brahmaputra</p> <p>Study Group: Swapnali Barman (PI), J. V. Tyagi, & R.K. Bhattacharya (IITG) Duration: 3 Years (11/18-10/21)</p>	<p>Dr. Swapnali Barman presented the study and following suggestions were made.</p> <ul style="list-style-type: none"> • Dr. A. P. Dimri suggested to calculate variations in % and use hybrid ANN-SWAT model. • Dr. A. K. Saraf suggested to use void free data. <p><i>Note: Due to transfer of PI to CFMS Guwahati, the study is transferred to CFMS Guwahati.</i></p>
Sponsored Projects (Continuing)		
3.	<p>Environmental Assessment of Aquatic Ecosystem of Upper Ganga Basin</p> <p>Study Group: C.K. Jain (PI), Manohar Arora, M. K. Sharma, Pradeep Kumar, R. Singh, & D. S. Malik (GKU) Sponsored by: DST (NMSHE) Project Cost: Rs. 2.25 Crore Duration: 5 Years (04/16-03/21)</p>	<p>Dr. M. K. Sharma presented the study and following suggestions were made:</p> <ul style="list-style-type: none"> • Dr. Anil Gautam suggested to explore indexing of water quality based on biological parameters.
4.	<p>Ground Water Quality Assessment with Special Reference to Sulphate Contamination in Bemetara District of Chhattisgarh State and Ameliorative Measures</p> <p>Study Group: M. K. Sharma (PI), C.K. Jain, Surjeet Singh, & Pradeep Kumar Partner: WRD, Raipur & CGWB, Raipur Sponsored by: NHP-PDS Project Cost: Rs. 25.4 Lakh</p>	<p>PI Dr. M. K. Sharma presented the study and following suggestions were made:</p> <ul style="list-style-type: none"> • Dr. Deshpandey enquired about the criteria for selection of sampling sites considering the aquifer geometry. Dr. Sharma replied that the sampling sites were selected on the basis of wells connected to different aquifers, which are continuously being observed either by WRD, Raipur or CGWB. • Dr. Dimri wanted to know the causes of

	Duration: 03 Years (09/17-08/20)	the dilution of water quality parameters. Dr. Sharma supplemented that rainfall and surface irrigation may be the causes of dilution. <ul style="list-style-type: none"> • Dr. Jha advised to use same colour combination for pre- and post-monsoon data presentation to have more visibility of dilution effect.
5.	Water Quality Assessment of Southwest Punjab Emphasizing Carcinogenic Contaminants and their Possible Remedial Measures Study Group: Rajesh Singh (PI), Pradeep Kumar, M. K. Sharma, & Sumant Kumar Partner: Water Resources Organization, Punjab Sponsored by: NHP-PDS Project Cost: 65.6 Lakh Duration: 3 Years (09/17 – 08/20)	PI Dr. Rajesh Singh presented the study and following suggestions were made: <ul style="list-style-type: none"> • Dr. S.S. Grewal suggested collecting the samples from the villages/locations in depressions.

WORK PROGRAM FOR THE YEAR 2019-20

SN	Study	Study Team	Duration/Status
Internal Studies (Continuing)			
1.	Development of Habitat Suitability Curves for the Aquatic Species of Western Himalayan Streams and Assessment of Environmental Flows	Pradeep Kumar (PI)	3 Years (04/16-05/19)
Internal Studies (New)			
2.	Water Quality Assessment of Haridwar District	R.K. Nema (PI) Rajesh Singh, J. V. Tyagi Pradeep Kumar	3 years (05/19-04/22)
Sponsored Projects (Continuing)			
3.	Environmental Assessment of Aquatic Ecosystem of Upper Ganga Basin	M. K. Sharma (PI) Manohar Arora, Pradeep Kumar, Rajesh Singh D. S. Malik (GKU)	5 Years (04/16-03/21) Sponsored by: DST (NMSHE)
4.	Ground Water Quality Assessment with Special Reference to Sulphate Contamination in Bemetara District of Chhattisgarh State and Ameliorative Measures	M. K. Sharma (PI) Surjeet Singh, Pradeep Kumar Partner: WRD, Raipur, CGWB, Raipur	3 Years (09/17-08/20) Sponsored by: NHP-PDS Project Cost: Rs. 25.4 Lakh Status: In-progress
5.	Water Quality Assessment of Southwest Punjab Emphasizing Carcinogenic	Rajesh Singh (PI) Pradeep Kumar, M. K.	3 Years (09/17-08/20) Sponsored by: NHP-

	Contaminants and their Possible Remedial Measures	Sharma, Sumant Kumar Partner: Water Resources Organisation, Punjab	PDS Project Cost: Rs. 65.6 Lakh Status: In-progress
Sponsored Projects (New)			
6.	Leachate Transport Modeling for Gazipur landfill site for suggesting ameliorative measures	Anjali (PI) Sudhir Kumar, J. V. Tyagi, M. K. Sharma, Nitesh Patidar Partner: CGWB (Delhi unit)	3 Years Project cost: Rs. 76.10 Lakh Status: PDS proposal submitted to NHP, yet to be approved by Review committee
7.	Study of Emerging Pollutants and Geochemical Processes Responsible for the Groundwater Contamination in and around Raipur Agglomerate, Chhattisgarh and Suggestive Ameliorative Measures	M. K. Sharma (PI) J. V. Tyagi Surjeet Singh Pradeep Kumar Rajesh Singh WRD, Raipur	3 Years Project cost: Rs. 77.32 Lakh Status: PDS proposal submitted to NHP, yet to be approved by Review committee

Proposed Training Programmes during 2019-20

SN	Topic	Duration	Place
1.	Hydrologic Modelling using SWAT (Coordinator: Dr. J. V. Tyagi)	Two weeks 20-31 May 2019	Roorkee
2.	Ground Water Quality Monitoring & Assessment under NHP-PDS (Coordinator: Dr. M. K. Sharma)	5 Days 3-7 June 2019	Roorkee
3.	Water Quality Assessment & Management under NHP-PDS (Coordinator: Dr. Rajesh Singh)	5 Days 17-21 June 2019	Roorkee
4.	Water Quality: Concepts and Analysis under NHP (Coordinator: Dr. Pradeep Kumar)	5 Days Oct. 2019	Roorkee

GROUND WATER HYDROLOGY DIVISION

Mr. C. P. Kumar, Scientist 'G' & Head presented a brief overview, status of studies and activities carried out by the division. He informed that one in-house R&D study and ten sponsored studies were approved for the year 2018-19. Out of these, the in-house R&D study was dropped due to various issues in customization because the designed system was not allowing the level of customization. He also informed that since suitable land could not be made available for the study "*Grey Water to Blue Water – Natural Treatment Techniques for Transforming Wastewater into Sustainable Useable Water*", this study has been dropped. In addition, scientists of the division have a major role in activities of NHP such as coordinating the Purpose Driven Studies (PDS) of all implementing agencies of NHP, DSS planning and management in selected states, development of groundwater module for "*Integrated Hydrologic Model*" with IIT Kharagpur and procurement.

The study-wise progress was presented by respective Principal Investigators and emerged suggestions are given below.

1. **Project Code: NIH/GWH/NIH/15-19: Peya Jal Suraksha - Development of Six Pilot Riverbank Filtration Demonstrating Schemes in Different Hydrogeological Settings for Sustainable Drinking Water Supply**

Dr. Surjeet Singh (PI) briefed about the study and progress made during the last six months. He informed that Phase-I works at the four sites; Agra and Mathura in U. P. along Yamuna river, Berhara village in Ara district in Bihar along the Ganga river, and Varaha river at Visakapatnam have been completed through respective state water supply departments. He informed that Phase-II works are partly completed for the Agra and Mathura sites involving the installation of submersible pumps, the establishment of a pump house, etc. For the other two sites, Ara and Visakapatnam, the Phase-II works are likely to start through the respective state government departments.

2. **Project Code: NIH/GWH/BGS/17-20: Groundwater Fluctuations and Conductivity Monitoring in Punjab - New Evidence of Groundwater Dynamics in Punjab from High Frequency Groundwater Level and Salinity Measurements**

Dr. Gopal Krishan presented the results for variation in water level indicating different times of fluctuation thereby ascertaining the relationship between deep and shallow aquifers and also indicated the recharge sources.

3. **Project Code: NIH/GWH/NMSHE/16-20: Study of River - Aquifer Interactions and Groundwater Potential at Selected Sites in the Upper Ganga Basin up to Dabrani**

Dr. Surjeet Singh presented the progress of the study during the last six months. He also described the status of installation of piezometers being developed, water sampling and analysis being carried out, future plans and presented the results of water quality and isotopic analysis.

4. **Project Code: NIH/GWD/NIH/16-19: Grey Water to Blue Water – Natural Treatment Techniques for Transforming Wastewater into Sustainable Useable Water**

This study was dropped.

