Report on

"Regional Training on Multi-level Flood Risk, and Landslide Mapping"

ICIMOD, Nepal

09-13 June 2014

Jointly organized by

International Centre for Integrated Mountain Development, Khumaltar, Lalitpur, Nepal

UN Platform for Space-based information for Disaster Management and Emergency Response (UN-SPIDER) United Nations Office for Outer Space Affairs, Beijing, China

Contacts:

1. **Deo Raj Gurung, ICIMOD (deoraj.gurung@icimod.org)**
2. **Shirish Ravan, UN-SPIDER (shirish.ravan@unoosa.org)**

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Summary

The training on 'Regional Training on Multi-level Flood Risk Mapping' was jointly organized by International Centre for Integrated Mountain Development (ICIMOD) and UN Platform for Space-based information for Disaster Management and Emergency Response (UN-SPIDER) of the UN Office for Outer Space Affairs. Part of the support for this training course comes from "SERVIR-Himalaya", funded by United States Agency for International Development (USAID) through the National Aeronautics and Space Administration (NASA).

The purpose of the training programme is to improve disaster risk management using space based and geospatial information by imparting hands-on training to the officials of member countries supported by the ICIMOD and UN-SPIDER.

The training covered topics namely, climate change, disaster risk reduction and space technology; developing hazard and vulnerability indicators at national and sub-national level; flood inundation modelling using HEC-RAS methods; flood inundation mapping and monitoring using satellite images and landslide hazard mapping using satellite remote sensing. More than 50% time was devoted to the hands-on sessions on flood inundation model (held by an expert of ICIMOD), on flood mapping and monitoring (held by an expert of NDRCC) and on landslide hazard mapping (held by an expert of the National Remote Sensing Centre of India).

A total of 20 participants from disaster management agencies and stakeholder departments of ICIMOD Member States participated in the training programme. All but one ICIMOD Member states (Afghanistan) attended the programme.

1. Context and Justification

Hindu Kush Himalayan (HKH) region is prone to natural hazards due to several causative factors: fragile geology, complex topography and relief, tectonic activities, and sensitive to climatic variability. This region is also known for high population density, wide spread poverty, governance issues, which makes this region vulnerable to natural hazards. Member states[1] of International Centre for Integrated Mountain Development (ICIMOD) has witnessed 1912 major hydro-meteorological disaster plus earthquake events between 1900 to 2012 (Em-DAT). The estimated economic loss from the accounted disasters is in the range of USD 46 million, and over 19 million people killed (Em-DAT). Flood and storm constitute 40% and 32% of the total disaster witnessed between 1900 and 2012 in this region. Both in terms of people killed and inflicted economic loss, flood is way ahead of other types of natural hazards. Devastation witnessed during recent flooding in Pakistan (2010) and India (2012) are testimony to furry of natural elements and compounding impacts on vulnerable communities. As much as pre-disaster interventions are important for DRR, post event disaster management is equally important. Rapid response mapping as a tool for quick assessment of the situation in the ground is gaining importance and being pursued by many mapping agencies.

While there is urgency to mainstream disaster risk reduction (DRR) in development policy and plans, lack of capacity to assess risk at multi-level of decision making process is critical gap in resilience building process. Need to fill this knowledge and information gap on hazard, vulnerability, and risk is the motivation for organizing "Multi-level flood risk mapping" training focusing on flood. Landslide being next to floods in terms of occurrence and impact, and highly relevant to mountain context, a day is devoted on detecting landslide through satellite data, and susceptibility mapping.

2. Objectives of the Training

The short term objective of the training is to build understanding of national partners on use of geospatial framework and remote sensing tools/techniques in DRR domain. While the training focus was on deploying spatial framework for multi-level flood risk mapping, building capacity on use of satellite data in conjunction with image processing tools for rapid response mapping (flood), and mapping landslide for susceptibility analysis is part of the larger objective to enable national partners to use space based resources in DRR.

[1] Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan.

