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MIRANDA HOUSE UNIVERSITY OF DELHI

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3-DAY ONLINE TRAINING PROGRAMME

ON

GIS MAPPING FOR DISASTER MITIGATION AND RISK REDUCTION

MAY 09-11, 2023

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EXECUTIVE SUMMARY

The Online Training Programme on GIS Mapping for Disaster Mitigation and Risk Reduction was successfully conducted from 9th to 11th May 2023. The event, organized by Miranda House, DU, in collaboration with the National Institute of Disaster Management (NIDM), aimed to enhance participants' knowledge and skills in utilizing Geographic Information Systems (GIS) for effective disaster management and risk reduction strategies.

We would like to extend our sincere appreciation and gratitude to Shri Rajendra Ratnoo, the Executive Director of the National Institute of Disaster Management (NIDM), and Prof. (Dr.) Bijayalaxmi Nanda, Principal of Miranda House, Delhi University, for their invaluable support and guidance in the successful execution of the Online Training Programme on GIS Mapping for Disaster Mitigation and Risk Reduction.

The inaugural session, led by Dr. Rakhi Parijat from Miranda House, initiated discussions on GIS in disaster mitigation and risk reduction. Dr. Garima Aggarwal, Sr. Consultant, RID, NIDM highlighted the crucial role of GIS in hazard identification, evacuation planning, public awareness, and coordination of disaster response efforts. The session emphasized the significance of GIS in disaster management and laid the foundation for exploring its diverse applications throughout the program.

The training program consisted of six informative and interactive sessions, each facilitated by esteemed experts in the field.

- In Session 1, **Mr. Shreyash Dwivedi**, Jr. Consultant at RID, NIDM, provided a comprehensive overview of disaster management basics, including hazards, risk, and vulnerability. He also discussed the vulnerability profile of India, major hazards in India, and the application of GIS in disaster management.
- Session 2 was conducted by **Mr. CM Bhatt**, a Scientist/Engineer at IIRS, Dehradun. He focused on the role of GIS in different phases of disaster management, the capabilities of remote sensing and GIS, and specific applications such as flood management, landslide mitigation, hazard zonation mapping, and watershed prioritization.
- In Session 3, **Prof. A K Saha** from the Department of Geography at the University of Delhi highlighted the basics of Geoinformatics, advancements in GIS technology,

major application areas, and mitigation strategies. He also delved into topics such as landslide inventory mapping, rule-based classification using Object-Based Image Analysis (OBIA), and statistical modeling in GIS.

- **Dr. Homolata Borah** from ADPC led Session 4, which focused on the intersection of GIS mapping and climate change. The session explored the identification of climate risk areas, the necessity of geospatial technology, and the implementation of GIS as a climate-smart solution. The Climate Change Knowledge Portal by the World Bank and the USAID Adpc Gender Monitoring Tool were also discussed.

- Session 5 was conducted by **Dr. Sansar Raj Meena**, an Assistant Professor at Universita' degli Studi di Padova, Italy. He introduced participants to artificial

  Intelligence (AI) and computer vision, emphasizing their applications in the remote sensing and GIS domain. The session covered topics such as landslide inventories, landslide detection through deep learning, and vulnerability analysis in India.

- In Session 6, **Ms. Dipali Jindal**, Assistant General Manager at IG Drones, provided insights into the use of drones in disaster management. She explained the steps for data collection using drones and demonstrated the creation of maps from collected images. Participants learned about digital terrain modeling, the difference between orthomosaic and orthophotomap, and were presented with a drone-generated flood map.

During the valedictory address, Prof. Chandan Ghosh, Head of RID at NIDM, emphasized the need for advancements in machine learning to analyze interior Earth data and improve prediction capabilities. He highlighted the potential of IoT, AI, and ML in enhancing disaster management by analyzing large datasets and facilitating effective decision-making. Dr. Garima Aggarwal, Senior Consultant at RID, expressed gratitude to the speakers for their insightful presentations and highlighted the relevance of the topic to the participants' objectives. The training program provided a platform for learning and exchanging ideas on remote sensing, GIS, and related technologies in disaster management. The final remarks acknowledged the contributions of the speakers and emphasized the importance of the topic in advancing disaster management practices. The discussions shed light on leveraging technology for better understanding and prediction of Earth's systems, benefiting disaster mitigation and risk reduction efforts.

The training program received significant participation, with a total of 260 attendees, consisting of 100 males and 160 females. The participants represented various sectors, including government jobs, NGOs/CSOs, private sector, public sector, self-employed, and students. They hailed from different regions across India and international locations, including Andaman & Nicobar, Delhi, Bihar, Maharashtra, Kerala, and West Bengal, among others.

Overall, the Online Training Programme on GIS Mapping for Disaster Mitigation and Risk Reduction proved to be a valuable and comprehensive learning experience. The diverse sessions, delivered by expert speakers, equipped participants with the necessary knowledge and skills to leverage GIS technology for effective disaster management and risk reduction strategies. The event successfully fostered collaboration and knowledge-sharing among participants, contributing to a more resilient and prepared community in the face of disasters.

1. INTRODUCTION

1.1. Rationale of the Training Program

Disasters can have a profound impact on communities and societies worldwide, causing loss of life, property damage, and economic devastation. With the increasing frequency and severity of disasters, it has become essential to develop effective strategies and tools for disaster mitigation and risk reduction. Geographic Information Systems (GIS) and mapping have emerged as key tools in disaster management, providing critical data and analysis to support decision-making, planning, and response.

For instance, during the 2015 earthquake in Nepal, GIS mapping played a vital role in the immediate response to the disaster. Relief workers used GIS to track the movement of people, distribute resources, and identify areas that required aid. GIS mapping has also been instrumental in flood management in many parts of the world, including the United States and the Netherlands. By analyzing flood patterns and understanding the topography of affected areas, GIS helps authorities to take proactive measures to reduce the impact of floods and mitigate their consequences.

Moreover, the use of GIS and mapping is not limited to natural disasters alone. They have also proven useful in managing human-made disasters, such as oil spills and industrial accidents. For example, during the 2010 Deepwater Horizon oil spill, GIS mapping was used to monitor the movement of the oil slick and track its impact on the environment.

