Climate Vulnerability Impact Assessment (VIA)Tools for Phewa Watershed in Nepal

Technical Support Training Workshop (TSTW)

Module 2

Madhav Karki, Team Leader & CCA Expert

Outline

- Climate vulnerability, impact, and adaptation
- Purpose of VIA
- Conceptual Framework: Integrated Approach
- Vulnerability Concept & VIA process
- Field Work & Methodology
- Vulnerability results
- Adaptation Results
- Discussion Points

A 2° or more warmer world, what does it mean for …

The purpose of doing VIA: overall

- To assess short-term effects and long-term impacts of CC not only on society but also on the ecosystem and the links between the two,
- To define the objectives and focus of adaptation using ecosystem services in the centre.
- To develop a knowledge base for developing human centred adaptation strategy for ecosystem management
- to develop adaptation strategies that reduce climate sensitive risks and enhance resilience of community & ecosystem

Specific purpose

- vulnerability assessment to be used also for:
  - Raising awareness (education) of the community ?
  - Developing Adaptation plans and programmes
  - Policy influencing and impacting? (e.g., to inform the planning decision of the new Gaun/Nagar palikas)
- Different kind of outputs are needed to do vulnerability assessment

UNDERSTANDING QUESTIONS, FRAMEWORK & DEFINITIONS

General Questions to Asked

- What is the source, nature and types of hazards and risks to or sensitivity and exposure to the communities?
- What will be the impact of climate Change on food, water, energy in the watershed?
- How vulnerable is food production/food security, water and energy supply to climate change and variability?
- What is the adaptation capacity/adjustment options for communities in the Phewa watershed?

Specific questions

- What are the key areas of concern?
  - Food production, water and energy supply, survival of tourism industry?
  - Concerns may not be expressed in climate terms, e.g., extreme temperature and rain, but in consequences of climate change for people
- Who in the watershed may be most affected?
- How far into the future is of people's concern?
  - In Panchase, peoples' concerns focused on current risks and hazards (which could be made worse by climate change)

Questions to ask to yourself

- What resources are available to conduct the study?
  - Money
  - Staff
  - Expertise
- How much time is available?

Basic Approach of doing VIA

- Establish past (20 years) and current status of climate
- Find model of future trends - 20 years - under climate change scenario in Nepal
- Use findings from 1 and 2 determine vulnerability - discuss results with communities and other stakeholders.
- Work out adaptation strategies and implementation schemes at different levels – includes active stakeholder participation.
- Communicate results widely in the watershed at local, provincial and national level.

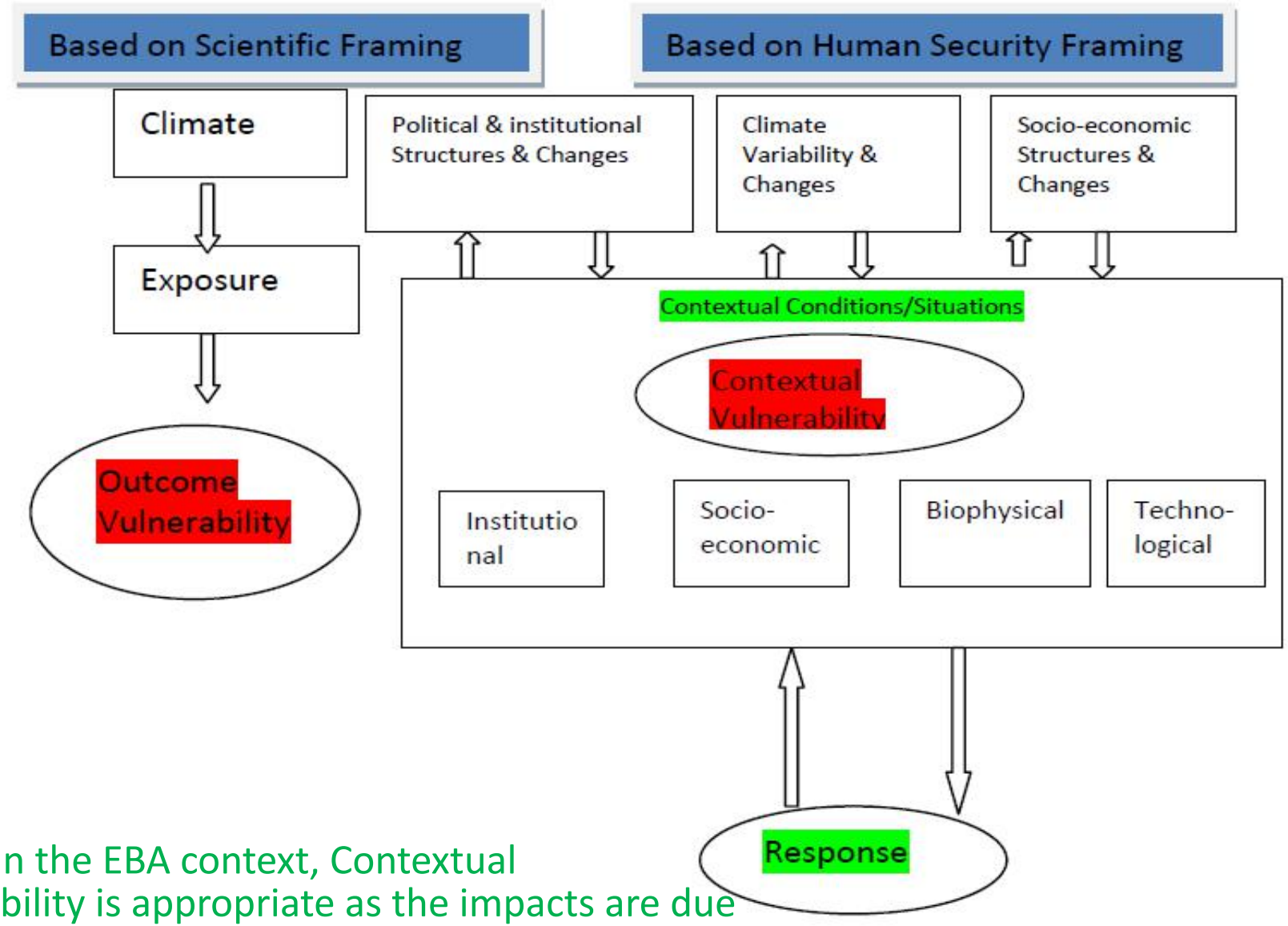
Identify Constraints and Problems

- Climate information sharing service of the Govt agencies
- Interpretation and Awareness Raising by the NGOs/CBOs
- Formal and Informal Institutional support to the communities
- Human resources, capacity, technology and finance available to implement the solutions

VIA Concept, Process, Component Definitions for Developing the VIA Tools

Different Interpretation of Vulnerability

(Source: O'Brian et al, 2007)



Note: In the EBA context, Contextual Vulnerability is appropriate as the impacts are due to surrounding changes and existing conditions:

Conceptual Definitions (1)

- **Vulnerability (V)** is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes; is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC 2007).

- **Resilience (R)** is the ability of the Connected Human-environment System to adapt on its own or naturally to the impacts of climate change.

Definitions (2)

- **Human or Landscape exposure (H/LE):** indicates how exposed population and biodiversity may be in a particular location based on a series of exposure-buffering features including metrics derived from habitats or settlements, social, economic, topographic, hydrologic, and geographic datasets.

LE= topography+ hydrology+ geography (t+h+g)

- **Adaptive constraint or gap (Act or Agt):** measures how fragmentation and land use change can reduce the adaptive capacity of the human beings, ecosystem and species; Adaptive constraints is the inverse of adaptive capacity, since, like impacts, it positively influences vulnerability.

Conceptual Definitions: (3)

(Source: Kirk r. Klausmeyer et al, 2011; also see Williams et al. (2008))

- **System Exposure (E):** The nature and degree to which a System is exposed to significant climatic variations.
- **System Sensitivity (S):** The degree to which a System is affected, either adversely or beneficially, by climate-related stimuli. [. . .] The effect may be direct [. . .] or indirect [. . .]
- **Adaptive Capacity (Ac):** The ability of a System to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Conceptual definitions (4)

- **Climate Stress (Cs)** combines an estimate of exposure from the projected regional climate changes and an estimate of the sensitivity of biodiversity in an area from a coping range derived from historical climate variability.

Cs= E+S

- **Climate stress, landscape exposure, and adaptive constraints** are combined to estimate System's (ecosystem+social system) vulnerability to climate change based on landscape-scale indicators.

V = Cs+LE+Act

Conceptual Definitions (5)

- **Landscape sensitivity (LS)** is a function of the ecology, physiology, and genetic diversity of a species, which are in turn influenced by external factors like resource management and habitat changes.

LS = f(Eco+Phy+NRM+Hc(habitat change)

- **Impacts** (I) at landscape level are a combination of exposure and sensitivity to climate change, but can be mitigated by micro-habitats and topographic buffering.

I = LE+LS–Nr (Natural Resilience)

Conceptual definitions (6)

- **Vulnerability Reduction (VR)** can be achieved by the adaptive capacity of the species, which is also a function of the ecology, physiology, and genetic diversity.

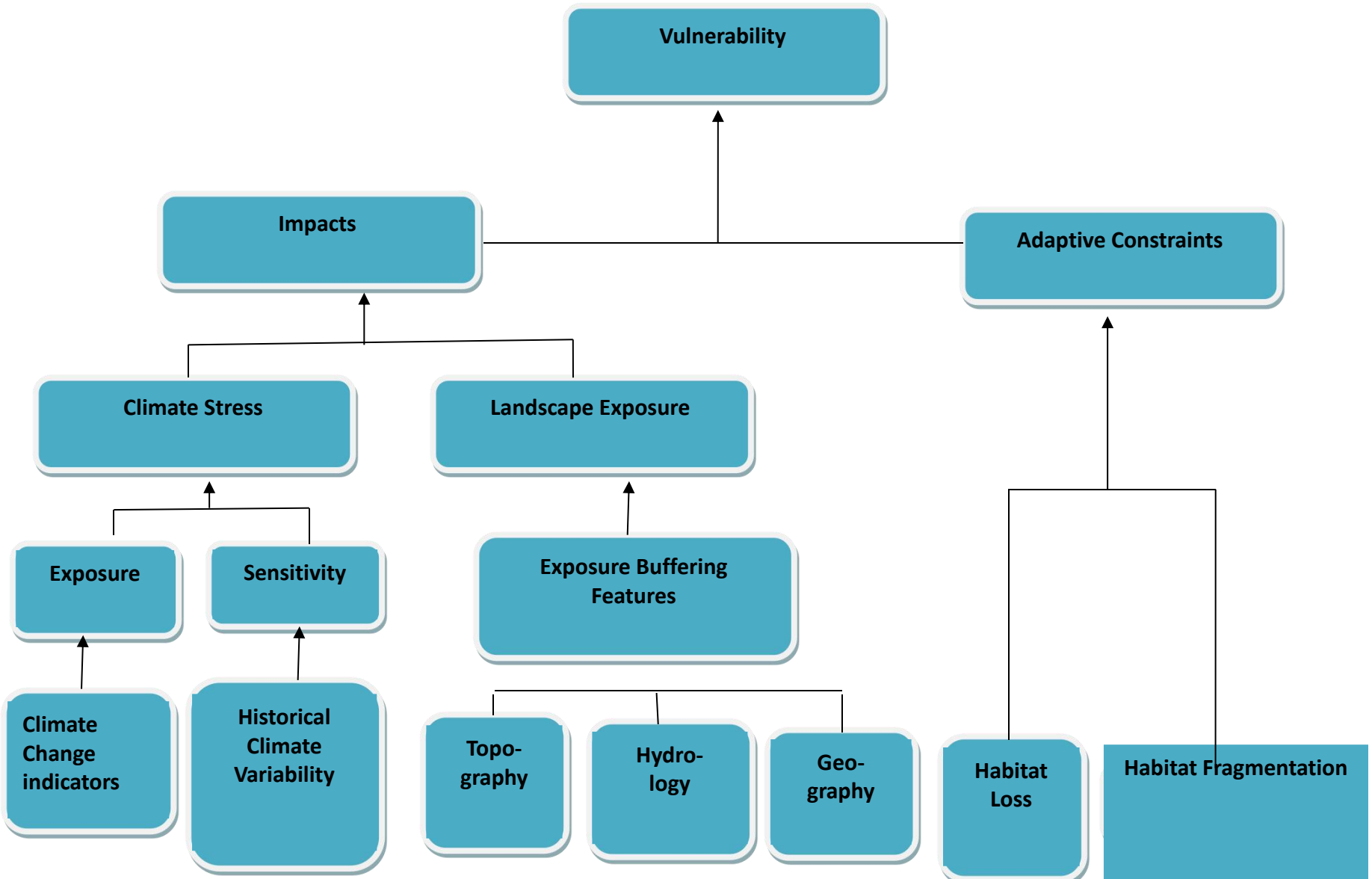
VR=Ac (capacity) = F(Eco+Phy+GD)

- **Landscape vulnerability (Lv)** is a function of climate change related impacts and the adaptive capacity/adaptive constraints of the species/landscape.

Lv= I+ Act or = I-Ac

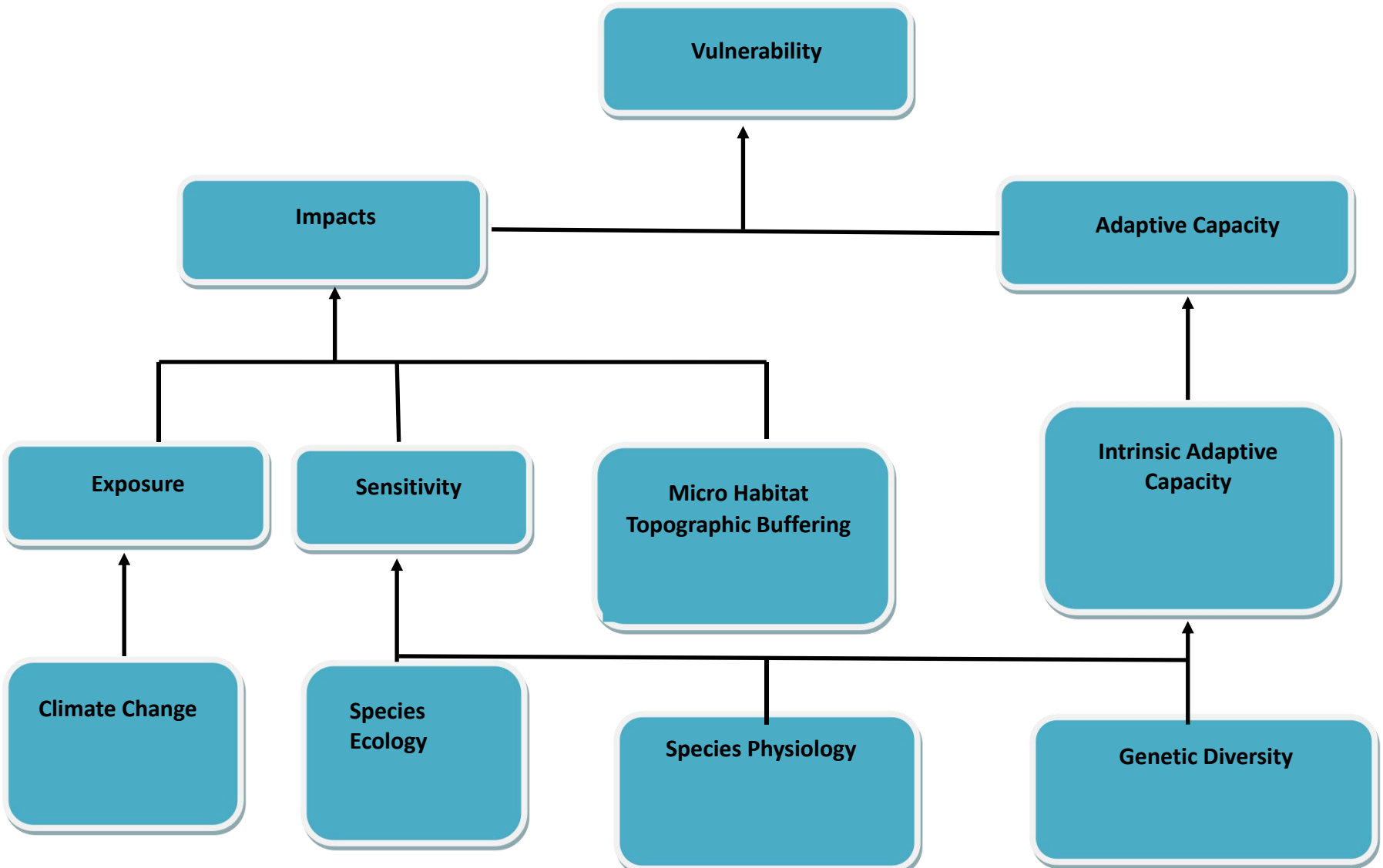
Landscape-based Vulnerability Assessment

(adapted from Klausmeyer et al 2011)

