

Annex-I(a)

Report of the District Level Workshop on Community Based Flood Disaster Management at Banke District, Nepal

A half day introductory Workshop was organized in Nepalgunj on September 19, 2007 in order to make familiarize the objectives of research and discuss on the various issues of flood disaster in Banke District. The workshop was attended by 38 representatives of district level government and non-governmental organizations besides representatives from the Matehiya, Gangapur, Holiya and Bethani VDCs of the district.

Objectives:

Objectives of the Workshop were as follows:

- To provide information about the proposed research of community based flood disaster management to the stakeholders and to get general approval from the stakeholders about the research project.
- To share the importance of technical and social hazard mapping and community based plan preparation.
- To identify the driving force and its effects, major intervention and gaps of the flood disaster in Banke District.
- To get information about the activities of various stakeholders in the district.

Proceeding:

At first, Mr. Narhari Baral, Local Development Officer of District Development Office, Banke introduced the ICHARM / PWRI / NDRI and outlined objectives of the study. After that, Honorable Member of Parliament Mr. Prabhakar Barma formally inaugurated the workshop. Participants from different district level line agencies and flood effected communities introduced themselves. Dr. Mahesh Raj Gautam of NDRI welcomed the participants and shared an overview on the initiative of ICHARM / PWRI / NDRI. Dr. Rabindra Osti from ICHARM briefed about the importance of flood hazard mapping for flood management. He discussed on the practices of flood hazard mapping and flood management in different developed and

under developed countries in Asia and Africa. He also clarified on the process of hazard mapping and application of it in community based flood disaster management.

Mr. Samir Dhakal, represent from NDRI facilitated the discussion session on cause and effect analysis of flood disaster in Banke District. The participants openly discussed on the various issues related to the flood disaster in the District. They shared their experiences of flood management in the recent years' floods. They discussed on the causes and effect of flood in the lower West Rapti River including the drainage problem of Nepalgunj, the vulnerability and present coping mechanism. The participants also discussed on gap / weaknesses of the intervention of Government and non Government sectors.

The discussion was conducted on participatory approach. The participants' were solicited on various matters and issues is summarized such as driving force/cause of the flood and associated disasters, effects of flood disaster and gap/weaknesses in the flood disaster management activities. The respondents were also asked for filling an information sheet which provided activities of the major the stakeholders and helped to identify potential local governmental and non-governmental organizations. From the information sheets and discussion, the district development office, district public health office, district administration office, district police office, DWIDP divisional office, district water supply office, red cross, UNOCHA field office, Action Aid Nepal, CARITAS, CARE Nepal and, BEE-group Nepal were found as active organizations involved in the various activities related with flood management.

After completion of discussion on the issues of flood disaster by the participants, Dr. Mahesh Raj Gautam briefed about the research framework. Dr. Gautam discussed on the goals, objectives, methodology and expected outcomes of the proposed research. He also highlighted the importance of research products on increasing the possibilities of implementation of the disaster management plan by the different national and international donors. He also discussed the limitations and scopes of research, answered questions and clarified issues put forward by some participants during open discussion session.

At the end of session, Dr. Gautam presented closing remarks and vote of thanks to the participants. The workshop was very useful to make the major stakeholders familiar with the research matters and identify the general scenario of flood disaster in Banke District.

Annexes:

A. List of the Participants:

Participants of the Workshop were as follows:

S.N.	Name	Designation	Institution
1	Mr. Paramananda Verma	Member of Parliament	NCP(Maoist)
2	Mr. Krishna Prasad Acharya	Acting Chief District Officer	District Administration Office
3	Mr. Narahari Baral	Local Development Officer	District Development Office
4	Mr. Keshav Raj Bistha	Division Head	Water Supply and Sanitation
5	Mr. Ashok Dhungana	District forest Officer	District Forest Office
6	Mr. Karna Bahadur K.C	Engineer	Nepaljung Municipality
7	Mr. Durga Sanker Sharma	Division Head	Irrigation Division, Banke
8	Mr. Om Prasad Upadhyaya	Officer	DPHO
9	Mr. Lok Bahadur K.C	Engineer	WIDP-7, Banke
10	Mr. Pradip Kumar DC	Police Inspector	Ward Police Office
11	Ms.Meena Singh	Woman Worker	Water Supply and Sanitation
12	Mr. Chandra Kanta	Secretary	NCP(Maoist)
13	Mr. Dhirendra Kumar Chaudhary	Representative(Betahani VDC)	NCP(Maoist)
14	Mr. Krishna Bahadur Karki	Representative	Nepali Congress (Democratic), Banke
15	Mr. Sarjan Bahadur Bogati	Chairman	Samyukta Bammorcha
16	Mr. Laxman Tharu	Representative	Nepali Congress
17	Mr. Rana Bahadur Singh	Representative	Holiya VDC
18	Mr. Sohan Lal Yadhav	Representative	Holiya VDC
19	Mr. Shrawan Kumar	Representative	Holiya VDC
20	Mr. Jeevan Lal Yadhav	Mukhiya	Gangapur VDC, Ward no 8
21	Mr. Girbar Prasad Yadhav	Social Worker	Gangapur VDC, Ward no 9
22	Mr. Munsu Prasad Yadhav	Mukhiya	Matehiya VDC
23	Mr. Bhawadhish Kumar Pandey	Social Worker	Matehiya VDC
24	Mr. Prem Awasthi	NCO	OCHA
25	Mr. Padhma Raj Neupane	Infrastructure Dev. Advisor	SNV
26	Mr. Amir Rajbhandari	Project Officer	UNICEF
27	Mr. Pramod Jaiswal	Project Support Officer	Action Aid Nepal
28	Mr. Deepak Bohora	Representative	RRN
29	Mr. Tirtha Kumar Sinha	Civil Engineer	GTZ/HSSP
30	Mr. Shree Bhakta Subasi	Sr. Development Advisor	GTZ/HSSP
31	Mr. Dol Bahadur Bhandari	Chairman	BEE- Group, Banke
32	Mr. Damber Sunar	Technician	BEE- Group, Banke
33	Mr. Ram Raj Kathayat	Project Coordinator	BEE- Group, Banke
34	Mr. Anup Basnet	Chairman	DUYO, Nepaljung
35	Mr. Kamal Kunwar	Program Engineer	DFID-CSP
36	Mr. Keshav Nepali	Program Manager	Rescue Nepaljung
37	Mr. Keval Singh Tharu	Member	NGO Coordination Committee, Banke
38	Mr. Umesh Mahaseth	Manager	District Cooperative Union
39	Dr. Rabindra Wasti	Researcher	ICHARM- PWRI
40	Dr. Mahesh Gautam	Coordinator	NDRI
41	Mr. Samir Dhakal	Representative	NDRI

B. Schedule of the Workshop on Community Based Flood Disaster Management at Banke District

Date: September 19, 2007

Venue: Kitchen Hut, Surkhet Road, Nepalganj, Banke District

Time	Topics	Responsible/ Facilitator	Methodology
10.30-10.40	Registration by the Participants	All	
10.40-10.50	Introduction Note	Mr. Narhari Baral, LDO	Speech
10.50-11.00	Inauguration of the Workshop	Mr. Prabhakar Barma, Member of Parliament	Electronic Display
11.00-11.15	Welcome and Introduction about the objectives of Workshop	Dr. Mahesh Raj Gautam, NDRI	Speech
11.15-11.45	Importance of flood hazard mapping for flood management	Dr. Rabindra Osti, ICHARM	Presentation, discussion
11.45-1.00	Cause and Effect Analysis on the issues of flood disaster	Mr. Samir Dhakal, NDRI	Group Discussion and presentation
1.00-1.30	Launch Break	-	
1.30-2.00	Goals, objectives, methodology and expected outcomes of planned joint research activities of ICHARM/PWRI/NDRI	Dr. Mahesh Raj Gautam, NDRI	Speech, Presentation
2.00-2.20.00	Feedback by the participants on the research activities	-	Open Discussion
2.20-2.30	Conclusion, vote of thanks and closing	Dr. Mahesh Raj Gautam, NDRI	Speech

C. Acronyms:

BEE-group: Bheri Environmental Excellence group.

DFID-CSP: Department for International Development-Community Support Programme

DPHO: District Public Health Office

GTZ: Deutsche Gesellschaft für Technische Zusammenarbeit

ICHARM: International Center for Water Hazard and Risk Management

LDO : Local Development Officer

NCP: Nepal Communist Party

NDRI : Nepal Development Research Institute

PWRI : Public Works Research Institute

RRN : Rural Reconstruction Nepal

UNICEF: United Nations Children’s Fund

UN-OCHA: United Nations Office for the Coordination of Humanitarian Affairs

VDC : Village Development Committee

WIDP: Water Induced Disaster Prevention

D. Photos:



Photo 1: Participants of Consultation Workshop



Photo 2: A Speaker making Presentation

Annex I(b)

Report of the Central Level Meeting on Community Based Flood Disaster Management at Banke District, Nepal

A half day high level consultation meeting was organized in Kathmandu on September 21, 2007 in order to make the stakeholders at National level to be familiarized with the objectives of research and discuss on the issues of flood disaster management in Banke District. Despite political procession and inconvenience in traffic flow, the meeting was attended by 27 representatives of central level government and non-governmental organizations (domestic and international), academia, and international aid organizations.

Objectives:

Objectives of the meeting were as follows:

- To disseminate the proposed research framework of community based flood disaster management to the stakeholders and to brief the outcome of the district level consultation meeting at Nepalgunj.
- To solicit opinion and suggestions about the initiative.
- To share the importance of technical and social hazard mapping and community based plan preparation.
- To form a research-interest team comprising of members from various agencies.

Proceeding:

Dr. Nawa Raj Khatiwada, Executive Director of Nepal Development Research Institute welcomed the participants and made opening remarks in the meeting. Mr. Tana Gautam, Secretary of the Prime Minister's Office of the Government of Nepal chaired the session. Dr. Mahesh Raj Gautam of NDRI presented the outcome of the district/regional level consultation meeting held at Nepalgunj. Dr. Rabindra Osti from ICHARM briefed about the importance of flood hazard mapping for flood management. He discussed on the practices of flood hazard mapping and flood management in different developed and under developed countries in Asia and Africa. He also clarified stressed the importance of hazard mapping

and application of it in community based flood disaster management. Finally, Dr. Gautam presented the research framework of community based flood disaster management to the stakeholders.

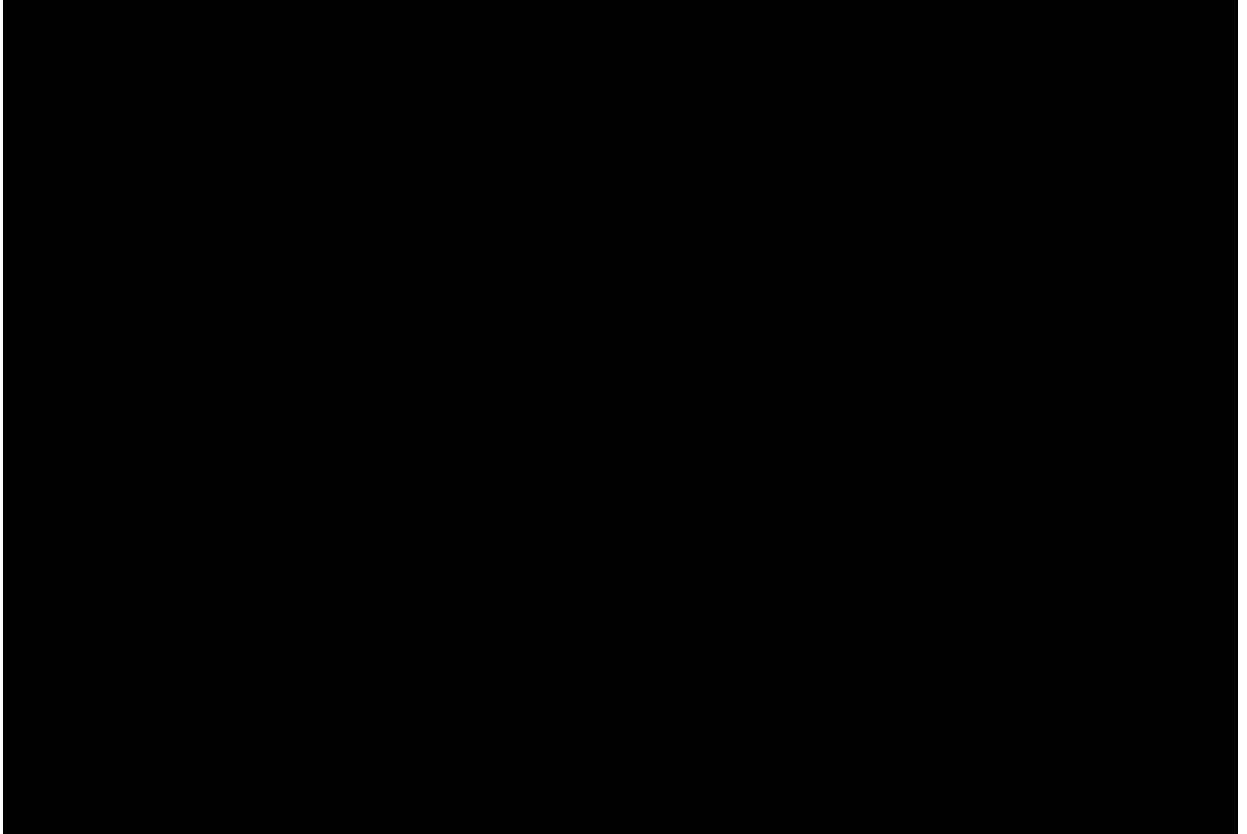
The presentations were followed by the question-answer session. There were a number of queries, and suggestions from among the participants. The queries and suggestions were put by many participants which included Mr. Bhola Ghimire(IOE), Mr. Dhan B. Tamang (Director general/DOLIDAR), Mr. Manik L. Tuladhar(Department of Irrigation), Mr. Charles Pradhan(Canadian Cooperation Agency), Mr. Shanker K. Khagi (USAID), Mr. Sushil Acharya (DWIDP), Ms. Archana Shrestha (DHM), Mr. Anup Gopal Phanju and Mr. Peter Crawford (Practical Action) among some others. The participants were of the view that the existing level of coordination in development activities in Nepal was rather weak and enough effort should be made to avoid duplication and promote coordination. There were suggestions that the study would be objective and the inputs were taken from different line agencies working in this area. Dr. Gautam and Dr. Osti responded the queries and finally the chair concluded the technical session with appreciation and encouraging concluding remarks. After the conclusion of the technical session, Dr. Khatiwada outlined the objectives of the formation of research-interest-team and solicited the opinion of the stakeholders about their interest. A research-interest team was then formed with an aim of sharing the process, progress and outcomes of the research. The research interest team included:

