

# A Preliminary Evaluation of Post Disaster Epidemics of August 2008, Koshi River Flood in Nepal

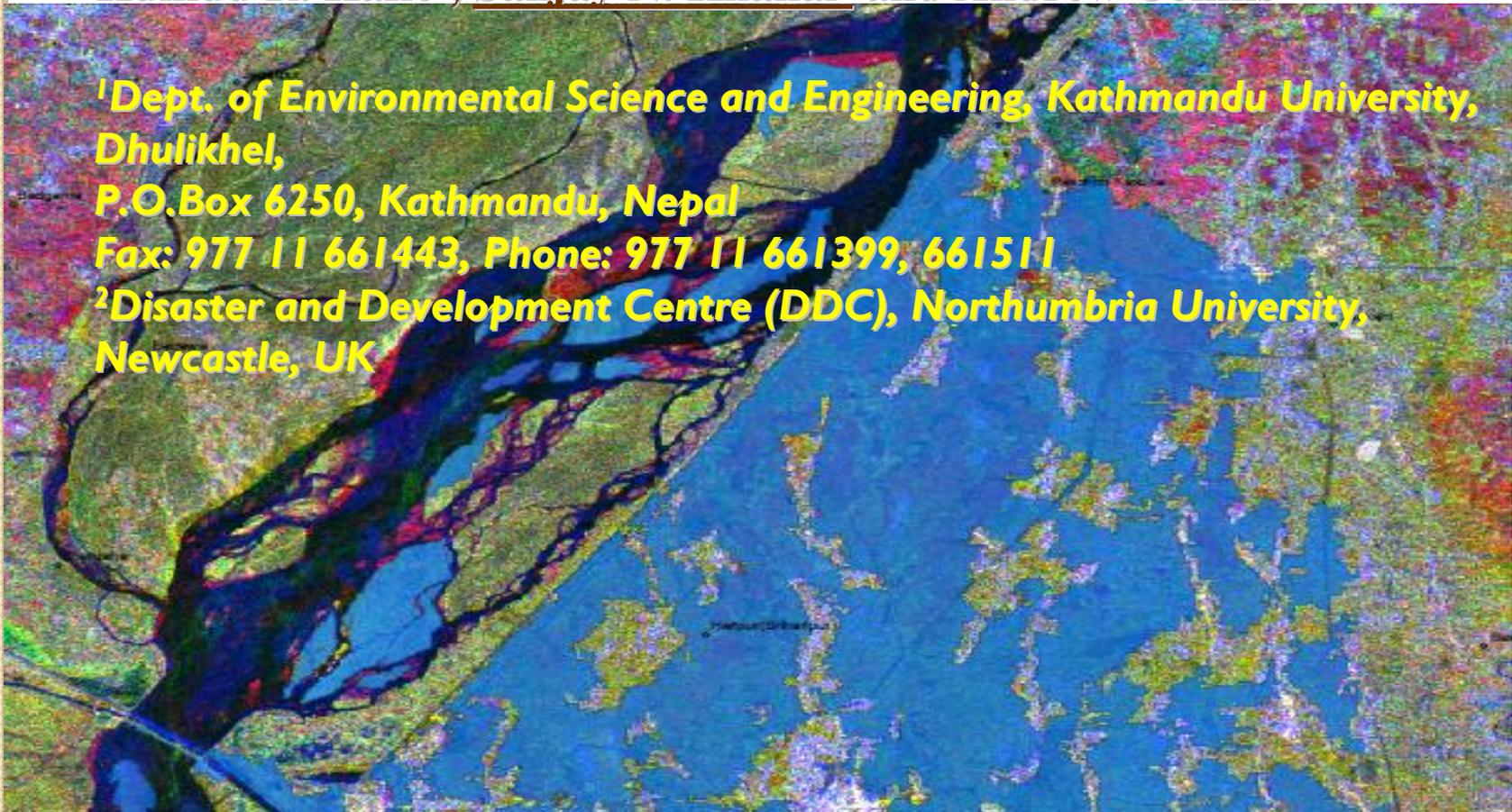
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*(Source: ICIMOD, 2008)*

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# Content

- Introduction
- Objective of the study
- Physiography and climate of Nepal
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- Flood disaster
- Flood disaster epidemics in Nepal
- The Koshi river
- Koshi flood 2008 and its impacts
- Post flood epidemiology (**Analysis and Results**)
- Conclusions

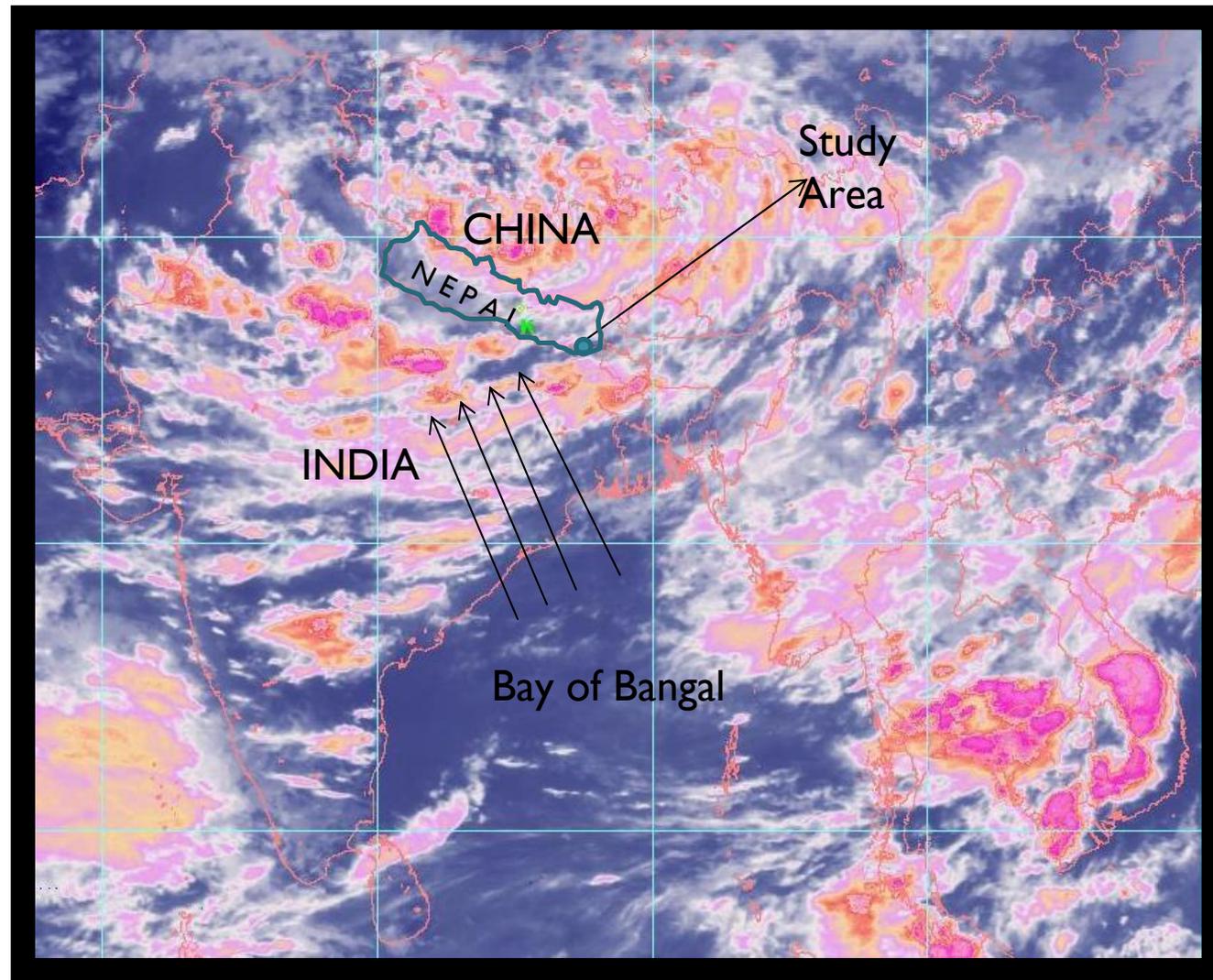
Image Processing: S. Dech, A. Holz & R. Meisner  
German Aerospace Research Establishment DLR  
Centre DED

Image Base: NOAA-II LAC  
13-JAN-1989  
20-OCT-1990  
15-FEB-20-APR 06/13/14/21/31-MAY 01-JUN 14-JUL 17-OCT-19

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al and A.  
Collins

# INTRODUCTION

## Meteorological Condition with Relation to Monsoon



(Source: DHM, Nepal 2010)



## Introduction Contd.....

- Nepal Himalayan Range is about 800 Km out of 2400 Km long Hindu-Kush Himalayas
- Altitudinal variation from South to North- from 70m to 8848m (msl) (within 200 Km)
- Plain Terai (the southernmost part of country)

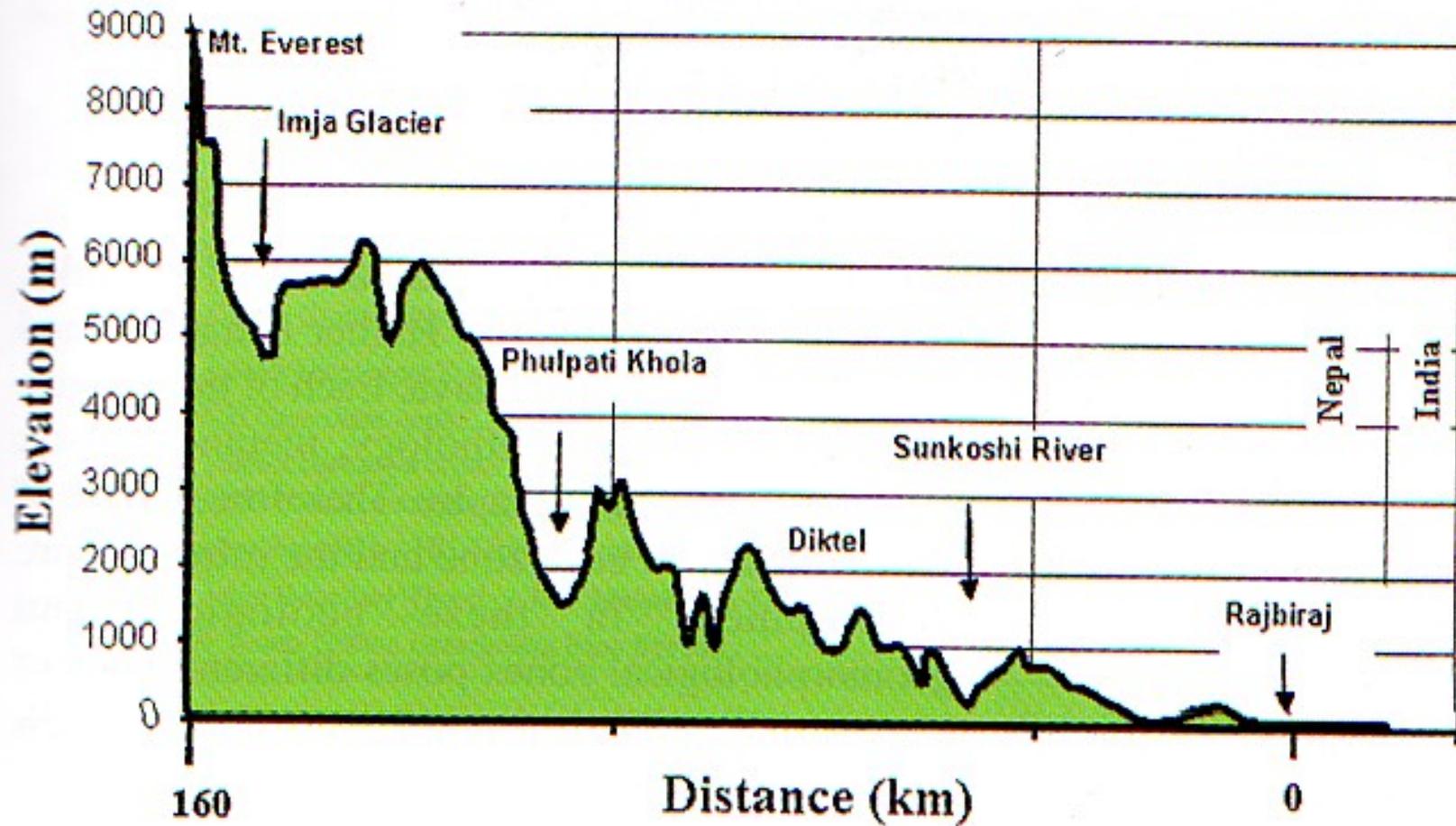
**Width:** varies from 10 Km to 50Km

**Altitude:** 70m to 200m

**Alluvium thickness:** 1.5Km thick

Introduction Contd.....

