SAARC

Disaster Management Centre (IU)

ANNUAL REPORT

2023-24

SAARC DISASTER MANAGEMENT CENTRE (IU)

GIDM CAMPUS, GANDHINAGAR, GUJARAT, INDIA

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1. Background

South Asia stands out as the world's fastest-growing region, yet it simultaneously grapples with being one of the most disaster-prone areas globally. The region regularly faces the impact of large-scale catastrophic disasters, with major population centers such as Kabul, Dhaka, Thimphu, New Delhi, Male, Kathmandu, Karachi, Colombo situated along seismic fault lines or vulnerable coastal areas susceptible to cyclones, floods, and storm surges. The frequency and intensity of these extreme weather events are expected to rise due to the effects of climate change. The combination of unplanned human settlements, unsafe building practices, and high population densities has heightened the exposure and vulnerability of both people and economies in the region. Consequently, earthquakes, cyclones, floods, tsunamis, droughts, and various other disasters frequently claim lives, damage property, and disrupt livelihoods across South Asia.

In 2023, the world experienced its hottest year on record, surpassing the previous peak set in 2016. According to NOAA's National Centers for Environmental Information, August 2023 is recorded as the hottest August month since the recorded data are available. Further, The Secretary-General of the United Nations has stated that “era of global warming has ended; the era of global boiling has arrived”. According to the European Union’s Copernicus Climate Change Service, average surface temperatures increased by nearly 0.2°C, reaching 1.48°C above preindustrial levels. This alarming temperature rise underscores the ongoing impact of climate change and emphasizes the urgent need for global efforts to address and mitigate its consequences. Further, the South Asia region has witnessed a substantial rise in the number of disasters, further emphasizing the pressing need for proactive measures to address and adapt to the changing climate conditions. The escalating frequency of such events underscores the vulnerability of South Asia to the adverse impacts of climate change and disasters, necessitating coordinated efforts to enhance resilience and mitigate the consequences on both human and environmental fronts.

Recognizing the need quite timely, the SAARC Disaster Management Centre (SDMC-IU) was set-up at the Gujarat Institute of Disaster Management (GIDM) Campus in Gandhinagar, Gujarat, India in November 2016 with a vision to be a Centre of Excellence for regional cooperation and specialised service delivery to Member States for Disaster Risk Reduction (DRR), Response and Recovery for Sustainable Development.

2. Scope of Work

SDMC(IU) is working to give a fillip to regional cooperation for holistic management of disaster risk in the SAARC region. It serves the Member States by providing policy advice, technical support on system development, capacity building services and training. The

Centre facilitates exchange of information and expertise for effective and efficient management of disaster risk. As needed, the Centre undertakes projects and programmes to serve the needs of the Member States. It seeks to expand from a 'knowledge sharing' organisation to an ‘action-response' organisation and develop Standard Operating Procedures, tools, guidelines and methodologies for different types and phases of disasters.

It is vital for SDMC (IU) to frame cooperation as technical responsibility for regional Disaster Management and Disaster Risk Reduction (DRR) making material contribution to the lives of vulnerable population and those exposed by the natural disasters. The centre is entrusted with the responsibility to support Member States in their DRR initiatives through application of Science & Technology, knowledge from multiple disciplines, exchange of good practices, capacity development, collaborative research and networking in line with the global priorities and goals and other relevant frameworks adopted by Member States.

In addition, the SDMC (IU) has been re-established with an expanded role by merging four erstwhile SAARC Centres namely (1) SAARC Disaster Management Centre (SDMC– New Delhi, India); (2) SAARC Meteorological Research Centre (SMRC - Dhaka, Bangladesh); (3) SAARC Forestry Centre (SFC - Thimphu, Bhutan); (4) SAARC Coastal Zone Management Centre (SCZMC - Male, Maldives). Disaster Risk Reduction relevant functions of these centres are also a part of the scope of work.

3. Vision

To be a Centre of Excellence for regional cooperation and specialised service delivery to Member States for Disaster Risk Reduction (DRR), Response, Recovery and Sustainable Development.

4. Mission

To support Member States in their DRR initiatives through application of Science & Technology, knowledge from multiple disciplines, exchange of good practices, capacity development, collaborative research and networking in line with the global priorities and goals and other relevant frameworks adopted by Member States.

5. Functions of SDMC (IU)

1. Provide assistance in formulation of Policies, Strategies and Sustainable Development Frameworks in relation to disaster Management and Disaster Risk Reduction
2. Undertake/ promote research for better understanding of the various meteorological phenomena of particular interest to the SAARC Region, with a view to enhance the

capability of National Meteorological Services (NMSs) of the Member States, particularly in the field of early warning to provide support for preparedness and management of natural hazards involving relevant knowledge and operational institutions in India.

3. Collect, compile, document and disseminate data, information, case studies, indigenous knowledge and good practices relating to disaster risk reduction, and sustainable development.
4. Compile and collate information for the region required for weather forecasting and monitoring special weather phenomena.
5. Strengthen regional response mechanisms to reduce loss of lives, injuries and to provide timely humanitarian assistance to people affected by disasters.
6. To identify organisations in the region dealing with relevant key focus areas, facilitate interaction, promote coordination and cooperation amongst institutions (ministries, authorities, inter-governmental organisations, international organisations, non-governmental organisations, funding agencies, etc.) and other stakeholders involved through networking for the exchange of experiences, information, data, expertise, knowledge and technology transfer in the key focus areas of SDMC.
7. Organise training workshops, conferences, seminars, lectures for various stakeholders on key priority/focus areas of the Member States and on various aspects of disaster management.
8. Develop educational materials and conduct academic and professional courses on key priority/focus areas.
9. Develop training modules on various aspects of key priority/focus areas and conduct programmes for Training of Trainers including simulation exercises.
10. Coordinate SAADMEx with the Member States.
11. Analyse information, undertake research and disseminate research findings on key priority/focus areas among the Member States.
12. Undertake preparation of databases, publication of journals, research papers and books, and establish and maintain online resource centre in furtherance of the aforesaid objectives.
13. Collaborate with other global, regional and national centres of excellence to achieve synergies in programmes and activities.
14. Conduct studies on assessment and management of disaster risks posing a threat to inclusive and sustainable development in South Asia.
15. Undertake research, projects, programmes contributing towards mitigating the impact of trans-boundary disasters.
16. Facilitate from within and outside the region supply of emergency needs in times of disaster, in line with SAARC disaster response mechanisms.
17. Facilitate exchange of experiences and technical support among Member States on National Action Plans for Disaster Risk Reduction.

6. Activities in the Financial Year 2023-24

6.1 Preparation of Activity Plan

SDMC (IU) had prepared its annual Activity Plan for FY 2022-2023 based on the discussion in fifth Inter-Ministerial Meeting and shared with MEA, GoI. Based on the administrative and financial approval received by MEA, following capacity building programs/ webinars were conducted.