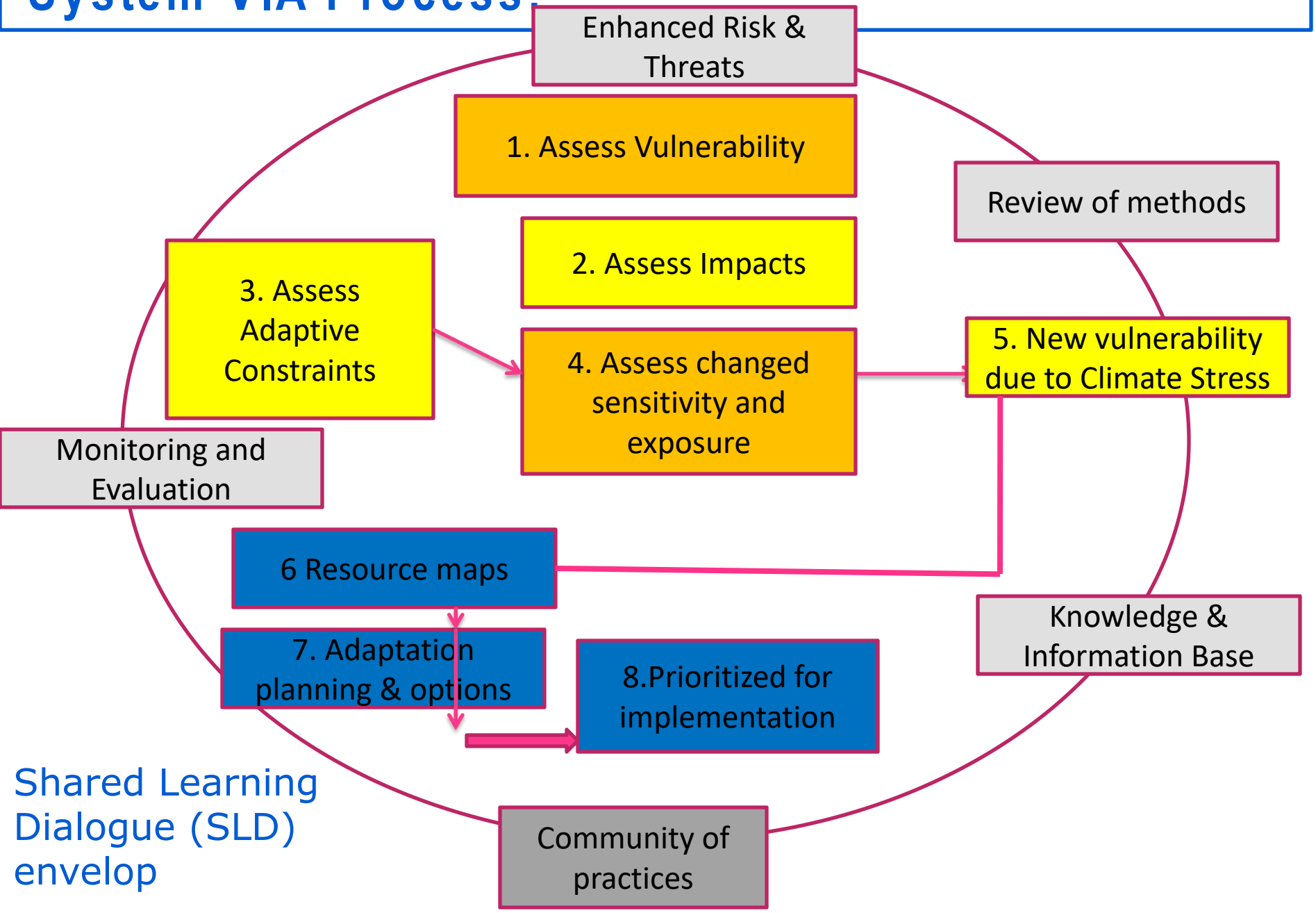


Species-based Vulnerability Assessment

(adapted from Klausmeyer et al, 2011)

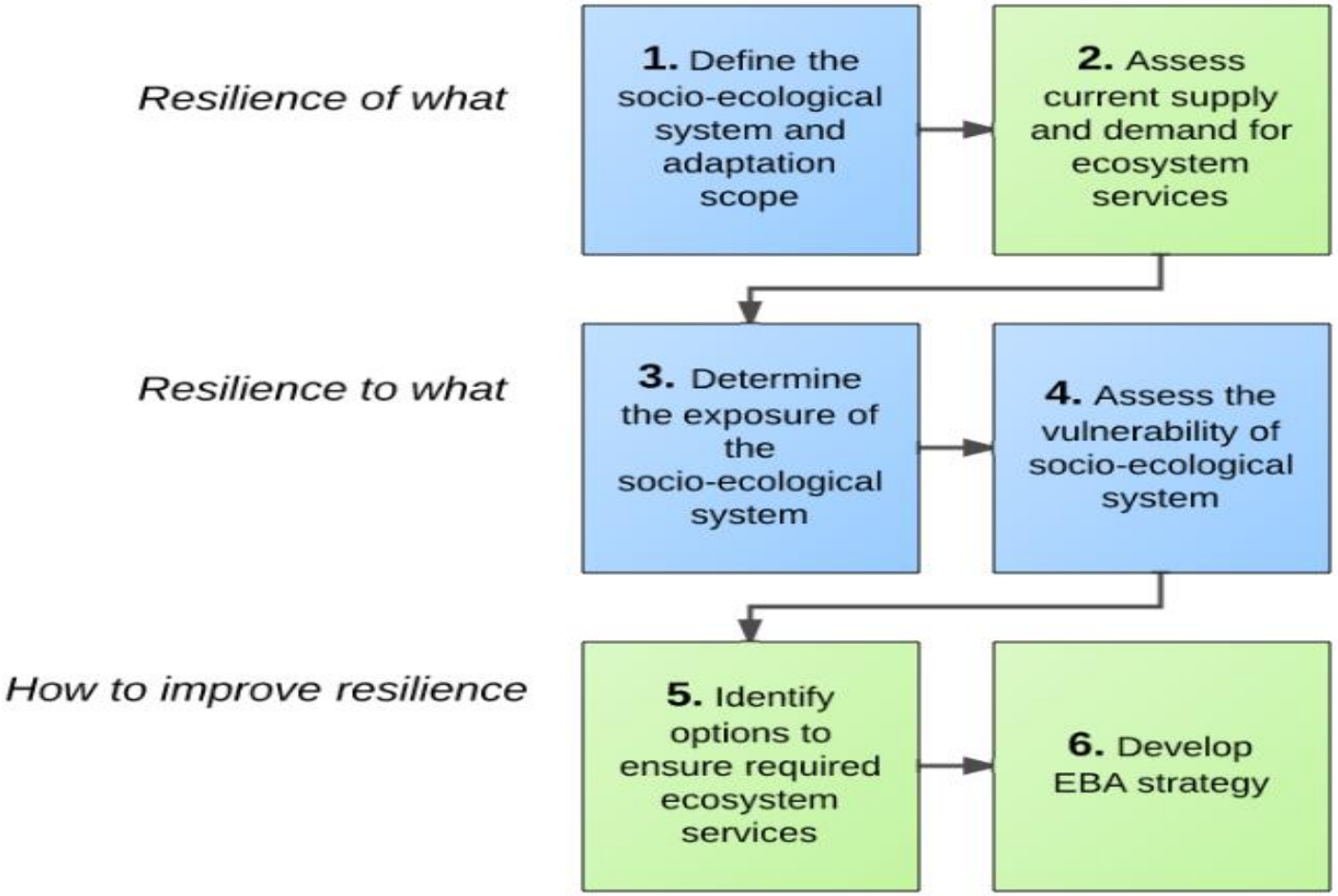


System VIA Process:



Shared Learning Dialogue (SLD) envelop

General Process of VIA for EBA planning and implementation (UNEP/WCMC Guidelines)



Steps for Local System-based Vulnerability Assessment (VIA Tools for Panchase) (Adapted from UNDP V/A Tools and KIRK R. KLAUSMEYER et al Landscape VIA Tool

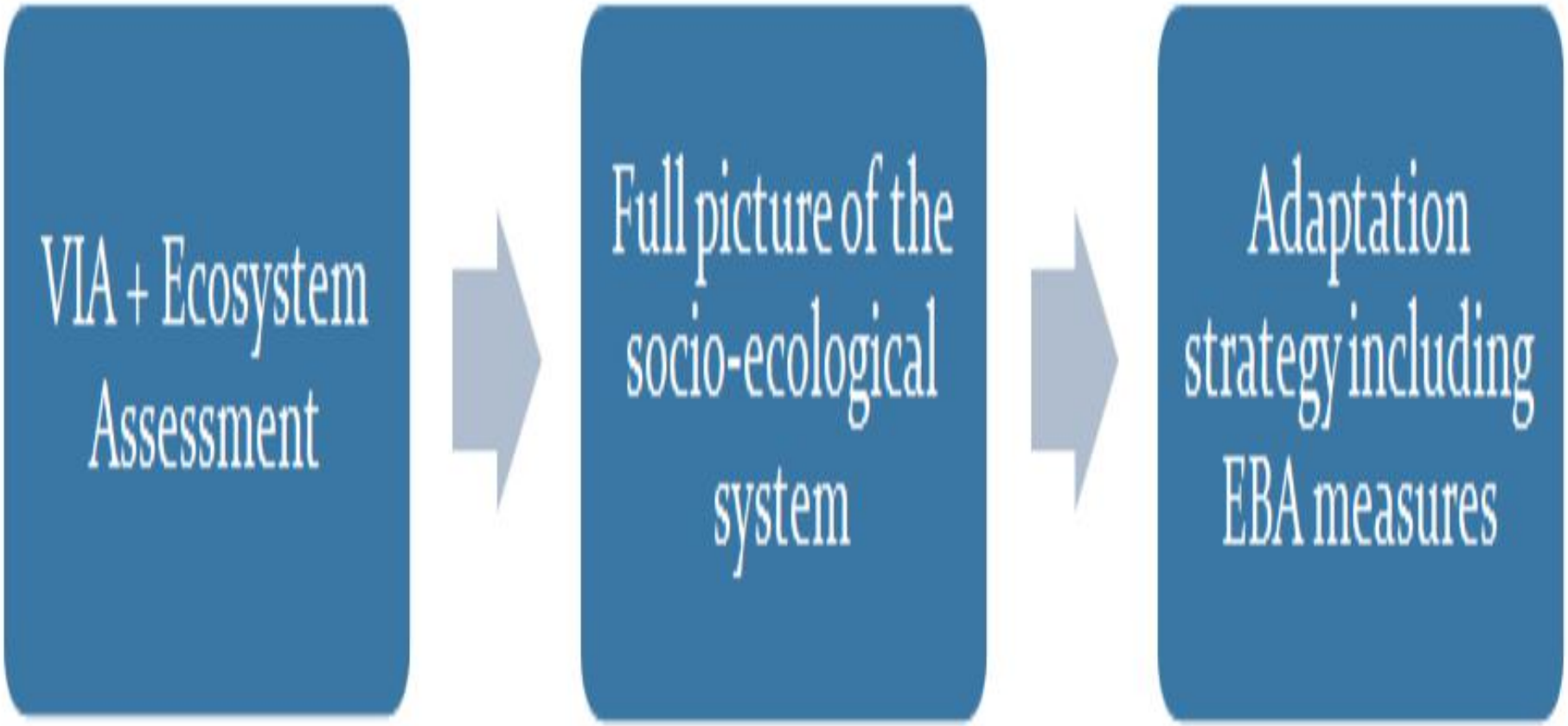
1. Participatory Resource Mapping
2. Adaptation Capacity/Constraint Assessment
3. Vulnerability Trend Assessment
4. Current Climate Vulnerability Mapping
5. Landscape Level Vulnerability Mapping
6. Community-level Climate Change Perception
7. Participatory Scenario Building
8. Adaptation Planning and Visioning (Shared Learning Dialogue)
9. Adaptation Strategy Development

FIELD WORK INSTRUMENTS, METHODS AND PRELIMINARY RESULTS

Panchanse Protected Area Boundary

VIA of the Society & Ecosystem

(Source: UNEP/WCMC Guidelines)



Landscape Vulnerability Components & Reduction Strategy

The primary components of the system vulnerability assessment framework are:

a. Sensitivity (Se),
b. Climate Stress (Cs),
c. Landscape Exposure (Le),
d. Adaptive Capacity (Ac) or
e. Adaptive Constraints (Acst) (Inverse of Ac)

National Vulnerability Ranking and Index of Project Districts (MOEnv., 2010)

District	Vulnerability Index	National Ranking
Parbat	0.525	38
Kaski	0.389	54
Syangja	0.182	69

Sensitivity, Exposure & Adaptive Capacity Index (Source, MOEnv, 2010)

District	Sensitivity	Rank	Risk/ Exposure	Rank	Adaptive Capacity	Rank
Parbat	0.276	11	0.524	23	0.216	15 (moderate)
Kaski	0.419	3	.416	34	0.047	2 (High)
Syangja	0.204	42	0.235	60	0.212	14 (moderate)

Population Growth/Decline in Project Districts

Source: CBS, 2011

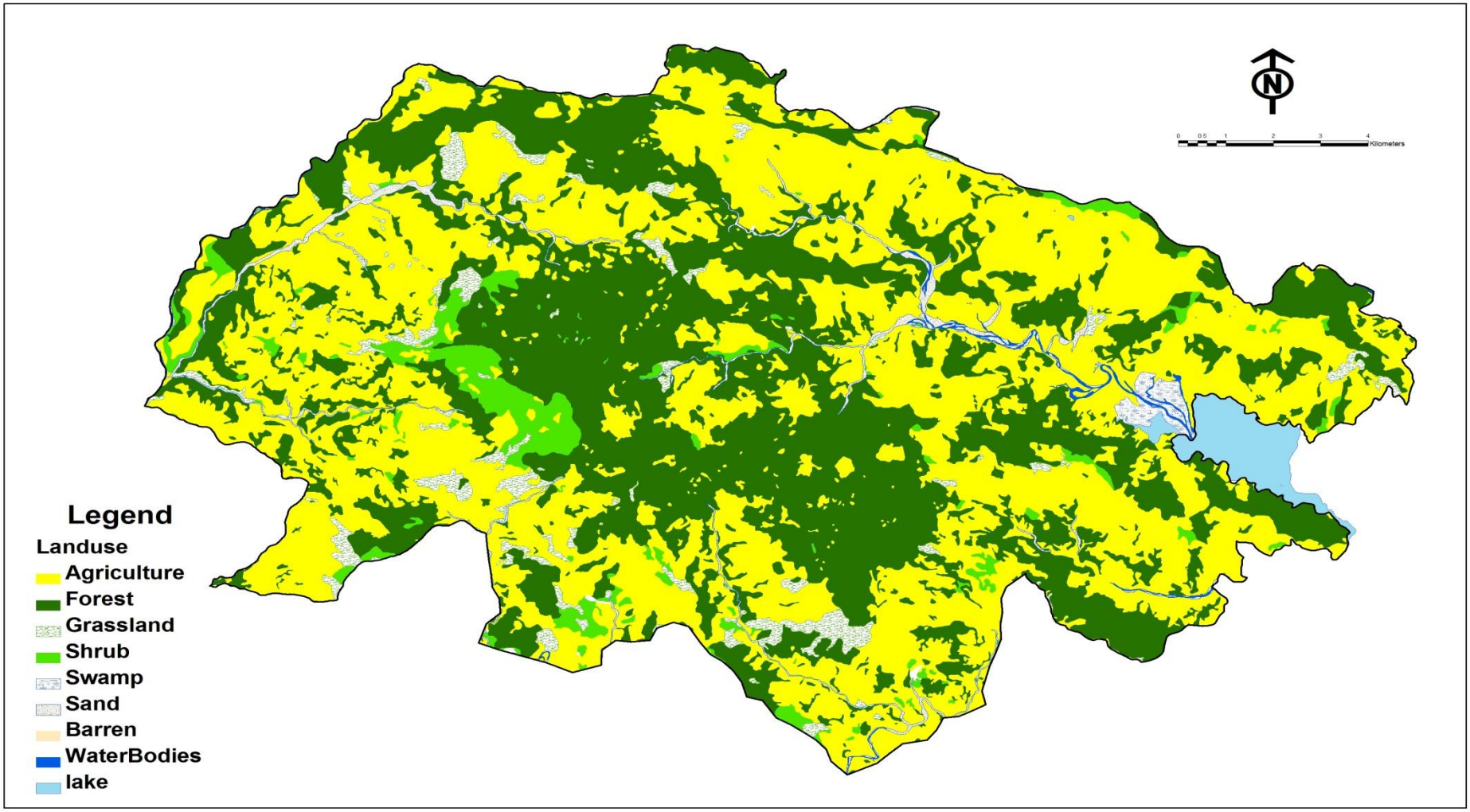
District	2001 Census figures	2011 Census figures	Rate of Pop. Growth
Kaski	380527	490429	+29% or +2.9%/anum
Parbat	157826	147076	-6.8% or -0.68%/anum
Syangja	317320	288040	-9.23% or -0.923%/anum

Panchase Conservation Area (VDC Boundaries)

