Consultation Workshop on

"Disaster Risk Reduction and Climate Change Adaptation in Koshi River Basin, Nepal"

21 September 2013, Rajbiraj, Saptari

Organized by:

Nepal Development Research Institute (NDRI),

Pulchowk, Lalitpur, Nepal

Supported by:

Climate Development Knowledge Network (CDKN)

and

Global Change System for Analysis, Research and Training (START)

23 September, 2013

1. Brief description of the project and the workshop

*'**Disaster Risk Reduction and Climate Change Adaptation in Koshi River Basin, Nepal**'* is a research based project that aims to assess the impact of climate change on current and future development in Koshi River Basin. Nepal Development Research Institute (NDRI) is conducting the project under the principal investigation of Dr. Laxmi Prasad Devkota. The project is supported by Climate and Development Knowledge Network (CDKN) and global change SysTem for Analysis, Research and Training (START).

The major objectives of the project are a) Advancing knowledge on climate change impact on water resources; b) Assessment of flood risks in the context of climate change; c) Revisiting the design standards/values; d) Contributing to policy formulation process; and e) Awareness building of stakeholders including local communities and training of new generation. The methodological steps include the hydro-meteorological diagnostics, hydrological modeling (SWAT and SRM) and the hydraulic modeling (HEC-RAS) using regional climate model data for the IPCC scenario A1B as well as the social vulnerability and risk assessment.

This consultative workshop in Rajbiraj Municipality, the district capital of Saptari District, on 21 September 2013 is the third workshop in progress after two successful workshops. The first consultative workshop was held in Kathmandu at national level on 10 January 2013. The second consultative workshop was held in Inaruwa, Sunsari at local level on 22 February 2013.

The major objective of this consultative workshop was to disseminate the up-to-date findings from the research; to participate the local stakeholders including the local people in active discussion in order to understand the local perspectives that necessary to include in the local and national policy for the disaster risk reduction and climate change adaptation in the Koshi River Basin.

There was enthusiastic participation from governmental, non- governmental, social organizations; and also from local people interested in this study. There were altogether 37 participants and 4 research members present during the workshop. (Refer Annex A for the list of participants and Annex B for the registration list)

2. Location Description

The 3rd consultative workshop on *"Disaster Risk Reduction and Climate Change Adaptation in Koshi River Basin, Nepal"* was held in Rajbiraj Municipality, the district capital of Saptari District, on 21 September 2013. Rajbiraj Municipality lies about 16.7 km west of the Koshi Barrage and about 51 kms west of Biratnagar Municipality. Adjacent areas to Koshi River and lower parts of the Saptari district namely Bairawa, Bhardaha, Gobargada, Inarwa and Hanumannagar are very prone to flood disasters. Since, this study aims to involve the local people and stakeholders in the identifying the local issues, sharing opinions and experiences towards the flood disaster risk reduction and climate change adaptation. As such, Rajbiraj-Saptari was an obvious location for conducting the workshop. **Figure 2-1** shows the location map of workshop venue -Rajbiraj, Saptari.

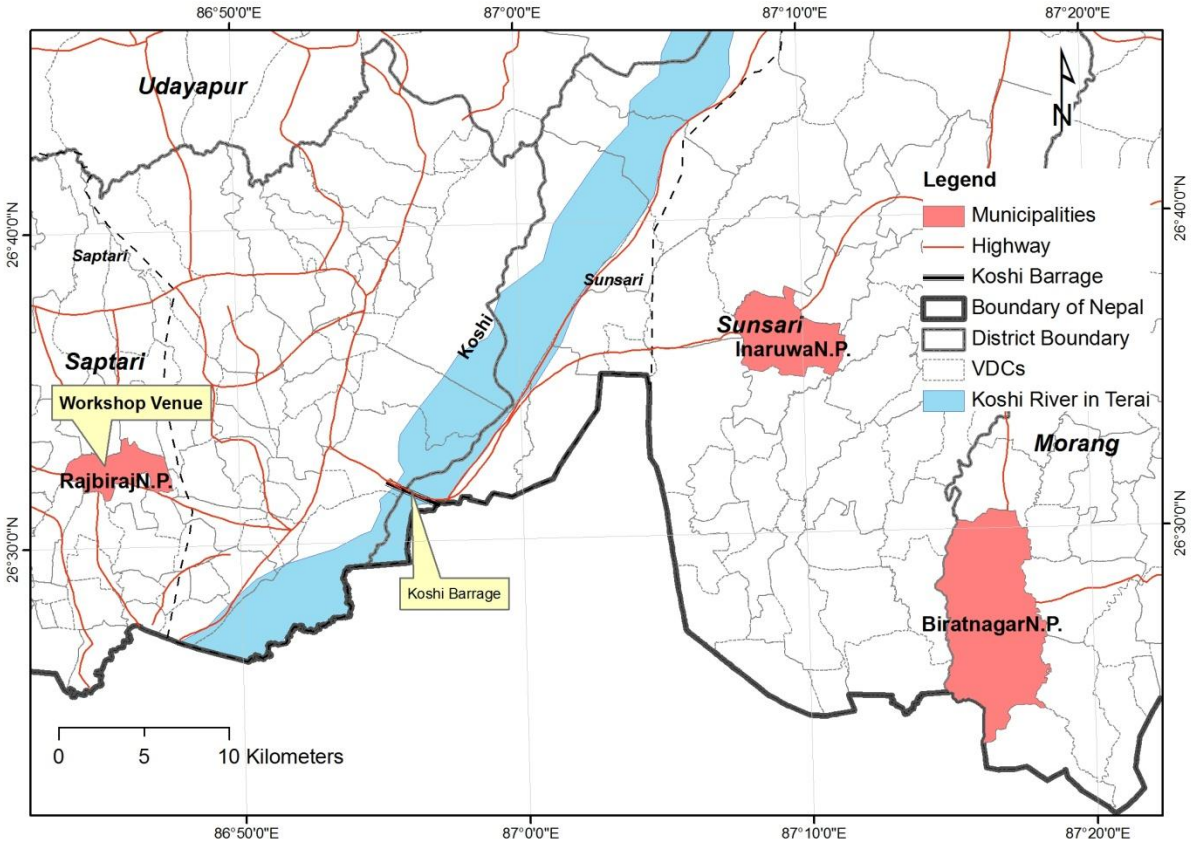

Figure 2-1: Location map of the Workshop Venue- Rajbiraj Municiplaity, Saptari district

3. Consultative Workshop Module

The workshop was conducted from 7:00am to 3:00pm. The workshop was divided into three sessions: Inaugural Session, Technical Session and Feedback/ Consultation Session.

3.1. Inaugural Session

This session was formally opened by welcoming the chief guest -Mr. Lalit Kumar Yadav, the acting Campus Chief, Mahendra Bindeshwari Multiple Campus-Rajbiraj,Saptari; very special guest Mr. Rudra Hari Bhandari, the chief district education officer, District Education Office- Saptari; special guest - Mr. Nabaraj Khadka, the program officer - District Development Committee (DDC); the chairperson - Dr. Manjeshwori Singh, the treasurer of Nepal Development Research Institute Secretary and the Co-principal Investigator of this study; and the Principal Investigator of this research- Dr. Laxmi Prasad Devkota, the senior research scientist, Nepal Development Research Institute upon the dias. It was followed by warm welcome speech and the brief project description by Dr. Laxmi Prasad Devkota. It was then followed by important remarks from the special guest; very special guest and the chief guest. Later, this session was concluded by vote of thanks by the chairperson. The Master of Ceremony for the session was Mr. Dibesh Shrestha, Research Associate, Nepal Development Research Institute. The session was managed by Mr. Dhiraj Gwayali, Research Associate, Nepal Development Research Institute.

3.1.1. Summary of welcome speech and brief project description by the Principal Investigator , Dr. Laxmi Prasad Devkota, the senior research scientist, Nepal Development Research Institute

Dr. Laxmi Prasad Devkota opened the inaugural session by welcoming the chief guest, the very special guest, the special guest, the chief guest and all the participants from different governmental, non-governmental, social organizations and individual sectors to the workshop. He further explained about the on-going reserach - '***Disaster Risk Reduction and Climate Change Adaptation in Koshi River Basin, Nepal***' and the objective of this workshop to all the participants. He discussed about the different objectives of this project, systematically providing the recent update on the research findings. He then requested all the participants to be actively involved in the workshop discussions in order to provide and share their local experiences and knowledge towards the subject related to this study, so that, they can be further included in the study. He argued that this input will certainly assist the study team to strengthen the research linking them with the local and national policy. He sincerely hoped that this will help the local people in the disaster risk reduction and adaptation to climate change impacts. (Refer Annex C for presentation on the research description)

Photo 3-1: Welcome speech by the Principal Investigator , Dr. Laxmi Prasad Devkota

3.1.2. Summary of Speech by the Special Guest, Mr. Nabaraj Khadka, the Program Officer, District Development Committee

Mr. Nabaraj Khadka thanked NDRI for inviting him and providing opportunity to express his views in the workshop. He first stated that this workshop will be very much beneficial for understanding about the climate change and its impact on water resources, including floods. Such study, regarding the Koshi Dam, should focus on the both the beneficial and negative aspects. Besides, he hoped that such study will provide necessary scientific inputs for design local risk reduction and adaptation strategy at both local and national level. He finally expressed that this workshop will be learning opportunity for him and other participants.

