CHAPTER - I

A STUDY REPORT OF NARAYANI RIVER COURSE, CENTRAL NEPAL, 2007

1.1. Background

Flood is the natural phenomena that losses more property and human life in Nepal. The precipitation is highly concentrated in the monsoon season in Nepal. About 75 percent precipitation occurs in monsoon (June-September). [1] The flood phenomenon is common in the rainy season. Due to the high concentration of monsoon, high relief, steep mountain topography and deep and narrow river valleys with frequent mass wasting phenomena renders the country more hazardous and losses more property and human life annually. Every year about Rs. 748.95 million has been lost due to water Indus disaster in Nepal.[2] The overall development of the country has been severely affected by repeated flooding. In the context of recent global warming phenomena, a consequent increase in the intensity of extreme precipitation events and the dynamic of glacial lakes in high mountain areas, the probability and potentially damaging of flood is likely to increase.

In the past or before eradication of malaria in Terai, Dun and low land were prone of malaria. So the people lived in the low land in winter and shifted to the high land during the summer. This seasonal migration caused the flood hazard seemed not so destructive. After the eradication of malaria people, started to live in the Terai permanently. So the infrastructure in the recent past has increased the exposure of these areas to flood hazards. This happened after 1956. After the malaria eradication the investment to infrastructure development from the government side has been tremendously increased.

The population growth of the country is increasing rapidly. The increased population needs more consumption. The people of the terai encroaches the river bank and the hilly people influence to the forest resources. This trend has caused to poor managed to farming practice and that has caused the heavy landslide and soil erosion in hillside. Rivers carry the loads from the hill and start to deposit in the terai. So the river course is being continuously increased in the terai. River current falls down when they reach in the terai. In addition the monsoon flood enters to the settlement area and invites the flood disaster in terai. Narayani River flows in the middle part of the country. It covers to 26,300 Sq. km.[3] prior to the record of human history depends on proxy data, which are inferred from natural climatic indicators. Plants and animal fossils in various sedimentary deposits are the primary clues to duration and geographical extent of temperature and moisture conditions since the beginning of the Cambrian period nearly 600 million years ago. The tendency of the writers of this field, mention droughts, severe storm, or other disaster and generally have neglected relatively in stable interludes. The climatic change is occurring from the very beginning of the plants and fossils in various sedimentary deposits. Plants and fossils in various sedimentary deposits are the primary clues to duration and geographical extent of temperature and moisture condition. Contain of moisture of the particular area reflects to the temperature. Also the plants depend upon to the moisture and temperature. The soil formation

[1] *Lekhnath Pokheral, Disaster training Materials 2004, slide No*

[2] ibrd

[3] Pandey, R.K. Altitude Geography, PP-85

process also depends on plants, temperature and moisture. Climate is the combine afford of the above. The each spatial unit contributes the global environment and effects to the ecosystem.[4]

The disaster is the result of the environmental degradation that depends on the capacity of local inhabitants. The high landslides exist in the Himalayas and mountain region and the flood problem in the foothills and terai in Nepal. Due to the global warming, Nepal has faced some glacier lake outburst problem in different period in the Himalayas. It faces many landslide problems in mountain region. Many roads are blocked in the highway during monsoon. As the same way the foothills are going to be raised and it invites many flood problems in foothill and terai region. The riverbed is being increased in terai and it encourages to river meandering and course change. Again the results effect to the climatic change that influence to global environment.

1.2. Rational of the study

The rotation of ecliptic and their angle affect the climatic change. The angle varies 21.1^0 to 24.5^0 during a cycle of about 41000 years. The earth has changed its orbit in 96000 years cycle; it affects the climatic condition in the world.[5] Ecosystem makes the certain climate in the certain region. The changing ecosystem affects to the climatic change. Due to the high deforestation in the hill, the top soil has been eroded and deposited to the foothill and plain. The river course has been increasing and be wider in terai that helps to river meandering and channel shifting. It helps to invite disaster and change to the ecosystem and also the climatic change. Chitwan and Nawalparasi districts are irrigated from the Great Narayani River. It is said that it has been changing its course.

Reconstruction of climates prior to the record of human history depends on Proxy data, which are inferred from natural climatic indicators. Plants and animals fossils in various sedimentary deposits are the primary clues to duration and geographical extent of temperature and moisture conditions since the beginning of the Cambrian Period nearly 600 million years ago. The climatic change has been occurring from the very beginning of the plants and the fossils in various sedimentary deposits. Plants and fossils in various sedimentary deposits are the primary clues to duration and geographical extent of temperature and moisture condition. Contain of moisture of the particular area reflects to the temperature. Also the plants depend upon to the moisture and temperature. The soil formation process also depends to plants, temperature and moisture[6]. Climate is the combine afford of the plants, temperature and moisture. The each spatial unit contributes the global environment and effects to the ecosystem. The disaster is the result of the environmental degradation that depends on the capacity of local inhabitants. The high landslides exist in the Himalayas and mountain region and the flood problem is common to foothills and terai of Nepal. Due to the global warming Nepal has been facing some glacier lake outburst problem in different period in the Himalayas. Many roads are blocked in the highway during monsoon. And the levels of foothills are going to be raised that it invites many flood problem in foothill and in terai region. The riverbed has been increasing in terai and the river course change is common. Result effects to the climatic change in local and influence to global environment.

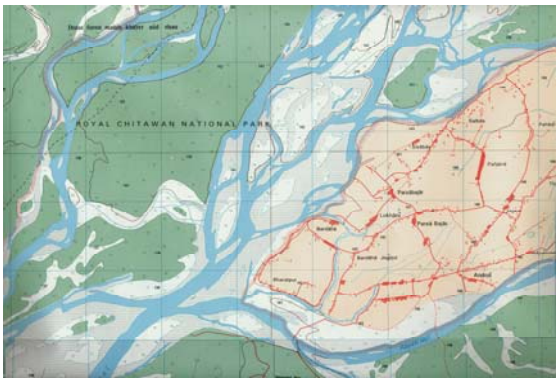
[4] General Climatology, Fourth edition 1992, Howard J. Critchfield, Western Washington University, USA, PP. 227-228
[5] Op cit
[6] Op cit

In Nepal the loss of human lives from flood in terai is not as high as hill but the damage and loss of property are significantly high. The amount of damage and loss of property caused by flood in the terai is 77 percent of the total loss due to flood, landslide, and avalanches combined from 1992-2001.[7]

The central part of the country Nepal is irrigated by Saptagandaki (Narayani River) river system. The catchments area is 26300 Sq. km. It is clearly understood as the most populated region. Narayani river system is the major river system in central Nepal. The river originates from the High Himalaya region across mountain region and flows in terai of Nepal in south west. In terai Narayani River seems more devastated to some part of Chitwan and Nawalparasi districts. It creates the chance to be uniting the adjoining people of Narayani River to reduce its destruction.

Narayani River has more branches in terai

July, 2007 1994



The floods occur during monsoon period due to rainwater every year. Nepal is sinking to ocean, which is said by an American environmentalist Mr.Yarik Yak helm. The top fertile soil has been eroded to 240 million m^3 yearly estimated. An island of New Mora is rising in Bay of Bangal. The soil formation process is very slow. To reform 7 inch thick soil larger cost 1965 years. It has flowed 201 years in fellow land and 50 years in cultivated land.[8]

Due to the heavy cultivated and manufacturing, the catchments area is converted to flood and landslide prove area. The heavy erosion occurs in Narayani and its tributaries in hill and high sedimentation exist terai caused the bed rising is common. High pesticide has been used for agriculture transformation in the region. It effects to water bio-diversity of Narayani and to the floor and fauna.

The limitation on the vertical erosion is known as base level. Generally the base level of the river reaches in the sea. Afterward the river meandering is to exist. We can easily see the possibility of the

[7] Khanal and et. al Preparing for Flood Disaster, Maping and Assessing Hazard in the Ratu Watershed, Nepal,2007, pp.13-14
[8] Shrestha, Bisho, 1986, Nepal Ko Bhogolic Ruprekha, p. 68

river meandering and possibly the river course will be changed. The Trebeni barrage of Nawalparasi district works as obstacle to flows the river naturally and it supports to more sedimentation in the low land of Nawalparasi and Chitwan. Thus the possibility of flood havoc is going rising.

1.3. Objective of the Study

The general objective of the study is to carryout the knowledge of Narayani River course. The specific objectives of the study are followings;

- Calculate the Narayani River course
- Sedimentation status of Narayani river course
- Identify the vulnerable VDCs and settlements of Chitwan and Nawalparasi District due to the flood occurring in Narayani River
- Community perception for the protection of vulnerable settlements

1.4. Study Area

The Narayani River is called from Deoghat, of Chitwan. The river has narrow gorge up to foothills of Mahabharat hill near Narayangurd of Bharatpur Municipality, Chitwan Nepal. Afterwards the river flows slowly in the plain. The river has braided. The river has more small islands and makes more river branches up to Tribeni Barrage.

The study has been carried out between 84^0 25' 40" and 27^0 42' 18" east and north longitude and latitude respectively to 83 ^{0} 54' 24" and 27 ^{0}26' 36" east and north longitude latitude respectively. The area lies between Mahendra Bus Park of Chitwan district which is just beneath of dewghat and Trebeni barrage of Nawalparasi district. The channel length is 82.15 Km. covering 143.25 Sq. Km.

There are more than 6000 rivers/Kholas in Nepal. The total length of them is about 45000 Km. Nepal's Rivers rise from the lower altitudinal region of the boarder Himalayans cross to the great Himalayas and flow down to the Gangetic plains. The big rivers are originated from the Himalayas and cross the Mahabharat Lakh (Koshi in the Barahachhetra, Gandaki in the Deoghat and Karnali in Chisapani) and their destination is to Ganga River which flows ultimately to the Indian Ocean. Rivers of Nepal contribute about 75 % water to the river Ganga. Narayani River flows in the middle part of the country. The total catchments area is 26300 Sq. Km. It has 7 major tributaries.[9]

Tributaries of Narayani River

Sno	Tributaries	Source Region	Catchments area in Sq.Km	Length in Sq. Km.	Confluence
1	Trusili	Tibet	4000	362	Kali (Deoghat, Chitwan)
2	Budigandaki	Tibet	3700	117	Tisuli (Benighat, Dhading)
3	Daraundi	Gorkha	900	53	Marsyangdi (Kharahani, Tanahu)
4	Marsyangdi	Damodar Himal	4600	153	Trisuli (Mugline, Tahanhu)
5	Madi	Annapurna Himal, Kaski	1100	74	Seti, Damauli, Tanahu

[9] *Pandey Ram, Kumar, Altitude Geography, Geography of Nepal, pp.85-86*

6	Seti	Annapurna Himal	2700	125	Trisuli, Kandrang Tanahu
7	Kali (Krishna)	Mustang	9300	316	Trisuli, Deoghat, Chitwan
Total			**26300**	**1200**	

