Assessing the Environmental Vulnerability and its Impacts on Livelihood in Dudhkoshi Basin in Eastern Nepal

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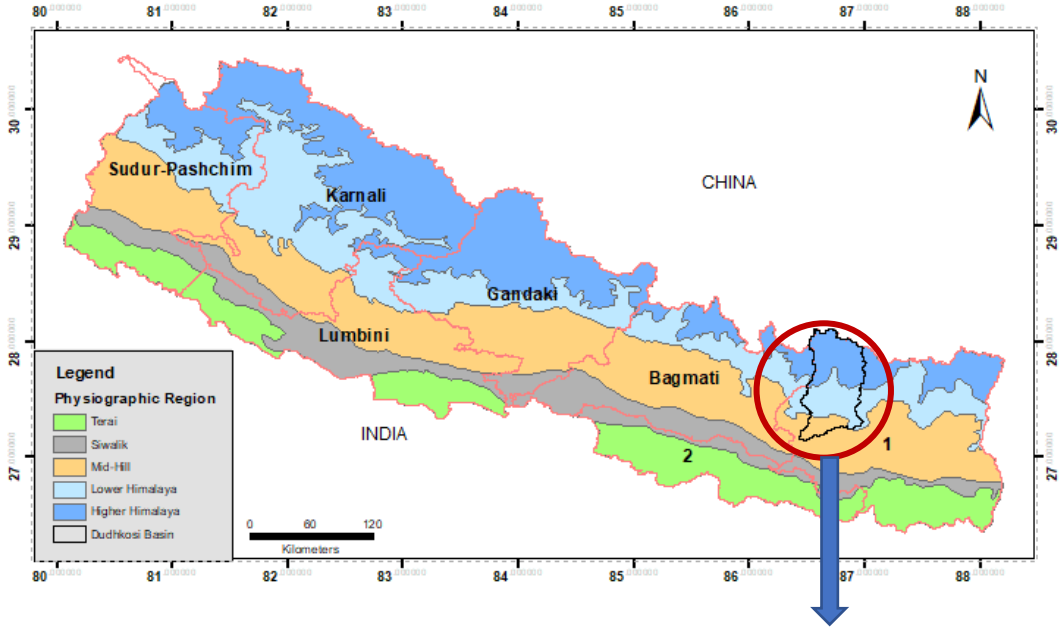
(Virtual Participation)

Study Area : Dudhkoshi Sub Basin, Nepal

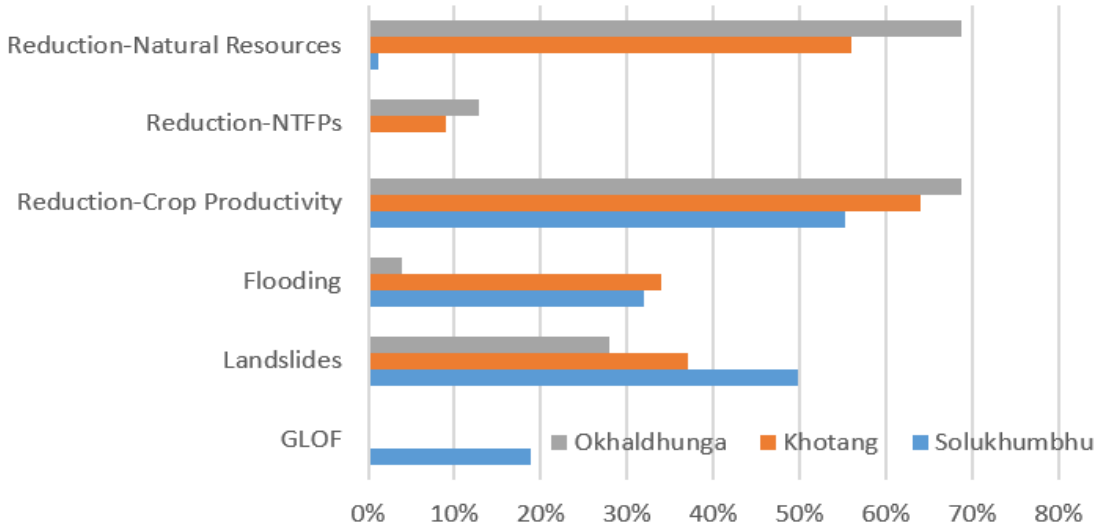
Background:

