



## Summary Report

Three Days' Online Training Programme

**“River Dynamics, Flood and Sediment Hazards Assessments in  
Indian Rivers”**

**Dates: 23-25 August, 2021**

*Jointly Organized by*

**Department of Civil Engineering, National Institute of  
Technology Warangal**

**&**

**National Institute of Disaster Management (NIDM),  
Ministry of Home Affairs, Government of India**



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## Introduction to the Course

The natural hazards posed by a river system depend on the river's changing ability to convey its water and sediment loads. This ability is affected by patterns of erosion and deposition that are ultimately determined by base level, the lowest elevation to which the river can flow. Base level, in turn, is set by the interplay between tectonic deformation of the land surface and sediment supply - quantities that can vary both in space and time. Thus, base level plays a dynamic, but poorly understood role in determining the evolution of a river system and its associated natural hazards.

The above concept has serious implications for understanding the recent development of the major river systems in hilly streams. Here, large rivers with high sediment load flow south from the Himalayas into a series of narrow valleys, or duns that run parallel to the mountain front. While many of these rivers are deeply incised where they exit the hills, there are large spatial differences in valley incision across the Gangetic Plain.

This course will explain the hypothesis that both landslide and flood hazards are intimately linked to erosion, scour and deposition of sediment. This erosion and deposition is driven by local base level changes, and is highly variable in space and time. Base level changes drive flood risk in the Plain but also feedback to influence hazards along the mountain front.

India is one of the most highly risk-prone countries to river hazards. The geo-climatic variations of the country make the population vulnerable to flood and sediment related disasters in varied degrees, intensities and patterns. Natural disasters such as flood, drought, cyclone etc., aggravated by impacts of climate change have been perceived as some unprecedented, but natural phenomenon by the community. Erosion, deposition scour and sediment transport in rivers are most hazardous and common hydrological processes. Sediment transport in rivers is one of the main cause of scouring and deposition and, therefore, precise estimation of the erosion is of major importance to reduce hazards. Lack of preparedness and appropriate adaptation strategy make the people more risk-prone. India needs to be concerned about the impacts of flood sediments hazards because a large portion of its population depends on sensitive sectors like agriculture and forestry for livelihoods as well as for several other reasons. In view of this, the current workshop cum training on 'River Dynamics, Flood and Sediment Hazards Assessments in Indian Rivers' is organized to share experiences, exchange knowledge on adaptation and risk reduction strategies, communities' responses and best practices. The training will provide novel insights into flood and sediment hazards risk reduction in trans-disciplinary contexts.

This 3-day online training program brought together experts from the academia, water resources engineers and professionals involved in water resources and hydrologic engineering to understand the background, issues and objectively analyse them to come out with best ways possible towards disaster resilient flood and sediment hazards for achieving the objectives.

The training programme is jointly organized by Department of Civil Engineering, National Institute of Technology Warangal, Telangana and National Institute of Disaster Management (NIDM), Ministry of Home Affairs, Government of India.



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### Sub-themes:

- Various modes of disasters and relief strategies
- Flood Hazard and Risk Assessment
- River Dynamics, Sediment and Scour Hazards
- River Hazards- An Environmental Perspective
- Climate change overview in India and Atmospheric rivers



## Program Schedule:

23 <sup>rd</sup> August, 2021 (10:00-13:00)				
Day	Session No.	Topic	Speaker	Time
	1	Welcome Address and Brief overview of webinar  Inaugural Message and Overview of the Department  Welcome Address and Introductory Remarks  Overview of the Water and Environment division  Inaugural Address by the Chief Guest	Dr. Manish Pandey, NITW  Prof. P. Rathish Kumar, NITW  Prof. Anil K. Gupta, Head ECDRM NIDM  Dr. P. V. Rao, NITW  Prof. N.V. Ramana Rao, NITW	10:00 – 11:00
	2	Rubberdam and bituminous geomembrane (BGM) for advance water resources management	Prof. P.K. Dixit Professor, Department of Civil Engineering, IIT BHU & Mr. Om Jangid Vice President (Design and Projects), Yooil Infra, India	11:00 – 12:00
	3	Various modes of disas and relief strategies	Prof. Anil K. Gupta Head ECDRM, NIDM, New Delhi	12:00 – 13:00
24 <sup>th</sup> August, 2021 (10:00-13:00)				
DAY 2	4	Lecture 3 Flood Hazard and RiskAssessment	Prof. N. V. Umamahesh Professor, Department of Civil Engineering, NITW	10:00 – 11:00
	5	Lecture 4 Scour hazards and AI approaches	Prf. Hazi Azamathulla Professor, University of West Indies, Trinidad and Tabogo	11:00 – 12:00
	6	Lecture 5 River Hazards- An Environmental Perspective	Dr. P. V. Rao Associate Professor, Department of Civil Engineering, NIT warangal	12:00 – 13:00
25 <sup>th</sup> August, 2021 (10:00-13:00)				



<b>DAY 3</b>	7	Lecture 6 Climate change overview in India and Atmospheric rivers	Dr. Manish K. Goyal Associate Professor, Department of Civil Engineering, IIT Indore	10:00 – 11:00
	8	Lecture 7 Scour and Sediment Hazards in Natural Streams	Dr. Manish Pandey Asst. Prof. Department of Civil Engineering, NIT warangal	11:00 – 12:00
	9	Group presentation by NIDM research scholars and research associates	Prof. Anil K. Gupta NIDMand Research Fellows/Associates NIDM	12:00 – 13:00
	10	Valedictory Remarks	Miss Fatima Amin, NIDM, New Delhi & Dr. Manish Pandey, NIT Warangal	13:00 – 13:10

### List of Speakers

1. Prof. Umamahesh NV, Professor, Department of Civil Engineering, NIT Warangal
2. Prof. Anil K. Gupta, Head ECDRM NIDM
3. Prof. P. K. Dixit, Professor, Department of Civil Engineering, IIT BHU
4. Mr. Om Jangid, Vice President (Design and Projects), Yooil Infra, India
5. Prof. Hazi Azamathulla, Professor of Civil and Environmental Engineering, University of the West Indies, Trinidad.
6. Dr. Manish K. Goyal, Associate Professor, Department of Civil Engineering, IIT Indore
7. Dr. P. V. Rao, Associate Professor, Department of Civil Engineering, NIT Warangal
8. Dr. Manish Pandey, Assistant Professor, Department of Civil Engineering, NIT Warangal
9. Research Fellows/Associates, NIDM



## Important Announcements

The important housekeeping announcements were announced to ensure smooth flow of the programme on all the three days. These included:

- Join the meeting on time.
- Ensure at least 80% of attendance.
- 15-20 minutes for Q & A after each lecture.
- The questions must not be posted as Anonymous attendee.
- Ensure that the questions are precise.
- Refrain from making general comments.

