Climate Change and Water Induced Disaster Risk and Adaptation in Nepal Himalaya

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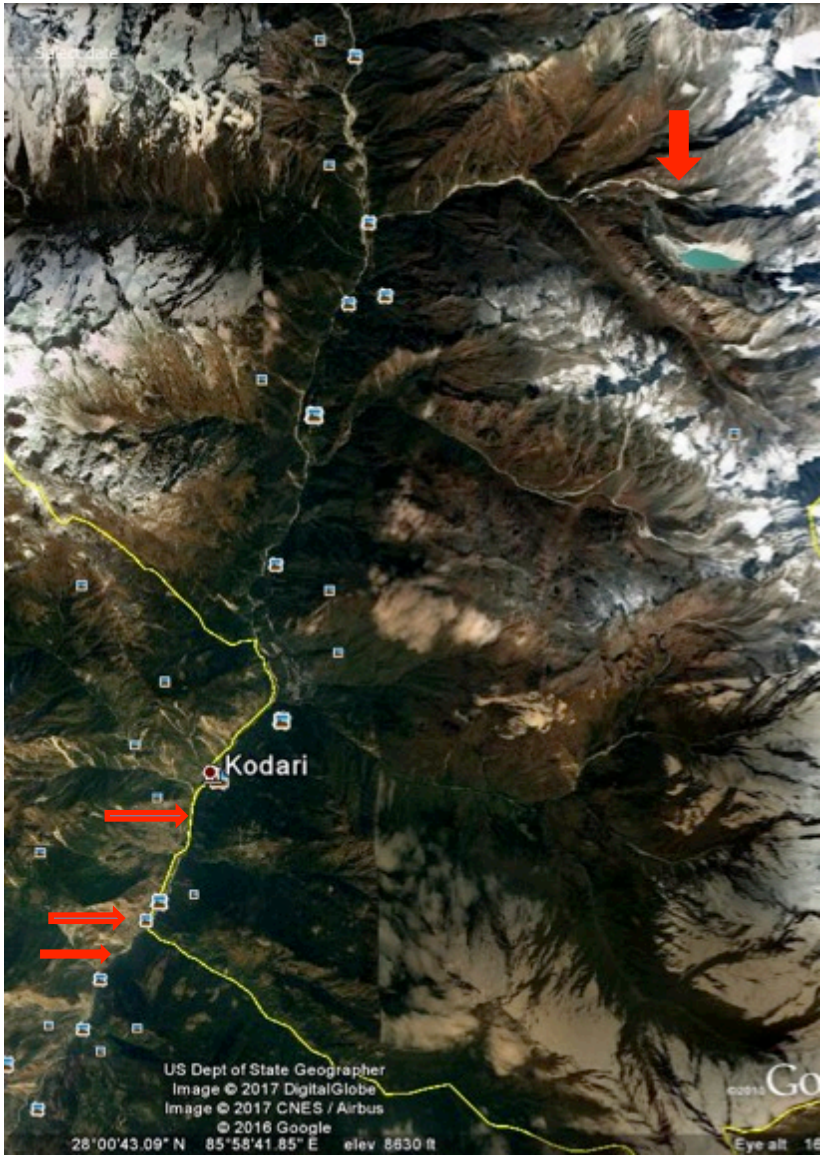
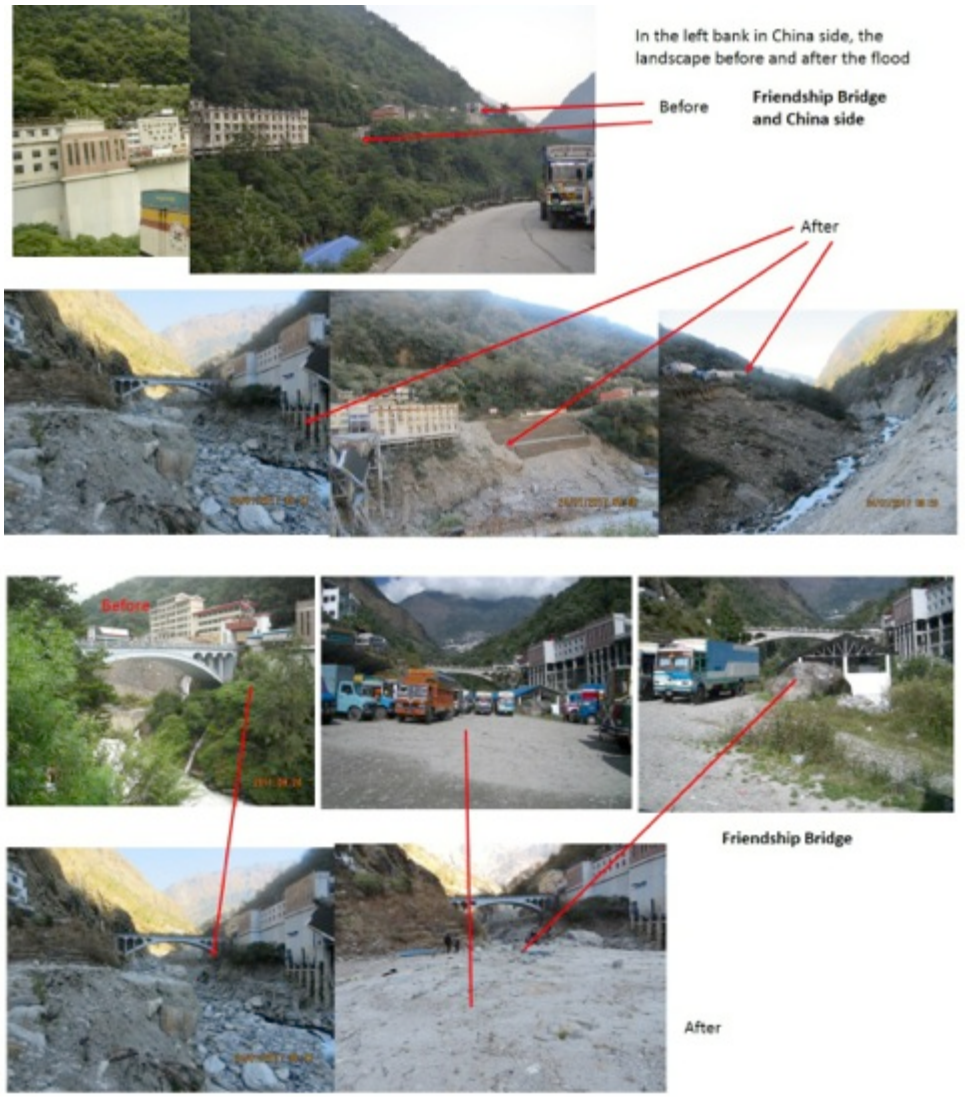
Climate change implications to disaster risk