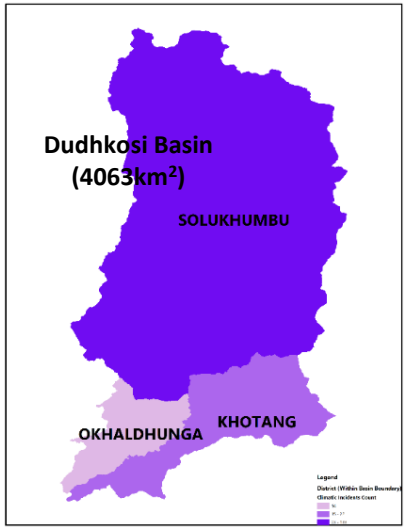
- Dudhkoshi Sub basin (~4,063km2) in eastern Nepal, comprises- **Higher Himalaya, Lower Himalaya and Mid Hill- highly sensitive to the Climate Change**
- Dudhkoshi Sub basin highly vulnerable in terms of **physical environmental degradation**, **compounded with the climate change induced multi-hazards**;
- Has **highest number of disaster incidents** among the provinces of Nepal & the most multi-hazards (Floods/GLOF, Landslides, drought) prone sub basins in Nepal;
- Climate Change has **increased the magnitude, intensity & frequency** of **environmental degradation** and **unsustainable development activities** has undermined livelihoods.



Objective:

To Assess the Environmental Vulnerability and its impacts on livelihood in Dudhkoshi Basin in Eastern Nepal





District Boundaries clipped to basin area
District Level Incidents data available from 2011/05/17 to 2022/05/22

Climate Variability and Change : Nepal Context Sectoral Impacts

Agriculture
- Reduced crop production due to climate related risks such as drought, heavy rain, hailstorm and so on;
- Loss of fertile land due to flood, landslide, soil erosion;
- Introduction of new fungal and bacterial diseases;
- Famine and food scarcity due to regular crop failure.

Forestry & Biodiversity
- Changes in composition and distribution of species;
- Accelerate the rate of species extinction;
- New pests and more forest fire.

Hydro-met hazards
- Enhanced frequency and intensity of floods, landslide and droughts;
- Rapid melting of glaciers and snows increasing threat to glacial lake outburst flood (GLOF)

Health
- Mosquitoes move to higher altitude due to warming increasing prevalence risk of Malaria, Japanese Encephalitis;
- Water borne diseases during disaster events;
- Heat stress and heat wave

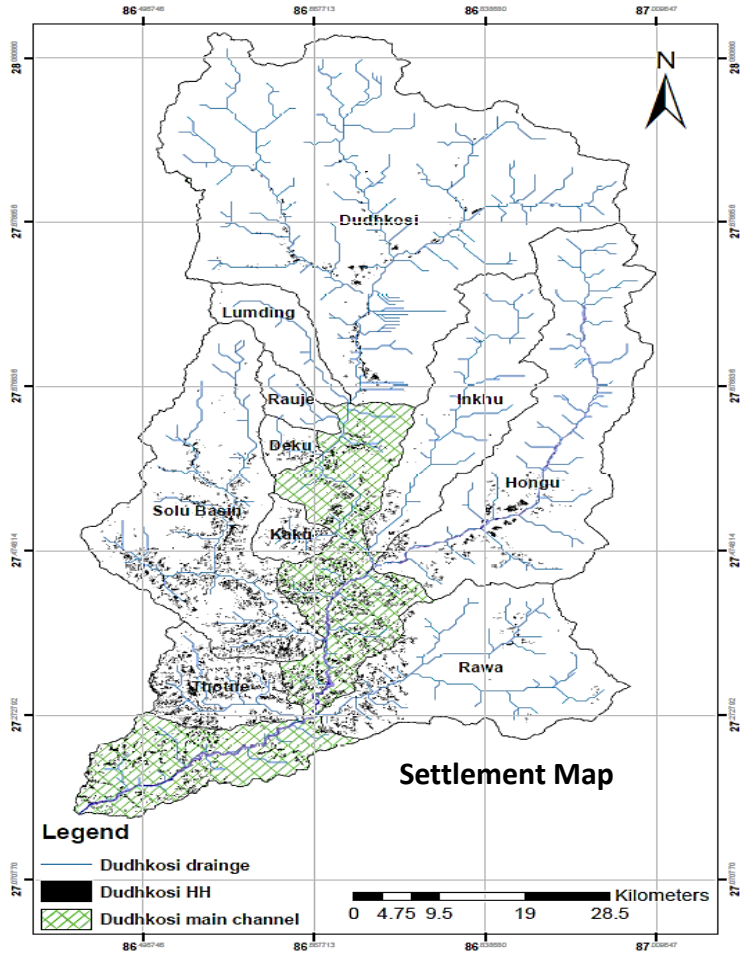
Water Resources
- Variation in river runoff;
- Unreliable and unpredictable river flow pattern affecting hydroelectricity power plants;
- Enhanced frequency and intensity of flood and droughts;
- Rapid melting of glaciers and snows increasing threat to Glacial lake outburst flood;
- Shrinkage of fresh tower due to rapid melting of glaciers