5. **Project Code: NIH/GWH/DST/18-20: Future Secular Changes and Remediation of Groundwater Arsenic in the Ganga River Basin - FAR GANGA**

Dr. Surjeet Singh presented the progress made so far. He informed that the project is of 4 x 4 consortium partner from each country and the Indian partners are NIH (Indian Lead); IIT Kharagpur; IIT Roorkee; and Mahavir Cancer Sansthan, Patna and UK partners are University of Manchester (UK Lead), British Geological Survey, Salford University; and University of Birmingham. While presenting the objectives and hypotheses to be tested in the project, he also explained the future plans.

6. **Project Code: NIH/GWH/DST/18-20: Impact of Rainwater Harvesting on Groundwater Quality in India with Specific reference to Fluoride and Micro-pollutants**

Dr. Anupma Sharma presented the research gaps, objectives of the study, and the work packages. The study sites in which field investigations are being conducted were discussed. It was informed that a few

more sites besides Laporiya watershed are being surveyed that would be taken up for research investigations.

7. **Project Code: NIH/GWH/PDS/17-21: Ganges Aquifer Management in the Context of Monsoon Runoff Conservation for Sustainable River Ecosystem Services - A Pilot Study**

Dr. Surjeet Singh presented the objectives, progress of work and future plans of the study. Dr. Ramakar Jha enquired about the selection of the Sot river catchment which was replied by Dr. Singh.

8. **Project Code: NIH/GWH/PDS/17-21: Assessment of Impacts of Groundwater Salinity on Regional Groundwater Resources, Current and Future Situation in Mewat, Haryana – Possible Remedy and Resilience Building Measures**

Dr. Gopal Krishan presented the background, statement of the problem, objectives, methodology, progress and future plans of the study.

9. **Project Code: NIH/GWH/PDS/17-20: Hydro-geochemical Evolution and Arsenic Occurrence in Aquifer of Central Ganges Basin**

Mr. Sumant Kumar presented the objectives, methodology, achievements and expected outcome of the study. The Chairman, Working Group suggested doing sampling in the other side of Ganga river to know the present situation of Arsenic contamination.

10. **Project Code: NIH/GWH/CEHM/18-22: Integrated Management of Water Resources for Quantity and Quality in Upper Yamuna Basin up to Delhi**

Dr. Anupma Sharma presented the special study taken up under the Centre of Excellence for Hydrologic Modeling in NHP. The project entails large data processing, field investigations and modeling pertaining to surface water and groundwater flows, contaminant transport and water resources management. The progress made in respect of data collection and processing, field experiments and hydrologic modeling was presented. It was informed that in view of the large study area, satellite data would be used to the extent possible. Field investigations and laboratory experiments are planned to build up the soil parameters database. The working group members expressed concern about the decline in groundwater levels in certain areas of the eastern and western Yamuna canal commands. It was informed that except in salinity affected areas, groundwater pumpage has increased during the last two decades. However, groundwater withdrawal data are not readily available and would be collected through field surveys.

11. **Project Code: NIH/GWH/NIH/18-19: Application for Conjunctive Use Management of Surface Water and Groundwater in Saryu Nahar Pariyojna, U.P. using “Strategic Basin Planning for Ganga River Basin”**

This study was dropped.

12. **Project Code: NIH/GWD/NIH/19-21: Assimilation and Application of Satellite Data Products for Water Resources Assessment of Inland River Basins of India**

Ms. Suman Gurjar presented the background, objectives, methodology, and expected outcome of the study. Dr. A. P. Dimri suggested changing the title of the study because the assimilation techniques are not being used in this study. Therefore, the title of the study has been changed as “*Application of Satellite Data Products for Water Resources Assessment*”. He also suggested that to begin with, an area in the Ganga basin can be used as a study area. He also indicated that the estimation of the land surface

temperature using satellite data can be a great output. Dr. S. P. Aggarwal suggested getting the basic information of satellites which are providing the data. He also suggested defining the methodology. The Chairman, WG suggested to start with the water balance equation and consider all major processes.

13. Project Code: NIH/GWH/NIH/19-22: Integrated Hydrological Modelling to Investigate the Surface-Subsurface Water Interactions

Mr. Nitesh Patidar presented the background, objectives, methodology, and expected outcome of the study. Dr. S. M. Sharma indicated that finding the information related to the aquifer geometry of the study area will be a complex task as it is dominated by basalt rocks.

The work program of the division for the year 2019-20, as recommended by the Working Group below:

WORK PROGRAM FOR THE YEAR 2019-20

S. No.	Project	Project Team	Duration & Status	Funding Source
Internal Studies				
1. NIH/GWH/ NIH/19-21	Application of Satellite Data Products for Water Resources Assessment	Suman Gurjar (PI), Vishal Singh, Surjeet Singh, C. P. Kumar, P. K. Singh	2 years (05/19 - 04/21) <i>Status: In progress</i>	Internal Study
Sponsored Projects				
2. NIH/GWH/ NIH/15-19	Peya Jal Suraksha - Development of Six Pilot Riverbank Filtration Demonstrating Schemes in Different Hydrogeological Settings for Sustainable Drinking Water Supply	Surjeet Singh (Lead), B. Chakravorty, Y. R. S. Rao, Anupma Sharma, Sumant Kumar, Gopal Krishan, Suman Gurjar, Anju Chaudhary, Sanjay Mittal	2.5 years (11/15–12/19) Extended till Dec. 2019 <i>Status: In progress</i>	Sponsored by MoWR, RD & GR under Plan Fund
3. NIH/GWH/ NMSHE/16-20	Study of River - Aquifer Interactions and Groundwater Potential at Selected Sites in the Upper Ganga Basin up to Dabrani	Surjeet Singh (PI), C. P. Kumar, R. J. Thayyen, Sudhir Kumar, Manohar Arora, Gopal Krishan, Nitesh Patidar, Anjali	5 years (01/16 - 12/20) <i>Status: In progress</i>	Sponsored by DST under NMSHE SP-8
4. NIH/GWH/ BGS/17-20	Groundwater Fluctuations and Conductivity Monitoring in Punjab - New Evidence of Groundwater Dynamics in Punjab from High Frequency Groundwater Level and Salinity Measurements	Gopal Krishan (PI), Surjeet Singh, C. P. Kumar <i>From: BGS, UK</i> Dr. Dan Lapworth (PI) Prof. Alan MacDonald	3 years (12/17-11/20) <i>Status: In progress</i>	Sponsored by BGS, UK

5. NIH/GW H/PDS/17 -20	Hydro-geochemical Evolution and Arsenic Occurrence in Aquifer of Central Ganges Basin	Sumant Kumar (PI), Sudhir Kumar, Rajesh Singh, Gopal Krishan, Anju Chaudhary <i>Partner Organization:</i> MWRD, Bihar <i>Collaborator:</i> Brijesh Yadav, IIT Roorkee and N.S Maurya, NIT Patna	3 years (12/17-11/20) <i>Status: In progress</i>	Sponsored by NHP under PDS
6. NIH/GW H/PDS/17 -21	Assessment of Impacts of Groundwater Salinity on Regional Groundwater Resources, Current and Future Situation in Mewat, Haryana – Possible Remedy and Resilience Building Measures	Gopal Krishan (PI), Surjeet Singh, C. P. Kumar, S. K. Verma <i>IIT-Roorkee:</i> M. L. Kansal, Brijesh Yadav (PI) <i>Sehgal Foundation, Gurgaon:</i> Lalit Mohan Sharma	3 years (12/17-11/21) <i>Status: In progress</i>	Sponsored by NHP under PDS
7. NIH/GW H/PDS/17 -21	Ganges Aquifer Management in the Context of Monsoon Runoff Conservation for Sustainable River Ecosystem Services - A Pilot Study	Surjeet Singh (PI), C. P. Kumar, Sudhir Kumar, Suman Gurjar, Gopal Krishan	4 years (12/17-11/21) <i>Status: In progress</i>	Sponsored by NHP under PDS
8. NIH/GWH/ DST/18-20	Future Secular Changes and Remediation of Groundwater Arsenic in the Ganga River Basin - FAR GANGA	B. Chakravorty (India Lead), Surjeet Singh (Dy. Lead), Sumant Kumar, Gopal Krishan, Suman Gurjar <i>Other India Partners:</i> IITR, IITKg, MCS, Patna <i>UK Partners:</i> Univ. of Manchester, BGS, Salford University, Univ. of Birmingham	3 years (01/18 - 12/20) <i>Status: In progress</i>	DST-Newton Bhabha-NERC- India-UK Water Quality Research Programme