Longer term objective is that mainstreaming of DRR through assimilation of multi-tier information on risk happens in all levels of decision making process in ICIMOD's member states, and is contributed towards achieving sustainable development goals.

Photo 1. Mr. Basanta Shrestha, Director of Strategic Cooperation (left), Dr. MSR Murthy, Theme Leader, Geospatial Solutions (right), of ICIMOD, and Dr. Shirish Ravan, Head of UN-SPIDER Office in China, UNOOSA (centre), during the opening session of the training program.

3. Terms of Reference / Purpose of the Training Activity

The purpose of the training program is to provide understanding of geospatial and modelling framework for multi-level flood risk mapping to enable mainstreaming of DRR into national policy and plans, by assimilation of multi-tier risk information into decision making process. A week long training is expected to enhance capacity of participants in preparing national, sub-national and local level flood hazard, vulnerability and risk maps relevant for policy makers and disaster managers.

In addition to focus on multi-level flood risk mapping, purpose of the training is to build capacity on rapid response mapping, and build understanding of global and regional protocols to access satellite data. Through this training it is also aimed to build national capacity to use earth observation data and remote sensing tools for semi-automatic detection of landslides, and generate susceptibility maps to support land use policy and plans.

4. Summary of the Training Programme

The training was organized from 9-13 June 2014 at ICIMOD on the topic of "Multi-level Flood Risk Mapping", while touching upon rapid response mapping, and landslide detection and susceptibility mapping. The programme was jointly organised with United Nation Office for Outer Space Affairs (UNOOSA). This event was organised as a part of SERVIR-Himalaya activity to train national partners on risk mapping as a starting point for DRR intervention.

The weeklong training program was designed with special focus on practical session to give participants adequate time to work with real datasets and tools. To facilitate hands on session, comprehensive manual and working data was made available. Training covered flood hazard, vulnerability and risk (HVR) mapping at national level and sub-national level using indicator based approach, and local (watershed) level using HEC series hydrodynamic models.

4.1 Opening Session

Opening session saw Mr. Basanta Shrestha, Director of Strategic Cooperation, and Dr. MSR Murthy, Theme Leader, Geospatial Solutions Theme, of ICIMOD, and Dr. Shirish Ravan, Head of UN-SPIDER office in Beijing, China, highlighting the need to build knowledge on hazard, vulnerability, and risk as a means to mainstreaming DRR into national policy and plans. They highlighted space based information and geospatial framework as integral part DRR for generating actionable information. Refer Annex 1 for detail opening session program.

Photo 2. Dr. Shirush Ravan, Dr. MSR Murthy, Mr. Basanta Shrestha, and Mr. Deo Raj Gurung delivering opening remarks and program outline during the opening session.

4.2 Technical Session

Technical session began with introductory lectures on SERVIR-Himalaya activities (by Mr. Deo Raj Gurung, ICIMOD), DRR terminology and concepts (by Hari Krishna Nebanupudi, ICIMOD), International and regional framework for DRR (by Dr. Shirish Ravan, UNOOSA), and Regional Flood Information System in the Hindu Kush Himalayan Region (HKH-HYCOS) Project (by Dr. Mandira Shrestha, ICIMOD). Demonstration of disaster management information system (DIMS) of Nepal was done by Mr. Hari Krishna Dhonju (ICIMOD).

Photo 3. Mr. Hari Krishna Nebanupudi, Sr. DRR Specialist, and Dr. Mandira Shrestha, Sr. Water Resource Specialist, of ICIMOD during introductory session.

Following on the introductory lectures, training participants were given an over view of indicator based approach for hazard, vulnerability and risk (HVR) mapping at national and sub-national level. Lecture on methodological framework for multi-level HVR mapping was delivered by Mr. Deo Raj Gurung of ICIMOD, followed by hands-on session conducted by team (Mr. Bijan Debnath, Mr. Govinda Joshi, Mr. Hari Krishna Dhonju) from ICIMOD. At national and sub-national level participants were taught to develop hazard and vulnerability indicators in spatial framework in ArcGIS using physical and socio-economic data. These indicators were finally composited to arrive at composite hazard and vulnerability maps. These maps were used to develop risk profile at national and sub-national level. At local (watershed) level Dr. Khand Nanda Dulal, consultant delivered lecture and conducted hands on session on using HEC-Ras and HEC-GeoRas in conjunction with ArcGIS for inundation modelling and developing hazard maps.