Climate change trend	Processes	Disaster
Increase in temperature (0.056 ^{o}C/Y)	Melting of glaciers	Avalanche and GLOF
Increase in extreme precipitation event	Increase in run off	Landslide, landslide dam, landslide dam outburst floods, debris flow, and flash floods
Increase in precipitation variability	Shift in temporal precipitation pattern and discharge	Drought

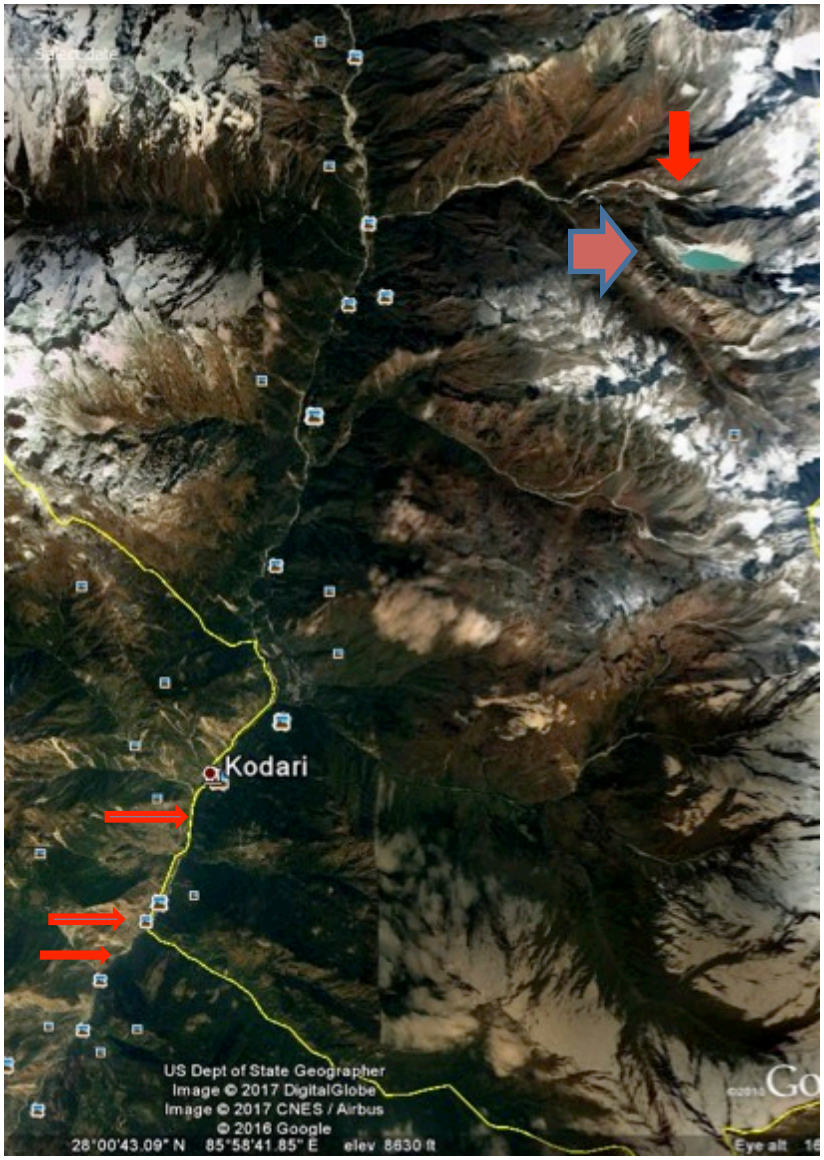
Glacial Lake Outburst Floods

Gongbatongshacuo Lake on July 5, 2016 in Poiqu/ Bhotekoshi/ Sunkosi)