9. NIH/GWH/ DST/18-20	Impact of Rainwater Harvesting on Groundwater Quality in India with Specific Reference to Fluoride and Micro-pollutants	Anupma Sharma (Indian Lead), Sumant Kumar, Gopal Krishan, Suman Gurjar, M. K. Sharma <i>Other Indian Partners:</i> IIT Ropar, IIT Jodhpur <i>UK Partner:</i> Cranfield University School of Water, Energy and Environment; Cranfield University <i>Project Partners:</i> Wells for India and Excellent Development, UK based NGOs together with their Indian offices and local NGO partners in Rajasthan	3 years (01/18 - 12/20) <i>Status: In progress</i>	DST-Newton Bhabha-NERC- India-UK Water Quality Research Programme
10. NIH/GWH/ CEHM/18-22	Integrated Management of Water Resources for Quantity and Quality in Upper Yamuna Basin up to Delhi.	Anupma Sharma (PI) Sanjay K. Jain, Archana Sarkar, M. K. Sharma, L. N. Thakural, Sumant Kumar, Suman Gurjar, Vishal Singh, Nitesh Patidar <i>Partner Organization:</i> C.E, IWRD Haryana, Tech. Coord., GWD UP, S.E. YBO, CWC New Delhi	4 years (04/18-03/22) <i>Status: In progress</i>	Special Project under “Centre of Excellence” (NHP)
11. NIH/GWH/ DST/19-23	Enhancing Food and Water Security in Arid Region through Improved Understanding of Quantity, Quality and Management of Blue, Green and Grey Water	Anupma Sharma (Lead NIH), Nitesh Patidar (Lead: CAZRI Jodhpur, Partner: NIH)	4 years (03/19 - 02/23) <i>Status: In progress</i>	Sponsored by DST
12. NIH/GWH/ NMCG/19-20	Environmental Flow Assessment for Yamuna River from Hathnikund Barrage to Okhla Barrage	Anupma Sharma (PI), Sharad K. Jain, Manohar Arora, Pradeep Kumar, Rajesh Singh, Vishal Singh	1 year (04/19 - 03/20) <i>Status: In progress</i>	Sponsored by NMCG
13. NIH/GWH/ MoES/19-19	Improving our Understanding of the Aquifer Systems in Sunderbans	Gopal Krishan (PI), C. P. Kumar (Co-PI)	5 months (05/19 - 09/19) <i>Status: In progress</i>	Sponsored by India-UK Water Centre (MoES & NERC)
Other R & D Projects				
15.	Development of Groundwater Model for Integrated Hydrologic Model	Anupma Sharma, B Chakravorti, Surjeet Singh, Suman Gurjar, Sumant Kumar, Nitesh Patidar	3 years (08/18 -07/21) <i>Status: In progress</i>	CEHM, NHP

16.	DSS Planning & Management in Selected States	Anupma Sharma, D S Rathore and Team	6.5 years (06/19 -11/25) <i>Status: to start</i>	NHP
-----	--	-------------------------------------	--	-----

HYDROLOGICAL INVESTIGATIONS DIVISION

Dr Sudhir Kumar, Scientist-G and Head of the H. I. Division presented the brief details of the Division including the scientific staff strength and infrastructure. He briefly introduced about the scientific work of the Division and the various studies being carried by the Division including the new proposals, along with details about the publications by the Division and analytical work carried out at the Nuclear Hydrology Laboratory. He also made a brief presentation on Hydrology for Disaster management wherein the case study related to NIH involvement and hydrological investigation for the management of mining disaster in Meghalaya was presented.

Table 1: Status of studies carried out by HI Division during 2018-19

<i>Type of study/Project</i>	<i>Completed during 2018-19</i>	<i>Continuing in 2019-20</i>	<i>Total</i>
Internal Studies	-	-	-
Sponsored Projects	0	6	6
Consultancy Projects	5	4	9
Total	5	10	15

Table 2: Training Courses/Workshops organised by HI Division during 2018-19

S.N	Title of Training Course/Workshop	Duration	Venue
1.	Training Workshop on “Interpretation of Isotopic Data for Aquifer Mapping” for CGWB Officials	5 days 30 July-3 August, 2018	NIH Roorkee
2.	Training Workshop on “Interpretation of Isotopic Data for Aquifer Mapping” for CGWB Officials	5 days 27 th August to 31 st August, 2018	NIH Roorkee
3.	Training Workshop on “Environmental Isotopes for Climate Resiliency of Mountain Watersheds” Government Officials of Nepal.	5 days 22-26 October, 2018	NIH Roorkee
4	Training Workshop on “Coastal Zone Water resources: Challenges Investigation Techniques and Management”	11-15 February, 2019	NIH Roorkee

Table 3: Details of samples analysed by HI Division Labs during 2018-19

S.N.	Parameter analysed	No. of samples
1	$\delta^2\text{H}$ on DI-IRMS	6996
2	$\delta^{18}\text{O}$ on DI-IRMS	919
3	$\delta^{18}\text{O}$ on CF-IRMS	5653
4	Tritium	310
5	WQ samples on IC	950

Table 4: Details of Research Publications by HI Division during 2018-19

	Published	Accepted	Communicated
Books/Book Chapter	2	-	-
International Journals	8	4	8
National Journals	-	-	-
International Conferences	3	-	-
National Conferences	-	-	-

Table 5: Details of important instruments purchased by HI Division during 2018-19

S.N.	Name of Instruments	Approximate Cost
1	Normal Scintillation Counter	27 lakh
2	CHNS element analyser	47 lakh
3	DWLRs	5 lakh
4	WL Indicators	1.5 lakh

The progress of each individual study for the year 2018-19 was presented by the respective P.I. of the study. The comments/actions suggested by the working group for various studies are as follows:

INTERNAL STUDIES: Nil**SPONSORED PROJECTS:**

SN	Project	Duration	Funding	Status	Comments/ Action(s) Suggested
1.	Understanding of hydrological processes in Upper Ganga basin using isotopic techniques	5 Years (04/16-03/21)	NMSHE Project	Continuing Study	i) Dr. R. D. Deshpande suggested that isotopic signatures may be correlated with meteorological data. ii) Dr. R. D. Deshpande suggested that efforts be made to measure discharge of some springs.
2.	Rejuvenation of Springs and Spring-fed Streams in Mid-Himalayan Basin using Spring Sanctuary concept	3 Years (06/16 - 05/19)	Project with GBPIHE	Continuing Study	No specific action suggested
3.	Dating very old ground waters of deeper aquifers in Ganga Plains, India	3 Years (06/16 - 05/19)	IAEA	Continuing Study	No specific action suggested

4.	Chemical & Isotopic Characterization of Deep Aquifer Groundwater of Middle Ganga Basin	3 ½ year (1/18 – 6/21)	PDS under NHP	Continuing Study	No specific action suggested
5.	Integrated Study on groundwater dynamics in the coastal aquifers of West Bengal for sustainable groundwater management	3 ½ year (1/18 – 6/21)	PDS under NHP	Continuing Study	No specific action suggested
6.	Development of a comprehensive plan for conservation and sustainable management of Bhimtal and Naukuchiatal lakes, Uttarakhand	3 Years (1/18 – 12/20)	PDS under NHP	Continuing Study	No specific action suggested
7.	Climate resilient conservation & data management of spring water sources by strengthening monitoring mechanisms in drought prone areas of Sikkim	6 months (11/18-4/19)	Proposed to be funded by UNDP	Had to be dropped due to delay in approval	--

Besides the progress of the studies for 2018-19, two new studies proposed under the work programme of the Division for the year 2019-20 were presented by the respective PIs. The comments/actions suggested by the working group for these studies are as follows:

SN	Project	Duration	Funding	Status	Comments/ Action(s) Suggested
1.	Integrated hydrological investigations of natural springs in lesser Himalaya, Uttarakhand	3 years (04/10-03/22)	Internal	New	Director, NIH suggested to include Dr. S.S. Grewal in the project and involve more area from Siwalik region
2.	Isotope fingerprinting of precipitation over Indian Region	3 years (04/10-03/22)	Internal	New	Dr. Dimri suggested to include Odisha like Bhubaneswar and Shimla may be included for monitoring.