- i) Representative from Department of Hydrology and Meteorology. (NDRI requested Mr. Jagat K. Bhusal for representation in the research interest team).
- ii) Mr. Dhan B. Tamang, Director General of DOLIDAR.
- iii) Mr. Bal B. Parajuli, Senior Engineer of RRN
- iv) Dr. Sanjay Khanal , Assoc. Prof. of Kathmandu University
- v) Mr. Manik Lal Tuladhar, Senior Divisional Engineer of Department of Irrigation.
- vi) Mr. Peter Crawford, Practical Action Nepal.

At the end of meeting, Dr. Khatiwada presented closing remarks and vote of thanks to the participants. The high level meeting was very useful to make the major stakeholders familiar with the proposed research matters, clarify the objectives, and build partnership with various governmental and non-governmental organizations in the form of research-interest-team for interaction, guidance and support for research project. It was also effective to address the concern of one of the participants about the lack of dissemination of research/project activities and prevalent duplication prevalent in Nepal.

Annexes:

A. List of the Participants:



B. Schedule :

**COMMUNITY BASED FLOOD DISASTER MANAGEMENT
IN BANKE DISTRICT, NEPAL**

Organized by : NEPAL DEVELOPMENT RESEARCH INSTITUTE (NDRI) and INTERNATIONAL CENTER FOR WATER HAZARD AND RISK MANAGEMENT - PUBLIC WORKS RESEARCH INSTITUTE (ICHARM - PWRI)

Date : Friday, September 21, 2007 (Asoj 04, 2064)

Time : 13:30 hrs-17:00hrs

Venue : Arch Room, Hotel de l' Annapurna, Kathmandu
Tel: 4221711

Time Program

13:30-14:10 Registration

14:10-14:30 Welcome and Opening Remarks

Technical Session

Session Chair: Mr. Tana Gautam, Secretary, Office of the Prime Minister and Council of Ministers

14:30-14:50 Outcomes of district/regional level consultation meeting/workshop at Nepalgunj (Speaker: Dr. Mahesh R. Gautam, NDRI)

14:50-15:10 Importance of flood hazard mapping in flood management (Speaker: Dr. Rabindra Osti, ICHARM, Ibaraki, Japan)

15:10-15:30 Planned joint research activities of ICHARM-PWRI-NDRI at Banke District: Proposed goals, objectives, methodology, and expected outcomes (Speaker: Dr. Mahesh R. Gautam, NDRI, Dhobighat, Lalitpur)

15:30-15:40 Objectives and Scope of research-interest team comprising of representatives from Donors, GOs, INGOs,NGOs (Speaker: Dr. Nawa Raj Khatiwada NDRI)

15:40-15:45 Closing Remarks by the Session Chair

15:45-16:00 Tea Break

16:00-16:15 Formation of research interest team of the stakeholders

16:15-16:45 Discussion on the overall aspects of the planned activities.

16:45-17:00 Closing and vote of thanks

C. Acronyms:

ICHARM: International Center for Water Hazard and Risk Management

NDRI : Nepal Development Research Institute

PWRI : Public Works Research Institute

RRN : Rural Reconstruction Nepal

DoLIDAR: Department of Local Infrastructure Development and Agricultural Roads

UN-OCHA: United Nations Office for the Coordination of Humanitarian Affairs

USAID: United States Agency for International Development

D. Photos:



Photo 1: Welcome Address



Photo 2: A Speaker making Presentation

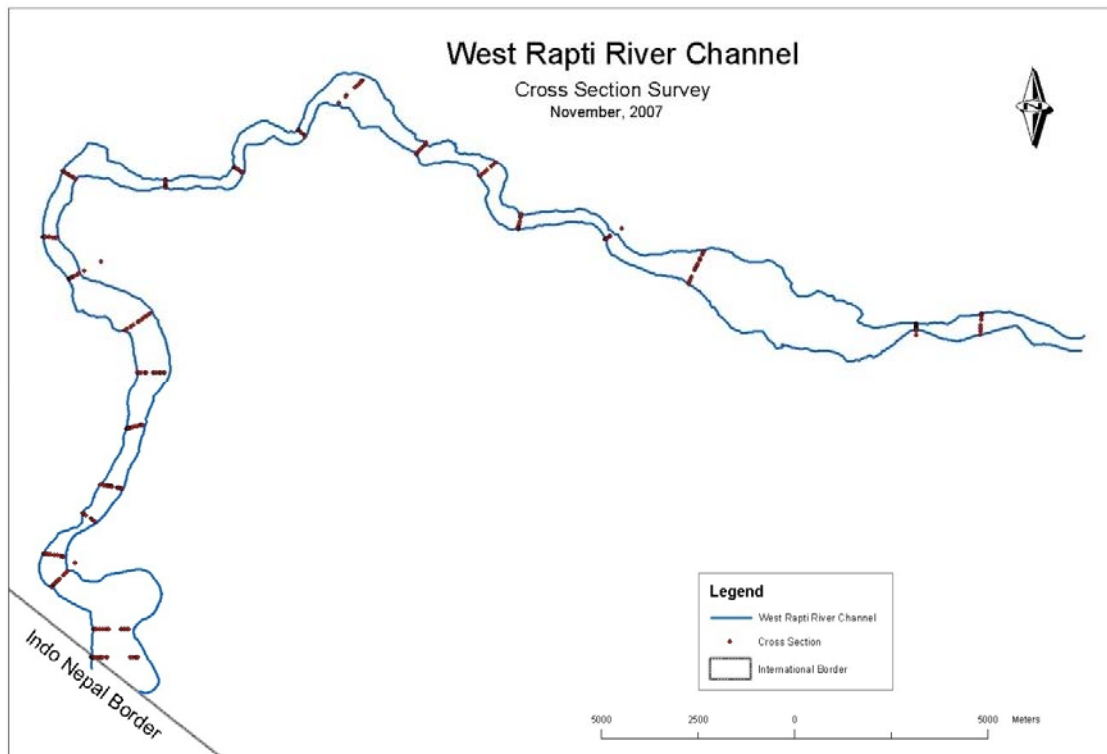


Photo 3: Participants of the Consultation Meeting

ANNEX-2

Details of Results of Technical Field Survey

1. River Bank Tracking Result and Location of Cross-Section Measurement



2. Survey of the Geomorphological Features of the West Rapti River Banks at different reaches of the rivers between the surveyed cross-sections. (Field Survey,2007/NDRI)

S.No.	Location	Left Bank	Main Channel	Right Bank	Remarks
1	From 0+000.0 to 0+745.35	Silty clay, weak bank- instability, slightly meandering ,Bank cutting	Silt, Silty clay, channel shifted L/B to R/B	Silty clay, <i>khar</i> plantation, unstable vertical bank, bank cutting year to year	Indian Boarder
2	From 0+745.35 to 1+860.21	Silty clay, weak bank-unstability, highly meandering, cultivated land	Silt, Silty clay, channel widening, channel shifted L/B to R/B	Silty clay, no plantation, unstable vertical bank, bank cutting year to year	Tepari
3	From 1+860.21 to 2+854.55	highly silt deposited, Silty clay, bank could not defined at site, highly meandering	Silt, Silty clay, channel widening, channel shifted L/B to R/B (>500m)	Silty clay, unstable vertical bank, bank cutting year to year, > 300m washed out since last 3 yr.	Piprhawa, boating axis
4	From 2+854.55 to 4+424.50	highly silt deposited, Silty clay, bank could not defined at site, highly meandering and river shifting	Silt, Silty clay, channel widening due to dunduwa tributery, channel shifted L/B to R/B	fertile clay, unstable vertical bank(>3m), bank cutting year to year, > 100m of land and 4nos of spurs wash out since last 3 yr,	D/S of Dunduwa khola
5	From 4+424.50 to 5+325.75	Silty clay, vertical bank, <i>khar</i> plantation, stability of bank, meandering	Silt, Silty clay, channel widening, channel shifted R/B to L/B	highly silt deposited, Silty clay	U/S of Dunduwa khola
6	From 5+325.75 to 6+925.75	fertile clay, vertical bank, stable bank, cultivated land	Silt, channel widening, channel shifted R/B to L/B	highly silt deposited, Silty clay	Satighat, boating axis
7	From 6+925.75 to 8+464.35	Silty clay, cultivated land, bank instability, no plantation	Silt, along the center of thalweg - gravel (<20mm), channel widening, channel shifted L/B to R/B	Silty clay, Unstable vertical bank(>1.5m)	u/s of Satighat, boating axis
8	From 8+464.35 to 9+636.6	Silt deposited, weak bank, no plantation	Silty Sand, along the center of thalweg - gravel (<20mm), channel widening, channel shifted L/B to R/B	Silty clay, Unstable vertical bank(>1.5m)	

Contd.

S.No.	Location	Left Bank	Main Channel	Right Bank	Remarks
9	From 9+636.6 to 11+913.91	Silty clay, unstable bank, no of dry stone spurs, Besarma plantation	Silty Sand, along the center of thalweg - gravel (<20mm), channel widening, channel shifted R/B to L/B	clay, Unstable vertical bank(>1.5m)	
10	From 11+913.91 to 13+185.56	Silty clay, unstable bank, no plantation, meandering, bank cutting	Silty Sand, along the center of thalweg - gravel (<20mm), channel widening, channel shifted R/B to L/B	clay, Unstable vertical bank(>3m)	D/S of Sidhaniya ghat
11	From 13+185.56 to 14+986.67	silty sand, low land bank, Besarma plantation (not continued), Steel truss bridge- bank protection measure ie. Spurs, Abutments, Embankment, etc.	Silty Sand, along the center of thalweg - gravel (<40mm), channel widening, channel shifted L/B to R/B	clay Soil, stable vertical bank(>4m)	Sidhaniya ghat near Bridge axis
12	From 14+986.67 to 18+537.17	fertile clay, cultivatable land, highly flood plain area, no of spurs, Besarma plantation, bank cutting	Silty Sand, along the center of thalweg - gravel (<100mm), channel widening, channel shifted L/B to R/B	clay Soil, near dense forest, stable vertical bank(>3m)	D/S of Jhajari khola
13	From 18+537.17 to 20+292.37	fertile clay, uncultivated land, highly flood plain area (>1.5Km widening), canal bank	Silty Sand, along the center of thalweg - gravel (<100mm), channel widening, channel shifted L/B to R/B	clay Soil, near dense forest, stable vertical bank(>3m)	U/S of Jhajari khola
14	From 20+292.37 to 22+801.32	fertile clay, cultivated land, highly flood plain area, bank cutting, river channelized	Silty Sand, along the center of thalweg - gravel (<100mm), channel widening, channel shifted R/B to L/B	clay Soil, near dense forest, stable vertical bank(>3m)	Phattepur on left
15	From 22+801.32 to 25+486.57	silt and gravel mixed, cultivated land, highly flood plain area, plantation, river out flanking	Silty Sand, along the center of thalweg - gravel (<100mm), channel widening, channel shifted L/B to R/B	clay Soil, near dense forest, stable vertical bank(>3m)	Khajura

Contd.