Highlighting the satellite data as convenient source of information for aiding post flood interventions, Mr. Lin Yueguan from National Disaster Reduction Centre of China (NDRCC) imparted hands on session to map flood water using optical and radar sensors. This is intended to build capacity of partners in using satellite data to support post flooding intervention by increasing situational awareness.

Photo 4. Participants from Nepal, Bangladesh, India and Myanmar engrossed with hands-on exercise.

Photo 5. Participants experimenting with landslide detection/mapping algorithm.

In addition to flood, landslide being one of the major natural hazard type specific to mountain environment, a day session was conducted on landslide mapping by Dr. Tapas Ranjan Martha from National Remote Sensing Center (NRSC), India. Session on landslide covered semi-automatic detection of landslide through image processing for inventory development and landslide susceptibility mapping.

Dr. Shirish Ravan, UNOOSA provided overview of HFA priorities and new discourses in an effort to formulate HFA-2. He also highlighted the role of satellite data and geospatial

framework for DRR, and talked about regional and international mechanisms to access satellite data for rapid response mapping.

Refer Annex 2 for details regarding technical session.

4.3 Closing Session

Closing session was graced by Dr. Eklabya Sharma, Director of Program Operation at ICIMOD who highlighted the need for multi-sectoral engagement for disaster risk reduction. He expressed hope that knowledge gained through this training will be made to use for addressing issues in the ground, and assured ICIMOD's support to help them implement what they managed to learn. Mr. Birendra Bajracharya, Acting Program Manager – MENRIS and also Technical Coordinator of SERVIR-Himalaya stressed the need to customize the methodological framework and technological leverages to their own context. It is only when these technological leverage can make a different in the ground that investment on technological pursuit is justified. Dr. Shirish Ravan, UNOOSA thanked all the participants, resource persons from NRSC and NDRCC, and ICIMOD team for successful completion of the training. He requested participants to make best use of ICIMOD and its' network.
Dr. Sharma also honoured the participants by distributing certificate of completion. Finally participants were given group photo and pen-drive containing manual and training data for learning purpose once back to their respective station.

Photo 6. Dr. Eklabya Sharma, Director of Program Operation, ICIMOD awarding certificate to the participant from Nepal.

Photo 7. Dr. Eklabya Sharma, Director of Program Operation, ICIMOD handing token of appreciation to Dr. Shirish Ravan and Dr. Tapas Ranjan Martha.

Please refer Annex 3 for detailed program for closing session.

5. Details on Dates and Venue

Dates: 09 -13 June, 2014
Venue: ICIMOD, Nepal

6. Participants

A total of 20 officials from seven[2] regional member states of ICIMOD participated in the programme (Figure 1). Participants were from all levels of professional career from technical to manager. Out of 20 participants only 2 were female (Figure 2) despite our effort to balance gender ratio. Refer Annex 4 for details of participants and affiliation.