Source, Pandey Ram, Kumar, Altitude Geography, Geography of Nepal

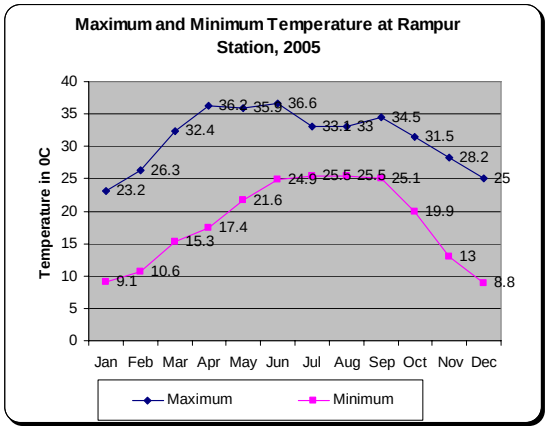
Water discharge

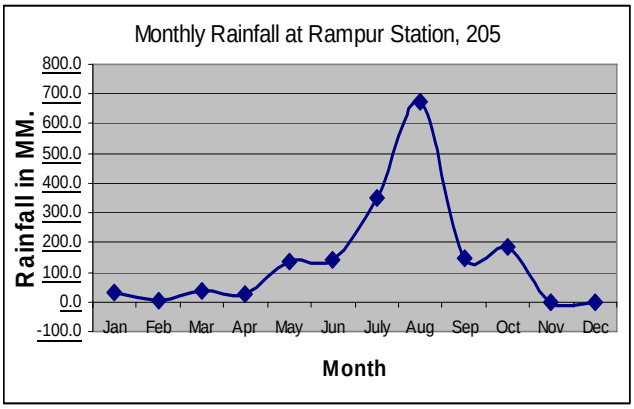
The annual average water discharge of the river in Deoghat point is 1599 cu. M. /Sec. It varies from 1230 cu. M. /Sec to 1950 cu. M. /Sec in 1992 and 1975 respectively. In addition the water discharge varies in different month. The lowest water discharge happens in March, 1970 having discharge 187 cu. M. / Sec. and the highest discharge happened in August, 1977. The discharge was 8530 cu. M / Sec. [10]

Climate (Temperature and Climate)

The study area lies in the terai. The river ranges from the elevation to 182 meter to 97 meter. height from the Mahendra Bus Park to an end of Trebeni Barrage of Nawalparasi district. The study area lies in the sub-tropical region. The temperature ranges 9^0C in winter and to 36^0 C in summer in adjoining metrological station of Rampur, Chitwan. The graph shows the temperature variance in the adjoining station.

Temperature and rainfall at Rampur Station, Chitwan





The total annual Rainfall at Rampur station recorded to 3776 mm in 2005. It varies 0 mm to 671.1 mm in August, 2005. The high precipitation occurs in June-August.

Encyclopedia-Narayani River: ***"****River* in central Nepal and northern India. It is formed by the union of the Kali and Trisuli rivers, which rise in the Great Himalaya Range in Nepal; from this junction to the Indian border the river is called the Narayani. It flows southwest into India and then turns southeast along the Uttar Pradesh–Bihar state border and across the Gangetic Plain. It enters the Ganges River."[11]

[10] Derived from the Department of Hydrology and Metrology
[11] World encyclopedia

Population of Chitwan

Chitwan situated at the central Nepal. The district is settled after the malaria eradication in Nepal. The people from central hills have been migrated there and the district established. The migration trend is still continuing. Population growth is high than the national average of 2.1. It is due to the natural population growth and the immigration. There are 468699 (236842 female and 231857 male) people having 92851 households lived in 2058. The urban population was 127114 (27 percentages in 2058). There are 5 Municipality/VDCs are situated along the Narayani River side. They are Bharatpur Municipality, Mangalpur VDC, Gunganagar VDC, Dibynagar VDC and meghauli VDC.

Bharatpur Municipality

District headquarters lies in Bharatpur municipality. Narayani River is in the northern side of municipality. The population growth rate is high of 7.1. There are 19922 households and 89323 (43465 female and 45858 male) people. Ward No. 1, 3, 4 and 5 wards are lies in the Narayani river bank.

Mangalpur

It lies just west of Bharatpur Municipality. There are 2951 households and 14508 (7382 female 7126 male) people. The VDC is going to be specifying to poultry farming and vegetable farming. The kavreghat and shivaghat are more vulnerable due Narayani.

Gunganagar

Gunganagar VDC is more vulnerable due Narayani. More HHs was displaced in 2050. The Gagipur (Agriculture pocket area of Maize seed production) is more vulnerable. The Simari town also is in high risk. The total population was 12875 (6655 female and 6220 male) having 2477 households.

Dibyanagar

The whole river bank of dibyanagar is vulnerable. There were 1652households and 8088 (4242 female and 3846 male) people. The more land and household were displaced in 2036, 2050 and 2061.

Meghauli

It is remote western VDC of Chitwan. Meghauli is surrounded by Narayani and Rapti River in north, west and south respectively. It is as island and more vulnerable due Narayani and Rapti. There are 2598 households and 18699 (7765 female and 6934 male) people.

Nawalparasi in brief

Physiography

Nawalparasi District lies in central terai. On the based on political division, it lies in the western development region. It covers 2016.16 Sq. Km. Out of which 31.6 %, 33.5% and 34.9% land lies in hill, inner terai and terai respectively having $15\text{-}50^0$, $0\text{-}15^0$ and $0\text{-}5^0$ slope angle. Due to the soil erosion in hill the river bed is increasing and river cutting is the common.[12]

[12] Periodic district development planning, nawalparasi, 2059/60-2063/64, p. 5

Population

The total population of nawalparasi was 562088 (277131 male and 284957 female) in 2058. The literacy rate was 54 percent (female 30 percent and male 77 percentage). The population increasing rate was 2.54 that were higher than the national average of 2.1. The population increasing rate was 3.45 in 2048 in nawalparasi.

Age wise and ecological population in Nawalparasi

SN	Age group	Hill	Inner terai	Terai	Total	Percentage
1	0-15	33689	80504	119560	233753	41.65
2	16-59	42259	103665	152849	298773	53.23
3	60+	4087	8542	16038	28667	5.10
Total		**80035**	**192711**	**288447**	**561193**	**100**

Source: Derived from Periodic district development planning, nawalparasi, 2059/60-2063/64, p. 8

Population of the adjoining VDCS of Narayani River

SN	Name of VDC	Population			Total HH	HH having latrine
		Male	Female	Total		
1	Agyauli	5187	4989	10176	1329	275
2	Amarapuri	5069	5054	10123	1064	582
3	Dibyapuri	3203	3191	6394	931	256
4	Dumkibas	4346	4073	8419	1293	285
5	Gaidakot	8879	8715	17594	2375	2021
6	Koluwa	4155	4008	8163	1136	217
7	Kumarbarti	2734	2666	5400	749	515
8	Mukundapur	4410	4421	8831	1313	914
9	Narayani	3821	3934	7755	1281	155
10	Nayabalani	5321	5107	10428	1734	447
11	Parsauni	3167	3032	6199	875	102
12	Pithauli	4632	4315	8947	1022	547
13	Pragatinagar	5736	5489	11225	1736	663
14	Rajahar	5199	5119	10318	1428	648
15	Tribeni Susta	5092	4956	10048	1530	156
Total		**70951**	**69069**	**140020**	**19796**	**7783**

Source: Periodic district development planning, nawalparasi, 2059/60-2063/64, pp. 179-180 and 206-207

The table cited that the more disadvantaged people are there. The average household size was 7 persons and having latrine only to 39 percent households. The socially excluded people i.e. Musahar, Maji, Tharu, Darai bote and Kami are in the river bank.

1.5. Scope of the study

Both districts of Chitwan and Nawalparasi are food sufficiency districts. They have been supplying paddy, maize, and oilseed to the food deficiency district of the country. In addition the scholars of the

nation have been suggested to shift the capital city to Chitwan. Narayani is the main source of water resource for both respective districts. It is said that the water pollution is exist in Narayani. Also due to the heavy soil erosion in the hill and deposition in the foothill and low land makes the river bed rising up. It supports to river course changing by cutting the farm land of the respective districts. Narayani River meanders in to many turnings in low land. And its breath is irregular. It varies from 125 meter in underneath of confluence point of Narayani and binai in dumkibas VDC of Nawalparasi district to 6500 meter between Meghauli VDC Chitwan and pithauli VDC of Nawalparasi. The river height under Narayani Bridge is 182 meter and 97 meter in the tribeni barrage of nawalparasi. Channel distance of the river is 82.11 Kilometers. The river gradient is very low. The distance and height ratio is 1000:1. One thousand meter river length have one meter height. So the river flows slowly. It gives the more chance to more sedimentation in the bed. That makes the river bed increasing and support to horizontal cutting and channel shifting. It should be aware of the possible breaking points of Narayani. The huge amount of land and property will be lost if the Narayani changes its course. For the strong advocacy from the side of victim and vulnerable communities the study will be more applicable.

1.6. Study Methodology

The Study has been carried out on the based on primary and secondary information. A draft report prepared and shared with district level different stakeholder including national donors and partners. The feedbacks of triangulation meeting are also incorporated in the final report.

Primary Data

For the primary data collection the sample points were defined to 10 clusters. The clusters were chosen on the based on equal basin distance. The ten sample sites were selected and marked in the TOPO sheet of 1994.

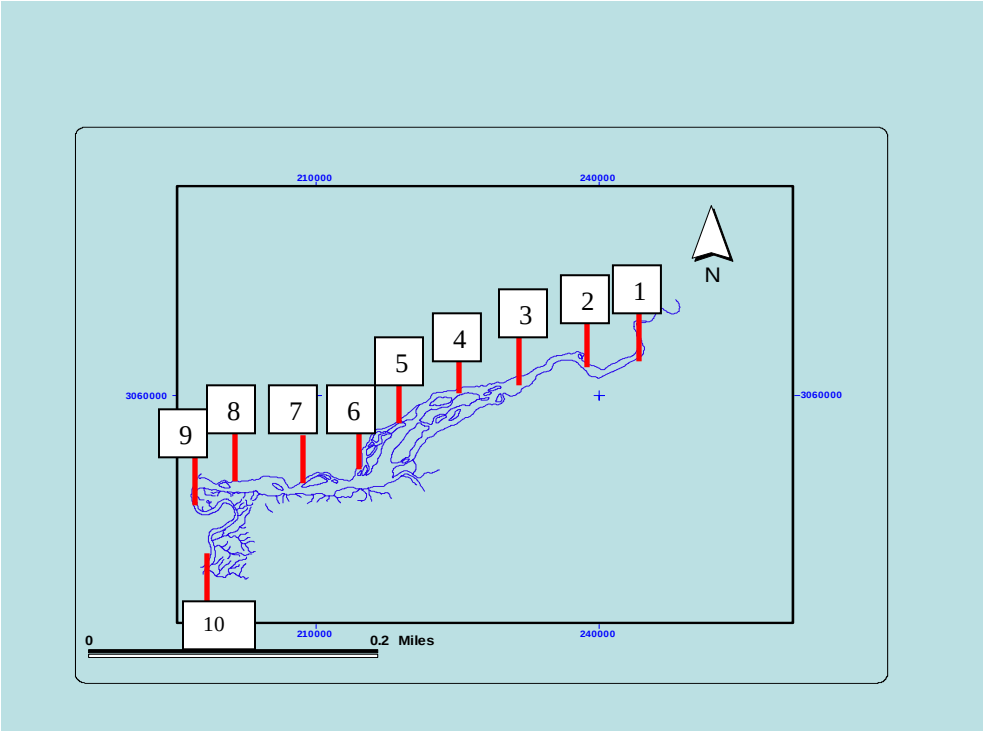
Sample Sites

The data were collected from the different 10 sites. Information is carried out from the sample survey. The sample has been taken in the 10 different points based on the river maundering and equal basin length. The followings are the sample sites.

