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| **Course Report** |

**2-week customized course on**

**“RS & GIS Technologies for Sustainable Watershed Management”**

***(07*th Feb – 18th Feb 2022*)***

National Hydrology Project (NHP) is taken up by the Ministry of Jal Shakti, Department of Water Resources, RD & GR, Govt. of India, and the mission objective is to aid in effective water resources planning, development and management. This project is intended for setting up of a system for timely and reliable water resources measurement, storage, monitoring and management. It will also facilitate to provide tools/systems for informed decision making through Decision Support Systems (DSS) for water resources management, flood management, reservoir operations, drought management, etc. NHP also takes care of capacity building of the relevant State and Central government organizations in water resources management through the use of Information Systems and adoption of State-of-the-art technologies like Remote Sensing & GIS.

National Remote Sensing Centre (NRSC) has taken up the task to support NHP based on the request from Ministry of Jal Shakti, Department of Water Resources, River Development & Ganga Rejuvenation (MoJS, Dept. of WR, RD&GR) through organizing capacity building training programs comprising of Remote Sensing & GIS technologies and customized applications on water resources. These programs are aimed at capacity building of all the stake holders in understanding and effective utilization of space technology in the field of water resources. To this effect, two customized training programs per year of one week duration on the fundamentals aspects of RS & GIS and two customized programs per year of two weeks duration on the applications of RS & GIS in water resources are planned.

In this regard, a two-week customised training programme on ‘Remote Sensing & GIS Technologies for Sustainable Watershed Management’ was conducted at National Remote Sensing Centre by Water Resources Group in association with Training, Education & Outreach Group, Geosciences Group and Rural Development & Watershed Management Division for water resources engineers of Central / State government departments under National Hydrology Project during 07-Feb-2022 to 18-Feb-2022. Due to Covid-19 pandemic situation across the country the training programme was conducted in Webinar mode. The details of which are described below.

The training programme was inaugurated on 07-Feb-2022 by Dr. Raj Kumar, Director, NRSC and Dr.V.V. Rao, Deputy Director, Remote Sensing Applications Area, NRSC. Shri.P.V.Raju, Group Director (WRG) welcomed all the participants and gave overview of the training programme. Dr.V.V. Rao, DD (RSAA) and Project Director (NHP) briefed about the training programme including NHP activities. Dr. Raj Kumar, Director, NRSC delivered key note address to the participants. A total of 49 officials participated in this course from water resources departments of both Central and State Governments (refer Annex-1).

The course is designed in such a way that it covers the overall concepts of remote sensing and GIS, besides theoretical and practical knowledge on the subject of sustainable watershed management, starting from the fundamentals of Remote Sensing and GIS till sustainable watershed management using geospatial data inputs (refer Annexure-2). During the first day, the participants were introduced to remote sensing, image interpretation techniques and hands-on exercises on image interpretation techniques in the afternoon sessions. Second day, topics on GIS were covered which includes introduction to GIS, Spatial data analysis techniques along with hands on exercises in afternoon sessions. On third day the topics covered include DEM concepts & applications in watershed, open sources GIS (QGIS), demo cum hands on exercise in QGIS. A guest lecture on ‘Integrated Watershed Management: A Strategy for Development of Rainfed / Degraded Land’ was special arrangement to the trainee participants on fourth day. In addition fourth day, topics covered are role of RS & GIS technologies on sustainable management of watersheds, estimation of water availability using SWAT for a watershed, hands-on exercise on estimation of water availability using SWAT for a watershed. Fifth day the hands-on exercise on estimation of water availability using SWAT for a watershed was continued.