S.No.	Location	Left Bank	Main Channel	Right Bank	Remarks
16	From 25+486.57 to 27+643.14	Clay soil, stable bank, Dense forest,	Silty Sand, along the center of thalweg - gravel (<150mm), braided, and island formation, channel shifted L/B to R/B	clay Soil, stable vertical bank(>2.5m)	Samsergunj on right
17	From 27+643.14 to 29+656.98	Clay soil, forest, heigh inclined embankment, retaining wall	Silty Sand, along the center of thalweg - gravel (<150mm), channel widening, braided, and island formation, channel shifted L/B to R/B	clay Soil, near dense forest, stable vertical bank(>3m)	Canal intake at left
18	From 29+656.98 to 31+370.25	Layer of Clay soil and mix gravel, forest, hill slope toward left	Silty Sand, along the center of thalweg - gravel (<150mm), channel widening, braided, channel shifted L/B to R/B	clay Soil, stable vertical bank(>2m)	Godoi goan left
19	From 31+370.25 to 33+891.57	fertile clay, cultivated land, highly flood plain area, bank cutting, meandering	Silty Sand, along the center of thalweg - gravel (<150mm), channel widening, braided, channel shifted L/B to R/B	clay Soil, stable vertical bank(<2m)	
20	From 33+891.57 to 36+276.42	fertile Clay, cultivated land, stable bank,	Silty Sand, channel shifted R/B to L/B, channel widenning more than 1km.	silty clay, stable bank(<1m)	Mdhuban, boating axis
21	From 36+276.42 to 42+534.63	fertile clay, cultivated land, stable bank, Besarma plantation, spurs and retaining wall	Silt, Sand and Mixed gravel, along the center of thalweg - gravel (<200mm) channel shifted L/B to R/B	clay, stable bank(<2.5m), forest	Lalahi boating axis
22	From 42+534.63 to 44+163.86	clay soil, gravel, forest, mild hill slope	Silt, Sand and Mixed gravel, along the center of thalweg - gravel (<200mm), channel braided and channel shifted R/B to L/B, channel widenning.	clay and mix gravel layer, stable bank(>35m), forest	Pasurampur

Contd.

S.No.	Location	Left Bank	Main Channel	Right Bank	Remarks
23	From 44+163.86 to 45+482.22	clay soil, mix gravel, pasture land, forest, mild hill slope	Mixed gravel, along the center of thalweg - gravel (<200mm), channel shifted L/B to R/B	clay and mix gravel, stable bank(>3m), forest	Argaia
24	From 45+482.22 to 46+433.22	Mix gravel, pasture land, forest, hill slope	Mixed gravel, along the center of thalweg - gravel (<200mm), channel shifted L/B to R/B	clay and mix gravel, stable bank(>3m), forest	D/S of Sikta barrage
25	From 46+433.22 to 47+433.22	Compacted mix gravel layer, stable bank, dense forest, hill slope	Mixed gravel, along the center of thalweg - gravel (<200mm), no channel shifting	Compacted mix gravel layer of stable bank(>3m), forest.	Sikta barrage axis
26	From 47+433.22 to 48+433.22	Compacted mix gravel layer, stable bank, dense forest, hill slope	Mixed gravel, along the center of thalweg - gravel (<200mm), no channel shifting	Compacted mix gravel layer of stable bank(>3m), forest.	U/S of Sikta barrage
27	From 48+433.22 to 48+833.22	Compacted mix gravel layer, stable bank, dense forest, hill slope			

ANNEX-3: Various Methods of Flood Frequency Analysis

Gumbel's Method

The value of discharge with a recurrence interval T is used as

$$Q_T = \bar{Q} + K\sigma_{n-1}$$

Where σ_{n-1} = standard deviation of the sample of size

$$= \sqrt{\frac{\sum(Q-\bar{Q})^2}{N-1}}$$

K = frequency factor expressed as

$$K = \frac{y_T - \bar{y}_n}{S_n}$$

In which y_T = reduced variate, a function of T and is given by

$$y_T = \left[\ln \ln \frac{T}{T-1} \right]$$

\bar{y}_n = reduced mean, a function of sample size N

And S_n = reduced standard deviation of function of sample size N

Log-Pearson Type III Distribution

If X is the variate of a random hydrologic series, then the series of Z variates

$$z = \log x$$

For this z series, for any recurrence interval T,

$$z_T = \bar{z} + K_z \sigma_z$$

Where, K_z = a frequency factor which is a function of recurrence interval T and the coefficient of skew C_s ,

σ_z = standard deviation of the Z variate sample

$$= \sqrt{\sum(z - \bar{z})^2 / (N - 1)}$$

And C_s = coefficient of skew of variate Z

$$= \frac{N \sum(z - \bar{z})^3}{(N-1)(N-2)(\sigma_z)^3}$$

\bar{z} = mean of the z values

N = sample size = number of years of record

Now the corresponding value of X_T can be obtained as

$$X_T = \text{antilog}(z_T)$$

Sometimes the coefficient of skew C_s is adjusted to account for the size of the sample by using a relation proposed by Hazen (1930)

$$\hat{C}_s = C_s \left(\frac{1+8.5}{N} \right)$$

Where \hat{C}_s = adjusted coefficient of skew.

However this adjustment is not included in our calculation.

Log Normal Distribution

When the skew is zero i.e. $C_s = 0$, the log-Pearson Type III distribution reduces to log normal distribution.

WECS method of calculating Discharge

Two year instantaneous flood,

$$Q_{inst, 2yrs} = 1.876 (A_{3000} + 1)^{0.8783}$$

100 year instantaneous flood,

$$Q_{inst, 100yrs} = 14.63 (A_{3000} + 1)^{0.7343}$$

Where, A_{3000} = Area Less than 3000m Elevation

$$Q_s = \text{Exp} \left[\ln(Q_2) + S \left\{ \frac{\ln \left(\frac{Q_{100}}{Q_2} \right)}{2.326} \right\} \right]$$

Table 3.1 Value of S for Various Return Period

Return Period, years	2	5	10	20	50	100
S	0	0.842	1.282	1.645	2.054	2.326

Modified Dickens Method

Modified dickens formula for estimation of flood according to which the flood flows in any river of catchment area 'A' is given by

$$Q_f = C (A)^{\frac{2}{3}}$$

$$C = 2.342 \log(0.6T) \log\left(\frac{1.185}{p}\right) + 4$$

$$P = 100 \left(\frac{A_s + 6}{A}\right)$$

Where,

A = Catchment area in km^2

A_s = Snow covered area within the catchment area A in km^2

T = Return period in years

Catchment Area Ratio Method

According to this method, the flood for any return period in any ungauged catchment is estimated in proportion to the area of the catchment or gauging point where the estimate of flood is available based on the observed instantaneous maximum flood.