Panchase Ecosystems: unique and challenging

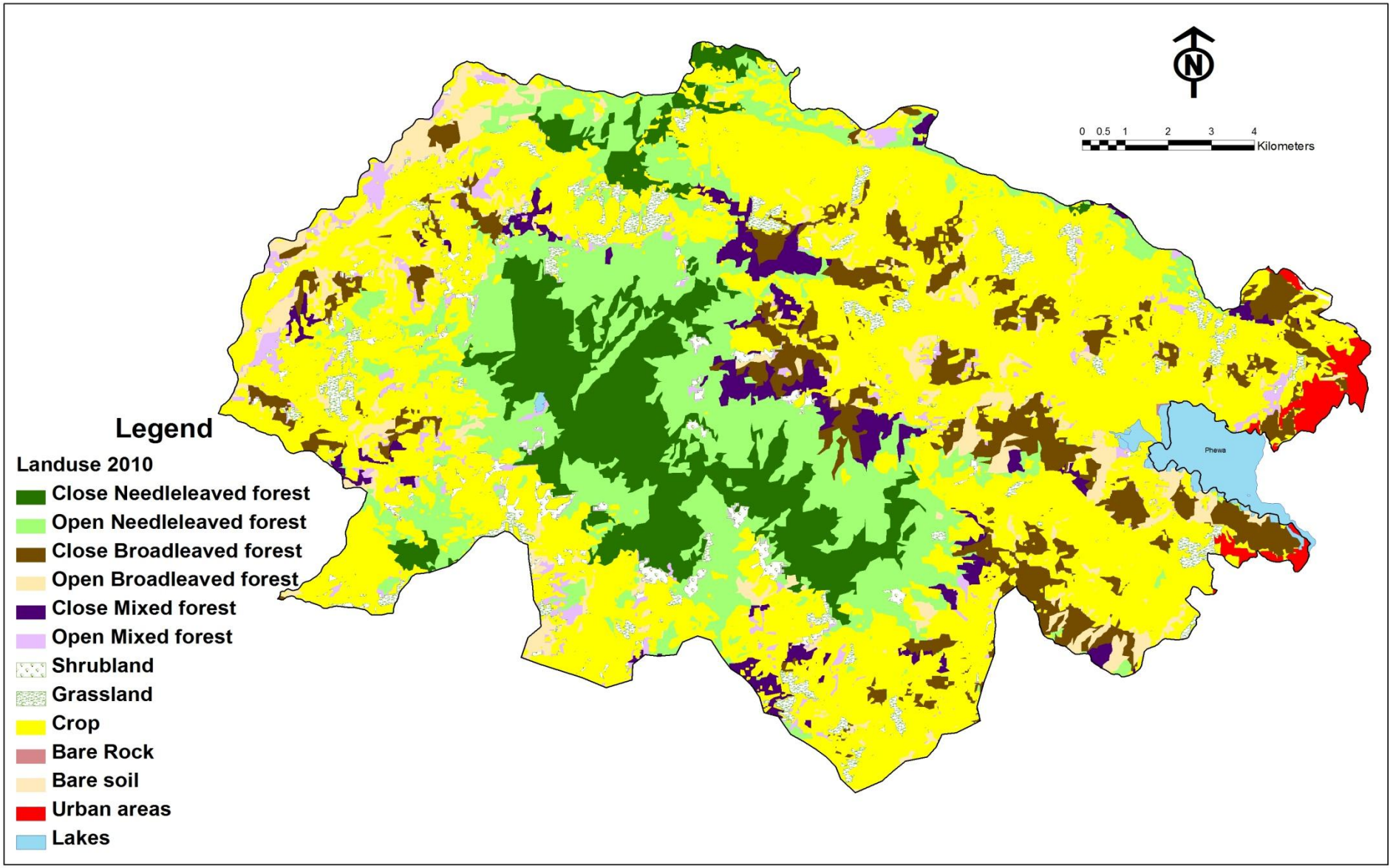
- Climatic conditions (e.g. sub-tropical-temperate);
- Geophysical conditions (e.g. mountainous);
- Dominant land use by humans (e.g. agriculture and –forestry ecosystem);
- Land cover – mainly forest, grassland, fresh water, and agriculture;
- Species composition (e.g. Oak-Castanopsis-Quercus forests);
- Resource management systems and institutions (e.g. protected and community managed forests, open grazing, mixed farming system).

Panchase Conservation Area (Land Use Land Cover Map, 1993)

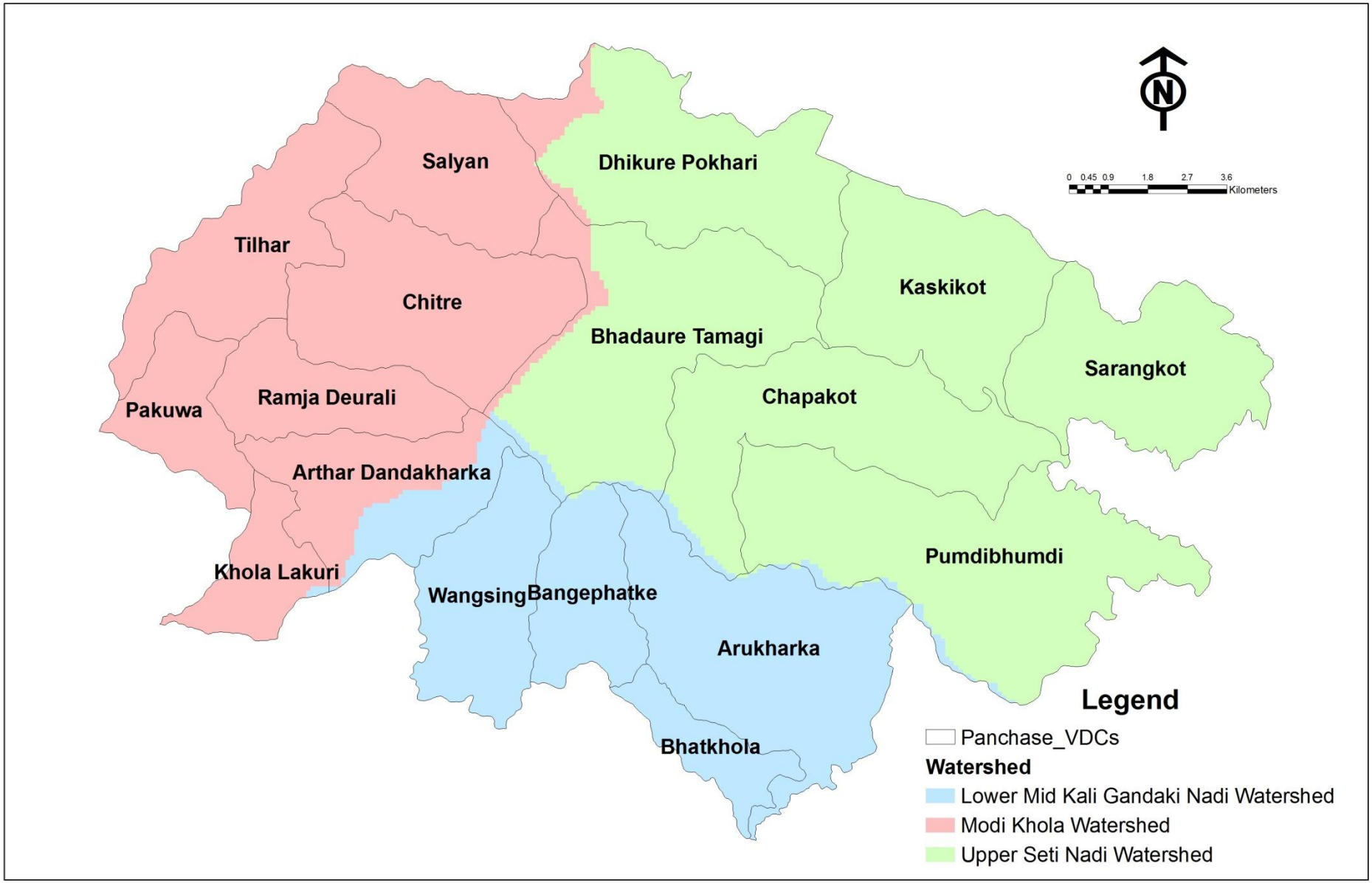


Panchase Conservation Area

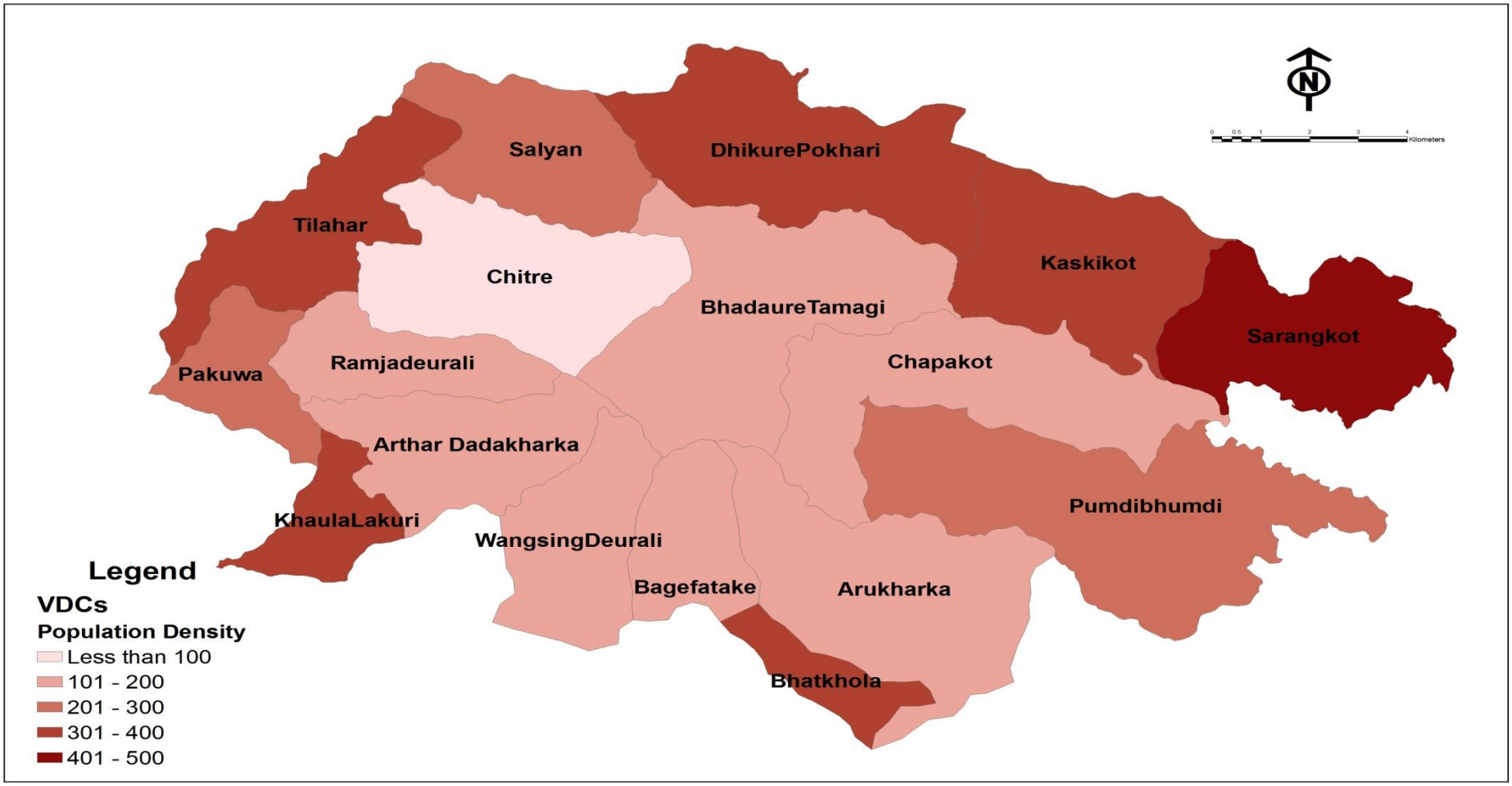
(Land Use Land Cover 2010) (Source: ICIMOD)



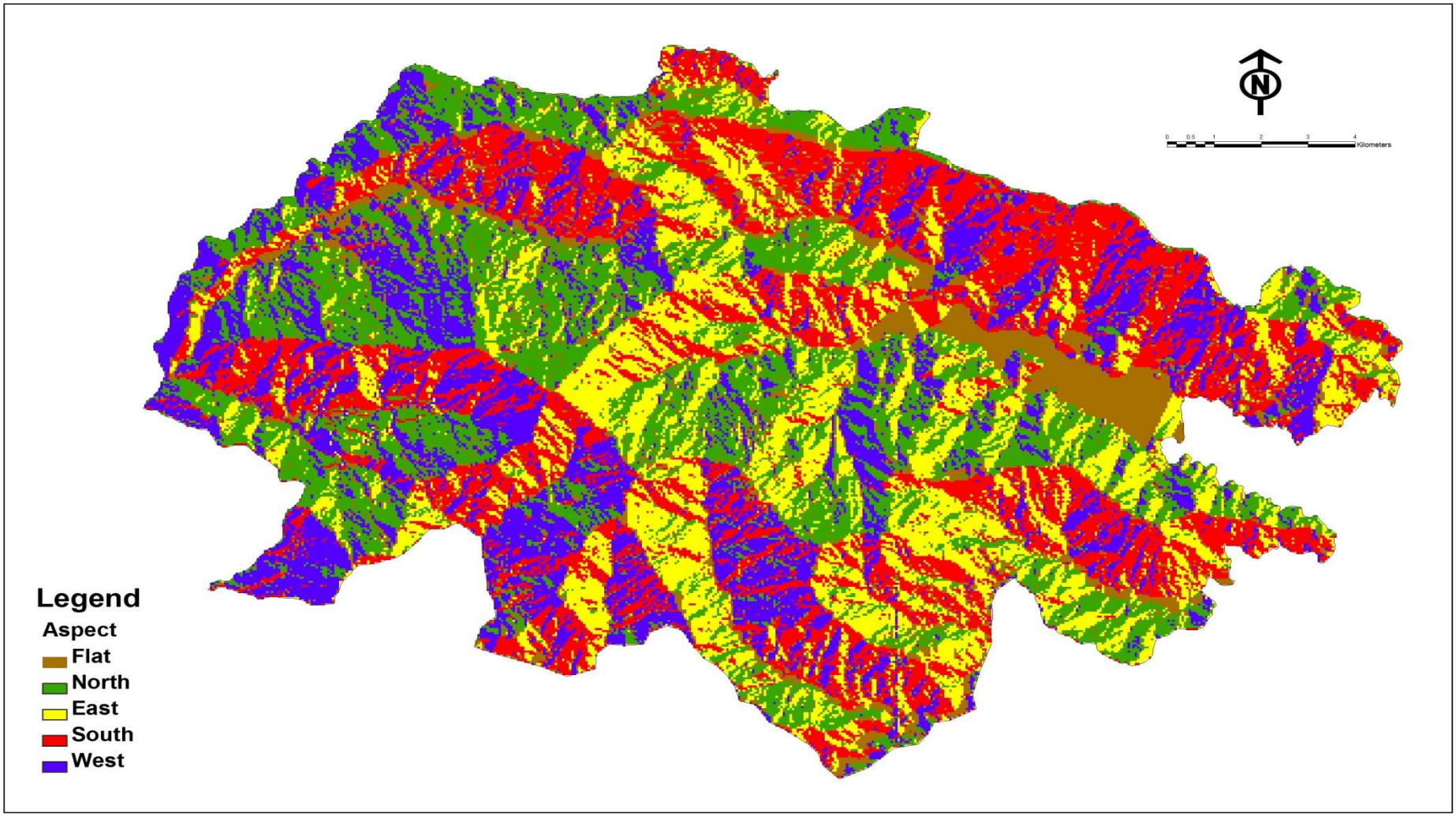
Panchase Conservation Area (Watershed boundaries)



Panchase Conservation Area (population density, 2011)



Panchase Conservation Area (aspect)



Panchase Conservation Area (elevation)