1. Lilachowk, Bharatpur Municipality ward No. 1 and Gopi Dham, Gaidakot Ward No. 2 (84^0 25’ 40” east longitude and 27^0 42’ 15” North latitude)
2. Beltari ward. no 9 of Gaidakot VDC and Mohonpur of Mangalpur VDC, Chitwan near Tame Stone (84^0 21’ 56” east longitude and 27^0 41’ 14” north latitude)
3. Gagipur Gunganagar, Chitwan and Harkapur of Mukundapur VDC , Nawalparasi (84^0 13' 05" and 27^0 41' 05)
4. Rajahar Rural Market Center of Rajahar VDC, Nawalparasi, Sisai of Dibyanagar, Chitwan (84^0 13’ 54” east and 27^0 39’ 51” north)
5. Gair, of Pithauli VDC of Nawalparasi, Meghauli of Chitwan (84^0 10’ 10” east and 27^0 37’ north)
6. Amaltarighat of Kumarbarti VDC of Nawalparasi (84^0 05’ 48” east and 27^0 33’ 44” north)

7. (Luslahari ward no. 6 of Narayani VDC in Nawalparasi District (84^0 01' 09" east and 27^0 33' 04" north
8. Chisapani of Parasauni, meeting point of Arun Khola and Narayani (830 58' east and 270 33' 05" north)
9. Tamaspur / Bahuban of Dumkibas VDC, Nawalparasi (83^0 55' 58" east and 27^0 33' 10" north)
10. Gandak Barrage Nawalparasi (83^0 54' 24" east and 27^0 26' 36" north)

Sample sites in map



The sample survey was made in April, 2007. Researcher and assistance researcher both visited to each sample cluster. The focus group discussion was made for the information collection. The participants of the focus group discussion were the victims and adjoining people of Narayani River. The discussion also made in almost river bank. Afterwards GPS survey was made in each sample site and carried out the information latitude, longitude and altitude. A mini triangulation was made in the sample site immidiatly and insures the altitude. Five points around each site were taken and calculated in average altitude of the particular site.

Assessment of the Narayani River on hazard, risk, and vulnerability is based on primary data collected from sample sites in April, 2007. Primary data basically depends on past hazards, socioeconomic conditions, vulnerability, response capabilities, and efforts made by local people to mitigate floods disaster. The structured questionnaires were used in the time of field survey.

GPS Survey

The Global Positioning System (GPS) survey was made for the altitude measurement and identified to the coordinate point in the different sample points.

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Check list

A checklist was developed on close coordination to district level expert and local authority. Also consultation made with focal person of district development committee Chitwan. The checklist guided to the researcher in the time of data collection and interaction with the local people who are the victim and people in risk from the flood of Narayani River down stream**.**

Secondary Data

The secondary data were used for the study. The published and unpublished records and the progress report were used during the time of survey. Map data were also used.

Unpublished Record

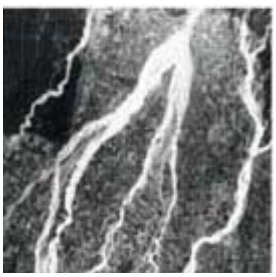
The rainfall, precipitation, water discharge and humidity type data were collected from the Department of Hydrology and Metrology, Katmandu. The raw records were collected and these raw data were arranged and verified in the concern personnel of the department of Hydrology and metrology.

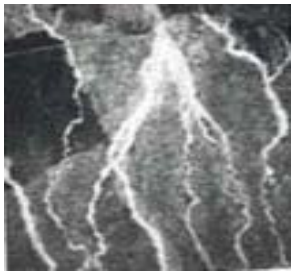
Map Data

Arial Photo Graph

An aerial photograph were used for the river meandering and its coverage. An aerial photograph of 1958 and 1992 were used for the study. Both respective photographs were 1:50000 in scale.

Arial Photo

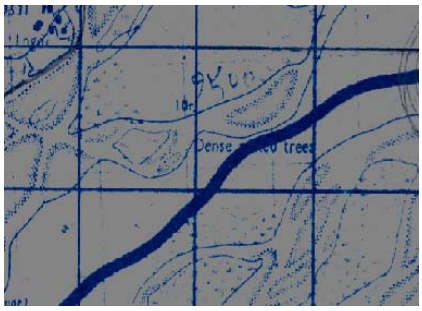


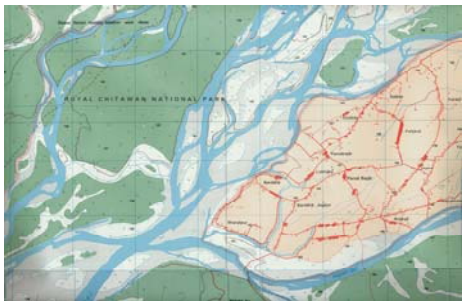


1992 **1954**

TOPO-sheet

The TOPO-Sheet of 1958 on the scale 1:50000 and 1994 on the scale 1:25000 were interpreted. The both Arial photo and TOPO-Sheet were carried from the topographical survey branch, Minhbabawan Katmandu, Nepal.





1958 **1994**

Triangulation of the initial findings

A draft report prepared and presented to the concern stakeholders in district level. Triangulation/sharing meeting happened in 19 July, 2007 in the district headquarter of Chitwan. The sharing meeting was made on the presence of Chief District Officer. DDC, Chitwan, Action aid Nepal, practical action, UNICEF, NGOs who are working in the field of disaster management, journalist, political parties and other concern parties were presented and active participation was made.

The sharing meeting suggested making a detail action plan for mitigate the potential flood disaster due to Narayani River in down stream and upstream separately.

Method of Data Analysis

The collected information was entered into the computer and analysis with graphic, tabular and explanatory form.

Final Report Preparation

The final report is prepared into 4 chapters. First chapter includes Introduction, the basic knowledge and study methodology. The research findings are in second chapter. Third chapter comprises the conclusion and recommendations. The four chapters include the annexes of ten sample sites findings and other annexes.

Study period and action plan

- The study carried out from March –July, 2007

1.7. Limitations

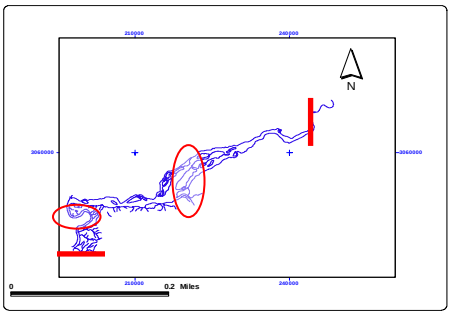
There are some limitations in the study. The study limits to only 10 sample points. The study couldn't include the upstream and other branches of Narayani. The field survey was made in dry season of April. So the researcher observed the actual water line but couldn't observe the flood water in the river bank. The study focuses more to physical aspect than social aspects. The used TOTO sheets have own error level. It has 25 Hector plus and minus error. The TOPO sheet of 1954 was non color sheet. The GPS survey was made in 8 m. plus minus error level. Due to the political constraints the researcher could not take the more information and photo from the Gandak Barrage of Nawalparasi.

CHAPTER TWO
RESEARCH FINDINGS

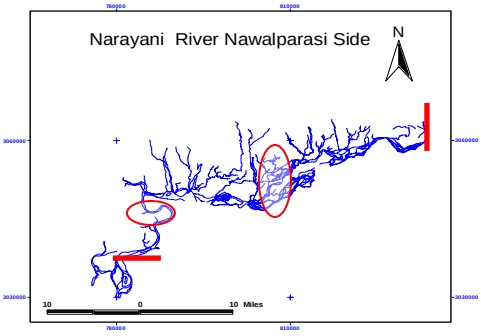
2.1. General Location of Narayani River

The Saptagandaki River is called "Narayani" when the Kali Gandaki River and Trisuli River confluence in Deoghat of Thanhu/Chitwan. The river flow north south direction until intake point of narayani lift irrigation system. The intake point lies in 84^0 25' 40" in east longitude and 27^0 42' 18" north latitude. This is the 1st sample point of the study. The point is near Maheandra bus park of Bharatpur Municipality. Afterward the river turned into the south west direction until Trebeni Barrage of 83^0 54' 24" in east longitude and $27^0$26' 36" north latitude. The basin length is 55.15 Km in total whereas the channel length is 82.11Km. The breath of the river is irregular. It varies 125m (83^0 55' 40" east longitudes and 27^0 31' 17" north latitude) in 3 Kilometers south of confluence point of Binai and narayani in Dumkibas VDC near Bahuban and 6500 meters between Pithauli VDC, Nawalparasi district and Meghauli VDC of Chitwan district. The crossing line is 84^0 10' 52" east longitudes.

Views of Narayani from Chitwan District



Views of Narayani from Nawalparasi District



The river has numerous tributaries in northern side and contributes more water in monsoon. And they supply more sediment in rainy season. But the tributaries seemed as the sandy desert in dry and summer season. The river looks meandering. The meandering is calculated as Sinuosity ratio is measured as follows:

$$\text{Sinuosity (P)} = \frac{\text{Channel Length (Actual length of the river) (LC)}}{\text{Basin Length (direst length of River) (LV)}}$$

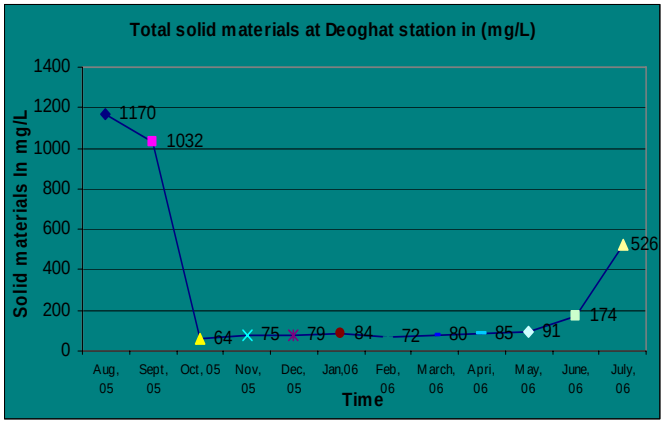
$$= \frac{82.11}{55.15} = 1.489$$

Sinuosity ratio is measured about 1.5. Until the sinuosity ratio reach to 1.5, the river cannot be defined the river meandering.[13] River having a sinuosity of 1.5 or greater are defined as meandering. Those below 1.5 are straight and braided. According to their views we can classify the River Narayani into highly braided type. Still it has chances to meandering. The sinuosity index is lower than the Ratu Khola watershed lies in Mahottari and Dhanusa district.[14]

2.2. Sedimentation

Narayani covers 26300 Sq. Km. in central Nepal. The catchments areas are highly influenced by the local and transit people. Indian sub continent is newly formatted land of rising up the Tethese Sea. Hill geology is week. The hills of Nepal are fragmented due to about 6000 rivers. The central Nepal has dense and more infrastructure in comparison to others regions. The roads are being built along the river side with huge explosion. Thus the top soil erosion and landslide is common in upstream. The rivers transport the sediments that laying in the course in high slope. Later the river reaches to terai and starts to deposit the carried materials in the riverbank and helps to rising up the river bed. People of the riverside have been trying to check the river by making check dam, retaining wall and other bio engineering activities. Thus the conflict situation exists between people and river. River compelled to flow in narrow gorge in dry season. Heavy water discharge occurs in monsoon and the channel cannot afford the water and overflowed takes place and the people have to pay the huge disaster.

Mountain regions are suffering from landslide and top soil erosion. The rivers work to vertical downward cutting in the region. The cutting problems are the common in hills. As the river flows to terai the deposition takes place. Narayani River transport fertile top soil and other solid materials from hills. The solid materials i.e. sand and gravels start to deposit in the foothills.