ANNEX IV

A Few Cross-Sections and Results of Inundation Mapping using HEC RAS

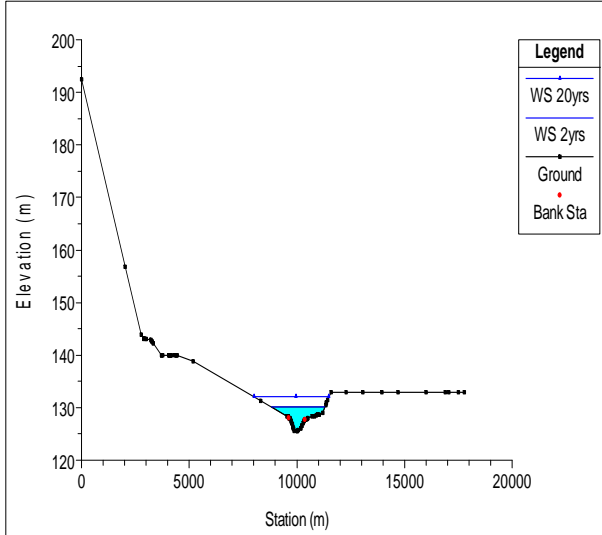


Figure 1 Cross section at 1740 reach 13

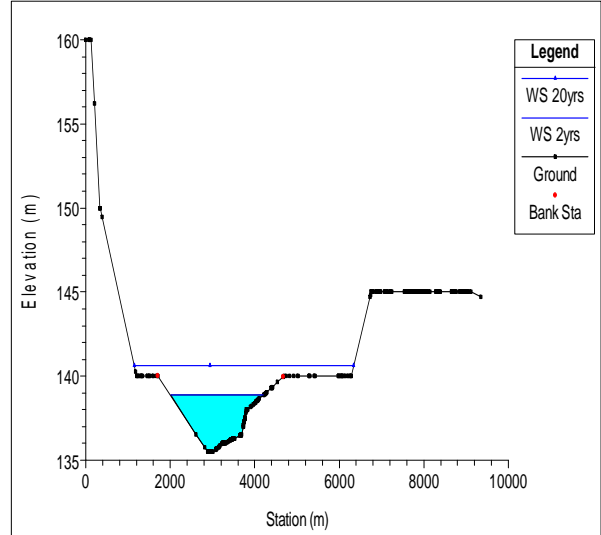


Figure 2 Cross section at 27990 reach 11

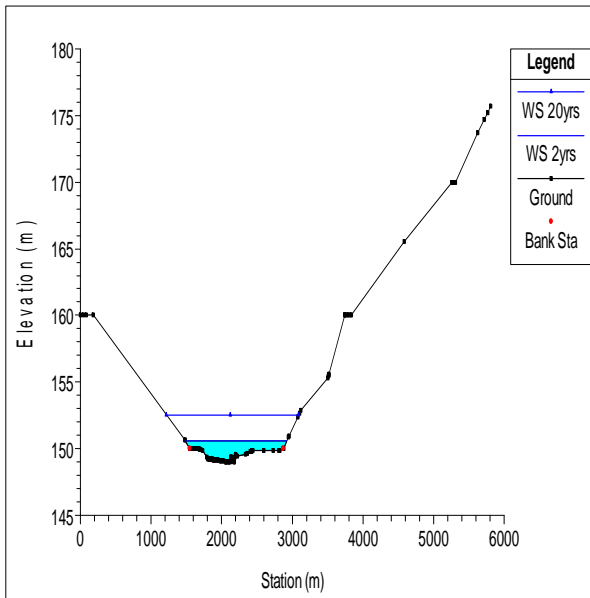


Figure 3 Cross section at 47300 reach 9

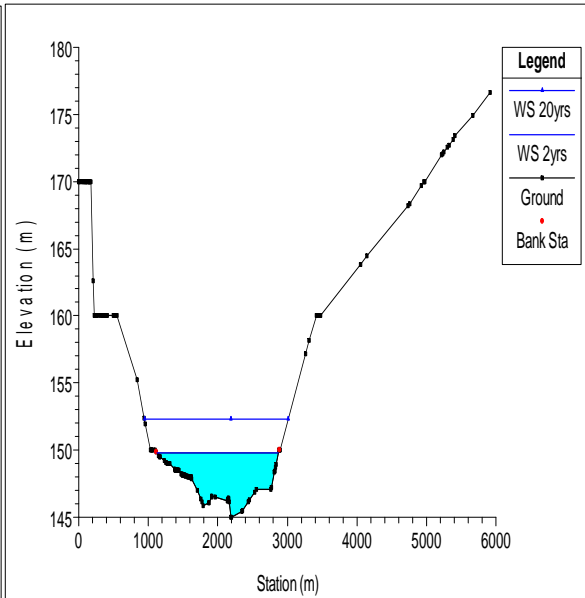


Figure 4 Cross section at 46300 reach 9

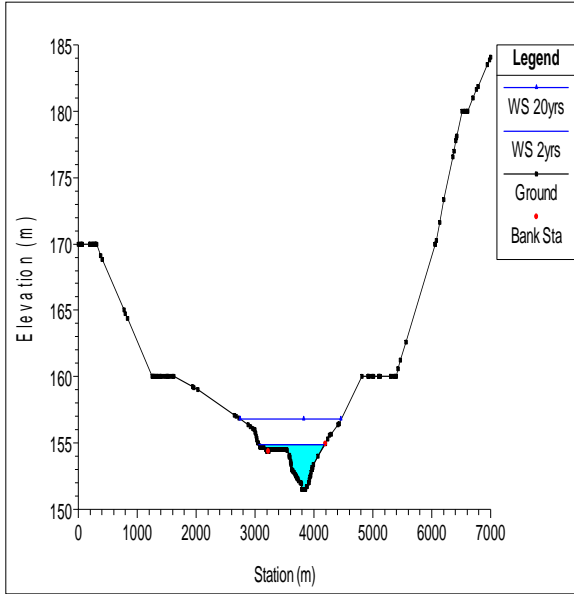


Figure 5 Cross section at 51330 reach 7

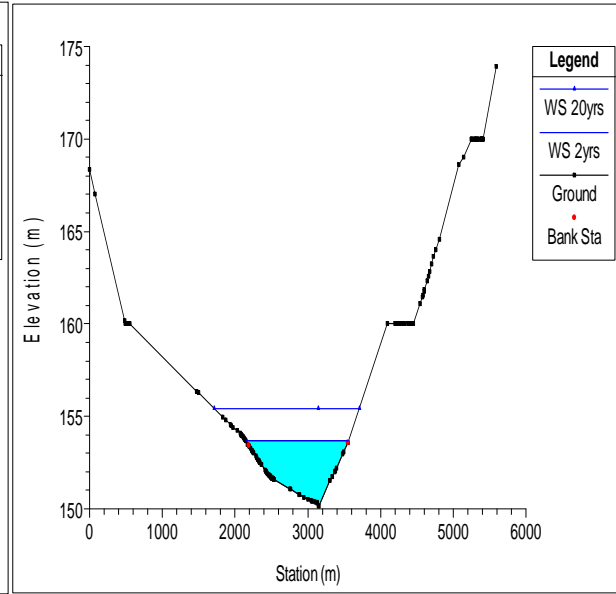


Figure 6 Cross section at 49725 reach 7

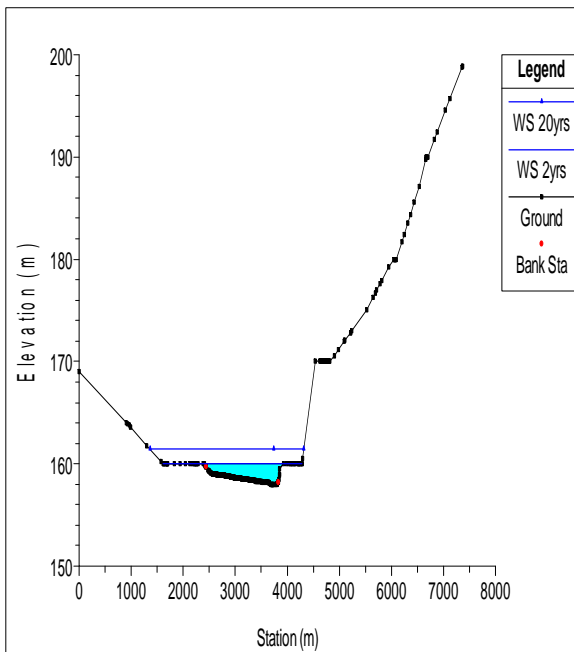


Figure 7 Cross section at 54840 reach 5

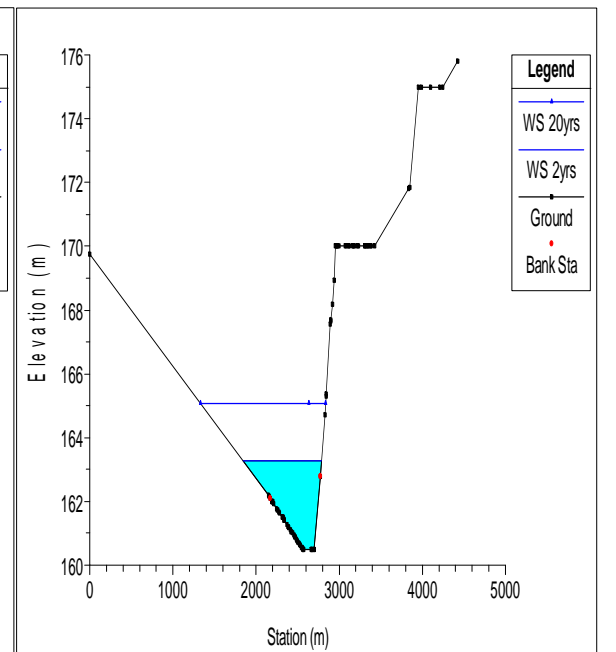


Figure 8 Cross section at 57625 reach 3

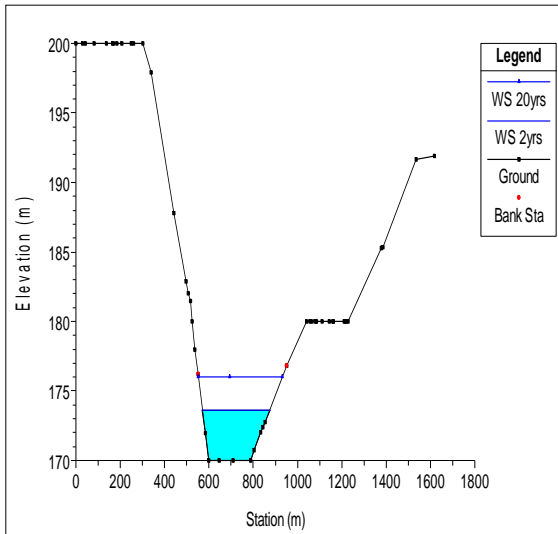


Figure 9 Cross section at 61070 reach 1

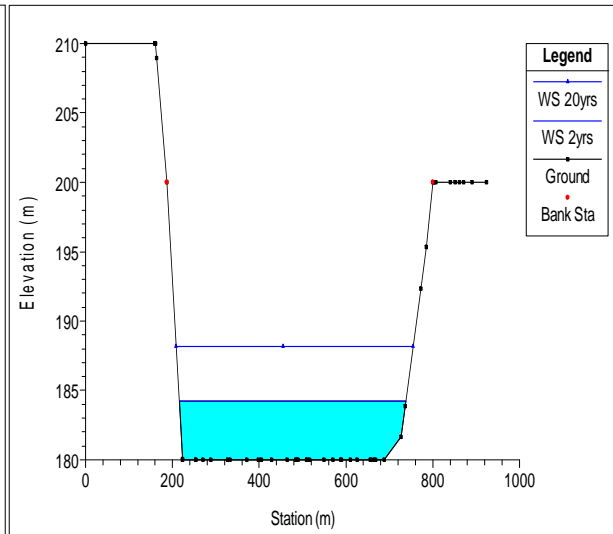


Figure 10 Cross section at 63395 reach 1

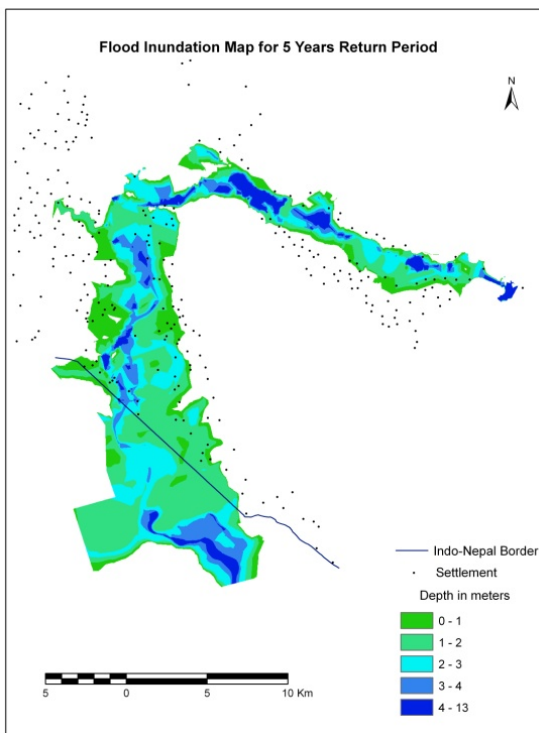


Figure 11 Inundation map with levee

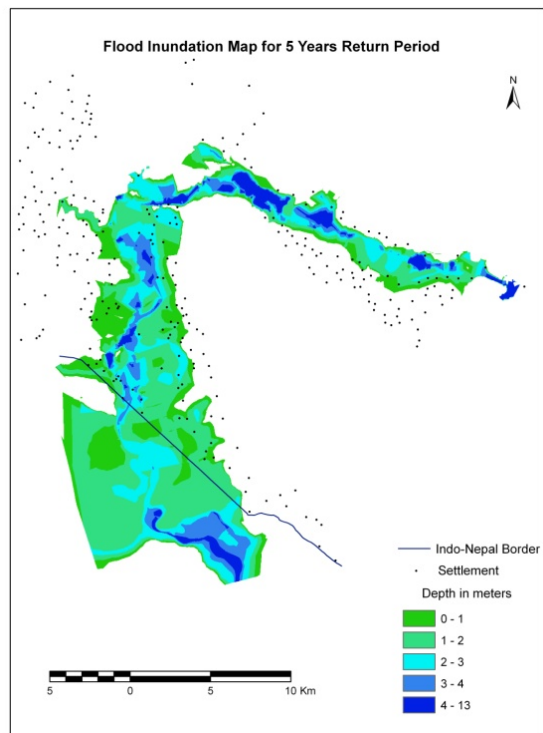


Figure 12 Inundation map without

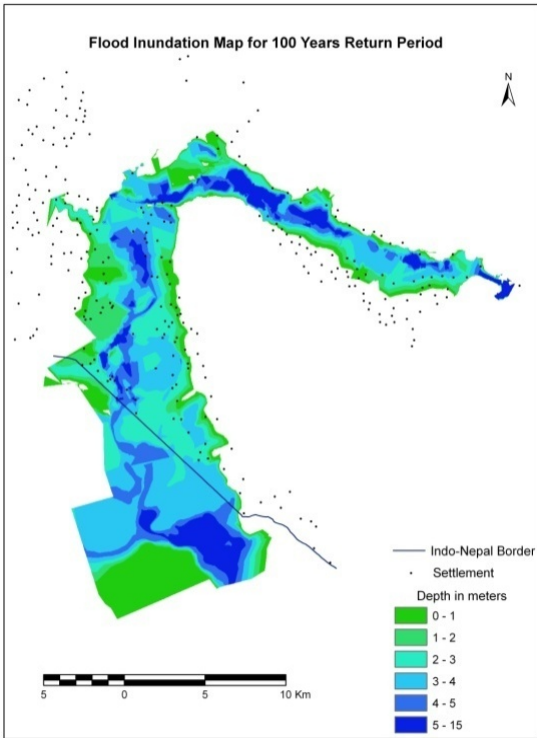


Figure 13 Inundation map with levee

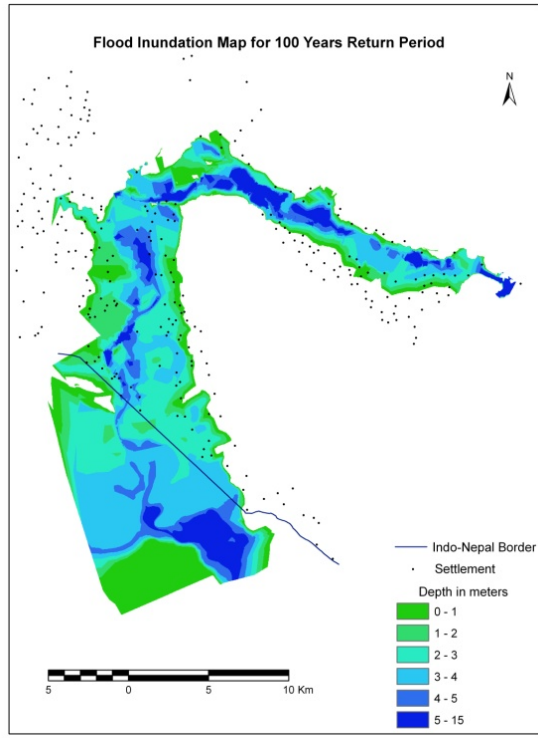


Figure 14 Inundation map without

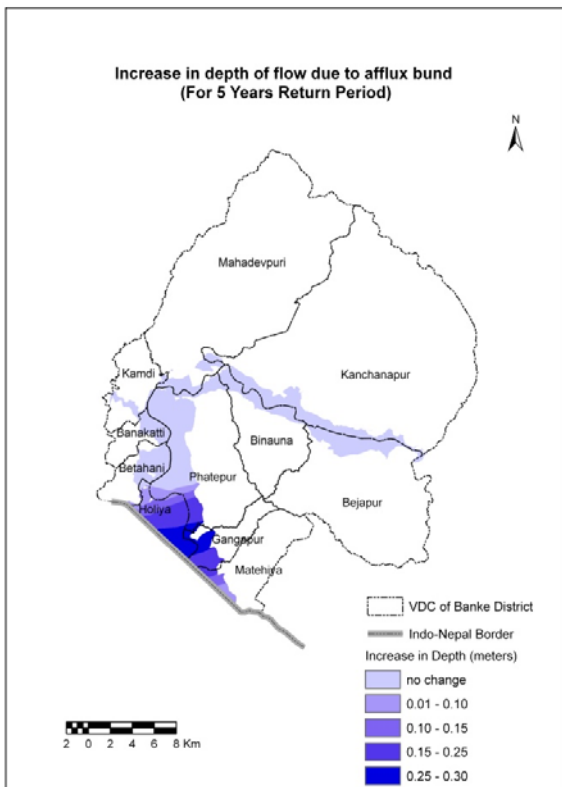


Figure 15 Increase in depth of flow due to levee for 5 years return period

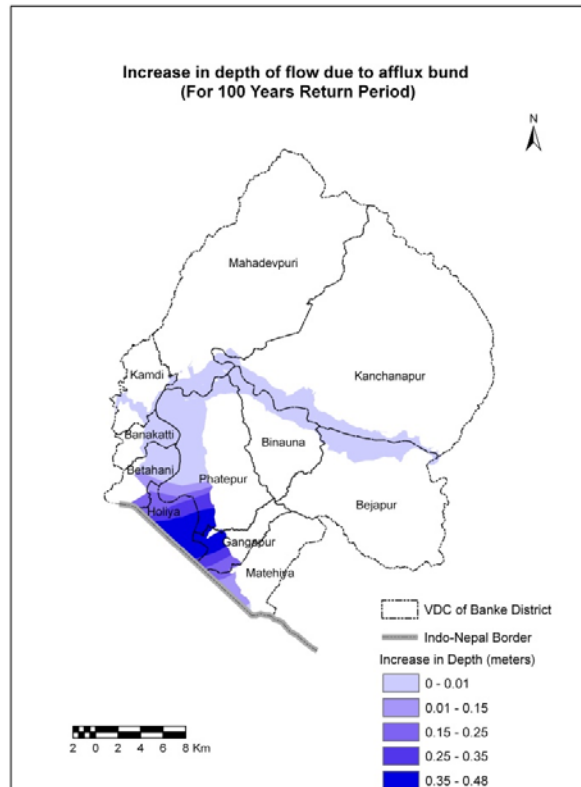


Figure 16 Increase in depth of flow due to levee for 100 years return period

ANNEX-V

Photos in the Field and Areal photos from Google Earth



Photo 1 General View of River and Bank Condition



Photo 2 Cross Drainage Structure



Photo 3 River Cross-section Measurements



Photo 4 Surveying Work at Field



Photo 5 Steel Truss Bridge with Bank Protection Still Under Construction Since 1997



Photo 6 Failure of Spurs



Photo 7 Protection of Cultivated Land with Spur



Photo 8 Series of Spurs for Protection of River Bank and Cultivated Land



Photo 9 Overbank Flow of Gravel Debris



Photo 10 Failure of Spur



Photo 11 Bank Failure and Deposition Silt



Photo 12 High Current Flow in the River



Photo 13 Soil Layers of the Bank



Photo 14 Besarma Plantation



Photo 15 River Section at 0m Chainage from Barrage (Source: Google Earth, 20 April, 2008)



Photo 16 River Section at 20525 m Chainage from Barrage (Source: Google Earth, 20 April, 2008)



Photo 17 River Section at 21550 m Chainage from Barrage (Source: Google Earth, 20 April, 2008)



Photo 18 River Section at 32500 m Chainage from Barrage (Source: Google Earth, 20 April, 2008)



Photo 19 River Section at 3500 m Chainage from Barrage (Source: Google Earth, 20 April, 2008)



Photo 20 River Section at 40000 m Chainage from Barrage (Source: Google Earth, 20 April, 2008)



Photo 21 River Section at 47900 m Chainage from Barrage (Source: Google Earth, 20 April, 2008)



Photo 22 River Section at 49000 m Chainage from Barrage (Source: Google Earth, 20 April, 2008)



Photo 23 River Section at 53000 m Chainage from Barrage (Source: Google Earth, 20 April, 2008)



Photo 24 River Section at 56500 m Chainage from Barrage (Source: Google Earth, 20 April, 2008)

Annex-VI: Supporting Report

VI-1. Methodology of the Field Work for Social Study

The participatory vulnerability analysis (PVA) was the guiding tool for the fieldwork. PVA is a systematic process that involves communities and other stakeholders in an in-depth examination of their vulnerability, and at the same time empowers or motivates them to take appropriate actions. The overall aim of PVA is to link disaster preparedness and response to long-term development (AA International: 2000).

1.1 Understanding the Study Context and Review of Relevant Literature

An attempt was made for understanding the study context and the output to be delivered from the study. Informal discussions were made with professionals and flood management practitioners in order to make proper understanding of the study problems. Likewise, a meeting was organized among research team to prepare the product framework and the study methodology. Similarly, to broaden the ideas and concept about the study, relevant reports and literatures were collected and reviewed. These included: publications and data generated by District Development Profiles, District Agriculture Development Office (DADO), District Public Health Office (DPHO) and Nepal Red Cross Society (NRCS).