Photo 3-2: Speech by the Special Guest, Mr. Nabaraj Khadka, the Program Officer, District Development Committee

3.1.3. Summary of Speech by the Very Special Guest, Mr. Hari Rudra Bhandari, the chief, District Education Office

Mr. Hari Rudra Bhandari at first expressed his vote of thanks to the study team for inviting him as the very special guest for the workshop. He focused on the implications of the outcomes of this research; and mentioned that research findings and the policy must be linked in order to achieve the effective management of the risk associated with the disaster as floods. He further appreciated the efforts made by the study team for the consultation with the stakeholders in order to discuss the research outcomes and their possible linkages with the policy and strategy. He pointed out that more and more research should be focused towards Koshi High Dam and its construction should be justifiable with regards to those researches. He further stated that the local experiences should be incorporated in the research; so that it will be more pragmatic towards the local disaster risk reduction and adaptation towards changing climate. He concluded his kind statements wishing success of this study.

Photo 3-3: Speech by the Very Special Guest, Mr. Hari Rudra Bhandari, the chief, District Education Office

3.1.4. Summary of Speech by the Chief Guest, Mr. Lalit Kumar Yadav, the acting Campus Chief, Mahendra Bindeshwari Multiple Campus, Rajbiraj, Saptari

Mr. Lalit Kumar Yadav thanked NDRI for inviting him as the chief guest for the workshop. He felt honored to have been appointed as a part of the consultation meeting on such a serious and contemporary research. He emphasized the fact that the research studies be conducted under justifiable conditions and the results should be disseminated amidst consultations with the local stakeholders as they are the one who have to bear the consequences in case of any adverse conditions. he welcomed the fact that research like this would only benefit the locals as it helps to understand the existing and upcoming scenarios, and in turn raises awareness and facilitates the capacity building of the locals. However, he told that the organizations like NDRI will have to alarm the policy makers, time and time again, on behalf of the locals. He wished to learn a lot from the workshop and concluded his remarks with vote of thanks.

Photo 3-4: Speech by the Chief Guest, Mr. Lalit Kumar Yadav, the acting Campus Chief, Mahendra Bindeshwari Multiple Campus, Rajbiraj, Saptari

3.1.5. Summary of closing speech of inaugural session by the chairperson and the Co-principal Investigator , Dr. Manjeshwori Singh, the senior research scientist, Nepal Development Research Institute

Dr. Manjeshwori Singh first thanked all the participants from different organizations for participating on the workshop. She highlighted the importance of any research for the development of the area and the country. She further added that research help bring the truth and scientific facts at the local and national level that are crucial for development planning. Besides, she focused on the value of workshop as to further enhance the information dissemination obtained from the research. She wished that the outcomes/ feedbacks from the consultation with all the stakeholders in this workshop will help in the progress of this research. She then by thanking all the participants for attending and making this workshop successful concluded the session.

Photo 3-5: Closing speech of inaugural session by the Co-principal Investigator , Dr. Manjeshwori Singh

3.2. Technical Session

There were three technical presentations in this sessions describing and informing the participants about the current state of this research and the current research . This session also elaborated on the issues for the discussion in the feedback/consultation session. The three presentations were:

1. Application of Climate data from RCM in Koshi River Basin and Snow Melt Runoff Modelling - by Mr. Dibesh Shrestha and on behalf of Ms. Anita Khadka, Research Associate
2. Technical presentation-Hydrologic and Hydraulic modeling of the Koshi Basin - by Mr. Dhiraj Gyawali, Research Associate
3. Socio-economic Vulnerability Assessment- by Dr. Manjeshwori Singh, Co-investigator

3.2.1. Summary of technical presentation on' Application of Climate data from RCM in Koshi River Basin and Snow Melt Runoff Modelling '- by Mr. Dibesh Shrestha and on behalf of Ms. Anita Khadka, Research Associate

The first technical presentation was focused on the use of the climate data from regional climate model for the study. Mr. Shrestha first discussed on brief about the climate change, IPCC - scenarios, availability of climate data in Nepal and about the bias correction. Later on he focused on the brief findings of the study. He first described the rainfall pattern from two RCM models, PRECIS-HadCM3 and PRECIS ECHAM05, on the Arun-basin of Nepal for the future period of 2030-2060. He later explained, fro the same period, about the pattern of temperature at the Dingboche station at altitude (4355m from msl). He pointed out the increase in annual rainfall and annual average temperature.
(Refer....Annex...for the presentation slides)

Photo 3-6: Technical presentation by Mr. Dibesh Shrestha, Research Associate

3.2.2. Summary of technical presentation on ' Hydrologic and Hydraulic modeling of the Koshi Basin' - by Mr. Dhiraj Gyawali, Research Associate

The first half of the presentation was on the Hydrologic modeling approaches, methodologies and results. After a brief introduction on the watershed models and the selected model, i.e. Soil and Watershed Assessment Tool (SWAT), Mr. Gyawali described about the application of SWAT model to the basin and the inputs used in the model. Comparison of simulated and observed flows at the outlet was then explained followed by statistical and graphical comparison of observed flows and projected flows under ECHAM05 climate data simulated by SWAT. The results showed a shift in peak flow from August (existing) to June-July (future). The results also suggested a sharp increase in flow during the 2040s and 2050s. The second part of the presentation was focused on the hydraulic modeling approach used to map the flood inundation in the study area for present and future conditions. Comparative inundation depth mapping at different VDCs, for existing high flood and the projected high flood were well explained and described.

(Note: Refer Annex II for presentation)

Photo 3-7: Technical presentation by Mr. Dhiraj Gyawali, Research Associate

3.2.3. Summary of technical presentation on ' Socio-economic Vulnerability Assessment' by Dr. Manjeshwori Singh, Co-investigator

Dr. Singh presented about the socio-economic vulnerability assessment methodologies, study area and the preliminary findings of the assessment. At first she explained aspects of vulnerability and described about the different aspects considered in this study for the vulnerability assessment. She then continued her presentation with the description on the socio-economic indicators used for the assessment. She then described about the preliminary findings of the study. She discussed about the computed risk values for different study areas. She followed her discussion with the flood mitigation activities and adaptation measures obtained from the survey. (Note: Refer Annex II for presentation)

Photo 3-8: Technical presentation by Dr. Manjeshwori Singh, Co-investigator

3.3. Feedback/ Consultation Session

The third session on the workshop was focused on group discussion to obtain the stakeholders perspectives, views and experiences on the existing condition of disaster risk reduction and climate change adaptation. The discussion was also focused on the issues that are to be included in the study that helps to back up the local and national policy processes. Three groups were formed in order to discuss on different issues. The first group discussed on the relevance of the proposed Koshi High dam on the development of the area. The second group was focused on the flood disaster risk reduction and the final group discusses on climate change induced flood disaster mitigation and its adaptation. Later, the summary of discussion were presented by group leader of each group. This session was moderated by Dr. Laxmi Prasad Devkota. After the conclusion of this session Dr. Devkota concluded the program with vote of thanks to all the participants for making this workshop successful and fruitful.