The proposed training program aimed to equip participants with the necessary knowledge and skills to use GIS and mapping effectively in disaster management. Through lectures, case studies, and practical exercises, participants gained insights into the best practices, tools, and techniques used in disaster mitigation and risk reduction. By the end of the program, participants had an enhanced understanding of the role of GIS and mapping in disaster management and were better prepared to apply these tools in their work.

1.2. Objectives

The training program aimed to provide participants with a comprehensive understanding of the role of mapping and Geographic Information Systems (GIS) in disaster mitigation and risk reduction.

By the end of the program, participants were expected to:

- Understand the importance of disaster mitigation and risk reduction.
- Understand the basic principles and applications of GIS in disaster management.
- Comprehend the fundamental principles of mapping and spatial data collection for disaster management.
- Apply GIS tools and techniques for disaster mitigation and risk reduction.
- Analyze and interpret hazard, vulnerability, and risk data using GIS and mapping techniques.

1.3. Participants' Profile

Participants from various sectors, including government jobs, NGOs/CSOs, private sector, public sector, self-employed, and students participated in the training programme. They hailed from different regions across India and international locations, including Andaman & Nicobar, Delhi, Bihar, Maharashtra, Kerala, and West Bengal, among others.

1.4. Expected Outcomes

This proposed online training program on "GIS Mapping for Disaster Mitigation & Risk Reduction" aims to equip participants with the necessary knowledge and skills to effectively apply GIS and mapping techniques for disaster management. The program intends to enable participants to gain insights into best practices, case studies, and practical exercises to enhance their understanding of GIS and mapping for disaster management. We believe that this training program will be beneficial to the participants in enhancing their knowledge and skills in GIS and mapping for disaster management.

2. PROCEEDINGS

The training program consisted of six informative and interactive sessions spanning into three days, each facilitated by esteemed experts in the field.

2.1DAY 1 (9/05/2023)

The inaugural session of the program, led by **Dr. Rakhi Parijat from Miranda House**, set the stage for the discussions on GIS in disaster mitigation and risk reduction.

Dr. Garima Aggarwal, Sr. Consultant, RID, NIDM during her address, highlighted the significant role of GIS in various aspects of disaster management. She emphasized its application in hazard identification and mapping, enabling authorities to identify vulnerable areas prone to natural disasters. Additionally, GIS plays a crucial role in developing evacuation plans by providing spatial information on safe routes and shelter locations. The use of GIS in raising public awareness about potential risks was also emphasized, as it helps disseminate critical information to the general population. Moreover, GIS facilitates coordination and management of disaster response efforts by integrating various data sources and enabling effective decision-making. It also supports the identification of safe areas for relocation and aids in the development of apps for early warning systems, leveraging GIS technology. The inauguration session set the tone for the program, highlighting the significance of GIS in disaster management and fostering an understanding of its diverse applications.

In Session 1, **Mr. Shreyash Dwivedi, Jr. Consultant NIDM (National Institute of Disaster Management)**, delivered an insightful presentation on the fundamental aspects of disaster management. He provided a comprehensive overview that encompassed key concepts such as hazards, risk, vulnerability, and the application of Geographic Information Systems (GIS) in disaster management.

One of the primary topics covered by Mr. Dwivedi was the vulnerability profile of India. He highlighted the various factors that contribute to the vulnerability of a region, including socio-

economic conditions, infrastructure, and environmental factors. By assessing these factors, it becomes possible to identify the communities and areas that are more susceptible to the impacts of disasters. Understanding vulnerability is crucial for effective disaster management planning and response.

The session also shed light on the major hazards faced by India. India is a diverse country with a wide range of hazards, both natural and man-made. These hazards include earthquakes, floods, cyclones, droughts, landslides, industrial accidents, and terrorist attacks. Mr. Dwivedi emphasized the importance of understanding the characteristics of each hazard, including their frequency, intensity, and spatial distribution, to develop appropriate strategies for disaster preparedness and response.

Throughout the session, Mr. Dwivedi emphasized the need for a multi-disciplinary approach to disaster management. Addressing disasters requires collaboration among various stakeholders, including government agencies, non-governmental organizations, community groups, and the private sector. By working together, these entities can leverage their expertise and resources to build resilience, enhance preparedness, and effectively respond to disasters.

Participants in the session gained valuable insights into the fundamental concepts and practices of disaster management. They were able to grasp the importance of understanding hazards, assessing vulnerability, and utilizing technologies like GIS to enhance disaster management efforts. The session encouraged participants to think critically about the unique challenges faced by India and the importance of proactive planning and preparedness.

Session 2 was delivered by Mr. CM Bhatt, a distinguished Scientist/Engineer from the Indian Institute of Remote Sensing (IIRS) in Dehradun. The session primarily centered on the pivotal role of Geographic Information Systems (GIS) in various phases of disaster management. Mr. Bhatt extensively discussed the capabilities of remote sensing and GIS technologies, highlighting their specific applications in flood management, landslide mitigation, hazard zonation mapping, and watershed prioritization.

The session began with a comprehensive overview of the different phases of disaster management, namely preparedness, response, recovery, and mitigation. Mr. Bhatt emphasized that GIS plays a crucial role in all these phases, as it enables effective decision-making through the integration and analysis of spatial data. GIS facilitates the identification of vulnerable areas, assessment of potential risks, and formulation of mitigation strategies. By employing GIS tools and techniques, authorities can enhance preparedness, respond efficiently to disasters, aid in recovery efforts, and reduce future risks.

Remote sensing, a key component of GIS, was also extensively discussed during the session. Mr. Bhatt highlighted the capabilities of remote sensing in acquiring data from a distance, typically through satellite or aerial platforms. Remote sensing technology enables the collection of valuable information about the Earth's surface, including land cover, topography, and changes over time. By utilizing remote sensing data, disaster management practitioners can monitor and analyze areas prone to floods, landslides, and other hazards.