**Event Page:** [https://nidm.gov.in/pdf/trgReports/2021/August/Trg\\_23-25August2021akg.pdf](https://nidm.gov.in/pdf/trgReports/2021/August/Trg_23-25August2021akg.pdf)



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## About National Institute of Technology Warangal (NITW)

National Institute of Technology Warangal, formerly known as Regional Engineering College, was established in 1959. Over the years it has developed into a premier institute of higher learning and is ranked among the top technical education institutions in India. 13 Departments are offering eight undergraduate and 32 postgraduate programs besides doctoral programs. About 5000 students across the country and about 500 international students' study on the campus. It is a fully residential campus sprawling over 250 acres with excellent infrastructure, state of the art library, seminar halls, guest houses, and laboratories. The department of Civil Engineering NIT Warangal offers a UG program, seven PG programs, and a Ph.D. program as well. There are 49 qualified and experienced faculties in the department. The department has a liaison with reputed industries and R&D organizations like CWC Delhi, Floodkon, Larsen and Toubro Construction, UltraTech Cements and AECOM etc. Presently the department is handling several R&D projects and consultancy works. The department has also been recognized as a QIP centre for M. Tech and Ph.D. programs.

## Brief Profile of the Department of Civil Engineering, NITW

The department of Civil Engineering offers a UG program, seven PG programs, and a Ph.D. program as well. There are 52 qualified and experienced faculties in the department. The department has a liaison with reputed industries and R&D organizations like M/s Larsen and Toubro Construction, UltraTech Cements and AECOM etc. Presently the department is handling several R&D projects and consultancy works. The department has also been recognized as a QIP centre for M. Tech and Ph.D. programs.

## About National Institute of Disaster Management (NIDM)

National Institute of Disaster Management (NIDM), Ministry of Home Affairs, and Government of India is a premier institute and a Statutory Body (under Disaster Management Act 2005) for training, research, documentation, awareness and human resources and capacity development in the field of disaster mitigation and management in India. The institute lays emphasis on multi-stakeholder interdisciplinary cross-sectoral approach for an effective and efficient proactive continuum disaster risk management based on participatory integrated multi-hazard-risk management concept.



## DAY-WISE SUMMARY

### Three - Days Online Training Program on “River Dynamics, Flood and Sediment Hazards Assessments in Indian Rivers”

Dates: 23-25 August, 2021

#### Day 1: 23<sup>rd</sup> August, 2021

Inaugurating the session Prof. Umamahesh N. V., Professor (HAG) and Dr. Manish Pandey, Assistant Professor, Department of Civil Engineering, NIT Warangal welcomed the speakers and participants to the programme with an introduction to the eminent panellist. Dr. Pandey stated the fact and objectives of this training and gave an overview of the basic physical concept and numerical modelling of river hazards, flood hazards, sediment hazards, describing principal ideas, important features, procedures, shortfalls, a general introduction to wave, current, scour, a brief introduction to boundary layer and its nature, wave current boundary layer interaction.

He highlighted that as an academicians, researcher and policy maker there is a need to understand the background, issues and problems thereby objectively analysing them to chart the best ways forward.

Day 1 of the programme included eminent speakers **Prof Anil Kumar Gupta**, *Head ECDRM, NIDM, New Delhi*, **Prof. P. K. Dixit**, *Head Department of Civil Engineering, IIT BHU* and Mr. Om Jangid, *Vice President (Design and Projects), Yooil Infra, India*, with patron being **Maj Gen Manoj K Bindal**, *Executive Director, NIDM, New Delhi* and **Prof. N. V. Ramana Rao**, *Director, NIT Warangal* and convener **Prof. P. Rathish Kumar**, *Department of Civil Engineering, NIT Warangal*.

#### Patron: Maj Gen Manoj K Bindal, Executive Director, NIDM, New Delhi

##### Patron

**Major General M. K. Bindal**  
Executive Director, NIDM



Major General M. K. Bindal is presently the Executive Director, National Institute of Disaster Management. He was commissioned into the Corps of Army Air Defence in December 1985. An alumnus of the National Defence Academy, Major General M. K. Bindal is a graduate of the Defence Services Staff College and has attended the prestigious Higher Command Course at the Army War College besides excelling in all other career courses in the army. He holds a masters degree in Defence and Strategic Studies as well as Masters of Philosophy in Defence and Management Studies. During his more than three decades of service he has held important command and staff assignments. Having held all echelons of command within an Air Defence Regiment in diverse theatres, he commanded an Air Defence Regiment and an Air Defence Brigade in the Kashmir region against the backdrop of counter insurgency operations. He was General Officer Commanding of a sensitive Sub Area in the North East. He has been on the staff of a Mountain Brigade deployed in counter insurgency ops and in High Altitude area, an Armoured Division deployed in the plains, a Desert Corps and in a Corps HQ in High Altitude Areas. He has also been posted as Deputy Director General in Directorate of Army Air Defence where he was dealing with operations, Training, Air Defence Control & Reporting and Air Intelligence issues. Major General M. K. Bindal served as the Provost Marshall in the United Nations Mission in Mozambique where he was deeply involved in the liquidation of the mission. He has been the Director, Centre for United Nations Peacekeeping (CUNPK) New Delhi. For three years he was also the Secretary of the International Association of Peacekeeping Training Centres.