## N-S Section from Everest to Rajbiraj



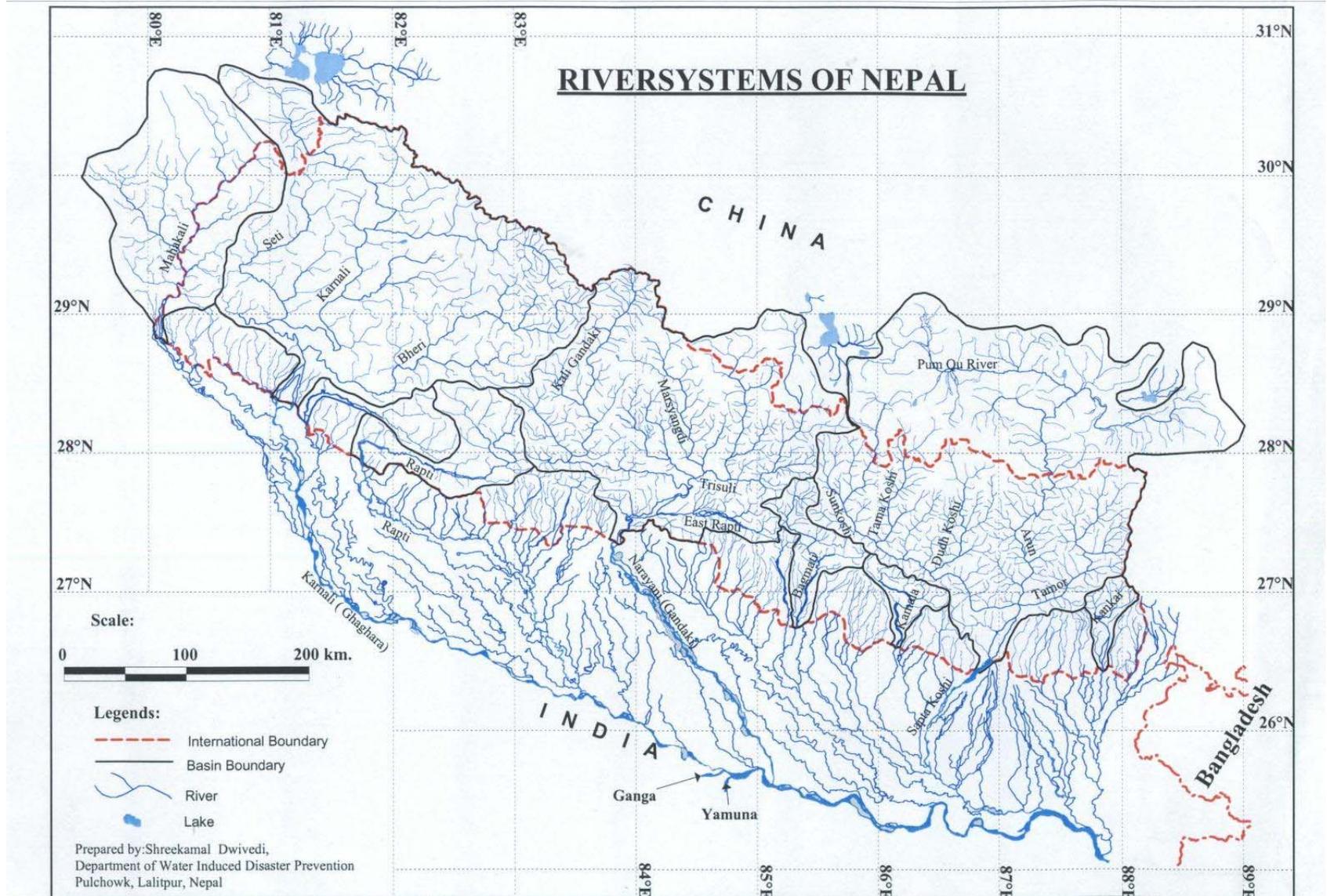
(Source: Upreti, 2005)



### Introduction Contd.....

- More than 6000 small and large rivers
- Koshi, Narayani, Karnali and Mahakali are the main rivers
- All river flow North to South.
- All major rivers are tributaries of the Ganga river, join in India.

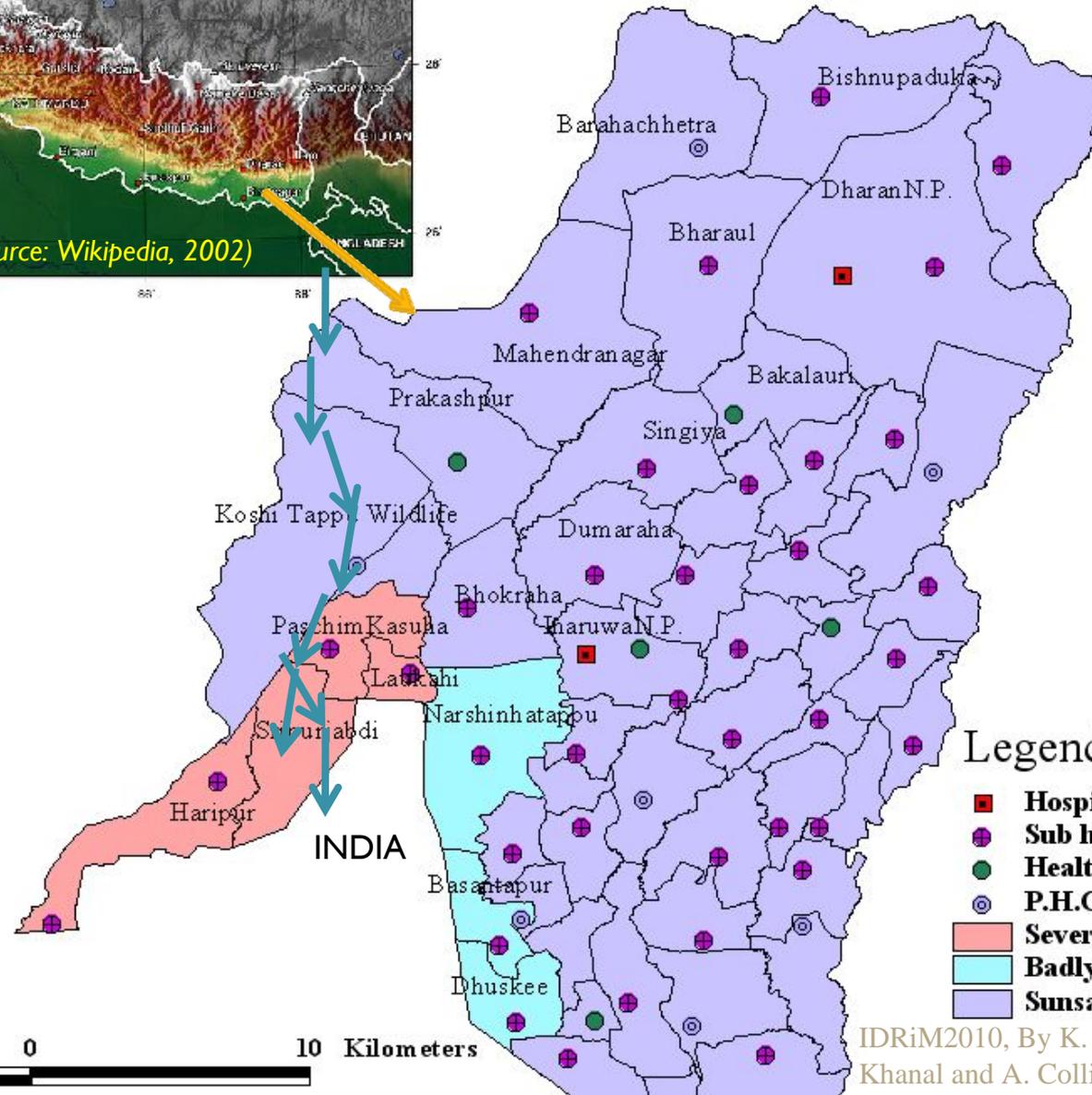
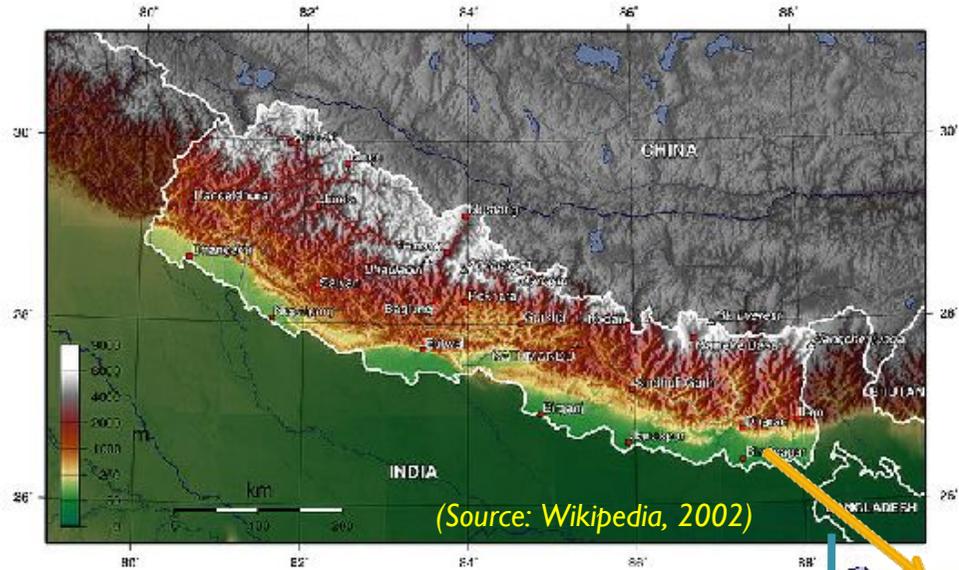
## Introduction Contd.....



(Source: Dwivedi, DWIDP)

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# Study Area



## Legend:

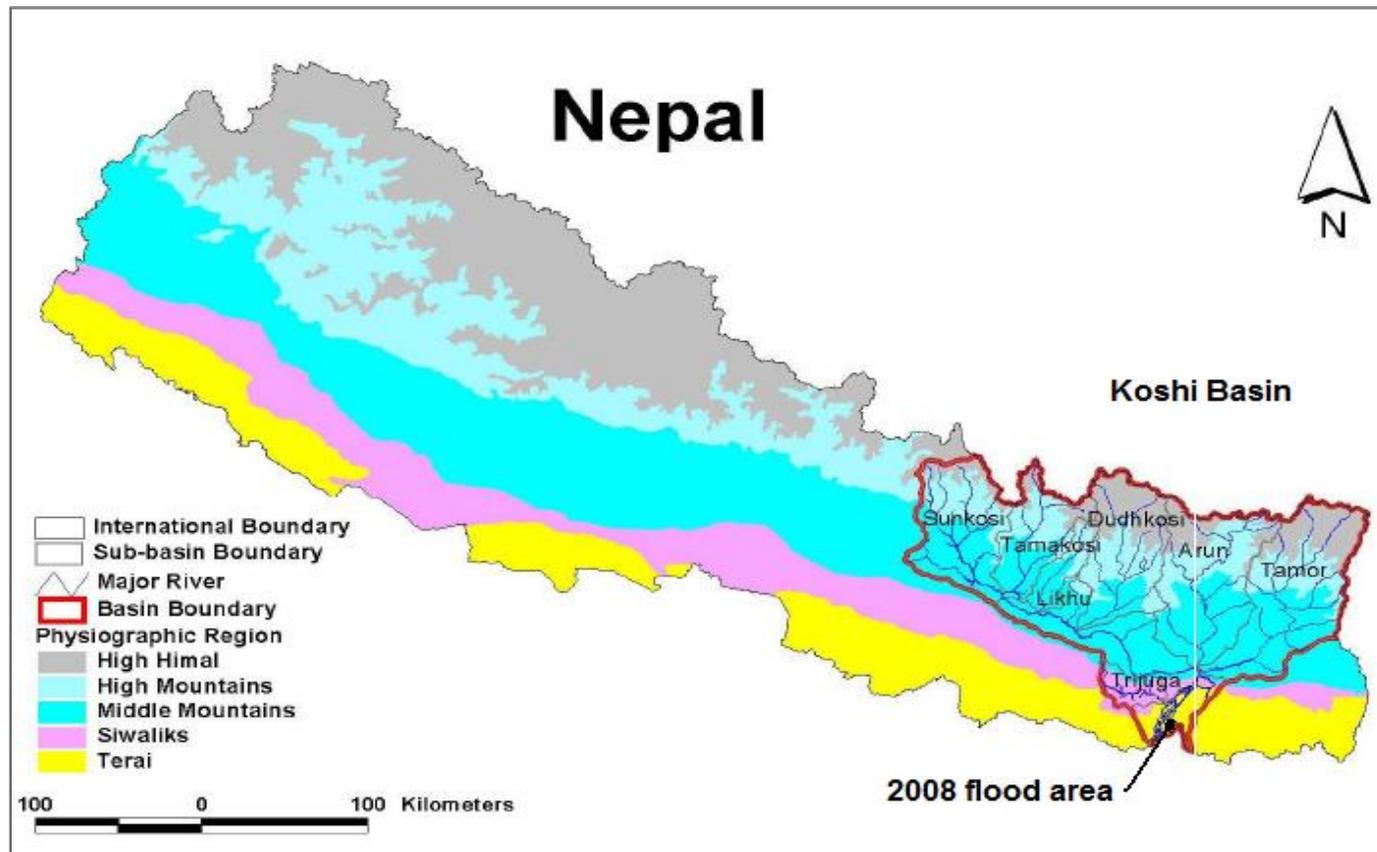
- Hospital
- Sub health post
- Health post
- ⊙ P.H.C.
- Badly affected VDCs
- Severely affected VDCs
- Sunsari district map



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Introduction Contd.....