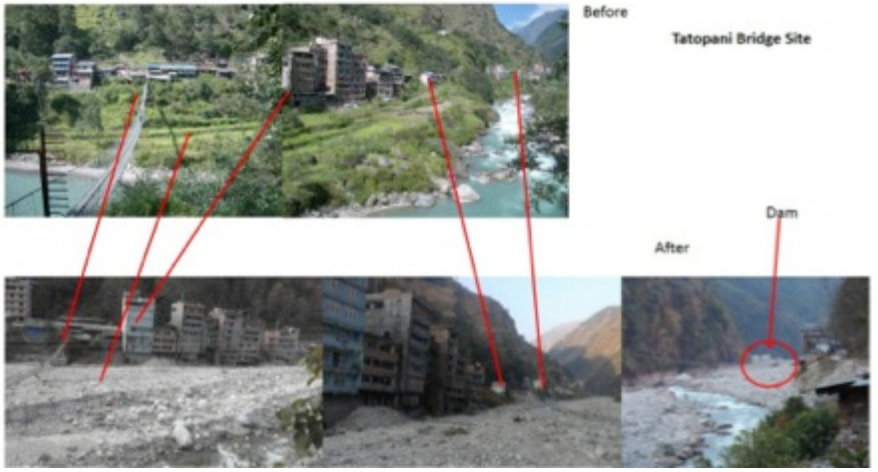


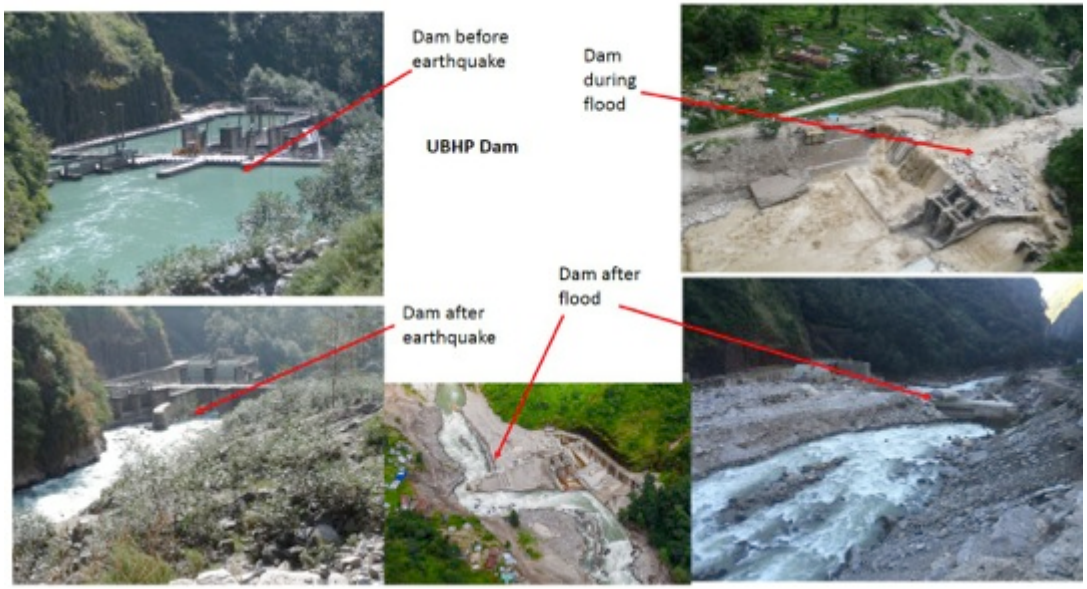


1981 GLOF in Poiqu



Gongbatongshacuo GLOF…..





Chain of hazards –flood, bank cutting, landslide

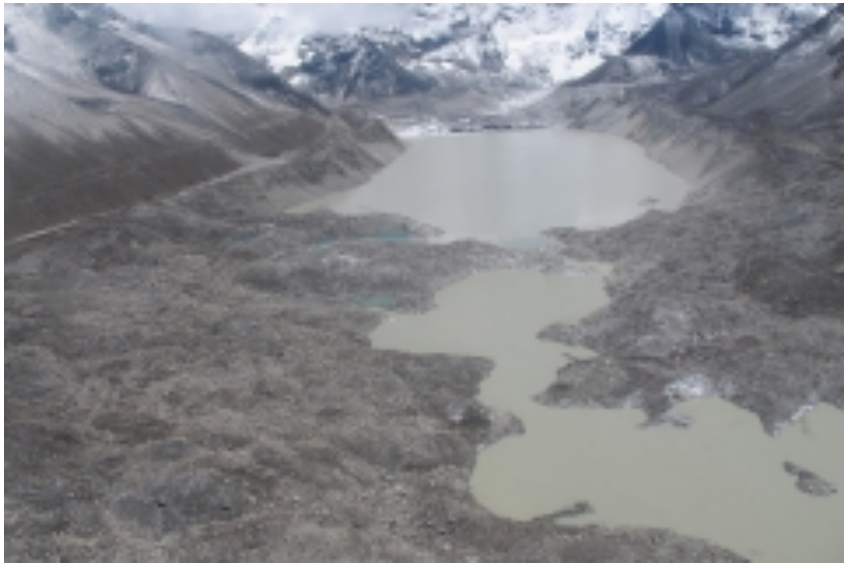
Estimated monetary value of elements lost