6.2 Capacity Building Programs Organised

#	Name of the program	No. Of Participants	Presence of Member States	Date
1	Building Disaster Resilience for SAARC Member States in Riskier Times through Customized ESCAP's Risk & Resilience Analytics	Cancelled		23-25 August 2023
2	Integrated Flood Risk Management *(Annexure)*	28	Five Member States (Except Afghanistan, Maldives and Pakistan)	08-11 December 2023
3	Extreme Heat Preparedness and Management	Cancelled		18-20 March 2024

6.3 Other Programs

#	Activity	Action Taken
1	**Updation of SAARC DM Framework**	• A draft of SAARC Framework on Comprehensive Disaster Risk Management was developed and shared with UNDRR ROAP for their comments/ inputs. • The framework has been revised, incorporating comments received from UNDRR ROAP. It will be finalised after following due procedure.
2	**39th SAARC Charter Day**	The 39th SAARC Charter Day was celebrated during the virtual workshop on Integrated Flood Risk Management held from 8th to 11th December 2023.

3	**Publications**	• One volume of the Newsletter. • Annual report for FY 2022-23.
4	**Web Portal**	• SDMC (IU) updates its portal with all the necessary information/ data on regular basis.

7 Financial Status for the FY 2023-2024 (₹)

Total Funds available as on date 01/04/2023	Fund Released during FY 2023-24	Total funds available for FY 2023-24	Expenditure incurred during FY 2023-24
39,52,270.00	64,14,230.00	1,03,66,500.00	54,11,424.00

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Annexure

SAARC
Disaster Management Centre (IU)

GUJARAT INSTITUTE OF DISASTER MANAGEMENT
BUILDING RESILIENCE

A Brief Report on the Virtual Workshop: Integrated Flood Risk Management

08 - 11 December 2023

SAARC Disaster Management Centre (IU)
GIDM Campus, Gandhinagar, Gujarat, India

Background

The SAARC region is facing multiple compounding and cascading crises simultaneously. The persistent reality of climate change is reshaping the disaster riskscape. Under the new climate scenarios based on the 6th IPCC Assessment Report, the difference between 1.5 and 2 degrees Celsius is substantial. Every fraction of a degree translates to increased and disproportionate impacts of heavy precipitation and flooding in the SAARC region.

The Region is home to some of the world's largest river catchment areas, including the Indus, Ganges, Brahmaputra, Godavari, Narmada, Kaveri, Kosi, and more, all of which contribute to a heightened susceptibility to floods and river erosion. Regrettably, the absence of a comprehensive interdisciplinary strategy for River Management and Flood Plain Conservation has led to substantial losses in terms of ecology and environment. A recent example is the devastating floods in Pakistan, which impacted over 32 million people and caused damages estimated at around $30 billion. Floods and inundations of varying intensity were recorded across other countries including Afghanistan, Bangladesh, India, Nepal, and Sri Lanka. The significant changes observed in geographical characteristics, monsoon behaviours, and urban development paint a challenging picture for the times ahead.

Glacial Lake Outburst Floods (GLOFs) also pose a significant concern within the SAARC (South Asian Association for Regional Cooperation) region due to its mountainous terrain and the presence of numerous glaciers and glacial lakes. GLOFs occur when a glacier-dammed lake suddenly bursts, releasing a massive volume of water, ice, and debris downstream. These events can lead to devastating downstream flooding, causing widespread damage to infrastructure, settlements, and ecosystems. The SAARC region is home to several countries with high-altitude regions, such as Nepal, Bhutan, and parts of India, where glaciers and glacial lakes are prevalent. The warming climate has accelerated glacier melt and led to the expansion of many glacial lakes, increasing the potential for GLOFs.

Recognizing the need for collaborative efforts to mitigate flood risks and enhance disaster resilience, the virtual Workshop on 'Integrated Flood Risk Management' has been organized.

Objective of the Workshop

1. Explore the intricate interplay between flood risks and evolving climatic conditions specific to the SAARC Region.

2. To discuss the principles, methodologies, and good practices related to Integrated Flood Risk Management within the SAARC Region.

3. Explore the implications of changing climate patterns on flood risks and equip participants with strategies to enhance resilience in the face of climate variability.

4. Introduce participants to innovative technologies, tools, and practices for early warning, flood monitoring, and real-time decision-making.

5. Enhance participants' ability to develop effective disaster preparedness and response plans, ensuring timely and coordinated actions during flood events.

6. Share successful case studies and lessons learned from within and outside the SAARC Region to inspire and inform participants' flood risk management strategies.

List of Participants

28 Participants from five SAARC Member States i.e. Bangladesh, Bhutan, India, Nepal and Sri Lanka attended the virtual workshop. The list of participants who attended the workshop is available on Annexure 2.

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SAARC
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Program Agenda

Day 1: 08 December 2023

Time	Session	Speaker/ Facilitator
13:45 - 14:00	Registration & Pre- Training Brief	
Welcome & Inaugural Session		
14:00 - 14:15	**About the Program**	SDMC (IU)
14:15 - 14:30	**Inaugural Address**	**Dr. Rajiv Kumar Gupta, IAS (Retd.)** Director - SDMC (IU)
14:30 - 15:00	**Session 1: Challenges and opportunities in Managing Climate Induced Flood Risk in SAARC Region** - Reflections	**Dr. Krishna AchutaRao** Professor, CAS, IIT-Delhi, Lead Author (IPCC)
15:00 - 15:30	**Session 2: Case Studies from SAARC Region: Nepal Experience on Glacial Lake Outburst Flooding (GLOF)** - Climate Risk at the 'Third Pole' - Increased frequency and intensity - High-risk transboundary water basins in the Himalayas - Existing second and monitoring systems in Nepal - Adaptation needs	**Mr. Anil Pokhrel,** Chief Executive, NDRRMA, Govt. of Nepal, Kathmandu, Nepal
15:30 - 16:00	**Session 3: Flood Disaster Preparedness & Response: Issues & Challenges - Odisha Floods** - Emergency response planning and management ' - Evacuation process - Search and rescue	**Mr. Lingaraj Gouda,** Engineer in Chief Planning & Design Dept of Water Resources, Govt. of Odisha
16:00 - 16:30	**Break**	
16:30 - 17:00	**Session 4: Insight on Integrated Flood Risk Management** - Concepts, Scope & Challenges	**Mr. A B Pandya** Secretary General, ICID & Former Chairman, Central Water Commission

Day 2: 09 December 2023

Time	Session	Speaker/ Facilitator
14:00 - 14:30	**Session 5: Flood Risk Assessment** - Basic Principles and aspects of flood risk assessment - Process of flood vulnerability and capacity assessment - Process of flood risk assessment - Community-based flood risk assessment	**Prof. (Dr) Anupam K. Singh** Adani Institute of Infrastructure Engineering
14:30 - 15:00	**Session 6: Flood Early Warning Systems: Case Study of Indian Meteorological Department (IMD)** - Components of a Comprehensive Flood EWS - Integrating FEWS into Dam Management - Role of IMD in Flood Management - Flash Flood Guidance System of MoES, India	**Ms. Manorama Mohanty** Scientist-E & Head Meteorological Centre, Ahmedabad
15:00 - 15:30	**Break**	
15:30 - 16:00	**Session 7: Role of cascading reservoirs in effective flood risk management** - Case of Integrated Management of Narmada River Basin	**Dr. M B Joshi** Chief Engineer (Retd.), Sardar Sarovar Narmada Nigam Ltd.
16:00 - 16:30	**Session 8: Role of Artificial Intelligence in Flood Management & Monitoring** - Concepts, Scope & Challenges	**Prof. (Dr.) Deepak Khare** IIT Roorkee