# Koshi Basin



(Source: UNESCO, 2009)



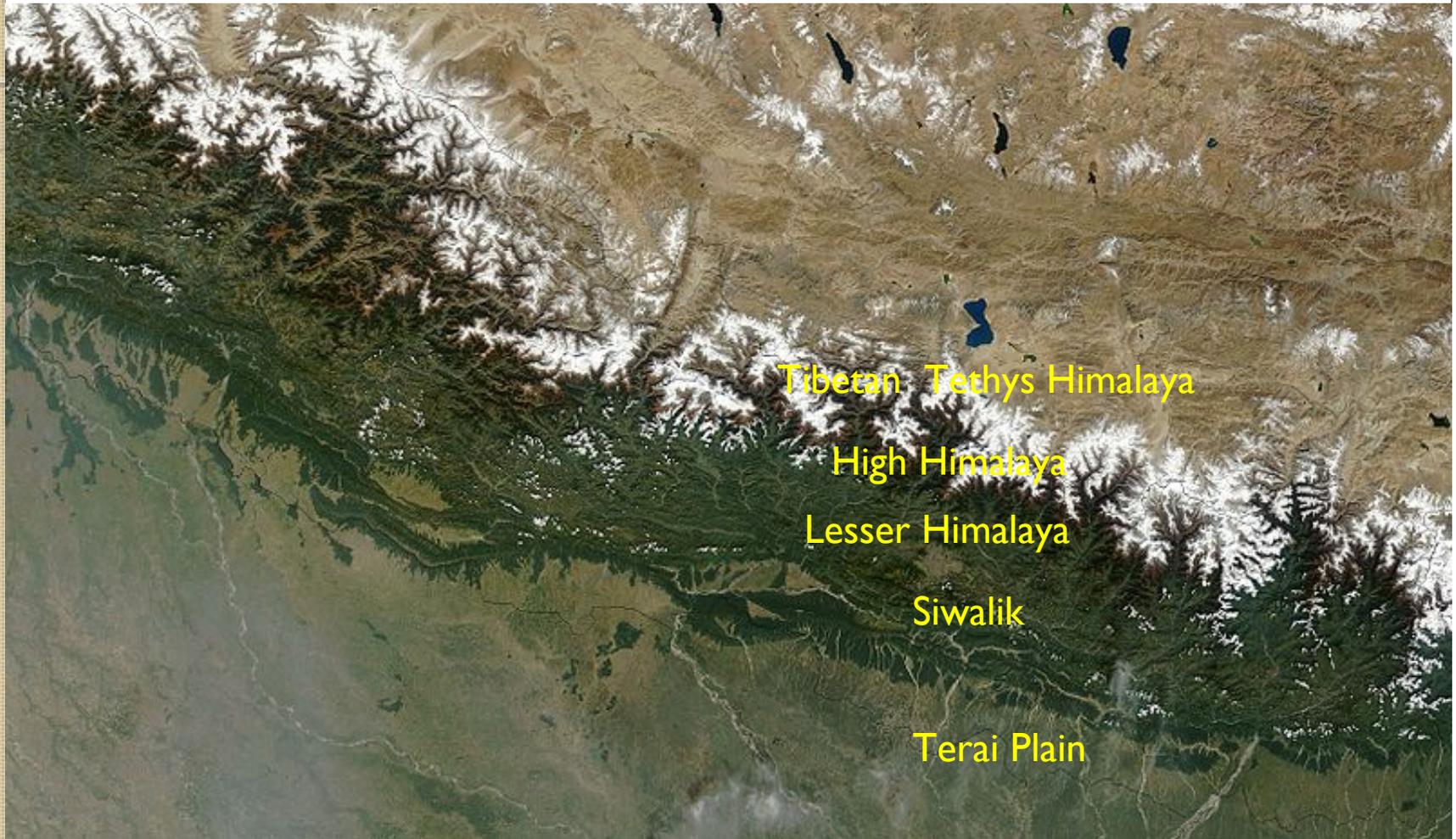
## OBJECTIVE OF THE STUDY

- Preliminary evaluation of different health consequences among the flood affected people particularly those who stayed in relief camps.



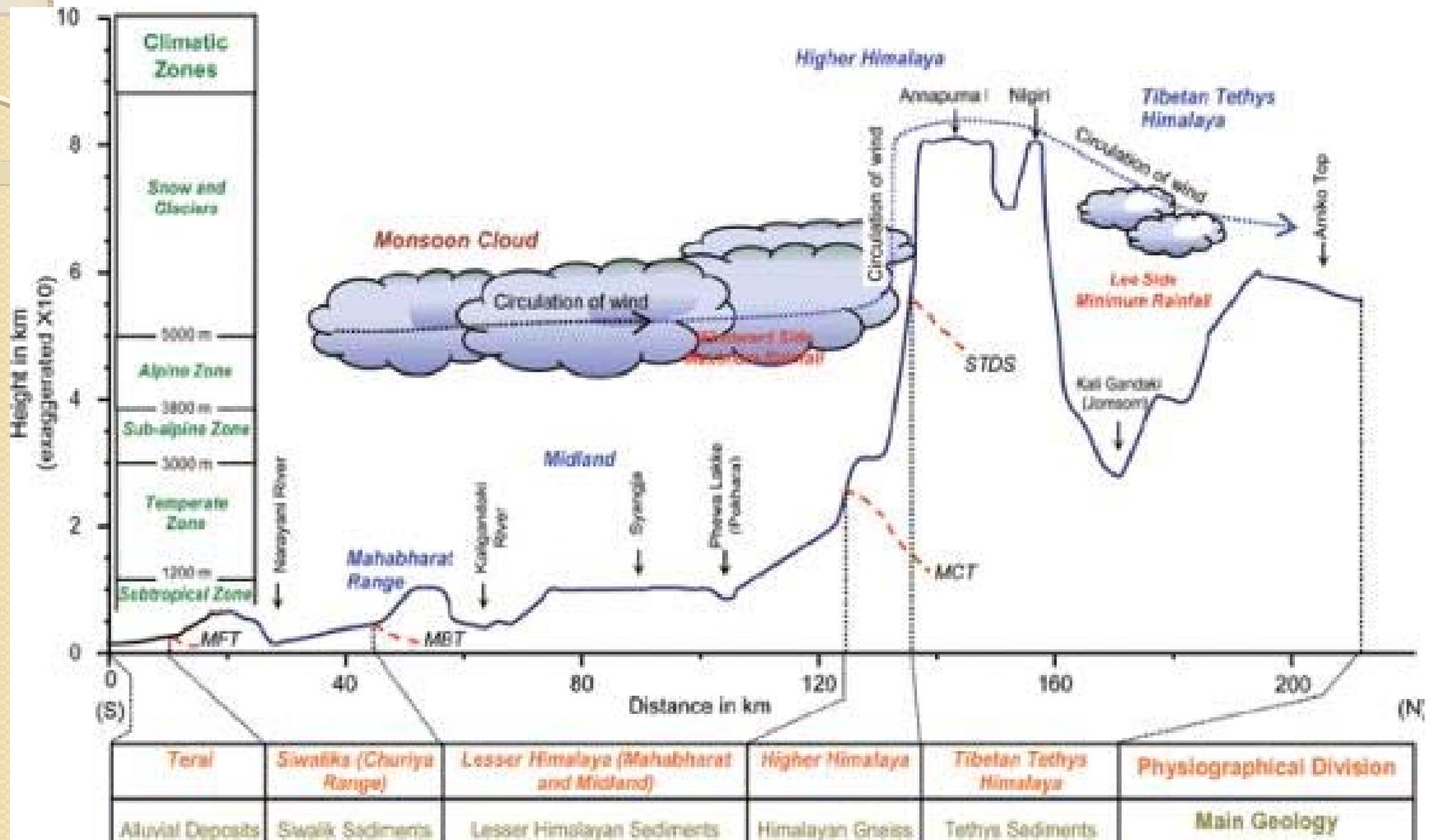
## PHYSIOGRAPHY AND CLIMATE OF NEPAL

- Nepal is divided into five physiographic divisions
  - Terai (Gangatic Plain)
  - Siwalik (Churiya Range)
  - Lesser Himalaya (Mahabharat and Midland)
  - Higher Himalaya
  - Tibetan Tethys Himalaya
- These divisions are basis on altitudinal and climatic conditions. Geology is also different in the different zones



(Source: Wikipedia, 2002)

## Generalized geological with respect to physiographical cross section of the Nepal Himalaya



Source: Dahal 2006

## Climate of Nepal

- Extremely varied and is controlled by the monsoonal winds and the physiography.
- Monsoon: Major Source of Rainfall in summer
- Monsoon period is June to September
- Winter precipitation occurs from November to February by western winds
- The Mean Annual Rainfall varying between 1500 to 2500mm.

*(Source: Dahal 2006)*

# NEPAL AND DISASTER





Nepal and Disaster Contd.....

## **Common hazards in Nepal**

- Earthquake
- Flood
- Landslide, Debris flow
- Soil erosion, River Bank cutting
- GLOF
- Ice/ rock Avalanche
- Land subsidence
- Windstorm, Thunder, Cloudburst
- Drought/ Famine
- Hot and Cold waves
- Fire
- Epidemic
- Road accidents etc.

Nepal and Disaster Contd.....

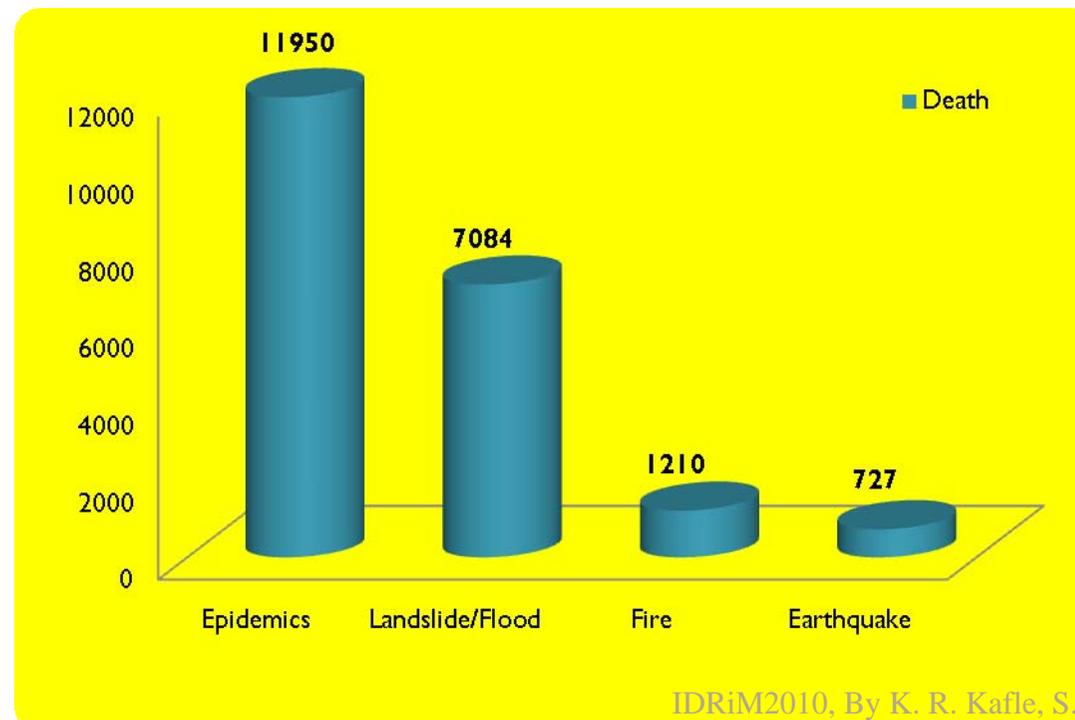
## Nepal Disaster Loss of Life 1983-2006