Sixth day the participants were taught on hydrogeological inputs for optimization of sites for recharge structures, integrated geohydrological analysis and modelling for site suitability of recharge structures for ground water sustainability and hand-on exercise site suitability for water recharge structures. A guest lecture on ‘Sustainable ground water/water resources planning of Rural micro-watershed- A case study’ was arranged on seventh day. In addition seventh day covered ‘Integrated Multi Criteria Decision Analysis technique for site suitability of check dams using ground water prospects maps and hands-on exercise on MCDA technique for site suitability for ground water recharge structures. Eighth day topics covered include water harvesting structures Inventory, Monitoring and Impact evaluation, Journey of MGNREGA towards G-Governance, and hands-on exercises on Water harvesting structures for Inventory, Monitoring and Impact evaluation. A guest lecture on ‘Rain Water Harvesting Technologies at Watershed Scale - Design, Development & Impact Evaluation’ was also arranged on eighth day. The ninth day covers Introduction to Pilot study and hands-on exercises on Water harvesting structures for Inventory, Monitoring and Impact evaluation. The tenth day topics covered include satellite data products & dissemination, open source data & software for water resources, water resources information portals, and the participants were shown demos on BHUVAN (covering topics like Watershed Applications, Bhuvan Bhujal, AIBP, WBIS, etc.).

Feedback was obtained from all the participants on the overall training programme and on each topic-wise. The trainees expressed happiness for including more hands on practical exercises in this training programme. The ratings are very good and the overall course feedback is 4.5 out of 5.

The concluding session was held on 18-Feb-2022, chaired by Dr.V.V. Rao, Deputy Director, RSAA, NRSC and co-chaired by Shri.P.V.Raju, Group Director (WRG), NRSC. The Training Programme was concluded with feedback from the Trainee Officers and remarks by the chair and co-chair.

Photograph taken during Inaugural Session of Webinar

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Photograph taken during Concluding Session of Webinar