## Patron: Prof. N V. Ramana Rao, Director, NIT Warangal

**Patron**  
**Prof. N.V. Ramana Rao**  
Director, NIT Warangal



Prof. N.V. Ramana Rao earlier worked as Rector & Professor of Civil Engineering at JNTU Hyderabad before joining as the Director, NIT, Warangal. He did his BE in Civil Engineering from (Osmania), M.Tech from (IIT Delhi), Ph.D. and Post Doctorate from U.K. in Civil Engineering from University of Wales, Swansea, UK. He has held several Administrative posts as Registrar, JNT University Hyderabad, Kukatpally, Hyderabad from 30.04.2012 to 21.07.2015, as Principal, JNTUH College of Engineering Hyderabad, Kukatpally, Hyderabad from 30.04.2008 to 24.11.2011, as Director, Bureau of Industrial Consultancy Services, JNT University, Hyderabad from 05.09.2003 to 05.05.2006, as Co-ordinator, Entrepreneurship Development Cell, JNT University, Hyderabad from 01.08.2002 to 31.01.2004. He has Edited three books and published 157 papers in International journals/International Conferences/ National Journals/ National Conferences. He has Organized 12 Conferences/workshops, Delivered 15 invited lectures. He has Guided more than 60 M.Tech's, 12 Ph.D's and guiding at present several Ph.Ds. He has been Nominated as an Expert Committee member constituted by the UGC for grant of Autonomous status to various Technical Institutions He has been a Subject Committee Member of Telangana State Public Service Commission. He is a member of Member of Telangana State Pollution Control Board, Expert Committee Member of Telangana State Power Generation Corporation. He has been the Convener of EAMCETs, for more than 6 years of both combined AP and separate Telangana States.

## The convener of the session Prof Anil Kumar Gupta, Head ECDRM, NIDM, New Delhi

**Convener & Expert**  
**Prof. Anil K Gupta**  
Head, ECDRM, NIDM



Head, ECDRM, NIDM. He was the Director of Institute of Environment and Development Studies, Bundelkhand University, Jhansi. He joined disaster mitigation & crisis management professional, with expertise in institutional development and international cooperation on area of DM capacity building/training, planning, governance, risk/vulnerability analysis, disaster risk reduction, among others. He has interdisciplinary expertise, with institutional development - administration & management, coordinated several international/national projects, over 100 publications including 10 books and 45 papers, guided Ph.D. research. His special contributions were in preparation of National DM Plan (including mitigation & response plan), National HR Plan for DRM, Perspective Plan for NIDM's strengthening, Strategy on Climate Change, NAP on Chemical Disasters, international cooperation with GIZ, UNEP, UNDP, ISET-US, UNU-EHS, UNESCO, CKDN, ICIMOD, NORAD, World Bank, etc. and coordination with States/UTs for DM capacity building/training matters. Areas include risk/vulnerability analysis, DMP, PDNA, CCA-DRR, housing safety & local emergency preparedness, DM planning, governance, etc. He also served NMDC, DMI, NEERI and CICON in administrative/technical capacities. He is coordinator of Technical Advisory Committee of NIDM, member of Governing Council & Academic/Research Advisory of several institutions and High level/Ministerial delegation abroad.

Starting with his remarks professor Gupta shared that there exists a strong nexus between rivers, cities and disasters which plays an important role today with increased urbanisation. Rivers has always been a huge challenge in terms of the amount and characteristics which human civilization is facing and stated that waste itself is a type of disaster and when disasters struck they leave a lot of waste which create serious issues. He highlighted that India has emerged as a leader in representing resilient infrastructure globally but the facilities needed to uphold these infrastructures like reservoir management, water supply and water resources management need more focus. He further underlined that there is a need to look at the interdependency of infrastructure. He highlighted that globally talking about different river hazards is an important aspect for making an economical water resources system. Hence there exist a number of issues that need to be thought upon and worked on to integrate to the overall concept of smart cities using modern technologies. He further added that the community plays an important role in waste management both as a beneficiary, contributor to challenge and part of the solution and hence their participation is essential



Convener: **Prof. P. Rathish Kumar**, Head, Department of Civil Engineering, NIT Warangal

**Convener**

**Prof. P. Rathish Kumar**

Head, Department of Civil Engineering, NIT Warangal



Head, Department of Civil Engineering, NIT Warangal. He has B.Tech degree in Civil Engineering from Kakatiya Institute of Technology, Warangal, Kakatiya University, India, M.Tech degree in Structural Engineering from National Institute of Technology, Warangal and two doctoral degrees from National Institute of Technology, Warangal India and Hokkaido University, Japan. His research interests and activities are in the fields of Sustainable Concrete Making Materials, Earthquake Engineering, Health Monitoring of Structures, Repair and Rehabilitation of structures. He has authored more than 120 peer reviewed journal papers and book chapters. He has guided 10 Ph.D. students and 50+ masters students. He has handled several research and consultancy projects at national and international level. He is an activereviewer in several reputed peer reviewed journals.

Speaker: **Prof. P. K. Dixit**, Head, Department of Civil Engineering, IIT BHU

**Speaker**

**Prof. P. K. Dixit**

Head, Department of Civil Engineering, IIT BHU



Prof. P. K. Singh Dixit is Head and Professor of Civil Engineering Department at Indian Institute of Technology BHU. He has done B.Tech in Civil Engineering from GB Pant University (India), Masters in Water Resources from IT BHU and Doctorate in Hydraulic engineering from GB Pant University. His research interests and activities are in the fields of physical hydraulic model studies and hydroinformatics. He has 23 years teaching and research experience. Prof. Dixit authored more than 70 peer reviewed journal papers and book chapters. He has handled several research and consultancy projects. Prof. Dixit has also guided 8 Ph.D. students and more than 50+ master students. He has been a member of the editorial board of several high ranked Journals. He is also a life member of ISH and fellow of The Institute of Engineers.

Prof. Dixit shared his views on building safe and economical hydraulics and river structures and human settlements inclusive, safe, resilient and sustainable thereby combating river hazards and its impact. Starting with he gave an introduction to dam and water engineering and stated hydraulics structures have implications not only for sustainable development goals but many more like environmental and water resources aspects. He further touched upon various rules provided in India for dam water and its uses.

Talking about different types of dam and impact of a dam on human life. He covered an advance topic i.e. Hydraulic Rubber Dam: An Effective Water Management Technology is the go-to source for information on the materials, manufacture, mechanics and functional benefit of rubber dams in flood hazard management. Participants found a detailed background on water conservation and coverage, how inflatable rubber dam technology contributes to the picture, and information on the proper manufacture and use of rubber dams



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to increase water storage for release and delivery during drought. In addition, he stated tactics on the even distribution of water across populations, how to increase water use efficiency, conservation, and how to prevent flooding.