Figure 1 Introductory Workshop at Bhojpur

Also, the district Maps of the relevant districts and land use maps of the districts were reviewed before the fieldwork. Situation reports from NRCS, UN OCHA and WHO were reviewed to get acquainted with the scale of the problems caused by floods. A series of consultation meetings were organized with Bheri Environmental Excellence Group (BEE group), a local NGO working in the study VDCs.

1.2 Participatory workshop involving the key stakeholders of the VDCs

As part of the introductory meeting, the key flood affected people, VDC functionaries, local level political leaders, social workers, teachers, deprived group members, etc. (please refer annex 4 for list of the participants) were involved in the discussion. The main agenda of the workshop was to share the rationale and objective of the study and role of local people and stakeholders in the study. The meeting decided to select 12 villages for the study and those villages were clustered in to three on the basis of similar nature of flood disaster.

1.3 Transect walk with key people

Right after the clusters and villages were confirmed, study team was involved in the transect walk with the key people of the respective villages in order to be familiar with the damage caused by the flood, nature of rivers and torrents, areas covered with sedimentation, etc. It helped to collect the prominent issues to be discussed later with the community people.

1.4 Adoption of Participatory Tools and Techniques

The formats developed prior to fieldwork were shared with the relevant stakeholders and modified later in order to capture the ideas of others. A checklist, appropriate to the study



Figure 2 Transect Walk Upland from Motipur



Figure 2 Participatory Discussion



Figure 4 Community Consultation at Kohala

requirements for semi-structured interviews (SSI) were developed. SSIs were undertaken with teachers, ex-VDC representatives, social elites, mother groups, NGOs and CBOs representatives (*Please refer annex VI-10 for checklist and guide questions*).

Similarly focus group discussions (FGDs) were made with the CBO members, CFUG members, water user's association (WUA) members and other networks existing in the communities. The selection of the respondent for the SSI and FGD was on the basis of their understanding about the flood disasters and relevant issues. But gender and social inclusion was kept in mind while selecting the respondents.

Before the SSI and FGDs, several participatory tools like: Flood hazard mapping, Risk mapping, Vulnerability mapping, Capacity assessment mapping, Venn diagram and power analysis, Time line and trend analysis, Livelihood analysis and Casual (cause and effects) analysis were carried out in the presence of community members.

Flood Hazard map, which can provide information including the past flood track records, flood anticipation, potential evaluation routes, evacuation places etc to the local

residents are indispensable for emergency response and for long term flood disaster management (Osti et al, 2008). Flood hazard map prepared by the community is based on the community's knowledge and necessarily may not have technical soundness. It is true that traditional knowledge on flood mitigation is much important (Osti, 2005).

1.5 Exit meeting with Key Informants

After the completion of the fieldwork in respective VDCs, exit meetings were organised and collected information was shared and validated with key informants such as CBOs, ex-VDC representatives, and those involved in discussions. These meetings helped in amplification and verification of the data and information collected from different sources.

1.6 Action plan preparation

A large mass meeting was organized involving the key people from all 12 villages for the preparation of an action plan. The action plan was prepared on the basis of the issues explored from the study to improve the flood situation in the future.

1.7 Analysis and reporting

The information and data collected from the desk study and fieldwork were synthesized and analysed in a systematic manner.