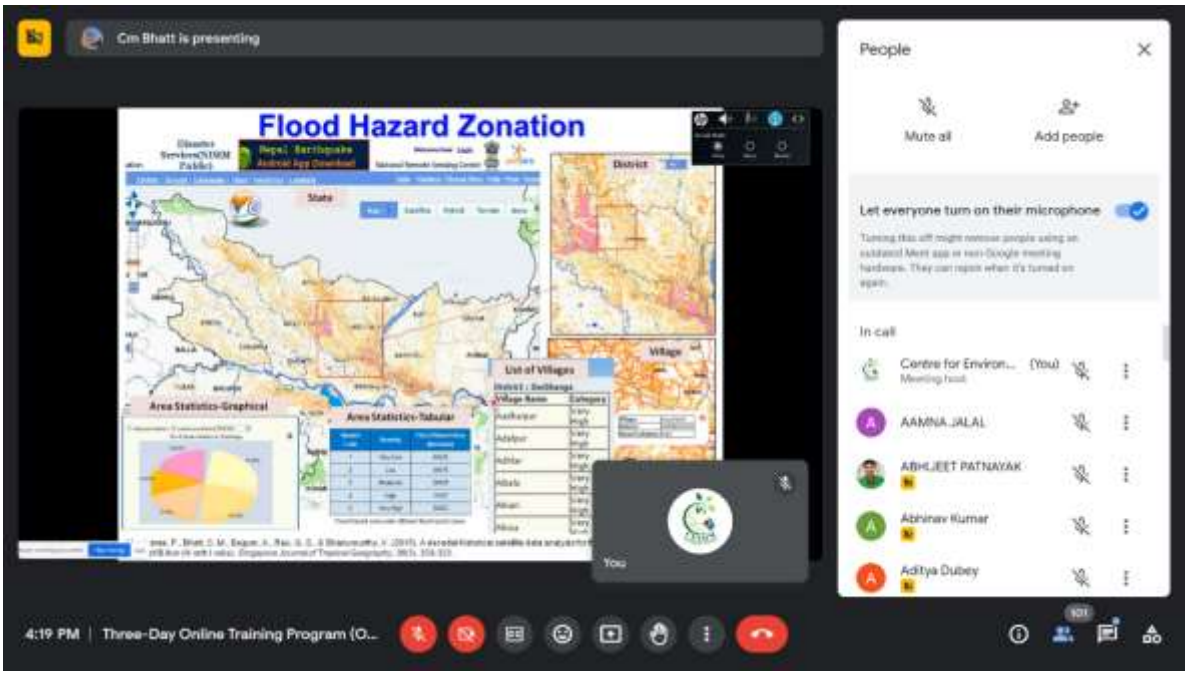
Flood management emerged as a prominent application discussed during the session. Mr. Bhatt illustrated how GIS and remote sensing can contribute to effective flood management by providing real-time data on rainfall patterns, river levels, and flood extents. These data can be integrated with other information, such as population distribution and infrastructure networks, to generate flood hazard maps, delineate vulnerable areas, and support evacuation planning. Additionally, GIS can aid in flood forecasting and early warning systems, empowering authorities to take proactive measures and mitigate potential damage.

Landslide mitigation was another significant area of focus. Mr. Bhatt emphasized that GIS, coupled with remote sensing, can assist in landslide hazard assessment and monitoring. By analyzing slope characteristics, land cover, and geological data, GIS enables the identification of landslide-prone areas. This information can be used to develop early warning systems, implement land-use planning measures, and guide infrastructure development away from high-risk zones.

Hazard zonation mapping, an essential component of disaster risk assessment, was also highlighted during the session. Mr. Bhatt elucidated how GIS can integrate multiple data layers, including topography, geology, and historical disaster events, to delineate different levels of hazards across a region. This zonation approach enables authorities to prioritize resources, implement targeted mitigation measures, and inform land-use planning decisions.

Mr. Bhatt also discussed the application of GIS in watershed prioritization. GIS technology facilitates the analysis of various factors such as land cover, soil characteristics, and hydrological parameters to identify critical areas within a watershed. This information aids in prioritizing conservation efforts, watershed management planning, and the implementation of measures to reduce the vulnerability of communities residing in those areas.

Participants gained valuable insights into the capabilities of GIS in each phase of disaster management, emphasizing its role in enhancing preparedness, response, recovery, and mitigation efforts. The session fostered a deeper understanding of how GIS can be effectively utilized to mitigate the impacts of disasters and build resilient communities.



2.2DAY 2 (10/05/2023)

Day 2 started with recapitulating the key takeaways from Day 1.

Session 3 of the programme featured Prof. A K Saha, an esteemed faculty member from the Department of Geography at the University of Delhi. Prof. Saha's presentation centered on Geoinformatics, focusing on its fundamental principles, technological advancements in

Geographic Information Systems (GIS), key application areas, and strategies for disaster mitigation. The session also delved into specific topics, including landslide inventory mapping, rule-based classification employing Object-Based Image Analysis (OBIA), and statistical modeling within GIS.

Prof. Saha commenced the session by providing a comprehensive overview of Geoinformatics, a discipline that integrates geospatial data with information technology. Geoinformatics encompasses various components such as GIS, remote sensing, and spatial analysis, enabling the collection, management, analysis, and visualization of geospatial information. The session emphasized the critical role of Geoinformatics in disaster management, as it aids in decision-making, resource allocation, and effective mitigation strategies.

Advancements in GIS technology were a key aspect of the session. Prof. Saha highlighted the evolution of GIS tools and techniques, from traditional paper-based mapping to modern digital platforms. The advent of computer systems and advanced software has revolutionized GIS, allowing for complex spatial analysis, 3D modeling, and real-time data integration. Prof. Saha emphasized the significance of staying updated with the latest GIS advancements to harness their full potential in disaster management.