- Demonstrated the proper use of rubber dams in water management, especially in flood prevention and water conservation during drought
- Included guidance on the materials engineering of rubber and technical fabrics involved in the construction of dams, bonding and anchoring systems, and inflation and deflation mechanisms
- Presented thorough coverage of modelling and stress analysis, along with lifecycle assessment of inflatable rubber dams

Sharing some of the learnings he said that there is a need for investing in data and technology for yielding exponential returns, revisiting river planning instruments, strengthening local governance framework and capacity tools, making cities financially self-reliant, reimagining collaborative architecture at local levels. He also stressed technological solutions for water resources management with skill developments and training.

## DAY 2: 24<sup>th</sup> August, 2021

Three lectures were delivered by eminent speakers viz. (i) Prof. Umamahesh NV, NIT Warangal; (ii) Prof. Hazi Azamathulla, University of West Indies, Trinidad; and (iii) Dr. P.V. Rao, NIT Warangal.

Starting with the session Dr. Manish Pandey, Assistant Professor, NIT Warangal, welcomed the speakers and participants to the programme with an introduction to the eminent panellist.

### Speaker: Prof. Umamesh NV, Professor (HAG), Department of Civil Engineering, NIT Warangal

#### Speaker

**Prof. Umamahesh NV**  
**Department of Civil**  
**Engineering, IIT BHU**



Prof. Umamahesh is faculty in Department of Civil Engineering, National Institute of Technology Warangal. He has done B.Tech in Civil Engineering from Osmania University, Hyderabad in year 1984, masters in Water Resources Engineering from Indian Institute of Technology, Kharagpur in year 1986 and Ph.D. from National Institute of Technology Warangal in 1995. His research interests and activities are Reservoir Operation and Management, Hydrological Analysis and Modelling, Irrigation Management, Watershed Management, Water Resources Systems, Water Quality Modelling and Management, Remote Sensing and GIS Applications, Neuro-Fuzzy Applications in Water Resources. He authored more than 60 peer reviewed journal papers and book chapters and presented 50+ papers in National and International conferences. He has handled several research and consultancy projects like (i) Warangal Watershed Development Project; (ii) Integrated Urban Flood Management in India: Technology Driven Solution; (iii) Real Time Flood Forecasting using SWAT Model; (iv) Integrated Water Management Model for BIS Countries under Climate Change Scenarios and many more. He has also guided 11 Ph.D. students and more than 100 masters students.

Prof. Umamahesh threw light on flood hazards in Indian Rivers. He stated that the hazards associated with flooding can be divided into primary hazards that occur due to contact with water, secondary effects that occur because of the flooding, such as disruption of services,



health impacts such as famine and disease, and tertiary effects such as changes in the position of river channels. He stated that throughout the last century flooding has been one of the most costly disasters in terms of both property damage and human casualties. He gave some international flood hazard examples viz.(i) major floods in China, for example, killed about 2 million people in 1887, nearly 4 million in 1931, and about 1 million in 1938; (ii) The 1993 flood on the upper Mississippi River and Midwest killed only 47 people, but the U.S. Army Corps of Engineers estimates the total economic loss at between 15 and 20 billion dollars. Later he explained the primary and secondary effects of floods

### **Primary Effects**

The primary effects of floods are those due to direct contact with the flood waters. As seen in the video last lecture, water velocities tend to be high in floods. As discharge increases velocity increases.

- With higher velocities, streams are able to transport larger particles as suspended load. Such large particles include not only rocks and sediment, but, during a flood, could include such large objects as automobiles, houses and bridges.
- Massive amounts of erosion can be accomplished by flood waters. Such erosion can undermine bridge structures, levees, and buildings causing their collapse.
- Water entering human built structures cause water damage. Even with minor flooding of homes, furniture is ruined, floors and walls are damaged, and anything that comes in contact with the water is likely to be damaged or lost. Flooding of automobiles usually results in damage that cannot easily be repaired.
- The high velocity of flood waters allows the water to carry more sediment as suspended load. When the flood waters retreat, velocity is generally much lower and sediment is deposited. After retreat of the floodwaters everything is usually covered with a thick layer of stream deposited mud, including the interior of buildings.
- Flooding of farmland usually results in crop loss. Livestock, pets, and other animals are often carried away and drown.

### **Secondary and Tertiary Effects**

He stated that the secondary effects are those that occur because of the primary effects and tertiary effects are the long term changes that take place. Among the secondary effects of a flood are:

- Disruption of services -
  - Drinking water supplies may become polluted, especially if sewerage treatment plants are flooded. This may result in disease and other health effects, especially in under developed countries.
  - Gas and electrical service may be disrupted.



- Transportation systems may be disrupted, resulting in shortages of food and clean-up supplies. In under developed countries food shortages often lead to starvation.
- Long - term effects (tertiary effects)-
  - Location of river channels may change as the result of flooding, new channels develop, leaving the old channels dry.
  - Sediment deposited by flooding may destroy farm land (although silt deposited by floodwaters could also help to increase agricultural productivity).
  - Jobs may be lost due to the disruption of services, destruction of business, etc. (although jobs may be gained in the construction industry to help rebuild or repair flood damage).
  - Insurance rates may increase.
  - Corruption may result from misuse of relief funds.
  - Destruction of wildlife habitat.

Lastly, he underlined various impacts of flood hazards and stated that resilience for water resources management will come from autonomy and financial sustainability of river management systems.

**Speaker: Prof. Hazi Azamathulla, Professor of Department of Civil and Environmental Engineering, University of the West Indies at St. Augustine, Trinidad**

**Speaker**

**Prof. Hazi Azamathulla  
University of the West  
Indies at St. Augustine,  
Trinidad**



Dr Hazi Azamathulla is Professor of Civil and Environmental Engineering at the University of the West Indies at St. Augustine, Trinidad. He has a degree in Civil Engineering from SKD University (India), masters degree in Water Resources from Devi Ahilya University (India) and a Doctorate in Hydraulic Engineering from Indian Institute of Technology, Bombay. His research interests and activities are in the fields of physical hydraulic model studies, climate change, water resources engineering and hydroinformatics. He has authored more than 100 peer reviewed journal papers and book chapters. He has guided 7 Ph.D. students and 25+ masters students. He has been a member of the editorial board of several high ranked Journals: Water Science and Technology, Water Science and Technology: Water Supply, Journal of Pipeline Systems Engineering – ASCE (2009-2013), Dam Engineering Journal. He was the Associate Editor of journal of hydrology (Elsevier).