APPROVED WORK PROGRAMME FOR 2019-20

SN.	Project Title	Study Team	Duration	Remarks
INTERNAL STUDIES:				
1	Integrated hydrological investigations of natural water springs in lesser Himalaya, Uttarakhand	S M Pingale (PI), Sudhir Kumar, S. D. Khobragade, Soban Singh Rawat, Rajeev Gupta	3 years (04/19-03/22)	New Study
2	Isotope fingerprinting of precipitation over Indian Region	Nidhi Kalyani (PI) Sudhir Kumar, MS Rao; Scientists from RC's	3 years (04/19-03/22)	New Study
SPONSORED PROJECTS:				
1.	Understanding of hydrological processes in Upper Ganga basin by using isotopic techniques	Suhas Khobragade (PI), Sudhir Kumar, Rajesh Singh, M. Arora, R. J. Thayyen, S.K. Verma	5 Years (04/16-03/21)	Continuing Study under NMSHE Project
2.	Rejuvenation of Springs and Spring-fed Streams in Mid-Himalayan Basin using Spring Sanctuary concept	Sudhir Kumar (PI) S.K. Verma	3 Years (06/16 -05/19)	Continuing Study Project with GBPIHE
3.	Dating very old ground waters of deeper aquifers in Ganga Plains, India	MSRao (PI) Sudhir Kumar, S.K. Verma	3 Years (06/16 -05/19) Extended till Dec. 2021	Continuing Study IAEA under CRP
4.	Chemical & Isotopic Characterization of Deep Aquifer Groundwater of Middle Ganga Basin	Sudhir Kumar (PI) M.K. Sharma, M. Someshwar Rao, S.K. Verma	3 ½ year (1/18 – 6/21)	Continuing Study PDS under NHP
5.	Integrated Study on groundwater dynamics in the coastal aquifers of West Bengal for sustainable groundwater management	M. Someshwar (PI), Sudhir Kumar, S.K. Verma, Nidhi Kalyani, V. S. Jeyakanthan	3 ½year (1/18 – 6/21)	Continuing Study PDS under NHP
6.	Development of a comprehensive plan for conservation and sustainable management of Bhimtal and Naukuchiatal lakes, Uttarakhand	Suhas Khobragade, Sudhir Kumar	3 Years (1/18 – 12/20)	Continuing Study PDS under NHP

7.	Unravelling Submarine Discharge (SGD) zones along the Indian subcontinent and its islands (Mission SGD) – Pilot Study	Sudhir Kumar, MS Rao, Nidhi Kalyani BK Purandra YRS Rao	1 year (04/19 – 03/20)	MoES through NCESS
----	---	--	---------------------------	-----------------------

SURFACE WATER HYDROLOGY DIVISION

WORK PROGRAMME FOR THE YEAR 2019-20

ONGOING STUDIES (SPONSORED)			
S. No. & Ref. Code	Title	Study Team	Duration
1.NIH/SWHD/17-20	Water efficient Irrigation by using SCADA system for medium irrigation Project (MIP) Shahnehar (PDS-NHP).	R.P. Pandey J.P. Patra Rajesh Singh N.K. Bhatnagar	3 years (Dec 2017 to Dec 2020)
2.NIH/SWHD/16-21	Hydrological modeling in Alaknanda basin and assessment of climate change impact (NMSHE).	A.K. Lohani Sanjay K. Jain Archana Sarkar V.S. Jeyakanthan L.N. Thakural	5 years (April 2016 to March 2021)
ONGOING STUDIES (INTERNAL)			
S. No. & Ref. Code	Title	Study Team	Duration
3.NIH/SWHD/17-21	Development of regional relationships for water availability analysis and flood estimation for lower Godavari basin (3f)	Sanjay Kumar Rakesh Kumar J.P. Patra Pankaj Mani	4 years (April 2017 to March 2021)
4.NIH/SWHD/15-19	Study of hydrological changes in selected watersheds in view of climate change in India	L.N. Thakural D.S. Rathore Surjeet Singh Sanjay K. Jain Sharad K. Jain	4 years (April 2015 to March 2019) extended up to March 2020
5.NIH/SWHD/17-20	Development of regional methods for design flood estimation in Uttarakhand	J.P. Patra Rakesh Kumar Pankaj Mani Sanjay Kumar	3 years (April 2017 to March 2020)
6.NIH/SWHD/18-21	Evaluation of seasonal extreme rain events across river basins of India in 3D global temperature change scenario	Ashwini Ranade Archana Sarkar	3 years (April 2018 to March 2021)
7.NIH/SWHD/18-20	Assessment of climate change impact on water availability and agriculture in part of Banas basin.	Archana Sarkar Surjeet Singh Suman Gurjar Sunil Gurrapu	2 years (Nov 2018 to October 2020)

8.NIH/SWHD/18-21	Evaluation of the influence of low- frequency atmosphere-ocean oscillations on annual floods in the watersheds of the Indian subcontinent.	Sunil Gurrapu Ashwini Ranade J.P. Patra	3 years (Nov 2018 to March 2021)
9.NIH/SWHD/18-20	Evaluation of water quality of Government schools in Roorkee block, District Haridwar	N.K. Bhatnagar M.K. Sharma L.N. Thakural	2 years (Oct 2018 to Sept. 2020)

NEW STUDIES (INTERNAL)

S. No. & Ref. Code	Title	Study Team	Duration
10.NIH/SWHD/19-22	Development of drought monitoring system for early warning and preparedness for a selected region in India	R.P. Pandey, D.S.Rathore, Ravi Galkate, Sunil Gurrapu	Proposal to be revised based on comments in the 48 th Working Group meeting

S.N.	Title of Project/ Study, Study Group, Start/ Completion Dates	Status and Recommendations/Suggestions
SPONSORED STUDIES		
1.	<p>Water efficient irrigation by using SCADA system for medium irrigation project (MIP) Shahnehar (Ongoing) PDS under NHP.</p> <p>StudyGroup:</p> <p>R.P. Pandey J. P. Patra Rajesh Singh N.K. Bhatnagar</p> <p>DOS: Dec. 2017 DOC: Dec. 2020</p>	<p>Dr. R.P. Pandey (PI) presented progress of the study. He informed that the NIH team has conducted field investigations in the Shahnehar command area and three experimental sites identified as follows: (i) Lift Irrigation Scheme (LIS) at Sathana Vilage, Terrac Sub-Division, (ii) field plots in distributary-1 (D-1) command area – at Riyali village, Badukhar Sub-Division and (iii) distributary-2 (D-2) command area- at Kathghar village.</p> <p>Dr Man Singh suggested to consider suitable optimum size of furrow length or check basin in field water application. Dr. Amrish Tiwari, IISWC, suggested to monitor flows in canal system for precise assessment and quantification of losses. Dr SS Grewal informed that the land leveling and shaping is one of the very important components in irrigation water saving. Therefore, the farmers should be convinced level their fields to improve irrigation water use efficiencies. It was informed that the conveyance system in Shahnehar command areas are lined have high conveyance efficiency.</p>

2.	<p>Hydrological modeling in Alaknanda basin and assessment of climate change impact (Ongoing).</p> <p>Study Group: A.K. Lohani Sanjay K. Jain Archana Sarkar V.S. Jeyakanthan L.N. Thakural DOS: Jan. 2016 DOC: Dec. 2020</p>	<p>Dr A.K. Lohani presented the progress of the study. He informed that all the required spatial and temporal data for the study have been prepared. Flow data of various gauging sites and meteorological data have been collected from CWC, and processing of the data is in progress. VIC model has been setup for the study basin and calibration and fine-tuning of the model with the available data is in progress. He mentioned that the climate projection data are required to project impact of climate change on river flow. Projection data is to be generated through another NMSHE study and utilized.</p>
----	--	---

INTERNAL STUDIES		
-------------------------	--	--

3.	<p>Development of regional relationships for water availability analysis and flood estimation for lower Godavari basin (3f) (Ongoing).</p> <p>Study Group: Sanjay Kumar Rakesh Kumar J. P. Patra Pankaj Mani DOS: April 2017 DOC: March 2021</p>	<p>Dr. Sanjay Kumar presented the study and stated that the study specifically focuses on developing design flood estimation methods for ungauged regions based on the concept of regionalization using L-moments approach. He stated that at site frequency analysis based on L-moments approach for eleven sites (for GEV distribution) has been completed. The results of NAM model calibration for one sub-basin and its applicability in other (ungauged) sub-basins using calibrated NAM parameters were also reported based on the use of IMD gridded rainfall data. Limitation of using gridded rainfall data in the un-gauged basins was highlighted. Chairman suggested to examine the use of area weighted NAM parameters in un-gauged basins for possible improvements.</p>
----	--	---

4.	<p>Study of hydrological changes in selected watersheds in view of climate change in India (Ongoing).</p> <p>Study Group: L.N. Thakural S. Rathore Surjeet Singh Sanjay Kumar Jain Shard Kumar Jain DOS: April 2015 DOC: March 2020</p>	<p>Dr. Thakural presented the GIS database created to meet out the objectives of the study using Digital Elevation Model (DEM) and satellite imagery for flow accumulation, stream network, watershed boundary, Land use/Land cover thematic maps in addition to soil map for the four watersheds. Spatio-temporal analysis of hydro-meteorological data using parametric and non-parametric approaches for the Ramganga, Bina and Chaliyar river basins were also presented. The outcomes/results of hydrological models (NAM and SWAT) were presented.</p> <p>To study the impact of climate change, gridded rainfall and temperature data, historical NCEP/NCAR reanalysis data (observed predictors) and GCM Predictor grid boxes for the four river basins processed to generate RCP2.6 RCP 4.5, RCP 6 and RCP 8.5 using statistical downscaling model (SDSM) were presented. The model calibration and validation for the rainfall and temperature using NCEP reanalysis data for the RCP 2.6, 4.5, 8.5 were also presented.</p> <p>Members inquired about the gridded data being used. Dr. Thakural mentioned that these data were obtained from various national and international sources available in public domain. Dr. Thakural also requested to allow extension of one year for the study to further investigate the impact of climate change which was agreed.</p>
----	---	---