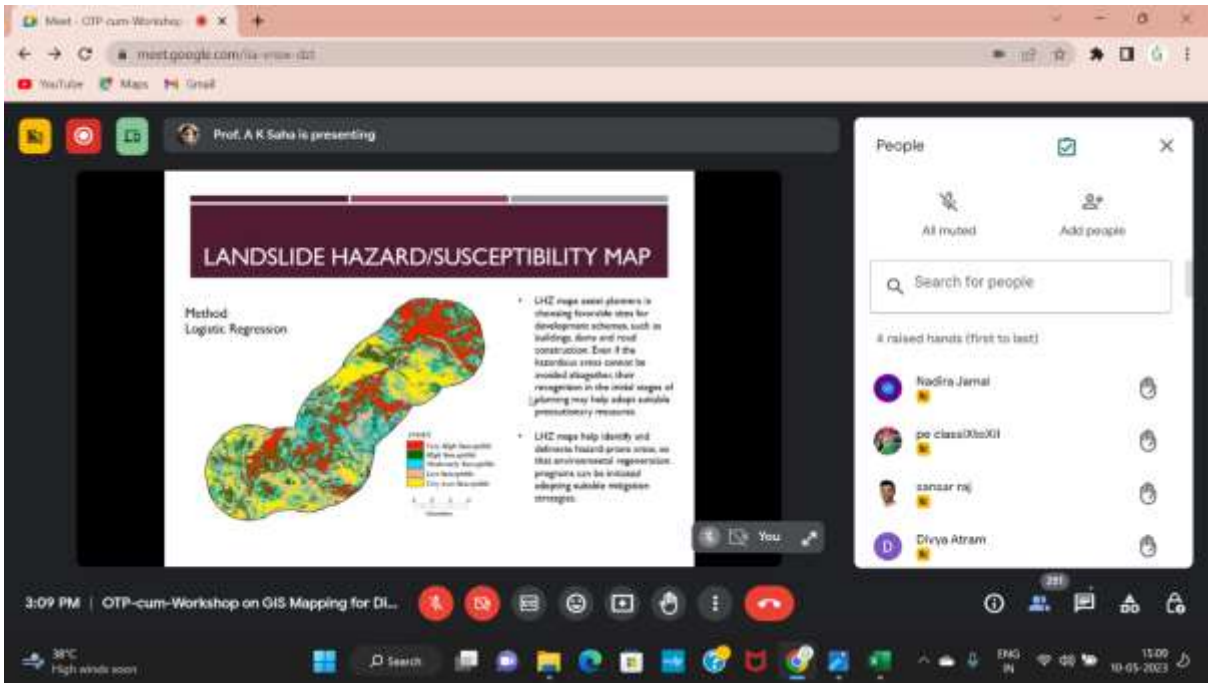
The session explored major application areas of GIS in disaster management. Prof. Saha discussed how GIS can facilitate hazard assessment, vulnerability mapping, risk analysis, and decision support systems. GIS enables the integration of diverse datasets, including topography, land cover, population density, infrastructure networks, and historical disaster records, to generate comprehensive risk maps and inform mitigation strategies. Prof. Saha emphasized the need for interdisciplinary collaboration to leverage GIS effectively in disaster management, involving professionals from fields such as geography, engineering, and social sciences.

Landslide inventory mapping emerged as a significant topic within the session. Prof. Saha highlighted the importance of accurately mapping landslide-prone areas to understand their spatial distribution and characteristics. GIS, combined with remote sensing data, allows for the

identification and delineation of landslides, aiding in risk assessment and management. Prof. Saha also introduced the concept of rule-based classification using Object-Based Image Analysis (OBIA), wherein specific rules and algorithms are applied to satellite imagery to automate the identification and classification of landslide features.

Statistical modeling within GIS was another notable aspect of the session. Prof. Saha discussed the utilization of statistical techniques to analyze and model various spatial phenomena. These techniques enable the identification of spatial patterns, prediction of future trends, and assessment of the impacts of disasters. Prof. Saha emphasized the significance of statistical modeling in informing decision-making processes and formulating effective mitigation strategies.

In conclusion, Prof. A K Saha's session on Geoinformatics in disaster management provided a comprehensive exploration of the subject. The session covered the fundamental principles of Geoinformatics, advancements in GIS technology, major application areas, and mitigation strategies. Participants gained insights into specific topics such as landslide inventory mapping, rule-based classification using OBIA, and statistical modeling within GIS. Prof. Saha's presentation highlighted the crucial role of Geoinformatics in enhancing decision-making, risk assessment, and effective disaster mitigation. The session inspired participants to leverage GIS advancements and interdisciplinary collaboration to build resilient communities and reduce the impacts of disasters.



Session 4 was led by Dr. Homolata Borah, an expert from the Asian Disaster Preparedness Center (ADPC). The session concentrated on the interplay between GIS mapping and climate change. Dr. Borah explored the identification of climate risk areas, the indispensability of geospatial technology, and the implementation of GIS as a climate-smart solution. Additionally, two important tools, namely the Climate Change Knowledge Portal by the World Bank and the USAID Adpc Gender Monitoring Tool, were discussed in the session.

The session commenced with an in-depth examination of the intersection between GIS mapping and climate change. Dr. Borah emphasized the significance of geospatial technology in understanding and addressing climate change-related challenges. GIS mapping enables the identification and mapping of areas that are vulnerable to climate risks such as extreme weather events, sea-level rise, and changes in temperature and precipitation patterns. By analyzing geospatial data, decision-makers can gain insights into the spatial distribution and magnitude of climate risks, facilitating effective planning and adaptation strategies.