Prof. Azamathulla started with various ways to be prepared for effective river and water resources management and elaborated on the types of disasters occurring at national and international levels. He stated that dam accidents, including the structure failure, are severe threats to life and property. Ageing of dams, changes in hydrologic conditions and increasing population in valleys justify increased attention to dam safety and valley management. Potential dam failures as well as the public pressure for a safer environment



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recommend in contemporary society the dam risk assessment and its reduction in downstream valleys.

He stressed having a dam failure and disaster plan especially in disaster-prone areas for tackling water disasters effectively. He elaborated on pre-disaster and post-disaster plans.

As emphasized by Prof. Azamathulla, the dam and the downstream valley must be considered as a combined system, in what concerns the risk induced by dam accidents, including both the dam-reservoir and downstream valley systems. An integrated risk management of both systems must be considered as a continuous and dynamic process during dam lifetime, namely in the dam design and construction phases. He also stated about dam risk management and it is a consequence of two fundamental aspects: (i) a dam is always a potential hazard and (ii) there is a need to guarantee a reasonable and equitable safety to those involved, should an accident occur. Further he talked about the process of dam risk management and it can be considered as a consistent methodology based on a sequence of actions that need to be cyclically undertaken for downstream valley protection.

Elaborating further Prof. Azamathulla shared the main purpose of a dam-break risk management and hazard mitigation is to reduce the expected human losses and the downstream damages related to dam accidents, through both structural and non-structural measures. In risk assessment, the results of the risk analysis and risk evaluation processes are integrated and recommendations are made concerning the need to reduce the risk or to just control the residual risk.

**Speaker: Dr. P. V. Rao, Associate Professor, Department of Civil Engineering, NIT Warangal**

### Speaker

**Dr. P. V. Rao Department  
of Civil Engineering, NIT  
Warangal**



Dr. P. V. Rao is working as Associate Professor in Water and Environment Division, Department of Civil Engineering, NIT Warangal. He is also holding administration posts like Associate Dean (Planning and Development), Divisional Head Water and Environmental division. He has done B.Tech in Civil Engineering from Sri Venkateswara University, Tirupati in year 1999, Masters in Environmental Engineering from Anna University in year 2002 and Ph.D. from BITS Pilani in 2011. His research interests and activities are Water supply, treatment and distribution, wastewater treatment, waste management, low-cost water and wastewater treatment, Anaerobic digestion of organic wastes, waste to energy technologies. He authored more than 40 peer reviewed journal papers and book chapters and presented 30+ papers in National and International conferences. He has handled several research and consultancy projects. He has also guided 1 Ph.D. student and more than 30 masters students and at the present time he is guiding 5 Ph.D and 7 masters students

Dr. Rao covered Integrated Flood Management (IFM) and addresses issues of human security and sustainable development from a perspective of flood management, within the framework of Integrated Water Resources Management (IWRM). Some of the underlying causes that make it difficult to integrate the growing concerns regarding environmental degradation into sound flood management practices revolve around communication gaps between the various



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discipline groups involved – understanding the varying perspectives of sustainable development. He presented IFM approaches with special reference to environmental aspects. He provides useful information for policy makers, environmental groups, NGOs and communities, to help them assess flood risks in relation to environmental concerns and sustainable development. He stated that human activities impact watersheds worldwide, meaning countless rivers are polluted and regulated, and many coastal areas have degraded habitat or reduced fisheries. The altered flow regimes of almost all world rivers constrain the restoration of riparian and estuarine habitats that rely on annual flood cycles and other aspects of natural flow regimes.

He also stated that the man-made hydraulics structures like dams which can cause these alterations are considered permanent landscape features, however, dams should not be considered immutable constraints, as exemplified by successful dam removals that have been occurring as part of restoration actions around the world. He gave one example of worst socio-environmental disasters that marks the current history, occurred in November 2015 in Brazil. This involved an iron mining tailings dam rupture that resulted in the contamination of water, soil, and sediments along the 600 km of the entire course of the Doce River. He also talked about the extreme demands on natural resources due to population growth have forced people and their property to move closer to rivers in many parts of the world. Further, he stated the flood control and protection measures that have encouraged people to utilize newly protected areas extensively, thereby increasing flood risks and consequent losses. Talking on way head for India he emphasizes on urban local bodies to come up with water resources management plans to ensure that usable river training works. At the end, he talked about importance of flood management policies and practices.

### DAY 3: 25<sup>th</sup> August, 2021

Two lectures and six group presentations were delivered by eminent speakers and research scholars, NIDM viz. (i) Dr. Manish Kumar Goyal, IIT Indore; (ii) Dr. manish Pandey, NIT warangal; and (iii) Research scholars and research associates, NIDM, New Delhi.

Starting with the session Dr. Manish Pandey, Assistant Professor, NIT Warangal, welcomed the speakers and participants to the programme with an introduction to the eminent panellist.

**Speaker: Dr. Manish Kumar Goyal, Associate Professor, Department of Civil Engineering, IIT Indore**

#### Speaker

**Dr. Manish Kumar Goyal**  
**Department of Civil**  
**Engineering, IIT Indor**



Dr. Dr Manish Kumar Goyal is Associate Professor and Dean of Infrastructure Development at Indian Institute of Technology, Indore. He is recently featured in the list of Top 2% scientists in the world (prepared by Stanford University). Also in the top 500, the leading researcher in field of Environmental Engineering (Meteorology & Atmospheric Sciences). His research interests include Agriculture, Climate, Water, Artificial intelligence and GIS-remote sensing applications. He worked as research Assistant at University of Waterloo, Canada. He went to pursue further research as postdoctoral fellow at Nanyang Technological University Singapore and McGill University, Canada. He was visiting Professor at University of Nebraska, Lincoln,



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USA and Aristotle University of Thessaloniki, Greece. Dr Goyal holds 04 books, 25 book chapters and more than 120 technical research publication in various refereed journals. He serves as an Associate Editor for the ASCE-Journal of Hazardous, Toxic and Radioactive Waste. He has supervised 10 PhD and 08 postgraduates students in last 10 years.