Narayani has 7 major tributaries. They have been contributing the water to Narayani. The average solid materials are 294 mg. /liter water in Deoghat point. The average water discharge rate is 1598 Cubic meter / second in the same point. So we can calculate the river has been discharging to 14815991 tones solid materials annually from the point.

Source: Dr. Madav Shrestha, Nepal RMC, Chitwa, 2006

Narayani flows from the high Himalayas to an end in the Trebeni Barrage in Nepal. Trebeni Barrage stands as an obstacle to flow down the river naturally and support to layer/deposit of the carried loads

[13] "Depositional Sedimentary Environments, H.E. Reineck and I.B Sing second revised and updated Edition, New York.

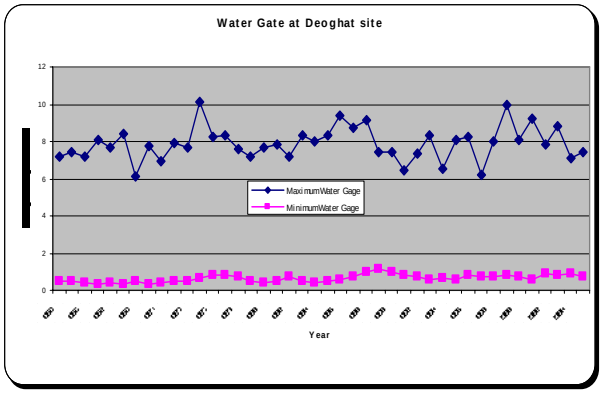
[14] (Narendra Raj Khanal, and others, ICMOD, Preparing for flood disaster, 2007.

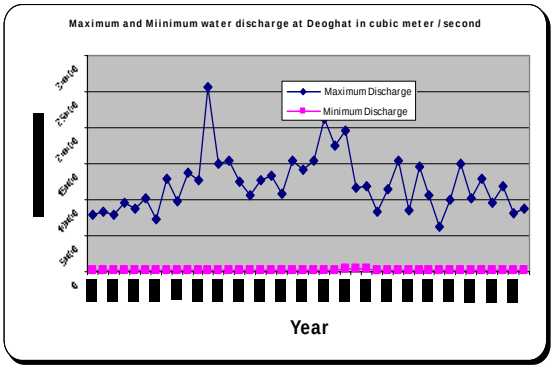
in the way. The water flow begins slowly from sample point five (Meghauli VDC, Chitwan and Gair, of Pithauli VDC). The local people said the water flows opposite direction in flooding time due to the closed dam of Trebeni. The local inhabitants Mr. Lal Bahadur Mahatto (Chairperson of Tulasi Upabhokta Samuha, Amaltari -9 Kumarbarti VDC) confidently said due to the Trebeni barrage the high sedimentation exist in the riverside.

Mr. Krishna Lal Chaudhari of 63 years old (Retire Police officer) from Luslahari ward no. 6 of Narayani VDC in Nawalparasi District said that the boat man spent two hour to reach Trebeni barrage before and now a days it cost three and half hours. It is due to decreasing of river gradient and water speed.

2.3. Water level Gage height

The maximum water discharge happened in August, 5, 1974 in Narayani River. The water discharge was 25700 Cusec from the Narayangard and the minimum discharge was 163 cusec occurred in April, 5, 1970.



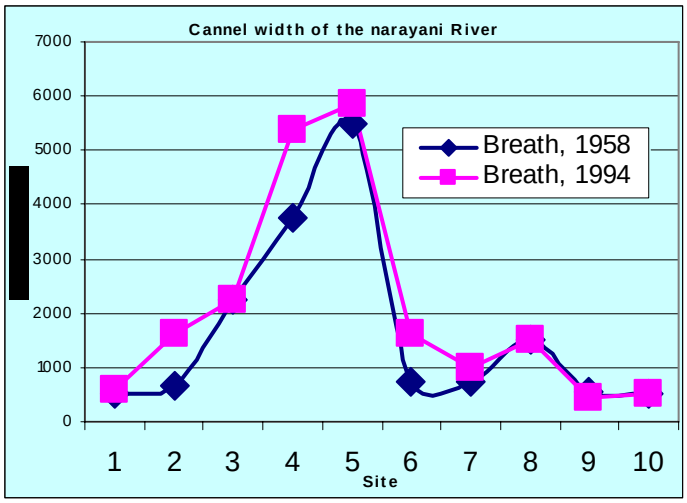


The minimum water gage height was 0.30 meter in the same date as the minimum water discharge of 1970 and the maximum gage height was 10.12m in Narayangard in the same date as the maximum water discharge of 1974.

2.4. Channel shifting

The river morphology has been changing with expansion of its course due to heavy sediments and lateral cutting and high deposition in downstream. Narayani has been intense bank cutting and frequent channel shifting and affecting thousand of families and destroying hectares of agriculture land in low land.

Narayani River Breath in meter		
Site	**Breath, 1958**	**Breath, 1994**
1	500	600
2	650	1625
3	2250	2250
4	3750	5375
5	5500	5875
6	750	1625
7	750	1000
8	1500	1500
9	550	550
10	500	500



The site 5 has top width in both respective years. The point fifth has highly width in 1994. And the point 4th has highly changed its breadth. The 1625 meter breath expended during 36 years period and reach to 5375 meters in 1994. The sites 8, 9 and 10 has no expended in both respective years. The river flows with narrow gorge between two hills (Someshor in south and Daunneye in the north) up to Indo-Nepal boarder to Trebeni.

Narayani is the sorrow of Chitwan and Nawalparasi district. It works as the boundary line of the respective districts. The river has cutting to the bank, sediments filling in the course and making to an island in he ways and shifting its cannel is common. The huge agriculture land has converted into desert in both districts.

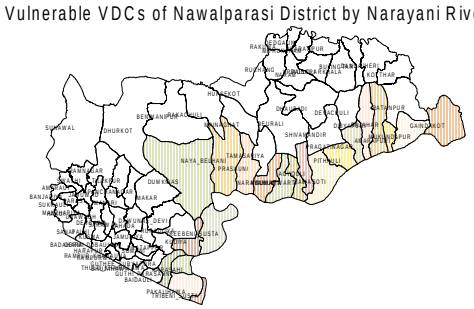
The river covered 121.346 Sq. Km. in 1958 and expended to 143.25 Sq. Km. in 1994. The river expended its coverage to 21.904 Sq. Km. within the 36 years of period. Thus the river has covered 0.5476 Sq. Km. farm land annually.

Year	Area In Sq. Km	Change
1958	121.346	-
1994	143.25	21.904

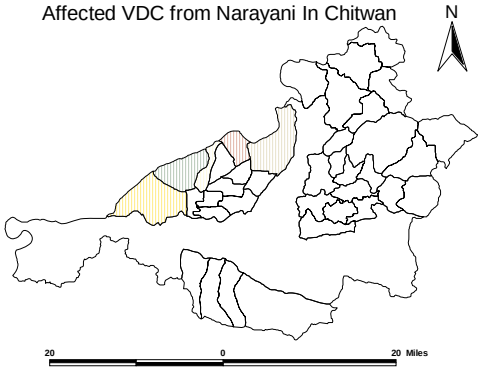
2.5. Affecting VDCs due to Narayani River

The river affect to more land of Nawalparasi district. There are 14 VDCs are in the river bank. All of the VDCs are in risk due Narayani. And there are 5 VDCs/municipality in Chitwan (Dibyanagar and Meghauli, Gunga nagar, Mangalpur and Bharatpur municipality) along the riverside of Narayani. Out of which 2 VDCs are severely affected. They are Meghauli and Dibyanagar.

Affected VDCs in Chitwan



Affected VDCs in Nawalparasi



NDC Name	Nearest Settlements	Altitude of settlements (IN Meter)	River height
Gaidakot	Toltola	181	180
Mukundapur	Pithauji	172	169
Amarapuri	Aamaipichhe	165	160
Rajahar	Kottadi, Kujauli	165 rock cliff	160
Dibyapuri	Devigaira	160	Narayani-154 Mukmde Khola-160 Deusat Khola-160
Pragatinagar	Chhatisghare	166 rock cliff	151
Pithauli	Bhasarghat	144	142
Agyauli	Sherganj	134	133
Kumarbarti	Amaltari	136	134
Koluwa	Nandapur	135	133
Narayani	Dhagaha/ Sitapur	131, Dhaja already swept away	132
Parsauni	Chisapani	129	124
Nayabalani	Tamaspur	125	118
Dumkibas	Bahuban	130	Narayani-120, Binai, 126

VDC/Municipality	Nearest Settlements	Altitude of settlements (IN Meter	River height
Bharatpur Municipality	Baraghare	182	180
Mangalpur VDC	Shivaghat	182	180
Gunganagar VDC	Langauta	163	159
Dibyanagar VDC	Dadrahani	149	151
Meghauli VDC	Baharatpur	142	141 (Rapti & Narayani

Thus the River has been changing the farm land into desert in Chitwan and Nawalparasi. It changes almost 22 Sq. Km. (3234 Bigaha of land) into desert. The areas of the river bank are mostly settling by the left behind community of Bore, Musahar, Maji and tharu community.

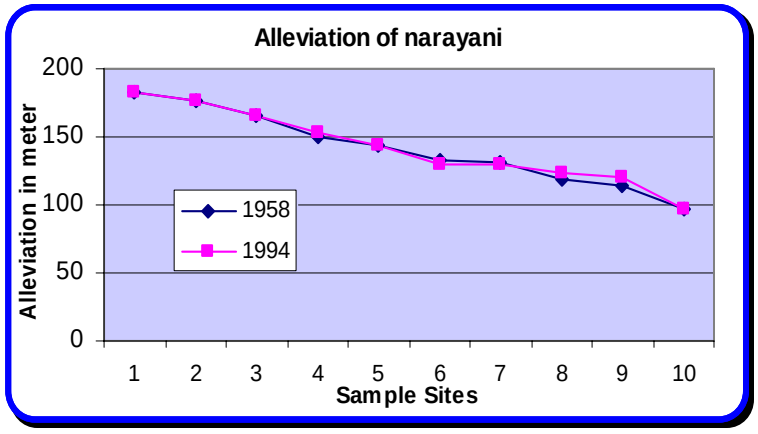
The desertification process is high in terai of Nepal. The high population increasing rate in terai, natural resource i.e. forest land has been converted into agriculture land and also the crown density of forest has been decreasing. The river carries the loads (soil, gravels, stone and fell down trees) from middle hill and Churia range. The flooded sediments are deposited in terai. So the high desertification process takes place along the riverside. Also the course is increasing up. Many settlements in terai located along the riverside and they are in risk due to flood of July and august. There are 100 HH are severely affected in 5 VDCs of Nawalparasi district in Jyly, 2007.[15]

2.6. Alleviation of Narayani River

Narayani flows in the terai. It has discharged about 14815991 tones non dissolvable solid materials annually. The small islands are being in the river course. The river alleviation is as follos;

Average Altitude of sample cluster (In meter)

Points	1958	1994
1	182.9	182.9
2	176.78	177
3	165.2	166
4	149.3	153
5	143.8	143.5
6	133.2	130
7	131.1	130
8	118.26	123.6
9	114.3	120
10	97	97
Total	**1411.84**	**1423.00**
	141.18	142.30



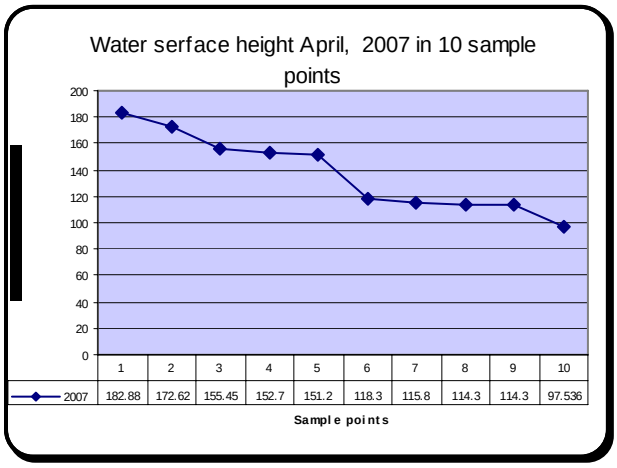
The channel length of the river is 82 Km. with about 85.9 m height. The gradient is about one meter in per Km channel length in average. Thus river has no more power to flow its loads. It has been deposited the loads on its bank and the deposited load make island. The newly formed island has pushed the river to another side and the chance is increasing to enter river into settlement areas.