- Nepal's contribution to global GHG emission is **Negligible** - 0.025% (MoPE, INC 2004), 0.027% (MoSTE, SNC 2014) and 0.06% (MoFE, TNC-2020) and 0.09% (WRI CAIT 4.0, 2017)
- Annual maximum temperature increment in Nepal was significantly positive, at 0.056°C/yr over 1971–2014 (DHM 2017);
- Greater warming rate of **0.086°C/year** in the **Higher Himalaya**
- The **frequency and intensity** of heavy precipitation events have increased over the years
- Nepal loses **647 lives** and property worth over USD 23 Million each year to extreme climate events;
- More the 80% of property loss due to disaster is attributable- climatic hazards.

Method: MCDA - Eight primary Environmental Variables

- MCDA – AHP to assess the Physical Environmental Vulnerability &

- Field Assessment - Participatory & Consultative Approach
  - HH Level (Survey)
  - Community Level (FGD)
  - Local Government (KII)
  - Provincial (KII)
  - Federal (KII)



Method: MCDA – Environmental and Anthropogenic Variables

A- LULC (*Sentinel 2 , 21 October 2021*)

B- Soil type (*NARC Nepal- Digital Soil Database*)

C- Annual Avg. Rain, (*DHM 1980- 2020*)

D- Road Network (*DOLI, Nepal Google Earth Pro and OSM- 3665 Kilometers*)

E-NDVI (*Sentinel 2 , 21 October 2021)*

F-Drainage network (*ALOS 12.5 M- DEM*)

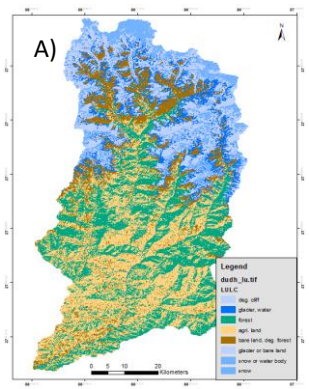
G- Slope (*ALOS 12.5 M- DEM*)

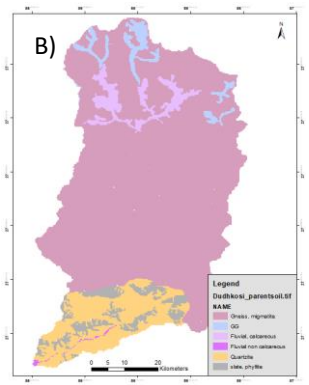
H- Terrain Wetness Index- TWI

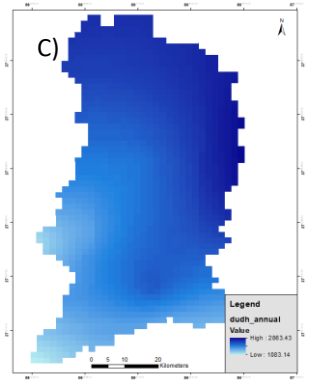
(*ALOS 12.5 M- DEM*)

