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

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(Source: ICIMOD, 2008)
Introduction
Objective of the study
Physiography and climate of Nepal
Nepal and disaster
Flood disaster
Flood disaster epidemics in Nepal
The Koshi river
Koshi flood 2008 and its impacts
Post flood epidemiology (Analysis and Results)
Conclusions
INTRODUCTION

Meteorological Condition with Relation to Monsoon

(Source: DHM, Nepal 2010)

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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 50 Km
  - Altitude: 70m to 200m
  - Alluvium thickness: 1.5Km thick
Introduction Contd……..

N-S Section from Everest to Rajbiraj

(Source: Upreti, 2005)
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……..
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.
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 based on altitudinal and climatic conditions. Geology is also different in the different zones.
Terai Plain
Siwalik
Lesser Himalaya
High Himalaya
Tibetan Tethys Himalaya

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

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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 Disaster Loss of Life 1983-2006

<table>
<thead>
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</thead>
<tbody>
<tr>
<td>Flood and Landslide</td>
<td>293</td>
<td>363</td>
<td>420</td>
<td>315</td>
<td>391</td>
<td>328</td>
<td>680</td>
<td>307</td>
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<td>71</td>
<td>1336</td>
<td>49</td>
<td>203</td>
<td>258</td>
<td>83</td>
<td>273</td>
<td>193</td>
<td>173</td>
<td>196</td>
<td>441</td>
<td>232</td>
<td>131</td>
<td>141</td>
<td>114</td>
<td>7084</td>
</tr>
<tr>
<td>Earthquake</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>727</td>
</tr>
<tr>
<td>Windstorms, Hailstorms &amp; Thunderbolts</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>2 NA</td>
<td>28</td>
<td>57</td>
<td>63</td>
<td>20</td>
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<td>6</td>
<td>62</td>
<td>10</td>
<td>18</td>
<td>16</td>
<td>641</td>
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<td>Avalanche</td>
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<td>102</td>
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<tr>
<td>Fire</td>
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<td>Epidemics</td>
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<td></td>
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<td>11950</td>
</tr>
<tr>
<td>Stampede</td>
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<td></td>
<td></td>
<td></td>
<td>71</td>
</tr>
<tr>
<td>Total</td>
<td>579</td>
<td>941</td>
<td>1387</td>
<td>1512</td>
<td>1881</td>
<td>1584</td>
<td>1716</td>
<td>913</td>
<td>971</td>
<td>1318</td>
<td>1524</td>
<td>765</td>
<td>873</td>
<td>895</td>
<td>1190</td>
<td>1190</td>
<td>1466</td>
<td>377</td>
<td>415</td>
<td>458</td>
<td>310</td>
<td>192</td>
<td>221</td>
<td>137</td>
<td>21785</td>
</tr>
</tbody>
</table>

(Source: MoHA, 2007)
24 Year Nepal Disaster Death Summary (1983 - 2006)

- Epidemics: 11950
- Flood/Landslide: 7084
- Fire: 1210
- Earthquake: 727
- Total: 20971
FLOOD DISASTER

(Date: 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)
Population Growth Rate is Higher at river basins than that of the total corresponding districts growth rate.
FLOOD DISASTER
EPIDEMICS IN NEPAL

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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)
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)
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)
Japanese encephalitis regularly 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)
### Summary of risk communicable diseases in flood-affected population

<table>
<thead>
<tr>
<th>Communicable disease</th>
<th>Of immediate concern following floods</th>
<th>Of concern in weeks to months following floods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholera/Typhoid/Shigellosis</td>
<td>+++</td>
<td></td>
</tr>
<tr>
<td>Acute lower respiratory tract infections</td>
<td>+++</td>
<td></td>
</tr>
<tr>
<td>Hepatitis A &amp; E</td>
<td>++</td>
<td></td>
</tr>
<tr>
<td>Leptospirosis</td>
<td>++</td>
<td></td>
</tr>
<tr>
<td>Measles</td>
<td>++</td>
<td></td>
</tr>
<tr>
<td>Malaria</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Japanese encephalitis</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Dengue fever</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Meningitis</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Poliomyelitis</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td></td>
<td>++</td>
</tr>
</tbody>
</table>

(Source: WHO, 2007)

**Key:**  
+ = low risk  
++ = moderate risk  
+++ = high risk
Over the Last 250 years, shifted 120 km from East to West (NYT, 2008)
### Some features of Koshi river

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length</td>
<td>729 km</td>
</tr>
<tr>
<td>Catchment area</td>
<td>60,400 Sq.Km</td>
</tr>
<tr>
<td>Average annual flow</td>
<td>1564 m³/sec</td>
</tr>
<tr>
<td>During flood:</td>
<td>18 times of average</td>
</tr>
<tr>
<td>Average annual sediment volume:</td>
<td>118 million cubic meter</td>
</tr>
<tr>
<td>Past maximum flood</td>
<td>913,000 cusec (25849 m³/sec; 5th Oct.1968)</td>
</tr>
<tr>
<td>Recent Flood:</td>
<td>168,500 cusec (4770 m³/sec; 18th August, 2008)</td>
</tr>
</tbody>
</table>

*Source: Wikipedia, 2009*
## Annual Sediment Load from Different River Basins (Watersheds) in Nepal

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

(Source: DWIDP, 2009)
KOSHI FLOOD 2008 (18th August) AND ITS IMPACTS

(Source: UN OCHA, 2008)
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

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

(Source: UNESCO, 2009)
POST FLOOD EPIDEMIOLOGY
(Analysis and Results)
Analysis and Results Contd…..

<table>
<thead>
<tr>
<th>Diseases</th>
<th>No. of Patient</th>
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<tbody>
<tr>
<td>Total OPD Patient</td>
<td>190769</td>
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<tr>
<td>Diarrhoea Patient</td>
<td>30742</td>
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<tr>
<td>Fever</td>
<td>17415</td>
</tr>
<tr>
<td>ARI</td>
<td>45340</td>
</tr>
<tr>
<td>Eye Infection</td>
<td>7581</td>
</tr>
<tr>
<td>Ear Infection</td>
<td>9921</td>
</tr>
<tr>
<td>Skin Diseases</td>
<td>15940</td>
</tr>
<tr>
<td>Others</td>
<td>63733</td>
</tr>
</tbody>
</table>
Prominent Diseases

Analysis and Results Contd.....
Analysis and Results Contd…..
Analysis and Results Contd.....
Analysis and Results Contd…..
Analysis and Results Contd.....

**Eye and Ear Infection**

![Graph](image)

**Eye Infection**
**Ear Infection**

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Analysis and Results Contd.....
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.
Mortality Vs Time

![Mortality Chart](chart.png)

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Mortality Vs VDCs

Mortality

IDRiM2010, By K. R. Kafle, S.N. Khanal and A. Collins
Mortality Vs Diseases & Age Groups

- **Diarrhoea**: 33%
  - Others: 67%

- **Age Groups**:
  - < 5 years: 23%
  - 5 to 50 years: 34%
  - > 50 Years: 43%
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
Thank You