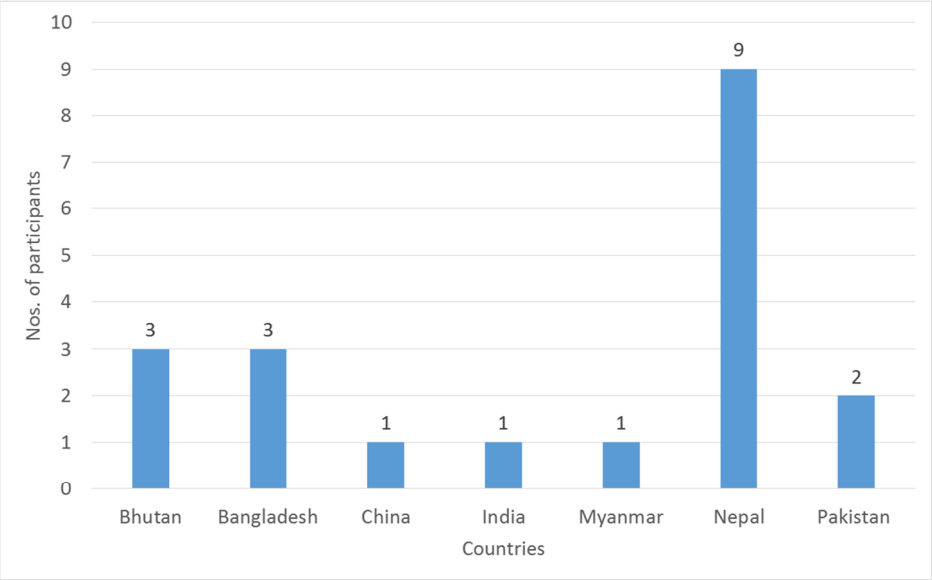

Figure 1. Participant number by countries.

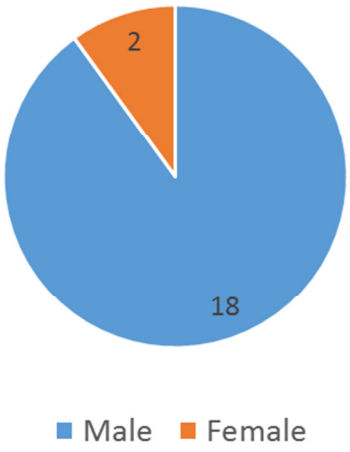

Figure 2. Participant number by gender

[2] Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan.

7. Experts

Following experts contributed to the training course by conducting specific sessions:

Experts	Organisation	Topics
Dr. Shirish Ravan	UN-SPIDER, China	International and national DRR initiatives
		Use of satellite data for DRR support
		Global and regional mechanism to access satellite data for rapid response mapping
Mr. Deo Raj Gurung	ICIMOD, Nepal	Introduction to SERVIR-Himalaya Initiatives
		Indicators for flood hazard, vulnerability, and risk assessment at national and sub-national level.
Dr. Khand Nanda Dulal	Consultant, ICIMOD, Nepal	Inundation modelling and hazard mapping using hydrodynamic models – HecRAS and HecGeoRas.
Mr. Hari Krishna Nebanupudi	ICIMOD, Nepal	DRR Concepts and Terminologies
Dr. Mandira Shrestha	ICIMOD, Nepal	Regional Flood Information System in the Hindu Kush Himalayan Region (HKH-HYCOS) Project
Mr. Hari Krishna Dhonju	ICIMOD, Nepal	Disaster Information Management System (Nepal)
Mr. Lin Yueguan	NDRCC, China	Flood mapping using satellite data – pre and post disaster
Dr. Tapas Ranjan Martha	NRSC, India	Semi-automatic detection of landslide;
		Landslide susceptibility mapping
Mr. Govinda Joshi, Mr. Hari Krishna Dhonju, Mr. Deo Raj Gurung, Ms. Sonam Zangmo	ICIMOD	Resource persons for hands-on sessions.

8. Programme Schedule

Program was designed to start with introductory session to revisit basic concepts of DRR and set the stage for upcoming technical deliberation and hands on session. From Day-2 focus was on hands on exercise giving participants an opportunity to work with real data and tool. Please refer Annex 2 for detailed training program.

9. Impression of Participants

The training program was very well appreciated by participants as it dealt with two of the most important natural hazards experienced by this region: flood and landslide. The fact that training had multi-level focus on risk mapping, which is the first of its kind, and touched upon both pre- and post- disaster contents was found comprehensive by the participants. Focus on hands-on-exercise and working with real world datasets is found to generate interest and better engage participants. The right mix of participants – technical and policy makers as per one of the participant provided an opportunity to interact across individual domain and understand DRR in a holistic frame.