Day 3: 10 December 2023

Time	Session	Speaker/ Facilitator
14:00 - 14:30	**Session 9: Recovery and Rehabilitation - Case Study of 2018 Kerala Floods** - Flood damage assessment - Management of sustainable recovery and rehabilitation activities - Build Back Better - Flood Resilience Concepts, Scope and Challenges	**Dr. Sekhar L. Kuriakose** Member Secretary, Kerala State Disaster Management Authority
14:30 - 15:00	**Session 10: Safeguarding Communities in Flood Management - Case Study of National Disaster Response Force (NDRF)** - Pre-Flood Preparedness - Response During Floods - Post-Flood Recovery and Rehabilitation - Success Stories & Lessons learned from past experiences	**Shri. Atul Karwal, IPS** Director General, National Disaster Response Force

15:00 - 15:30	**Break**	
15:30 - 16:00	**Session 11: Case Studies from SAARC Region: Lessons from the 2013 Kedarnath Floods** - Causes, Contributing Factors: Natural Anthropogenic - Social and Infrastructural Impacts - Immediate response from Govt. agencies, Army, etc. - Need for Actionable End to End EWS - Induced Policy intervention & incorporating BBB Adaptation Needs	**Dr. Ranjit Kumar Sinha** Secretary - Disaster Management, Uttarakhand State Disaster Management Authority

Day 4: 11 December 2023

Time	Session	Speaker/ Facilitator
14:00 - 14:30	**Session 12: Lessons learned in WASH: Response during Floods** - Tackling Water Borne Diseases - Sanitation & Hygiene related challenges - Emergencies & Outbreaks	**Dr. Saurabh Dalal** World Health Organisation
14:30 - 15:00	**Session 13: Cross-cutting Issues** - Anticipatory Actions Targeting Transboundary Floods - Impact Based Forecasting and Forecasting based Financing	**Shri. Lalit Dashora,** Senior Multi-Hazard Early Warning Specialist, ADPC
15:00 - 15:30	**Break**	
15:30 - 16:00	**Session 14: Case Study of Sikkim Floods** - Causative Factors - Response by Govt. and Non-Govt. Agencies - Planning for Resilient Future	**Dr. Vinod K. Sharma,** Sikkim State Disaster Management Authority
16:00 - 17:00	**Country Presentation**	
	1. Bangladesh	**Ms. Lutfun Nahar** **Dr. Robin Kumar Biswas**
	1. Bhutan	**Mr. Sonam Tshewang**

	2. Nepal	**Er. Krishna Prasad Rijal**
	3. Sri Lanka	**M.A.C. Mohamed Riyas**
17:00 - 17:10	**Concluding Remarks**	

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SAARC
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Virtual Workshop on Integrated Flood Risk Management

Inaugural Address

On behalf of the SAARC Disaster Management Centre, Mr. Shubham Daberao, (I/c) Research Officer & Program Manager (PM/RO), SDMC (IU) welcomed all the participants from respective SAARC Member States for the virtual workshop conducted by SDMC (IU).

Dr. Rajiv Kumar Gupta, IAS (Retd.)
Director, SDMC (IU)

The keynote address was given by Dr. Rajiv Kumar Gupta, Director, SDMC (IU). He welcomed all the participants and expressed his gratitude towards the Member States for having deputed them. He emphasized the importance of cooperation and coordination among the SAARC Member States in the region to address the challenges of flooding, GLOFs, rising temperature and aid in mitigation activities. Quoting the recent example of flash floods in Sikkim-India on October 4, 2023 he raised his concern and also mentioned about the efforts which are still needed to enhance and implement comprehensive strategies in integrated flood risk management to save lives and economic losses. As December 8, 2023 commemorated the 39th SAARC Charter Day, he extended his warmest wishes and appealed the Member States and their people to reaffirm their commitment to make SAARC more Disaster Resilient.

Session 1: Challenges and Opportunities in Managing Climate Change Induced Flood Risk in SAARC Region: Reflections

Dr. Krishna AchutaRao, Professor
Centre for Atmospheric Sciences,
Associate Faculty School of Public Policy, IIT-Delhi

Dr. Krishna discussed about climate change followed by its challenges and opportunities. During the session, participants gained insights into several crucial aspects, including the water cycle and its variations, the influential factors driving climate impact along with their trends and confidence levels, such as floods, compounding flooding, precipitation alterations, and event attribution. An illustrative case was presented which involves a consortium of global weather attribution experts addressing the 2022

floods in Pakistan. Additionally, he delved into understanding the functioning of climate models and their associated challenges. Furthermore, he explored household (HH) factors encompassing social-economic, institutional, physical, and attitudinal vulnerabilities. The Sixth Assessment Report of United Nations Intergovernmental Panel on Climate Change highlighted that climate change is already impacting inhabited regions worldwide, with human influence playing a significant role in observed alterations in weather and climate extremes.

Session 2: Case Studies from SAARC Region: Nepal Experience on Glacial Lake Outburst Flooding (GLOF)

Mr. Anil Pokhrel,
Chief Executive, National Disaster Risk Reduction And Management Authority (NDRRMA), Govt. of Nepal

Several noteworthy points were discussed, including the comparison of the impact of different events like COVID-19 and road accidents to that of floods in Nepal. The discussion also touched upon how black soot from fires affects glacier melting, the challenges posed by the Melamchi floods, and the increased vulnerability associated with sediment flow into river systems. Notably, floods caused damage to hydropower plants and bridges. Concerns were raised about certain events, particularly those occurring before the monsoon, which were vividly depicted through intriguing photographs, often referred to as Himalayan tsunamis. The aftermath of the monsoon resulted in substantial economic losses, significantly affecting the GDP of Nepal. Additionally, incidents related to Glacial Lake Outburst Floods (GLOFs) were emphasized, underscoring their critical impact on lives and livelihoods. Despite these challenges, there was optimism regarding various initiatives and policies in disaster risk reduction. During the discussion, specific attention was given to the details of GFLO early warning systems, including their mechanisms and working principles. The focus was on enhancing the capacity of the general public to comprehend the dangers associated with GLOFs. The participants also engaged in conversations about the duration sediment remains on riverbeds and discussed approaches for effectively managing landslides.