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***Annexure 1***

**List of Officers attended the Training Programme**

| **S.No** | **Name** | **Designation** | **Organization** | **City** |
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| 01 | Ms.A Jyothirmaye | Geologist | Ground Water and Water Audit Department, Government of Andhra Pradesh | Kakinada |
| 02 | Mr.P Harish | Assistant Geophysicist | Ground Water and Water Audit Department, Government of Andhra Pradesh | Guntur |
| 03 | Ms.K Swarna Chandrika | Assistant Engineer (Civil) | Ground Water and Water Audit Department, Government of Andhra Pradesh | Eluru |
| 04 | Mr.A V Raghurami Reddy | Assistant Engineer | Ground Water and Water Audit Department, Government of Andhra Pradesh | Vijayawada |
| 05 | Mr.U Chiranjeevi | Assistant Hydrogeologist | Ground Water and Water Audit Department, Government of Andhra Pradesh | Vijayawada |
| 06 | Mr.K Surya Teja Reddy | Assistant Hydrologist | Ground Water and Water Audit Department, Government of Andhra Pradesh | Ongole |
| 07 | Ms.M Kalavathi Bai | Assistant Hydrologist | Ground Water and Water Audit Department, Government of Andhra Pradesh | Eluru |
| 08 | Ms.M Yoga Lakshmi Prasanna | Hydrogeologist | Ground Water and Water Audit Department, Government of Andhra Pradesh | Kakinada |
| 09 | Mr.Dasari Chaitanya | Assistant Executive Engineer | Water Resources Department, Government of Andhra Pradesh | Kurnool |
| 10 | Ms.Ponnada Bala Tripura Sundari | Assistant Executive Engineer | Water Resources Department, Government of Andhra Pradesh | Guntur |
| 11 | Mr. M D Ananda Babu | Assistant Executive Engineer | Water Resources Department, Government of Andhra Pradesh | Vijayawada |
| 12 | Ms. Manasa Munagala | Assistant Executive Engineer | Water Resources Department, Government of Andhra Pradesh | Vijayawada |
| 13 | Ms.Anusha Modurouthu | Assistant Executive Engineer | Water Resources Department, Government of Andhra Pradesh | Vijayawada |
| 14 | Mr. Saikiran Saravakota | Assistant Executive Engineer | Water Resources Department, Government of Andhra Pradesh | Nellimarla |
| 15 | Mr.Pranab Baruah | Assistant Engineer | Water Resources Department, Government of Assam | Tezpur |
| 16 | Mr. Ashwin Kumar Atey | Hydrogeologist | Central Ground Water Board | Nagpur |
| 17 | Mrs. Priti D Raut | Scientist B | Central Ground Water Board | Nagpur |
| 18 | Mr. Anukaran Kujur | Scientist B | Central Ground Water Board | Ranchi |
| 19 | Mr.Sujatro Ray Chowdhuri | Scientist B | Central Ground Water Board | Lucknow |
| 20 | Mr.Vipin Kumar Mishra | Hydrogeologist | Central Ground Water Board | Allahabad |
| 21 | Mr. Tapas Kumar Sahoo | Assistant Hydrogeologist | Central Ground Water Board | Kolkata |
| 22 | Mr. Prince Awadhiya | Junior Engineer | Water Resources Department, Government of Chattishgarh | Raipur |
| 23 | Ms.Khushbu Yadav | Geo-Hydrologist | Water Resources Department, Government of Chattishgarh | Raipur |
| 24 | Ms.Anuja Rajagopalan | Scientist B | Central Water & Power Research Station | Pune |
| 25 | Ms.Suneeta Jatwa | Scientist C | Central Water & Power Research Station | Pune |
| 26 | Ms.Ripal Sanatbhai Chavda | Assistant Engineer | Water Resources Department, Government of Gujarat | Gandhinagar |
| 27 | Mr.Parth Patel | Assistant Engineer | Water Resources Department, Government of Gujarat | Gandhinagar |
| 28 | Ms.Sheetal Solanki | Assistant Engineer | Water Resources Department, Government of Gujarat | Gandhinagar |
| 29 | Ms.Mittal Bodar | Assistant Engineer | Water Resources Department, Government of Gujarat | Gandhinagar |
| 30 | Mr.Bhargav Kothia | Deputy Executive Engineer | Water Resources Department, Government of Gujarat | Gandhinagar |
| 31 | Mr.Vinay Puri | Assistant Engineer | Narmada Water Resources, Water Supply & Kalpsar Department, Water Resource Investigation | Ahmedabad |
| 32 | Mr. Ashvin Baraiya | Assistant Engineer | Water Resources Department, Government of Gujarat | Bhavnagar |
| 33 | Ms.Heli Jani | Assistant Engineer | Water Resources Department, Government of Gujarat | Gandhinagar |
| 34 | Ms.Gautami Patel | Assistant Engineer | Water Resources Department, Government of Gujarat | Gandhinagar |
| 35 | Mr.Hiral Bhalodiya | Assistant Engineer | Water Resources Department, Government of Gujarat | Gandhinagar |
| 36 | Ms.Shruti Halli | Research Assistant | Water Resources Department, Government of Karnataka | Bengaluru |
| 37 | Mr.Arun Das B | Hydrogeologist Jr. | Ground Water Department , Government of Kerala | Idukki |
| 38 | Mr.Lalruatkima | Technical Expert (GW) | Irrigation & Water Resources Department, Government of Mizoram | Aizawl |
| 39 | Ms.Gospel Rohmingthangi | GIS Expert | Irrigation & Water Resources Department, Government of Mizoram | Aizawl |
| 40 | Ms.Nishi R Choudhary | Research Assistant | Narmada Control Authority | Indore |
| 41 | Ms.Namrata Patel | Research Assistant | Narmada Control Authority | Indore |
| 42 | Ms.M Madhavi | Deputy Engineer | Irrigation & CAD Department, Government of Telangana | Hyderabad |
| 43 | Ms.P Shailaja | Deputy Engineer | Irrigation & CAD Department, Government of Telangana | Hyderabad |
| 44 | Ms.S Madhava Rao | Assitant Geophysicist | Ground Water Department, Government of Telangana | Hyderabad |
| 45 | Mr.Santanu Sarkar | Junior Engineer, TES Gr- V(A) | Water Resources Department, Government of Tripura | Agartala |
| 46 | Mr.Kamal Suklabaidya | Junior Engineer, TES Gr- V(A) | Water Resources Department, Government of Tripura | Agartala |
| 47 | Ms.Runulipsa Barik | Asistant Executive Engineer(Civil) | Water Resources Department, Government of Odisha | Bhubaneswar |
| 48 | Ms.Ananya Singha Ray | Asistant Executive Engineer(Mech) | Water Resources Department, Government of Odisha | Bhubaneswar |
| 49 | Ms.Trilochana Basnett | GIS Analyst | Water Resources Department, Government of Sikkim | Gangtok |