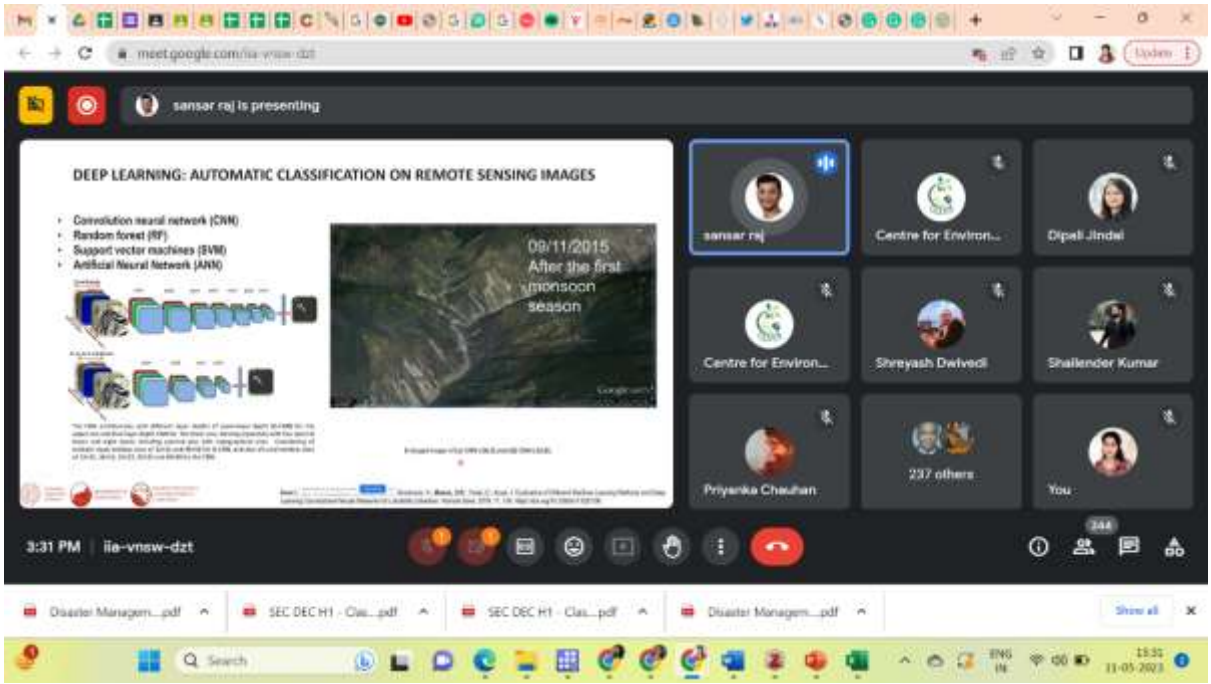
The session also shed light on the necessity of utilizing geospatial technology in climate change management. Dr. Borah highlighted that climate change impacts are not evenly distributed across regions, making it crucial to identify areas that are most at risk. GIS mapping plays a vital role in this process by integrating various geospatial data layers such as elevation, land cover, population density, and infrastructure to identify climate risk areas. This spatially explicit information helps decision-makers prioritize interventions and allocate resources effectively.

Furthermore, the session discussed the implementation of GIS as a climate-smart solution. Dr. Borah elaborated on how GIS mapping can contribute to climate change mitigation and adaptation strategies. GIS enables the visualization and analysis of complex geospatial data, facilitating evidence-based decision-making and the development of climate-resilient policies. Through GIS, stakeholders can assess the impacts of climate change on ecosystems, plan for sustainable land use, optimize energy infrastructure, and enhance disaster preparedness. The integration of GIS into climate change initiatives promotes informed decision-making and facilitates the transition towards a climate-smart future.

In addition to GIS mapping, the session highlighted two important tools that aid in climate change management. The Climate Change Knowledge Portal, developed by the World Bank, provides access to a wealth of climate-related data, including climate projections, historical climate records, and vulnerability assessments. This portal serves as a valuable resource for

researchers, policymakers, and practitioners involved in climate change adaptation and mitigation efforts. The USAID Adpc Gender Monitoring Tool was also discussed, emphasizing the importance of considering gender perspectives in climate change initiatives. This tool enables the monitoring and evaluation of gender-related indicators within climate change programs, ensuring that gender equality and social inclusivity are incorporated into climate action plans.

In conclusion, Dr. Homolata Borah's session on the intersection of GIS mapping and climate change provided a comprehensive understanding of the subject. The session emphasized the identification of climate risk areas, the indispensability of geospatial technology, and the implementation of GIS as a climate-smart solution. The discussion highlighted the significance of utilizing GIS mapping to analyze climate risks, plan adaptation strategies, and promote sustainable development. The session also introduced important tools such as the Climate Change Knowledge Portal and the USAID Adpc Gender Monitoring Tool, which contribute to effective climate change management. Participants gained valuable insights into the role of GIS mapping in addressing the challenges posed by climate change and were inspired to integrate geospatial technology into their climate-related initiatives.



2.3 DAY 3 (11/05/2023)

Session 5 was taken by Dr. Sansar Raj Meena, an esteemed Assistant Professor at the Universita' degli Studi di Padova in Italy. The session focused on artificial intelligence (AI) and computer vision, specifically exploring their applications in the realm of remote sensing and Geographic Information Systems (GIS). Dr. Meena introduced participants to various topics, including landslide inventories, landslide detection utilizing deep learning techniques, and vulnerability analysis in India.

Dr. Meena commenced the session by providing an introduction to artificial intelligence and computer vision, highlighting their significance in analyzing remote sensing data and GIS applications. Artificial intelligence encompasses algorithms and models that enable computers to mimic human intelligence and perform tasks such as image recognition, classification, and prediction. Computer vision focuses on the development of algorithms and techniques that allow computers to analyze and interpret visual data, including satellite imagery and aerial photographs.

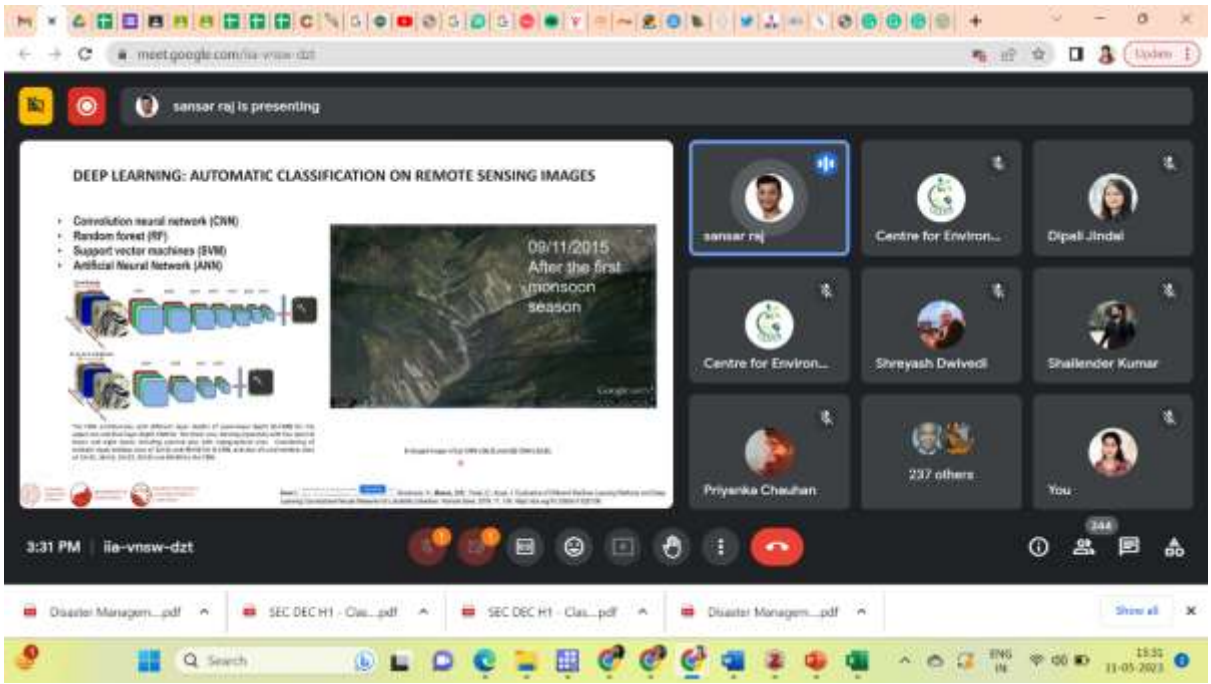
The session delved into the specific application of AI and computer vision in landslide inventories. Dr. Meena emphasized the importance of accurately mapping landslides to assess their distribution, characteristics, and impacts. AI algorithms, particularly those based on deep learning techniques, can be trained to automatically detect and classify landslides from remote sensing data. By utilizing computer vision and AI, landslide inventories can be generated more efficiently, providing valuable information for hazard assessment, risk management, and mitigation strategies.