Summary of the discussions are as follows:

3.3.1. Summary of group discussion- Group 1: Technical Group

Agenda:

How useful the Koshi High Dam can be to the prosperous development of this area with regards to:

a. Type and Size of the Dam

b. Water-use sectors (what and how)

c. Disaster risk reduction (what and how)

Summary of discussion:

a. We should use the statistical information obtained from the detailed geological investigation of the dam site carefully and sensitively. Since the area is in very high risk zone of earthquake disaster, earthquake resistivity should be considered as primary factor. Detail study should be carried out from the information from field survey.

b. There should be good management of silts and sediments.

c. We should consider the water storage and its consequent submergence area before construction of the dam.

d. The design and implementation of the dam should be construction sensitive for cost effectiveness. We should consider construction period, time period and the rate analysis at each phase.

e. Strong and positive aspects of the Dam:

- It is good to do something than to do nothing.
- Hydropower generation
- Water Supply
- Irrigation
- Recreation activities/ Tourism
- Flood Management in downstream
- Bridging for easy transportation

f. Weak and negative aspects of the Dam:

- Lies in the earthquake prone zone
- Since the proposed dam height is 269m, there is risk of very high inundation in upstream of the dam, loss in the agriculture land, vegetation, forest area and the loss of species
- May lead to very high disaster in case of dam breach
- Increase in the water table in upstream and decrease in downstream
- Affects the life of the dam due to sedimentation and scouring

g. The construction of the dam should incorporate the feeling of ownership by the people and profit sharing; and the feeling of responsibility

h. Effective risk management framework should be present

	
A. Group 1 (Technical Group) on discussion	B. Representative from Group 1 (Technical Group), Mr. Suman Dahal, presenting the summary of discussion

Photo 3-9: Group 1 (Technical Group) on action during the feedback and technical session

3.3.2. Summary of group discussion: Group 2: Flood Disaster Reduction: Indigenous Techniques

Agendas:

1. What are indigenous techniques, traditional strategies followed by the local people of this area for the flood related natural disaster risk reduction? (household and community level)

- **Preparedness/strategies adopted during pre-flood condition**
- **Indigenous Techniques / Strategies adopted during flood**
- **Response work and strategies adopted during post-flood condition**

2. How this study can be interlinked with the local and national policy?

Summary of discussion:

Agenda 1: Flood Disaster Reduction: Indigenous techniques and strategies

Household level	Community Level
Before Flood disaster: • Monsoon Preparedness (Food, raised safe shelter selection, WASH, Health, protection, Rope, wooden boats, Machan, Safe Jhatpat bags, Identification of disable, child lactating mothers, pregnant mother, old etc) • Pre-identification of safe location for shelter	**Before Flood disaster:** • Preparedness (Food, raised safe shelter selection, WASH, Health, protection, Rope, wooden boats, Machan, Safe Jhatpat bags, Task force team SR,EW, equipped CDMCs/ VDMCs etc . • Information sharing management, installation of Siren etc. • Formation of community based disaster

• Reserving food, drinking water, fuels etc. • Identification and managing the safe location for keeping important objects as money, documents etc • Exercise and practice of swimming, availability of equipments as spade, managing life jacket and Safety aid box	risk reduction committee, cooperation between local people and stakeholders at local and district level
<u>During flood disaster:</u> • SR, Selection of relatives for their safety • Protection of the children; women and important properties • Use of boat, banana tree-bark ready for transportation • Untying livestock, farm animals • Helping each other	**<u>During flood disaster</u>**: • Raised area shelter, EW, SR, stock piling for mass, Emergency Response distribution based on condition of the flood disaster, communication, Heath, education, Protection IRA/MIRA, WASH, nutritious food, and manage according to the flood disaster situation. • Mobilization of the skilled man-power and distribution of very important materials required for rescue • Supply of ready-made food like beaten rice, noodles; and non-food items like utensils, clothes • Moving to safe location for shelter • Social security and health services • Managing the primary requirements for children and pregnant women • Effective two way communication and information sharing
<u>After flood disaster:</u> • Recovery from Nepal Govt./ INGOs/NGOs/ Community	**<u>After flood disaster:</u>** • Recovery from Nepal Govt./ INGOs/NGOs based on their Losses, • Livelihood option • Cooperation with the governmental, non-governmental organizations • Provision of the shelter, food, safe drinking health services, proper sanitation,

	education • Data collection from the victims, losses of property and livestock • Reconstruction of roads, basic services • Provision of nutritious food for children • Provision of fuels • Social Security and preventing gender violence • Inclusion of all these factors in the policy making

Agenda 2: Link with national Research policy

- There should national level Policy for DRR.
- Response and Recovery policy should be developed by Nepal govt.
- Should be Common for all flood disaster affected people
- DDRC and Clusters should be follow the developed government policy
- Researcher and policy maker should be established to developed DRR Policy

	
A. Group 2 on discussion	B. Representative from Group 2 (Mr. Bhimsen Prasad Chaudhary) presenting the summary of discussion

Photo 3-10: Group 2 on action during the feedback and technical session

3.3.3. Summary of group discussion- Group 3: Climate Change Induced Flood Disaster Mitigation and its Adaptation

Agendas:

1. What should be included in the local and national policy for the climate change induced flood disaster risk reduction and adaptation?

2. What should be the roles of government, local governmental agencies, non-governmental organisations, community based organisations and private sectors for policy for the climate change induced flood disaster risk reduction and adaptation?

Summary of discussion:

Agenda 1:

Local Level	National Level
• Public debate and discussions , workshops etc related to disaster risk reduction and climate change adaptation at local level in order to make local policy	• Broader discussions and required at national level to address the local, regional and national issues in the national policy
• Formation of disaster risk management committee at ward level to district level	• Formation of the policy regarding the formation of high level disaster management committee
• Mass awareness is the important factor that should be considered during policy / strategy formation.	• Effective and quick coordination between local level and national level
• Effective Communication Policy is needed.	• Effective Communication Policy is needed.
• Early warning system at local level should be established	• Framework for installation of networks of early warning system at river systems countrywide
• Formation of different working groups at wards and Village development committee levels	• Formation of different working groups at District level and National Level committee levels
• Harmonious work division among different institutions at district level	• Formation of different central institution like ministry for disaster risk reduction and climate change adaptation
• Pre-disaster preparedness including food, drinking water, safety and rescue equipments at local and VDC level	• Provision of emergency large scale storage facility
• Pre-identification of safe shelter area	• Provision of basic facilities at those locations

• Post Disasters Relief Management Policy at local level is needed.	• Post Disasters Relief Management should be carried out in networks of institutions at all levels
• Proper strategy for implementing emergency fund distribution and its management at ward and VDC level	• Proper strategy for implementing emergency fund distribution and its management at district and national level
• Trainings to local people increase their capacity for disaster risk reduction for pre-, during and post-disaster conditions	• Provision of skilled trainers, training facilities at all level
• Programme for conservation of Chure and hills regions	• Programme and stratefy for conservation of Chure and hills regions
• Making technical and social strategy for river erosion control, sedimentation control and bank protection at local level	• Making technical and social strategy for river erosion control, sedimentation control and bank protection at national level
• Strategy for conservation of Himalayan Watersheds	• Strategy for conservation of Himalayan Watersheds
• Inclusion of all social and economic population classes in the formation, management, evaluation and monitoring , feedback collection with regards to policy for disaster risk reduction and climate change adaptation.	• Inclusion of all social and economic population classes in the formation, management, evaluation and monitoring , feedback collection with regards to policy for disaster risk reduction and climate change adaptation.

<u>Agenda 2:</u>

- Afforestation/ Reforestaion at river banks
- Construction of the river control and protection structures like embankments to meet the needs of the people
- Provision of good drainage
- Raising Awareness
- Management of losses including the insurance of live and property
- Conservation and promotion of water sources
- Channelization of rivers and drainages
- Water resources and its benefit management

	
A. Group 3 on discussion	B. Representative from Group 3 presenting the summary of discussion

Photo 3-11: Group 3 on action during the feedback and technical session

1 Annexure

Annex A: List of participants

Sno	Name	Position	Office/Organisation	Telephone Number	Email
1	Keshaw Kumar Das	Engineer	KPCCIMD-2, Saptari	9842360920	keshawdas@yahoo.com
2	Sanjaya Kumar Mandal	Staff	Koshi Victims' Society, Saptari	9807710379	xx
3	Ramawaxav Mandal	District Health Officer	District Public Health Office	9842853215	xx
4	Bhimsen Prasad Chaudhary	Program Coordinator	Koshi Victims' Society, Saptari	9852820613/ 031-522524	koshivsociety@gmail.com
5	Sarita Kumari Yadav	Member	Koshi Victims' Society, Saptari	9801010297	xx
6	Lal Bahadur Chaudhary	Member	Re. Po. Mahaasangh, Sitapur	9814766958	xx
7	Dr. K.N. Yadav	Chief	DLSO, Saptari	9852820696	xx
8	Ramprakash Yadav	Member	Koshi Victims' Society, Saptari	9804708702	xx
9	Lalit Kumar Yadav	for Campus Chief	Saptari Bindeshwari Multiple Campus, Saptari	9842821929	xx
10	Nurman Dangol	Technician	W.Sa.S Office	9842821770	xx
11	Suman Dahal	District Engineer cum DRRO Officer	Rural Reconstruction Nepal (RRN), Saptari	9851086653	dahal.ersuman@gmail.com
12	Mahendra Kumar Chaudhary	Pressident	Nepal Bar Association -Appellate Court, Rajbiraj, Saptari	9743000407	xx
13	Jitendra Deo	Focal Person	Save the Saptari, Saptari	9842831793	savethesaptari@gmail.com
14	Anup Lal Shah	District Agriculture Development Officer	District Agriculture Development Office, Saptari	9852820765	dadosaptari@gmail.com
15	Yogendra Bhagal	President	Nepal Red Cross Society, Saptari	9852820121	xx
16	Shyam Kant Chaudhary	President	NGO Federation, Saptari	9842820176	shyamkant_2008@yahoo.com
17	Pradip Shrestha	Sub-engineer	EIDD No.4, Saptari	9842207908	pdp.heart@gmail.com
18	Gopal Singh Dhami	Sub-engineer	EIDD No.4, Saptari	9848730983	gopidhami@yahoo.com
19	Surendra Pd. Yadav	Reepresentative from	yet Nepal, Saptari	9804703959	xx
20	Prawin Kumar Yadav	Member	Student Front, Saptari	9804730070	xx
21	Arun Kumar Thakur	A.F.O.	District Forest Office	9842878044	xx