Element	Million USD	%
Land	0.17	0.26
Crop	0.00	0.00
Livestock	0.01	0.01
Building	3.33	5.01
Road	0.47	0.71
Trail	0.00	0.00
Transm line	0.02	0.03
Irrig. canal	0.00	0.00
Bridge	0.04	0.07
Hydropower	62.00	93.40
Others	0.34	0.52
	66.38	100.00

Adaptation

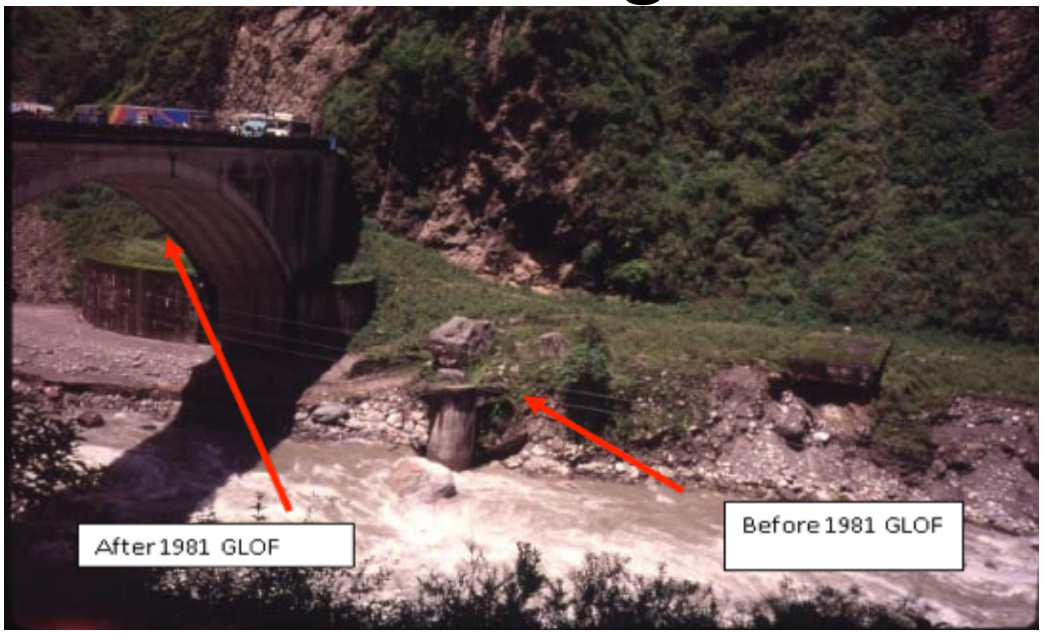
- Lake level lowering
- Monitoring and early warning
- Change in infrastructure design – road and bridges

Glacial Lake Lowering: Imja and Tsho Rolpa



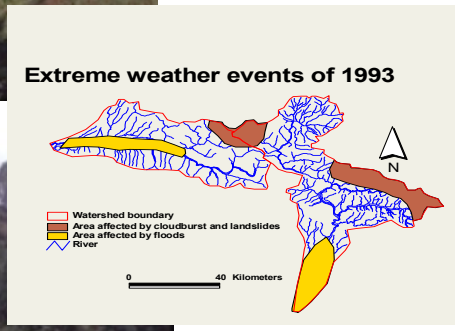
Monitoring and early warning

Change in infrastructure design



Extreme precipitation: July 19, 1993 in Kulekhani

(540mm in 24 hours and 73 mm/hour)