The average river course increase to 112 cm in during 36 years. The annual average increment calculates to 3 cm. It varies to different places. To raise 1 m. surface height of river course costs 33 years. If so happen, we can predict what settlement will be swept away/ flooded away in what period.

According to the community members of the Narayani VDC ward No. 6 Luslahari of Nawalparasi District {(84^0 01' 09" and 27^0 33' 04" and altitude is 375ft (114.3m).}, the river has been continuously shifting to the northern sides of village area. It is due to the dam of Trebeni, high

[15] Nepal Red Cross Society, Flood and Land slide information bulletin, No: 14-29/07/2007

deforestation, sandy and loose soil in the northern bank of river. The respondents of sites 8 and 9 said due to the Trebeni Barrage the water current slowdown and Narayani pushed back to its tributaries and bed of Arun and Binai khola were remarkably increased. The summer water channel flows by making the deep gorge between the deposited gravels. The slope of the water channel in April, 2007 is as follows;

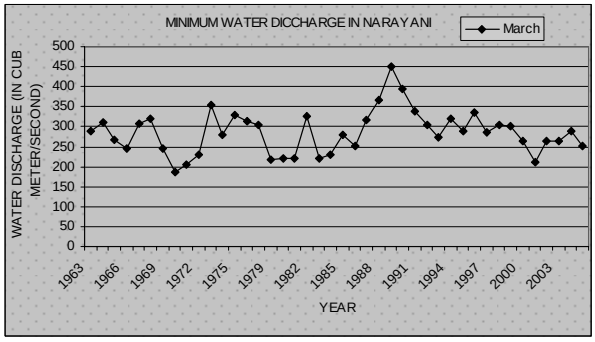


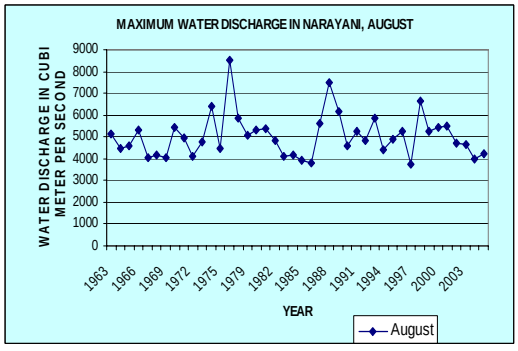
The river gradient is gentle. It has 82 Kilometer channel length whereas the height different is 86 meter. The river has 1 meter height for the 1 Kilometer channel distance in average. So the river flows very slowly and more potentiality to more sedimentation.

2.7. Water discharge

The water volume of the river depends upon the precipitation in its catchments. The high rainfall occurs in the hill the water volume is increasing. Also the temperature may affects to water discharge. The water volume increase as the temperature increased in the Himalayas. The river discharge is varies. The low discharge made in April, 5 1970. The discharge was 163 cubic meters per second and the highest discharge made in August, 5 1974. The discharge was 25700 cubic meter per second. The average water discharge comes in 1598 cubic meter /s in average of during 1963-2005.

The water discharge in Narayani River

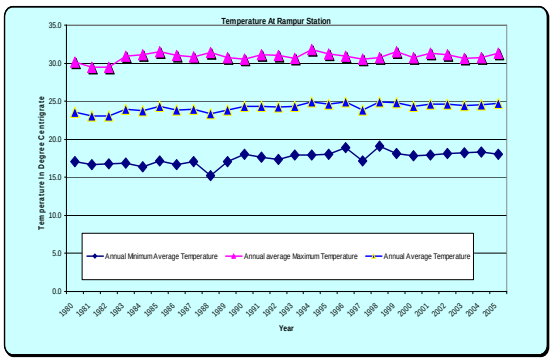


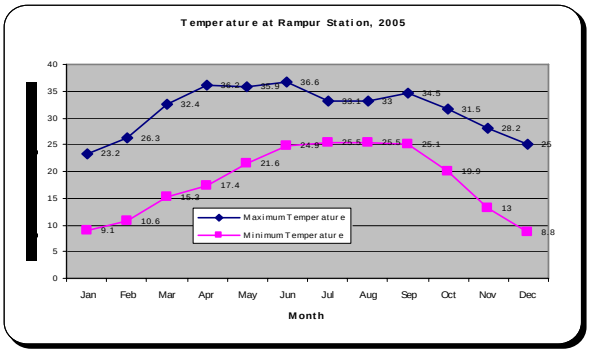


The water discharge varies and irregular pattern in both maximum and minimum. It depends on precipitation of the catchments.

2.8. Temperature

The mean annual temperature at Rampur station is 24.5^0 C. The mean annual temperature varies 17.5^0c to 30.9^0c and the absolute temperature varies 6.4^0c to 39.9^0C. May and January are the hottest and coldest month.

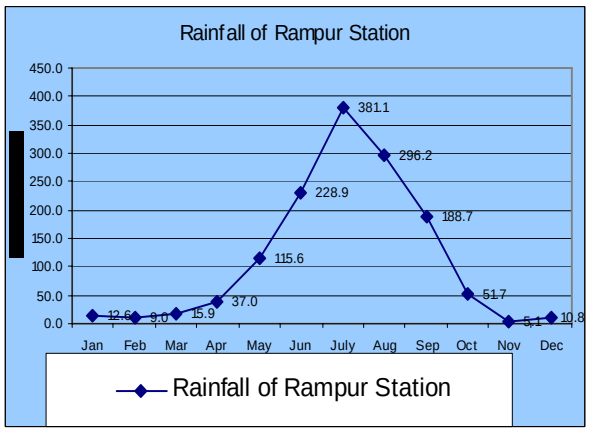


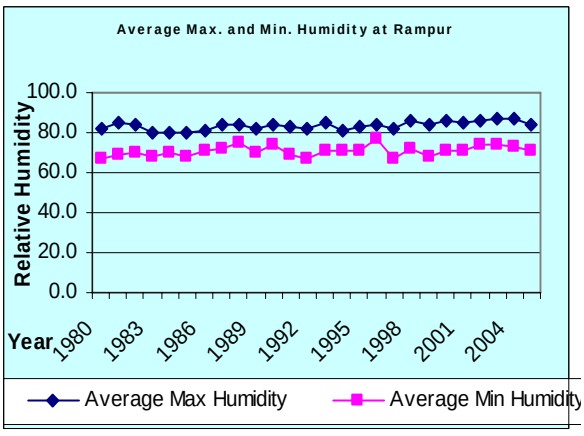


The minimum, maximum and average temperature is going up. During the period of 1980-2005 the average temperature increases to 1^0c.

2.9. Precipitation

The intensity of rainfall varies in Rampur station. The annual average rainfall recorded to 220 mm. It average value of 39 years (1963-2005). The highest rainfall recorded in 1998. The rainfall occurred 1046.5 mm at Rampur station and 1002 in Jhuwani station of Chitwan. The minimum rainfall recorded November and December and January.





The average humidity seemed increased in both minimum and maximum as the temperature increase. The maximum humidity ranges 79-86 percent and minimum ranges 67-74 percent. The minimum humidity recorded to 24.4 in April, 1992 and maximum recorded to 100 in December, 1996 and 1998.

2.10. Some effects of the River course changing and expansion

National Park Area: Narayani River captured more farm land and entered into the command area of Chitwan National Park and the coverage of national park has been increasing.

Humidity content: It flows covering more surface, due to the expansion of the river course it influence to the water content to resent top air and it affect to climate.

Drinking Water supply to Wild Animals: The River makes more branches in downstream. The wild animals can get drinking water in narrow distance.

Grazing Land increased: The River has expanded to grazing land that support to wild animals for their feeding. Also the adjoining communities have been using the grazing land to feeding their domestic animals and cover their hut's roof.

Resource providing: The River has been providing sand and gravel to the local people. The local communities have been using gravel for graveling the road and sand for construction the buildings.

The Some place irrigation: Due to the river meandering, the river flows underneath of the agriculture land. The boarder communities have been using the river water as irrigation by pumping.

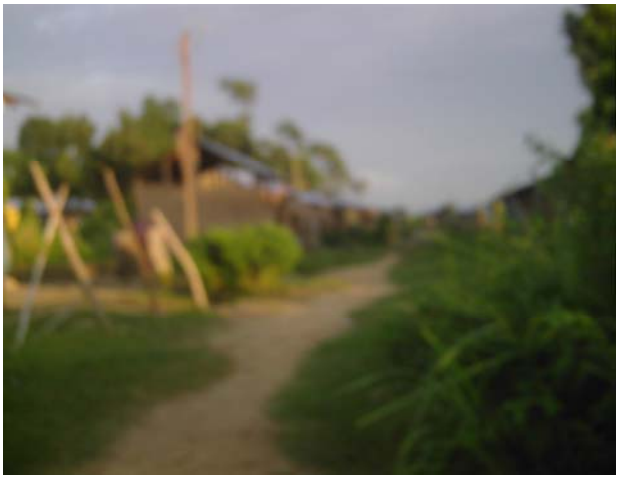
Water table Increase: The river course has been increasing that influence the water table along the river side. Water table has been increased that helps to irrigation potential.

Forestation: The river edge's communities have encouraged to plantation to check the river.

Community Organized: The River is the matter to organize community beyond the political interest to manage the river problem and safe their life and property. The local communities are able to raise the resource. And they are as a pressure group to the concern agencies.

Reduce the agriculture land: About 22 sq. km. agriculture land converted into river course, sandy area and grazing land along the river sides. The agriculture production has reduced in Chitwan and Nawalparasi districts. The food deficiency exists and effect to food security. Due to the changing land use system, the climatic change exists.

Challenges to Poverty reduction program: Due to the regular flood disaster, the poverty reduction program along the riverside is being hardship. The 167 victim households were resettled in Dibyapuri VDC Ward No 7 of Nawalparasi district. They were victimized by the Narayani river in Rajahar (63 households) and Pithauli VDC (104 Households). By the help of local some NGOs they were resettled. Out of total households there were only 2 upper caste (Brahmin and chhetry) families. There were only three water tap and no safe latrine. The people have been living with one time feeding.




They have roof on their house but no walls in their huts. Some organizations visited and asked to help them. They collected the information and never returned back said Mr. Prem Bahadur B.K. Now they make a rule on providing information. Without commitment to support no personnel can take any information. They rejected me to take their photos. Thus poverty reduction seems challenges to the government of Nepal.

Deforestation: The river flood flew the forest area of the Chitwan National Park and converted into the sandy area.

Migration: People of the river bank compel to evacuate the river edge. They have migrated and resettle in the jungle area. They have faced many problems in the newly resettle area of education, drinking water supply, health facilities and many others.