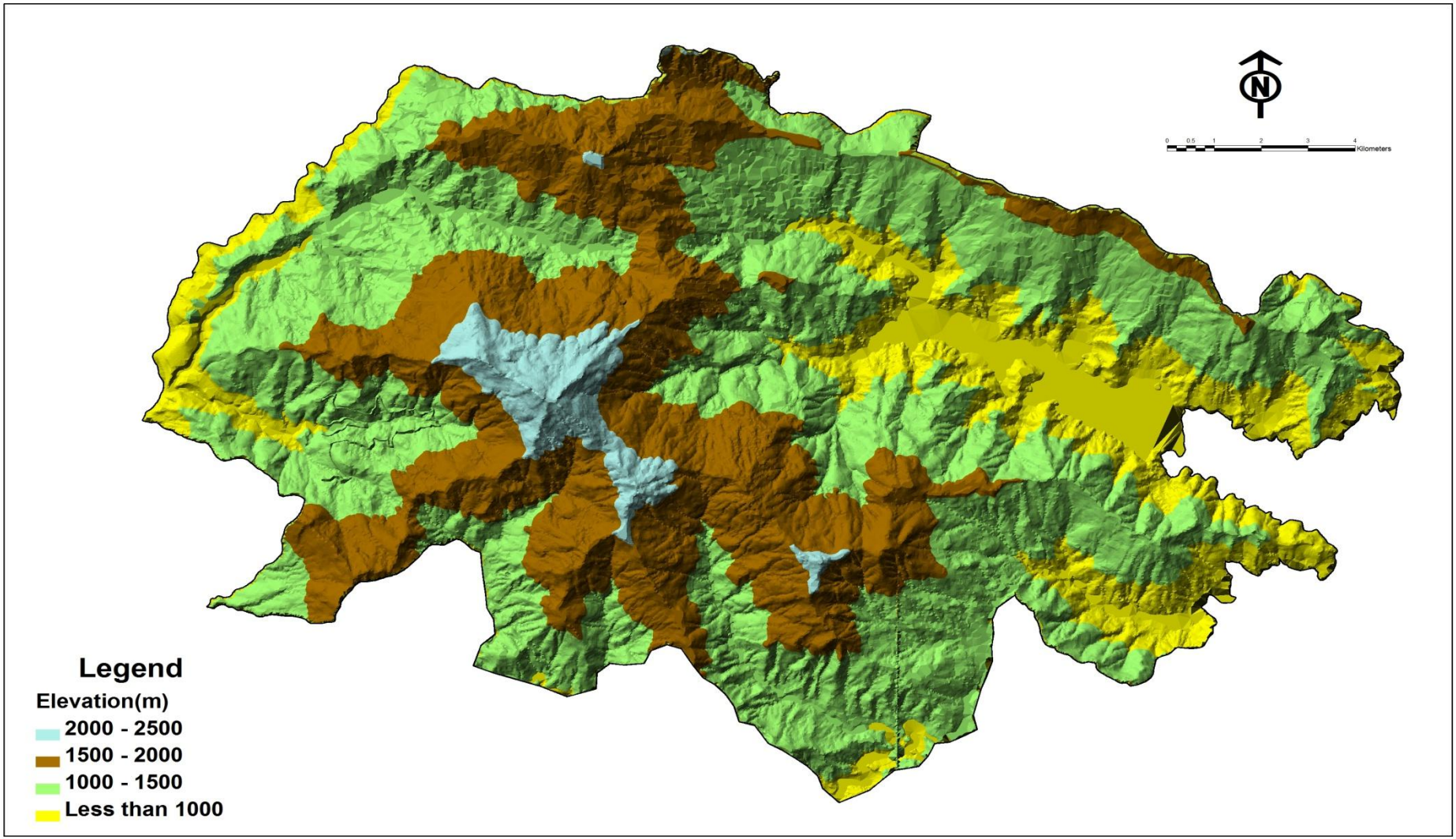
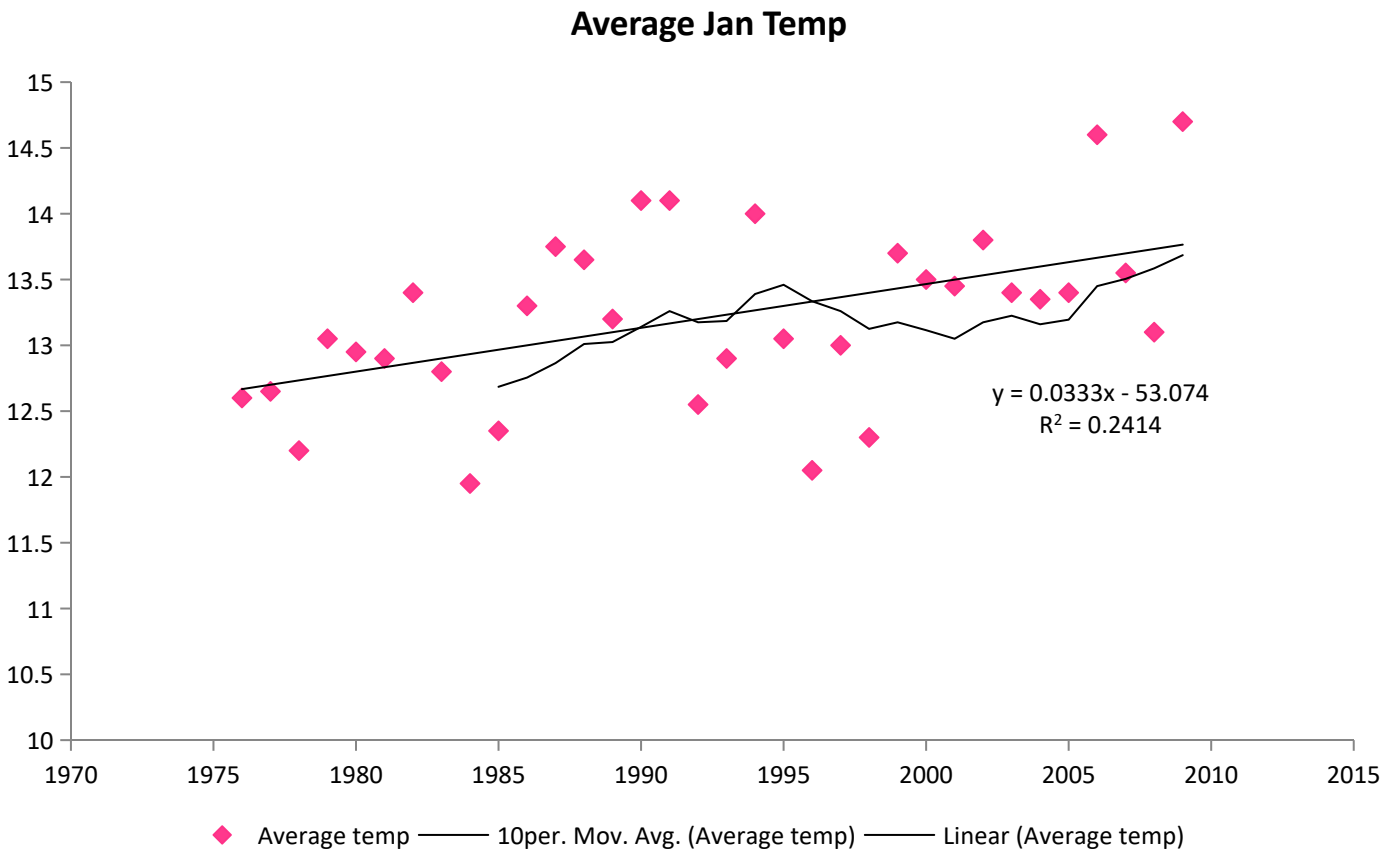


Table 1: Summary of station, available rainfall and temperature data and period of measurement

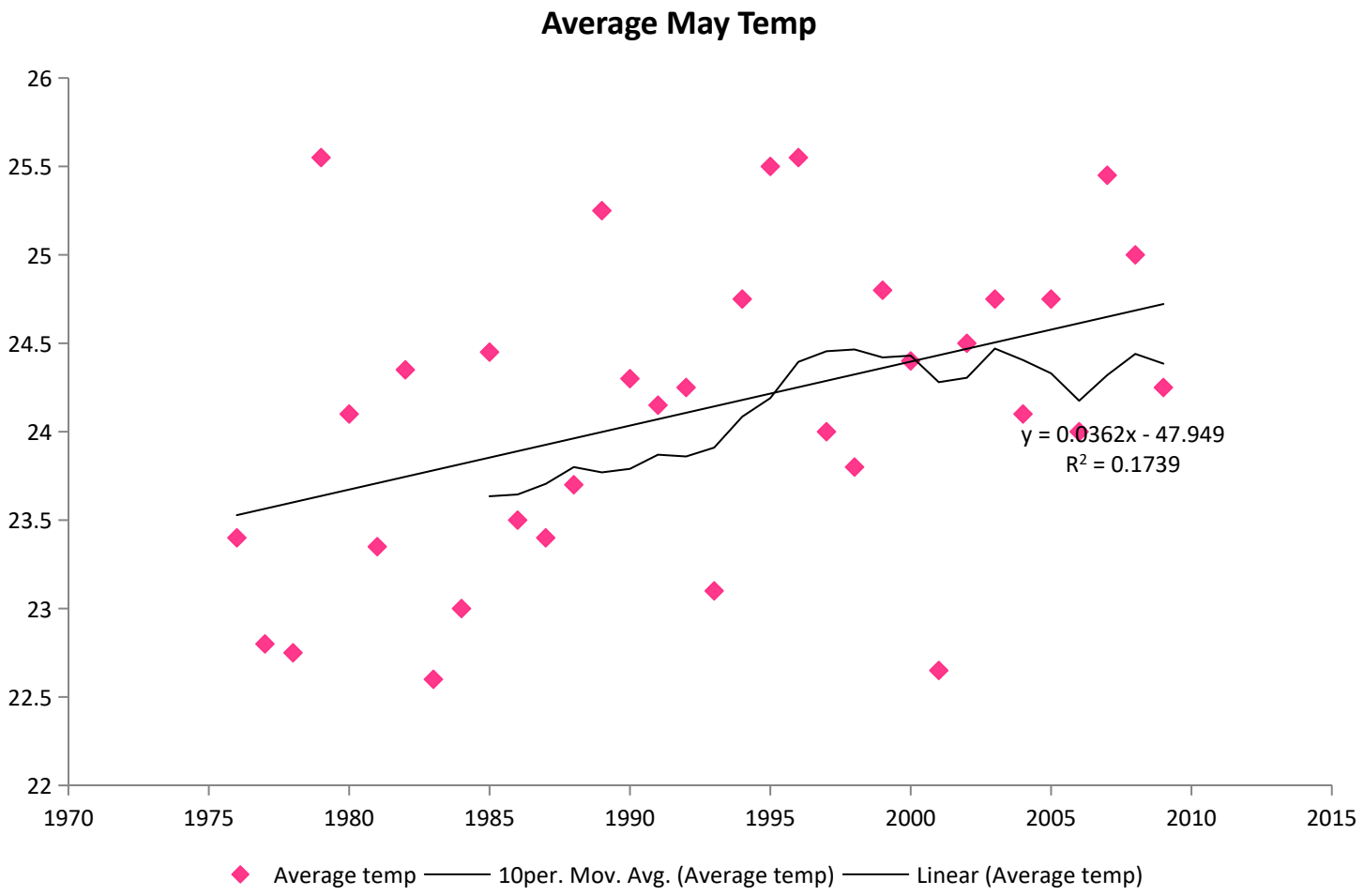
District	Station Code	Longitude	Latitude	Elevation	Rainfall	Temperature
Parbat	613	28.11	83.45	1720	1977-2009	
	614	28.13	83.42	891	1977-2009	1976-2009
	620	28.02	83.39	700	1977-2009	
	829	28.16	83.45	1000	1977-2009	
Kaski	804	28.13	84.00	827	1977-2009	1976-2009
	813	28.16	83.49	1600	1977-2009	
	814	28.18	83.48	1740	1977-2009	
	818	28.16	83.58	1070	1977-2009	
	821	28.23	83.48	1960	1977-2009	
	830	28.16	83.47	1160	1977-2009	
Syangja	805	2806	8353	868	1977-2009	1979-2009
	810	2753	8349	460	1977-2009	
	826	2759	8346	750	1989-2009	

Temperature Trend – Kaski (804)*

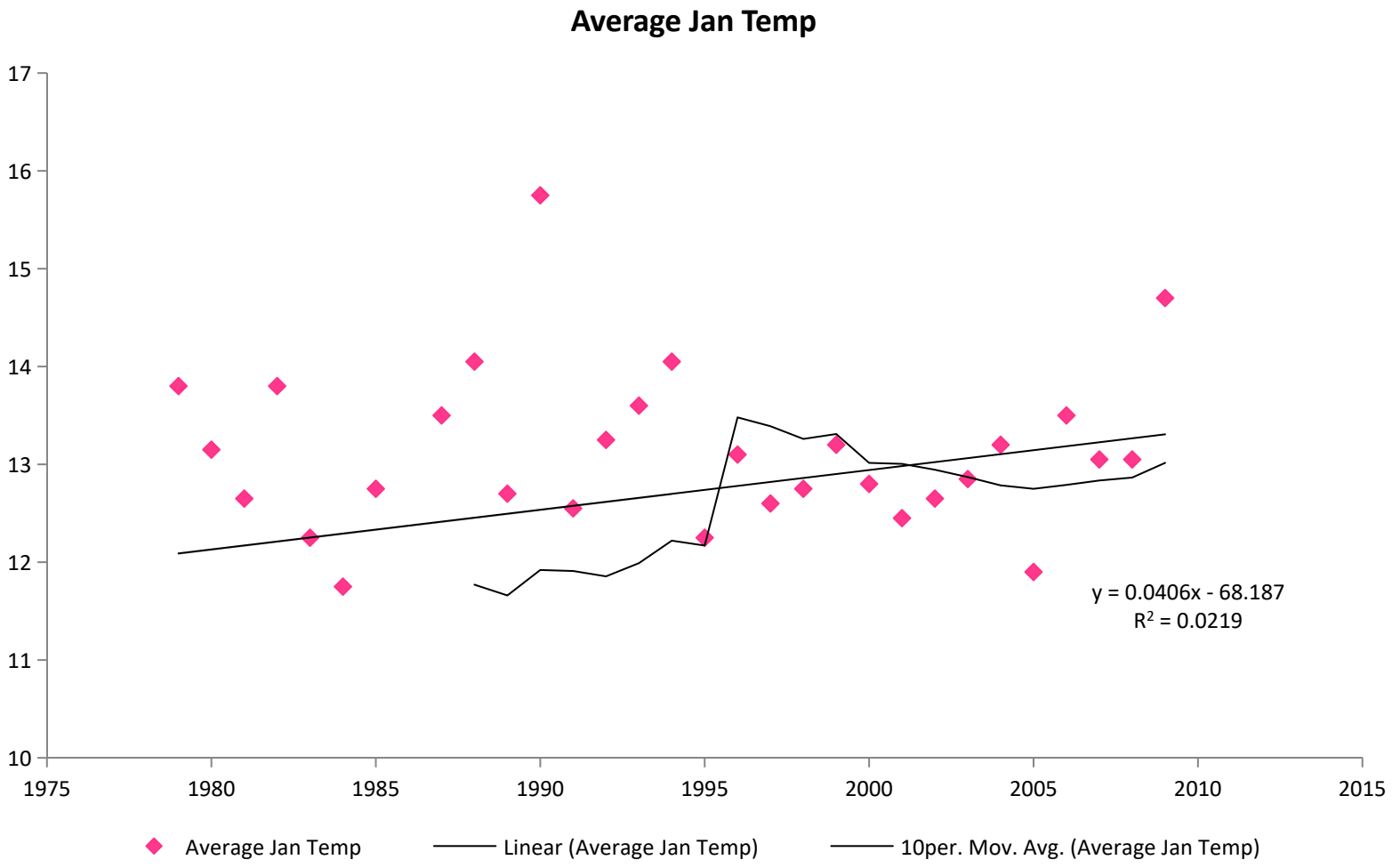


* The number in the bracket is the DHM Station Number

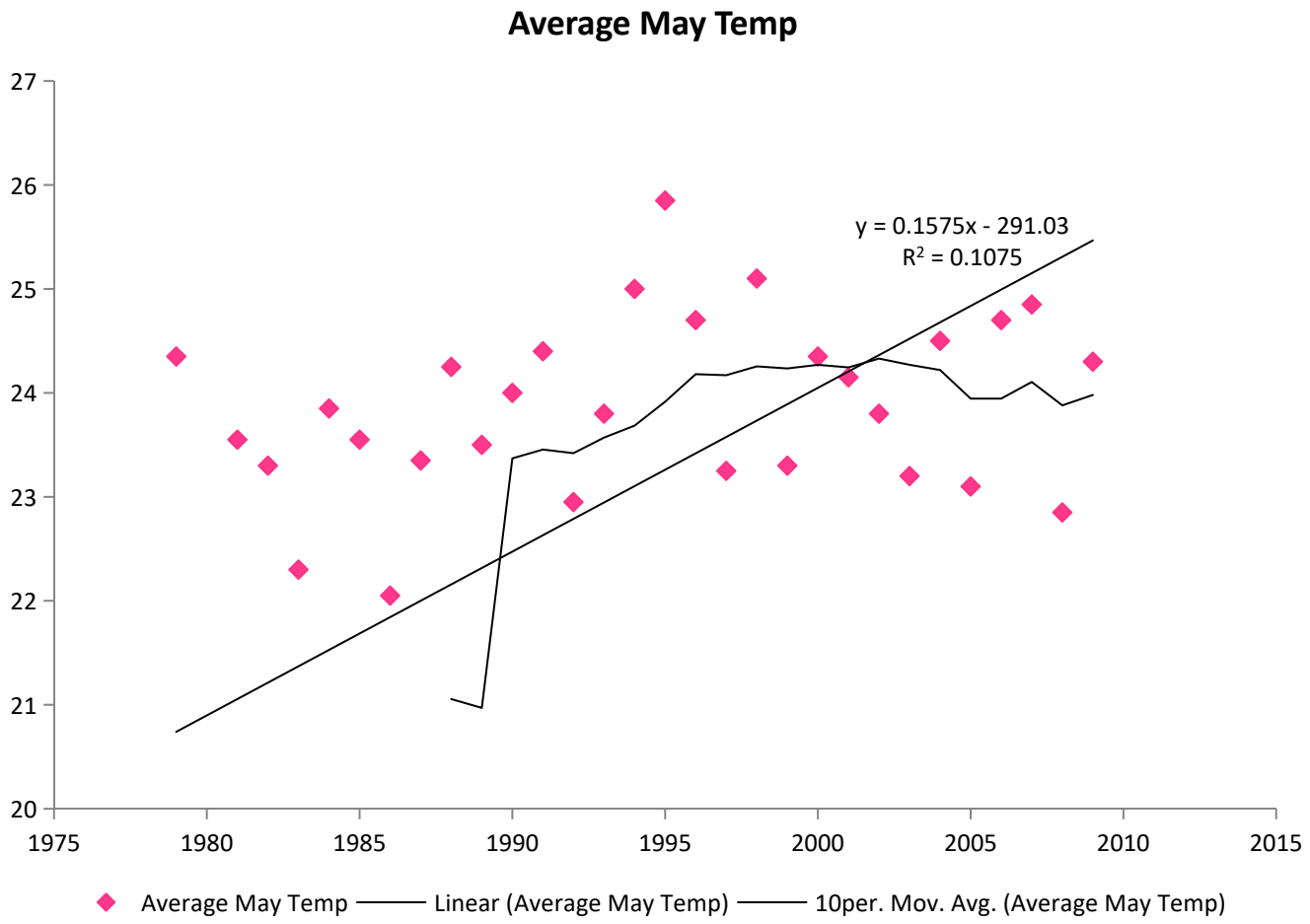
Temperature Trend Kaski (804)