***Annexure 2***

**PROGRAMME SCHEDULE**

| Date & Time | Title of the Lecture | Faculty |
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| **Day-1 : 7 February 2022 (Monday)** | | |
| 10:30-11:00 hrs. | **Inauguration Session** | RSAA & TEOG |
| 11:00-12:00 hrs. | Introduction to Remote Sensing | Mr.PVSSN Gopala Kirshna, TEOG |
| 12:00-13:00 hrs. | Image Interpretation & Classification Techniques | Mr.P Hariesh, TEOG |
| 13:00-14:00 hrs. | *Lunch Break* |  |
| 14:00-16:30 hrs. | Hands-on Exercise on satellite Image Interpretation | Mr.P Hariesh, TEOG |
| **Day-2 : 8 February 2022 (Tuesday)** | | |
| 10:30-11:45 hrs. | Introduction to GIS | Mr.PVSSN Gopala Kirshna, TEOG |
| 11:45-13:00 hrs. | Spatial Data Analysis Techniques | Mr.T S Viswanadham, TEOG |
| 13:00-14:00 hrs. | *Lunch Break* |  |
| 14:00-15:00 hrs. | Open Source GIS (QGIS) | Mr.P Hariesh, TEOG |
| 15:00-16:30 hrs. | Hands-on Exercises on GIS (shape file creation & editing, point data to spatial conversion) | Mr.P Hariesh, TEOG |
| **Day-3 : 9 February 2022 (Wednesday)** | | |
| 10:30-11:45 hrs. | DEM Generation Concepts and its Applications in Watershed | Mr.B Narender, AS & DMA |
| 11:45-13:00 hrs. | Hands-on Exercises on GIS (spatial data query and analysis) | Mr.T S Viswanadham, TEOG |
| 13:00-14:00 hrs. | *Lunch Break* |  |
| 14:00-16:30 hrs. | Hands-on Exercises on GIS (map preparation) | Mr.T S Viswanadham, TEOG |
| **Day-4 : 10 February 2022 (Thursday)** | | |
| 10:30-11:45 hrs. | Integrated Watershed Management: A Strategy for Development of Rainfed / Degraded Land | Dr. C.P. Reddy  Sr. Addl. Commissioner (WD)  Department of Land Resources |
| 11:45-13:00 hrs. | Role of RS & GIS technologies on Sustainable Management of Watersheds | Dr. T Ravi Sankar  Deputy Director, BGWSA |
| 13:00-14:00 hrs. | *Lunch Break* |  |
| 14:00-15:00 hrs. | Estimation of Water Availability using SWAT for a Watershed | Mrs. Annie Marie Issac, WRG |
| 15:00-16:30 hrs. | Hands-on Exercise on Estimation of Water Availability using SWAT for a Watershed | Mr. V Yogesh Palenivel &  Mr. Visakh, WRG |
| **Day-5 : 11 February 2022 (Friday)** | | |
| 10:30-11:45 hrs. | Estimation for Water Availability using SWAT for a Watershed  (Environment flows and Dependable flows) | Mrs. Annie Marie Issac, WRG |
| 11:45-13:00 hrs. | Hands-on Exercise on Estimation of Water Availability using SWAT | Mr. V Yogesh Palenivel & Mr.Visakh, WRG |
| 13:00-14:00 hrs. | *Lunch Break* |  |
| 14:00-16:30 hrs. | Hands-on Exercise on Estimation of Water Availability using SWAT | Mr. V Yogesh Palenivel & Mr.Visakh, WRG |
| **Day-6 : 14 February 2022 (Monday)** | | |
| 10:30-11:45 hrs. | Understanding hydrogeological inputs for optimization of sites for recharge structures | Dr. I C Das, GSG |
| 11:45-13:00 hrs. | Integrated geohydrological analysis and modeling for site suitability of recharge structures for ground water sustainability | Mr. Rajarshi Saha, GSG |