22	Hriday Kumar Jha	District Soil Conservation Officer	District Soil Conservation Officer, Saptari	9855021129	hridayjha34@yahoo.com
23	Sushila Chaudhary	WDO	WCO,Saptari	9842820731	shusilachaudhary31@gmail.com
24	Vijay Kumar Yadav	Member	Bar Association, Saptari	9842821398	xx
25	Dev Narayan Yadav	Team Leader	Koshi Victims' Society, Saptari	9852820612	koshivsociety@gmail.com
26	Rudra Hari Bhandari	District Education Officer	District Education Office, Saptari	9852820520	bhandarirh@yahoo.com
27	Nabaraj Khadka	Program Officer	District Development Committee, Saptari	9852820557	ldosaptari@yahoo.com
28	Bimal Yadav	Member	Local Cooperative, Rajbiraj, Saptari	xx	xx
29	Jawed Alam	Campus Chief	Institute of Engineering-Purwanchal Campus, Dharan	9852045805	ajawedc@ioe.edu.np
30	Narendra Kumar Dagni	Associate Professor	Institute of Engineering-Purwanchal Campus, Dharan	9841173888	narendradangi@hotmail.com
31	Surya Narayan Yadav	Member	Jan-chetna Samaj Nepal, Saptari	9842833628	xx
32	Dhirendra Pd. Sah	President	FNJ, Saptari	9842820681	dhirurajbiraj@gmail.com
33	Jitendra Sahani	Teaching Assisstant	Institute of Engineering-Purwanchal Campus, Dharan	9842038653	jitendra4_2009@yahoo.com
34	Mahesh K. Sal	Representative from	Ra. A. G. Ka. Saptari	xx	xx
35	Dev Narayan Yadav	Chairperson	Prokop Prabhabit Sanjal	9842628355	xx
36	Indra B. Budhathoki	Staff	District Education Office, Saptari	9842754926	xx
37	Sukdeo Chaudhary	F.O.	L.W.F pro	9842853034	xx

Annex B: Registration List

Consultation Workshop On
Disaster Risk Reduction and Climate Change Adaptation in Koshi River Basin, Nepal

Rajbiraj, Saptari
September 21, 2013 (Ashwin 05, 2070)

Registration List

S.N	Name	Position	Office/ Organization	Telephone Number	Email	Signature
1	Keshaw Kr. Das	Engineer	K.P.C.C.I.M.D.-2, Saptari	9842360920	keshawdas@yahoo.com	Keshaw
2.	Sanjay Kr. Mandal	Representative	I.C.V.S, Saptari	9807710379	Sanjay Mandal	Sanjay
3.	Ramawatar Mandal.	P.H.O.	D.P.H.O. Saptary	9842853215		
4	Bhimsen Pd. Chaudhary	Program coordinator	Oxfam Partner KVS	9852820613 031-522524	koshiv society@gmail.com	
5	Sarita Kumari Yadav	Accountant	KVS	9801010257		Sarita
6	Lal Bahadur Chaudhary	[illegible]	[illegible]	[illegible]		
7.	DR. K.M. YADAV	CHIEF	DLSO Saptary	9852820696		Kadav
8	Ramprakash Yadav	T.	K.V.S	9804708702		Ramprakash
9	Lalit Kumar Yadav	for campus chief staff	S.M.B. M.Campus Rajbiraj	9842821929		Lyadav
10	Norman Dangol	Technician	W.S.S.O. Office	9842821770		
11	Suman Dahal	District Engineer cum DRR officer	RRN	9851086653	dahal.ersuman@gmail.com	
12	Mahendra Kumar Chaudhary	Executive Magistrate Bench Clerk	[illegible]	9743000402		
13	Jitendra DEO	Focal Person	Save the Saptari	9842831733	savethesaptari@gmail.com	
14	Anup Lal Sah	DADO	Dist. Agri. Devt. Off. Saptari	9852820765	dadosaptari@gmail.com	

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Rajbiraj, Saptari
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Registration List

S.N	Name	Position	Office/ Organization	Telephone Number	Email	Signature
15	Yogendra Bhagat	President	N.R.C.S.	9852820121		
16	Shyam Kant Chaudhary	president	NGO Fed.	9842820176	shyamkant_2008@yahoo.com	
17	pradip Shrestha	sub-engineer	EIDD NO.4	9842207908	pdp.heart@gmail.com	
18	Gopal Singh Dhami	Sub-engineer	11	9848730983	gopidhami@yahoo.com	
19	Birendra Adyadan	P.L	yet Nepal	9804703959		
20	Prawin Kumar yadav	member.	Student forest	9804730070		
21	Arun Kumar Thakur	A.F.O	district forest office	9842878044	-	
22	Hriday Kumar Jha	DSCO	DSCO, Saptari	9855021129	hridayjha34@yahoo.	
23	Susila Chaudhary	WDO	WCO, Saptari	9842820781	sushilachaudhary31@gmail.com.	
24	Vijay Kumar Yadav	B.M Sah		9842821396		
25	Deo Narayan Paul	TL	KVS	9852820612	kcclivs@gmail.com	
26	Rudra Hari Bhandari	DEO	DEO Saptari	9852820502	bhandarish@yahoo.com	chair
27	Nabaraj Khadka	PO.	DDC. Saptari	9852820557	ddcsaptari@yahoo.com	
28	Bimal Yadav	member		9807721914		

Consultation Workshop On
Disaster Risk Reduction and Climate Change Adaptation in Koshi River Basin, Nepal

Rajbiraj, Saptari
September 21, 2013 (Ashwin 05, 2070)

Registration List

S.N	Name	Position	Office/ Organization	Telephone Number	Email	Signature
29	Jawed Alam	Campus Chief	IOE/Purwanchal Campus	9852045805	ajawedc@ioe.edu.np	J.Alam
30	Narendra Kumar Dangi	Asso. Prof	IOE, Purwanchal Campus, Dhn	9841173888	narendradangi@hotmail.com	
31	Surya Neza yam Yadav		Janchetnasamaj Nepal	9842833628		
32.	Dhirendra Pd Sah	president	FNJ, Saptari	9842820681	dhirurajbiraj@gmail.com	Dhsah
33.	Jitendra Sahani	Teaching Asst.	IOE, Purwanchal Campus, Dharan	9842038653	jitendra4_2009@yahoo.com	JSahni
34	Mahesh K. Sah	Smd.	Ra. A. G. Ka Sahayog	9842824459		
35.	Dev. Narayan Yadav	[illegible]	[illegible]	9852273[illegible]		
36	Indra B. Budha	P	[illegible]	9852[illegible]		
37	Surdeo Chaudhary	F.O	L.W.F. [illegible]	9842853[illegible]		

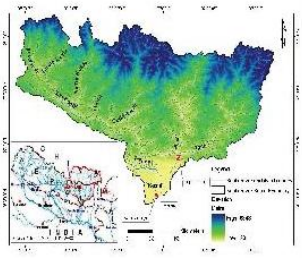
Annex C: Presentation on the description of the research by Dr. Laxmi Prasad Devkota, the Principal Investigator

Disaster Risk Reduction and Climate Change Adaptation in Koshi River Basin

Laxmi Pd. Devkota, D. Eng.
Principal Investigator
NDRI-CDKN/START Research Project

Study Area

- Koshi River : One of the largest tributaries of the Ganges River System
- Trans-boundary river: China, Nepal and India
- Drains 29,400 km^2 in China and 30,700 km^2 in Nepal (ICIMOD, 2008)



Introduction: Koshi River Basin

- South-west monsoon greatly influences the hydrology of the Koshi River Basin
- High sediment laden river
- Shifting nature of main river course
- Flooding incidences
- Glacial Lakes: 599, covering 26 km^2 (ICIMOD, 2011)

Rationale

- **Water induced disasters:**
  - Devastating Flood events: Recent 18th August 2008; 16 GLOF events
- **Rapid development including urbanizations in the lower part of the basin:**
  - the communities and infrastructure more vulnerable to the increasing flood hazards including the risks of GLOFs
- **Koshi High Dam:**
  - Flood control, Irrigation and Hydropower generation
- **Climate Change:**
  - Impact the hydrological regime

Objectives

Overall Objective:
To assess the impact of climate change on current and future development in Koshi River Basin