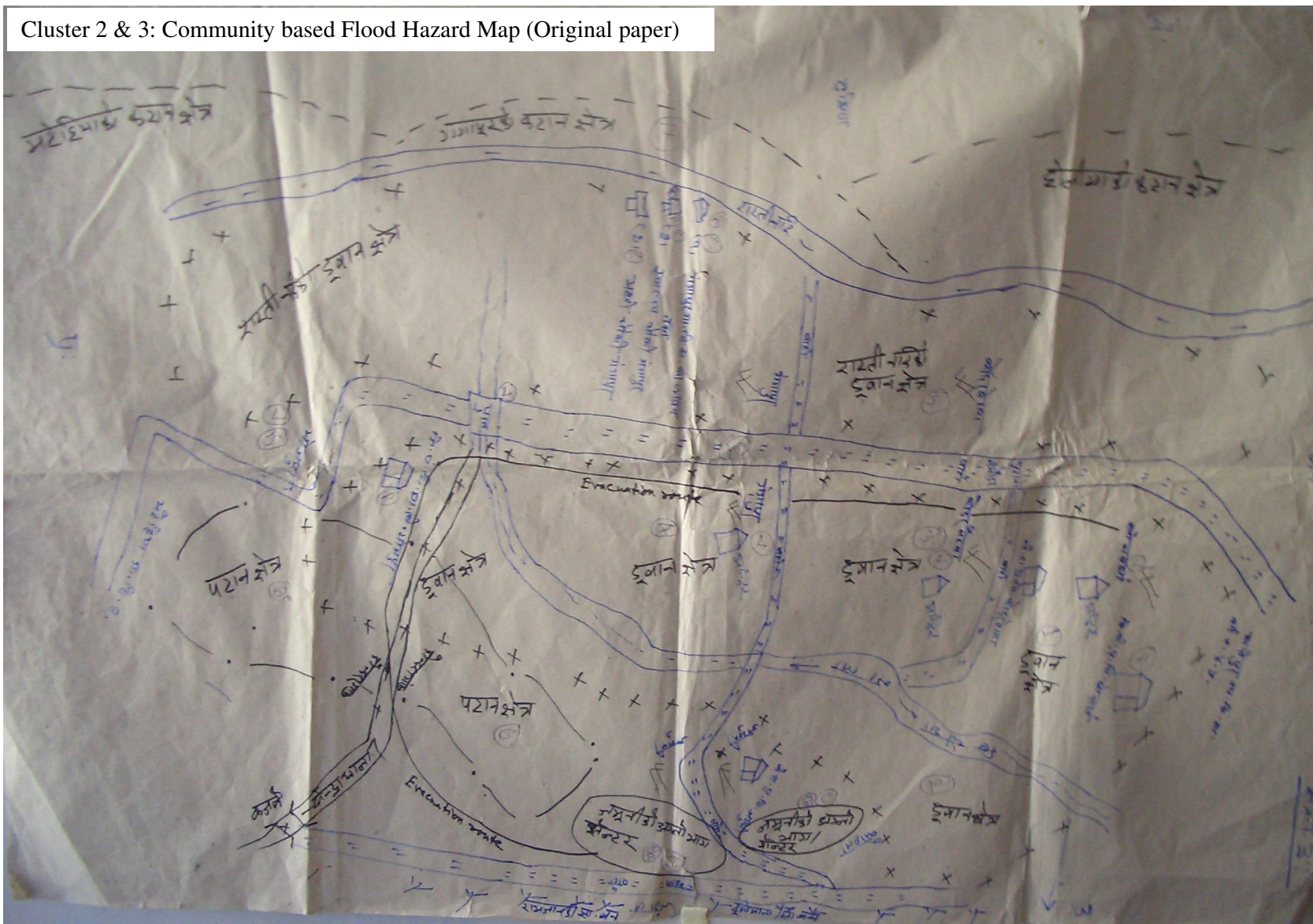


Figure 5 Cross-checking of Hazard Map at Kohala

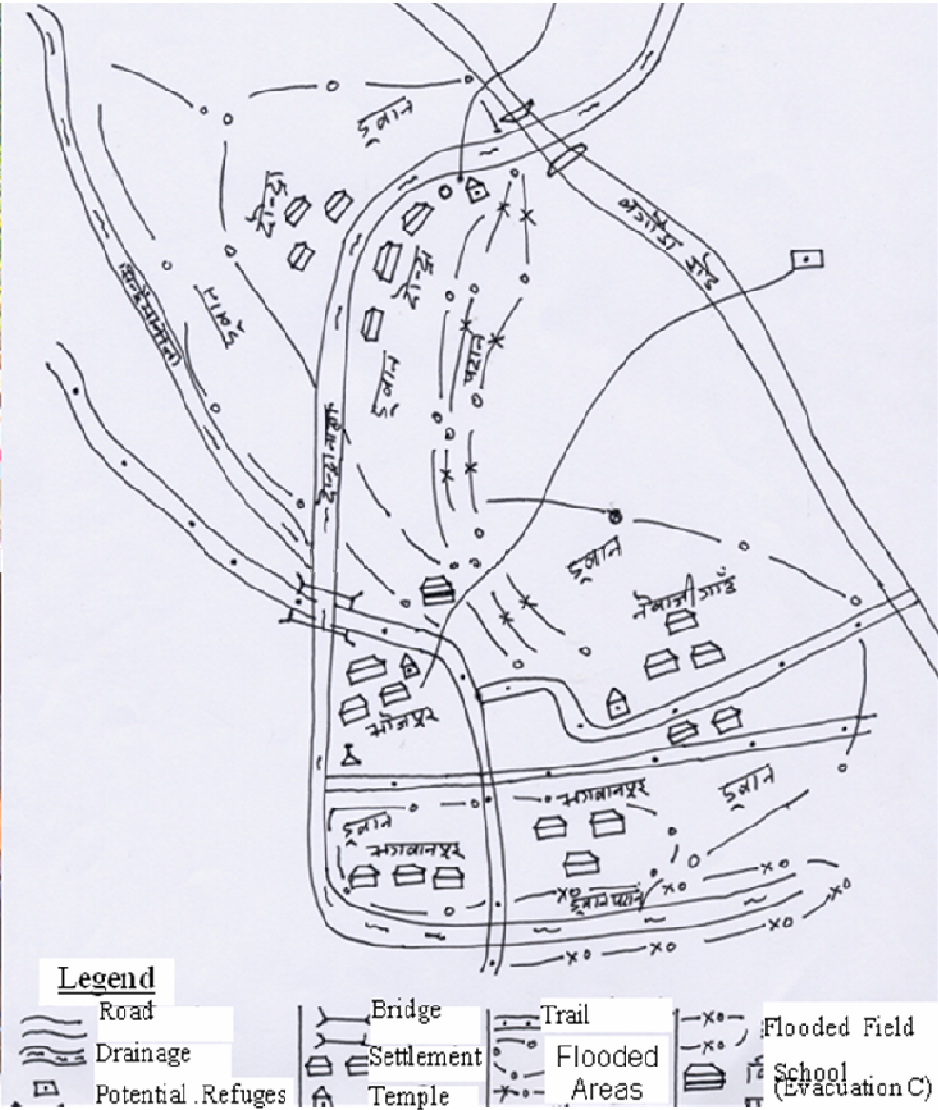
Study Area



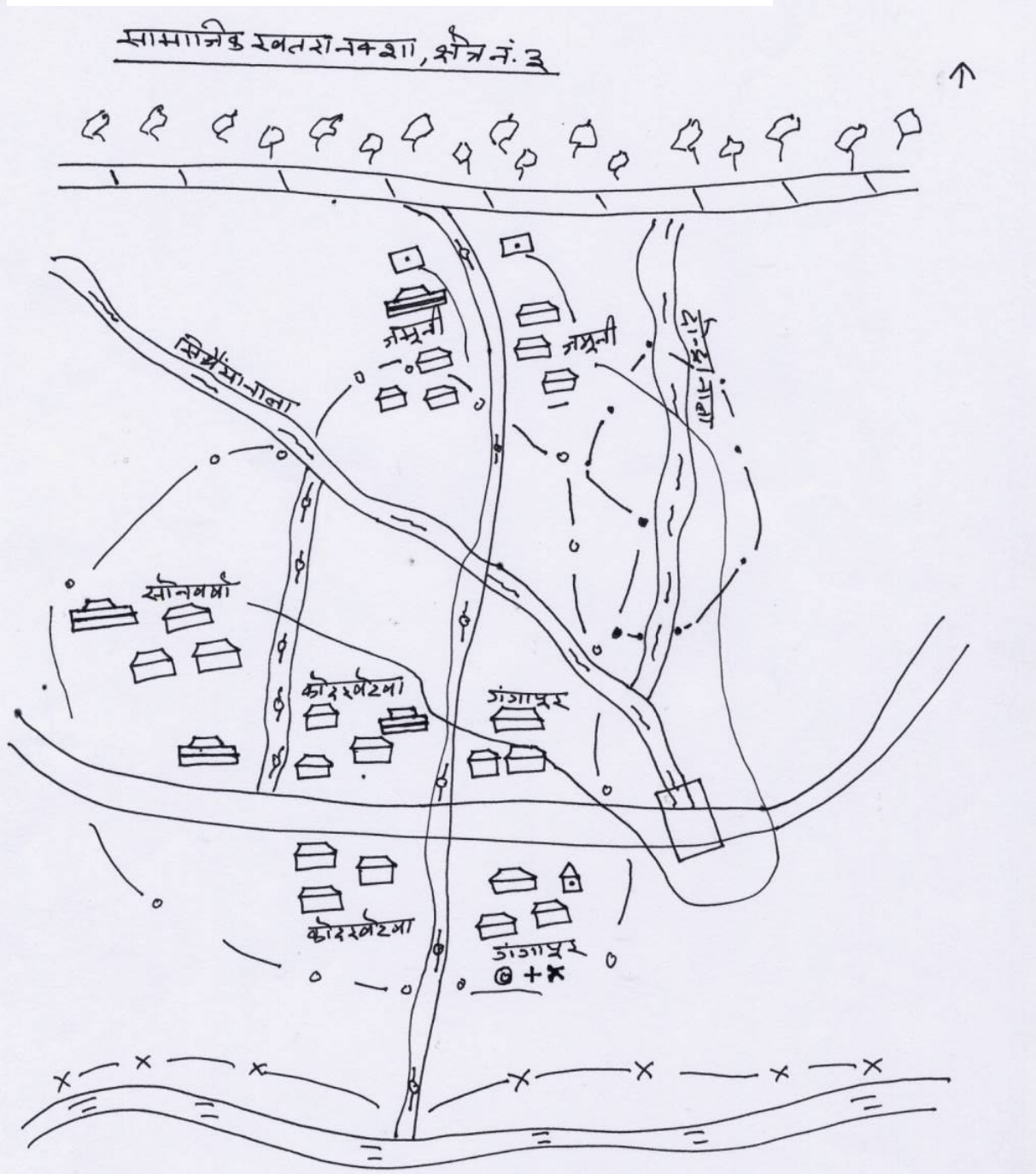
Cluster 2 & 3: Community based Flood Hazard Map (Original paper)



Cluster 2: Community based FHM (digitized based on the original map)



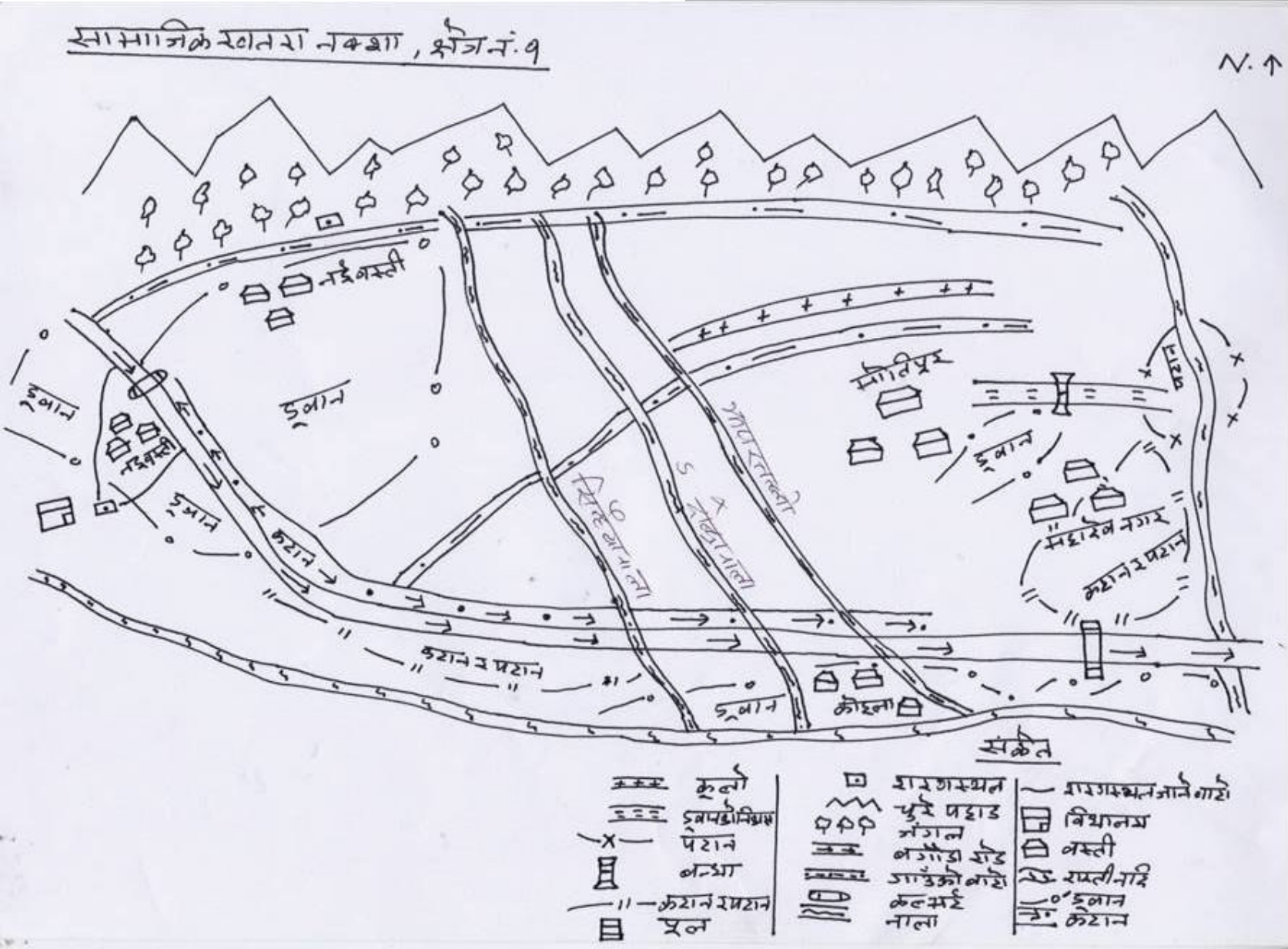
Community based Flood Hazard Map (Cluster No. 3)



संकेतः

	मुख्य सड़क		गाउँको सड़क		घर
	प्रधान सड़क		नाला		प्राथमिक विद्यालय
	जंगल (सायबुद्धासुख)		बस्ती		झरान
	सरकारको कार्यालय (अगला क्षेत्र)		पट्टा		फेस
	सरकारको कार्यालय (अर्को क्षेत्र)		पट्टा		फेस
					जा.वि.स.सुख

Community based Flood Hazard Map (Cluster No 1)



Annex VI-2: Village-wise HHs number

Socio-economic context (demographic information, settlements)

Cluster-One:-

S.N.	VDC	Ward No.	Gaun/Tole	No. of HHs.
1	Matehiya	4	Motipur	26
2	Matehiya	5	Mahadev Nagar	12
3	Gangapur	7	Naibasti	63
4	Gangapur	7	Kohala	125
Total				226

Cluster-Two:-

S.N.	VDC	Ward No.	Gaun/Tole	No. of HHs.
1	Gangapur	4 & 5	Dondra	257
2	Matehiya	1	Newajigaun	58
3	Matehiya	2 & 3	Bhagawanpur	251
4	Gangapur	6	Bhojpur	134
Total				700

Cluster-Three:-

S.N.	VDC	Ward No.	Gaun/Tole	No. of HHs.
1	Gangapur	9	Gangapur	204
2	Gangapur	8	Kudarbetwa	93
3	Gangapur	1,2 & 3	Sonbarsa	261
4	Gangapur	7	Jamuni	81
Total				639

Cluster-Four

S.N.	VDC	Ward No.	Gaun/Tole	No. of HHs.
1	Matehiya	6	Matehiya	85
2	Matehiya	7	Hulaspur	85
3	Matehiya	8	Jamunaha	235
4	Matehiya	9	Sarbarajpurwa & Maheshpur	58
Total				463

Annex VI-3: Population composition by caste/ethnicity by cluster

Household and Population Description by Caste / Ethnicity:

Cluster -One:

S.N.	Caste/ Ethnic Group	No. of HHs	Population		
			Male	Female	Total
Matehiya VDC-4, Motipur					
1	Brahmin, Chhetri	25	77	62	139
2	Dalit	1	4	3	7
Sub-Total		26	81	65	146
Matehiya VDC-5, Mahadev Nagar					
1	Tharu	11	34	41	75
2	Rana Magar	1	3	5	8
Sub-Total		12	37	46	83
Gangapur VDC-7, Naibasti					
1	Madhesi Non Dalit	40	122	107	229
2	Mushlim	15	46	57	103
3	Brahmin, Chhetri	8	18	23	41
Sub-Total		63	186	187	373
Gangapur VDC-7, Kohala					
1	Brahimi, Chhetri	68	167	153	320
2	Magar, Gurung	51	137	126	263
3	Tharu	6	24	20	44
Sub-Total		125	328	299	627
Total		226	632	597	1229