> "**The lessons I have learned about multi-risk flood mapping will enable me to facilitate coordination between divisions and agencies within our department. With this knowledge, I can also play a role in changing the outlook within policy and decision making processes with regards to disaster risk reduction**"
>
> Ms. Pelden Zangmo, Chief Program Officer, Department of Disaster Management, Government of Bhutan.

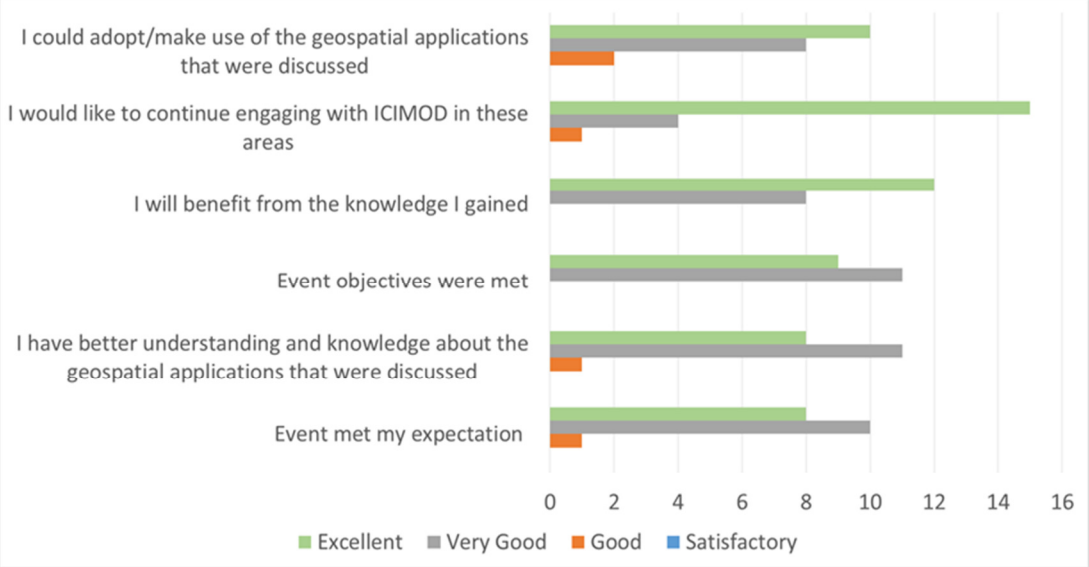

Figure 3. Participants' impression on relevance and objective of the training event

Figure 4. Participants' impression on content and resource persons

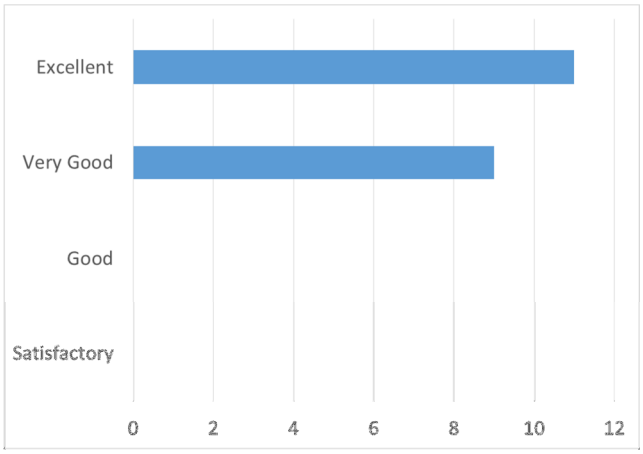

Figure 5. Overall impression of participants on the training event

Summary of detailed feedback provided by participants on the last day of the training is presented in Figures 3, 4, 5.

10. Conclusions and Recommendations

The training program was very well appreciated by the participants for mainly three aspects – relevant content, resource persons, and mixture of participants. It is the partnership between ICIMOD and UN-SPIDER (UNOOSA) that made it possible to take advantage of each other's strength and bring the best from the region. ICIMOD's presence in the region and good understanding of the need, helped draw good mixture of participants and target right group, and develop training content that is of high relevance. UN-SPIDER with global network brought in global experience and resource persons from their network (NRSC and NDRCC in this case) in addition to their contribution. This partnership also provided an

opportunity for cost sharing mechanism to achieve common target of building regional capacity.