Year/Types	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
Flood and Landslide	293	363	420	315	391	328	680	307	93	71	1336	49	203	258	83	273	193	173	196	441	232	131	141	114	7084
Earthquake	-	-	-	-	-	721	-	-	-	2	-	-	-	3	-	-	-	-	1	-	-	-	0	0	727
Windstroms, Hailstrom & Thunder bolts	NA	NA	NA	NA	2	NA	28	57	63	20	45	47	34	75	49	23	22	26	38	6	62	10	18	16	641
Avalanche	-	-	-	-	-	14	20	-	-	-	-	-	43	4	12	-	5	-	-	-	-	-	-	4	102
Fire	69	57	52	96	62	23	109	46	90	97	43	43	73	61	65	54	39	37	26	11	16	10	28	3	1210
Epidemics	217	521	915	1101	426	427	879	503	725	1128	100	626	520	494	951	840	1207	141	154	0	0	41	34	0	11950
Stampede	-	-	-	-	-	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	71
<b>Total</b>	<b>579</b>	<b>941</b>	<b>1387</b>	<b>1512</b>	<b>881</b>	<b>1584</b>	<b>1716</b>	<b>913</b>	<b>971</b>	<b>1318</b>	<b>1524</b>	<b>765</b>	<b>873</b>	<b>895</b>	<b>1160</b>	<b>1190</b>	<b>1466</b>	<b>377</b>	<b>415</b>	<b>458</b>	<b>310</b>	<b>192</b>	<b>221</b>	<b>137</b>	<b>21785</b>

(Source: MoHA, 2007)

## 24 Year Nepal Disaster Death Summary (1983 -2006)

• Epidemics	<b><u>11950</u></b>
• Flood/Landslide	<b><u>7084</u></b>
• Fire	<b>1210</b>
• <u>Earthquake</u>	<b><u>727</u></b>
• <b><i>Total</i></b>	<b><i>20971</i></b>



# FLOOD DISASTER



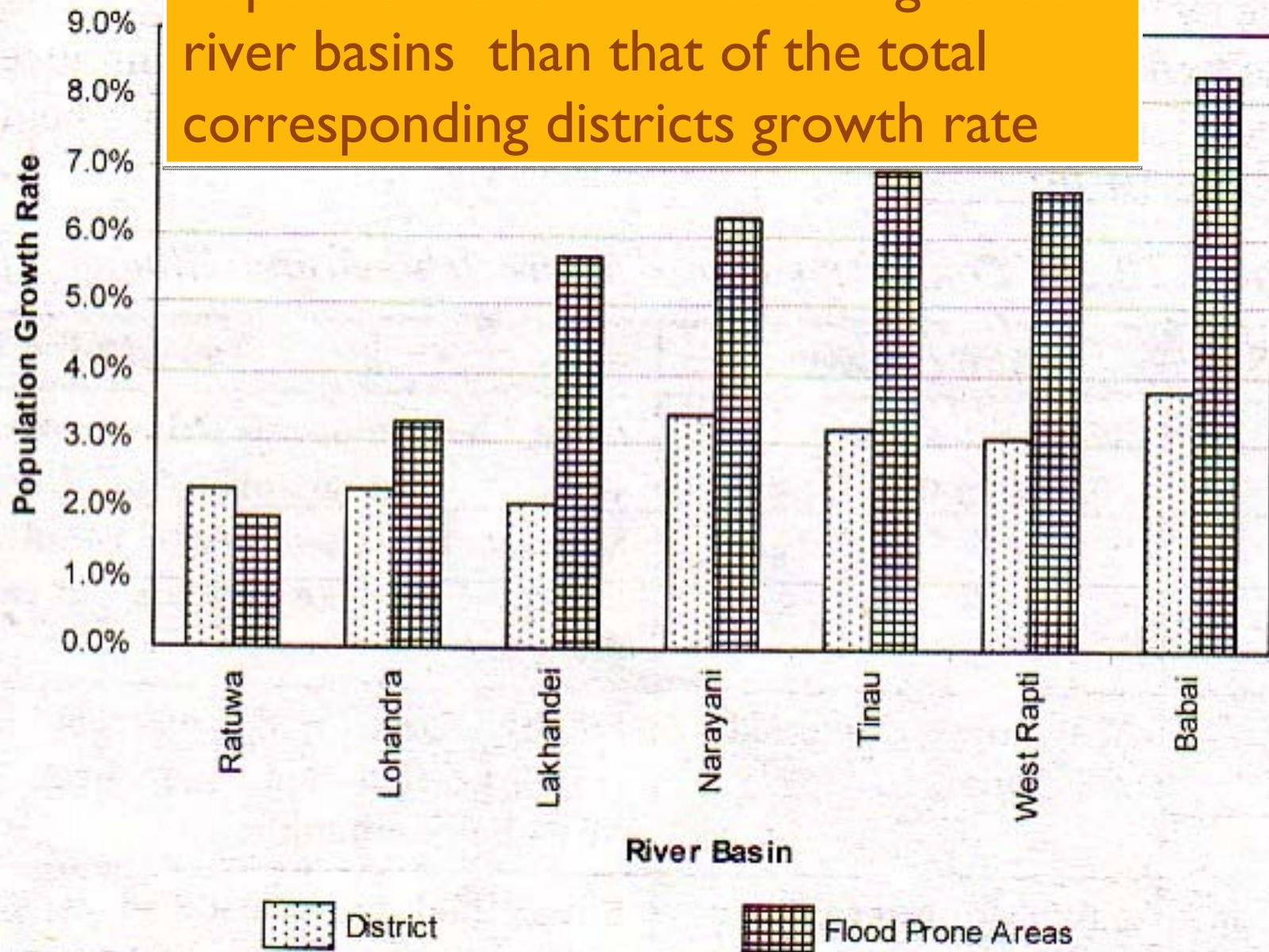
*(Photo: UN OCHA, 2008)*

## Flood

- Every year flood kills many people
- 80% of precipitation which occurs during the monsoon season (June – September) and all major rivers (Koshi, Gandaki, Karnali and Mahakali) are heavily affected and flooded during this season.
- About 51% population are in hills and mountains where as 49% are in terai zone (Flood Prone Area).
- *(Source: Baral, 2009)*

Flood and Disaster Contd.....

Population Growth Rate is Higher at river basins than that of the total corresponding districts growth rate



(Source: Dahal, 2006)

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# FLOOD DISASTER EPIDEMICS IN NEPAL



# Flood Disaster Epidemics in Nepal

- **Immediate risk of outbreaks due to flood are:**
  - Cholera,
  - Typhoid,
  - *Shigella dysenteriae type 1*,
  - *Hepatitis A and E*.
- **Reasons are:**
  - Faecal contamination caused by overflow of latrines;
  - Inadequate sanitation;
  - Contamination by dead animals; and
  - Upstream contamination

(Source: WHO, 2007)



Flood Disaster Epidemics in Nepal Contd.....

In Western Region of Nepal between 1 July and 2 August 2007, 257 cases of laboratory-confirmed *Vibrio cholerae* were reported to WHO.

- ***Since*** the onset of the rains, cases of diarrhoea and dysentery, including deaths, have been reported from the flood-affected areas, and the immediate risk of further cases was extremely high.

(Source: WHO, 2007)



Flood Disaster Epidemics in Nepal Contd.....

- *Plasmodium falciparum* and *P. vivax malaria* are endemic in the low-lying (<1200 metres), flood-affected areas of Nepal.
- Dengue fever Observed in 2006 (Western part of Nepal) ,

(Source: WHO, 2007)



Flood Disaster Epidemics in Nepal Contd.....

- **Japanese encephalitis regulary almost every rainy season in western terai Nepal** (During the 2005 outbreak of the disease, 1879 suspect cases were reported, of whom 298 died (case-fatality rate: 16%). Of these, 1636 cases and 262 deaths occurred in the western, mid Western and far western regions of in Nepal.

*(Source: WHO, 2007)*

Flood Disaster Epidemics in Nepal Contd.....

## Summary of risk communicable diseases in flood-affected population

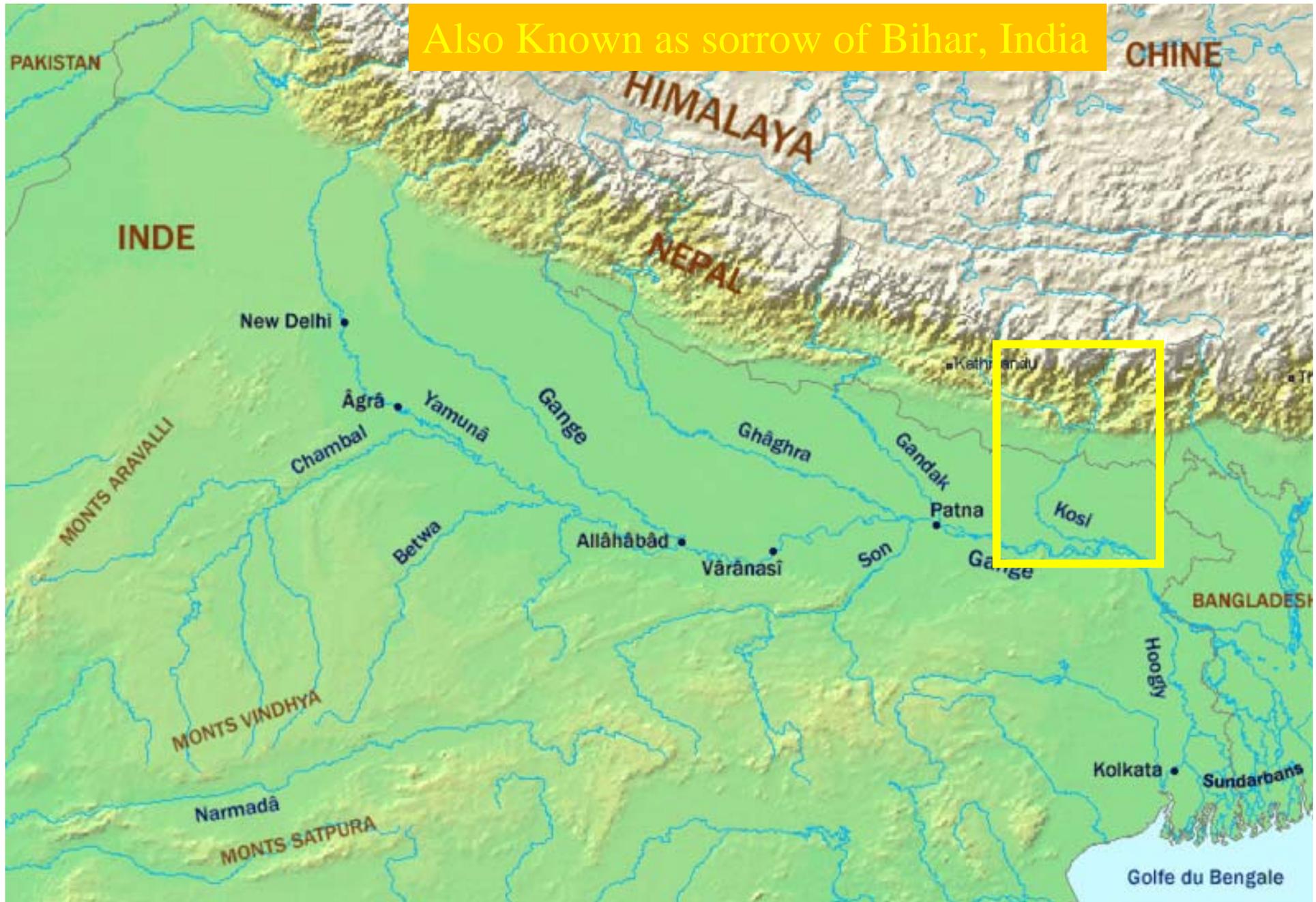
Communicable disease	Of immediate concern following floods	Of concern in weeks to months following floods
Cholera/Typhoid/Shigellosis	+++	
Acute lower respiratory tract infections	+++	
Hepatitis A & E	++	
Leptospirosis	++	
Measles	++	
Malaria	+	+++
Japanese encephalitis	+	+++
Tuberculosis	+	++
Dengue fever	+	++
Meningitis	+	
Poliomyelitis	+	
HIV/AIDS		++

(Source: WHO, 2007)