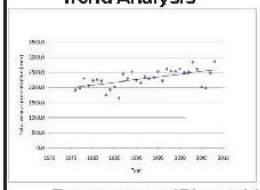
Specific objectives:
- Advancing knowledge on climate change impact on water resources
- Assessment of flood risks in the context of climate change
- Revisiting the design standards/values
- Contributing to policy formulation process
- Awareness building of stakeholders including local communities and training of new generation

Methodology

Research Component	Methodology
1. Advancing knowledge on climate change impact on water resources	**i. Hydro-meteorological Diagnostics** Analysis of available historical data on climatological and hydrological variables for any trend and changes in its statistics **ii. Hydrologic and Hydraulic Modeling** a. Acquisition of data from suitable RCM models b. Development and Use of the Snow/ Glacier Melt Runoff Model c. Development and Use the Hydrologic (rainfall-runoff) Model d. Development and Use of Hydraulic Models

Hydro-meteorological Diagnostics

Trend Analysis



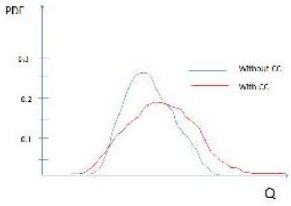
Change in Statistics

Precipitation (Sankhuwasawa)
HistoricScenario (1976-2000)
Rainfall Increase Rate:
1.6 mm/year

Future Scenario (2030-2060)
Rainfall Increase Rate:
10-19 mm/year

Temperature (Dingachhe: 4335 m)
Future Scenario (2030-2060)
Increase Rate: 0.05-0.06 °C/year

Hydro-meteorological Diagnostics



Change in Statistics

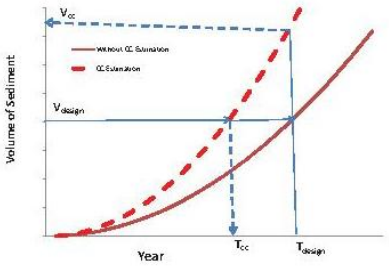
One day maximum (Chatara)
Historic Scenario (1982-2000)
9600 m3/s
Projected Scenario (2025-2060)
36000 m3/s

Snowmelt (Tamor Basin : 4267 km², Snow cover: 921 km²)
Historic Scenario (2000-2008): 17.5 cm
Projected Scenario (250-2059): 31.0 cm

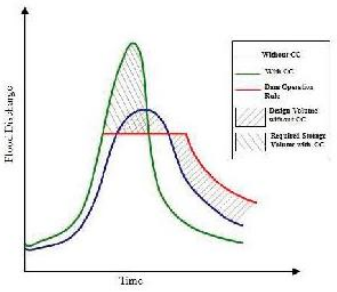
Methodology (Contd.)

Research Component	Methodology
2. Revisiting the design standard / values of the infrastructure: the proposed Koshi High Dam	Results of the hydrologic, hydraulic and sediment transport modeling will be used to a. Analyze the design parameters / values of the reservoir with climate change scenario: Capacity of Dam b. Access the climate change Risk: Dam breaking, Water availability

Design Values



Operation Rule/Design Values



Methodology (Contd.)

Research Component	Methodology
3. Assessment of Socio-economic Vulnerability and Risk	**Risk =** **Hazard x Exposure x Vulnerability** **Hazard:** Flood Hazard Map- **Modeling Result** **Exposure:** Population and Agricultural **Vulnerability :** Demographic, economic and social characteristics & degree of preparedness and recovery capacity (Eidsvig, 2011)- **Field Survey**

Flood Hazard

Bairawa Scenario (Inundation)

Inundation Depth, m	Present Scenario (1982-2008)	Projected Scenario (2025-2060)
	Area, sq. kms	Area, sq.kms
0 - 1m	1.99	2.17
1 - 2m	0.318	1.30
2 - 3m	0.208	0.80
3 - 4m	0.098	0.20
4 - 5m	0.043	0.10
5 - 6m	0	0.04
Total Area	25 sq. km	

Hazard Values

	Present	Future
Laukahi 8	1	3
Bairawa - >	3	4

Legend Value	Category
<0.5 m	1
0.5-1.0 m	2
1.0-5.0 m	3
>5 m	4

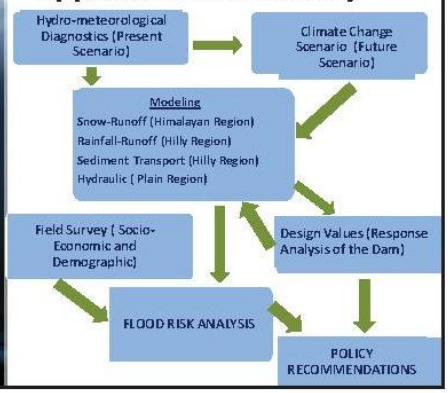
Methodology (Contd.)

Research Component	Methodology
4. Contributing to policy formulation process on climate resilient development	•Research result dissemination workshops •Hazard, vulnerability and risk maps will be helpful to the planners to take decisions

Methodology (Contd.)

Research Component	Methodology
5. Awareness building to stakeholders including local communities and Training of new generation	**•Stakeholders' consultations/ workshops** ❖ Two feedback workshops in study area ❖One feedback and one dissemination workshop in Kathmandu **•Inclusion of** ❖ 3 research associates and ❖ 5 master's level thesis students

Approach in Summary



Outputs, Outcomes and Impacts

Expected Impacts :

- Reduction on climate related disasters and consequent losses from future water resources development works in the Koshi River Basin
- Formulation of better policy related to DRR and CCA

Specific Outputs:

- Models to assess the climate change impacts
- Hazard, Vulnerability and Risk Maps
- Policy recommendations at national and community levels for DRR and CCA
- Awareness Buildings of the concerned stakeholders
- Capacity building of young researchers
- Publication of peer-reviewed journal articles

Study Team

A. INVESTIGATORS	NAMES
Dr. Dr. Laxmi Devkota	PI
Dr. Manjeshowri Singh	CI
Dr. Sunil Babu Shrestha	CI
Dr. Rijan B. Kayastha	CI
B.RESEARCHERS	
Mr. Dibesh Shrestha	RA
Mr. Dhiraj Gyawali	RA
Ms. Anita Khadka	RA

C. THESIS STUDENTS
Mr. Surya Narayan Shreshta
Ms. Gunjan Silwal
Mr. Jeevan Chhetri
Mr. Mahesh Chaulagain
Mr. Rekha Uprety

Victims of the Koshi flood sharing their survival stories

Conducting interview with advocate of the Koshi Victim Society

Conducting FGDs with the local people in Koshi basin

Enumerators conducting questionnaire survey with the locals

Bank cutting by Sunsari River

Locals crossing the river for their daily work activities even in the low flow season due to lack of bridge

Flood inundated area now used for sand mining

Jute as one of the important cash crops in the Koshi basin area

Fishing as one of the important alternative livelihood options in the area

Some Issues for Feedback

1. Are benefits of Koshi Dam and associated risks tradable?
2. What are the policy questions that government should be prioritized ?
3. What are the possible flood adaptation strategies for Pre-flood, during flood and post flood
4. How awareness building of stakeholders including local communities on Climate Change?

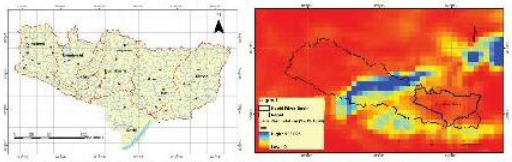
How to connect this research with local and national policy ?

यहाँहरू सबैलाई धन्यवाद !

Annex D: Presentation on Technical approach followed in the research (Climate data and SRM Model) by Mr. Dibesh Shrestha, Research Associate

Nepal Development Research Institute

"Disaster Risk Reduction and Climate Change Adaptation in Koshi River Basin, Nepal"

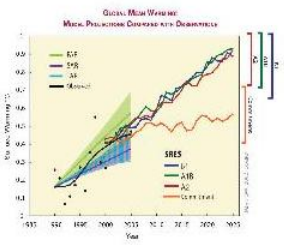


Application of Climate data from RCM in Koshi River Basin Snow Melt Runoff Modelling

Presented by:
Dibesh Shrestha, and on behalf of Anita Khadka
M.Sc. In Interdisciplinary Water Resources Management
Research Associate, NDRI

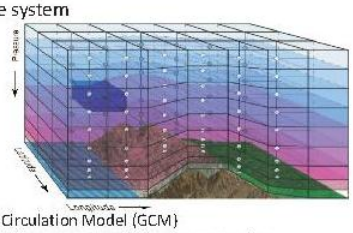
Climate and Climate Change

- Climate is the average condition of the atmosphere, ocean, land surfaces and the ecosystems that dwell in them.
- Weather is the state of the atmosphere and ocean at a given moment in time.
- Climate Change: Change in the average condition.