Session 3: Flood Disaster Preparedness & Response: Issues & Challenges- Odisha Floods

Mr. Lingaraj Gouda
Engineer in Chief Planning & Design Dept. of Water Resources Govt. of Odisha

Key points discussed by Mr. Gauda included the developmental trajectory post

Components of Flood Risk Assessment

the 1999 cyclone and the coastal characteristics of Odisha. Emphasis was placed on major river basins, particularly the Mahanadi River, various types of reservoirs, and the flooding patterns

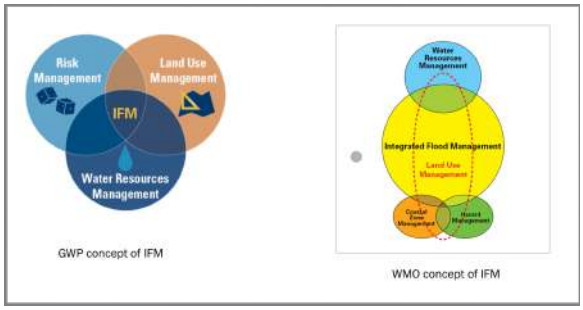
observed. Notably, there was a mention of the critical aspect of the response time in the case of flash floods, with a focus on unprotected rivers such as the Budhabalanga and the Baitarani experiencing frequent flooding. Rivers like the Mahanadi and Subarnarekha, with large catchment areas in neighbouring states, were highlighted for their susceptibility to flooding caused by rainfall in those states. The discussion pointed out the unique challenge faced by the Mahanadi River, with the travel time from the Hirakud Dam to the delta-head taking almost 48 hours. This underscored that rainfall in the lower catchments alone could lead to a flood situation. The conversation extended to flood management, covering pre-flood arrangements in terms of preparedness measures, responses during floods, and post-flood arrangements focusing on rehabilitation and reconstruction efforts. Participants also engaged in a discussion about storm surge management during cyclones.

Session 4: Insight on Integrated Flood Risk Management

Mr. A B Pandya

Secretary General, International Commission on Irrigation and Drainage & Former Chairman, Central Water Commission (CWC)

As discussed by Mr. A B Pandya, various



Conceptualisation of Integrated Flood Management (IFM)

categories of floods, namely riverine flooding, flash floods, and coastal floods, necessitate distinct types of flood forecasting systems. The assessment of flood risk involves considering both hazard exposure and vulnerability. Integrated flood management plays a crucial role, relying on hydrology and investment strategies to ensure that floods are managed in a manner that yields benefits for all stakeholders. This approach comprises three key components: water resources management, land use management, and coastal zone management, all interlinked with hazard management. The integration of components involves basin-level

integration, stakeholder integration, as well as both vertical and horizontal integration. Different mechanisms, including structural and non-structural measures, are available to reduce vulnerability to floods. In establishing flood forecasting systems, a comprehensive setup is essential.

Session 5: Flood Risk Assessment

Prof. (Dr.) Anupam K. Singh
Adani Institute of Infrastructure Engineering

Being a dedicated researcher and academician, Prof. Singh delved into several key areas, starting with background definitions and moving on to flood risk analysis, assessment, and measurement. The discussion encompassed various flood risk assessment approaches, highlighting different models, and explored the flood risk mitigation strategies. Concluding the presentation, he provided recommendations, using the Tapi River as an illustrative example. The impact of variability on calculating the return period of structures and rivers was emphasized, and the importance of addressing flood risk through communication, assessment, reduction, and management strategies was underscored. The comprehensive understanding extended to planning, hydrology, hydraulics, economics, geotechnical considerations, operations, runoff, and the causes of urban flooding. The knowledge gained included insights into flood models and mitigation strategies such as zoning and channelization. Regarding flood risk assessment reports, he stressed the inclusion of considerations like ensuring that projects unintentionally do not increase flood risk in neighbourhoods, and planning for how people will interact with floodwaters in case of flooding. The conclusion underscored the necessity of incorporating flood risk assessment into master plans, advocating for its inclusion by urban local bodies and municipal corporations as part of building development plan permissions.

Occurrence of Floods in last few years

Year	River Basin
2022	Mahanadi, Subarnarekha
2020	Mahanadi, Brahmani, Baitarni, Budhabalanga
2019	Baitarni
2018	Budhabalanga, Baitarni

Session 6: Flood Early Warning Systems: Case Study of Indian Meteorological Department (IMD)

The session revolved around Flood Early Warning Systems (EWS), with a particular emphasis on risk communication and the administrative role. The discussion delved into the comparison of Structural Measures versus Non-Structural Measures. In terms of structural measures, the construction of dams and embankments was highlighted as a costly yet effective approach, safeguarding both movable and immovable properties. She introduced new initiatives, such as extending the lead period of River Sub Basin Quantitative Precipitation Forecast (QPF) from 5 to 7 days, issuing Probabilistic QPF, establishing new

Dr. (Mrs.) Manorama Mohanty
IMD Ahmedabad, Ministry of Earth Sciences

Forecast Meteorological Offices (FMOs) in Srinagar, Bengaluru, Chennai, and Thiruvananthapuram, expanding the rain gauge network to 5896 rain gauge stations under District wise Rainfall Monitoring Scheme (DRMS), utilising more models for decision-making, and providing high-resolution dynamical model forecasts to the Central Water Commission for hydrological modelling. Noteworthy improvements include a 6% increase in river sub-basin-wise Quantitative Precipitation Forecast (QPF) skill in recent years and the extension of Flash Flood guidance to 100,000 watersheds from the previous 30,000. Joint advisories by the India Meteorological Department (IMD), Central Water Commission (CWC), and National Disaster Response Force (NDRF) on the flood status of the country were also discussed. Ms. Mohanty highlighted areas of concern, including the network, accuracy of forecasts for heavy rainfall events, and Quantitative Precipitation Forecast accuracy, suggesting a way forward that involves enhancing the observational network, employing high-resolution Numerical Weather Prediction (NWP) modelling, post-processing for NWP rainfall (BIAS correction/ downscaling), multi-model ensemble for probabilistic sub-basin-wise categorical rainfall forecasts, coordination among stakeholders for information exchange, and applying dynamical models in Extended Range Rainfall Forecast in river sub-basins.

Session 7: Role of cascading reservoirs in effective flood risk management

Dr. M. B. Joshi
Chief General Manager (Retd.), Sardar Sarovar Narmada Nigam Limited

Sharing his longterm experience with the Sardar Sarovar Project on River Narmada, Dr. Joshi focused on the pivotal role of cascading reservoirs in effective flood risk management, with a thematic exploration of flood routing. The session featured an elucidation of the rule curve for reservoir operation, and participants engaged in discussions that touched upon integrated planning and the development of the Narmada basin. The various stages of the Sardar Sarovar Dam were also examined from flood risk management point of view, accompanied by a visual representation of the state-of-the-art SCADA control room with mimic display.