5.	<p>Development of regional methods for design flood estimation in Uttarakhand (Ongoing).</p> <p>Study Group: J.P. Patra Rakesh Kumar Pankaj Mani Sanjay Kumar</p> <p>DOS: April 2017 DOC: March 2020</p>	<p>Mr. Jagadish Prasad Patra, presented the objectives and need of the study with brief methodology. The progress made for at-site flood frequency analysis using L-moments approach for annual maximum peak flood series data obtained from CWC were presented. The relationships developed to estimate design flood for various return periods with catchment area were also presented. The progress made in Nonstationary Extreme Value Analysis considering the aspect of non-stationary in the data series was presented for one of the sites. The effect of Tehri dam operation for moderation of flood peaks at Rishikesh, Haridwar etc. as well as the hypothetical dam at Alaknanda river were explained.</p>
6.	<p>Evaluation of seasonal extreme rain events across river basins of India in 3D global temperature change scenario (Ongoing).</p> <p>Study Group: Ashwini Ranade Archana Sarkar</p> <p>DOS: April 2018 DOC: March 2021</p>	<p>Dr. Ashwini Ranade presented important results from the first objective. Working Group noted the work on updation of eleven major and nine independent minor river basin rainfall series and the results obtained from trend analysis for understanding the recent changes in rainfall pattern across India.</p>
7.	<p>Assessment of Climate Change Impact on Water Availability and Agriculture in part of Banas basin.</p> <p>Study Group: Archana Sarkar Surjeet Singh Suman Gurjar Sunil Gurrapu</p> <p>DOS: Dec. 2018 DOC: Dec. 2020</p>	<p>Dr Archana Sarkar presented the background and objectives of the study. She informed that the Banas river basin up to Bisalpur dam and the irrigation command are located in the State of Rajasthan in western India has been selected as the study area. Trend analysis of the historical & future patterns of rainfall and temperature time series in Banas basin and command area is being carried out using modified Mann-Kendall's technique and Sen's Slope method and presented the preliminary results. The future time series data is being taken from the GCM downscaled data of the Copernicus website which consists of data of 19 GCMs under two RCPs (RCP4.5 & RCP 8.5).</p> <p>Dr R.K. Goyal advised not to use the CROPWAT software due to huge data requirements and use simple methods for the same. Dr. S.S. Grewal advised to carry out the trend analysis of rainfall events producing runoff using historical data of rainfall.</p>
8.	<p>Evaluation of the influence of low-frequency-atmosphere-ocean oscillations on annual floods in the watersheds of the Indian subcontinent.</p> <p>Study Group: Sunil Gurrapu Ashwini Ranade J.P. Patra</p> <p>DOS: Dec. 2018 DOC: Dec. 2021</p>	<p>Mr. Sunil Gurrapu, Scientist C and PI of the study was on official tour, hence Mr. Jagadish Prasad Patra, presented the progress of the study and explained that the Narmada basin and Godavari basin are identified for evaluating influence of various low-frequency atmosphere-ocean oscillations on flood magnitude and frequency. It was informed that the data of 31 gauging sites have been collected and PDO indices, Southern Oscillation Index (SOI), Dipole Mode Index (DMI), etc. are being collected from various international agencies. During the presentation, committee members suggested to include name of the basin in the title of the study.</p>
9.	<p>Evaluation of Water Quality of Government Schools in Roorkee Block, District Haridwar.</p> <p>Study Group: N. K. Bhatnagar</p>	<p>Sri NK Bhatnagar presented the objectives of the study and progress. Dr Ramakar Jha inquired whether sampling could be done on weekly instead of pre-monsoon and post-monsoon basis as it is being done in CGWB. Dr. Mukesh Sharma replied that water quality sampling is done during pre and post-monsoon only. Dr.</p>

M. K. Sharma L. N. Thakural Reena Rathore DOS: Dec. 2018 DOC: Dec. 2020	Sudheendra Sharma inquired whether water samples are collected from hand pumps of Schools. It was informed that the samples will be collected as suggested by the Working Group members.
---	--

NEW STUDIES(INTERNAL)	
------------------------------	--

10.	Development of drought monitoring system for early warning and preparedness for a selected region in India Study Group: R.P. Pandey D.S. Rathore Ravi Galkate Sunil Gurrapu Suman Gurjar DOS: May 2019 DOC: March 2022	Dr. R.P. Pandey informed that the primary purpose of the proposed project is to develop a scientific tool for regular drought monitoring and early warning system (EWS) for preparedness in drought affected Bundelkhand region. Chairman WG suggested to recast some the objectives of the study. Accordingly, objectives of the study have been revised as: <ol style="list-style-type: none"> 1. Identification and evaluation of key hydro-meteorological indicators/indices for monitoring and assessment of drought and severe water scarcity condition. 2. Development of base maps showing demarcation of areas vulnerable to drought using physiographic, climatic and social factors including demarcation of rainfed and irrigated areas. 3. Development of systematic database setup and computation programs for different drought indices/techniques. 4. Development of composite program and dashboard with menu driven generic system for various drought indicators/ indices linked with common data base. 5. Customization of drought monitoring system for district/sub-district level assessment. 6. Evaluation and result verification with field observations. 7. Hosting of the EWS/drought monitoring system on the NIH website. Dr Dimri suggested to explore possibility to include soil heat flux index as one of the early warning indicator. Dr S.P. Agrawal suggested to contact MNCFC and NRSC to obtain input and support for the proposed monitoring and early warning system. Dr Man Singh informed that IARI is working with the University of Nabraska, USA to develop a composite index for drought monitoring. He suggested to share the proposal with him for providing suitable inputs. Director, NIH suggested to send the proposal to IARI seeking comments and input for the proposed study, and to include Dr. T. Thomas, Sc D, RC Bhopal in the study team.
-----	---	---

WATER RESOURCES SYSTEMS DIVISION

SUGGESTION/ COMMENTS RECEIVED FROM MEMBERS DURING 48th WORKING GROUP MEETING

Dr. Sanjay K Jain, Sc. G and Head, presented an overview of the division – scientific strength, the ongoing studies, sponsored & consultancy studies, technical publications and training courses organized. Thereafter scientists of the division presented their studies. Following are the comments received from working group on the presentations of the various studies:

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

1. Catchment scale evaluation of cold-arid cryospheric system Hydrology, Ganglass catchment, Ladakh (Completed)

RJT presented this completed project which established the characteristics of the Himalayan permafrost for the first time. He elaborated on the field monitoring of GST in the Ganglass catchment Ladakh and modelling of soil temperature upto 10m using the measured GST distributed at 12 plots between 4727 - 5610 m a.s.l. Core permafrost characteristics such as Surface offset, thermal offset, active layer thickness variations, Mean Annual Ait Temperature (MAAT) are discussed. He has shown that the site at 4727 m a.s.l. did not show the permafrost signatures while the site at 4900 m a.s.l. has strong permafrost presence. Active layer thickness in the catchment vary between 4.3 m to 0.3 cm at higher elevation regions. The spatial distribution of permafrost is assessed by regression models and suggest around 95% permafrost cover in the catchment. RJT acknowledged the collaboration and assistance with Carleton University, Ottawa, Canada and ICIMOD, Nepal.

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

1. Hydrological Processes and Characterization of Lesser Himalayan Catchments (Ongoing)

The progress of the study was presented by MKN. It was informed that all proposed instrumentation have been installed in the experimental catchment and data is being received at NIH, Roorkee. Soil monitoring station (COSMOS) has also been established at project site. Analysis and time series graphs of few of the meteorological, hydrological and lithological variable were presented. The results of the evapotranspiration (ET) estimated by Eddy-covariance (EC) flux tower were compared with the ET estimates by Penman-Monteith method.

PI: Deepa Chalisgaonkar, Scientist “G”

1. Development of window based software for hydrological data processing and Unit Hydrograph Analysis (Ongoing)

Mrs. Deepa presented the progress of the project. She informed that a user friendly software in vb.net platform has been developed for hydrological data processing and unit hydrograph analysis for the estimation of flood for gauged as well as ungauged catchments of small and medium size catchments. Online help for the software is available and the package is capable of displaying the results in tabular and/or graphical form.