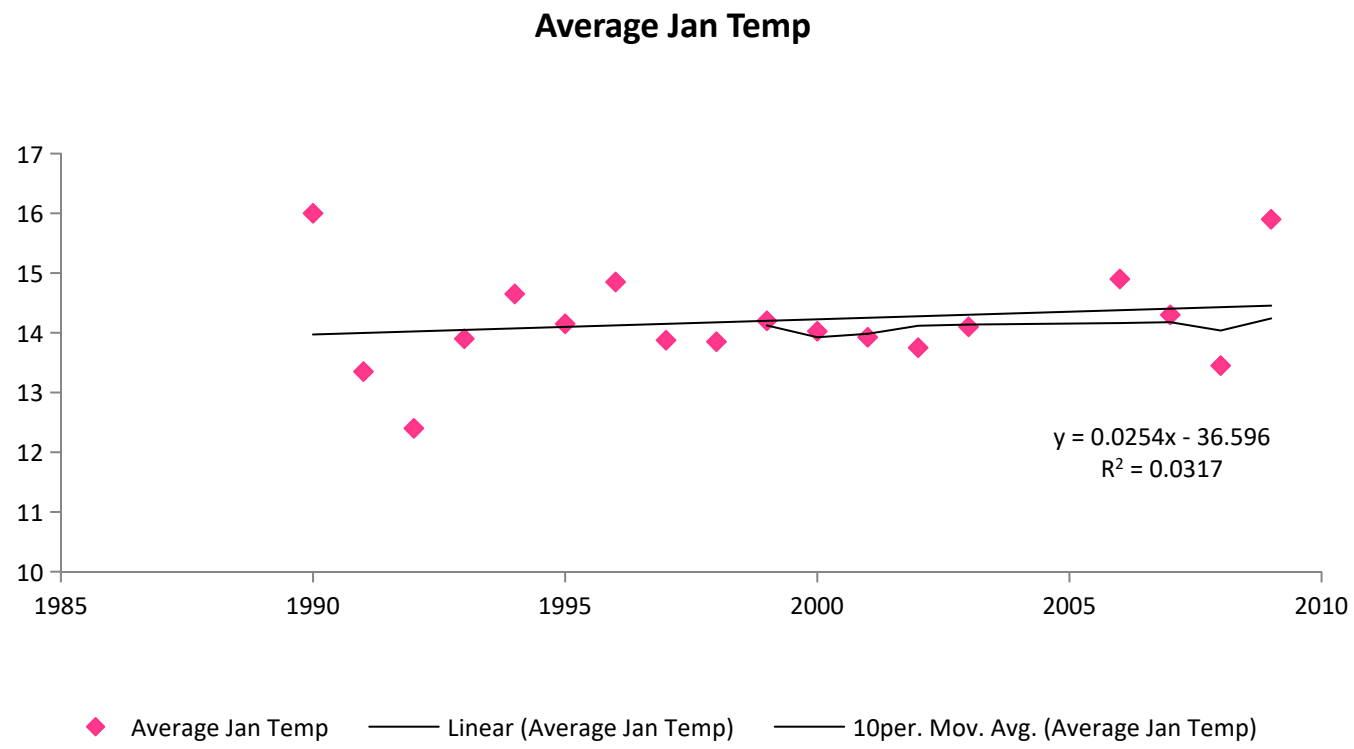
Temperature Trend, Syangja (805)



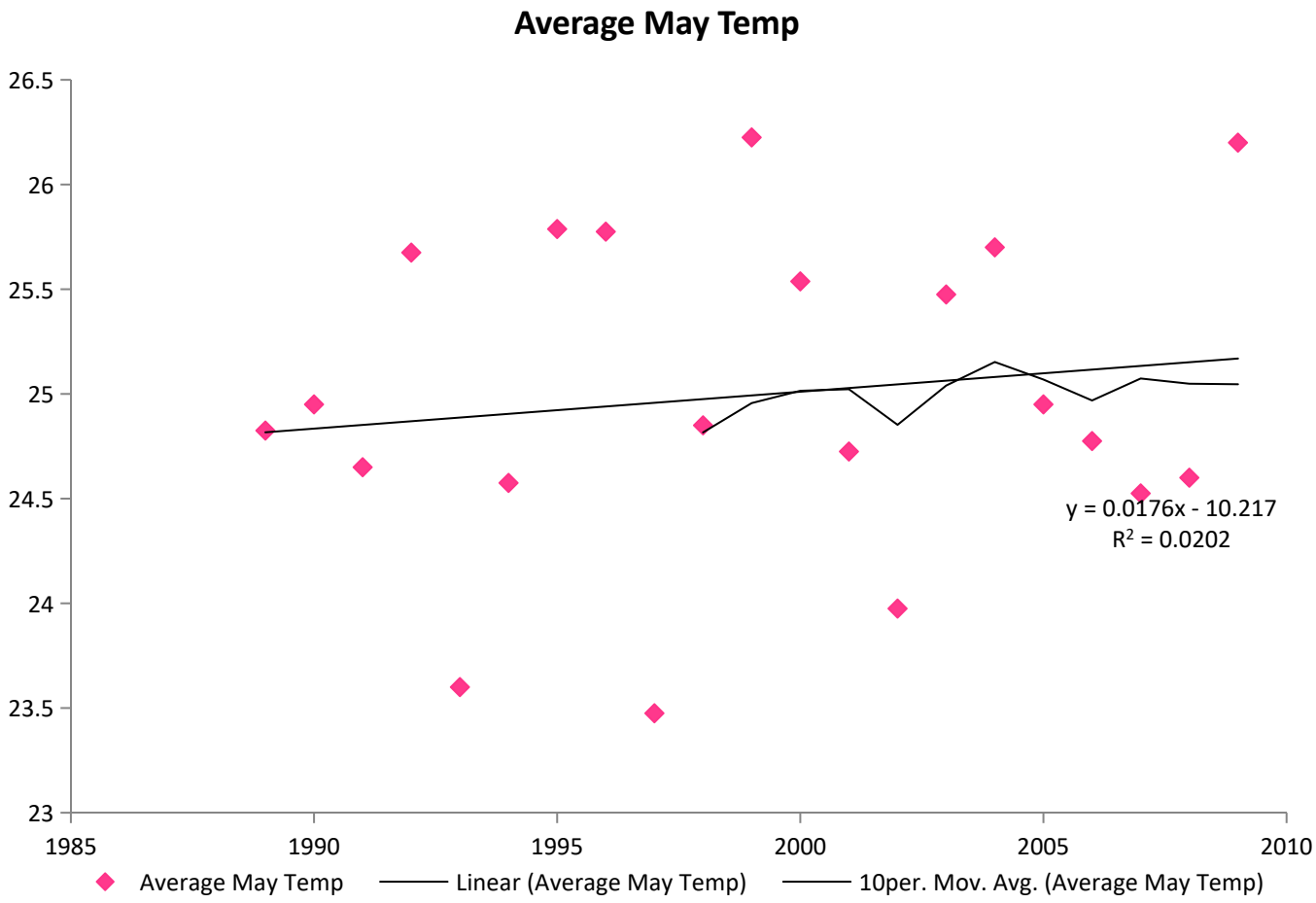
Temperature Trend, Syangja 805



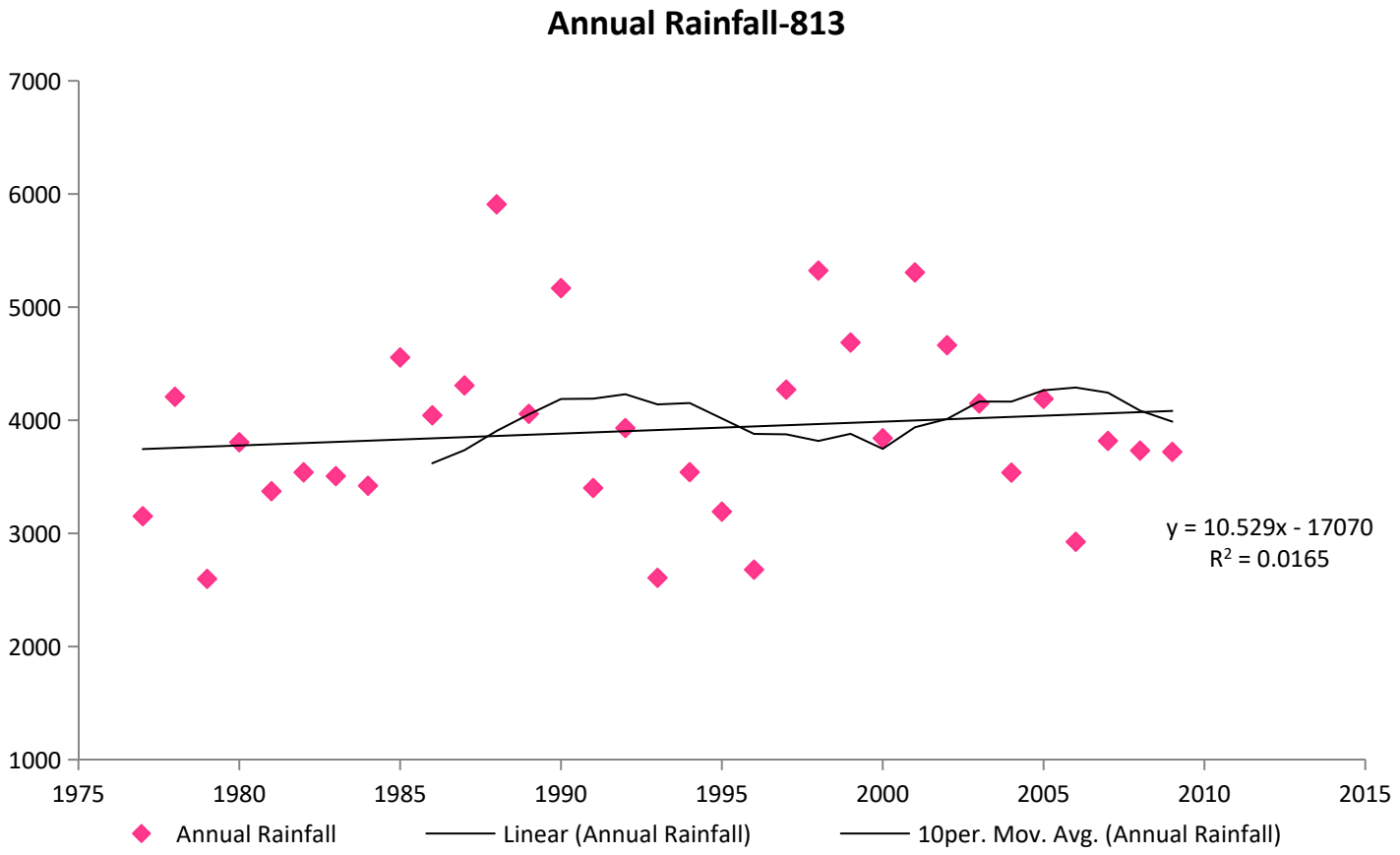
Temperature Trend, Parbat 614



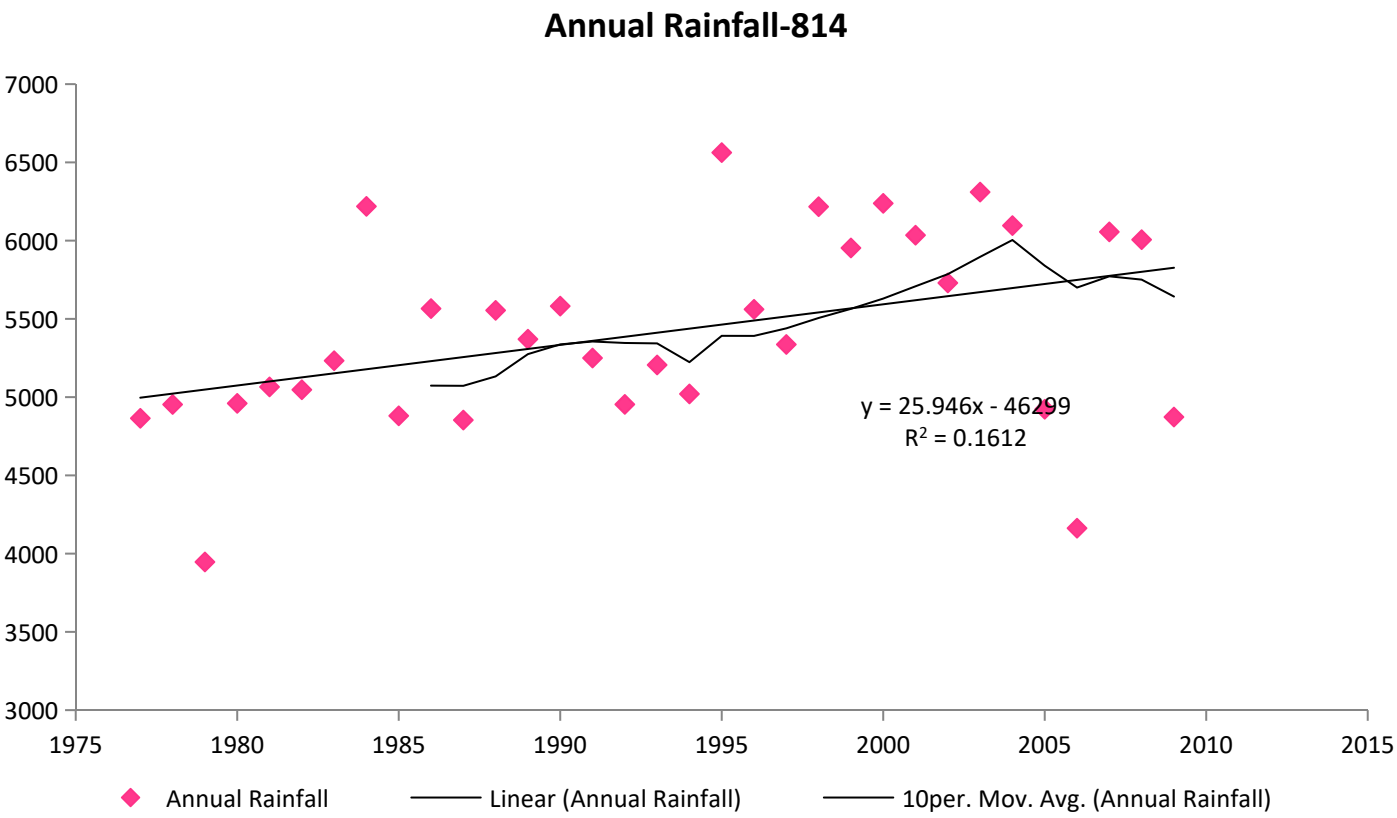
Temperature Trend, Parbat 614



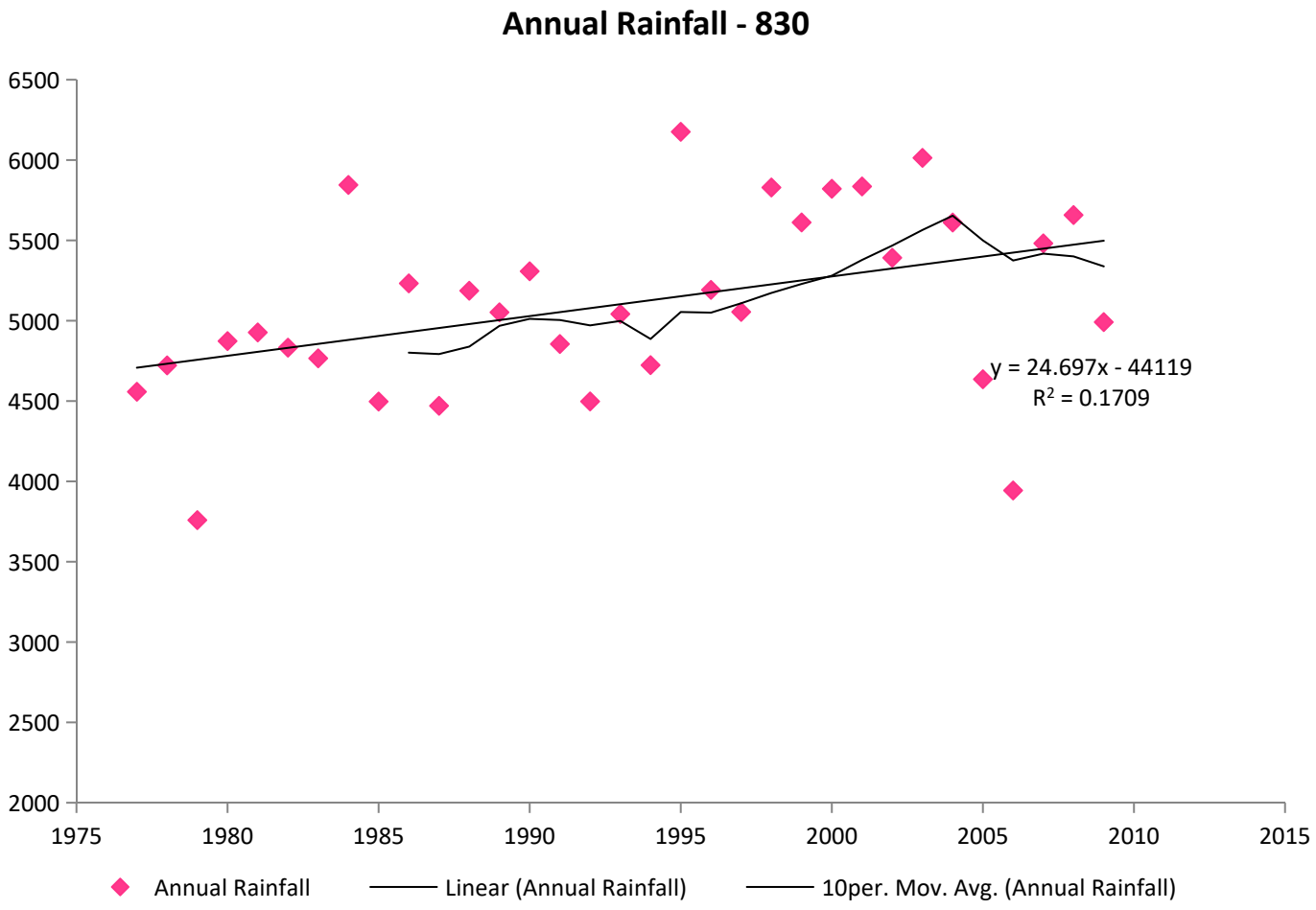
Rainfall Trend, Kaski (813)