Climate Model

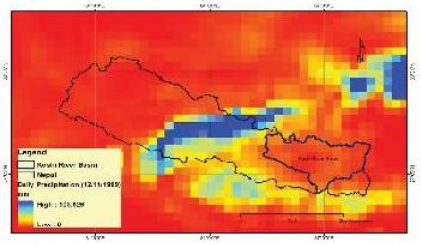
- Climate model is the mathematical representation of climate system



•Global Circulation Model (GCM)
Global Scale, coarser resolution 300 – 500 km
•Regional Climate Model (RCM)
Small region focused, spatial resolution 12-25 km

Climate Change Projection Data in Nepal

Daily precipitation (in mm) of 12/11/1999 as per PRECIS HadCM3Q0



Data Source:
Department of Hydrology and Meteorology

Climate Change Projection Data in Nepal

- Regional Climate Model (RCM Data) in Nepal

Nepal Climate Data Portal (By Department of Hydrology and Meteorology)

RCM	PRECIS	RegCM4
Parent GCM	HADCM3Q0, ECHAM05	ECHAM05
IPCC Scenario	A1B	A1B
Validated period	1970-2000	1970-2000
Downscaled period	2020/30-2060	2020-2060
Horizontal Resolution	25 km	20 km
Temporal Resolution	Daily	
Variables	Rainfall, Temperature (Mean, Max and Min)	Rainfall, Temperature (Mean, Max and Min

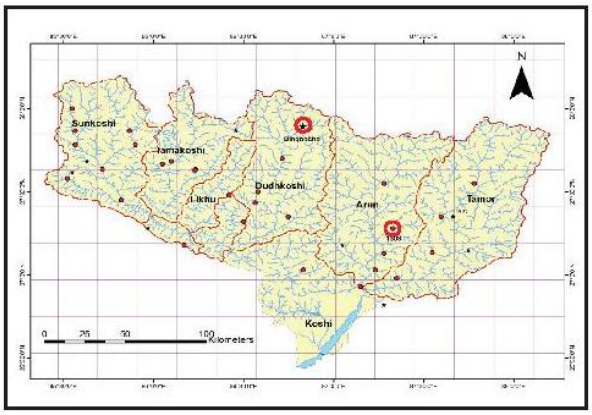
Source: Technical Approach and Methodology for Projected Data Preparation, DHM

Bias Correction

- Bias is basically deviation between simulated value and observed value
- Power transformation method:
- Non-linear method
- Corrects the Coefficient of Variation and Mean
- $P_{corr} = a \times P^b$

Where,

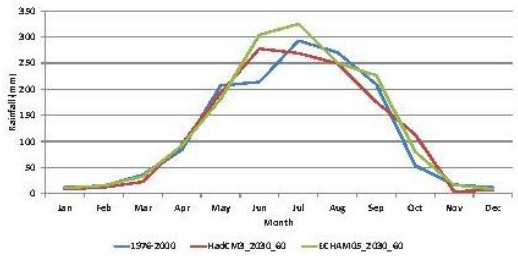
P_{corr} = Bias corrected daily precipitation amount
P = Uncorrected RCM daily precipitation amount
b = Parameter corresponding to CV of the observed daily precipitation
a = Parameter corresponding to mean of the observed daily precipitation



Climate Data: Historic Pattern (1976-2000) and Future Pattern (2020/30 – 2060)

Station: Arun Subbasin Index 1303 (CHAINPUR (EAST) Sanhuwasabha

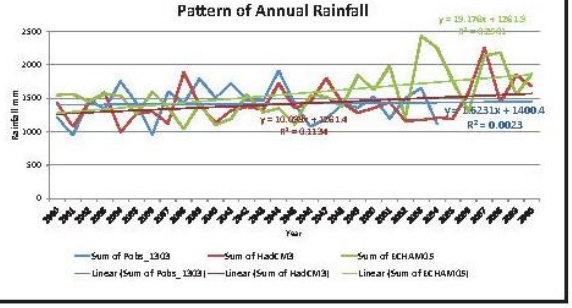
Historic and Future Monthly Rainfall Pattern



Climate Data: Historic Pattern (1976-2000) and Future Pattern (2020/30 – 2060)

Station: Arun Subbasin Index 1303 (CHAINPUR (EAST) Sanhuwasabha

Pattern of Annual Rainfall



Climate Data: Historic Pattern (1976-2000) and Future Pattern (2020/30 – 2060)

Station: Arun Subbasin Index 1303 (CHAINPUR (EAST) Sanhuwasabha

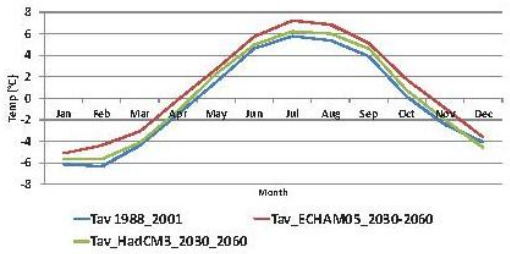
Frequency Analysis of Peak Rainfall Events

	Frequency		
Rainfall(mm)	Pobs	HadCM3	ECHAM05
	(1976/2000)	(2030/2054)	(2030/2054)
0-25	8769	8924	8878
25-50	293	145	167
50-100	63	51	66
100-150	4	8	7
150-200	2	1	10
200-300	0	2	3

Climate Data: Historic Pattern (1976-2000) and Future Pattern (2020/30 – 2060)

Station: Dingboche at Dudhkoshi (4355m)

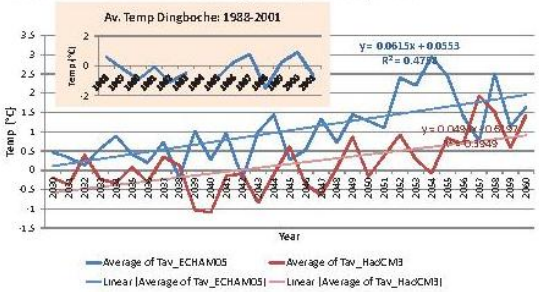
Historic and Future Monthly Average temperature pattern



Climate Data: Historic Pattern (1976-2000) and Future Pattern (2020/30 – 2060)

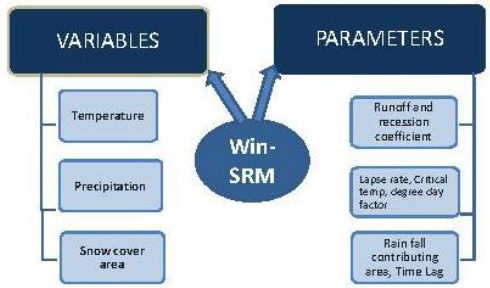
Station: Dingboche at Dudhkoshi (4355m)

Historic and Future Annual Average temperature pattern



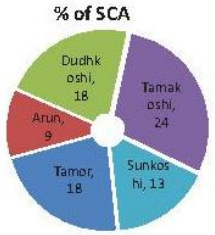
SNOW MELT RUNOFF MODELING

MODEL INPUT



STUDY AREAS

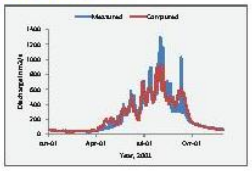
Sub-basins	Basin Area in Km2	Area >5000
Tamor	4267.03	920.98
Arun	28225.43	1159.85
Dudhkoshi	3968.45	1169.67
Tamakosi	3132.23	1252.86
Sunkoshi	1970.13	1970.13



TAMOR CALIBRATION AND VALIDATION

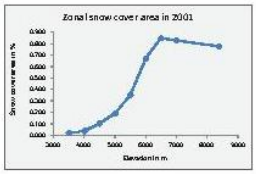
➢ Calibration year

Year	R2	Dv
2001	0.847	-1.43

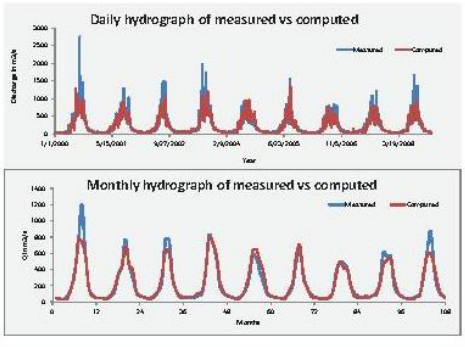


➢ Validation year

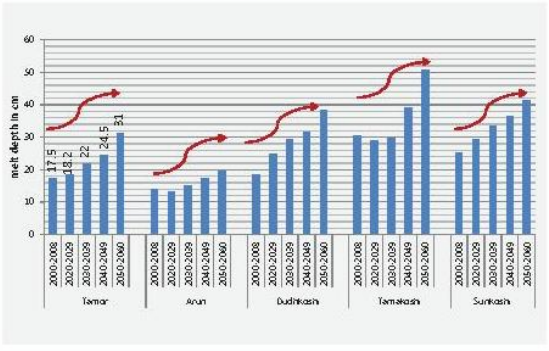
Year	R2 on av	Dv on av
2000, 2002-2008	80.05	2.82



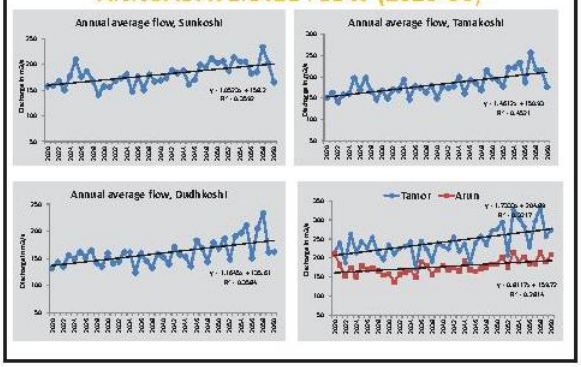
HYDROGRAPH FROM 2000-2008



AVERAGE SNOW MELT DEPTH IN SUB-BASIN



ANNUAL AVERAGE FLOW (2020-60)



Thank you!

