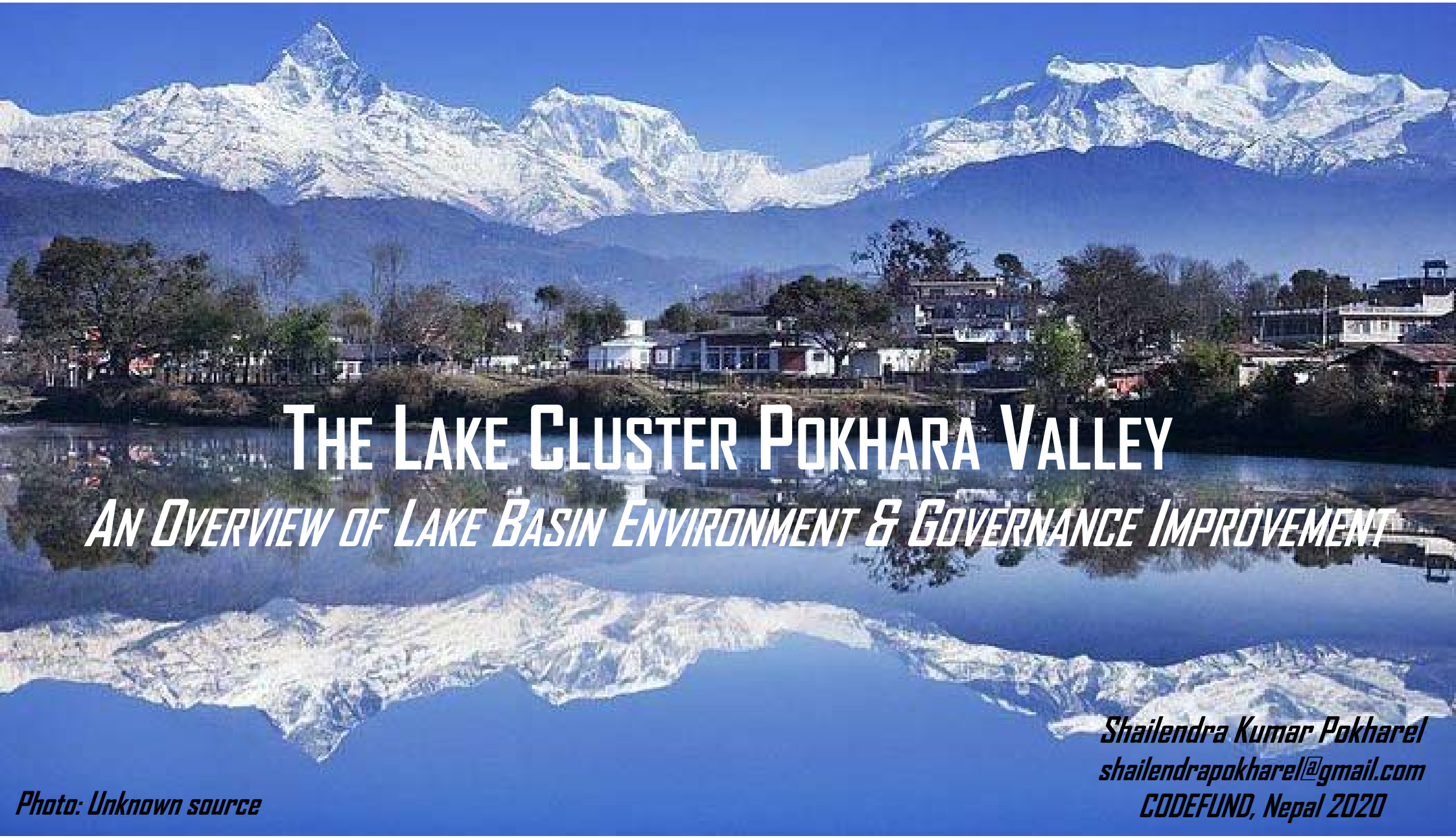