Dr. Joshi concluded the session by elaborating on the diverse roles of cascading reservoirs in flood risk management. Key points emphasized include the importance of an integrated basin approach, particularly for mitigating flood risks induced by climate change. The presentation underscored the challenges posed by the unpredictability of nature and

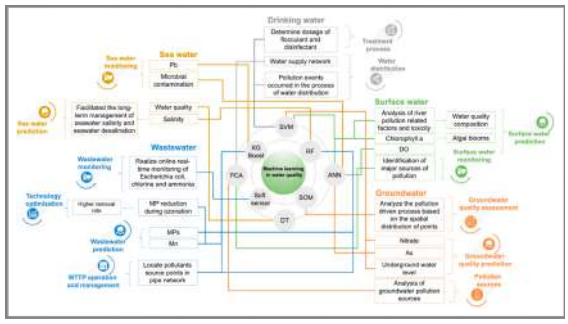
the limitations of rain/flood forecasting methods, highlighting how higher storage capacities in reservoirs and their pre-depletion can contribute to reducing flood risks. The discourse delved into the delicate balance between averting potential risks and damages for millions of people and animals, while also addressing the need to avoid wasting precious water solely for flood risk mitigation, which could lead to water-stressed conditions throughout the rest of the year. The speaker advocated for a thoughtful integration of both structural and non-structural strategies, emphasizing the importance of wisdom and cooperation at the basin level. The session concluded by highlighting that state-of-the-art technological solutions can indeed play a significant role in achieving effective flood risk management.

Session 8: Role of Artificial Intelligence in Flood Management & Monitoring

The discussion started with the significance of KYA - “Know Your Area" likewise the KYC - “Know Your Customer" and delved into the applications of machine learning in water resources. A key focus was on proposing solutions to reduce flood risk, particularly through the utilization of the Internet of Things (IOT) and Synthetic Aperture Radar (SAR). During the session, participants raised inquiries about the various applications of

Prof. Deepak Khare
BIS Chair Professor & Professor (HAG)
Department of Water Resources Development and Management
Indian Institute of Technology Roorkee

artificial intelligence (AI), its usage, and its implications. In summary, it was highlighted that AI provides valuable tools and techniques to address the water crisis. The deployment of low-cost AI-powered sensors for widespread monitoring and management of water resources was emphasized. The urgency of addressing basic necessities, especially in the face of water scarcity challenges, was underscored. The speaker advocated for the development of AI-based intelligent machines to tackle global issues, asserting that AI possesses the solutions to address water scarcity problems. The collective efforts of researchers were acknowledged



Detailed Application of Machine Learning in Water Resources (Source: Zhu, 2022)

as they work towards establishing a reliable, sustainable, and resilient water infrastructure, with the assistance of artificial intelligence. In the concluding

remarks, the significance of AI in providing tools and techniques to solve the water crisis was reiterated. The deployment of low-cost AI-powered sensors for monitoring and managing water, coupled with the potential for addressing global issues through AI, was emphasized. The message conveyed was that AI, when used appropriately, holds the answers to solving water scarcity problems, and ongoing research aims to establish a robust water infrastructure with the support of artificial intelligence.

Session 9: Recovery and Rehabilitation - Case Study of 2018 Kerala Floods

Dr. Sekhar L. Kuriakose
Chief Resilience Officer, Dept. of Env.
Member Secretary, KSDMA
Head, KSEOC, Govt. of Kerala

Dr. Sekhar discussed the hazards and disasters faced by Kerala, encompassing floods, epidemics, droughts, and more. The video documenting the Kerala floods left a profound impact, evoking strong emotions and providing a gripping narrative. Detailed insights were provided into government strategies, measures, and mechanisms, including risk bonds and the Kerala Warnings, Crisis, and Hazard Management System (KaWaCHaM), developed with the assistance of organizations such as WHO, NDMA, and CMS. The presentation showcased various orange books outlining Standard Operating Procedures (SOPs) for monsoon and cascading hazards, portals guiding the direction of lightning, and the integration of early warning systems. Other initiatives, such as the Risk Lab, aimed at mitigating flood risks, were highlighted, along with the importance of CORDEX and the downscaling exercise. The speaker reiterated the famous Kerala saying, *"When floods rise above your heads, float boats above it*" which served as an inspiring perspective. The session became thought-provoking when the speaker discussed the anticipated routine of recurring floods in the coming decade. Additionally, local government disaster management plans were addressed during the presentation, adding further depth to the discussion.

KaWaCHaM

Session 10: Safeguarding Communities in Flood Management - Case Study of National Disaster Response Force (NDRF)

Mr. Atul Karwal, IPS
Director General,
National Disaster Response Force (NDRF)

Mr. Karwal provided insights into various battalions and their deployment, both nationally and internationally. A brief overview of the National Disaster Response Force (NDRF) preparedness for

floods was discussed, emphasising coordination with stakeholders, pre-positioning plans, reconnaissance of flood-

Specialisation of NDRF

prone areas, and comprehensive training programs for rescuers, volunteers, and community awareness. During floods, the NDRF closely monitors forecasts, coordinates with administrations, conducts rescue and evacuation operations, establishes medical camps, and assists in relief efforts. Post-flood activities include a review of affected areas, medical check-ups for rescuers, demobilisation, debriefing, and documentation of lessons learned, along with counselling for rescuers.

A case study of the Silchar floods in 2022 provided practical insights into various aspects of disaster response, revealing challenges in rescue operations and highlighting the importance of disaster management plans. The session emphasized the need for comprehensive disaster management plans at the state and district levels, incorporating measures such as a robust telecommunication system, SMS gateway for alerts, lighting arrangements for prolonged operations, and workshops for equipment maintenance. Other key elements include awareness campaigns, training for vulnerable sections of society, volunteer training, and regular mock exercises.

He shared the proactive approach of the NDRF, including planned deployments,

Airlifting of NDRF Team during Silchar floods, 2022

advance surveys, all-weather helipads, and an incident response system with unity of command at the local level. The establishment of a call centre with web-based information on rehabilitation/ relocation was also highlighted. When questioned about women's participation in the NDRF, he acknowledged the increasing number of female members and expressed further requirements in near future.

Session 11: Case Studies from SAARC Region: Lessons from the 2013 Kedarnath Floods

Dr. Ranjit Kumar Sinha

Secretary Disaster Management, Uttarakhand State Disaster Management Authority

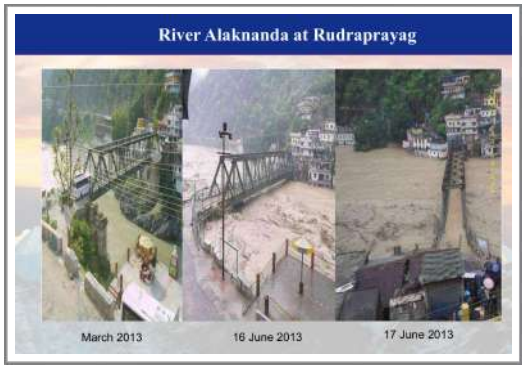
Dr. Sinha shared harrowing experiences from the Kedarnath floods, detailing the extensive devastation in areas near Mandakini, Rudraprayag, and others. The loss of fertile land near Okhimath was highlighted, and the tentative cost of losses amounted to 2662.6 million INR.