Landslide detection through deep learning was another key topic explored during the session. Dr. Meena highlighted the potential of deep learning algorithms, such as convolutional neural networks (CNNs), in automatically detecting landslides from satellite imagery. These algorithms can learn and identify specific features and patterns associated with landslides, allowing for accurate and timely identification of areas prone to landslides. By utilizing deep

learning techniques, the process of landslide detection can be significantly expedited, aiding in early warning systems and disaster response planning.

The session also touched upon vulnerability analysis in India. Dr. Meena discussed how AI and computer vision can contribute to vulnerability assessment by integrating various datasets, including socio-economic, demographic, and environmental factors. These technologies enable the identification of areas and communities that are most vulnerable to hazards, facilitating targeted interventions, and informed decision-making in disaster management.

In conclusion, Dr. Sansar Raj Meena's session on the applications of artificial intelligence and computer vision in remote sensing and GIS provided a comprehensive overview of the subject. The session covered topics such as landslide inventories, landslide detection through deep learning, and vulnerability analysis in India. Participants gained insights into the potential of AI and computer vision in automating tasks, improving efficiency, and enhancing decision-making in the field of remote sensing and GIS. Dr. Meena's session inspired participants to explore the integration of these technologies into their research and applications, fostering advancements in disaster management and geospatial analysis.



Session 6 was taken by Ms. Dipali Jindal, an experienced professional serving as the Assistant General Manager at IG Drones. Ms. Jindal's presentation focused on the utilization of drones in disaster management. The session encompassed insights into the steps involved in data collection using drones, the creation of maps from collected images, digital terrain

modeling, the distinction between orthomosaic and orthophotomap, and a demonstration of a drone-generated flood map.

Ms. Jindal commenced the session by emphasizing the role of drones in disaster management. Drones, also known as Unmanned Aerial Vehicles (UAVs), provide a unique advantage in accessing areas that are challenging to reach manually. They can capture high-resolution imagery, collect data, and rapidly assess disaster-affected regions. Drones offer valuable capabilities for disaster response, damage assessment, and situational awareness.

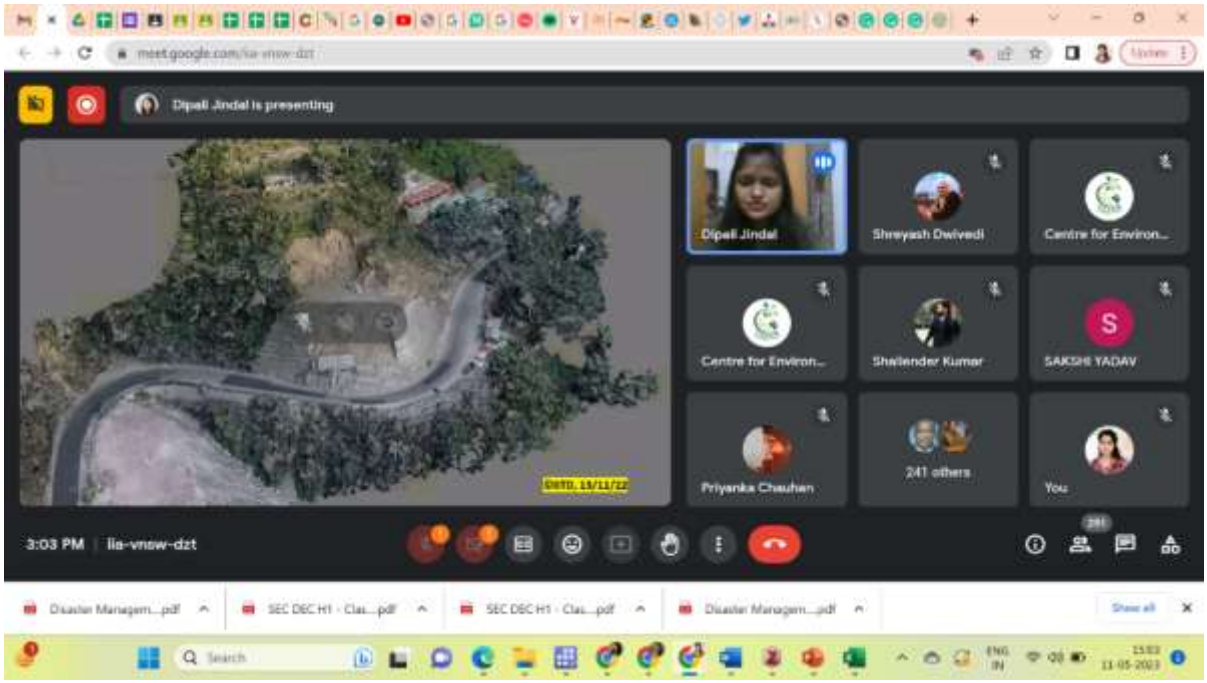
The session proceeded with a detailed overview of the steps involved in data collection using drones. Ms. Jindal highlighted the importance of planning the mission, considering factors such as flight altitude, image overlap, and flight path. Participants were introduced to different types of sensors, including RGB cameras and multispectral sensors, which can capture visible light and additional bands of electromagnetic radiation. The data collected by drones can be used to generate accurate maps and 3D models.