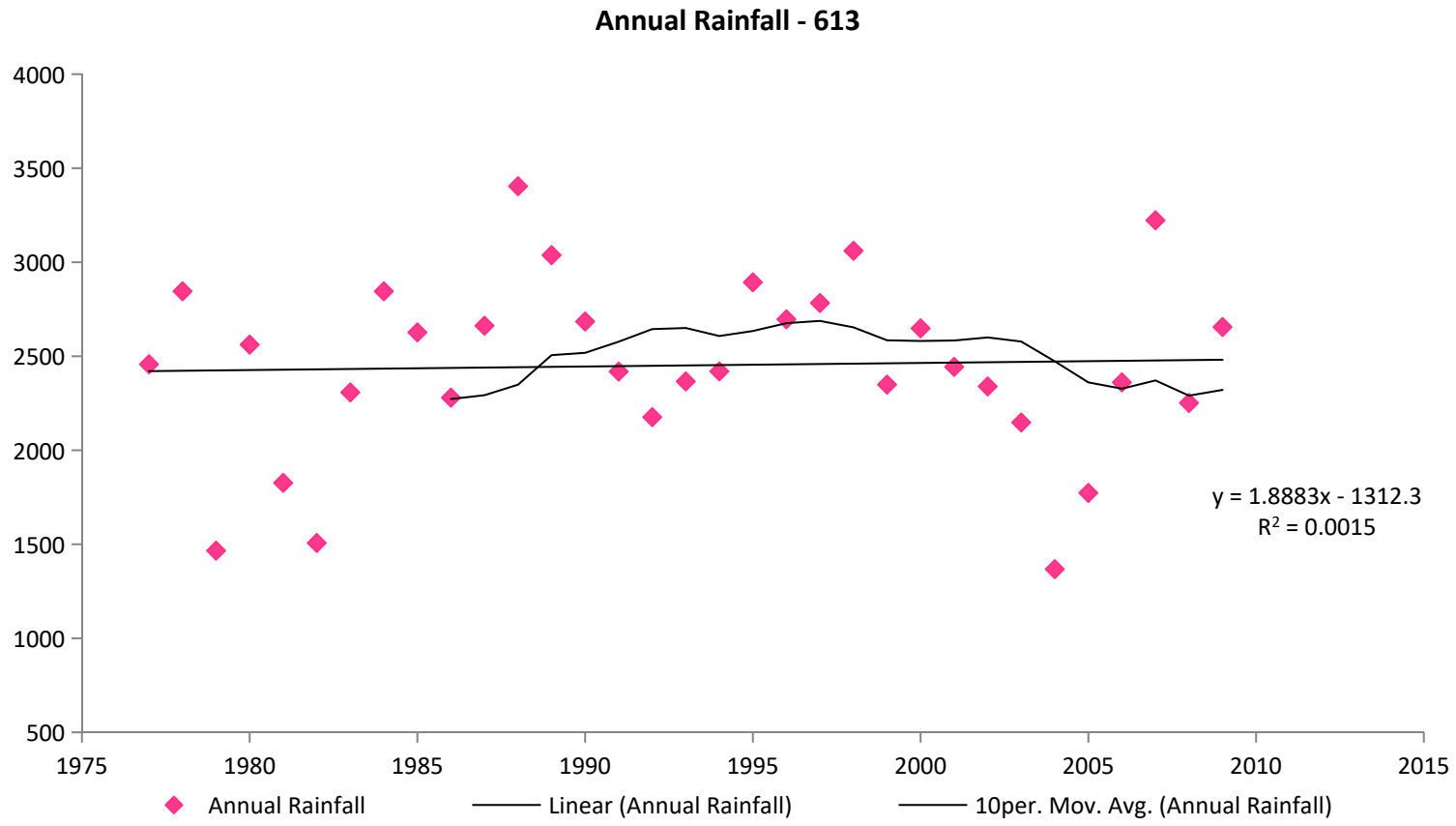
Rainfall Trend, Kaski (814)



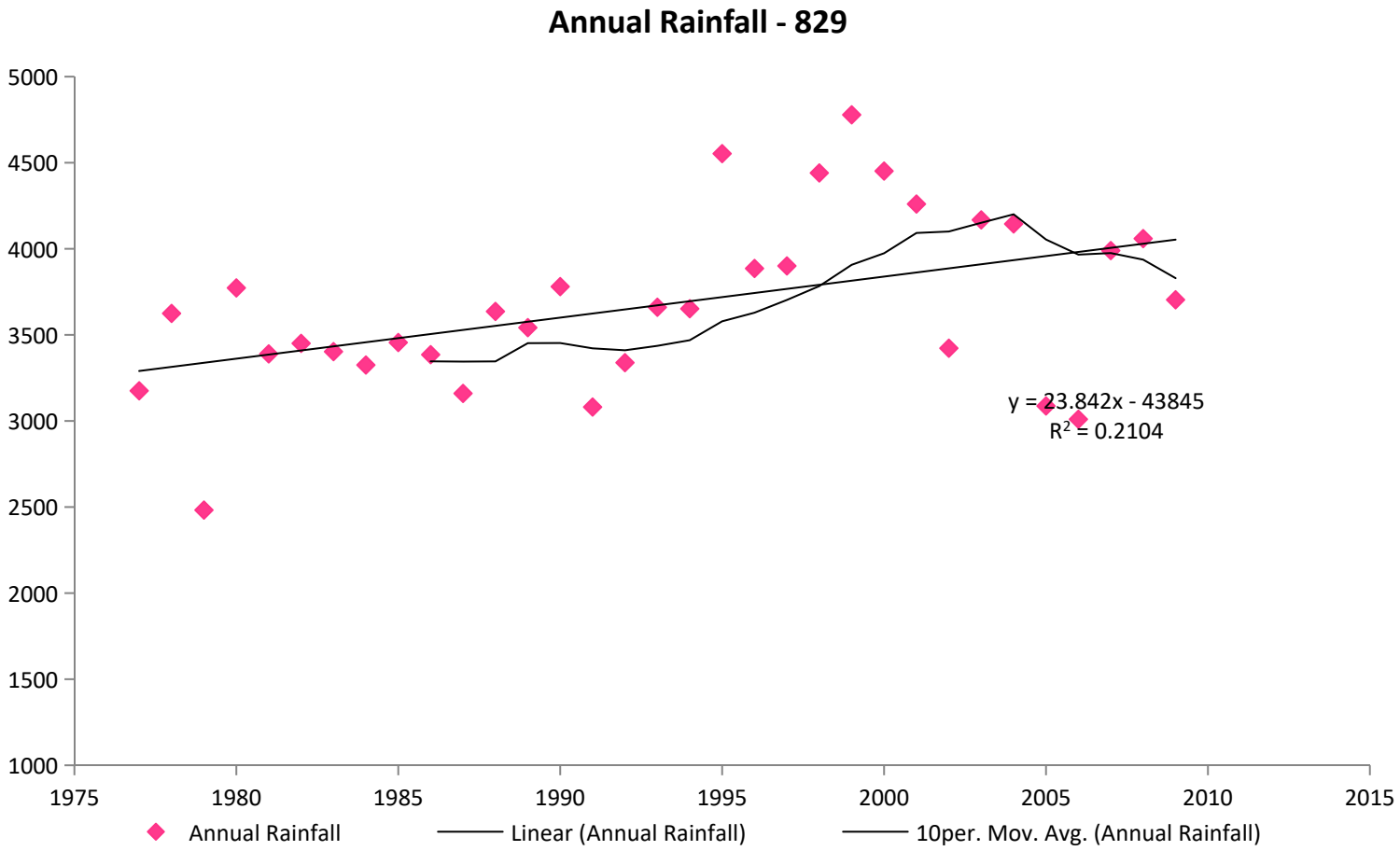
Rainfall Trend, Kaski (830)



Rainfall Trend, Parbat (613)



Rainfall Trend, Parbat (830)



Preliminary Results (Climate Stress)

Cs+ Exposure +Sensitivity

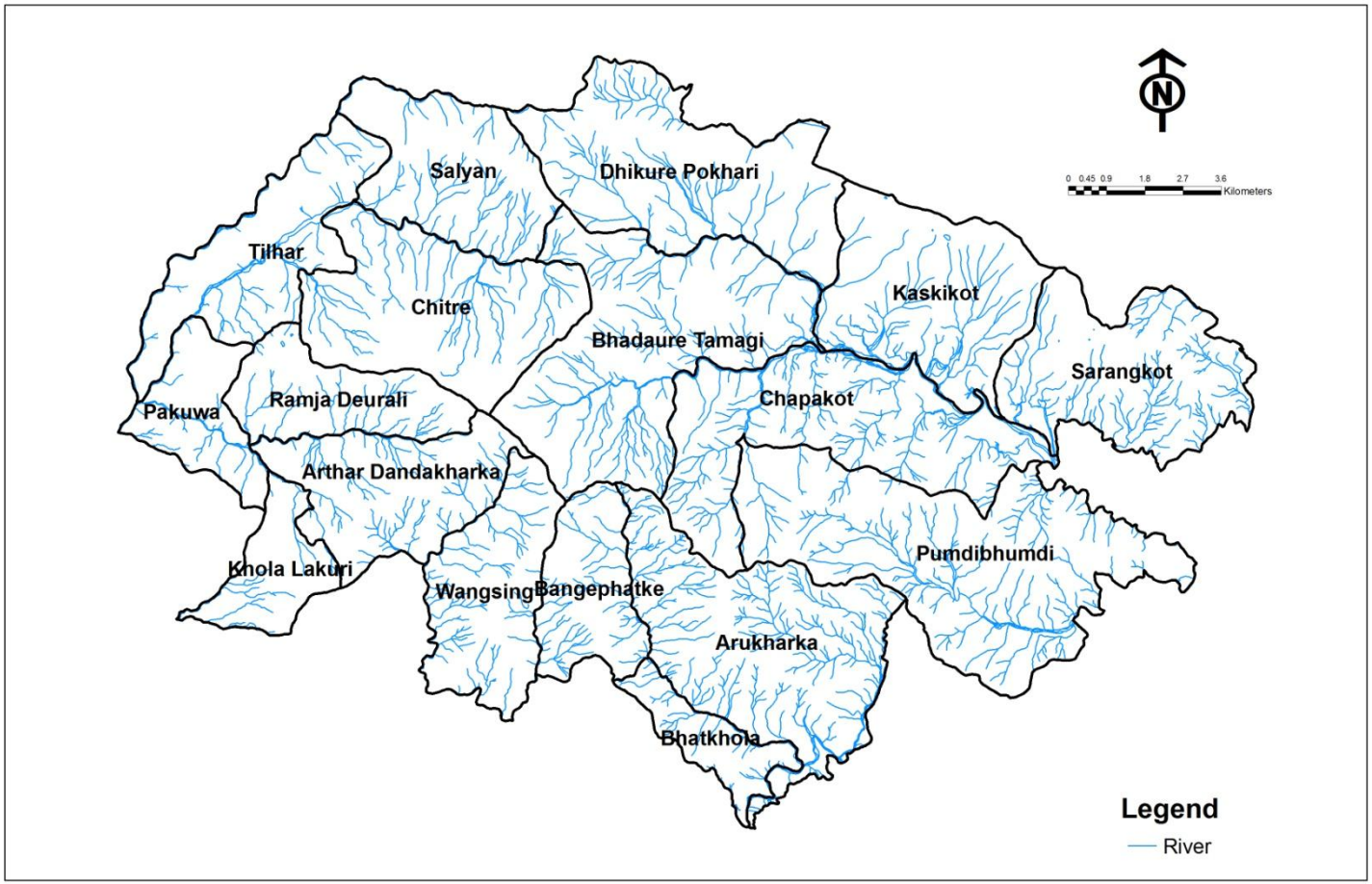
- Based on the increasing trend both in historical and predicted Temperature data as well as high regional variability, the temperature related exposure and sensitivity are Moderate to High;
- Since Rainfall indicates no trend with higher frequency of extreme events observed and predicted, moisture stress in the month of May is expected to be Moderate.

Preliminary Results (Landscape Exposure)

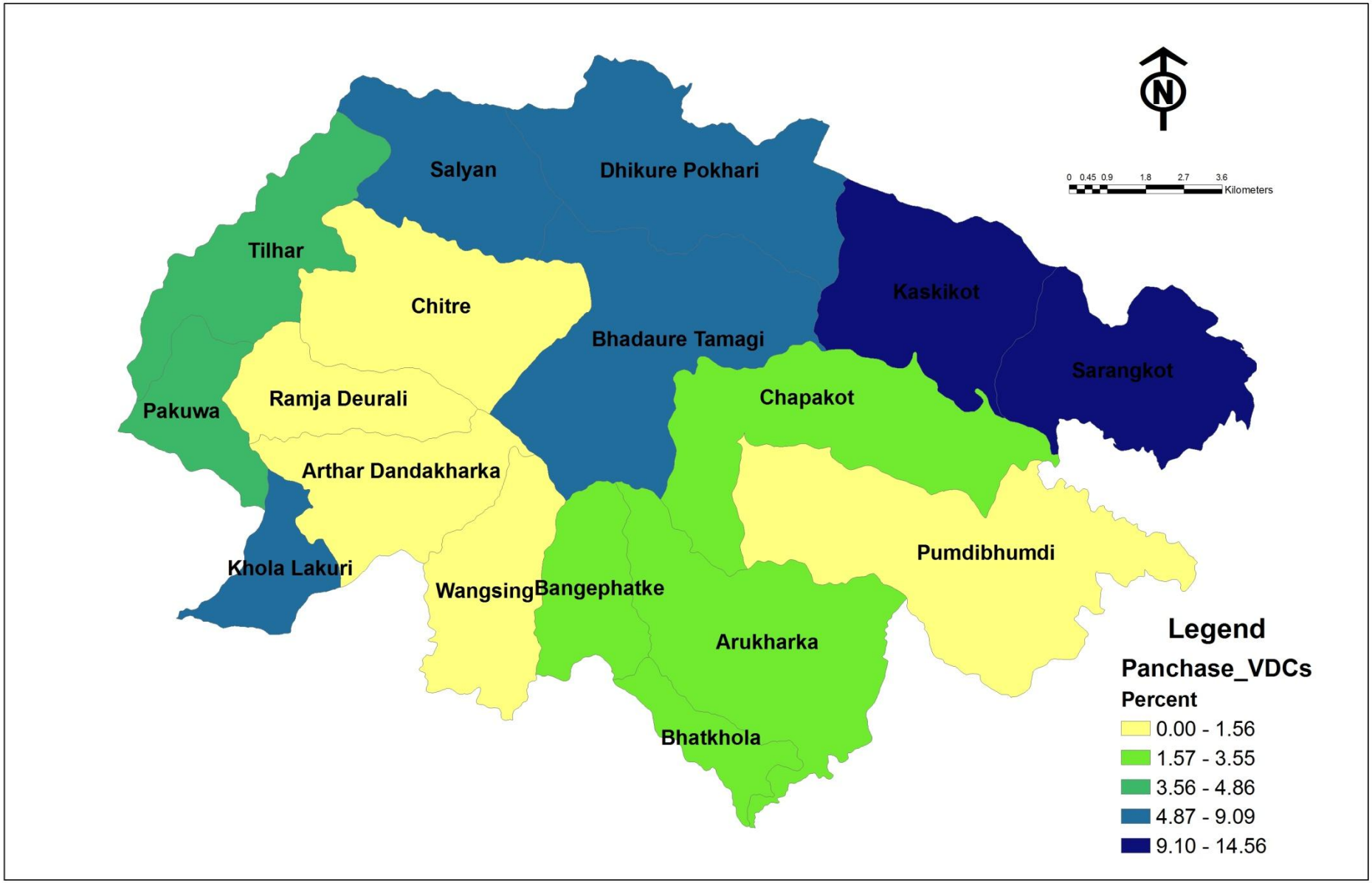
LE= topography+ hydrology+ geography (t+h+g)

As the series of Maps indicate, the Landscape is characterized by mountainous/hilly topography with moderate to high slope gradients dominated by Southern & Western facing aspects (that are generally dry), as well as the hydrology is characterized by extreme events; the Landscape Exposure is considered Moderate.