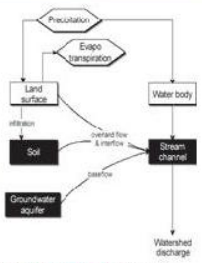
Annex E: Presentation on Technical approach followed in the research (Hydrologic and Hydraulic Modeling) by Mr. Dhiraj Gyawali, Research Associate

TECHNICAL PRESENTATION: Hydrologic & Hydraulic Modeling

Dhiraj Raj Gyawali
Nepal Development Research Institute

Introduction

✓ Watershed? – Natural System with all major components of cycle
✓ Hydrologic Cycle? (Water Cycle) – Water Distribution
✓ **Model? – Abstraction of reality using Mathematics**



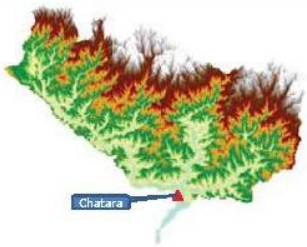
✓All **hydrologic models** attempt to simulate the **Hydrologic Cycle** at the basin scale.

SWAT MODEL: Overview

- Soil and Water Assessment Tool, Arnold *et al.*, 1998
- River basin scale model
- Quantifies the impact of climate and land management practices on hydrology and sediment.
- Physically based, semi – distributed
- Time continuous and operates on a daily time step

Introduction

- Application of the SWAT Model:
  - Hilly region of the basin
  - Upto Chatara

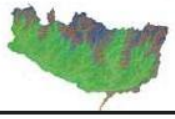


INPUT DATA

- **Spatial Inputs**
  - **Topography:** *Digital Elevation Model (DEM)*
    - *ASTER GDEM 2.0*

  - **Landuse:** *(Department of Survey)*

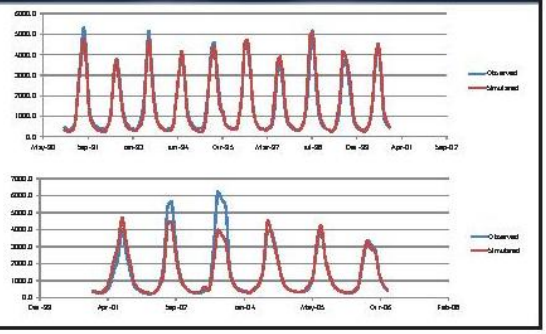
  - **Soil:** *(FAO Soil Map)*



INPUT DATA (contd)

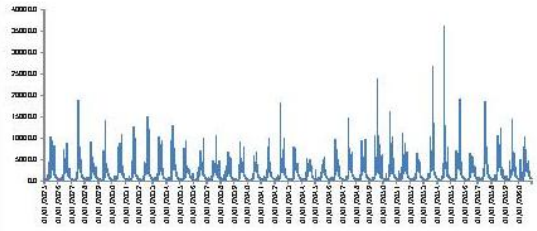
- **Temporal Inputs *(1976 – 2008)**
  - **Weather Stations:**
    - *Daily Rainfall*
    - *Daily Max. and Min. Temperature*
  - **Weather Generating Stations:**
    - *Daily Rainfall , Daily Temperature, Daily Wind speed, Daily Solar Radiation, Daily Humidity*
  - **Calibration and Validation:**
    - *Observed Flows*
    - *Observed Sediment Load*

Calibration and Validation Results



RCM data application to SWAT

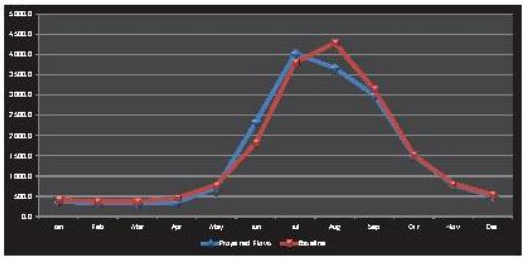
- **Data used: ECHAM 05**
  - Projection Period: 2025 – 2060



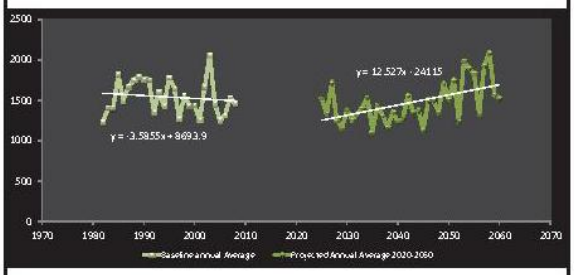
Comparison Historical and Projected Flows

Statistics	1982 - 2008	2025 - 2060
Mean	1540.9	1472.6
Standard Deviation	1554.4	1797.6
Maximum	9610.0	36020.0

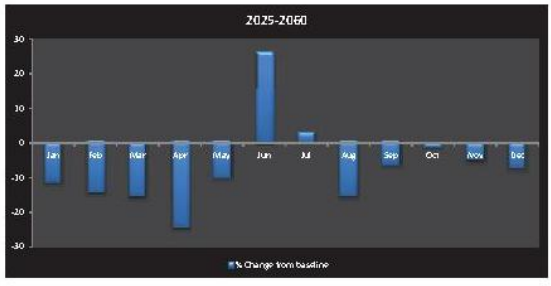
Comparison Historical and Projected Flows



Historical and Projected Flow Trends

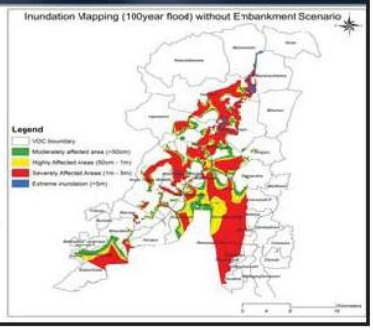


% Change in Flow from Observed

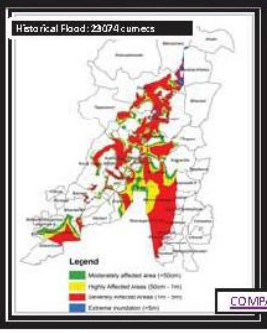


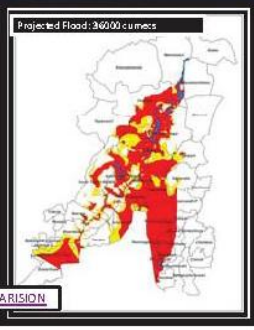
FLOOD INUNDATION MODELING

- After Chatara
- TIN Preparation using Topo maps, surveyed crossectional data and GPS spot elevation
- Scenario used:
  - Without embankments
- Based on 100 yr Return period flood



FLOOD INUNDATION MAPPING





COMPARISION

FLOOD INUNDATION MAPPING

Case of Bairawa:

Inundation Depth, m	Present Scenario Area, sq. kms	Projected Scenario Area, sq.kms
0 - 1m	1.29	2.17
1 - 2m	0.318	1.10
2 - 3m	0.208	0.30
3 - 4m	0.098	0.20
4 - 5m	0.043	0.10
5 - 6m	0	0.04

Thank you for your Attention

Annex F: Presentation on Technical approach followed in the research (Socio-Economic Vulnerability Assessment) by Dr. Manjeshwari Singh, Co-Investigator

Disaster Risk Reduction and Climate Change Adaptation in Koshi River Basin, Nepal:
Socio-economic Vulnerability Assessment

By
Manjeshwori Singh, Ph.D.
Co-investigator, NDRI - CDKN/START Study Team

(September 21, 2013)

Introduction

- One of the components of the study is Assessment of Socio-economic Vulnerability of the study area.
- It helps to identify the vulnerable areas.
- It is required for the assessment of the Flood Risk Zoning

  R= H X E X V
- It will useful for making flood disaster risk reduction policies/strategies so that risk can be minimize.