2. Development of window based software for Flood Estimation (New)

Mrs Deepa presented the proposed study. She informed that this software will be used for the flood estimation of large catchments. At the later stage, the unit hydrograph package can be merged into this

package so that a comprehensive software for flood estimation and small, medium and large catchments will be developed.

PI: Dr. P. K. Singh (PKS), Scientist “D”

1. Developments of Water Accounts for Subarnarekha Basin Using Water Accounting Plus (WA+) Framework (Ongoing)

PKS presented the ongoing study and relevance of global data used in WA+ as input, before presenting the results on Sheet 2 and Sheet 3 on evapotranspiration from the basin and land and water productivity respectively. He also discussed on the data biasness in global rainfall data particularly CHIRPS and TRMM products w.r.t the IMD rainfall data. Dr. R. K. Goyal from CAZRI desired to organize a training programme as well as execute a research project work on WA+ for the basins of Rajasthan with the scientists from NIH. Dr. Ambrish Kumar, Principal Scientists, IISWC, Dehradun also evinced his interest to deliver lectures on WA+ at IISWC for which he will soon communicate.

PI: Dr. Vishal Singh (VS), Scientist “C”

1. Real time flood modelling using HEC-RTS modelling framework (Ongoing)

VS presented study on Real time flood modelling using HEC-RTS framework in Periyar river basin. He briefly presented the different components under HEC-RTS. He also shared the preliminary findings of flood modelling. Few members suggested the following:

- Use of different rainfall dataset which has less bias.
- Use of WRF model for the prediction of more accurate rainfalls for the flood event.
- Revisiting the reservoir rules for Mullaperiyar dam.
- Use of High resolution DEM for flood inundation modeling and mapping the flood extent.

PI: D. S. Rathore, Scientist “F”

1. Design and development of DSS (H) platform for Neeranchal National Watershed Project (Ongoing)

The study was not presented since it was dropped by the sponsoring agency.

2. Investigating water stress using hydro-meteorological and remote sensing data (Ongoing study under NHP-PDS)

Mr D.S. Rathore informed that various data e.g. precipitation, and groundwater level data, technical reports etc. were collected from Water Resources Department and State Groundwater Board. The validation of the data is in progress. Missing daily precipitation data were observed and gap filling will be carried out. Declining trend in groundwater was observed in both pre and post groundwater levels. For last 15- 20 years, several wells and piezometers remain dry in summer. Nearly 2.5 MCM storage is created by small and medium size water harvesting structures in the basin. Procurement of equipment namely soil moisture profile probe and digital tipping bucket raingauge with datalogger is initiated. Satellite data products were browsed for initiating their purchase. R script was written for data filling using linear/ multiple linear regression technique. For spatio- temporal analysis, bfastspatial R-package was selected and was applied to sample data.

PI: Dr. M. Arora (MA), Scientist “D”

1. Modeling of Gangotri Glacier melt runoff and simulation of stream flow variation under different climate scenarios (Ongoing study)

MA presented the progress of the study. No specific comments were received from the members.

PI: Dr. M. K. Goel (MKG), Scientist “G”

1. Study title: National Mission for Sustaining the Himalayan Ecosystem (NMSHE) (Ongoing)

MKG initiated the combined presentation on NMSHE sub-projects where-in six presentations for six sub-projects of NMSHE (in which Scientists of WRS Division are involved) were made.

Sub-project – 1: Development of a project website and hydrological database in Upper Ganga Basin (PI-Dr. M. K. Goel, Sc-G)

No specific comments were received from the members.

Sub-project – 2: Real-time snow cover information system for Upper Ganga basin (PI-Mr. D. S. Rathore, Sc-F)

The study was presented by Dr. M.K. Goel. It was informed that post processing procedure (with altitude mask and temporal filter) was implemented in R-software as a semi-automated method. The method was applied to Upper Ganga and Subansiri and adjoining basins. The script will further be modified to calculate zone wise area. Dr S.P Aggarwal inquired whether topographic aspect was considered in applying the altitude based masking in post processing. Mr. Rathore replied that aspect was not considered in this post processing procedure of altitude mask. Present method will provide initial snow cover estimates and will be useful as an input in hydrological models.

Sub-project – 3: Glacial Lakes & Glacial Lake Outburst Flood (GLOF) in Western Himalayan Region (PI-Dr. Sanjay K. Jain, Sc-G)

No specific comments were received from members.

Sub-project – 4: Assessment of downstream impact of Gangotri glacier system at Dabrani and future runoff variations under climate change scenarios (PI-Dr. Renoj J. Thayyen, Sc-D)

No specific comments were received from members.

Sub-project – 5: Observation and modelling of various hydrological processes in a small watershed in Upper Ganga basin (PI-Dr. Sharad K. Jain, Sc-G)

No specific comments were received from members.

Sub-project – 11: Water Census and Hotspot analysis in selected villages in Upper Ganga basin (PI-Dr. P. K. Mishra, Sc-C)

No specific comments were received from members.

WORK PROGRAMME FOR THE YEAR 2019-2020

SN	Title	Study Team	Duration	Funding (Rs. in Lakhs)
Ongoing Internal Studies				
1.	Hydrological process and characterization of Lesser Himalayan Catchments	M. K. Nema Sharad K. Jain, Sanjay K. Jain, Renoj J.Thayyen, P. K. Mishra	5 years (12/14-12/19)	
2.	Developments of Water Accounts for Subarnarekha Basin Using Water Accounting Plus (WA+) Framework	P. K. Singh P. K. Mishra, M. K. Goel, Suman Gurjar	2 years 2018-2020	
3.	Real time flood modelling using HEC-RTS framework	Vishal Kumar A. K. Lohani, Sanjay K. Jain	2 years 2018-2020	
Ongoing Sponsored Studies				
1.	Development of a project website	M. K. Goel	5 years	DST

	and hydrological database in Upper Ganga Basin (Sub-project – 1)	M. Arora, A. K. Lohani, D. S. Rathore, D. Chalisgaonkar, P. Mani, P. K. Mishra	(01/16-12/20)	(52.15)
2.	Real-time snow cover information system for Upper Ganga basin (Sub-project – 2)	D. S. Rathore D. Chalisgaonkar, V. S. Jeyakanthan, L. N. Thakural	5 years (01/16-12/20)	DST (48.83)
3.	Glacial Lakes & Glacial Lake Outburst Flood (GLOF) in Western Himalayan Region (Sub-project – 3)	Sanjay K. Jain A. K. Lohani, Sudhir Kumar, P. Thakur (IIRS)	5 years (01/16-12/20)	DST (36.79)
4.	Assessment of downstream impact of Gangotri glacier system at Dabrani and future runoff variations under climate change scenarios (Sub-project – 4)	Renoj J.Thayyen Sanjay K. Jain, Sharad K. Jain, P. K. Mishra, M. Arora, AP Dimri (JNU)	5 years (01/16-12/20)	DST 51.43 (NIH) + 28.29 (JNU)
5.	Observation and modelling of various hydrological processes in a small watershed in Upper Ganga basin (Sub-project – 5)	Sharad K. Jain Renoj J.Thayyen, Sanjay K. Jain, Surjeet Singh, M. K. Nema , P. K. Mishra, P. K. Agarwal, AP Dimri (JNU)	5 years (01/16-12/20)	DST (54.07)
6.	Water Census and Hotspot analysis in selected villages in Upper Ganga basin (Sub-project – 11)	P. K. Mishra M. K. Nema, Renoj J. Thayyen, P. K. Sachan	5 years (01/16-12/20)	DST (90.99)
7.	Dynamics of Himalayan Ecosystem and its impact under changing climate scenario-Western Himalaya	Renoj J.Thayyen P. K. Mishra	3 years (03/17-03/19)	NMHS-MoEF (58.76 lakh)
8.	Measurements and Modeling of Evapotranspiration and other Hydrological Processes in Lesser Himalayas	M K Nema Renoj J. Thayyen, Sharad K. Jain, Sanjay K. Jain, P. K. Mishra, AP Dimri (JNU)	3 years (2016-19)	MOES (Rs. 98 Lakh)
9.	Sustaining Himalayan Water Resources in a Changing Climate (SusHi-Wat)	Sanjay K. Jain (PI) Sharad K. Jain CSP Ojha (PI, IITR)	3 years (2016-2019)	MOES-NERC, Newton- Bhabha project (11.59 Lakh)
10.	Investigating Water Stress using Hydro-meteorological and Remote Sensing data	D. S. Rathore L. N. Thakural, Sanjay Kumar, B. Venkatesh, M. K. Jose, T. Chandramohan	3 years 2017-2020	PDS under NHP
11.	Seasonal Characterization of Gangotri Glacier melt runoff and simulation of streamflow variation under different climate scenarios	M. Arora Deepak Singh Bisht, Sanjay K. Jain	3 years 2018-2021	NIH
New Internal Studies				
1	Development of windows based software for Flood Estimation	D. Chalisgaonkar A. K. Lohani, M. K. Goel	1 year (04/19-03/20)	