This training was also used for cross learnings among participants by allocating time for experience sharing from each country/individual. It is recommended that such interaction as a cross learning opportunity is built in the program in future.

11. Lessons Learned

The training conducted as joint program is found to be effective. Use of real world datasets in the training made the participants relate the training to real situation. Good mix of participants is seen to help understand and relate the content in holistic manner through experience sharing.

12. Contact Information

Mr. Deo Raj Gurung,
SERVIR-Himalaya Disaster Lead,
ICIMOD, P.Box: 3226,
Khumaltar, Lalitpur, Nepal
E-mail: deoraj.gurung@icimod.org

Dr. Shirish Ravan,
UN-SPIDER Beijing Office,
Beijing, China.
E-mail: shirish.ravan@unoosa.org

ANNEXES

1. Opening Session

Time	Program	Speakers
(MC: Angeli Shrestha)		
09:00–09:15	Registration	Suyesh Pradhan/Sonam Zangmo
09:15-09:30	Welcome remarks	Dr. MSR Murthy, Theme Leader, Geospatial Solution Theme, ICIMOD
09:20-09:25	Welcome remarks	Dr. Shirish Ravan, Head, UN-SPIDER Office in Beijing, China
09:25-09:30	Program outline	Mr. Deo Raj Gurung, Training Coordinator, ICIMOD
09:30-09:35	Self-introduction	All participants
09:35-09:40	Remarks	Mr. Basanta Shrestha, Director of Strategic Cooperation, ICIMOD
09:40-09:50	Group photo	All
09:50-10:00	Tea/coffee break	

2. Final Training Program

Time	Program	Resource Persons
Day 1 (Monday, June 09, 2014)		
09 :00 - 09:15	Registration	Suyesh Pradhan, Sonam Zangmo
09:15 – 09:40	Opening session	Basanta Shrestha, Director of Strategic Cooperation, ICIMOD; MSR Murthy, Theme Leader, Geospatial Solutions Theme, ICIMOD; Shirish Ravan, UN-SPIDER, UNOOSA.
09:40 – 09:50	Photo session	All participants, resource persons
09:50 -10:00	**Tea/coffee break**	
10:00 - 10:30	Introduction to SERVIR Himalaya and disaster related activities	Deo Raj Gurung, ICIMOD
10:30 - 11:15	DRM Concepts and terminology	Hari Krishna Nebanupudi, ICIMOD
11:15 – 12:30	Space technology contribution in DRR – Challenges with respect to implementation of HFA and HFA 2	Shirish Ravan, UNOOSA
12:30-13:30	**Lunch Break**	
13:30 - 14:15	Regional Flood Information System in the HKH region (HKH HYCOS)	Mandira Shrestha, ICIMOD
14:15 – 14:30	Disaster Information Management System - Demo	Hari Krishna Dhonju, ICIMOD
14:30 – 15:15	Integrating climate change adaptation, sustainable development and ecosystems in disaster risk reduction – Space Technology Perspective	Shirish Ravan, UNOOSA
15:00 - 15:15	**Tea/coffee break**	
15:15 - 16:00	Hazard, vulnerability indicators	Deo Raj Gurung, ICIMOD
16:00 – 17:00	Hands on: Developing hazard and vulnerability indicators at national and sub-national level	Deo Raj Gurung, Bijan Debnath, Govinda Joshi, Hari Krishna Dhonju