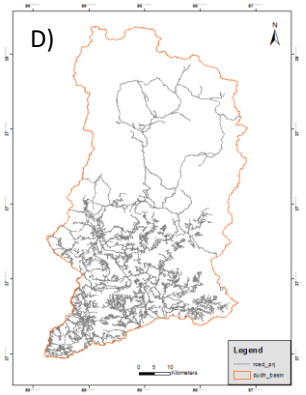
I –Rain (RCP4.5) *AR5 IPCCC*

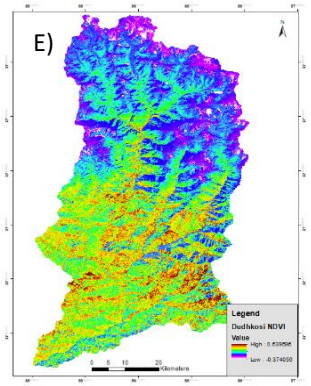
J - Rain RCP8.5) - *AR5 IPCCC*

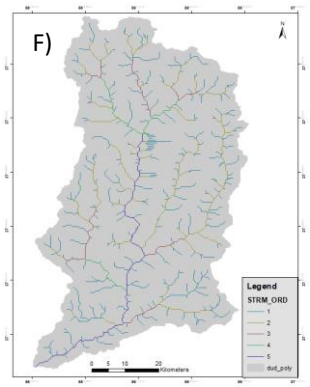


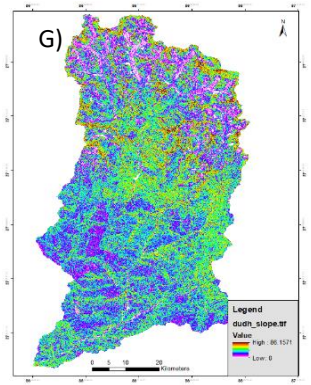


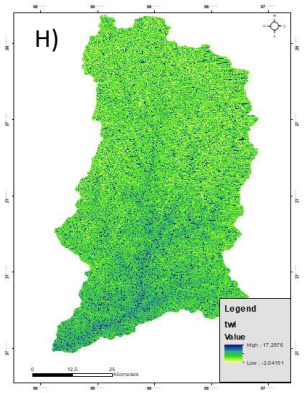


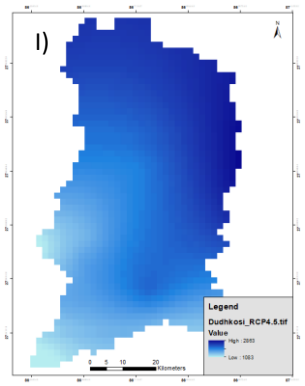


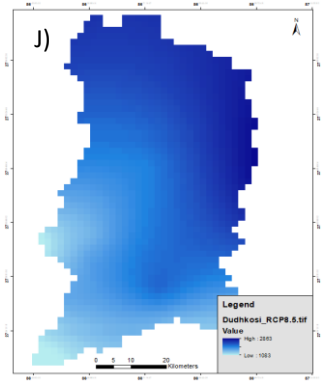












Method: Classification of Environmental Variables (Saaty 2008)