He briefed the audience about relief efforts, on-site rescue operations by various stakeholders and government bodies, and the emergence of the

Uttarakhand Disaster Recovery Project (UDRP) as a beacon of hope for the disaster victims.The UDRP, supported by the World Bank, played a crucial role in the recovery process. It involved the implementation of hydro-meteorological early warning systems, meteorological early warning systems, and the installation of automatic water stations and snow gauges, including the Surface Field Observatory in Kalsi. The UDRP project also focused on developing a Disaster Risk Database for Disaster Risk Reduction (DRDB) and the Uttarakhand Morphology Information System (URMIS), along with

Disaster Risk Database (DRDB)

the establishment of a Decision Support System. The importance of information systems, knowledge-based integration of river systems and vulnerable areas, and the use of decision support systems were emphasized. Dr. Sinha highlighted the significance of refining hydro-meteorological forecasting systems and modelling, and the ongoing efforts in creating a Landslide Inventory Atlas for Alaknanda, Bhagirathi, and Mandakini Valleys. Landslide hazard and risk assessments in major hill townships, establishment of geo-technical and geophysical labs, and mitigation measures at landslide-affected areas like Baliyanala, Nainital, Mansa Devi hill, Haridwar, Karnprayag, were discussed. During the



Devastation after the disaster during Kedarnath Floods

Q&A session, Dr. Sinha shared insights from the 6th World Congress on Disaster Management held in Dehradun, emphasizing the need for collective efforts from the government, academicians, and researchers. He also provided details of the successful rescue operation in the Uttarkashi tunnel and how challenges were overcome in the process.

Session 12: Lessons learned in WASH: Response during Floods

Dr. Saurabh Dalal
National Professional Officer
Emergency Preparedness and
Risk Management, WHO India

The presentation provided a comprehensive understanding of various aspects of water and sanitation during floods. After floods, issues such as contaminated water supplies, disrupted access to WASH facilities, increased risks of waterborne and vector-borne diseases, and damage to infrastructure were discussed. Critical lessons were drawn

from inadequacies in surveillance systems, absence of early warning systems that study trends in rainfall and flooding patterns to predict infectious diseases, and a lack of testing kits for common waterborne diseases in flood-affected regions. Data sharing among different sectors, especially from the private sector, was noted as inadequate, leading to incomplete information and ineffective resource utilization. Sanitary and hygiene-related issues were addressed, emphasizing the need for temporary facilities to be hygienic, scientific, and disability-friendly, with considerations for gender, age, and persons with disabilities. The absence of disaster-resilient WASH infrastructure and the technical knowledge to maintain them during floods were identified as areas requiring attention.

Good practices were highlighted, including initiatives like the Wayanad Initiative in Kerala, where the community played a crucial role as first responders, and examples from Pakistan involving the construction of climate-resilient latrines. Looking forward, the speaker advocated for a comprehensive response that includes emergency preparedness, timely interventions, and sustained efforts to rebuild infrastructure and communities, emphasizing an all-hazard approach in disaster management. Promotion of new technologies and engineering innovations was also suggested as a way forward. In response to a question about the impact of climate change on WASH practices in disasters, the speaker lucidly explained the relationship between climate change, its impact on water, and the changing usage patterns.

Session 13: Cross-cutting Issues

Mr. Lalit Dashora,
Senior Multi Hazard Early Warning Specialist, Asian Disaster Preparedness Centre, Bangkok

Mr. Dashora explained about cross-cutting issues and gave global perspective on multi - hazard early warning system. He delved into the anticipatory actions targeting transboundary floods and its critical components of modern disaster risk reduction strategies, aiming to mitigate the devastating impact of floods that traverse international borders. One innovative approach in this regard is Impact-Based Forecasting and Forecasting-based Financing. This method integrates advanced forecasting techniques with a focus on the potential impact of floods, allowing for more proactive and targeted response measures. By anticipating the consequences of a flood event, authorities can implement pre-emptive actions such as early warning systems, evacuation plans, and resource mobilization. Additionally, Forecasting-based Financing involves the allocation of financial resources based on forecasted impacts, ensuring that funds are readily available for immediate response efforts were discussed during the session. These anticipatory measures not only enhance preparedness but also contribute to building resilience in vulnerable regions,

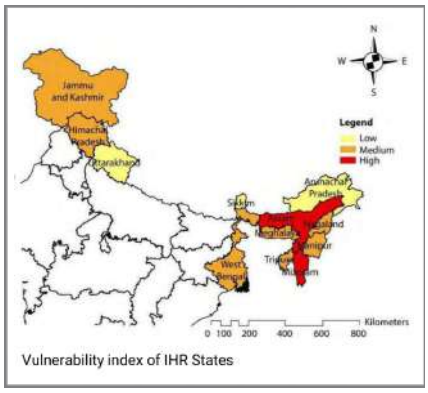
fostering a more effective and collaborative approach to transboundary flood management on a global scale.

Session 14: Case Study of Sikkim Floods

Prof. Vinod K. Sharma

Senior Professor, Indian Institute of Public Administration, New Delhi

Vice Chairman, Sikkim State Disaster Management Authority, Govt. of Sikkim



Source: Climate Vulnerability Assessment for the Indian Himalayan Region

Having been honoured with the Subash Chandra Bose Aapda Praband Puraskar for 2022, Prof. Sharma shared valuable insights drawn from his extensive experience in the field of disaster risk management, both in Sikkim and across India. In the context of the Himalayas, disaster risk encompasses the likelihood of detrimental consequences resulting from natural hazards such as earthquakes, landslides, and floods. This consideration involves evaluating the region's susceptibility to these hazards, the exposure of human settlements and infrastructure, and the vulnerability of communities, with a particular focus on the potential adverse impacts on the Himalayan states. During the presentation, Prof. Sharma discussed recent disasters in Sikkim, including damage to Indian Army truck, bridges, roads, infrastructure, economy and many more. He highlighted ongoing initiatives for Glacial Lake Outburst Flood (GLOF) mitigation, emphasizing the detailed analysis of South Lhonak Chho lake.

Some glimpses from the second expedition

Three expeditions were conducted in August 2014, September 2016, and September 2017. The third expedition encountered challenges as the sensor designed to monitor water levels collided with floating icebergs. Observations included a shift in the river course and the displacement of a siphoning pipe due to improper anchoring. Despite these challenges, efforts were made to reinstall and anchor the siphoning pipe, although fixing the water level monitoring sensor proved difficult as it was submerged. Community based disaster risk management approach helped the officials to evacuate most of the population before the event. Prof. Sharma underscored the importance of ecosystem management, biodiversity conservation, water resource management, agroecology, and sustainable agriculture in addressing these issues. He particularly stressed the significance of community-based

adaptation and resilience as crucial elements in disaster risk management.

Country Presentations

As planned well in advance, following the technical sessions, representatives from SAARC member states provided concise overviews of flood situations in their respective countries. These presentations encompassed demographic details, the status of welfare and development schemes, statutory arrangements for Disaster Risk Reduction & Management, and sector-specific challenges including agriculture, water resources, hydrology, meteorological services, WASH, and more as per the Standard Template circulated to them by SDMC (IU). The discussions touched upon the delicate balance between population growth, economy, and development. During the discourse on flood risks and challenges, the representatives delved into various aspects such as vulnerability indicators, geographical challenges, institutional structures, details of major flood events over the past decade, and the mechanisms employed for early warnings and flood response.In the context of ensuring risk-informed development and resilience, the discussions covered integrated river basin approaches for flood management, community-based solutions to reduce flood risks, support from national governments to local governments for fostering disaster risk reduction (DRR) and climate action, as well as showcasing successful instances of flood risk-informed development. These insights and presentations collectively contributed to a comprehensive understanding of the diverse challenges and approaches adopted by SAARC member states in managing and mitigating flood risks.