Land less: Narayani River has made landless to thousands of family of Nawalparasi and Chitwan. Many of them have been refugee.

Water ecosystem: The flood water influence flora and fauna that live in water. The inhabitants of river bank relies the change pattern of water ecosystem. In the past there were many fishes, crocodiles and shark in the river. They almost disappeared.

Desertification; River captured more land and become water course. In monsoon the river course almost covered by flowing water. It is happened about 3-4 months. The rest time about 60 percent course has been lying down as a desert.

Temperature change: Due to the high desertification affect to the surrounding temperature.

Housing and food security: Community of the river edges evacuated and resettles to other sites. The people who live along the river sides, they have made floating houses which able to discharge the water of its ground flower.

CHAPTER THREE
CONCLUSION AND RECOMMENDATIONS

3.1. Conclusion

The main hazards repeatedly accruing and causing heavy losses in terms of lives and property in Nepal are floods, landslides avalanche, hailstorms, windstorms, lighting strikes, earthquakes fire and epidemics. Out of which 70 percent family affected from the water Indus disaster. Losses of property from floods, landslide and avalanches combined are about 61 %. The flood is common in Terai. The hillside of the country is highly encroached by the increased population. The developmental work is highly concentrated to the central Nepal helps to decompose the rocks. The youth and young rivers erode the top soil and mass movement occurs in the young and youth stage of river. The river comes elder in the Terai and starts to deposit in the plain caused the course rising, river meandering and shifting its channel. The river Narayani captured thousands hector of farm land and make the people landless. The victim people compelled to live with hardship.

The river looks as the meandering. The sinuosity ratio is still less than 1.5 so it is still possible to meandering. The cannel shifting is common. The loads that it eroded are deposited on its bed and bank makes course rising up. The loads what it brings from the hill and mountain helps to lateral cutting and deposit in the bank makes the course wider and bank rising. The huge landmass has been converted into as a desert and helps to rising temperature of its peripheries. Also the moisture content in the air is rising up and affect to crop pattern and the diseases to plant and human.

3.2. Recommendations

Flood is the natural phenomenon and its complete control is beyond the capacity of human efforts. However, the magnitude of flooding and its impact can be reduced to a certain extent through development and effective implementation of land use zoning guideline, building codes, and enhance to the community capacity.

The problems of increasing risk and vulnerability are not associated with physical features only, but also with socioeconomic conditions. Programs well integrated with physical process and socioeconomic developments are therefore needed. Watersheds should define as a geographical unit in which the problems of flood hazards can be assessed and monitored properly.

Attention should be given to integrate watershed management development programs in national development plans. Political commitment and accountability in planning and implementing such programs are essential.

The Narayani flows between Chitwan and Nawalparasi district in Terai. To canalize the river in certain channel in downstream, the common plan of the respective districts for canalized the river is essential. The community along the Narayani River of two districts should be aware and make will be campaigned for reducing vulnerability. The dam with bioengineering is essential in both shoreline of the river. The vulnerable community of respective districts should raise the issues from the community, district and national level with political and religious neutral.

The sedimentation will be continuing unless using sedimentation control measure techniques in the upland of the catchments of Narayani. The local knowledge will be enhanced to reduce the soil erosion and landslide and make better up to the upstream.

The losses depend upon the community capacity. Beyond it the traditional community practices make themselves to more vulnerable. And local people have to realize the importance of preparedness plan incorporating component of watersheds conservation and drainage management through proper land use plan. The local people should have better up on use of land use guideline, income rising activities, early warning system, and creation awareness activities. However, a local institutional network to devise and implements such programs and disseminating the information is essential.

All major rivers of Nepal flow to India. Narayani flows to India from the Trebeni of Nawalparasi district. The high dam constructed in 2016 in Trebeni. The river water has turned to another direction from its original course. It helps to makes ecological unbalance and invites numerous problems. The inundation committee has been established with members of Nepalese and Indians officers to cope the flood problems in Indo-Nepal boarder. The committee found inactive and functionless. So the community should push the committee to work better.

Effective early earning systems can reduce the potential losses by 6 times. So the early earning system will initiate in upstream and down stream as per require. And the water gage survey will be continue and not to keep in record only. Rather they are disseminated through media.

CHAPTER FOUR
FINDINGS IN SAMPLE SURVEY

4.1. Survey Site one: Diyalo Bangala / Mahendra Bus Park of Narayangurd and Gaidakot Of Nawalparasi District

The 1st sample point lies in the intake point of Narayani lift irrigation system. It is near Diyalo Bangala / Mahendra Bus Park of Narayangurd City. The Geographical location is 84^0 25' 40" east longitudes and $27^0$42'15"North latitude. Before reaching the point the river flows to southwards direction. Afterward, the river turns to westward. The river continuously strikes to the dam made by the Narayani lift irrigation system. Just below the dam there is a building of Diyalo youth club. The foundation of the Diyalo youth club building has continuously strike and make in risk. Bharatpur Municipality has made a retaining wall on foot of Diyalo by the assistance of Asian Development Bank loan received by the Government of Nepal under Urban and Environment Improvement Project (UEIP).

1958

According to the TOPO sheet 1958, based on Arial photograph was taken in March, 1954, the river had one lane. The point is just turning point to the river to westward. In the north part of the river were busses and scattered thin settlements. The southern parts there were dense settlements with huts of Narayangurd. The nearest contour line was 600 ft. The river breath was 500 meter (1 C.M. in the map). The map scale was 1:50000. The east west highway crossed from there.

1994

The river has two lanes and made an island between the made lanes. An island seemed covered with busses. The sandy area was in the northern riverbank. The nearest contour line was 180 meter. There is a temple and intake of Narayani irrigation cannel in the south edge of the river. The river breath was 600m.

April, 2007.

The point was observed in April, 2007. Some community members were participated in the time of field survey. Fisherman (Bote) community dominated the meeting participants. Among them Mr. Suk Dev Bote was the oldest and he has been living there since 62 years. He said that the river has deposited more gravel of the river bank and the river has been eroded vertically. In the past river flew more strongly than now. Also he urged the water volume is going down. Before the construction of the Narayani Bridge the dolphin (said in their language "SAS") were visited. But these days they cannot see dolphin. Also many crocodiles were lying down in the bank of river. Mr. Surya Bahadur Maske, 70 years of aged (Oldest businessman of Narayangard) the river entered into Narayangurd in 2014 from the Diyalo Bangala (Royal Palace). So the Rapti Dun Project shifted the town planning in ward no. 12 (Eastern side of institutional areas on Government of Nepal, Police training centre to district administration Office) of bharatpur municipality. However, the businessman of Narayangurd ignored the town plan and resettled in the Narayangurd. The altitude of the Narayani River was 182.88 meter in 84^0 25' 40" east longitudes and $27^0$42'15"North latitude.

4.2. Survey Site two Gaidakot VDC of Nawalparasi district and Mohonpur of Mangalpur VDC of Chitwan

The second site of the survey area was the meeting point of Jayashree Khola and Narayani River in the north. The location of the site is thumsi and beltari ward no 9 of gaidakot VDC of Nawalparasi district. Mohonpur of Mangalpur VDC of Chitwan lies in the southern bank of ricer. The geographical location is 84^0 21' 56" and 27^0 41' 14" and the altitude was 575 Ft. (172.65 meter) at the time of field survey.

1958

Both sides the dense mixed forests were there. The river starts to turn west north direction from the laxmipur. The nearest counter was 600 ft. and the points where observed was 174.6 meter height from the sea level. The water lane seemed in single. Thumsi River confluences in the north bank of Narayani. The breath of the river found 650 meter out of which only 250 m covered by waterway and the rest have sand (350 m. in north side and 10 m. in south).

1994

The river has made its course wider than 1958. The river has pushed to northern direction and flew in two lanes. The main cannel was in the original place of 1958. An island emerged between the river cannels and some huts were constructed. The river breath calculates to 1625 meters out of which only 250 meter was covered by the water body and the rest has processed in desertification.

April, 2007

Northern Bank: Mrs. Chandra Kali Kandel aged 72 said that the seen plain field was the river course in the past. A huge flood occurred in 2028/29 and the river deposited many sediments and made highland there. At that time 10 yaks (Juwa, materials that is used to ox neck at the time of plough) were flew by the river. So the local people said that the year to Juwa Bagayako Sal to 2028. Before the flood there was a huge fellow land with Sissau Khayar, Simal. At the time of flood all of the trees were swept away. N the time of field survey there was a grass land.

The Village Development Committee of Gaidakot protected the grassland. Since two years the land was converted into farm land. The local people were pulled of its productive soil and the land has been cultivated. The local people deny using tractor for plough. They make rule to burn the tractor that used to plough in the restricted land. So the local farmers initiated to protect land from the erosion.

Laxman Darai aged 65 is the oldest local inhabitant. According to him, His grandfather told him that there was a Bishni Ghol (wet land / low land) that was elongated about 1 hour walking distance. It

was surrounded by jungle. The jungle was cut down in 2020. The flood of Narayani River occurred in 2029 entered and made a plain upland and it pushed the river to southern.

He said there was a lake. The local inhabitants worshiped to the lake. Mr. Darai said referring to his grand father that, at the time of marriage party ceremony the local people has requested with lake to get the required utensil. A boat came up with requested utensil and provided. The utensil borrower should reimburse after completion their program and the boat has been sinking with the reimbursed materials. The local people believed the water God. One time a rice stair (Padiyo) was missed to reimburse. Then the boat did not sink and then the help was closed down. So the local people worship to the lake. The lake was filled up in 2029.

Southern bank of the river: In the south part of the sample, Mangalpur VDC of Chitwan District lies. The local inhabitants said the river has been flowing in the same line since 20 years. The river was very deep (one bamboo height) in the past. Now the river is rising up. Mr. Surya Prasad Poudel measured the height (deep) of the river in 2062 Baisak. He sank and raised his hand, the hand saw in the water surface.

Mr. Bhim Khanal, and Mr. Gaw Bahadur Baram were oldest. They said that an island that was seen across the river (red Box in the photo). An island was covered by the crocodile (Crocodile were touch in the boating). These days they cannot see the crocodile. This was happened after the flood of 2050. In the flood of 2050 the huge number of fishes decomposed and spread bad smell around the settlement. Afterwards the fish are in thin dense there.

The seen island was cultivated in 2040-2042 (3 years) by the 8 households. Mr. Gaw Bahadur Baram was one of them. The Geographical location of the surveyed site is 84^0 21' 56" and 27^0 41' 14" and found altitude was 575 Ft. (175.26m)

Cupper Stone

There is a stone in the river bank. The people said the stone was seemed at 4 men height. At the time of survey the stone was not at more height as they told. Around the stone there were very hard rocks lying down. The local people believe if the cupper stone sinks by the River water, the western Chitwan also sinks. The Cupper stone was surrounded by the hard rock around. But the hard rocks are filled with the small gravels around.

4.3. Survey Site three (Bote Tole of Mukandapur VDC, Nawalparasi District)

The survey site was Harkapur of Mukundapur VDC of Nawalparasi and Gagipur of Gunganagar VDC on Chitwan district. The location of Gagipur is 84^0 13' 05" and 27^0 41' 05".

1958

The sample cluster 3rd leis near Harkapur of Mukundapur VDC of Nawalparasi district in the north and near Laungata of Gunganagar VDC of Chitwan district. The river was narrow in just up of the point. The point was Saranpur of Mangalpur VDC. There was only 500 meter breath. However the breath was immediately expanded to 2250 meter in the sample site. The average alleviation was 164.6 m. The river seemed in two lanes and seemed an island between lanes.