Ms. Jindal demonstrated the process of creating maps from the collected drone images. She explained how overlapping images captured during the drone flight are stitched together using specialized software to generate a composite image known as an orthomosaic. Orthomosaic maps provide a high-resolution, geometrically corrected representation of the surveyed area. The session also covered digital terrain modeling, which involves using the drone data to create a three-dimensional representation of the terrain, including elevation information.

The distinction between orthomosaic and orthophotomap was another important topic discussed. Ms. Jindal explained that while both products provide georeferenced representations of the surveyed area, there is a difference in their pixel properties. An orthomosaic consists of pixels representing the true reflectance values of the terrain, while an orthophotomap is a visual representation where each pixel represents the true color values. Understanding this distinction is crucial for accurate interpretation and analysis of the data.

As part of the session, Ms. Jindal presented a drone-generated flood map. She showcased how drones can be used to capture imagery before, during, and after a flood event. The collected

images were processed to create a flood map, which depicted the extent of the inundated areas. Such maps are invaluable for emergency response, damage assessment, and recovery planning.



In conclusion, Ms. Dipali Jindal's session on the use of drones in disaster management provided valuable insights into the application of this technology. Participants learned about the steps involved in data collection using drones, including mission planning and sensor selection. The session also highlighted the creation of maps, such as orthomosaic and orthophotomap, and the significance of digital terrain modeling. The demonstration of a drone-generated flood map illustrated the practical application of drones in disaster response and recovery. Ms. Jindal's presentation deepened participants' understanding of how drones can contribute to enhanced situational awareness, rapid data collection, and informed decision-making in the field of disaster management.

During the valedictory address, Prof. Chandan Ghosh, the Head of RID at NIDM discussed the need for development in machine learning, particularly in relation to analyzing interior data of the Earth. He emphasized the importance of understanding the internal processes and activities of the Earth's systems to improve prediction capabilities. Prof. Ghosh also highlighted the potential of new technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and Machine Learning (ML) in enhancing disaster management. These technologies can play a

crucial role in analyzing large datasets, improving forecasting models, and facilitating more effective decision-making in disaster scenarios.

In the concluding and final remarks, Dr. Garima Aggarwal, a Senior Consultant at RID, NIDM, expressed gratitude to all the speakers for their excellent presentations and knowledge sharing throughout the training. She acknowledged the relevance of the topic and how it resonated with the participants' training objectives. Dr. Aggarwal emphasized the significance of the discussions and the valuable insights gained from the sessions. The training program provided a platform for learning and exchanging ideas on the applications of remote sensing, GIS, and related technologies in disaster management. The final remarks acknowledged the contributions of the speakers and highlighted the importance of the topic in advancing disaster management practices.

3. KEY TAKEAWAYS OF THE PROGRAMME

1. **Emphasize the Integration of Geographic Information Systems (GIS) in Disaster Management:** Recognize the pivotal role of GIS in all phases of disaster management and promote its integration into organizational strategies. Encourage the use of GIS tools and techniques for effective decision-making, risk assessment, and mitigation efforts. Invest in GIS technology and provide training to staff members to enhance their capabilities in utilizing GIS for flood management, landslide mitigation, hazard zonation mapping, and watershed prioritization.

2. **Leverage Remote Sensing for Enhanced Disaster Preparedness:** Acknowledge the value of remote sensing technology in acquiring crucial data for disaster management. Promote the utilization of remote sensing data, obtained through satellite or aerial platforms, to monitor and analyze areas prone to floods, landslides, and other hazards. Encourage the incorporation of remote sensing in early warning systems, flood forecasting, and real-time data collection for informed decision-making. Support research and partnerships that leverage remote sensing to enhance disaster preparedness and response efforts.

3. **Leverage GIS Mapping to Identify and Address Climate Risks:** Encourage the use of GIS mapping to identify areas vulnerable to climate risks, such as extreme weather events and sea-level rise. Promote the integration of GIS mapping into climate change assessments, risk management plans, and adaptation initiatives.

4. **Integrate AI and Computer Vision for Landslide Inventories:** Recognize the potential of AI and computer vision, specifically deep learning techniques, in automating the detection and classification of landslides from remote sensing data. Encourage the integration of these technologies into landslide inventories, enabling efficient mapping and assessment of landslide distribution, characteristics, and impacts. Invest in research and development to enhance the accuracy and speed of landslide detection using AI algorithms, contributing to more effective hazard assessment and mitigation strategies.

5. **Integrate Drones for Rapid Data Collection:** Recognize the unique advantages of drones in accessing and capturing high-resolution imagery of disaster-affected areas that are challenging to reach manually. Encourage the adoption of drones in disaster management to enable rapid data collection, damage assessment, and situational awareness.

6. **Utilize Drone-Generated Maps for Emergency Response and Recovery:** Emphasize the value of drone-generated maps, such as orthomosaic and orthophotomap, in disaster response and recovery efforts. Promote the use of drones to capture imagery before, during, and after a disaster event, enabling the creation of flood maps and other valuable resources. Encourage the integration of these maps into emergency response operations, damage assessment activities, and recovery planning for more informed decision-making.

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ANNEXURE

I.1 ANNEX 1: CONCEPT NOTE


ONLINE TRAINING PROGRAMME-CUM-WORKSHOP ON GIS MAPPING FOR DISASTER MITIGATION AND RISK REDUCTION

9 – 11 May 2023

Organized by

CENTRE FOR ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT (CESDM)
MIRANDA HOUSE, UNIVERSITY OF DELHI

In collaboration with

NATIONAL INSTITUTE OF DISASTER MANAGEMENT (NIDM), MHA, GOI

Introduction:

Disasters can have a profound impact on communities and societies worldwide, causing loss of life, property damage, and economic devastation. With the increasing frequency and severity of disasters, it has become essential to develop effective strategies and tools for disaster mitigation and risk reduction. Geographic Information Systems (GIS) and mapping have emerged as key tools in disaster management, providing critical data and analysis to support decision-making, planning, and response.