**Key:** + = low risk    ++ = moderate risk    +++ = high risk

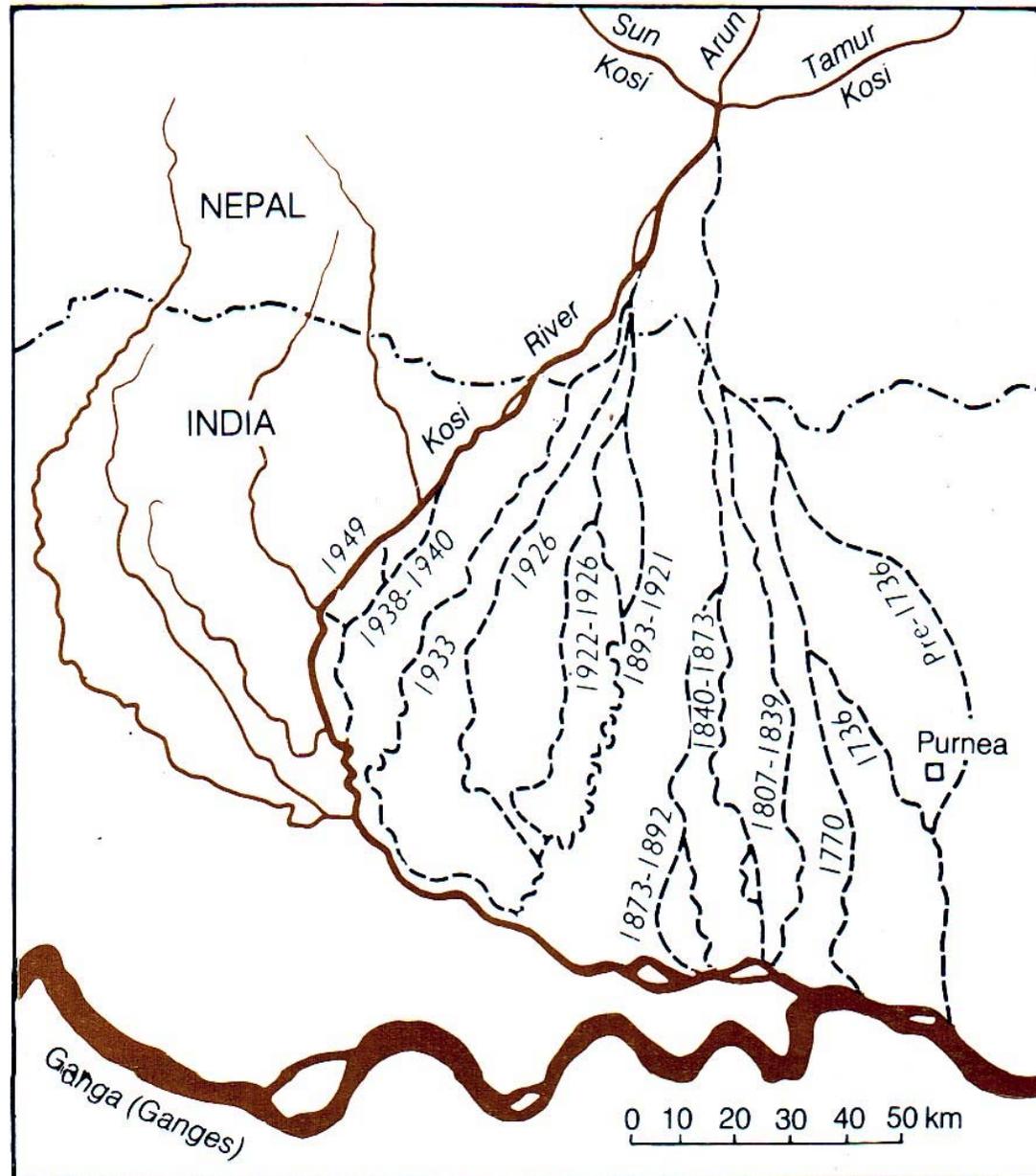
# THE KOSHI RIVER

Also Known as sorrow of Bihar, India



(Source: Wikipedia, 2010)

# Dynamics of the Koshi River



Over the Last 250 years,  
shifted 120 km  
from East  
to West  
(NYT, 2008)

(Source: Duff, 1992)

The Koshi River Contd.....

## Some features of Koshi river

Total length	729 km
Catchment area	60,400 Sq.Km
Average annual flow	1564 m <sup>3</sup> /sec.
During flood:	18 times of average
Average annual sediment volume:	118 million cubic meter
Past maximum flood	913,000 cuse (25849m <sup>3</sup> /sec; 5th Oct.1968)
Recent Flood:	168,500 cusec ( 4770 m <sup>3</sup> /sec; 18th August, 2008.

*(Source: Wikipedia, 2009)*

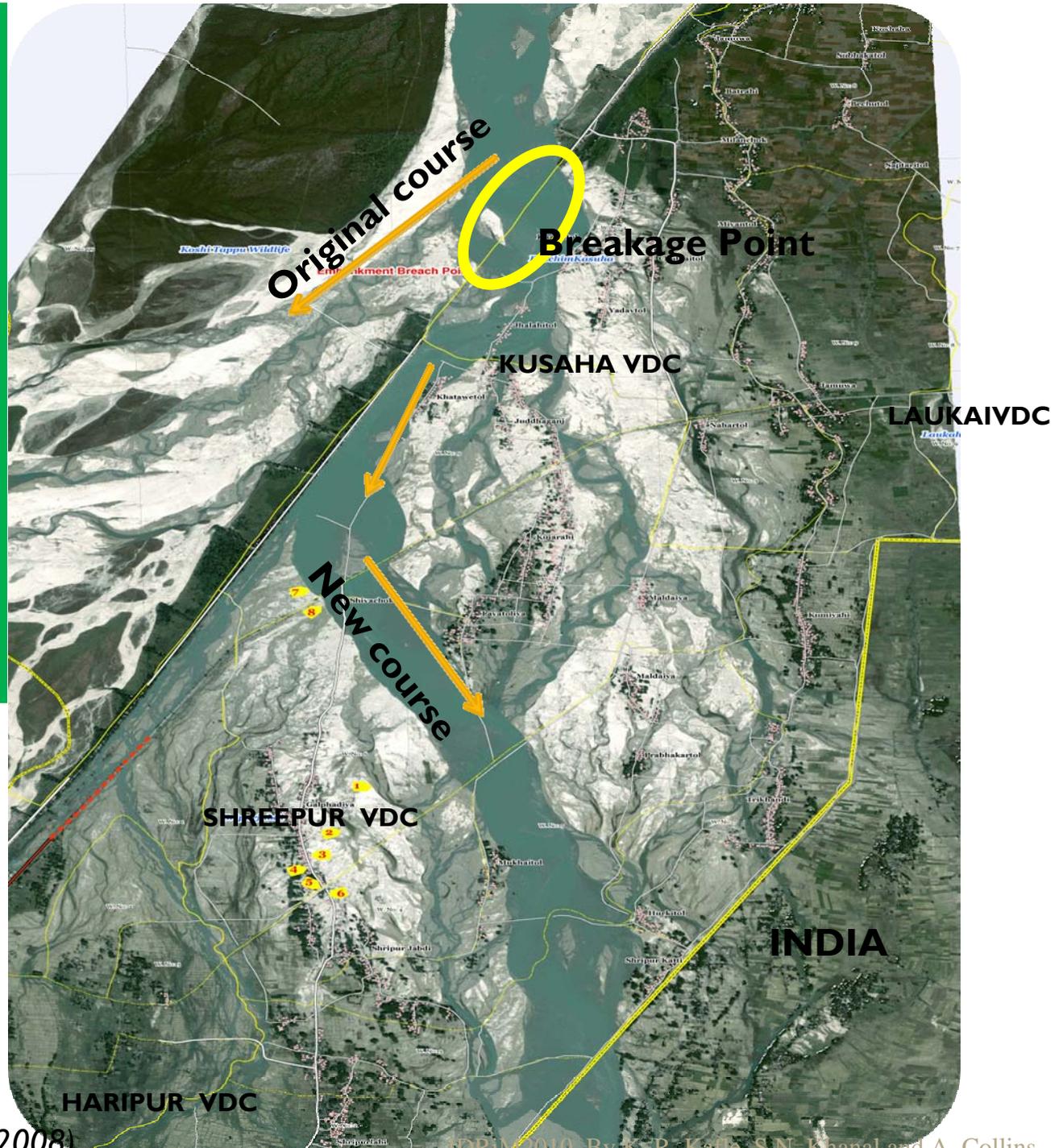
## Annual Sediment Load from Different River Basins (Watersheds) in Nepal

St.No/Location	River Basins	Watershed area (sq. km)	Sediment load/yr (tons/sq. km/yr)	Sediment Yield/ Year (Million tons)	Remarks
280 Chisapani	Karnali	42890	2548	109.3	
360 Jalkundi	Rapti	5150	1625	8.4	
450Narayangarh	Narayani	31100	5118	159.2	
470 Lothar	Lothar	169	1026	0.2	
589 Pandhera	Bagmati	2700	1470	4.0	
695 Chatara	Koshi	54100	1533	82.9	
795 Mainachuli	Kankai	1148	3388	3.9	
	Total	137257		367.9	245 M cu.m

(Source: DWIDP, 2009)

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# KOSHI FLOOD 2008 (18<sup>th</sup> August) AND ITS IMPACTS



(Source: UN OCHA, 2008)

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Koshi flood and its impacts Contd.....

## **Disaster scenario of Koshi flood 2008 in Nepal**

- ✓ About 60,000 people of 8 VDC (4 completely, 4 partially) in Sunsari districts were affected (ICIMOD, 2008).
- ✓ 2 human death was reported at the time of disaster. The total human death toll is 43.
- ✓ The national highway was damaged at several places by the flood.
- ✓ Displaced people were kept in 28 different temporary shelter camps.
- ✓ 7995 families (NRC, 2008) were taken to the temporary shelters.
- ✓ Domestic animals of 55,000 affected, 20,000 displaced.
- ✓ 14,571 Domestic animals were killed small size 3,270 (Chicken, Duck),  
11,301 (Cow, Buffalo)
- ✓ 5,500 people were rescued within three days of disaster.
- ✓ 3 Helicopters, 10 rafting boats, 3 ordinary boats, 4 elephants mobilized for rescue and distribution of relief materials.
- ✓ Many people suffered from different type of diseases diarrhea,
- ✓ pneumonia, eye conjunctivitis, high fever etc.