A- LULC

B- Soil type,

C- Annual Avg. Rain,

D- Road Network

E-NDVI,

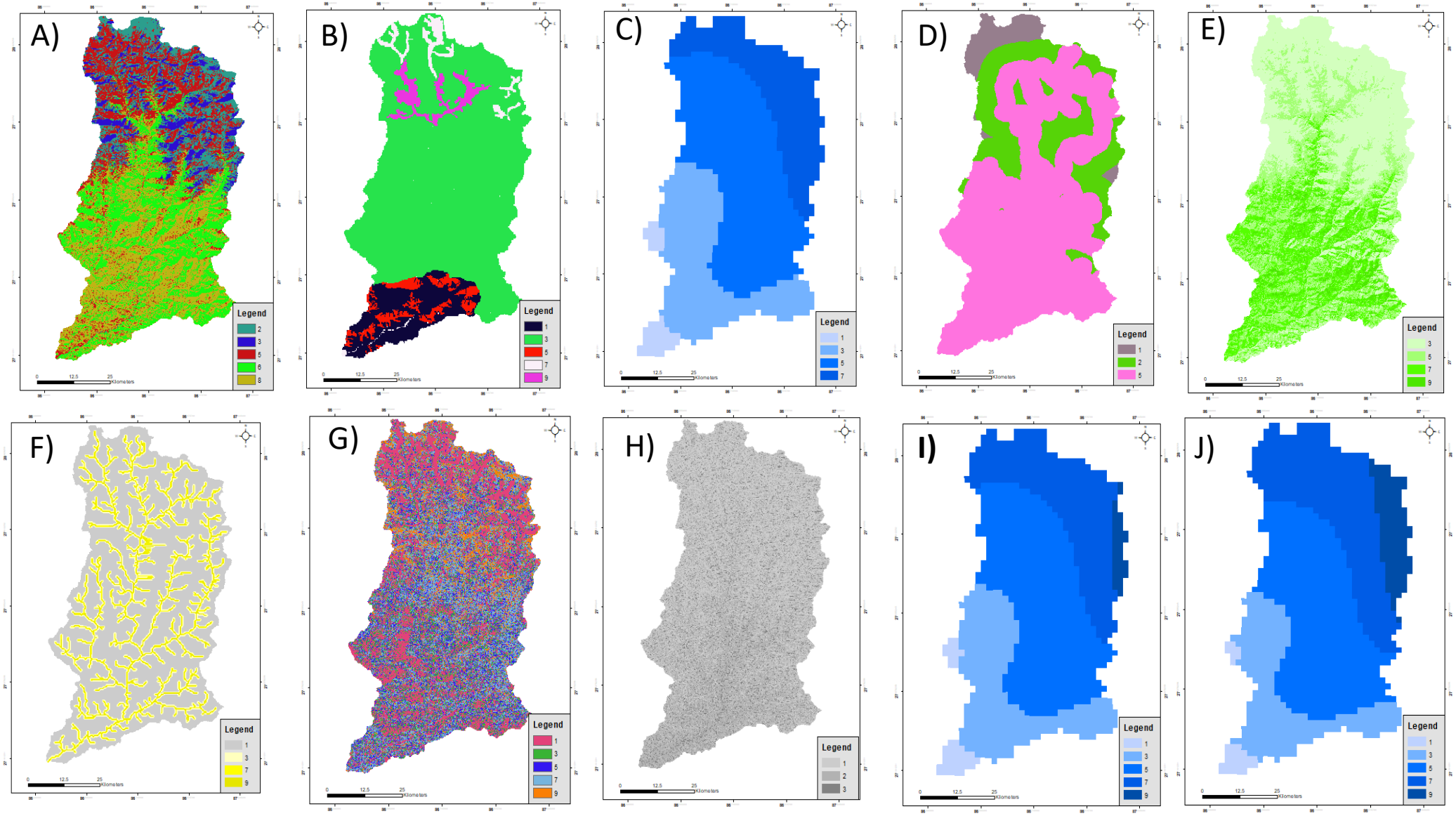
F-Drainage,

G - Slope

H- Terrain Wetness Index (TWI)

I –Rain (RCP4.5)

J - Rain (RCP8.5)



Method: Classification of Environmental Variables (Saaty 2008)

AHP Pairwise Matrix & Weight of the Factors:

Item Description	Slope	Precipitaiton	Soil Type	Landuse	Dist Road	Dist Drainage	TWI	NDVI	Weight	CR	CI
Slope	1	1	2	2	2	2	2	2	0.20	0.055	0.078
Precipitaiton	1	1	1	1	1	1	0.5	0.5	0.10		
Soil Type	0.5	1	1	1	2	1	1	0.5	0.11		
Landuse	0.5	1	1	1	1	0.5	0.25	1	0.09		
Dist Road	0.5	1	0.5	1	1	1	1	1	0.10		
Dist Drainage	0.5	1	1	2	1	1	2	2	0.14		
TWI	0.5	2	1	4	1	0.5	1	1	0.14		
NDVI	0.5	2	2	1	1	0.5	1	1	0.12		

Factors Weight:

$$WS = \sum_{j=1}^{n} Wj * Cij$$

WS=watershed susceptibility for area *i*,

W_j = relative importance weight of criterion,

C_{ij} = classified value area *i* under criterion *j*, and

n = number criteria.

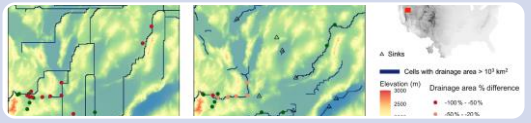
FACTORS causing Physical Vulnerability

SLOPE
(20 %)

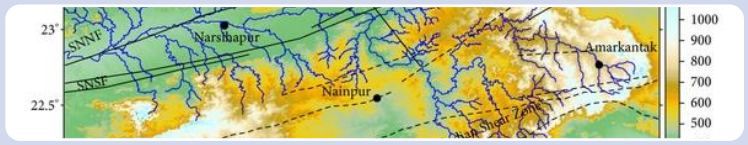
PRECIPITATION
(10 %)

SOIL TYPE
(11%)

LAND USE
(9 %)



DIST. TO ROAD
(10 %)