Dr. Manish Kumar Goyal threw light on atmospheric river (AR) and its impact on climate change hazards. He defined atmospheric river as; atmospheric river was coined by Zhu and Newell (1998) and refers to long narrow streams of high water vapour concentrations in the atmosphere that move moisture from tropical regions towards the poles across the mid latitudes. He stated that our understanding of these phenomena is still in development though some characteristics have been defined. On average, an AR is 400km wide and over 1000km long with between 3cm-6cm of water vapour (known as Vertical Integrated Water Vapour) in the middle of the stream. He stated that atmospheric rivers are a key feature in the global water cycle and are closely tied to both water supply and flood risks — particularly in the western United States. He stated that the atmospheric rivers are responsible for great quantities of rain that can produce flooding, they also contribute to beneficial increases in snowpack. A series of atmospheric rivers fuelled the strong winter storms that battered the U.S. West Coast from western Washington to southern California from Dec. 10–22, 2010, producing 11 to 25 inches of rain in certain areas. These rivers also contributed to the snowpack in the Sierras, which received 75 percent of its annual snow by Dec. 22, the first full day of winter. He presented NOAA research (e.g., NOAA Hydrometeorological Testbed and CalWater) uses satellite, radar, aircraft and other observations, as well as major numerical weather model improvements, to better understand atmospheric rivers and their importance to both weather and climate.

He suggested that the atmospheric scientists must consider and study both climatological and meteorological aspects of the transport of moisture in the atmosphere. It is particularly important to review the conceptual models of moisture transport to aid research into the origin of continental precipitation. The notion of the atmospheric river (AR) is key to the study of water vapour transport in extratropical regions. He stressed increasing the atmospheric river and climate hazards awareness.

**Speaker: Dr. Manish Pandey, Assistant Professor, Department of Civil Engineering, NIT Warangal**

#### **Coordinator and Speaker**

**Dr. Manish Pandey**  
**Department of Civil**  
**Engineering, NIT**  
**Warangal**



Dr. Manish Pandey is one of the coordinators and speaker of this training program. He graduated in Civil Engineering from Uttarakhand Technical University, India. He completed his masters and doctorate from Indian Institute of Technology Roorkee, India. Presently, he is Assistant Professor at NIT Warangal since 2019. He has more than three years teaching and research experience in experimental hydraulics and water resources engineering. He has authored more than 30 peer reviewed journal papers, book chapters and conferences. He is supervising 5 Ph.D. and 4 M.Tech students to investigate river hydrodynamics and sediment transport challenging applications. He was also awarded the MOST postdoctoral research grant in 2019 and MATS early career grant in 2018. He is an active reviewer in several reputed peer



reviewed journals like Environmental Fluid Mechanics, Water (MDPI), Flow Measurement and Instrumentations, Journal of Hydrology, Journal of the Brazilian Society of Mechanical Sciences and Engineering, ISH Journal of Hydraulic Research, Engineering (Elsevier), Water Supply etc.

Dr. Manish Pandey threw light on sediment transport, erosion, scour and fluvial processes flood in natural streams. He stated that the hazards associated with scour and sediment transport. He stated that the Rivers are changeable and unpredictable and can contain hidden dangers. Further he stated that the deposited and eroded sediment processes are responsible for the change of flow directions. He said Rivers often flood every year, causing damage to hydraulics structures and bridge elements. In his session he talked about natural River hazards, which mainly posed by the river systems depend on River flow characteristics and sediment transport in the River system. He stated that the sediment transport capacity is affected by the erosion and deposition of sediment that are finally determined by stream bed level, the lowest elevation to which a stream can flow. He gave some examples of sediment and scour hazards viz. (i) as per an American report published by water and transportation department, more than 500 bridges were collapsed in the USA between 1989 and 2000. This published data shows that bridge element scour was responsible for the 50% of the bridge failures. (ii) In 1993, around 20 bridges were failed due to bridge element scour, resulted from flowing water and waves caused a damage of approximate trillions of rupees in coastal regions. (iii) In Georgia, the total financial loss from tropical storm in 1994 was approximately \$130 million because more than 100 bridges had to be replaced and repaired due to river dynamics and sediment transport. (iv) As per an Indian water ways report, a bridge near Belgaon (Orissa) in India, was washed out by unpredictable scour around the bridge pier. (v) Most recently, Hussain and Jain (2016) reported that the Chadoora bridge in Budgam district, India was collapsed due to the excess scour around the bridge piers. He also stated that around 60% of the bridges collapse in India are caused by scour and erosion around the bridge elements.

He threw light on scour hazards and stated that throughout the world scour and sediment hazards have attracted extensive attention. HE talked about scour reduction methods viz. (i) bed-armouring method, and (ii) flow-altering method. In the first method, scouring process is reduced using coarser material around the pier or by providing suitable riprap; whereas in the latter, the reduction in scour is achieved using different pier scour protection devices, i.e. collars, slots, fins, and bed sills. Principally, these approaches reduce the scour rate by decreasing the impact of horseshoe vortex. He stressed increasing the scour and sediment hazards awareness and suggested various methods for reducing the scour and sediment hazards in Indian streams. She also suggested some research areas in this field.



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Presentations by research scholars and research associates:

S.No	Names	Title of topic
1	Ms Atisha Sood	Project HER-CAP
2	Dr. Sanayanbi Hodam	Project NADMP
3	Ms Richa Shrivastava	Project NEFC
4	Dr. Sweta	CAP-RES
5	Ms Fatima Amin	Erosion causes, risk mitigation and management



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Closing the 3-Day training session coordinators of the training program Dr, Manish Pandey, Assistant Professor, NIT Warangal and Miss Fatima Amin, young professional, NIDM, New Delhi gave the concluding remarks and thanked all the eminent speakers and participants. Miss Fatima underlined that a lot of important points have been brought up in the training with the objective of building river and sediment hazards. These kinds of training discourses play an important role in making people on the policy table accepting the existing issues and planning their policies through suggestions and statistics provided in the discourse.