For instance, during the 2015 earthquake in Nepal, GIS mapping played a vital role in the immediate response to the disaster. Relief workers used GIS to track the movement of people, distribute resources, and identify areas that required aid. GIS mapping has also been instrumental in flood management in many parts of the world, including the United States and the Netherlands. By analyzing flood patterns and understanding the topography of affected areas, GIS helps authorities to take proactive measures to reduce the impact of floods and mitigate their consequences.

Moreover, the use of GIS and mapping is not limited to natural disasters alone. They have also proven useful in managing human-made disasters, such as oil spills and industrial accidents. For example, during the 2010 Deepwater Horizon oil spill, GIS mapping was used to monitor the movement of the oil slick and track its impact on the environment.

The proposed training program aims to equip participants with the necessary knowledge and skills to use GIS and mapping effectively in disaster management. Through lectures, case

studies, and practical exercises, participants will gain insights into the best practices, tools, and techniques used in disaster mitigation and risk reduction. By the end of the program, participants will have an enhanced understanding of the role of GIS and mapping in disaster management and will be better prepared to apply these tools in their work.

In conclusion, the use of GIS and mapping in disaster management has become increasingly critical in today's world. With the proposed training program, participants will have the opportunity to learn from experts in the field and gain practical skills and knowledge to enhance their contribution to disaster management efforts.

About the Programme:

Miranda House, University of Delhi proposes to conduct an online training program for three days on the topic "GIS Mapping for Disaster Mitigation & Risk Reduction". The proposed training program will be conducted by experts in the field of disaster management and GIS. The program will include lectures, case studies, and hands-on exercises that will enable participants to apply the knowledge gained during the program in practical scenarios.

Aim & Objective:

The training program aims to provide participants with a comprehensive understanding of the role of mapping and Geographic Information Systems (GIS) in disaster mitigation and risk reduction.

By the end of the program, participants should be able to:

1. Understand the importance of disaster mitigation and risk reduction
2. Understand the basic principles and applications of GIS in disaster management
3. Comprehend the fundamental principles of mapping and spatial data collection for disaster management
4. Apply GIS tools and techniques for disaster mitigation and risk reduction
5. Analyze and interpret hazard, vulnerability, and risk data using GIS and mapping techniques.

Training Modules:

The proposed training program will cover the following themes:

1. **Introduction to Disaster Mitigation and Risk Reduction:** This module will provide an overview of disaster mitigation and risk reduction, highlighting the need for GIS and mapping in disaster management.

2. **Understanding GIS and its Applications in Disaster Management:** This module will cover the basics of GIS, its components, and its applications in disaster management.

3. **Basics of Mapping for Disaster Management:** This module will introduce participants to the fundamentals of mapping, including map projections, coordinate systems, and map scales.

4. **Spatial Data Collection Techniques for Disaster Management:** This module will focus on the collection of spatial data, including remote sensing, GPS, and other techniques.

5. **GIS Tools and Techniques for Disaster Mitigation and Risk Reduction:** This module will cover the various GIS tools and techniques for disaster mitigation and risk reduction, including hazard mapping, vulnerability assessment, and risk analysis.

6. **Case Studies of GIS and Mapping in Disaster Management:** This module will showcase best practices and case studies of GIS and mapping for disaster management.

Target Audience:

The target audience for this training program includes faculties, university officials and research scholars of Miranda House, University of Delhi, professionals working in disaster management, and individuals interested in learning about GIS and mapping for disaster management.

Platform:

The program will be conducted using online platform that will allow participants to attend the program from the comfort of their homes or workplaces. The program will be conducted over three days, with each day consisting of three hours of training.

We believe that this training program will be beneficial to the participants in enhancing their knowledge and skills in GIS and mapping for disaster management. We look forward to your positive response to this proposal.

I.2 ANNEX 2: POSTER

I.3 ANNEX 3: PHOTOGRAPHS

I.4 ANNEX 4: PROGRAMME SCHEDULE

Time	Learning Session/Theme	Speaker / Expert	Moderated by
Day 1 (9th May 2023)			
2:30pm to 3:00 pm	Inauguration	Principal, Miranda House Convener, CESDM	Dr. Ruchi Sachan Dr. Surabhi
3:00pm to 3:30 pm	Basics of Disaster Management & GIS	**Shreyash Dwivedi,** Jr. Consultant NIDM	
3.30 pm to 4:30 pm	Role of GIS in Disaster Management from Mitigation to Recovery	**C.M. Bhatt** Scientist/Engineer-SG, IIRS, Dehradun	
Day 2 (10th May 2023)			
2:30 PM to 3:30 PM	Geoinformatics for Disaster Management	**Prof. Ashis Kumar Saha** Professor, Department of Geography, Delhi School of Economics, University of Delhi	Dr. Vimla Singh Dr. Ankita Medhi
3:30 PM to 4:30 PM	Climate Change Solutions & Innovations through GIS Mapping	**Homolata Borah** Asian Disaster Preparedness Centre (ADPC)	
Day 3 (11 May 2023)			
2:30 PM to 3:30 PM	Hands-on-Training Module	**Dr. Sansar Raj Meena** Assistant Professor, Università degli Studi di Padova (Italy)	Dr. Monika Saroj Dr. Shipra Singh
3:30 PM to 4:30 PM	Integrating Drones and GIS for Disaster Management	**Dipali Jindal** Assistant General Manager, IG Drones	
Valedictory Session			

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I.6 ANNEX 6: CERTIFICATE FORMAT

Sl. No.: /

NATIONAL INSTITUTE OF DISASTER MANAGEMENT

(Ministry of Home Affairs, Govt. of India)

New Delhi

CERTIFICATE

This is to certify that

Participant Name

has participated in the online training on "GIS Mapping for Disaster Mitigation and Risk Reduction" from 09 May 2023 to 11 May 2023 organized by National Institute of Disaster Management, Ministry of Home Affairs, Govt. of India in collaboration with Miranda House - University of Delhi

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I.7 ANNEX 7: FEEDBACK