The country presentations were delivered by following participants:

- ***Bangladesh: Ms. Lutfun Nahar***
  Joint Secretary, Ministry of Disaster Management & Relief

Dr. Robin Kumar Biswas
Superintending Engineer (Civil), Directorate of Planning-1, Bangladesh Water Department

- ***Bhutan: Mr. Sonam Tshewang***
  Executive Engineer, Department of Local Government and Disaster Management

- ***Nepal: Mr. Krishna Prasad Rijal***
  Senior Divisional Engineer, Ministry of Energy, Water Resources & Irrigation

- ***Sri Lanka: Mr. M. A. C. Mohammed Riyas***
  Deputy Director, Disaster Management Centre

Concluding Remarks

Concluding remarks were given by Mr. Ankur Srivastava, Research Officer and Program Manager, SDMC (IU). The virtual workshop on 'Integrated Flood Risk Management' came to an end on Dec 11, 2023. During this period, they reflected on a period of rich discourse, collaborative learning, and the exchange of invaluable insights. The comprehensive discussions and presentations by experts from diverse fields had significantly contributed to advancing our understanding of integrated approaches to flood risk management. The engagement of participants from around the Member States underscored the urgency and shared commitment to address the multifaceted challenges posed

by flooding. This workshop had not only served as a platform for knowledge dissemination but has also fostered meaningful connections and partnerships among professionals and stakeholders. The knowledge gained had served as a catalyst for innovative strategies, resilient policies, and cooperative efforts that will fortify their global response to floods. On behalf of SDMC (IU), he had expressed his gratitude to all participants, presenters, and organizers for their dedication to make this virtual workshop a successful event.

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PS: All the presentations can be accessed through: https://saarc-sdmc.org/virtual-workshop-integrated-flood-risk-management-0

List of Attendees

#	Country Name	Flag	Participants Name	Designation & Department	Contact Details
1	**Bangladesh**		**Lutfun Nahar**	Joint Secretary, Ministry of Disaster Management & Relief	lutfun.nahar@modmr.gov.bd
2	**Bangladesh**		**Dr. Robin Kumar Biswas**	Superintending Engineer (Civil), Directorate of Planning-1, Bangladesh Water Development Board	biswasrobindup01@gmail.com
3	**Bangladesh**		**Mr. Sarder Udoy Raihan**	Executive Engineer (Civil), Flood Forecasting & Warning Centre	udoyraihan@gmail.com
4	**Bangladesh**		**Mr. Md. Kamrul Ahsan**	Deputy Project Director, Department of Disaster Management	dpdfloodshelter3@ddm.gov.bd
5	**Bangladesh**		**Mr. Juwel Mia**	District Relief & Rehabilitation Officer, Department of Disaster Management	hridoyahmedjuwel.du@gmail.com
6	**Bangladesh**		**Mr. Md. Abdul Haye Sarkar**	District Relief & Rehabilitation Officer, Department of Disaster Management	haye.adu@gmail.com
7	**Bangladesh**		**Mr. Md. Aktaruzzaman**	District Relief & Rehabilitation Officer, Sirajganj, Department of Disaster Management	mdaktaruzzaman1@gmail.com
8	**Bangladesh**		**Mr. Alamgir Hossain**	District Relief & Rehabilitation Officer, Jamalpur, Department of Disaster Management	drroalamgirhossain@gmail.com
9	**Bangladesh**		**Mr. Md. Hafizur Rahman**	Assistant Director (GIS), Department of Disaster Management	hafiz.ddm@gmail.com
10	**Bangladesh**		**Ms. Ananya**	Project Officer (Communication), PROVATi3 Project- DDM Component, Department of Disaster Management	ananyaroy058@gmail.com

11	**Bhutan**		**Mr. Bhagat Pokhrel,**	Asst. Environment Officer, Department of Local Governance and Disaster Management	bpokhrel@sjthromde.gov.bt stshewang@moha.gov.bt thinleyn@moha.gov.bt kyandorji19@gmail.com
12	**Bhutan**		**Ms. Dechen Chezom,**	Dy. Executive Secretary, Department of Local Governance and Disaster Management	dechenom@sjthromde.gov.bt dechhox303@gmail.com
13	**Bhutan**		**Mr. Thinley Norbu**	Chief Program Officer, Department of Local Government and Disaster Management, Department of Local Governance and Disaster Management	thinleyn@moha.gov.bt
14	**Bhutan**		**Mr. Sonam Tshewang**	Executive Engineer, Department of Local Government and Disaster Management, Department of Local Governance and Disaster Management	stshewang@moha.gov.bt papasonam@gmail.com
15	**Bhutan**		**Ms. Karma Yangzom Dorji,**	Environment and Social Expert, Department of Local Government and Disaster Management, Department of Local Governance and Disaster Management	kyandorji19@gmail.com
16	**India**		**Dr. Sweta Baidya**	Sr. Consultant (Cyclone), Mitigation Division, NDMA	cons-cyclone@ndma.gov.in drswetabaidyandma@gmail.com
17	**India**		**Dr. Piyush Gourav**	Sr Consultant (GLOF), Mitigation, NDMA	piyushgourav@gmail.com srcons-glof@ndma.gov.in
18	**India**		**Mr. Manoj Kumar Sharma**	Deputy Inspector General, 11 Bn NDRF.	mancharu2@gmail.com co11bnndrf@gmail.com up-11ndrf@gov.in

19	**India**		**Mr. Sharad Kumar Kaushal**	Deputy Commissioner, Flood Management Wing, Department of Water Resource, River Development & Ganga Rejuvenation, Ministry of Jal Shakti, New Delhi	dcfm2-mowr@gov.in
20	**India**		**Ms. Dimpal Garodia**	Assistant Director-II, HPP&I Division, Central Electricity Authority, New Delhi	dimpal.garodia@gov.in garodiadimpi@gmail.com
21	**Nepal**		**Mr. Krishna Prasad Rijal**	Senior Divisional Engineer, Ministry of Energy, Water Resource & Irrigation, Kathmandu	rch.krishnarijal@gmail.com krishnarijal@gmail.com
22	**Sri Lanka**		**GGH Alwis**	Lieutenant Commander, SriLanka Navy Headquarters.	gimantha.alwis@gmail.com
23	**Sri Lanka**		**Pulukutti Arachchige Anuji Kanchana Maduwanthi**	Development Officer, National Disaster Relief Services Centre, Sri Lanka	mudannayakeanu@gmail.com
24	**Sri Lanka**		**Mr. RMCD Rathnayaka**	Lieutenant Commander	chathuranga2363@gmail.com
25	**Sri Lanka**		**Mr. M A C Mohamed Riyas**	Deputy Director	ampara@dmc.gov.lk
26	**Sri Lanka**		**Mr. S Kokularajah**	Assistant Director	kilinochchi@dmc.gov.lk
27	**Sri Lanka**		**Lt. Col R.L.D. Liyanage**	Assistant Director	galle.dmc.gov.lk
28	**Sri Lanka**		**Lt. Col S.A.B. Dissanayake**	Assistant Director	dsanath@gmail.com