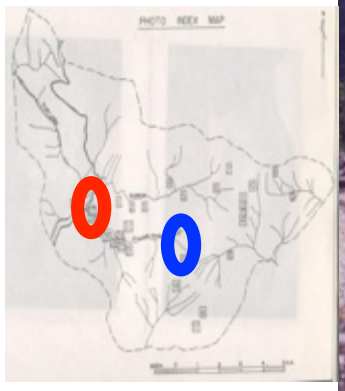
1000 people killed; 70, 000 families affected; many infrastructure damaged

Extreme Precipitation

Syangja in 1998

55 persons were killed and 640 houses were damaged

In Pragatinagar 34 houses amounting to Rs. 25.9 million damaged



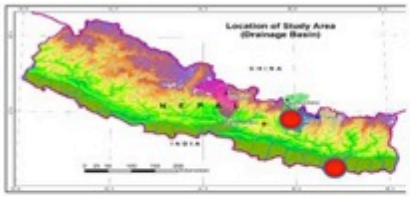
Landslide Dam and Outburst Flood

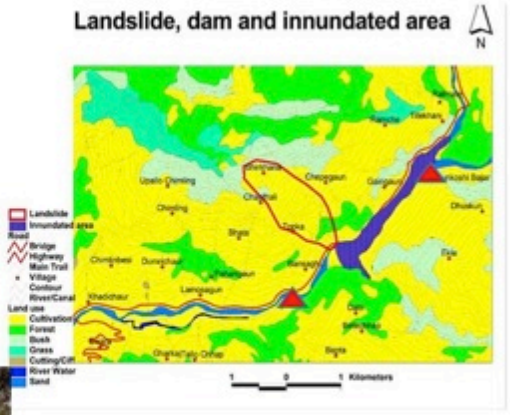
Landslide dam outburst flood

River/ District	Year	Loss/damages
Balephi/ Sindhupalchok	1982	97 people; 15 houses
Sunkosi/ Sindhupalchok	1987	98 people, 229 houses, Sunkosi Hydropower
Larcha	1996	54 people, 18 houses, highway bridge
Sunkosi/Sindhupalchok	2014	156 people, 155 houses, 2 hydropower project, 1 school, 26 houses in inundated area.
Tamor, Taplejung	2016	200 houses inundated

Larcha in 1996

Landslide, landslide dam and landslide dam outburst flood





Sunkoshi in 2014

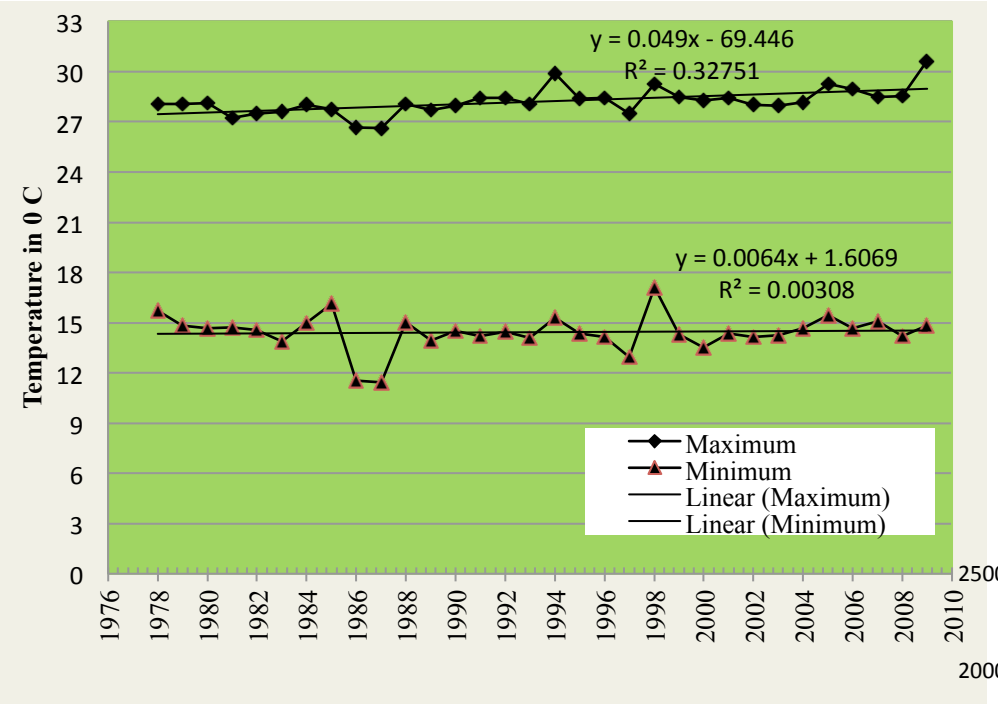
On 2 August, 2014, a huge landslide dammed the Sun Koshi river.