Time	Program	Resource Persons
Day 2 (Tuesday, Jun 10, 2014)		
09:00 - 09:45	Hands on: Developing hazard and vulnerability indicators at national and sub-national level	Deo Raj Gurung, Bijan Debnath, Govinda Joshi
09:45 - 10:30	Hands-on: Hazard & vulnerability mapping at national and sub-national level	Deo Raj Gurung, Bijan Debnath, Govinda Joshi
10:30-10:45	**Tea/coffee break**	
10:45 - 12:30	Hands-on: Hazard & vulnerability mapping at national and sub-national level	Deo Raj Gurung, Bijan Debnath, Govinda Joshi
12:30-13:30	**Lunch Break**	
13:30 - 14:15	Lecture on: Introduction to hydrodynamic modelling	Khada Nanda Dulal
14:15 – 15:00	Hands on: Data preparation for HEC-RAS model	Khada Nanda Dulal
15:00-15:15	**Tea/coffee break**	
15:15 - 17:00	Hands on: Data preparation for HEC-RAS model	Khada Nanda Dulal
Day 3 (Wed, June 11, 2014)		
09:00 - 09:15	Experience sharing - Use of Landscan data	Professor Anup Sa
09:15 - 10:30	Hands on: Inundation modelling using HEC-RAS model	Khada Nanda Dulal
10:30 - 10:45	**Tea/coffee break**	
10:45 – 11:30	Hands on: Inundation modelling using HEC-RAS model	Khada Nanda Dulal
11:30 – 12:30	Hands on: Hazard mapping using modelled output	Khada Nanda Dulal
12:30 - 13:30	**Lunch Break**	
13:30 - 14:15	Flood rapid response mapping	Lin Yueguan
14:15 – 15:00	Hands on: Flood inundation mapping using optical satellite data	Lin Yueguan, Deo Raj Gurung, Govinda Joshi
15:00 - 15:15	**Tea/coffee break**	
15:15 – 17:00	Hands on: Flood inundation mapping using optical satellite data	Lin Yueguan, Deo Raj Gurung, Govinda Joshi
Day 4 (Thu, Jun 12, 2014)		
09:00 - 09:15	Experience sharing – community based flood EWS in Bangladesh	ATM Shamsul Alam Bakul
09:15 –	Hands on: Flood inundation mapping using	Lin Yueguan, Deo Raj Gurung,

Time	Program	Resource Persons
10:00	microwave satellite data	Govinda Joshi
10:00 - 10:15	**Tea/coffee break**	
10:15 - 11:00	Global and Free Satellite Image Dataset Access and Avenues	Shirish Ravan, UNOOSA
11:00 – 12:00	Space based information during emergency – International Initiatives to respond to disasters	Shirish Ravan, UNOOSA
12:00 – 12:15	Flood EWS based on JASON-2 satellite data.	Deo Raj Gurung
12:15 – 12:30	Q & A	All participants
12:30-13:30	**Lunch Break**	
13:30 - 15:00	Semi-automatic landslide mapping using satellite data	Dr. Tapas Ranjan Martha
15:00 - 15:15	**Tea/coffee break**	
15:15 - 17:00	Landslide susceptibility mapping	Dr. Tapas Ranjan Martha
Day 5 (Fri, Jun 13, 2014)		
09:00 - 09:15	Experience sharing – flood forecasting using rainfall-runoff model and IFAS.	Mr. Atif Irshad
09:15 - 10:00	Hands on: Semi-automatic landslide mapping using satellite data	Dr. Tapas Ranjan Martha, Deo Raj Gurung, Govinda Joshi
10:00 - 10:15	**Tea/coffee break**	
10:15 – 11:00	Hands on: Semi-automatic landslide mapping using satellite data	Dr. Tapas Ranjan Martha, Deo Raj Gurung, Govinda Joshi
11:00 – 12:30	Hands on: Landslide susceptibility mapping	Dr. Tapas Ranjan Martha, Deo Raj Gurung, Govinda Joshi
12:30 - 13:30	**Lunch Break**	
13:30 - 15:00	Hands on: Landslide susceptibility mapping	All Participants
15:00 - 15:15	**Tea / Coffee**	
15:15 – 16:00	Closing session	