| 13:00-14:00 hrs. | *Lunch Break* |  |
| 14:00-16:30 hrs. | Hands-on Exercise on Site suitability for water recharge structures | Mr. Rajarshi Saha &  Mr. T Wankhede, GSG |
| **Day-7 : 15 February 2022 (Tuesday)** | | |
| 10:30-11:45 hrs. | Sustainable ground water/water resources planning of Rural micro-watershed- A case study | Dr. Ranga Rajan,  Former Scientist**,** NGRI |
| 11:45-13:00 hrs. | Integrated Multi Criteria Decision Analysis technique for site suitability of check dams using ground water prospects maps | Mr. R Majumdar, GSG |
| 13:00-14:00 hrs. | *Lunch Break* |  |
| 14:00-16:30 hrs. | Hands-on Exercise on MCDA technique for Site suitability for ground water recharge structures | Mr. T Wankhede, GSG |
| **Day-8 : 16 February 2022 (Wednesday)** | | |
| 10:30-11:45 hrs. | Water harvesting structures Inventory, Monitoring and Impact evaluation | Mr. B Shyamsunder, RDWMD |
| 11:45-13:00 hrs. | Journey of MGNREGA towards G-Governance | Dr. Girish Shankar Pujar, RDWMD |
| 13:00-14:00 hrs. | *Lunch Break* |  |
| 14:00-15:00 hrs. | Rain Water Harvesting Technologies at Watershed Scale - Design, Development & Impact Evaluation | Dr. K Srinivas Reddy  Principal Scientist, CRIDA |
| 15:00-16:30 hrs. | Hands-on Exercises on Water harvesting structures for Inventory, Monitoring and Impact evaluation | Dr. Stutee Gupta, RDWMD |
| **Day-9 : 17 February 2022 (Thursday)** | | |
| 10:30-11:45 hrs. | Role of Capacity Building in IWMP/MGNREGA | Dr. P. Kesava Rao  Head, Centre for Geoinformatics Application in Rural Development, NIRD |
| 11:45-13:00 hrs. | Introduction to Pilot study | Dr. Stutee Gupta, RDWMD |
| 13:00-14:00 hrs. | *Lunch Break* |  |
| 14:00-16:30 hrs. | Hands-on Exercises on Water harvesting structures for Inventory, Monitoring and Impact evaluation | Dr. Stutee Gupta, RDWMD |
| **Day-10 : 18 February 2022 (Friday)** | | |
| 10:30-11:15 hrs. | Satellite Data Products & Dissemination | Mr. G Someswara Rao, NDC |
| 11:15-12:15 hrs. | Open Source Data & Software for Water Resources | Mr. Saksham Joshi, WRG |
| 12:15-13:00 hrs. | Water Resources Information Portals | Mr. Anurag Mishra, WRG |
| 13:00-14:00 hrs. | *Lunch Break* |  |
| 14:00-16:00 hrs. | Introduction to Bhuvan and Demo (Watershed Applications, Bhuvan Bhujal, AIBP, WBIS, etc.) | Mr.Sai Rama Krishna, BGWSG |
| 16:00-16:30 hrs. | **Valedictory** | RSAA & TEOG |

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| **AS & DMA:** Aerial Services & Data Management Area | **NDC:** NRSC Data Centre |
| **BGWSG:** Bhuvan Geo-portal & Web Services Group | **TEOG:** Training, Education & Outreach Group |
| **GSG:** Geo-Sciences Group | **WRG:** Water Resources Group |
| **RDWMD:** Rural Development & Watershed Monitoring Division | |

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