*(Source: MoHA, Nepal & others sources)*

## Institutions' Work Responsibility during the Response Phase of the Flood Disaster

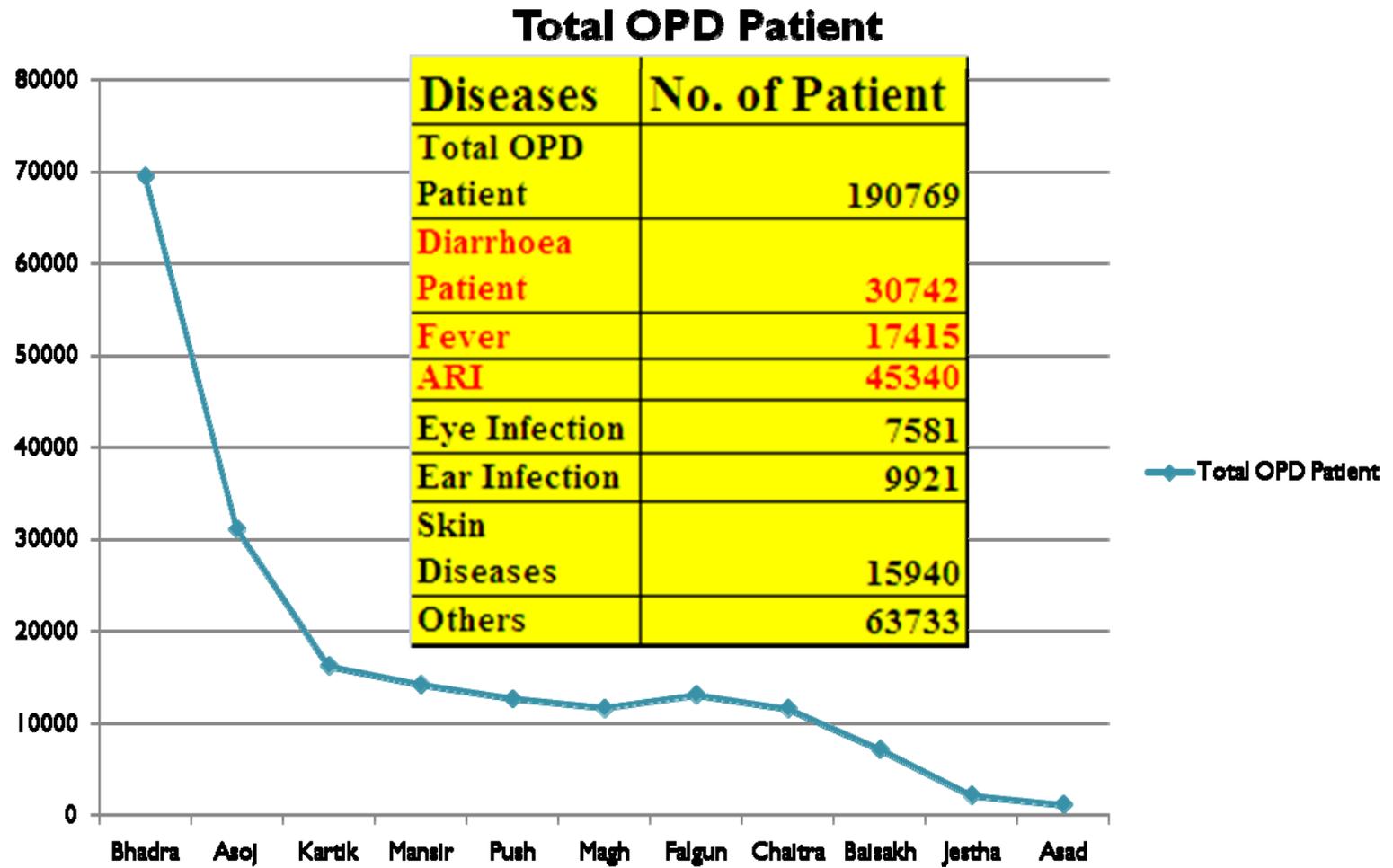
<b>Sector</b>	<b>Institutions involved</b>
• Food	WFP, NRCS, SC, LWF, FAO, DEPROSC, Concern, WVI, UNICEF
• Clothing	Oxfam, KVS, Care Nepal, NRCS, IOM, EV, SC, WEL, LWF, UNICEF, Rotary, WVI, Nepal Paribatan
• Shelter	Rotary International, Oxfam, KVs, NRCS, Care Nepal, EU, LWF, UNICEF, WEL, KODEF Nepal, IOM, Action Aid
• Medicine	NRCS, OXFAM, KVS, DPHO, Care Nepal, WEL, UNICEF
• Utensil	NRCS, Care Nepal, KVS, OXFAM, IOM, WEL, Rotary Club
• Drinking Water	DWO, Caritas, RRN, Oxfam, KVS, NRCS, UNICEF, WEL, Paribartan Nepal, CSDC
• Training	Rotary International, DPHO, Oxfam, KVS, NRCS, WASH, WEL, Paribartan Nepal, OHCHR, Plan Nepal, Action Aid
• Cash	District Disaster Committee, CDO Office
• Chulo	Care Nepal
• Litopitho	WFP, DEPROSC, CONCERT, SC
• Toiltet	Oxfam, KVS, Sabal Nepal, WEL, NRCS, UNICEF, LWF

(Source: UNESCO, 2009)

# POST FLOOD EPIDEMIOLOGY (Analysis and Results)

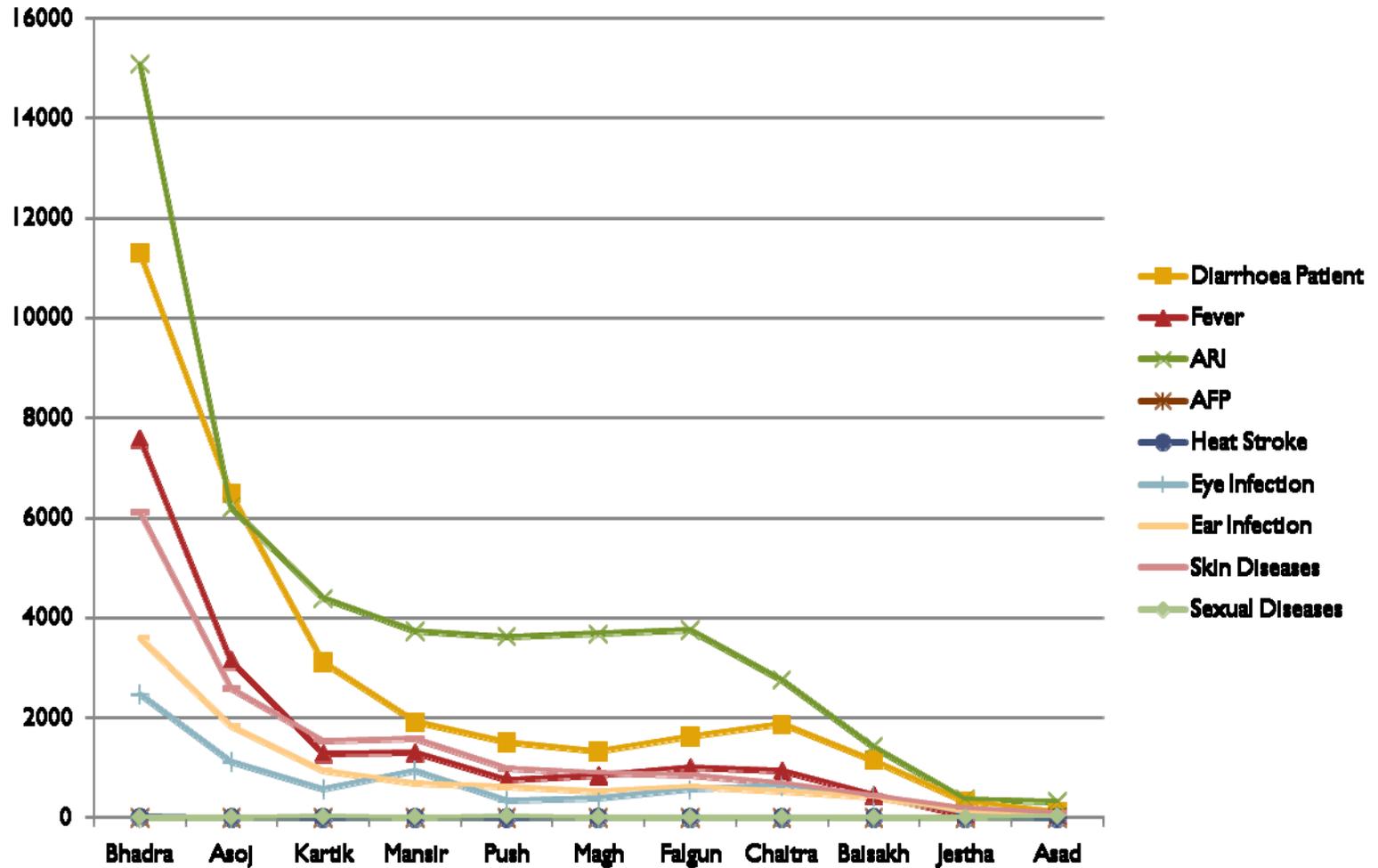


Analysis and Results Contd.....



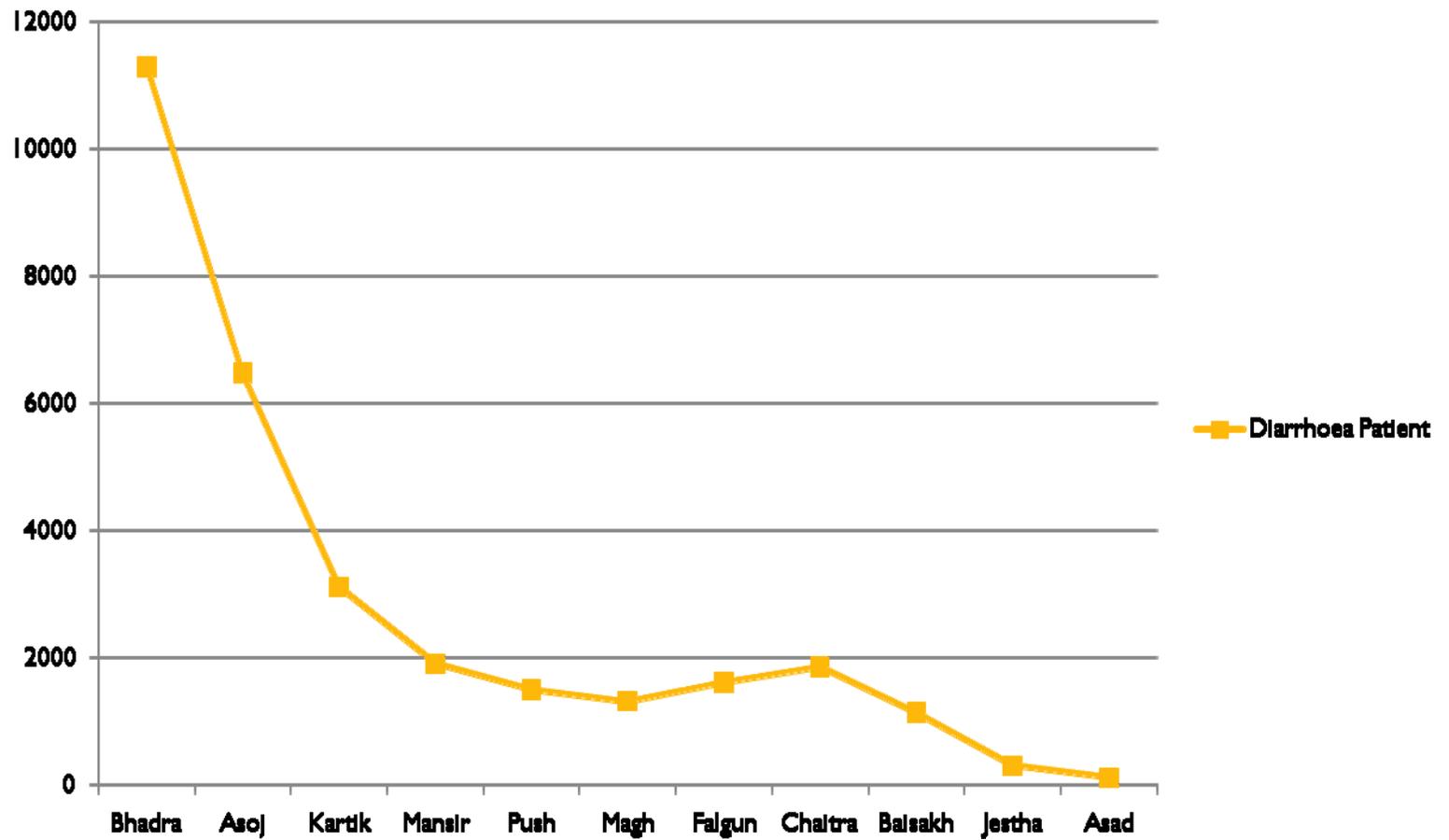
Analysis and Results Contd.....

## Prominent Diseases

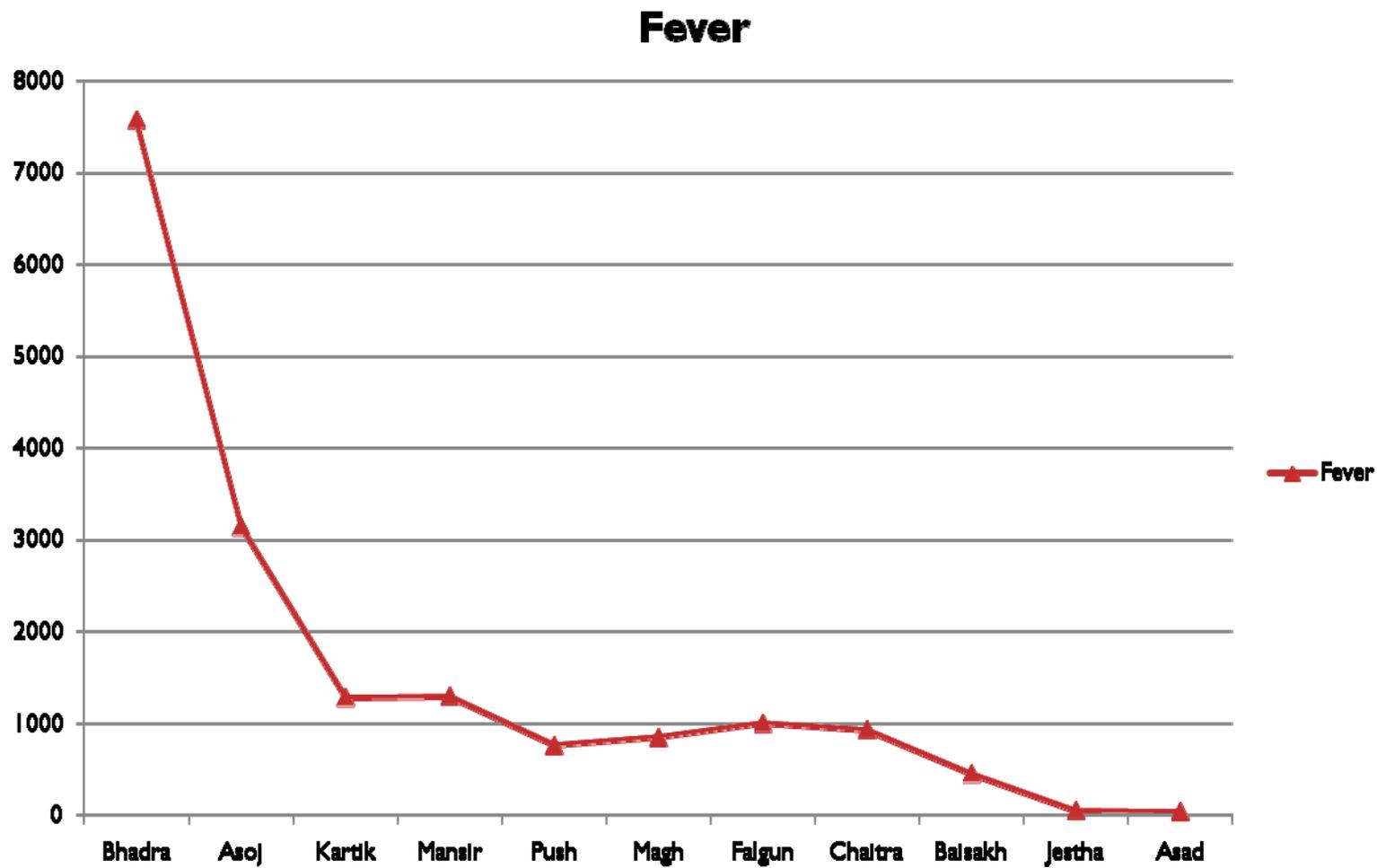


Analysis and Results Contd.....