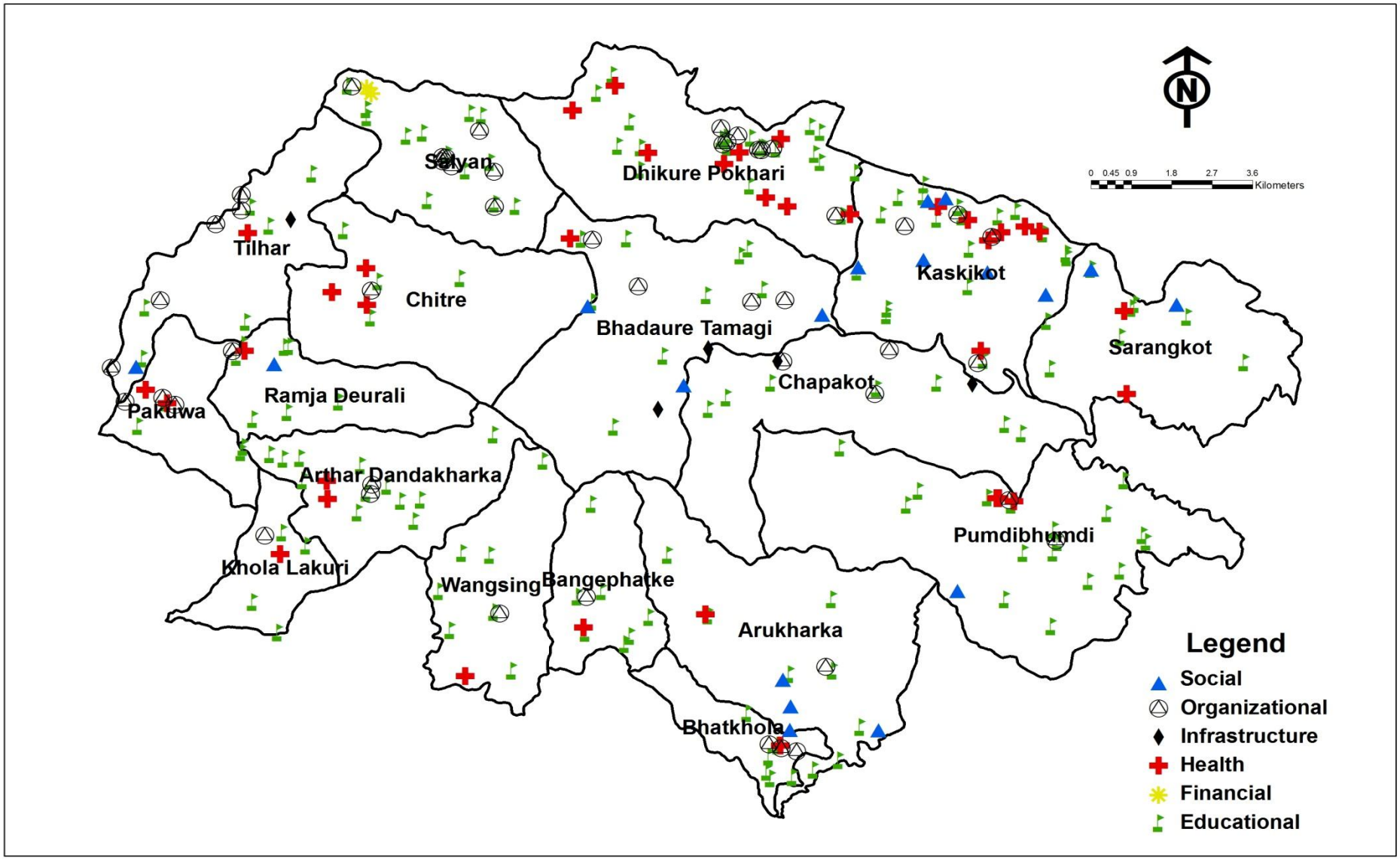
Resources Maps (Rivers and rivulets)



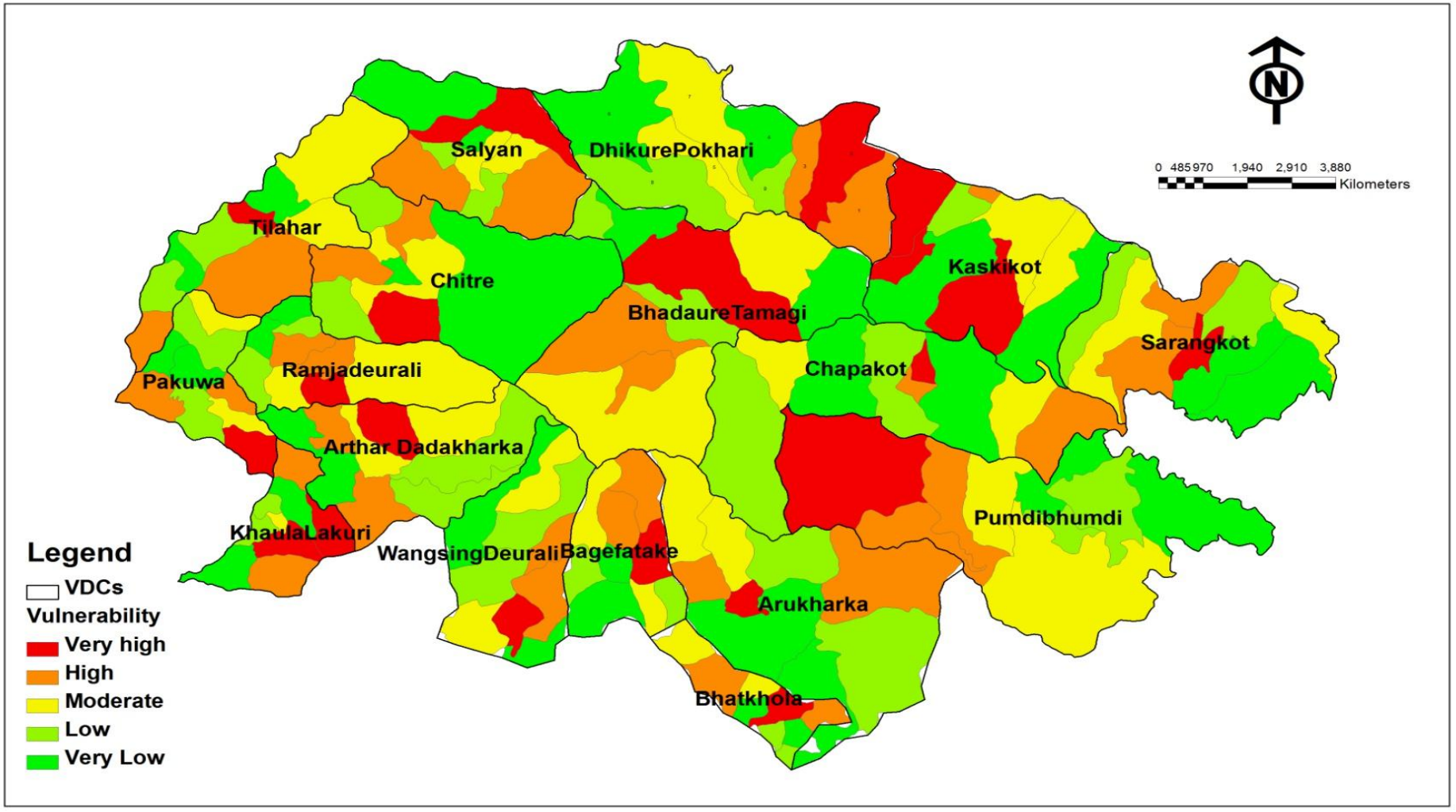
Socio-economic Vulnerability (% landless households/population)



Adaptive Capacity/Institutional Strength Map



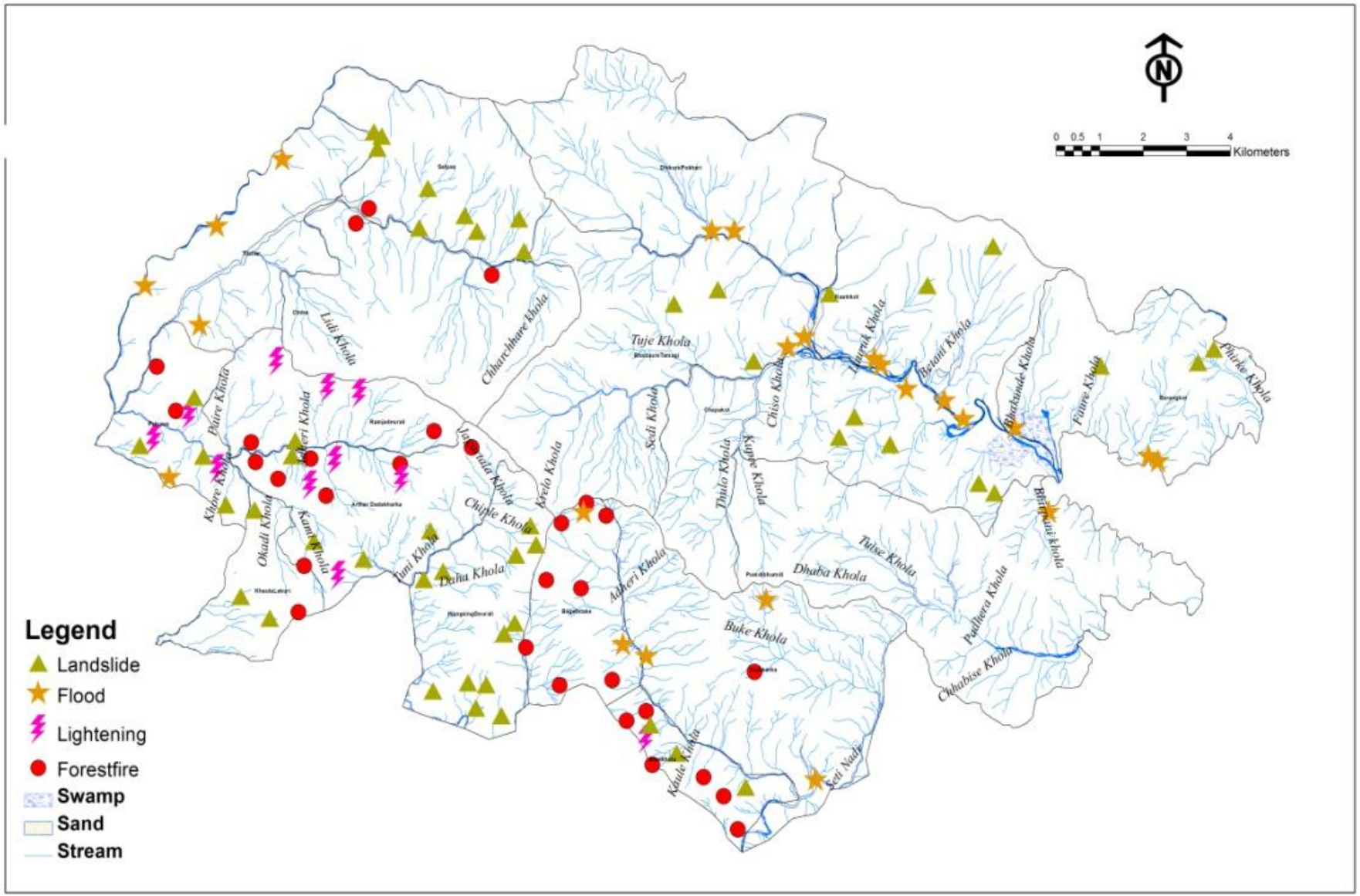
First order ward level vulnerability ranking (based on field survey & gateway system)



CLIMATE HAZARDS AND EXPOSURE

BASED ON COMMUNITY KNOWLEDGE AND PERCEPTIONS

Hazards map of Panchase Area

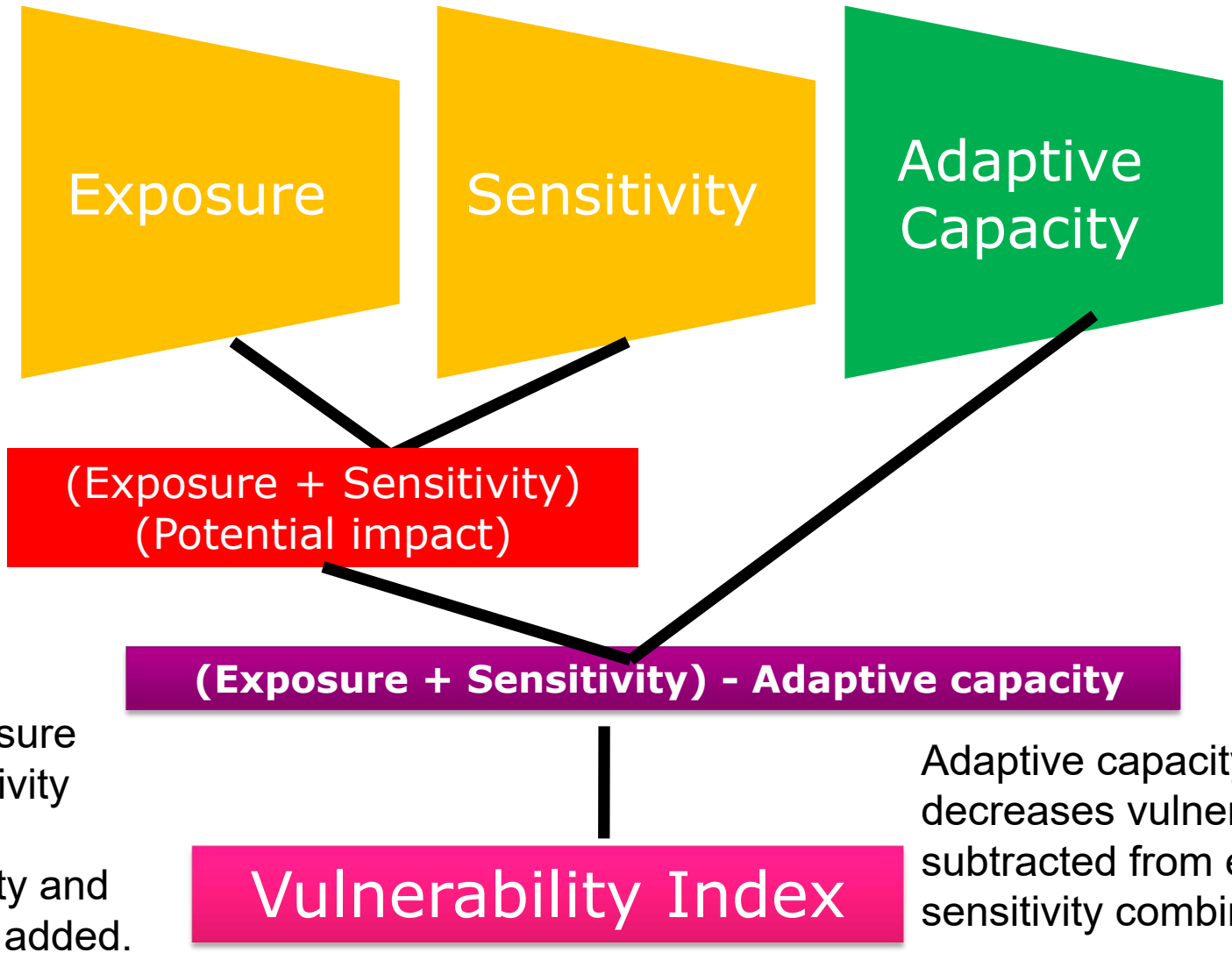


VIA Estimation: Indicators Used

Indicators used for ward level vulnerability assessment in Panchase Area (System Approach)

S.N	Indicator	Weightage (yes/high)	Weightage (low/none)
1	Demographic features (population density)	0.08	0.04
2	Per capita agriculture land (%landlessness)	0.08	0.04
3	Per capita forest resources (including grazing land)	0.08	0.04
4	% of HH using Traditional Energy (Firewood or Animal Dung considering Majority)	0.04	0.02
5	% of HH using Clean Energy (Electricity)	0.04	0.02
6	% of HH with piped drinking water facilities	0.04	0.02
7	% of Area Irrigated	0.08	0.04
8	% HH with Sanitation Coverage (%)	0.04	0.02
9	% Area Affected by Disaster (%) (Hazard prone)	0.08	0.04
10	% Food sufficiency	0.08	0.04
11	Road Density (high/low)	0.02	0.01
12	% HHs with mobile connection	0.02	0.01
13	% HH with other forms of Communication (Radio/Television sets)	0.02	0.01
14	% HH depended on Agriculture as main source of livelihoods	0.08	0.04
15	% Population dependent on off-farm income sources	0.04	0.02
16	% Household affected by Disaster	0.04	0.02
17	% House with pucca (cemented and/or stone/brick walled)	0.02	0.01
18	% Literacy Rate among total population	0.02	0.01
19	Number of Educational Institutions/VDC (adequate/not adequate)	0.02	0.01
20	% HH with access to institutional credit	0.02	0.01
21	No. of Health Services/VDC	0.02	0.01
22	% of people linked with CBOs/VDCs	0.01	0.005
23	No. of Traditional Network (Guthi, Dewali, Dikur, Others)/VDC	0.01	0.005
24	Number of Governmental Organizations/VDC	0.01	0.005
25	Number of NGOs/VDC	0.01	
Total	Consolidated figure	1.00	<0.05

VIA Estimation Approach



Both exposure and sensitivity increase vulnerability and hence are added.

Adaptive capacity decreases vulnerability so subtracted from exposure sensitivity combine (impact).