The training program ended with a vote of thanks by the moderator.



## Key Takeaways

### Segregation of river hazards

- The river hazards need to be segregated into various categories such as flood hazards, sediment and scour hazards, hazards due to failure of hydraulic structures and hazards due to climate change.
- Inculcating the idea of segregation of river hazards at national level

### Strengthening informal sector

- Provide a suitable drainage system and river training works.
- Require a proper maintained of reservoirs and other hydraulic structures
- Social integration and inclusion of informal sector.

### River disaster management plan

- **Sediment control measures**
  - Reducing their entry into the flowing water
  - Reducing their concentration once in the flowing water
  - Reducing their proliferation
  - Control Measures
  - Provide suitable river training works
- **Water extraction and storage systems plan**
  - Use of available water storage during and after periods of heavy rainfall
  - Appropriate location and protection of intake
  - Appropriate choice of off-take depth from reservoirs
  - Proper well construction including casing, sealing and wellhead security
  - Proper location of wells
  - Water storage systems to maximise retention times
  - Roofed storages and reservoirs with appropriate storm water collection and drainage
  - Securing tanks from access by animals
  - Security to prevent unauthorised access, sabotage and tapping and tampering

### Enhancing circular economy

- Use of circular economy pathway of generating resources from river and hydraulic structures (dams and barrages) by utilizing the river water.
- Creating extended producer Responsibility policy awareness.



## Annexures

### Annexure 1: Organizers

#### Patron:

- Major General Manoj Kumar Bindal, Executive Director, NIDM, New Delhi
- Prof. N. V. Ramana Rao, Director, NIT Warangal

#### Conveners:

- Prof (Dr) Anil K. Gupta, Head, Division of Environment Climate Disaster Risk Management, NIDM, New Delhi
- Prof. P. Rathish Kumar, Head, Department of Civil Engineering, NIT Warangal

#### Course Coordinators:

- Ms Fatima Binte Amin, Young Professional, ECDRM Division, NIDM
- Dr. Manish Pandey, Assistant Professor, Department of Civil Engineering, NIT Warangal

#### List of Speakers

- Prof. Umamahesh NV, Professor, Department of Civil Engineering, NIT Warangal
- Prof. Anil K. Gupta, Head ECDRM NIDM
- Prof. P. K. Dixit, Professor, Department of Civil Engineering, IIT BHU
- Mr. Om Jangid, Vice President (Design and Projects), Yooil Infra, India
- Prof. Hazi Azamathulla, Professor of Civil and Environmental Engineering, University of the West Indies, Trinidad.
- Dr. Manish K. Goyal, Associate Professor, Department of Civil Engineering, IIT Indore
- Dr. P. V. Rao, Associate Professor, Department of Civil Engineering, NIT Warangal
- Dr. Manish Pandey, Assistant Professor, Department of Civil Engineering, NIT Warangal
- Research Fellows/Associates, NIDM



## Photographs of the session

Day 1:



Day 2 and 3

**REGRESSION MODELS**

- Data related to scour collected from the model studies and various Tech. reports of CWPRS
- discharge intensity ( $q$ )
- head ( $H_1$ )
- tail water depth ( $d_w$ )
- lip angle of the bucket ( $\theta$ )
- radius of the bucket ( $R$ )
- particle size ( $d_{50}$ )
- scour depth ( $d_s$ ), scour width ( $w_s$ ), scour location ( $L_s$ )

Data Set:  
for training: 75 patterns  
for testing: 25 patterns

Water and Environment Division, CED, NITW

**Welcome**

River Dynamics, Flood and Sediment Hazard Assessment in Indian Rivers

National Institute of Disaster Management  
Department of Civil Engineering, NIT Warangal

**RIVER HAZARDS- AN ENVIRONMENTAL PERSPECTIVE**

By  
**Dr. P. Venkateswara Rao**  
Associate Professor & Head, Water and Environment Division  
Department of Civil Engineering  
National Institute of Technology  
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pvenku@nitw.ac.in; +91 9420161800

Viewing Manish Pandey's s...

a. Large debris blocking outflow  
b. Debris fan  
c. [Photograph of riverbank erosion]  
d. [Photograph of debris in a river]