Socio-economic Survey

Methodology

Survey Techniques	Sunsari (highly affected, 2008)	Saptari	Sunsari	N
HH Survey	Paschim Kusaha-1	Bairawa	Narshimha	270
	Paschim Kusaha-3	Inarwa	Ramnagar Bhutaha	
	Laukahi	Bhardaha	Harinagara	
Focus Group Discussion				3
Key Informant Interview				19

Socio-economic Vulnerability Assessment

Factors considered for the Assessment;

- Demography: Age, House type
- Economy: Income, landholding
- Social Aspect: Education, access to commutation & market facility, mobility, drinking water.
- Preparedness: Hazard map, EWS, ER, Evacuation place, Insurance, first aid facility
- Recovery: Health institutions, disaster fund

Indicators for Socio-economic Vulnerability Assessment (Eidsvig, 2011)

Indicators	Weights (Range 1-3)	Criteria for Indicator Ranking (1: Low vulnerability and 4 high vulnerability)
Demographic Indicators (weight: w_1, Value: V_1)		
Age distribution	1	1. Less than 20% population aged less than 10 years and above 65 years and disabled population 2. 20-30% population aged less than 10 years and above 65 years and disabled population 3. 30-50% population aged less than 10 years and above 65 years and disabled population 4. More than 50% population aged less than 10 years and above 65 years and disabled population
House Type (based on roof type)	2	1. RCC 2. GI/Asbestos sheet 3. Clay/tiles 4. Thatched roof

Economic Indicators (weight: w_2, Value: V_2)		
Income	3	1. Greater than $ 2 per capita per day 2. Between $ 1-$2 per capita per day 3. Between $ 0.5-$1 per capita per day 4. Less than $ 0.5 per capita per day
Land holding	2	1. Less than 20% population is dependent on agricultural land for primary source of income 2. 20-40% population is dependent on agricultural land for primary source of income 3. 40-60% population is dependent on agricultural land for primary source of income 4. Above 60% population is dependent on agricultural land for primary source of income

Social Indicators(weight: w_3, Value: V_3)		
Education level	2	1. More than 50% is literate 2. 40%-50% population is literate 3. 30%-40% population is literate 4. Less than 20% population literate
Access to communication	3	1. Access to more than one unit of telephone/mobile 2. Access to at least one unit of telephone/mobile 3. Not access to telephone/mobile in own home 4. No telephone/mobile in the community
Mobility	1	1. Access to private car 2. Access to motorbike 3. Access to cycle 4. None
Market facility	2	1. Less than 1 km distance 2. Within 2 km distance 3. Within 2-4 km distance 4. More than 4 Km distance
Drinking water	3	1. Access in own house 2. Access in neighbor's house 3. Available in community 4. None

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Preparedness Indicators(weight: w_4, Value: V_4)		
Hazard Evaluation	2	1. Community based detailed map available 2. Basic map available 3. Map under preparation 4. No
Emergency response	2	1. Good transportation (road) and organized response group in place 2. Good transportation or organized response group in place 3. Self-organized local group only 4. None
Early warning system	3	1. Advanced (24 hrs Radio, TV, Automatic siren, 1 day ahead) 2. Average (24 hrs Radio, TV, Manual Siren, same day) 3. Basic (Telephone, Mike) 4. None
Evacuation place	2	1. Less than 1 km distance 2. 1-2 km distance 3. Greater than 2 km distance 4. None
Insurance (life/property/any kind of insurance)	1	1. Life and all Property 2. Life of > 50% family members 3. Life of < 50% family members 4. None
First aid services	1	1. Adequate and in own home 2. Adequate and in community level 3. Limited 4. None

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Indicators	Weights (Range 1-3)	Criteria for Indicator Ranking (1: Low vulnerability and 4 high vulnerability)
Recovery Indicators (weight: w_5, Value: V_5)		
Health institution	2	1. Less than 1 km distance. 2. 1-2 km distance 3. 2-4 km distance. 4. More than 4 Km distance.
Disaster fund	2	1. Both local level and government 2. Local and non-government level 3. Local only 4. No

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Preliminary Findings

Vulnerability Index of selected indicators according to sampled wards

Wards	Demo.	Eco.	Social	Prep.	Rec.	Average VI
Paschim Kusaha-1	2.4	2.8	1.7	3.7	2.0	2.5
Paschim Kusaha-3	2.3	3.1	1.6	3.5	1.9	2.5
Laukahi=8	2.4	2.9	1.7	3.5	1.9	2.5
Bairawa-5	2.5	2.9	1.9	3.7	1.7	2.6
Inarwa-9	2.5	2.8	2.0	3.7	1.7	2.5
Bhardaha=9	2.6	2.8	1.9	3.7	1.9	2.6
Narshimha-4	2.5	2.9	1.8	3.7	2.0	2.6
Ramnagar Bhutaha-8	2.5	3.1	1.8	3.7	2.1	2.7
Harinagara-5	2.5	2.7	1.8	3.5	1.9	2.5
Gross average						**2.5**

Note: 1-2: Less vulnerable, 2-3: Moderately vulnerable, 3-4: Highly vulnerable

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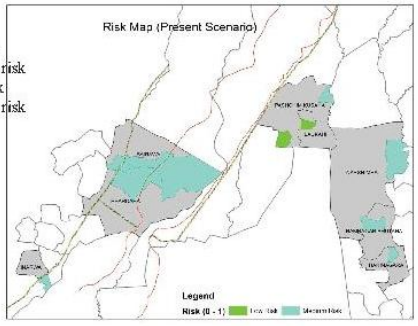
Criteria:
0.00- .25: Low risk
0.25-0.50: Medium risk
0.50-0.75: High risk
0.75-1.00: Extreme risk

Risk Situation:
Low risk : 2
Medium risk: 7
High risk: 0
Extreme risk: 0



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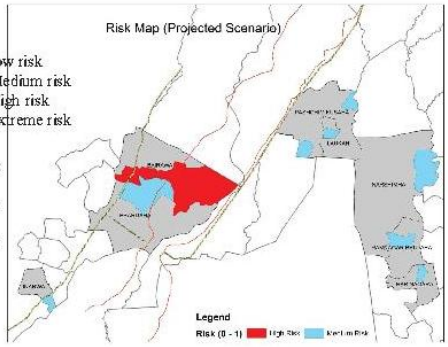
Criteria:
0.00- .25: Low risk
0.25-0.50: Medium risk
0.50-0.75: High risk
0.75-1.00: Extreme risk

Risk Situation:
Low risk : 0
Medium risk: 8
High risk: 1
Extreme risk: 0



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Findings from FGD

Impact of flood:

At 2056 BS flood, houses, roads, drinking water supply were damaged The flood occurred at 12 midnight, so the damage of houses, grains, cattle were high.
The agri-land were filled with sand, some of the fields were permanently damaged
women and children suffer the most. Men do not care anything and run for their life whereas women are left behind to take care of children and cattle.

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Reasons for occurrence of the flood

Heavy rainfall
Climate Change: high melting of snow
Deforestation at the mountains
Lack of maintenance of dam at Mahuri Khola
When the flow at Koshi is high it blocks Mahuri khola and the water flow and filled in land
Lack of proper management of dam
Lack of awareness: Training on mitigation/adaptation

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Flood mitigation activities

Pre-flood situation- Construction and Maintenance of embankments; management of information sharing mechanism; making good drainage to the irrigation canal, Provide training and materials, Removal of sediments settled time to time.
During flood situation- Run to the higher ground; Arranging rescue materials, boat and transport for quick rescue; Stay at machan; climb trees; Untie cattle; Using modern rescue technique and arrange quick rescue
Post flood situation- Managing rescue materials; Provide compensation; Making dam Managing road and transport; Repair damaged houses; Arranging medical facility for injured; Managing tunnel for the flow of water trapped inside dam Management of safe shelter, drinking water, food, clothes etc in coordination with Government, NGO sector. First aid facility should made access to each HH.

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Adaptation measures

Maintenance & rescue materials: need to build tunnel, dam, check wall etc. Other emergency transport and rescue materials should be arranged.
Cultivate before Monsoon season- Provision of irrigation facility should be given so that cultivation before monsoon can be done.
Flood plain cultivation- Government should provide seed and technical knowledge regarding flood plain cultivation.
Increase capacity against flood- Training should be given at also HH level to cope with flood.
Plantation: Introduction and plantation of flood resistance plants should be done.
Awareness: Public awareness regarding climate change and disaster risk management.

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Findings from KII

Peoples' perception on major changes (1970s-2010s) based on KII responses

Areas	Increase	Decrease	No change
Temparature	15	1	2
Rainfall	3	14	1
Natural disaster	6	11	1
water level	4	14	
Hazard evaluation	16	2	
Emergency response	17		1
Early warning system	16		2
First aid service	18		

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Thank you

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