3. Closing Session

Time	Program	Speaker
	MC: Suyesh Pradhan	
3:45 – 4:05	Participants' impression on the training event.	Participant(s)
4:05 – 4:10	Closing remarks	Mr. Birendra Bajracharya, Acting Regional Program, Manager, MENRIS, ICIMOD
4:10 – 4:15	Closing remarks	Dr. Shirish Ravan, Head, UN-SPIDER Office in Beijing, China
4:15 – 4:30	Certificate distribution	
4:30 – 4:40	Closing comments	Dr. Eklabya Sharma, Director of Programme Operation, ICIMOD
4:40 – 4:45	Vote of Thanks	Mr. Deo Raj Gurung, Training Coordinator, ICIMOD

4. List of Participants

No.	Name	Designation/Organization	E-mail
01	Mr. Netai Dey Sarker	Assistant Secretary, Department of Disaster Management, Ministry of Disaster Management & Relief, Bangladesh	netai@mail.com
02	Mr. Subrata Kumar Mondal	Principle Specialist, Center for Environmental and Geographic Information Services (CEGIS), Bangladesh.	smondal@cegisbd.com
03	Mr. ATM Shamsul Alam Bakul	Environmental and Geographic Information Services (CEGIS), Bangladesh.	aalam@cegisbd.com
04	Mr. Karma Chophel	Engineer, Department of Geology and Mines, Ministry of Economic Affairs, Thimphu, Bhutan	chophel86@gmail.com
05	Ms. Pelden Zangmo	Chief Program Officer, Department of Disaster Management, Ministry of Home and Cultural Affairs, Thimphu, Bhutan	peldenzangmo@gmail.com
06	Mr. Bikash Pradhan	Engineer, Department of Hydro-Met Services, Ministry of Economic Affairs, Thimphu, Bhutan	bikash.dhms@gmail.com
07	Mr. Qiang Zou	Institute of Mountain Hazards & Environment, Chinese Academy of Sciences	zouqiang@swust.edu.cn
08	Prof. Anup Saikia	Department of Geography, Gauhati University, Assam, India	anmsaikia@gmail.com
09	Mr. Nay Win	Staff Officer Relief and Resettlement Department, Myanmar	naywin.rrd@gmail.com
10	Mr. Man Bahadur Kshetri	GIS Analyst, Food Security Monitoring and Analysis	Man.kshetri@wfp.org

		/Vulnerability Analysis and Mapping Unit, United Nations World Food Programme, Country Office, Kathmandu, Nepal	
11	Mr. Sujan Raj Adhikari	Engineering Geologist National Society for Earthquake Technology-Nepal (NSET), Nepal	sadhikari@nset.org.np
12	Mr. Shekhar Paudel	Section Officer, Disaster Management Division, Ministry of Home Affairs, Government of Nepal, Singha Durbar, Nepal	shekhar.pou@gmail.com
13	Mr. Rocky Talchabhadel	Hydrologist Engineer Department of Hydrology and Meteorology, Ministry of Science, Technology and Environment, Nepal	
14	Mr. Vijaya Khatiwoda	Department of Water Induced Disaster Prevention, Ministry of Irrigation, Government of Nepal, Nepal	vckhatiwoda@gmail.com
15	Mr. Sabin Adhikari	Nepal Red Cross Society, Nepal	Sabin.adhikari@nrsc.org
16	Mr. Deepak Poudel	Disaster Preparedness Network (DPNET), Nepal	deepakndml@yahoo.com
17	Ms. Pramila Adhikari	Engineer, Department of Irrigation, Ministry of Irrigation, Government of Nepal, Nepal	Manuadhikari77@gmail.com
18	Mr. Atif Irshad	Meteorologist, Flood Forecasting Division, Pakistan Meteorological Department, Pakistan.	ati_ssg@yahoo.com
19	Mr. Abdul Latif	Assistant Director, (DRR) National Disaster Management Authority, Pakistan	ad_drr2@ndma.gov.pk
20	Dr. Jianqiang Zhang	Geospatial Solutions, ICIMOD	Zhang.jianqiang@icimod.org