Richa Srivastava

Richa Srivastava

**National Health Adaptation Plan for Disaster related Illnesses**

Ms Alisha Sood

nidm  
Resilient India - Disaster Free India

**Climate Adaptive Planning for Resilient Sustainable Development in Multi-Hazard Environment (CAP-RES)**

**Funder Organization:** Technology (DST), GoI  
**Department of Science &**

**Project Director:** Prof. Anil K Gupta, Head ECDRM Division, NIDM

**Project Staff:**  
Dr. Sweta Baldya (RA)  
Ms Pritha Acharya (SRF)  
Dr. Uzma Parveen (SRF)

Government of India

nidm  
Resilient India - Disaster Free India

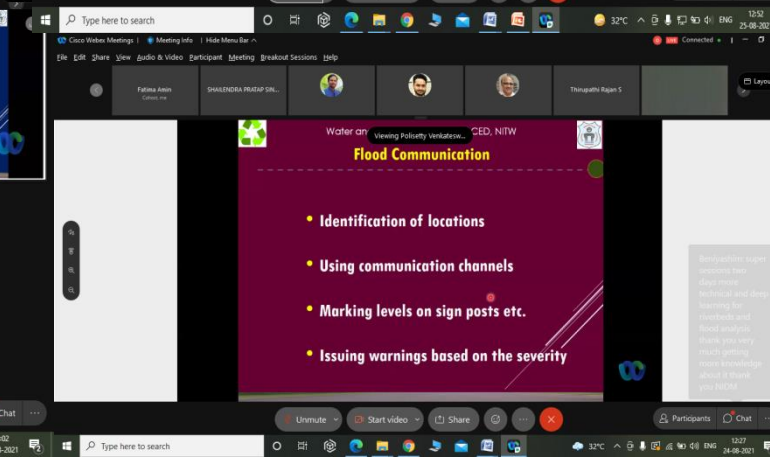
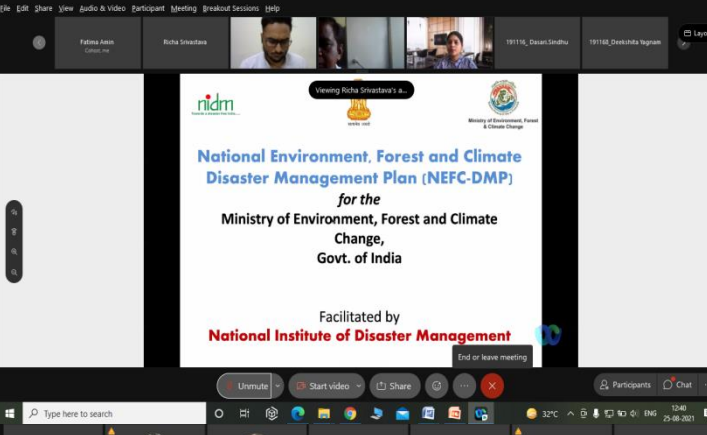
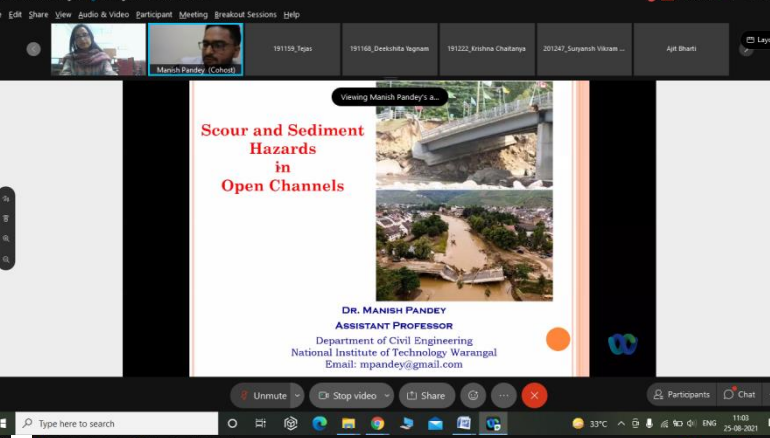
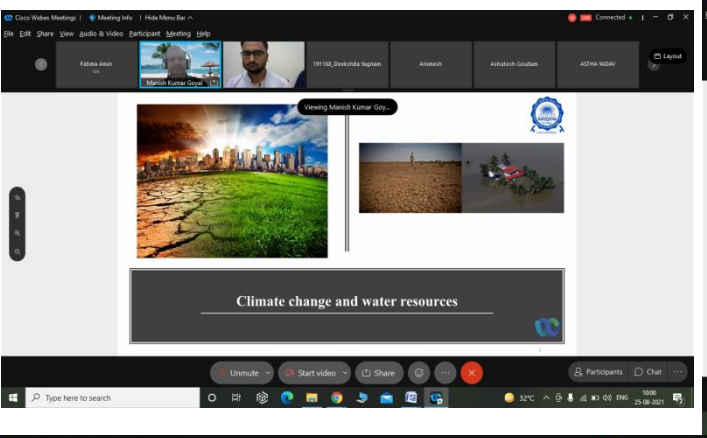
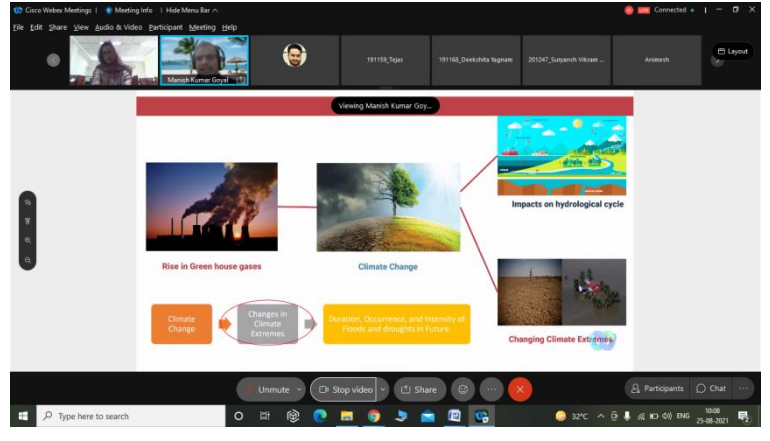
**National Agriculture Disaster Management Plan**

of the  
**Ministry of Agriculture and Farmers Welfare, Govt. of India**

PD: Prof. Anil Kumar Gupta, Head-ECDRM, NIDM  
Core Team: Richa Srivastava, Research Consultant  
Sanaynbi Hodam, Research Associate  
Swati Raghuvanshi, Consultant  
Allied Team: Shweta Bhardwaj, JRF and Anand Kumar, Consultant

Developed by  
**National Institute of Disaster Management (NIDM)**

nidm  
Resilient India - Disaster Free India



The screenshot shows a Cisco Webex meeting interface. At the top, the meeting title is "Climate Change and Extremes" and it is currently viewing a slide by Manish Kumar Goyal. The slide content is as follows:

- **Climate** is the average weather.
- Climate is what you expect, weather is what you get
- **Technical Usage:**  
Climate is the statistics of weather, not just including average weather, but the statistics of variability.  
Commonly calculate for 30 years or more
- **Climate Change** is the any observed changes in the statistics of weather for a long period of time(around 30 years).
- Climate Extremes are **extremes statistics of weather** resulting in **Extreme weather or extreme climate events** includes unexpected, unusual, severe, or unseasonal weather; weather at the extremes of the historical distribution—the range that has been seen in the past.

The meeting interface includes a top navigation bar with "File", "Edit", "Share", "View", "Audio & Video", "Participant", "Meeting", and "Help". A top participant bar shows "Fatima Amin" and "Animesh". The main video area displays "Manish Pandey (Cohost)". A bottom participant bar lists "Fatima Amin", "Manish Kumar Goyal", "191159\_Tejas", "191168\_Deekshita Yagnam", "201247\_Suryansh Vikram ...", and "Animesh". The bottom control bar includes "Unmute", "Start video", "Share", "Participants", and "Chat". The Windows taskbar at the bottom shows the search bar, taskbar icons, system tray with "31°C", "ENG", and "09:57 25-08-2021".



## Annexure 2: List of Participants

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