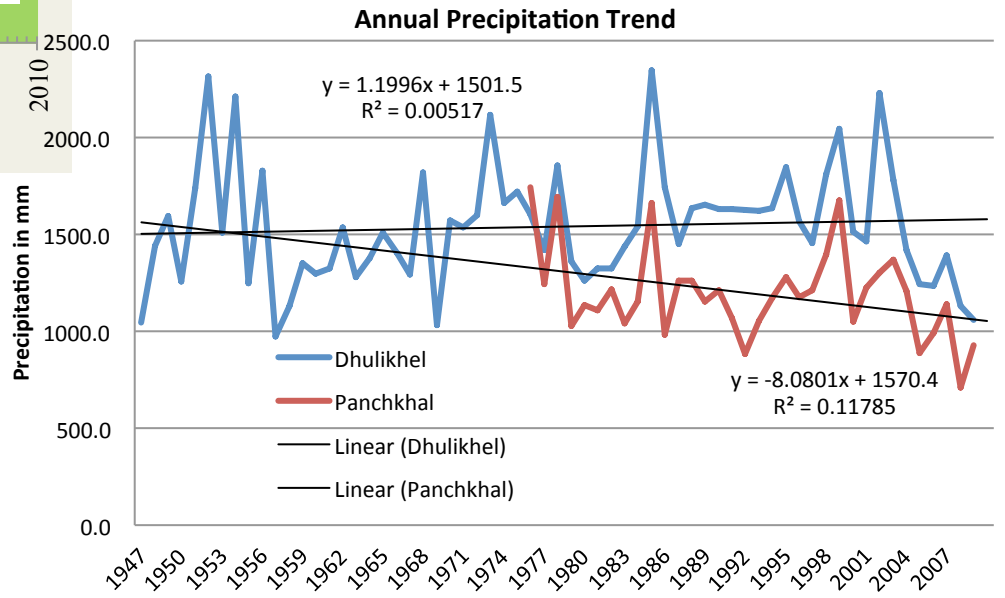
Tamor in 2016

Ramche Landslide before and after 2014

Drought

Observed temperature and precipitation trend



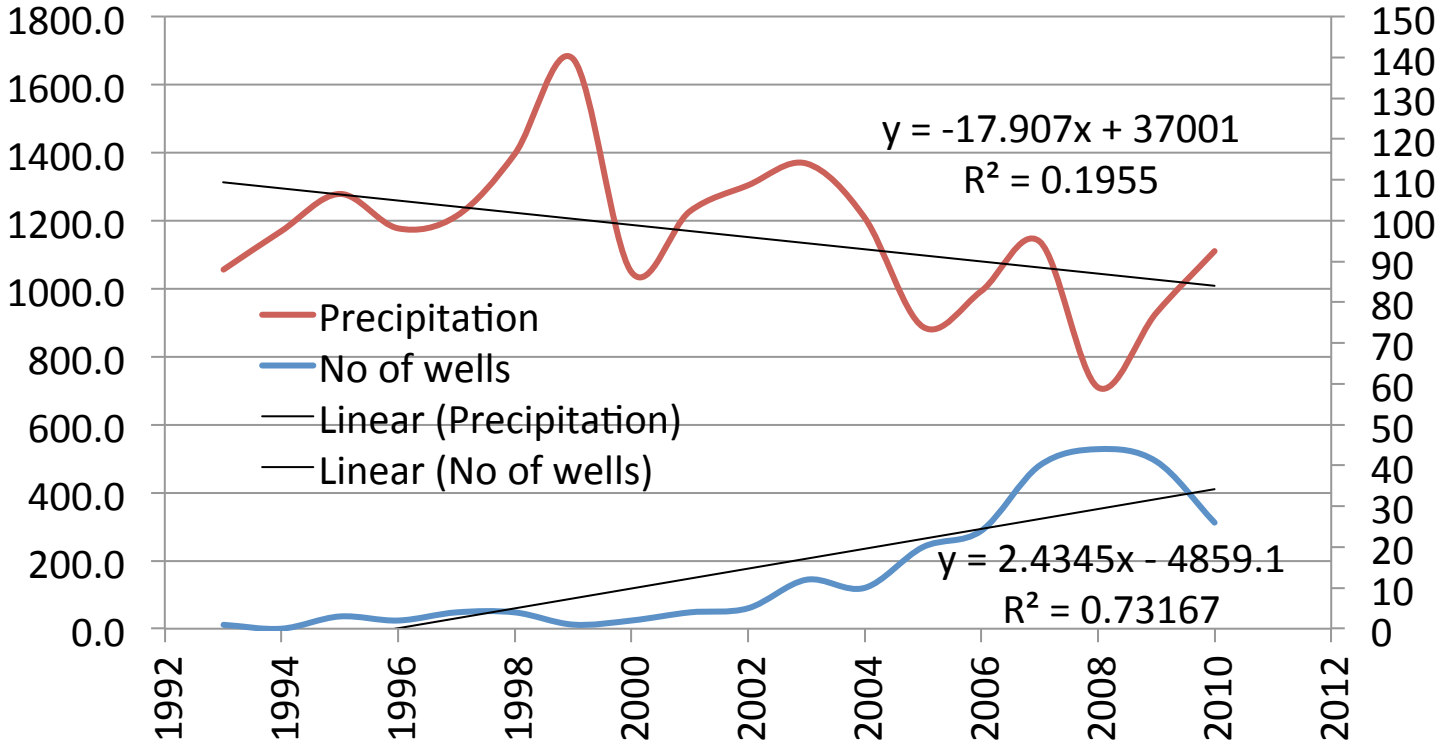


Adaptation

- Rain water harvesting (pond and tanks)
- Increasing in the use of ground water – wells and ditching of river bed
- Community management regulating the collection time

Adaptation: Rain water harvesting (Tank)

Rain water harvesting pond


1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
y = -17.907x + 37001
R² = 0.1955
Precipitation
No of wells
Linear (Precipitation)
Linear (No of wells)
y = 2.4345x - 4859.1
R² = 0.73167

Lessons Learned

- Though the area is naturally prone to water induced disaster and is likely to increase in the context of climate change, but the loss of life and to some extent the properties can be reduced through
  - Regular monitoring of environment and timely and effective implementation of mitigation and adaptation measures (Ramche)
  - Establishment of early warning system with enough lead time

Lessons Learned…..

- Awareness creation among stakeholders at all levels – local and national
- Better preparedness plan (evacuation and shelter)
- Planning, design and development of infrastructure with due consideration of water induced disaster risk
- Multi-hazard perspective in disaster risk assessment and management (chain of hazards – GLOF to river bank cutting, reworking of terraces, landslides and landslide to landslide dam (inundation), landslide dam outburst flood, river bank cutting and again landslide)
- Regional cooperation specially in trans-boundary river (Information sharing)

Thank You