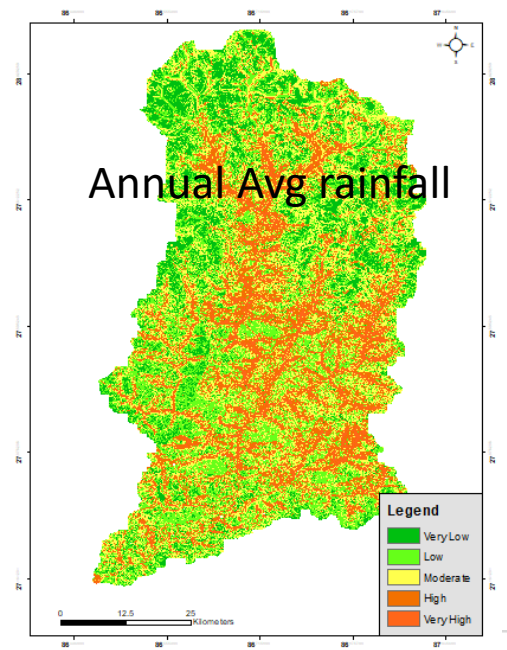
DIST. TO DRAINAGE (14%)

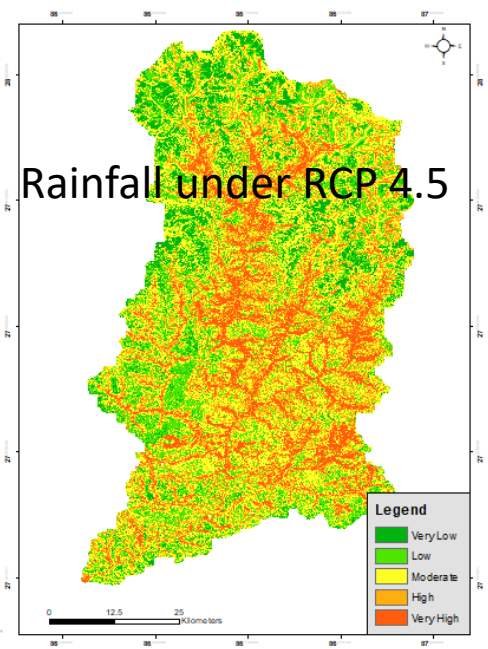
TERRAIN WETNESS (14%)

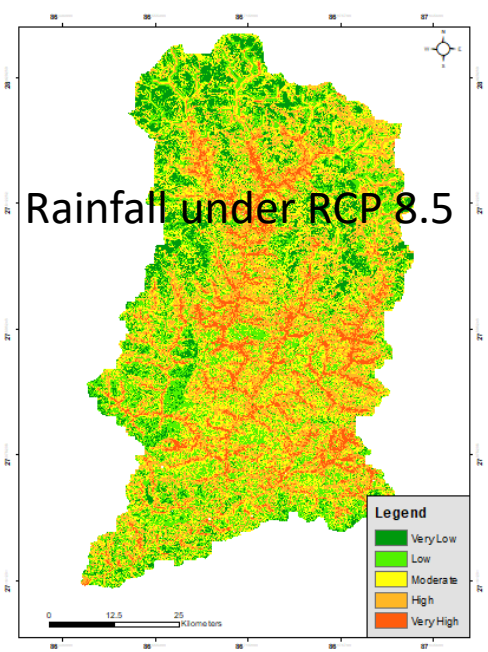
NDVI
(12 %)