RESEARCH MANAGEMENT AND OUTREACH DIVISION (RMOD)

SN	Title of Project/Study, Study Team	Status and Recommendations/Suggestions
1.	<p>Study on effect of climate change on sediment yield to Pong reservoir. Team: A. R. Senthil kumar, J. V. Tyagi, S. D. Khobragade and Manohar Arora DOS: Apr 2015, DOC: June 2019</p>	<p>Dr Senthil kumar (PI) presented the discharge and sediment yield at Nadaun Brdige (Pong reservoir) simulated using SWAT with data from ERA INTERIM. The downscaling of rainfall, maximum and minmum temperature for the sceanrios RCP2.6, 4.5 and 8.5 were carried using SDSM from CanESM2 using IMD gridded data from 1961 to 2005 and bias corrected by the probability of exceedence method. The discharge and sediment yield were simulated using IMD data of rainfall, maximum and minimum temperature for data from 1987 to 2005. The discharge was well simulated but sediment yield was poorly simulated. Prof Dimri suggested to find reason behind poor simulation of sediment yield and if not improved, the same may be reported in final report. The Chairman suggested all team members to try to fix the problem and complete the study by June 2019.</p>
2.	<p>Bathymetric survey and water quality monitoring of selected ponds in Bundelkhand region for development of water management plan. Team: Digambar Singh, Omkar Singh, Subhash Kichlu, Rajesh Kumar Nema, Hukum Singh and N R Allaka DOS: Apr 2018, DOC: March 2020</p>	<p>The study could not be presented due to paucity of time.</p>
3.	<p>Conservation of ponds in Ibrahimpur- Masahi Village and performance evaluation of natural treatment system Team: Omkar Singh, V C Goyal, Rajesh Singh, Digambar Singh, Subhash Kichlu, Rajesh Agarwal, Rakesh Goel & N R Allaka Partern Organization: Prof. Laurence Carvalho & Team, Centre for Ecology & Hydrology (UK). DOS: Apr 2018, DOC: March 2020</p>	<p>Sh. Omkar Singh (PI) infomed that weekly/ quarterly water and wastewater sampling is going on from both ponds (CW-NTS pond at Ibrahimpur Masahi and control pond at Masahi Kala). CEH-UK team is also visiting periodically to collect samples from the both ponds and providing data on GHG emissions and biota. Dr. Sadhana Malhotra desired to know about maintenance of CW-NTS at village pond. The PI & Co-PI replied their queries.</p>
4.	<p>Vulnerability Assessment to Climate Change in Chhattisgarh Team: Dr Jyoti P Patil, Scientist C and Ms Meeta Gupta, JRF DOS: July 2017, DOC: June 2019</p>	<p>This study was taken up under NNWP but is now converted to internal study due to closure of NNWP. Accordingly, title of the study is also changed. The objectives, brief methodology and results of the study were presented by Dr Jyoti Patil. The scheduled date of completion of this study is June 30, 2019 and analysis for two districts in Chhattisgarh is completed.</p>
5.	<p>Hydrological modelling in Bhagirathi</p>	<p>Dr. Senthil kumar (PI) mentioned that the discharge</p>

	basin up to Tehri dam and assessment of climate change impact Team: A R Senthil kumar, J. V. Tyagi, M. K. Goel, S. D. Khobragade, P. C. Nayak, Manohar Arora and Digambar Singh DOS: July 2016, DOC: June 2021 (NMSHE)	and sediment yield at Tehri dam was simulated using SWAT by considering the parameters randomly initially and input data obtained/generated from different sources. The discharge was simulated fairly good and the sediment yield was poorly simulated. The Chairman suggested to discuss with team members to sort out the problem.
6.	Development of water allocation plan of watershed in Kanker district, Chhattisgarh Team: A. R. Senthil kumar, Jyoti P Patil, T R Nayak and Rajesh Agarwal DOS: Apr 2018, DOC: March 2020	Dr. A. R. Senthil kumar (PI) mentioned that the WEAP model was setup for micro watersheds IWMP14 and IWMP15 of Kanker Districts Chhattisgarh. Results such as water demand, runoff generated, demand site inflows and outflows, unmet demand, reliability of demand met were presented for the base period (2015). The same output for reference period from 2016 to 2050 were being extracted from the results.
7	Rejuvenation of village ponds for identified villages in Muzaffarnagar and Meerut districts Investigators: V C Goyal, Omkar Singh, Rajesh Singh, Digambar Singh Scientific/Technical Staff: Subhash Kichlu, Rajesh Agarwal, Rakesh Goel, N. R. Allaka DOS: April 2017, DOC: March 2020	The technical progress of the study was presented by Er. Omkar Singh, Sc. F. The status regarding onsite rejuvenation work of 12 ponds as carried out by the NPCC, which is in an advanced stage, was also presented.
8	Rejuvenation of Village Ponds in Identified Villages of Baghpat, Ghaziabad and Meerut Districts of Uttar Pradesh Investigators: Omkar Singh, Rajesh Singh, V. C. Goyal, Digambar Singh Scientific/Technical Staff: Subhash Kichlu, Rajesh Agarwal, Rakesh Goel, N. R. Allaka DOS: Jan. 2018, DOC: Dec. 2020	The technical progress of the study was presented by Er. Omkar Singh, Sc. F. The status regarding onsite rejuvenation work of 9 ponds as carried out by the NPCC, which is in the advanced stage was also presented. There were no specific comments from working group members.
9	Innovation Centre for Eco-Prudent Wastewater Solutions (IC-EcoWS) Team: V.C. Goyal (PI) Partners: NIH, NIT-Jaipur, IIT-Bombay, IRMA-Ahmedabad DOS: Apr 2019, DOC: Mar 2024	The overview of the project was given by Dr. V. C. Goyal, Sc. G & Head (PI). The PI informed that an Inception cum-Need Assessment workshop is scheduled during 24-25 June 2019 at NIH Roorkee

WORK PROGRAMME FOR THE YEAR 2019-20

SN	Title of Project/Study	Funding	Study Team	Duration	Status
Internal Study					
1	Study on effect of climate change on sediment yield to Pong reservoir	NIH	A R Senthil kumar (PI) J V Tyagi, S D Khobragade ,	Apr 2015- Mar 2018 (extended up	On-going

			Manohar Arora	to June 2019)	
2	Bathymetric survey of identified ponds in the districts of Muzaffarnagar, Meerut, Ghaziabad and Baghpat (UP) for development of water management plan	NIH	Digambar Singh (PI) Omkar Singh Rajesh K.Nema Hukam Singh N R Allaka	Apr 2018- Mar 2020	On-going
3	Conservation of ponds in Ibrahimpur- Masahi Village and performance evaluation of natural treatment system	NIH,CEH (UK)	NIH: Omkar Singh (PI) V C Goyal, Rajesh Singh, Digambar Singh, Subhash Kichlu, Rajesh Agrawal, Rakesh Goel, NR Allaka CEH-UK: Prof. Laurence Carvalho & Team	Apr 2018- Mar 2020	On-going
4	Development of DSS for Watershed Hydrology	NIH	V C Goyal (PI) Jyoti Patil, Rohit Sambare	May 2019- Aug 2019	New
Sponsored Projects					
1	Vulnerability assessment of identified watersheds in Chhatisgarh	NNWP (under NIH scheme)	Jyoti P Patil (PI)	Jul 2017- Jun 2019	On-going
2	Hydrological modelling in Bhagirathi basin up to Tehri dam and assessment of climate change impact	DST (under NMSHE)	A R Senthil kumar (PI) J. V. Tyagi, M. K. Goel, S. D. Khobragade, P. C. Nayak, Manohar Arora	Mar 2016- Mar 2021	On-going
3	Rejuvenation of village ponds for identified villages in Muzaffarnagar and Meerut districts of UP	MoWR-funded project-Through INCSW	V C Goyal (PI) Omkar Singh, Digambar Singh, Rajesh Singh, Subhash Kichlu, Rajesh Agrawal, Rakesh Goel, NR Allaka	Apr 2017- Mar 2020	On-going
4	Rejuvenation of village ponds in identified villages of Baghpat, Ghaziabad and Meerut districts of Uttar Pradesh	MoWR-funded project (through Scheme funds)	Omkar Singh (PI), Rajesh Singh, V C Goyal, Digambar Singh, Subhash Kichlu, Rajesh Agrawal, Rakesh Goel, NR Allaka	Apr 2017- Mar 2020	On-going
5	Development of water allocation plan for identified watersheds in Kanker district (Chhattisgarh)	NNWP (under Scheme funds)	A R Senthil kumar (PI) T R Nayak, Jyoti P Patil, Rajesh Agarwal	Apr 2018- Mar 2020	On-going
New Sponsored Project					
6	Innovation Centre for Eco-Prudent Wastewater Solutions (IC-EcoWS)- establishment and operation of 'Live Laboratory' in	DST (GoI), Cost: Rs. 5.1 Crore	Partners: NIH, MNIT-Jaipur, IIT-Bombay, IRMA-Ahmedabad V.C. Goyal (PI), Omkar	Jun 2019-Mar 2024	New Project

	a rural setting near Roorkee		Singh, Rajesh Singh, Rohit Sambare		
--	------------------------------	--	---------------------------------------	--	--