1994

The river has three cannels. The main cannel flows in northern bank. We could easily observe the sandy area expanded in both sides. Open settlements were in both sides. The river started to be wider from the underneath of Mangalpur community forest. The average alleviation found 166 meter and breath expended to 2250 meter. The river seemed going down being wider and wider from that point.

April, 2007

There are 17 landless household. All of them are left beheaded ethnicity (Blacksmith, tailors, sarki and some families from Bote). The communities have been living for 20 years. According to the community southern upland was swept away in 1993 and river changed its course. The river made two lanes there. At the time of visit the northern track was dry and seemed rocky with thin bush plant. The water divider (upland between two cannels) was covered with dense shrub (Kansh). We visited to Mr. Jil Bahadur Tamang (watchman of community forest of Buffer Zone) in the water divider where the GPS survey made. The point was in 510 ft. (155m.) in altitude.

Watchman said due to the dense forest in the side of Chitwan the river has been shifting towards north. The river carries heavy sediments and trees in the rainy season and lays down and river bed has increase. The flood water compels to cut the bank. So the river has been cutting to weak river bank and enters to agriculture land of northern belt. Thus the river encroaches to the northern agricultural land. The river fills and makes upland to the original course and divert to north. River has been cutting downwards (vertical cutting) in the new course and make river deeper and deeper. The community planted the bamboo plant in the river bank. Tractors were used to pullout the deposited materials in the river course for making road gravelling and other purposes.

Gagipur of Gunganagar VDC of Chitwan

In the south bank of river, Gagipur of Gunjanagar VDC is the popular for the maize seed production. There is an Army barrack also. The dead body of Madan Bhandari was found there. The river has cut the place in 2036 due to the deforestation and the dam making of the Beer factory in the northern bank. The dam pushed the river southwards. The Beer factory made 22 spores turned the water into the south and the water of Narayani entered to Gagipur, community said. The river is rising up Mr. Man Bahadur Tamang (73 years), Harka Tamang (53 years) and Dhan Bahadur Tamang (82 Years) said in the same voice.

Some spears were made but the local leader and constructors stole the stone of spears and the dam damaged. They know the thieves but they could not check it because the thieves are stronger from the side of power. The altitude is 138.7 mete. Mr. Dhan Bdr. Tamang said that a check dam was made but the stones were stolen by the local leaders. All of the villagers know but they cannot do anything in the emergency period.

4.4. Survey Site Four Rajahar Rural Market Center of Rajahar VDC, Nawalparasi district

The site is very vulnerable to both sites. Rajahar Rural Market Center of Rajahar VDC, Nawalparasi district is in northern river bank and Sisai, Dibyanagar VDC of Chitwan in the southern bank. The river has been continuously cutting in the both sides. The geographical location of rajahar is 84^0 13' 54" and 27^0 39' 51" and the Sisai located in 84^0 14' 13" east and 27^0 37' 09" eastern longitude and northern latitude. .

1958

The sample cluster 4^{th} lies near Kujduli/Chhipani/Pipraha of Rajahar VDC of Nawalparasi District and near Sisai of Dibyanager VDC of Chitwan district. The river was wider there. The river made an island and it was covered by the dense forest. There was 3750 meter breath out of which 1650 meter breath was covered by the dense forest. The river was divided into three watercourses. The nearest contour line is 500 ft.

1994

The river has five clear watercourses. The main stream is in north. The sandy area expended there. The open settlements are there in the both banks of river. The average altitude is 153 meter. The

breath of the river is expanded than in 1958. The river has covered 5375 meter breath out of which 2250 meter is covered by an island of Chitwan National park.

April, 2007

The point is near the Rajahar Rural Market Center of Rajahar VDC, Nawalparasi district. The point lies in the ward No. 1. The river has been shifting to the northern side. Now the river flows in the public land said Mr. Gopal Bhusal who is the flood victim of Narayani. He lost about 1.5 hector of land. Around 30-40 hectors of land had been made desert. Mr. Bhusal said the river was far as half an hour walking distance from the present location. An island looks now where the river flowed in the past. The river has three lanes. The river continuously has been cutting towards the northern public land. Mr. Bhim Prasad Lamsal was also the victim. He further said the river has been cutting its bed continuously and has made the level deeper and deeper. But the river has deposited the gravels and sand in the previous course. At the visit time a spear has been being made by the community forest group.

Due to the high cutting to the agricultural land the community forest group has making a spear in the point of 84^0 13' 54" and 27^0 39' 51". Due to the high plantation to the southern part the river has been shifting to the northern side. With the continuous sedimentation the island is raising regularly. There was a temple where the people visited for worship. The template was swept away in 1993 and 60 household were evacuated.

Source: Field Survey, April. 2007

Sisai of Dibyanagar

The point Sisai in Chitwan has 515 Feet (156.9m) height from the sea level. The location is 84^0 14' 13" east and 27^0 37' 09" north. The Padiriya ward no. 8 of Dibyanagar VDC had 300 household up to in 2040/42. There are only 42 household out of 300. The rest HH were swept away by the Narayani River. The farm land what the river swept away has forest. .

According to Mr. Paremeshor Chaudhari (53 years Member of Fungi consumer committee**),** due to the weak and lose soil, the river bank cutting happened in the southern settlement area. Now the community group decided to restrict the grazing in the river bank thinking the grazing practice makes the soil lose and make easy to erosion. Due to the Tribeni dam, river water pushed back and it supports making soil lose and easy bank cutting is occurring in the monsoon season.

4.5. Survey Site Five (Gair, of Pithauli VDC of Nawalparasi) and Golaghat of Meghauli VDC, Chitwan

The location is the highest width of the Narayani River. It Covers about 6 Km. width. Islands are in the river course and Chitwan national park captured an islands and forestation took place. The sample site location is 84^0 10' 10" and 27^0 37' and altitude is 494 feet in 2007.

1958

The sample cluster 5th lies between Basanghat of Pithauli VDC of Nawalparasi and Golaghat of Meghauli VDC of Chitwan. The river was wider there. The river has made 6 small islands with covered by the dense forest. There was 5500 meter breath out of which 3250 meter is covered by small islands with dense forest. The river is divided into five streams. The nearest contour line is 500 feet.

1994

The river has five clear streams. It seemed as trees branches. The main stream was in the middle part. We could easily observe the sandy area expanded in southern side. The open settlements were there in the both sides. The average altitude calculate 142 meter. The breath of the river was expended than the 1958 A.D. and reaches to 5875 meter. Out of which 1875 m. is covered by an islands of Chitwan National park.

April, 2007 in Pithauli of Nawalparasi

The point is located at 84^0 10' 10" and 27^0 37' and altitude is 494 ft. (150.57 m.). The point lays Gair-2, Pitauli VDC of Nawalparasi. Mr. Dhan Bahadur Gurung watchman of local factory stressed the river course is rising up. Mr. Gurung said the point was much deeper. The local inhabitants said even the elephant did not cross the river from this point. But these days we can easily pass the river by walking. The small children were swimming at the time of visit. In the monsoon the River has been carrying huge trees and deposit in the way. There is loose soil and the river has been cutting continuously and shifting the river to the northern. The community forest has made a dam and spear there. The river is divided into three lanes there. Due to the plantation in Chitwan side the river has pushed to the Nawalparasi Mr. Gurung stressed.

Mr. Gurung has briefing the point. The small necked baby has just come from the swimming Source: Field Survey, April. 2007

Golaghat of Meghauli VDC, Chitwan

The point lies in the meeting point of Rapati and Narayani River in the Meghauli VDC. The rivers have made a great Delta there. There is a huge grass land. The grass land is ruled by the local school. The school sells the grass to the community and rise fund. The meeting point if Narayan and Rapti River is 84^0 09' 25" east and 27^0 33' 53". Mr. Ram Lal Kumal local inhabitant said the Laukhari floated in 2059. He said due to the Trebeni dam in the west the floating occurred.

Source: Field Survey, April, 2007

He said the sorrow of Meghauli is Rapti rather than the Narayani River. The Rapti carries the huge trees and check by Narayani and the Rapti flow to opposite direction and the water enters to the settlement. In the time of field survey, we could see the bed level of Rapti River was upper than the Narayani River.

4.6. Survey Site Six (Amalatari ward No. 6 of Kumarbarti VDC Nawalparasi)

The sample six lays Kumarbarti VDC of Nawalparasi District. It located to 84^0 05' 48" eastern and 27^0 33' 44" northern hemispheres.

1958

The sample cluster 6^{th} lies between Amaltarighat of Kumarbarti VDC of Nawalparasi District. The river narrows down in the point. The river was wider just up and again wider in just underneath down. The river has one lane. There is 750 meter breath. The nearest contour line is 500 ft. The geographical location is 84^0 05' 48" eastern and 27^0 33' 44" northern hemispheres.

1994

The River has two lanes. The total breath of the river course is 1625 meter out of which 500 meter has water course and the rest is covered by the sand. It is easily observed the sandy area expanded in northern side. The open settlements are there in the northern side. The average altitude is 132 meter. The breath of the river is expanded than in 1958. The Chitwan National Park has pushed the river to the northern side.

April, 2007

The sample point is in Kumarbarti VDC, Amlatari ward no 9 of Nawalparasi district. The geographical location is 84^0 05' 48" eastern and 27^0 33' 44" northern hemispheres. The altitude is 388 ft. (118.26meter). We visited to Mr. Lal Bahadur Mahatto (Chairperson of Tulasi Upabhokta Samuha, Amaltari -9 Kumarbarti VDC). The GPS survey showed the river course going deeper. But the Mr. Mahatto disagree it. He said due to the trebeni barrage the river flow is coming slow and high sedimentation exists there. It was started since 2016 B.S. The flood of 2060 swept away to 60 Bigahas of land from Amltari. The river is becoming wider and wider. The desert making process is there. The temperature is going up in the summer and inverse in winter. The river flowed on the lap of Churia Mountain in the south till 2026/27. The heavy flood occurred in 2029 and the river continuously has been shifting to the northern side. In 2059 and 2060 the village was flowed. In 2060 the water Indus disaster branch of Bhairawa did some work and made spur and retaining wall. But we could not get any Bio engineering works there.

Source: Field Survey, April. 2007

We observed someone surveyed there and the made survey point was marked in the stone. The surveyed point was NR/151.

4.7. Survey Site Seven (Luslahari ward no. 6 of Narayani VDC in Nawalparasi District)

The site lies in Narayani VDC. The river makes the soil cliff there. Near the surveyed site a primary school with three emergency boats are in ready position that supported by a NGO named Community Service Campaign (CSC), Nawalparasi on the assistance of Practical Action, Nepal. The geographical location is 84^0 01' 09" east longitudes and 27^0 33' 04" north latitude.

1958

There is dense forest in both sides of the river. The river has just narrowed down. At that point the river breath is 750 meter. Just up of the point the river has 2750 meter breath. The river has many turnings (seem as a snake walking). The nearest counter line is 500 ft. and the altitude is 131.1m. The river is pushed to northern by the Siwalic Mountain with dense forest from the southern part. Koluwa VDC has more wet land in the north.

1994

The sample site has narrowed river course. The river has many turnings. The river has two lanes and an island between the cannel. The river breath is 1000 meter out of which 300 meter covered by the water lane. The average altitude is 133 meter.