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List of Faculty Members

Sr No.	Speakers	Designation & Organisation	Email
1	Dr. Krishna AchutaRao	Professor, Centre for Atmospheric Sciences, IIT-Delhi	akrishna@cas.iitd.ac.in
2	Mr. Anil Pokhrel	Chief Executive, National Disaster Risk Reduction and Management Authority, Government of Nepal	anilpokhrel@yahoo.com
3	Mr. Lingaraj Gouda	Engineer in Chief Planning & Design Dept. of Water Resources Govt. of Odisha	cedesigns-eicwr.od@nic.in
4	Mr. A B Pandya	Secretary General, International Centre on Irrigation and Drainage, former Chairman, CWC	abpandya@yahoo.co.uk
5	Prof. (Dr.) Anupam K. Singh	Adani Institute of Infrastructure Engineering	prof.anupamsingh@gmail.com
6	Ms. Manorama Mohanty	Scientist-E & Head Meteorological Centre, Ahmedabad	met_mm@yahoo.co.in
7	Dr. M B Joshi,	Chief Engineer (Retd.), Sardar Sarovar Narmada Nigam Ltd. (SSNL)	dr.mbjoshi@gmail.com
8	Prof. (Dr.) Deepak Khare	Department of Water Resources, Development and Management, IIT-Roorkee	kharefwt@gmail.com
9	Dr. Sekhar L. Kuriakose	Member Secretary, Kerala State Disaster Management Authority	ms.ksdma@kerala.gov.in
10	Shri Atul Karwal, IPS	Director General, National Disaster Response Force	dg.ndrf@nic.in
11	Dr. Ranjit Kumar Sinha	Secretary-Disaster Management, Uttarakhand State Disaster Management Authority	ranjitksinha@gmail.com
12	Dr. Saurabh Dalal	National Professional Officer Emergency Preparedness and Risk Management, WHO India	sdalal@who.int
13	Mr. Lalit Dashora	Senior Multi Hazard Early Warning Specialist, ADPC	lalit.dashora@adpc.net
14	Prof. Vinod K. Sharma	Vice Chairman, Sikkim State Disaster Management Authority	profvinod@gmail.com

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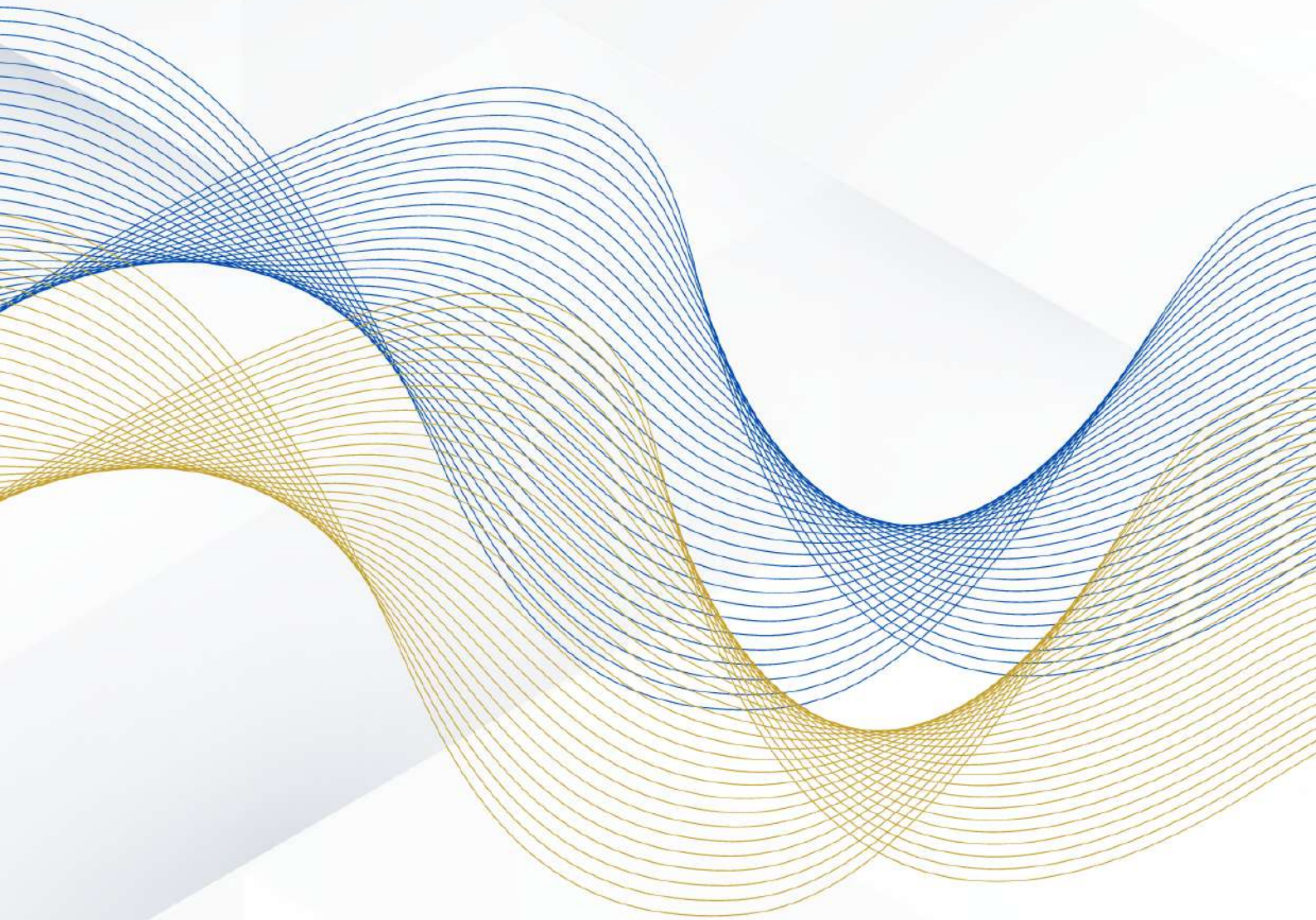

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SAARC DISASTER MANAGEMENT CENTRE (IU)
GUJARAT INSTITUTE OF DISASTER MANAGEMENT CAMPUS, KOBA-GANDHINAGAR ROAD. VILLAGE RAYSAN, B/H PANDIT DEENDAYAL ENERGY UNIVERSITY (PDEU), GANDHINAGAR - 382007 GUJARAT, INDIA
PHONE: +91 7923275801/04/33 | FAX:+91 7923275814
www.saarc-sdmc.org