Proposed Trainings/Workshop/Activities:

S.No.	Name of activity	Funding	Team/Div.	Period	Venue
1	Inception cum-Need Assessment of IC-EcoWS Project	DST (GoI)	V.C. Goyal (PI), Omkar Singh, Jyoti Patil, Rajesh Singh, Rohit Sambare	24-25 Jun, 2019	NIH Roorkee/MNIT Jaipur
2	Networking Project on Rejuvenation of Ponds-Review Meeting	DST (GoI)	T. Thomas (PI), Jyoti Patil	14-15 Jun, 2019	NIH Roorkee
3	National Workshop on Scientometrics	NIH	V C Goyal (PI), Archana Sarkar, Rohit Sambare, Furqan Ullah, Charu Mishra	Feb 2020	NIH Roorkee

Expected Outreach Activities:

S.No.	Name of activity	Funding	Team/Div.	Period	Venue
1	India Water Week	NIH	RMOD	24-28 Sep 2019	Vigyan Bhawan, New Delhi
2	India International Trade Fair	NIH	RMOD	14-27 Nov 2019	New Delhi
3	Indian Science Congress	NIH	RMOD	3-7 Jan 2020	UAS, Bangalore
4	Any other Outreach activity on demand/assigned	NIH	RMOD		

List of activities proposed under INC-IHP during 2019-20

Meetings to be organised/ attended

1. Meeting of INC-IHP, during May/June 2019, after obtaining approval on re-constitution of committee from the Ministry
2. 24th session of the InterGovernmental Council (IGC) of the International Hydrological Programme of UNESCO, Paris, France
3. 27th meeting of the IHP Regional Steering Committee for Asia and the Pacific, to be held at Myanmar in 2019
4. Participation in Asian GWADI meeting
5. Participation of Indian nominees in various UNESCO meetings

Thematic Trainings:

1. Training course on 'Water Security Assessment' during July 2019 (Location: New Delhi/ Roorkee)
2. Training course on 'Water Education- Key for Water Security' during March 2020 (Location: New Delhi/ Roorkee)

Brainstorming sessions/ exhibitions during conferences/ summits

Sl. No.	INC-IHP proposed event	Conference/ Summit	Host Organisation	Location	Date
1.	Exhibition on R&D in Hydrology, Wastewater treatment	3 rd World Water Summit 2019	Energy and Environment foundation	New Delhi	21-23 Aug, 2019
2.	Brainstorming session on Theme-V 'Ecohydrology-Engineering Harmony for a Sustainable World'	Water future Conference	IISc, Bengaluru	Bengaluru	24-27 Sep, 2019
3.	Session on 'Enhancing sustainable groundwater resources management'	8 th Int. Groundwater Conference on Sustainable Management of Soil-Water Resources	IIT-Roorkee	Roorkee	21-24 Oct, 2019
4.	Theme- Water-related Disasters and Hydrological Changes	Int. Conf. on Soil and Water Resources Management for Climate Smart Agriculture, Global Food and Livelihood Security	Soil Cons. Society of India (SCSI), New Delhi	New Delhi	5-9 Nov, 2019
5.	Theme- Game-changing approaches and technologies	Int. Conference on Future Cities	IIT-Roorkee	Roorkee	11-13 Dec, 2019
6.	Theme- Promoting innovative tools for safety of water supplies and controlling pollution	HYDRO-2019 (Hydraulics, Water Resources and Coastal Engineering)	Osmania University, Hyderabad	Hyderabad	18-20 Dec, 2019
7.	Theme- Water Education- Key for Water Security	Roorkee Water Conclave 2020	IIT-Roorkee and NIH	Roorkee	26-28 Feb, 2020
8.	Celebration of World Water Day		NIH, jointly with UNESCO New Delhi	New Delhi	22 Mar 2020

Dr. V C Goyal thanked the members for their valuable contributions during deliberations in the Working Group meeting. The WG members desired to form a Whatsapp group of WG members.

The meeting ended with vote of thanks to the Chair.

ANNEXURE-I

List of Working Group Members who attended the 48th WG meeting

1.	Dr. S.K. Jain, Director, NIH	Chairman
2.	Sh. Wasim Ahmed, CGWB, Dehradun	Member
3.	Dr. K V Singh, IMD, New Delhi	Member
4.	Dr. Ambrish Kumar, ICAR-IISWC, Dehradun	Member
5.	Dr. R D Deshpande, PRL, Ahmedabad	Member
6.	Dr. S P Aggarwal, IIRS, Dehradun	Member
7.	Dr. R K Goyal, ICAR-CAZRI, Jodhpur	Member
8.	Sh. Man Singh, WTC, ICAR-IARI, New Delhi	Member
9.	Prof. A K Saraf, IIT, Roorkee	Member
10.	Prof. M L Kansal, IIT, Roorkee	Member
11.	Dr. S S Grewal, Chandigarh	Member
12.	Dr. Kaushal K. Garg, ICRISAT, Hyderabad	Member
13.	Prof. Ramakar Jha, NIT, Patna	Member
14.	Prof. A P Dimri, JNU, New Delhi	Member
15.	Dr. Sadhana Malhotra, Mindspace, Dehradun	Member
16.	Sh. Sudhindra Mohan Sharma, Indore	Member
17.	Dr. Anil Guatam, PSI, Dehradun	Member
18.	Dr. Rakesh Kumar, Sc. G & Head SWH Division, NIH	Member
19.	Dr. J V Tyagi, Sc.G & Head EH Division, NIH	Member
20.	Dr. Sudhir Kumar, Sc. G & Head HI Division, NIH	Member
21.	Er. C P Kumar, Sc.G & Head GWH Division, NIH	Member
22.	Dr. Sanjay K. Jain, Sc. G & Head WRS Division, NIH	Member
23.	Dr. V C Goyal, Sc. G & Head, RMO Division, NIH	Member-Secretary

Scientists from National Institute of Hydrology

	EH Division		SWH Division
1	Dr. M.K. Sharma, Sc.D	23	Dr. A.K. Lohani, Sc.G
2	Dr. Rajesh Singh, Sc.C	24	Dr. R.P. Pandey, Sc.G
3	Dr. Pradeep Kumar, Sc.C	25	Dr. Sanjay Kumar, Sc.E
4	Dr. Swapnali Barman, Sc.C	26	Dr. Archana Sarkar, Sc.D
5	Sh. Rajesh K. Nema, Sc.B	27	Dr. L.N. Thakural, Sc.C
	GWH Division	28	Sh. J.P. Patra, Sc.C
6	Dr. Anupama Sharma, Sc.E	29	Dr. Ashwini A. Ranade, Sc.C
7	Dr. Surjeet Singh, Sc.E	30	Sh. N K Bhatnagar, Sc.B
8	Er. Sumant Kumar, Sc.C		WRS Division
9	Mrs. Suman Gurjar, Sc.C	31	Dr. M.K. Goel, Sc.G
10	Dr. Gopal Krishan, Sc.C	32	Smt. Deepa Chalisgaonkar, Sc. G
11	Sh. Nitesh Patidar, Sc.B	33	Er. D.S. Rathore, Sc.F
	HI Division	34	Dr. Renoj J. Thayyen, Sc.E
12	Dr. Suhas Khobragade, Sc.F	35	Dr. Manohar Arora, Sc.D
13	Dr. M.S. Rao, Sc.E	36	Dr. P K Singh, Sc.D
14	Sh. S.K. Verma, Sc.D	37	Er. Manish Nema, Sc.C
15	Dr. Santosh M Pingale, Sc.C	38	Dr. P K Mishra, Sc.C

16	Sh. Hukam Singh, Sc.B	39	Dr. Vishal Singh, Sc.C
17	Ms. Nidhi Kalyani, Sc.B	40	Sh. P K Agarwal, Sc.B
	RMO Division	41	Sh. Deepak Singh Bisht, Sc.B
18	Er. Omkar Singh, Sc.F		
19	Dr. A R Senthil Kumar, Sc.F		
20	Sh. Digamber Singh, Sc.C		
21	Dr.(Mrs) Jyoti P. Patil, Sc.C		
22	Sh. Rohit Sampatrao Sambare, Sc.B		