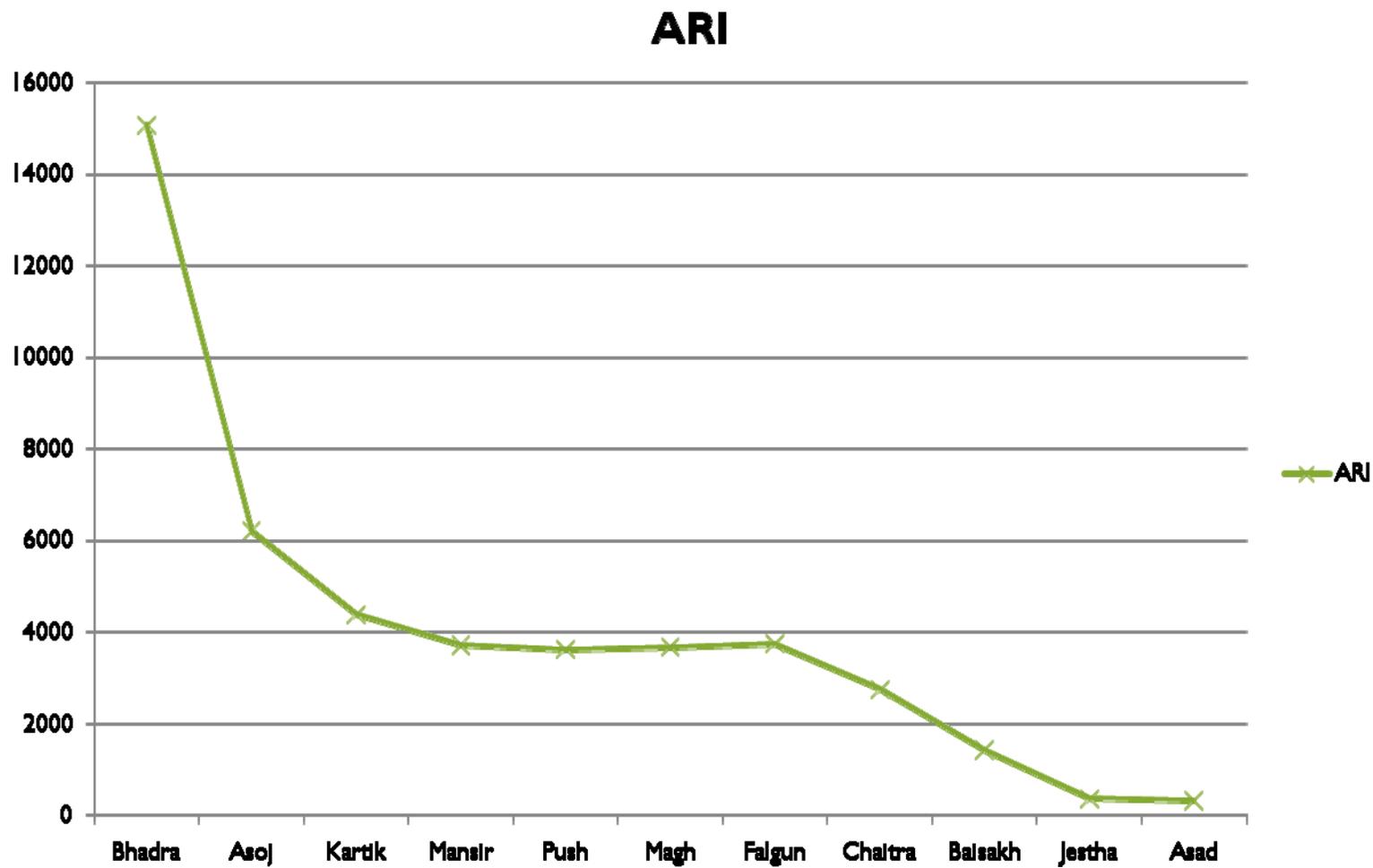
### Diarrhoea Patient



Analysis and Results Contd.....

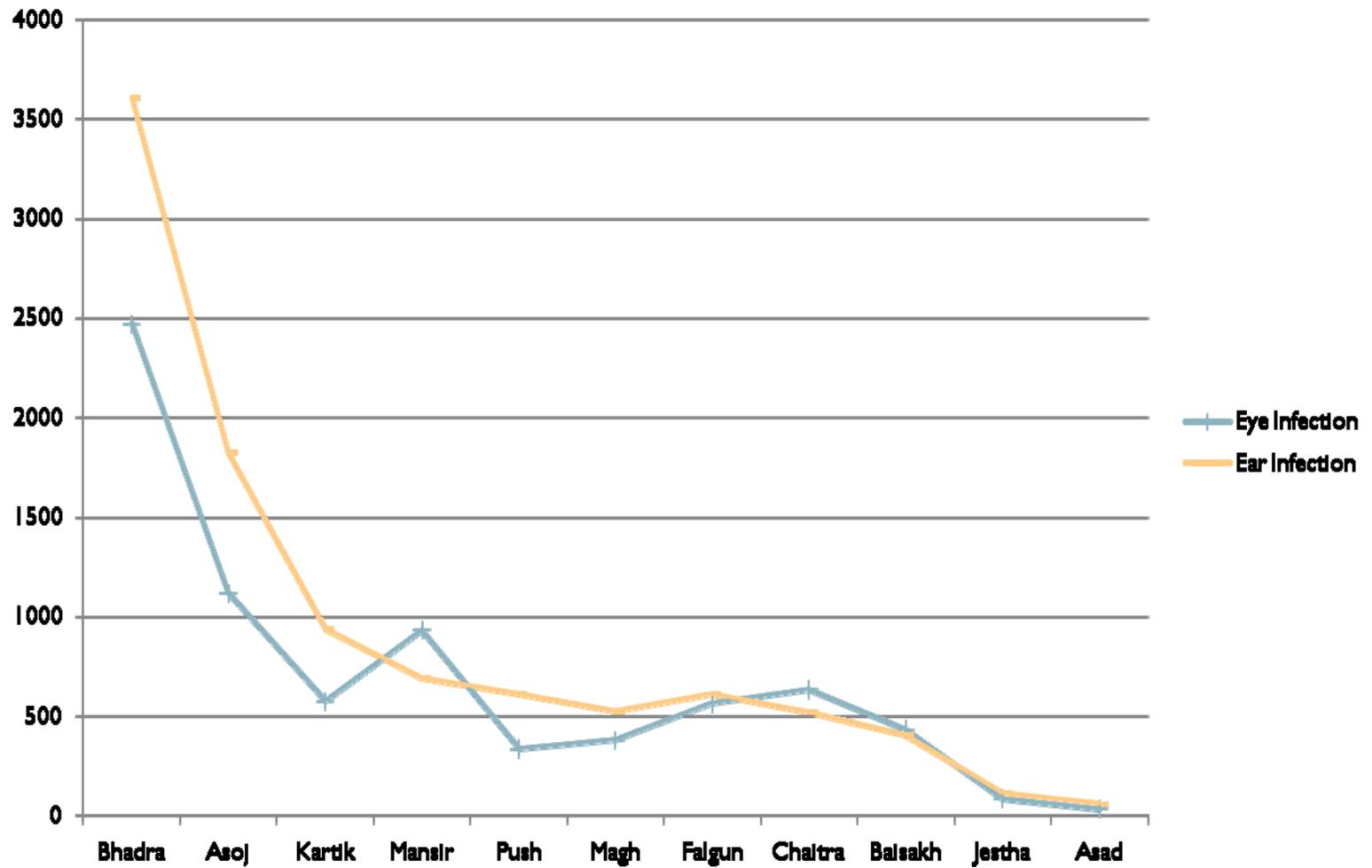


Analysis and Results Contd.....



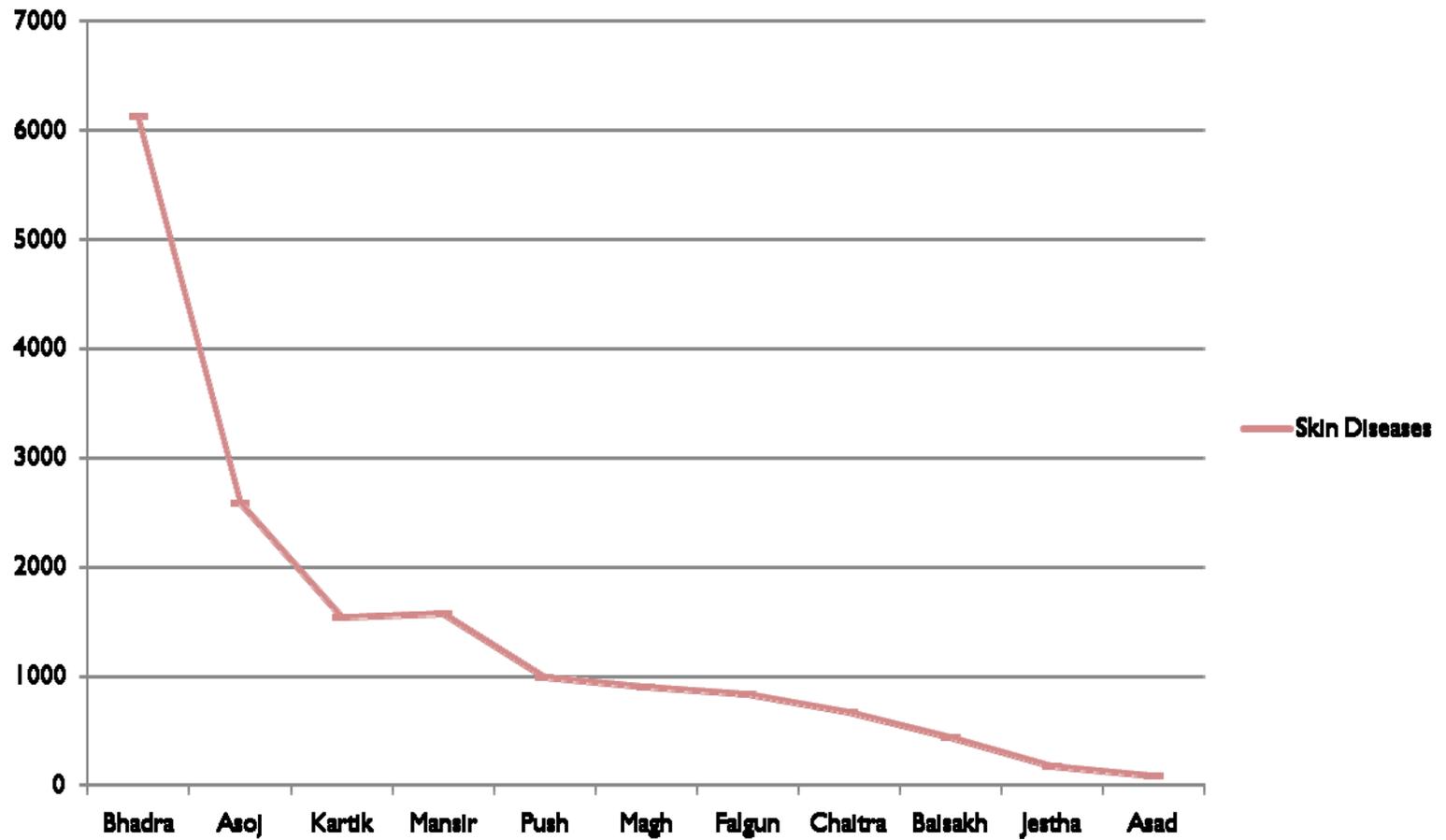
Analysis and Results Contd.....