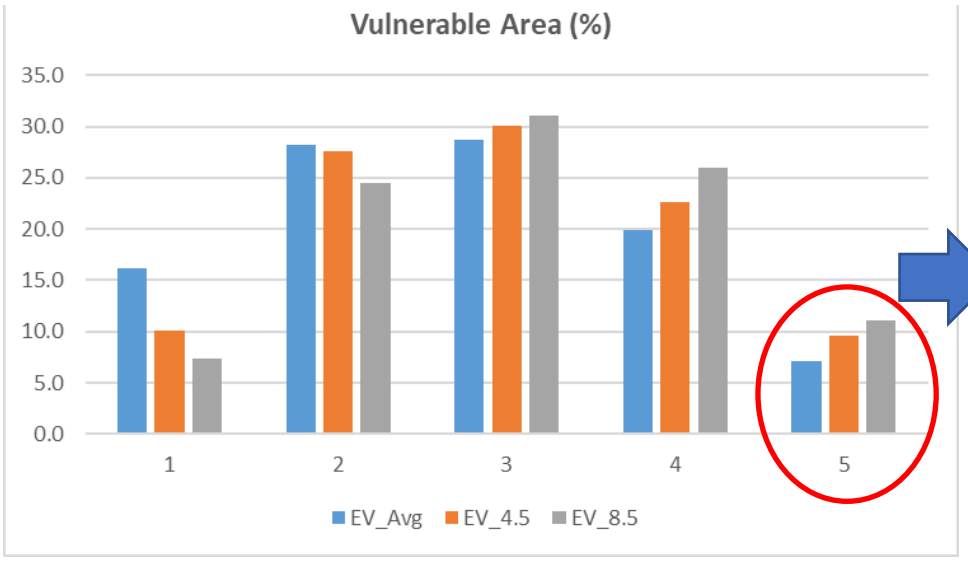
Results: Environmental Vulnerability

Increased Rainfall

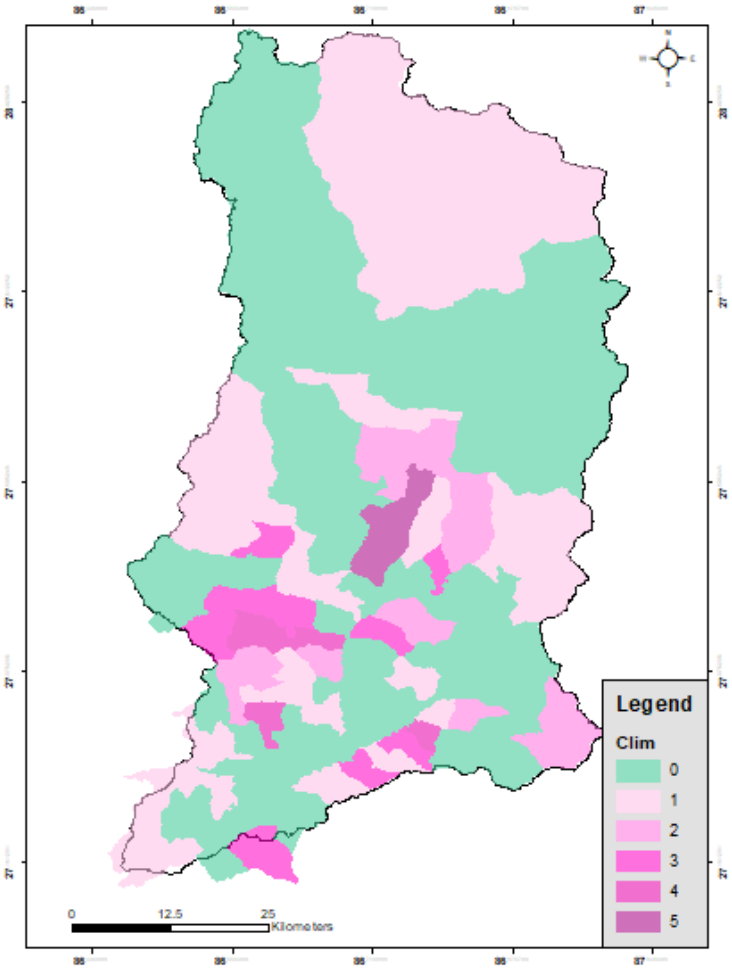






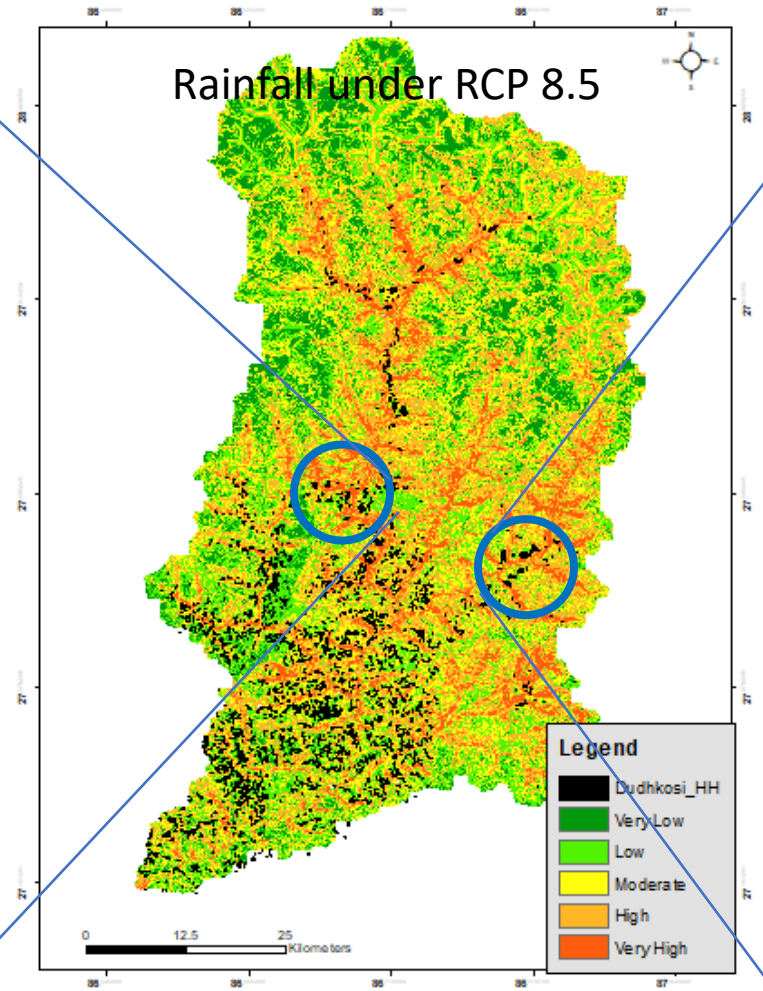


Increased rainfall also increased environmental vulnerability



Ward level Climate Induced Hazards in Dudhkosi Basin 2017-2020 (Govt. of Nepal)

Results: Environmental Vulnerability



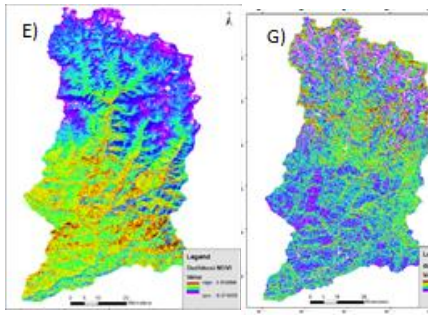
Out of 63266 HH, 15816 HH (~25%) are under the high to very high vulnerable area (RCP 8.5)

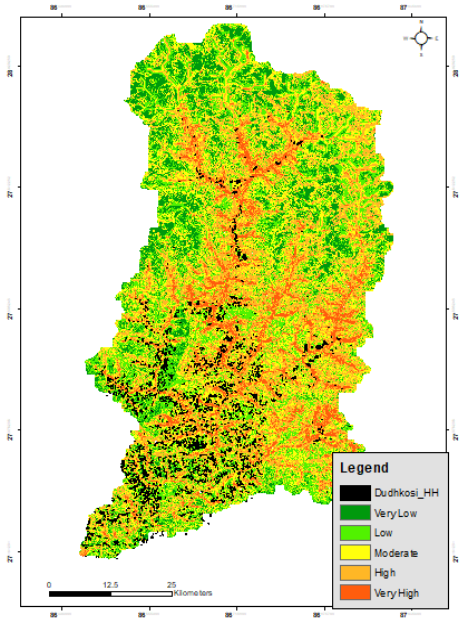
Conclusion

- **Slope factor** has the highest contribution **(~20%)** for the landscape to degrade followed by **distance to drainage and Terrain Wetness Index (~14%)** – indicated the importance of **risk sensitive land use plan** and **water resource management** to reduce the physical environmental vulnerability of the landscape of Dudhkoshi Sub- basin;
- The **Haphazard road construction has 10% contribution** in the environmental vulnerability – it is important to assess the sustainable roadside slope protection measures including nature-based solutions (NbS);
- Climate change has caused **to increase** the **rainstorms that triggers** soil erosion, landslides and debris flows which increase the degraded lands , decrease land productivity and quality of lives ;
- **25% of the households** of the basin are located in **high to very-high vulnerable areas** needing integrated approach for climate risks assessment and implementation of **suitable CCA, DRR and NbS measures** for climate/ disaster resiliency;

Recommendation : Integrated approach for Building Climate Resilience

Science and People's Knowledge based **Multi Hazards RISK ASSESSMENT and Mapping**





CAPACITY BUILDING
(Community- youth and Local Govt. Officials' Empowerment)

DRR , NbS , CC Mitigation and Adaptation Measures

Mainstreaming NbS, CCA and DRR in the sectoral planning process

Coordination, Linkages and Networking

Knowledge Sharing and Replication

Resilient Communities

Thank you for your Attention ! Feedback, questions are welcome !

NAMASTE from NEPAL

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