Calculation of index

- Ranked 1 to 14.
- Each exposure category in each cluster is added to obtain a composite value for that cluster (Wards, VDC, watershed unit or ecosystem). The ranking obtained is ranked (among cluster).
- The ranking number obtained is converted by giving 0.5 weightage.
- Done to get the rank range in pre designed range (very high vulnerability to very low vulnerability).
- Range will not change even when cluster number and/or exposure indicators increase or decrease)

- Similar approach is taken for sensitivity. The weightage is 0.5. This mean the exposure sensitivity combine get a weightage of 1
- For adaptive capacity weightage is 1. Ranking done similarly.
- Vulnerability index between -1 to +1.
- Five categories of vulnerability (very low to very high)

(0.61 to 1)	Very high vulnerable
(0.21 to 0.6)	High vulnerable
(0.20 to -0.19)	Moderate vulnerable
(-0.20 to -0.6)	Less vulnerable
(-0.61 to -1)	Very less vulnerable

Estimation of Climate Stress

Cs = Exposure +Sensitivity – estimated to be moderate

- Based on the increasing trend both in historical and predicted Temperature data as well as high regional variability, the temperature related exposure and sensitivity are Moderate to High;
- Since Rainfall indicates no trend with higher frequency of extreme events observed and predicted, moisture stress in the month of May is expected to be Moderate;
- Since January average temp. is increasing, low temperature stress will be Low;
- So climate sensitivity of ecosystem will be moderate

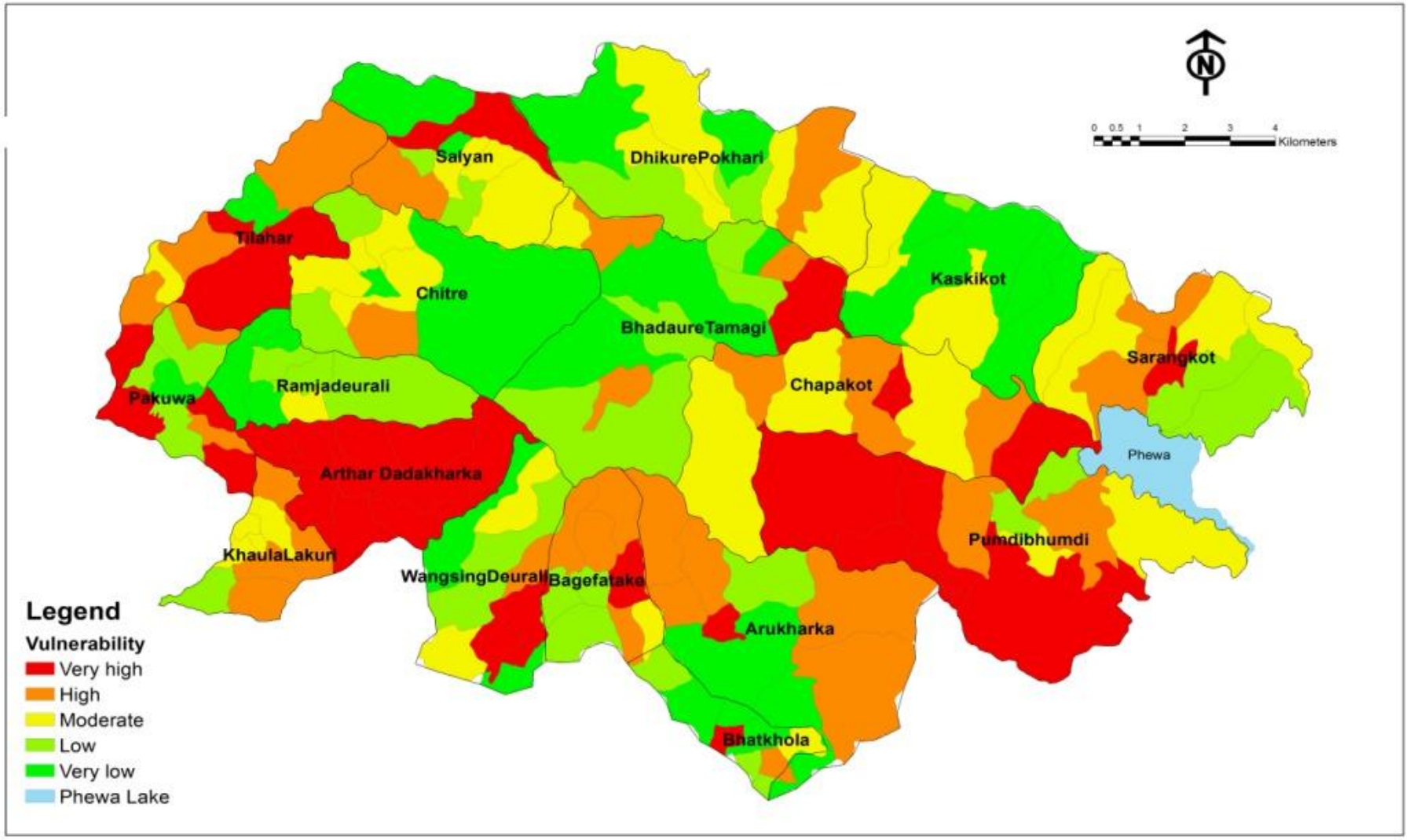
Community Perception-based Current Vulnerability Ranking

(Very low=1, Low=2, Moderate=3, High=4, Very high=5)

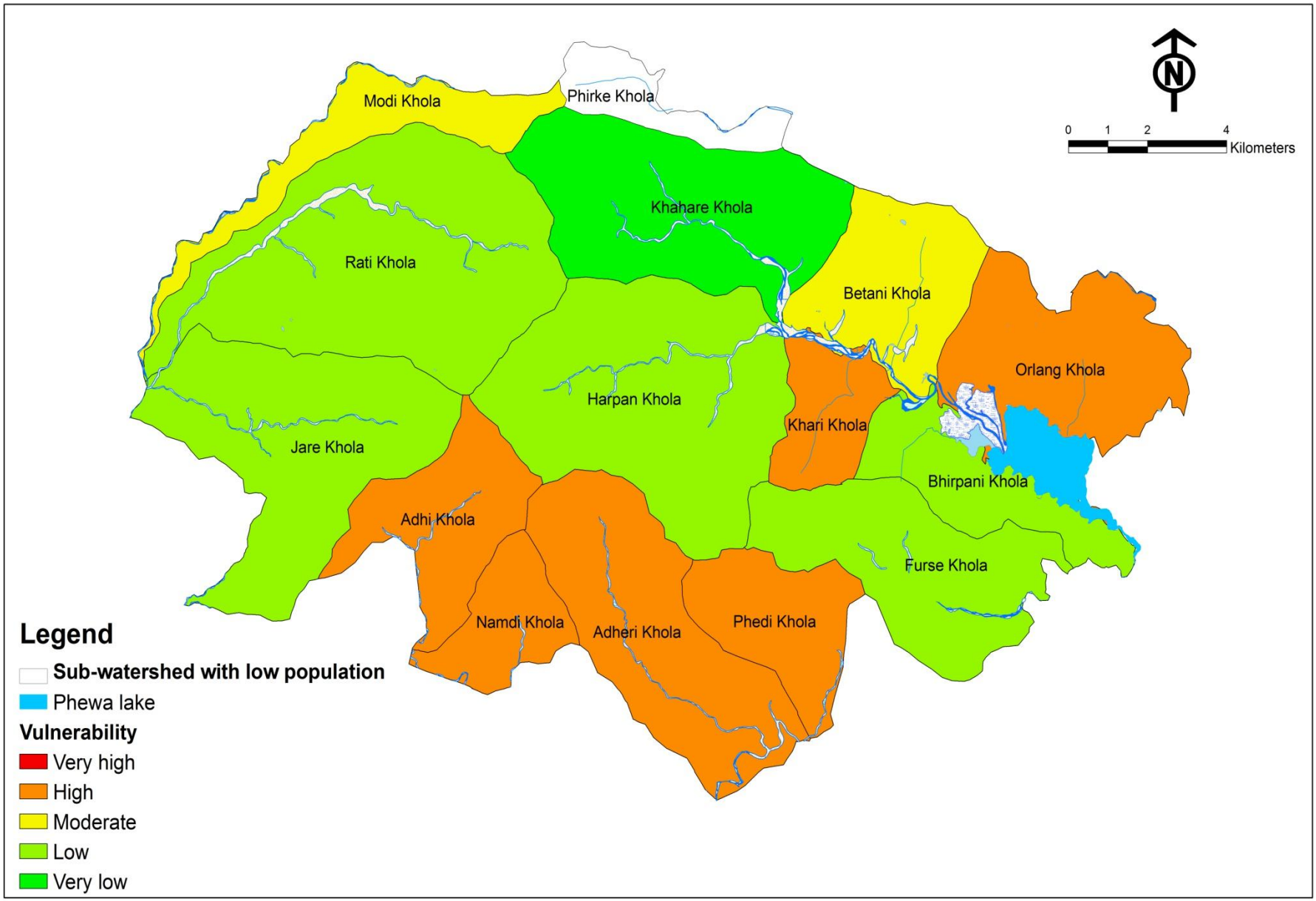
VDCs	SYSTEMS										
	Drinking water	Forest	Agriculture	Irrigation	Transportation (Roads/Trails)	indicative endangered species	Electricity	Other Energy	Communication	Grazing area	Land and Ecosystem
Parbat											
Khaulalakuri	5	5	5	5	4				4		
Ramja deurali	4	4	5	5	5	1	4	4			1
Chitre	4	2	4							5	
Tilahar	5		5	4	4						
Arthar Dandakharka	3		5	2	4	5	4		4		3
Pakuwa	5	5	5	5	3	5					
Kaski											
Chapakot	2	2	3		5	2	2		1		
Pumdibhumdi	4	3	5		4	3	5		3	2	
Kaskokot	5	1	3		3	5		2			
Sarangkot	3	2	3		5		3		1		
Dhikurpokhari	3	2	4		2	4		3	1		
Bhadaure Tamagi	3	2	4		2		4	1	3		
Salyan	5	4	4		4						
Syangja											
Bhatkhola	5	4	2			4					

First order ward level vulnerability ranking

(based on field survey & gateway system)



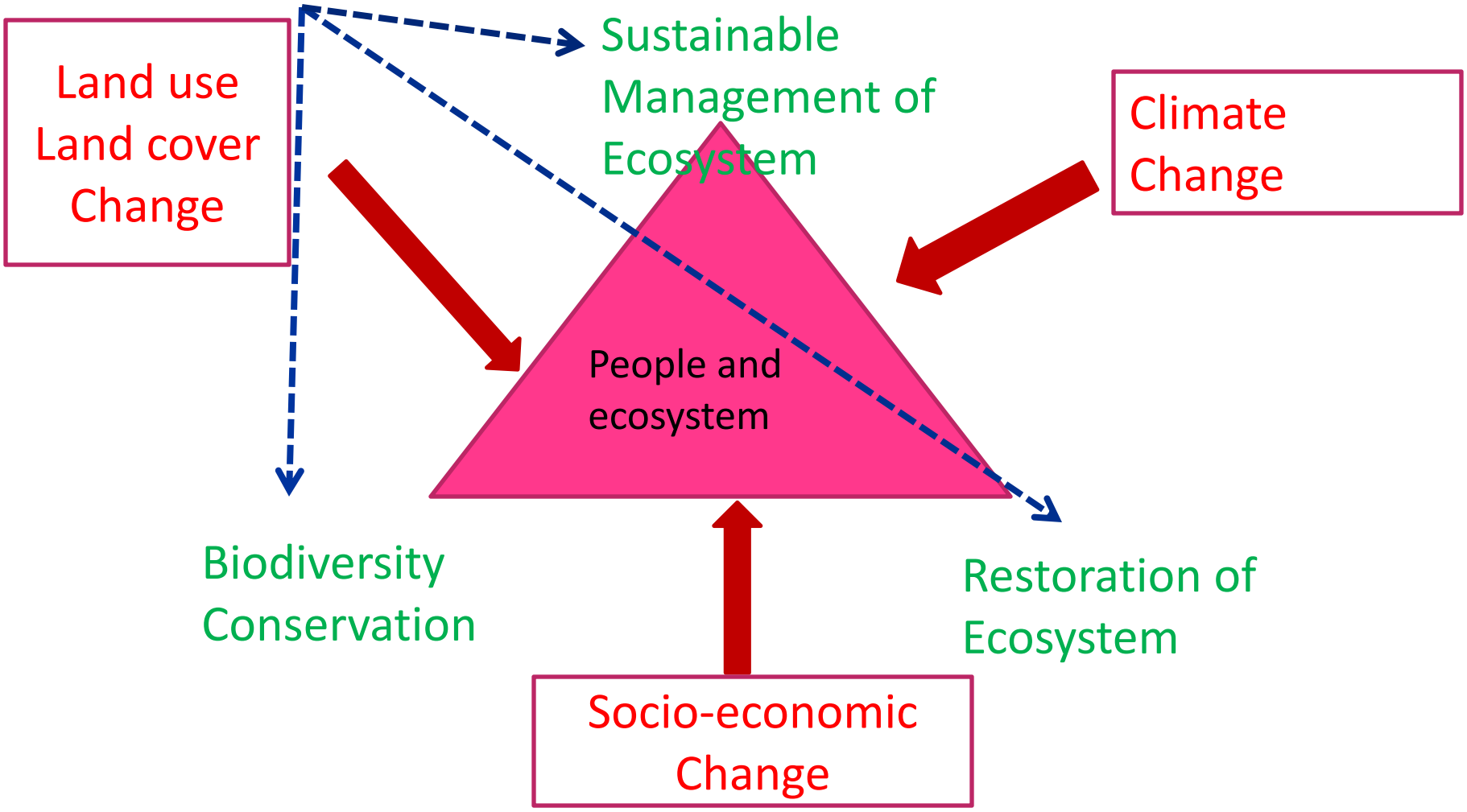
First order sub-watershed level vulnerability ranking



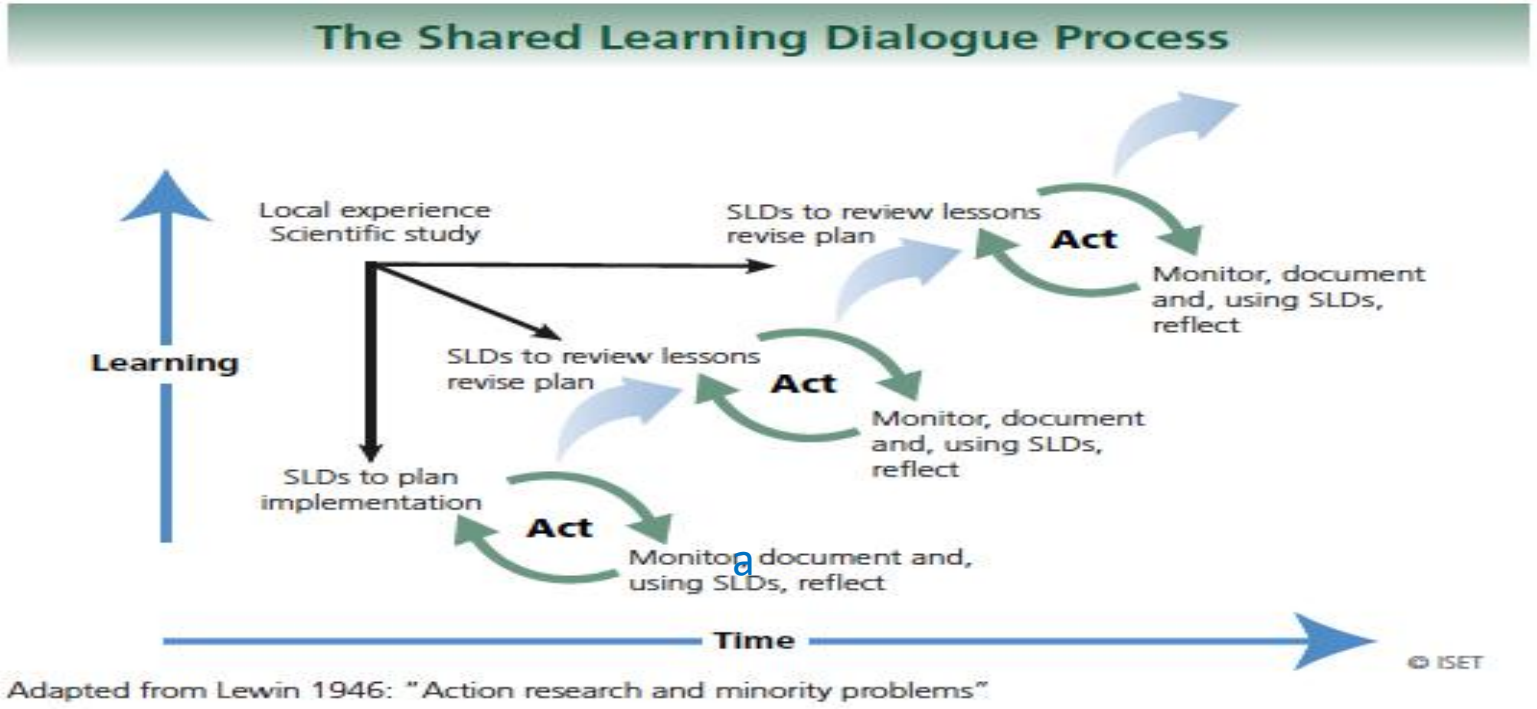
ADAPTAITON STRATEGY VISIONING AND PLANNING

BASED ON SHARED LEARNING DIALOGUE & GATEWAY APPROACH

EbA Strategy Development Framework



Adaptation Planning Process



- 4 VDC clusters were formed local communities were engaged in listing possible adaptation activities based on the Vulnerability scenario discussed
- This shared learning methods helped identify 7 thematic activities
- Out of these 2 options were prioritized one of which is on Forest and Biodiversity Conservation

Preliminary Results: Priority Themes for EBA

EBA Thematic Areas	Priority	Remarks
Making water sources & facilities resilient and adaptive	12	Rehab. Of Drinking Water Sources and Irrigation Structures
Agriculture production improvement and making it climate adaptive	9	Diversifications and Water Availability/Growing off-season crops
Climate resilient road design, construction and rehabilitation	3	Road Stabilization and Resilient Construction/Green Raods
Clean energy options and facility development	2	Renewable and Clean Local Energy Solutions; ICS
Forest & biodiversity conservation and management	2	Forest and Wildlife Management to Improve Livelihoods and Reduce People-WL conflict res.
Degraded land rehabilitation and management; landslide control	1	Landslides/Erosion Prevention and Rehab.

Adaptation decision (sample)

EBA Project name: Forest and Wildlife Conservation & management

1. **Activity Options:**

a) Increase Eco-tourism

b) Improve conservation of forest resources

2. Objectives:

a) Enhance local livelihoods

b) Manage wildlife by protecting/improving habitats

c) Identify and manage important medicinal herbs to increase income source

3. Operations (Activities):

a) Involve local people

b) Conservation with the help of helping/supportive local organizations

c) Create fire lines to avoid forest fire

4. Resources necessary:

- Technical service and technical knowhow; Financial support
- Improve human resources by building capacity, transfer skills, and conduct training

THANK YOU


गाउँ विकास समितिको कार्यालय
गाउँ वन समन्वय समिति
Village Forest Coordination Committee
F.C.B.
nepal