Cluster -Two:

S.N.	Caste/ Ethnic Group	No. of HHs	Population		
			Male	Female	Total
Gangapur VDC- 4 & 5, Dondra					
1	Madhesi Non Dalit	225	874	831	1705
2	Dalit	12	29	32	61
3	Mushlim	10	43	31	74
4	Tharu	10	44	37	81
Sub-Total		257	990	931	1921
Matehiya VDC-1, Newajigaun					
1	Madhesi Non Dalit	49	143	164	307
2	Dalit	8	23	27	50
3	Brahmin	1	3	2	5

Sub-Total		58	169	193	362
Matehiya VDC-2 & 3, Bhagwanpur					
1	Mushlim	103	297	321	618
2	Madhesi Non Dalit	83	234	273	507
3	Brahmin	53	144	153	297
4	Dalit	12	31	39	70
Sub-Total		251	706	786	1492
Gangapur VDC-6, Bhojpur					
1	Madhesi Non Dalit	68	188	206	394
2	Mushlim	39	111	124	235
3	Dalit	14	37	48	85
4	Brahmin	13	33	38	71
Sub-Total		134	369	416	785
Total		700	2234	2326	4560

Cluster-Three:

S.N.	Caste/ Ethnic Group	No. of HHs	Population		
			Male	Female	Total
Gangapur VDC- 9, Gangapur					
1	Madhesi Non Dalit	173	507	528	1035
2	Mushlim	16	44	54	98
3	Dalit	15	41	48	89
Sub-Total		204	592	630	1222
Gangapur VDC- 8, Kudarbetta					
1	Madhesi Non Dalit	54	161	181	342
2	Dalit	37	122	131	253
3	Brahmin	2	5	5	10
Sub-Total		93	288	317	605
Gangapur VDC- 1, 2 & 3, Sonbarsa					
1	Dalit	140	437	453	890
2	Madhesi Non Dalit	69	204	218	422
3	Mushlim	52	151	173	324
Sub-Total		261	792	844	1636
Gangapur VDC-7, Jamuni					
1	Mushlim	26	96	108	204
2	Dalit	26	86	91	177
3	Madhesi Non Dalit	21	71	76	147
4	Brahmin, Chhetri	8	21	24	45
Sub-Total		81	274	299	573
Total		639	1946	2090	4036

Cluster-4

S.N.	Caste/ Ethnic Group	No. of HHs	Population		
			Male	Female	Total
Matehiya VDC-6, Matehiya					
1	Madeshi Non Dalit	10	37	40	77
2	Dalit	20	74	80	154
3	Brahmin	5	19	20	39
4	Muslim	50	185	200	385
Sub-Total		85	315	340	655
Matehiya VDC-7, Matehiya					
1	Madhesi Non Dalit	48	169	202	371
2	Dalit	22	78	92	170
3	Brahmin	15	53	63	116
Sub-Total		85	300	357	657
Matehiya VDC-8, Matehiya					
1	Madeshi Non Dalit	59	242	247	489
2	Dalit	26	106	110	216
3	Muslim	150	615	630	1245
Sub-Total		235	963	987	1950
Matehiya VDC-9, Matehiya					
1	Madeshi Non Dalit	37	169	177	346
2	Dalit	12	55	58	113
3	Brahmin	5	23	24	47
4	Muslim	4	18	19	37
Sub-Total		58	265	278	543
Total		463	1843	1962	3805

Annex VI-4: Occupational composition by villages/cluster

Occupational Pattern of the Households by Zone:

S.N.	Zone	Location			Occupation	Percentage
		VDC	Ward No.	Gaun		
1	One	Matehiya	4,5	Motipur, Mahadev Nagar	Agriculture	90
					Ag. & seasonal Labour	7
		Gangapur	7	Naibasti, Kohala	Service	2
					Others (Business)	1
Total					100	
2	Two	Gangapur	4,5,6	Dondra, Bhojpur	Agriculture	91
					Ag. & seasonal Labour	8
		Matehiya	1, 2,3	Newajigaun, Bhagawanpur	Service	1
					Others (Business)	0
Total					100	
3	Three	Gangapur	1, 2 ,3 7,8, 9	Sonbarsha, Jamuni Kudarbetwa, Gangapur	Agriculture	76
					Ag. & seasonal Labour	22
					Service	1
					Others (Business)	1
Total					100	
4	Four	Matehiya	6,7,8 ,9	Matehiya, Hulaspur, Jamunaha, Sarbajpurwa & Maheshpur	Agriculture	87
					Ag. & seasonal Labour	10
					Service	2
					Others (Business)	1
Total					100	

Annex VI-5: Production scenario

Cluster 2

Crop	20 Years Ago (quintal /bigha)	Preset (quintal /bigha)	Reasons
Paddy	22	14	Over sedimentation in farm land, flooding and inundation
Maize	8	7	Dampness of land
Wheat	20	14	Over sedimentation, dampness of land, crop diseases
Mustered	4	0.5	Dampness of land, irregular rain hampered the cultivating season, poor irrigation facilities
Oilseed	10	1	Dampness of land, irregular rain hampered the cultivating season, poor irrigation facilities
Chana	7	0	Dampness of land, irregular rain hampered the cultivating season, poor irrigation facilities, unidentified diseases

Source: Discussion with Farmers, FGDs and KIIs

Cluster 3

Crops	20 Years Ago (quintal /bigha)	Preset (quintal /bigha)	Reasons
Paddy	18	10	Sedimentation of sand in farm land, reduced the farm land due to flooding
Maize	6	8	Use of fertilizers, cropping in high land which is less inundated
Wheat	18	16	Use of fertilizers, improved variety of seed
Mustered	4	1	sedimentation of sand in farm land, dampness
Oilseed	7	1	Dampness, sedimentation of sand
Chana	8	0	Dampness, sedimentation of sand, crop diseases

Source: Discussion with Farmers, FGDs and KIIs

Annex VI-6: Time line of flood of Cluster 2

Year, BS (AD)	Major Phenomenon (2034-2064 BS)	Impacts
About 150 years ago	Started the settlement by Chhedi Ram Daroga by diverting the route of torrent towards south east part of the village	-
2041(1984)	Inundation the area, heavy river bank cutting of Sinhaiya torrent	Losses of crop production, crop failure, immense in debt
2052(1995)	Houses are damaged by inundation, flooding of farm land, damage of foods (about 100 quintal) and brick and losses livestock, utensils, and woods	Unable to re-plantation due to shortage of seedlings, temporary migration in safer place (40 HHs to Tepra of Chaubis <i>bigha</i> side which lies in Gangapur-4/5), increase in indebt ness
2061(2004)	45 houses were collapsed, inundated farm land, lost several livestock by flood	45 HHs migrated to Tepra of Chaubis <i>bigha</i> side, farmers were compelled to sale their land, increased the disease in human being and livestock, increasing trend of seasonal migration, informed about the flood disaster and started to request with concern organizations
2063(2006)	Losses of stored food, wood and bricks, damaged the mud houses inundated farm land, losses the livestock	12 HHs were temporary migrated to Chaubis <i>bigha</i> side, out broke of water borne disease in human and livestock
2064(2007)	Damage of storage food, mud houses were collapsed, farm land inundated, loses of several livestock	10 HHs temporary migrated to Chaubis <i>bigha</i> side, repeatedly requested for sustainable flood management.

Source: Discussion with Farmers, cross checked with the responses of FGDs

Annex VI-6: Time line of flood of Cluster 3

Year BS (AD)	Major Phenomenon (2034-2064)	Impacts
2028(1971)	Settlements started	-
2048(1991)	Flooding the area, losses of foods, livestock, utensils	Continuous crop failure due to inundation, reduction in production
2052(1995)	Damaged some houses, inundated farm land, flooded the foods (150 quintal), losses the livestock, utensils etc.	Hunger and famine, immense in debt
2063(2006)	Damaged more houses and inundated farm land, losses the livestock, inundation raised up to 1 meter high and caused many damage of thatched houses	About 110 HHs temporary migrated to Chaubis <i>bigha</i> side, many families took loan by making their land in mortgage basis, out broke of water borne diseases in human being and livestock, threaten the livelihood, increase in seasonal migration, seek some alternative to reduce the effects of flood
2064(2007)	Thatched houses were collapsed due to continuous flood, losses of stored foods and seeds, inundation of farm land, losses the livestock and poultry, water level raised up to 0.5 meter within the village	8 HHs migrated to Chaubis <i>bigha</i> side, the villages along the Rapti river bank were affected by river cutting and siltation, repeatedly requested to government line agencies and other donor organizations for seeking some help

Source: Discussion with Farmers, cross checked with the responses of FGDs

Annex VI-8 Participatory Assessment of Affected HH due to 2007 Flood

On the basis of the indicators (Table 1), people during the interaction meeting classified the total numbers of HHs within the village and listed down the losses of number of people, livestock, damage of grains, and number of people suffering from different kinds of water borne diseases. The other indicators included: depth of flooding and water standing from number of hours to days. The following section gives the clear picture about the number of HHs affected by floods. The number of HHs affected from flood is given in Table 2.

Table 1: Degree of affectedness and their indicators

Degree of affectedness	Indicators
Highly affected	House completely or partially collapsed, loss of lives and livestock, inundation for longer period, people suffering from water borne diseases, flood depth up to 70 cm, flood standing for more than 3 days
Moderately affected	Cracking of the wall of houses, falling down of wall, damage of stored food, sedimentation in the crop land, flood depth up to 30-70 cm, flood standing between 1-3 days
Less affected	Minor destruction, minimal damage of grain, damage of standing crops, damage of newly planted crop, flood depth less than 30 cm, flood standing for less than 1 day

Source: FGD, 2007

Cluster 1

Matehiya-4, Motipur

- *Highly affected*: 8 HHs (loss of stored food grains from *Dehari* and utensils, damage of cloths, 3 people affected from diarrhea, loss of 17 goats and more than 80 poultry)
- *Moderately affected*: 5 HHs (cracking of walls of the house, loss of stored food)
- *Poorly affected*: 13 HHs (damage of standing crops, damage of stored food)

Mahadevnager

- *Highly affected*: 5 HHs (loss of stored food grains from *Dehari* and utensils, damage of cloths, 2 people affected from diarrhea, a 17 years girl was killed by snake bite and 3 people were sick due to diarrhoea and dysentery; loss of 23 chicken, 1 ox and 7 goats)
- *Moderately affected*: 2 HHs (cracking of the walls of the

Cluster	Villages	Flood affected HHs		
		High	Moderate	Less
1	Motipur	8	5	13
	Mahadevnager	5	2	5
	Naibasti	14	18	31
	Kohala	33	52	40
2	Dondra	30	111	116
	Newaji Gaun, Bhagawanpur, Bhojpur	44	310	89
3	Gangapur	142	62	0
	Kudarbetta	70	23	0
	Sonbarsha	68	167	26
	Jamuni	28	33	20

Source: SSI, FGDs

- houses, loss of stored food)
- *Poorly affected*: 5 HHs (damage in standing crops, damage of stored food)

Naibasti

- *Highly affected*: 14 HHs (losses of stored food grains from *Dehari*; losses of cloths and utensils; 7 people affected from diarrhoea; losses of 1 buffalo, 30 goats and more than 100 poultry)
- *Moderately affected*: 18 HHs (cracking of the walls of the house, losses of stored food)
- *Poorly affected*: 31 HHs (damage of standing crops, damage of stored food)

Kohala

- *Highly affected*: 33 HHs (inundating of the farm land from 2-5 months; losses of stored food grains and seeds from *Dehari* ; losses of cloths and utensils; death of 1 person from diarrhoea, 2-3 people were suffering from diarrhoea, other problems such as eye infection, pneumonia, fever, malaria, etc; heavy losses of 14 buffalos, 23 goats and 37 poultry.
- *Moderately affected*: 52 HHs (1 person from each HH was suffering from diseases like diarrhoea, eye infection, pneumonia, fever, malaria, etc., wall of houses fell)
- *Poorly affected*: 40 HHs (damage of newly planted crops)

Cluster 2

Gangapur VDC-4 & 5, Dondra

- *Highly affected*: 30 HHs (loss of 40 kg to 20 quintals foods stored in *Dehari*; damage of concrete and thatched houses, 3-4 person from each HHs affected from diarrhoea; loss of 1 buffalo, 30 goats and more than 100 poultry)
- *Moderately affected*: 111 HHs (cracking of walls and falling of walls, losses of stored food)
- *Poorly affected*: 116 HHs (Damage of crops that were ready to harvest, crop failure due to inundation)