April, 2007

The point lies in the 84^0 01' 09" and 27^0 33' 04" and altitude is 375ft (114.3m). The point lies in the Luslahari ward no 6 of Narayani VDC of Nawalparasi District. We visited to Mr. Krishna Lal Chaudhari (Retire Police officer) of 63 years. He was the oldest inhabitants of the place. First, he said, the Great Narayani flew from Khoriyaghat which was 1000 meter south from the present river course. Before, he had no any information of Narayani's suffer. Since 12 years the river continuously is shifting to the northern side. The river has shifted about 3000 meter from its previous course. The local inhabitants cost one and half hour time to reach the old course of Narayani River. The meandering takes place from Koluwa VDC to Belahani VDC of Nawalparasi.

Mr. Chaudhari and the local community forest watchman

The newly formatted river course and the formatted island in the

Source: Field Survey, April. 2007

The river had entered to in Dhajaha where 50 households have been living with 60 hectors of land. There were Majhi, Musahar, Tharu, Damai and Musahar community. The inhabitants evacuated an island and resettle to Chormaraha. Mr. Chaudhari said, there are mainly three factors to river course changing. They are;

- The Dam of Trebeni
- High Deforestation
- Sandy and loose soil is in the northern bank of the river.

Mr. Chaudhari gave an example of fisherman. He made a small dam and demonstrates us and he proved more deposition takes place just back of dam and it continues to upward. Thus Trebeni pushed up river and water flows goes down. Then the deposition existed from the bottom (near dam) and slowly it shifted to upstream. It helps to be river wider. The river course seemed as a desert. The small retaining walls were there. According to Mr. Chaudhari, the boatman cost 2 hour to reach to Trebeni has increased to 3 hour due to the water flow rate.

4.8. Survey Site Eight (Chisapani of Parasauni, meeting point of Arun Khola and Narayani)

The surveyed location is the most vulnerable. The Narayani push back to Arun Khola and the tributaries starts to flow the opposite direction. The sample location is 83^0 58' 0" east and 27^0 33' 05" North.

1958

Sample site eight lies in Chisapani of Parsauni VDC in Nawalparasi district. The Arun Khola is confluence with the Great Narayani River. Narayani has two lanes. The northern side is sandier desert deposited by the Arun Khola. The dense forest with Simal and busses with more than 8 ft. height are there. The Arun Khola has made a sand delta in its mouth. The altitude measured to 118.26 meter and its breath measured to 1500 meter.

1994

The Arun Khola and Ulti Khola meet with Great Narayani River there. The river has three lanes. The northern side there is sandier desert deposited by the Arun Khola. The area is covered with the sand and gravel. Arun Khola has made a sand delta in its mouth. The altitude measured to 125 m. And breath measured to 1500 meter.

April, 2007

The site is confluence point of Arun Khola and great Narayani River. The geographical location is 83^0 58' 0" east and 27^0 33' 05" north. The altitude measured to 380 Ft. (115.8m). The researcher and assistance researcher ourselves visited to a fisher couple Suka Dev Bote and his wife Mrs. Sochariya Bote at the time of fish harvesting. They were the flood victim and evacuated and resettled in Chormara. In the day time they come up there and fishing for affording their daily life. They sent their children school. The fisheries is the main occupation to expenses their children. He said that the river flow is going down. And the river has made several islands in the course. Also the river is being wider and wider. There was forest where the river flows in present. He said due to the Trebeni Barrage the river course is rising up.

The local community said the river flowed far from the present course. The area where the river flows was much fertile. The river has cutting continuously and shifting to the northern side. The local people lost 37 hectors (55 Bigaha) of land from Simara to Chisapani in the year of 2004. The high

flood happened in 2003. Many people saved their lives difficultly by climbing to the permanent concrete building said Mr. Mohon Prasad Upadaya.

According to Mr. Punya Poudel (Said the local Mohan Prasad Upadhya, Chair person of Consumer Committee) a delegation team (Local Development Officer, Chief District Officer and other Red Cross personnel) visited to Dam Protection Officials and requested to open the door to save the flood victim in 2003, they rejected. They said if the dam opens the huge cutting problems arise in the Indian side. So they rejected to open. They said that the bed of Arun Khola was deeper then two men's height in 2017/18. But we could easily see at the time of visit that there is no any height between to river bed and farm land. There was a river named Ulti Khola that suffered to the people and it is captured by the Narayani River. The local communities have planned to make football ground in the river side and wants to disseminate the problem to the visitors.
Mr. Tak Bahadur B.K. 81 years old is a flood victim. He saved his life by climbing to the upland tree in 2003. He has wrinkle face sited back in the discussion. He took loan for the potato farming by keeping the land as collateral. The collateral land was cut down by the river and the bank charged him to repay the loan with selling another land. He did so and became landless. He has a hut in the river bank that is very vulnerable we observed.

4.9. Survey Site Nine (Tamaspur / Bahuban of Dumkibas VDC, Nawalparasi

The site is the confluence of Binai Khola and Narayani River of Dumkibas VDC in Nawalparasi District. There was Tamaspur in the north of Narayani and Bahuban is across from the Binai Khola. Bahuban locates on the northern slope (foothill) of Siwalic Mountain along the Binai Khola. The Geographical location is 83^0 55' 58" east longitudes and 27^0 33' 10" north latitude.

1958

Binai River meets to the Narayani River. The Narayani River goes down making narrow gorge between two hills of Siwalic Mountain (Someshor in south and Daunne in the north). Afterwards the river narrows down with meandering up to Tribeni Barrage. The breath is 550 meter where Binai meets to Narayani. The altitude is 114.3 meter from the sea level.

1994

The river Narayani formed a flood plain just up of the point. That seems fertile land and river flows into two lanes. The river breath is 425meter, which is the narrowest point of the entire sample sites. The river flows in 120 meter height from the sea level.

April, 2007

The sample point is between Tamaspur and Bahuban of Nayabeleni VDC of Nawalparasi district. The Benai River meets to the Narayani River. The Geographical location is 83^0 55' 58" east longitudes and 27^0 33' 10" north latitude. The altitude measured to 115.8 meter. The personnel of Tamaspur said the water of Narayani flows opposite direction in rainy season. It happens due to the Trebeni Barrage. Also they said the Benai River flows with more current. The local people said the Rapti River carries many trees and it has pushed the Narayani to the northern side.

Mr. Khem Bahadur inhabitant of Bahuban is pointing out with his stick to the Bahuban and said it was almost plain with the Benai river course. The farm land was in 2 men height before.

Binai River between Bahuban and Tamaspur

Source: Field Survey, April, 2007

Bahuban of ward no 7 of Dumkibas VDC is the closest settlement of the River Narayani. Due to the Trebeni Dam the river bed of Benai (tributary of Narayani) is rising up, Mrs. Brama Kumari Kumal aged 60 years said. The height between Benai River and agricultural land was 2 men height. In the time of visit there was no any height between river and agricultural land. There were huge stones in the river said the inhabitants but the visit time they were already filled with the small gravel. The Bahuban has been flowed since 2 years. The house of Mr. Khem Bahadur is on highest pick of the settlement. This house was also flowed. The Narayani River flowed on the lap of Bheteri underneath of siwalic hill in the past, they said. There is now an island and the river shifted to northern side.

4.10. Survey Site Ten (Gandak Barrage Nawalparasi)

The Tribani barrage is in Tribani Susta of Nawalparasi district Nepal. The water of the Narayani has been turned to west in irrigation cannel of Uttar Pradesh of India. The barrage is the subject matter to the political leader of Nepal. Some political parties stress to resettle its treaty. The location is 83 ^{0} 54' 24" in east longitude and 27 ^{0}26' 36" north latitude.

1958

The river just meets to Terai. The river was wider after crossing the point. The river flowed in the gorge of the Siwalic hills up to this point. The river flowed in the 97 meter height and breath was 500 meter. The mapping was made under the authority of Brigadier Gambhir Sing, Surveyor General of India.

Point 10, April, 2007

Experts say the changing course of the Narayani River is the main reason behind the dispute. Over the decades, the Narayani River has been changing its course toward the Nepalese side in the west, and the Indians have been trying to capture Nepalese territory. India has so far grabbed about 13,500 hectares of Nepalese land because of this.

Source: Shrestha, Reagan, Indian Encroachment Threatening Nepal's Sovereignty.

The altitude of the Gandak Bridge is 97.5 meter) in the side of the 8 doors where there is 300 Cubic meter per second (m^3/s) water discharge. The location is 83 ^{0} 54' 24" in east longitude and 27 ^{0}26' 36" north latitude. The point has been taken the 8 doors of the Indian cannel. The local inhabitants said that when the rainfall occurs in Katmandu the water level increases. We observed the southern part of the reservoir is a natural hill and in north side a dam has made. At the time of visit the 8 door are opened to irrigate to the Uttar Pradesh of India.

The treaty was made in Munsir 19, 2016 said Mr. Yadav Prasad Syatal (VDC Secretary). In the treaty there is the provision to cope the flood problem by the Indian government to 15 KM along the cannel. It covers about 1000 Bigaha (633 hectors) of Land. Also the treaty restricted to do any kind of activities for flood management from the side of Nepal. If Government of Nepal wants to do work in flood management, the approval is must from the side of government of India. The treaty provides the entire responsibility to Indian government to protect Nepal side.

The treaty provides a cannel for Nepal. The cannel is constructed with some siphons (under bridge where the surface water drains off). Due to the high sedimentation in the monsoon, the siphons are full of gravel and blocked. The siphons cannot discharge the runoff water and the water flows to the settlement areas and flood problem occurs. The capacity of Nepalese side cannel is 66 $m^{3/}$s but we get only 30 m^3/s. The cannel height is 5m down from the intake point to and end. So the water flows very slowly and high sedimentation exit in the upper part. So slowly and slowly the cannel is going filled up said by Haidar Ali, Nepal Gandak West cannel president, Devgawn 4 of Nawalparasi District

Mr. Bikaram Khanel (President of NGO Federation of Nawalparasi) affiliated in the Indereni Samudayak Bikas Kendra a NGO, said they started to advocate in the way of renewed to the Gandak Treaty.

Susta

Susta is high controversial island situated in the cross boarder of India and Nepal. By 2034 the high flood occurred and many of the Susta families evacuated to the other places. The rest families started to encroach the boarder. Then the problem rose and it has made the national issues also. Formally, it is the land of Nepal. By 2039 The VDC Chairperson (Mukhiya) of Rampurawa (Indian VDC) and VDC chairperson (Pradhan Pancha) of Trebeni VDC compromised and drew the boarder line. This line has been formalized by two neighbor countries. There are 266.7 hector lands with 4100 population. The Indian people have been pushing the boarder and raising the problems time to time. Mr. Gopal Gurung (Coordinator of Susta protection) tried to start to raise the problem of Susta. He was arrested by the Indian Government charging him to hunting.

5. A brief of the research Institution

Forum of NGOs on Natural Disaster Management (CFONNDM) is a loose Network of NGOs, volunteer based social development organization established by the initiatives of District NGO Coordination Committee (DNGOCC), Chitwan, Nepal. The District NGO coordination committee has led to coordinate to NGOs working on disaster management in Chitwan and has made one door system to support the disaster victims. The 33 NGOs representatives meeting made a forum of 21 memberships and formulated secretariat of 11 members. Also it the meeting established an emergency relief fund in Chitwan. The research based advocacy is the main theme of the forum. CFONNDM has already successfully completed the Disaster Preparedness and safety net campaign program in Chitwan assisted by Action Aid Nepal. Without research no advocacy is made better. In this connection the forum wants to make research on the Narayani river course. DNGOCC provides office space on their own building. The activities carried out from there. The contract address is “District NGO Coordination Committee, Chitwan, common forum of NGO on Natural Disaster Management, Chitwan, Nepal. Tel: 977 56 522986.