### Eye and Ear Infection



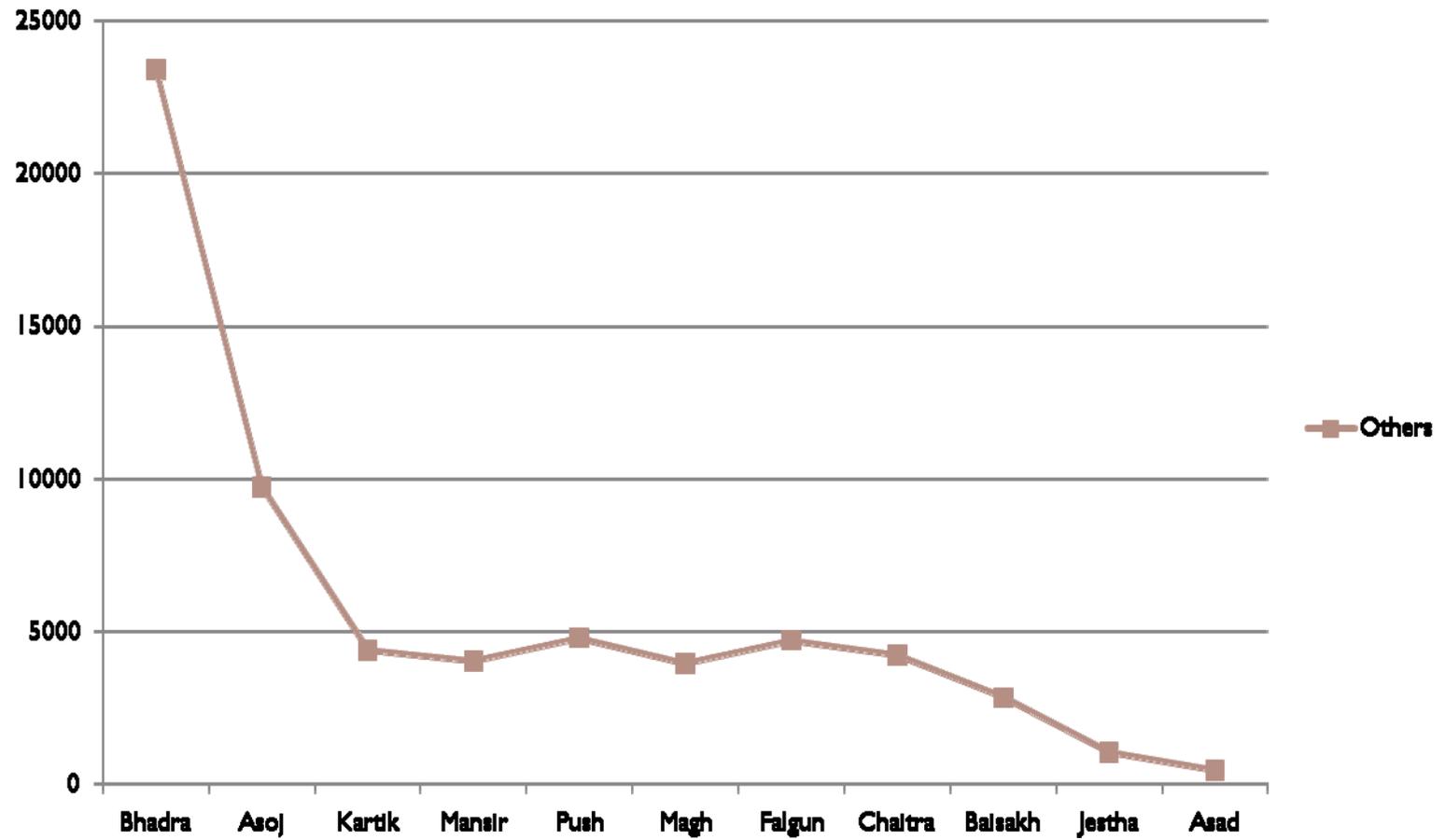
Analysis and Results Contd.....

### Skin Diseases



Analysis and Results Contd.....

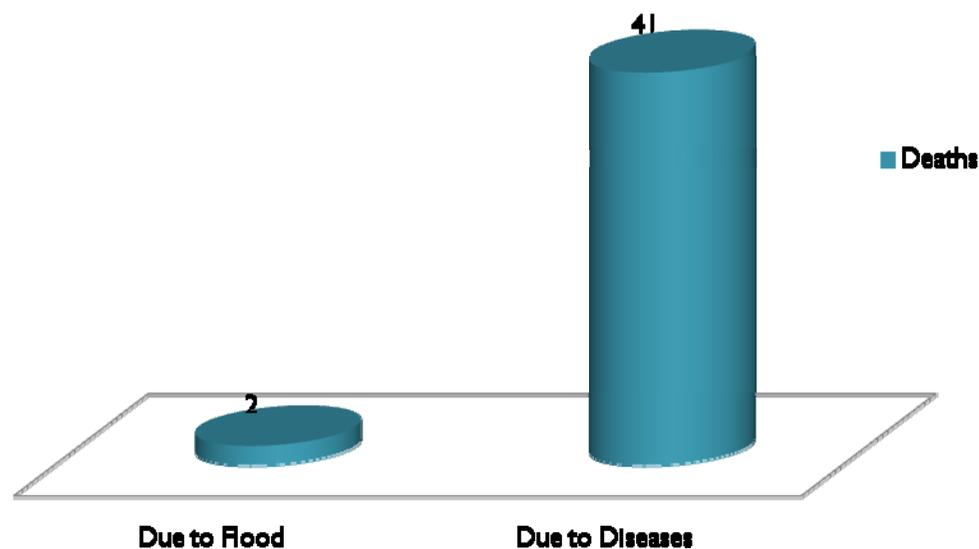
### Others



Analysis and Results Contd.....

## Mortality

- Only two individual are flown by the Flood
- Other 41 individual are due to health problem in the camps mainly waterborne diseases and ARI due to cold floor, crowd related diseases.



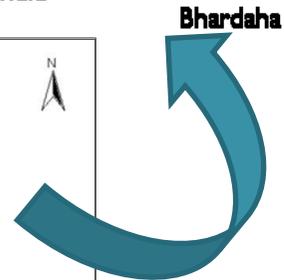
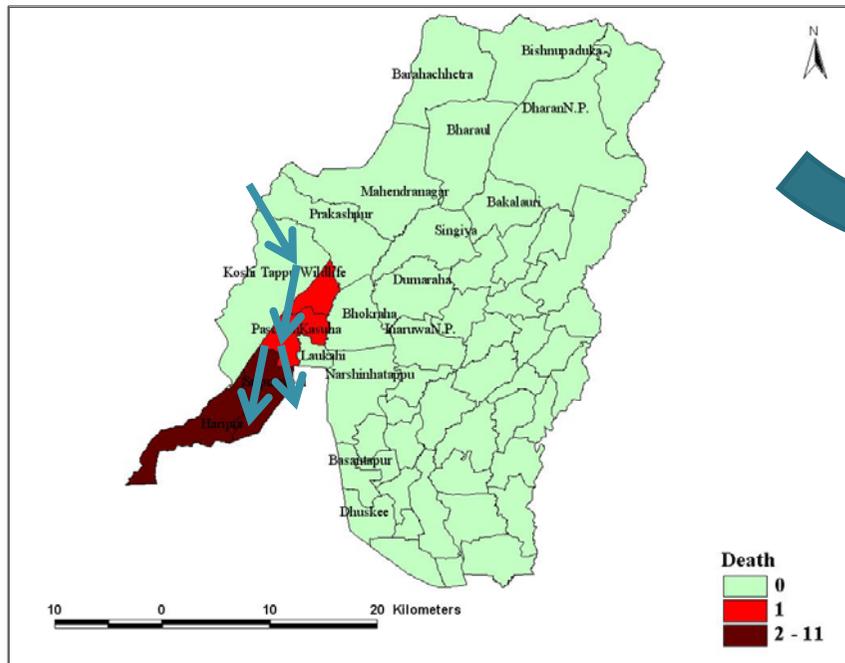
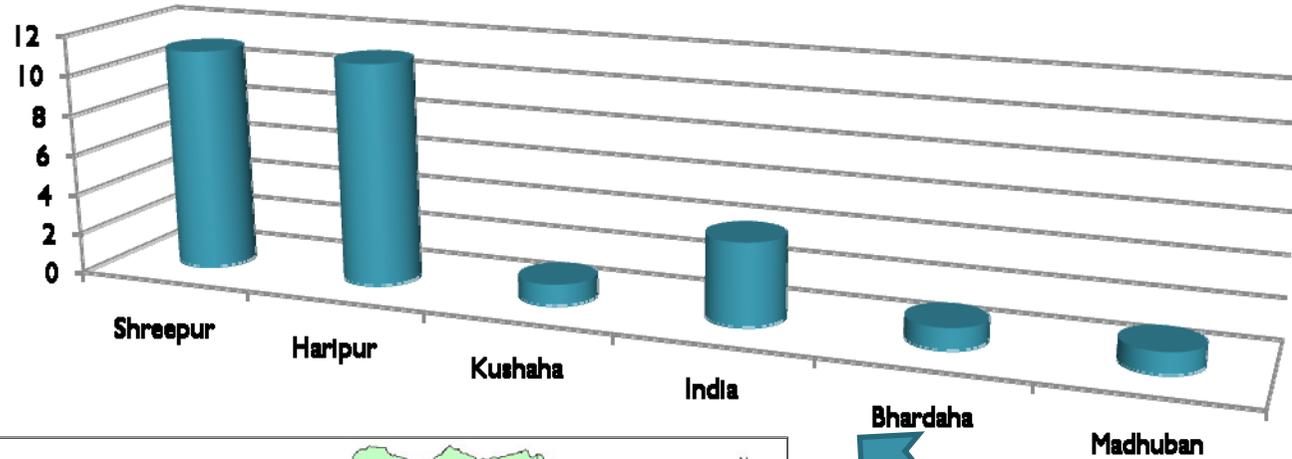
Analysis and Results Contd.....

## Mortality Vs Time

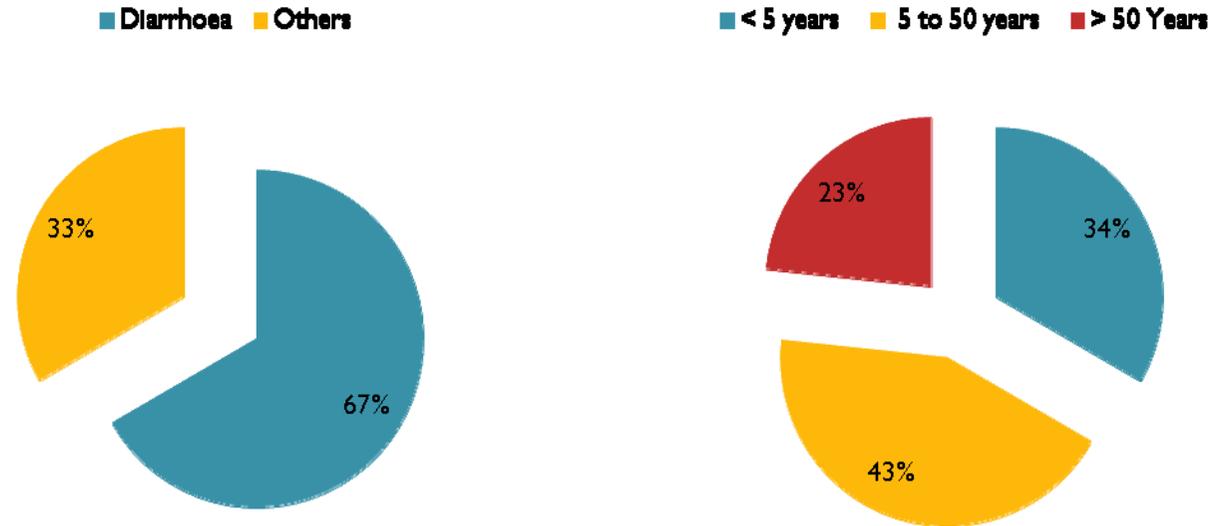


# Mortality Vs VDCs

## Mortality



# Mortality Vs Diseases & Age Groups





## Conclusions

- 0.2% of death from camps
- Mortality is higher in the following month than that of the event.
- Diarrhoea and ARI are the most prominent diseases.
- High risk death and diseases are on following first and second month of the event
- Waterborne diseases are the most risk after the flood.



*Photo: UN, OCHA, 2008*



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# Thank You