Matehiya-1, 2, 3, Newaji Gaun & Bhagawanpur and Gangapur-6, Bhojpur

- *Highly affected*: 44 households (death of 1 person, loss of 30 kg to 25 quintals foods stored in *Dehari*; loss of cloths and utensils; damage of concrete and mud houses, 22 people affected from diarrhoea, loss of 30 buffalo, 100 goats and more than 200 chicken)
- *Moderately affected*: 310 households (falling down of walls, loss of stored food, sedimentation)
- *Poorly affected*: 89 households (Damage of newly planted crops)

Cluster 3

Gangapur-9, Gangapur

- *Highly affected*: 142 HHs (loss of 40 kg to 20 quintals foods stored in *Dehari*; losses of cloths and utensils; 22 people affected from diarrhoea, loss of 60 goats and more than 100 poultry)
- *Moderately affected*: 62 HHs (water swelling in to the houses, cracking of the walls, loss of stored food, 102 people affected from diarrhoea, fever, eye infection etc.)
- *Poorly affected*: Not reported

Kudarbetta:

- *Highly affected*: 70 HHs (loss of 30 kg. to 18 quintal foods stored in *Dehari*, destroyed foods included paddy, wheat, mustard, oilseeds and maize; losses of cloths and utensils; 0.75 meter water level in the settlement areas, damaged concrete and mud houses, over 50 people affected from diarrhoea, eye infection, fever, malaria etc; loss of 50 goats and 20 buffalos)
- *Moderately affected*: 23 HHs (damage of stored food and seeds, 37 people affected from diarrhoea, fever, eye infection etc.)
- *Poorly affected*: Not reported

Gangapur-1, 2, 3; Sonbarsha

- *Highly affected*: 67 HHs (losses of 25 kg to 15 quintals foods stored in *Dehari* ; 16 people affected from diarrhoea and other diseases, losses of more than 70 goats and 100 chicken)
- *Moderately affected*: 168 HHs (crack clearly visible in the walls, falling of thatched houses, crop land sedimented from flooding)
- *Poorly affected*: 23 HHs (Had to re-plant due to destruction of newly planted crop)

Gangapur-7, Jamuni

- *Highly affected*: 28 HHs (death of 1 person from diarrhoea, loss of 30 kg to 12 quintals foods stored in *Dehari*; damage of thatched houses, 40 people affected from diarrhoea and other diseases; loss of 7 oxen and buffalos and more than 30 goats)
- *Moderately affected*: 33 HHs (loss of stored food, damage of standing crops, sedimentation)
- *Poorly affected*: 20 HHs (had to re-plant paddy, damage of crops that were ready to harvest)

ANNEX VI-9 HAZARDS, VULNERABILITY, RISKS, AND CAPACITY IN THE STUDY AREA

Cluster 1

Hazard

- Sedimentation of agriculture land near the Saujawa torrent
- Inundation area in the western side of Motipur
- Cutting and sedimentation in Mahadevnagar village
- Inundation around the Bagauda road at Dondra torrent
- Cutting on the east south part of Bagauda road
- Cutting and sedimentation on the southern part of Bagauda road by torrents
- Cutting on the north part of Bagauda road
- Inundation on south and north side of Durga temple in Kohala
- Inundation on the side of school in southern part of culvert in Naibasti

Physically vulnerable areas

- Settlement of Mahadevnagar
- Bridge near the Mahadevnagar in Bagauda road
- Western side of Motipur
- Settlement of Kohala on the eastern side of Sinhainya torrent
- Settlement of Naibasti on the north south part of Bagauda road

Possible risks areas

- Settlement of Motipur
- Bagauda road on the side of Mahadevnagar
- Bridge on the Bagauda road near the settlement of Mahadevnagar
- Drainage canal on the western side of Motipur

Capacity

- Community Forest Users Groups in Matehiya for support and increasing resilience
- School of Naibasti on the southern part of Bagauda road for shelter service

Cluster 2

Hazard

- Inundation on the western side of Sinhainya torrent
- Inundation and sedimentation on the east west sides of Dondra torrent
- Inundation of Newaji Gaun to the way of Matehiya
- Inundation and sedimentation in the settlement of Bhagawanpur on the south part-way to Matehiya
- Inundation and sedimentation on the east south part of Bhagawanpur on the side of Dondra torrent
- Inappropriate position of the shelter in the area of Chaubis Bigaha on the north side of causeway in Bagauda road
- Inappropriate position of the shelter in high land of forest area on the north side of Bagauda road and western side of Dondra torrent

Physically vulnerable areas

- Settlement of Newaji Gaun
- Settlement of Bhagawanpur
- Damaged causeway on the Bagauda road at Dondra
- Bridge on the joining point of Shinhaiya torrent to Dondra torrent
- Settlement of Bhojpur on the south part of Bagauda road
- Settlement of Dondra on the east and west sides of Dondra torrent

Possible risks areas

- Madarsha (Muslim School) in Bhojpur near the Dondra torrent
- Lower Secondary School near of the road in Bhojpur

Capacity

- Shelter of Chaubis Bigaha on the north side of causeway
- Shelter in high land of forest area on the western part of Dondra torrent and north side of Bagauda road
- Lower Secondary School near the road in Bhojpur for shelter
- Primary School on the north side of road for shelter
- Madarsha (Muslim School) in Bhojpur near the Dondra torrent for shelter

Cluster 3**Hazard**

- Inundation of Sonbarsha on the northern side of Bagauda road
- Inundation in the northern side of Shinhaiya torrent
- Inundation of Kodarbetwa on the north and south part of Bagauda road
- Inundation of Gangapur on the south part of Shinhaiya torrent and north side of Bagauda road
- Sedimentation on the east and south sides of Dondra torrent
- River cutting on the side of Gangapur and south part of the Rapti River

Vulnerable areas

- Culverts in the Bagauda road
- Settlement of Sonbarsha on the north side of Bagauda road
- Settlement of Kodarbetwa on the north and south part of Bagauda road
- Settlement of Gangapur on the north and south parts of Bagauda road

Possible risks areas

- Primary School, Sonbarsha
- Sub-health Post and Gangapur VDC
- Primary School, Kodarbetwa
- Settlement of Jamuni on the north side of Shinhaiya torrent

Capacity

- Gangapur VDC office
- Sub-health Post, Gangapur
- Police Post, Gangapur
- Lower Secondary School, Bhojpur
- Primary School, Sonbarsha; Primary School, Kodarbetwa; Primary School, Jamuni

Annex VI-10: Checklist and guide questions

1. Hazard mapping

- Show different hazards like flood, droughts, hailstone, epidemic, cases of snake bite, fire etc, in the map
- Identify which people; communities are more sufferers from these hazards? Why?
- Are the hazards increasing or decreasing order? Why?

2. Risk mapping

- Who (people; communities) are mostly at risks from hazards? Try to show in the map.
- Are risks increasing or decreasing order? Why?

3. Vulnerability mapping

- In the map, show who are most vulnerable? Why they are vulnerable? What are the coping and adaptation strategies to reduce the effects of vulnerabilities?
- Are people's vulnerability increasing or decreasing order? Why?

4. Capacity assessment mapping

- In the map, locate the different capacities of people who are in need during flood disasters.
- Are their services satisfactorily? Why?

5. Venn diagram and power analysis

- What are the institutions working so far to reduce the effects of vulnerability, hazards and risks?
- Are the services of these institutions satisfactorily? Why?
- What is needed in the future?

6. Time line and trend analysis

- Provide the major phenomenon of the study villages since its emergence, their link with flood if any.
- Describe the phenomenon relevant to flood disaster.

7. Livelihood analysis

- What are the major livelihood pattern of people living with flood focusing social capital, human capital, financial capital, natural capital, physical capital, political capital)
- What are the major effects of flood in livelihood of flood victims?

8. Casual (cause and effects) analysis

- Identify the major causes and their effects through 'Problem Tree' analysis.
- Link each causes and effects with flood disaster.

9. Key Informant interview (KII)

- Hazards, risks, and vulnerability
- Hazards and risks and its reasons
- The communities and groups affected from hazards and risks
- The communities and groups affected from vulnerability
- Main reasons for vulnerability
- Effects of vulnerability
- Institutions and roles of institutions to reduce the effects of vulnerability

- Available capacity to reduce the effects of vulnerability
- Coping strategies [short term plan]
- Adaptation strategies [long term plan]

10. Focus group discussion (FGD)

- Study area and people
- Socio-economic context
- Seasonal migration
- Traditional knowledge for early warning practices
- Evacuation practices
- Emergency and rescue operation at local level
- Please provide history of flood in the study area context.
- Which area is mostly flooding, why?
- Which area is mostly inundated? Why?
- What are the floods trends scenarios within the past 30 years (from 2034 BS) and coming 20 years (2084 BS)
- Needed programs to mitigate the effects of flood in the long run
- Priority among the needed programs/activities

Annex VI-11: List of the participants

S.N.	Name	Occupation/Positions	Address/Organization
1	Mr. Premchandra Maurya	Teacher	Gangapur VDC-5
2	Mr. Jokhan Prasad Maurya	Agriculture	Gangapur VDC-3
3	Mr. Panchram Yadav	Chairperson, School Management Committee	Gangapur VDC
4	Mr. Buddisagar Mishra	Teacher	Gangapur VDC-1
5	Mr. Mahendra Pal Singh	Teacher	Gangapur VDC-1
6	Mr. Ram Achal Maurya	Agriculture	Gangapur VDC-9
7	Mr. Aatma Ram Barma	Agriculture	Gangapur VDC-9
8	Mr. Chhailu Yadav	Agriculture	Gangapur VDC-4
9	Mr. Danda Bahadur Bohara	Agriculture	Mateheya VDC-4
10	Mr. Mujjima Ali Mukeri	Agriculture	Mateheya VDC-3
11	Mr. Shiv Prasad Bhujwa	Agriculture	Mateheya VDC-3
12	Mr. Chhotelal Maurya	Agriculture	Mateheya VDC-3
13	Mr. Mulim Nau	Agriculture	Mateheya VDC-3
14	Mrs. Munna Mukeri	Agriculture	Mateheya VDC-3
15	Mr. Indrajit Maurya	Agriculture	Gangapur VDC-5
16	Mr. Rambilas Maurya	Agriculture	Mateheya VDC-5
17	Mr. Riyasat Ali Mukeri	Agriculture	Mateheya VDC-3
18	Mr. Khemraj Yadav	Student	Mateheya VDC-4
19	Mr. Sabir Ali Mukeri	Treasurer, Red Cross, Sub Branch	Mateheya VDC-5
20	Mr. Salik Ram Yadav	Agriculture	Gangapur VDC-8
21	Mr. Sabir Ali Mukeri	Agriculture	Mateheya VDC-6
22	Mr. Ramdhani Maurya	Agriculture	Gangapur VDC-9
23	Mr. Malti Prasad Maurya	Agriculture	Gangapur VDC-9
24	Mr. Chhavi Lal Maurya	Agriculture	Gangapur VDC-9
25	Mr. Biddha Prasad Yadav	Agriculture	Holiya VDC-1
26	Mr. Chhavile Kori	Agriculture	Gangapur VDC-5
27	Mr. Rampheran Maurya	Agriculture	Gangapur VDC-9
28	Mr. Nandalal Barma	Agriculture	Gangapur VDC-5
29	Mr. Rampheran Yadav	Agriculture	Mateheya VDC-4
30	Mr. Keshav Ram Yadav	Agriculture	Mateheya VDC-4
31	Mr. Ainush Shesh	Agriculture	Mateheya VDC-6
32	Mr. Ram Sarovan Yadav	Agriculture	Mateheya VDC-9
33	Mr. Ram Niwas Yadav	Coordinator, Disaster Management Committee	Mateheya VDC-5
34	Mr. Ram Raj Kathayat	Program Coordinator	B Group, Nepalgang
35	Mr. Dhruva Gautam	Researcher	Kathmandu, NDRI
36	Mr. Niranjana Gyawali	Researcher	Kathmandu, NDRI
37	Mr. Samir Dhakal	Researcher	Kathmandu, NDRI

Participation in the community meeting at cluster 4

S.N.	Name	Occupation/Positions	Address/Organization
1	Mr. Ramgopal Kahar	Teacher	Matehiya - 7
2	Mr. Julfhkar Khan	Farmer	Matehiya - 7
3	Mr. Ramrup Chauhan	Laborer	Matehiya - 8
4	Mr. Mayudin Khan	Farmer	Matehiya - 8
5	Mr. Ram Monorath Pandey	Farmer	Matehiya - 9
6	Mr. Mahesh Tamoli	Farmer	Matehiya - 9
7	Mr. Rafik Ahamed Sekh	Farmer	Matehiya - 6
8	Mr. Durga Prasad Dhobi	Farmer	Matehiya - 6
9	Mr. Kurku Sekh	Farmer	Matehiya - 6
10	Mr. Ram Raj Kathayat	Program Coordinator	B Group, Nepalgang
11	Mr. Man B. Kshetri	Senior Research Associate	Kathmandu, NDRI