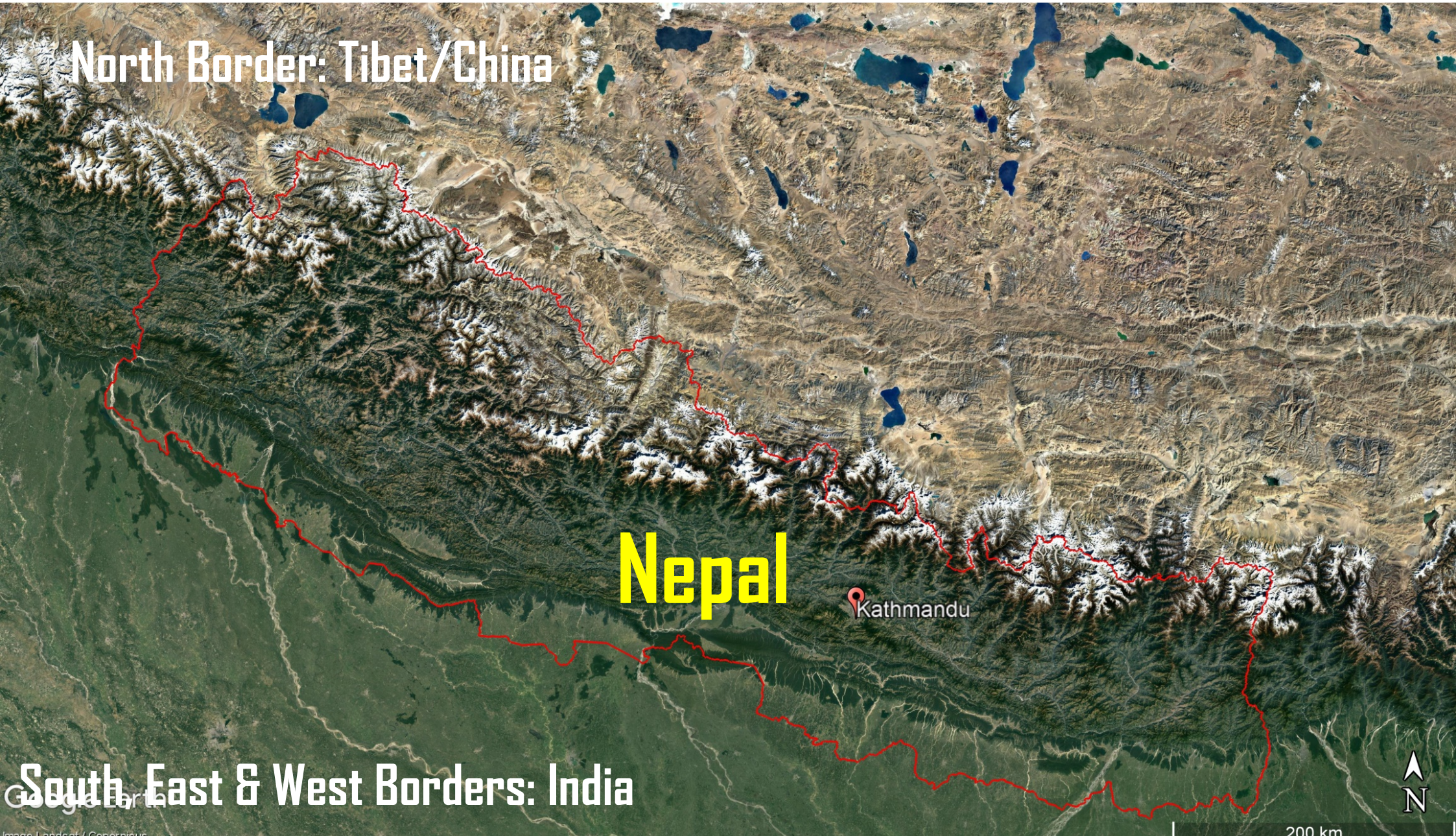


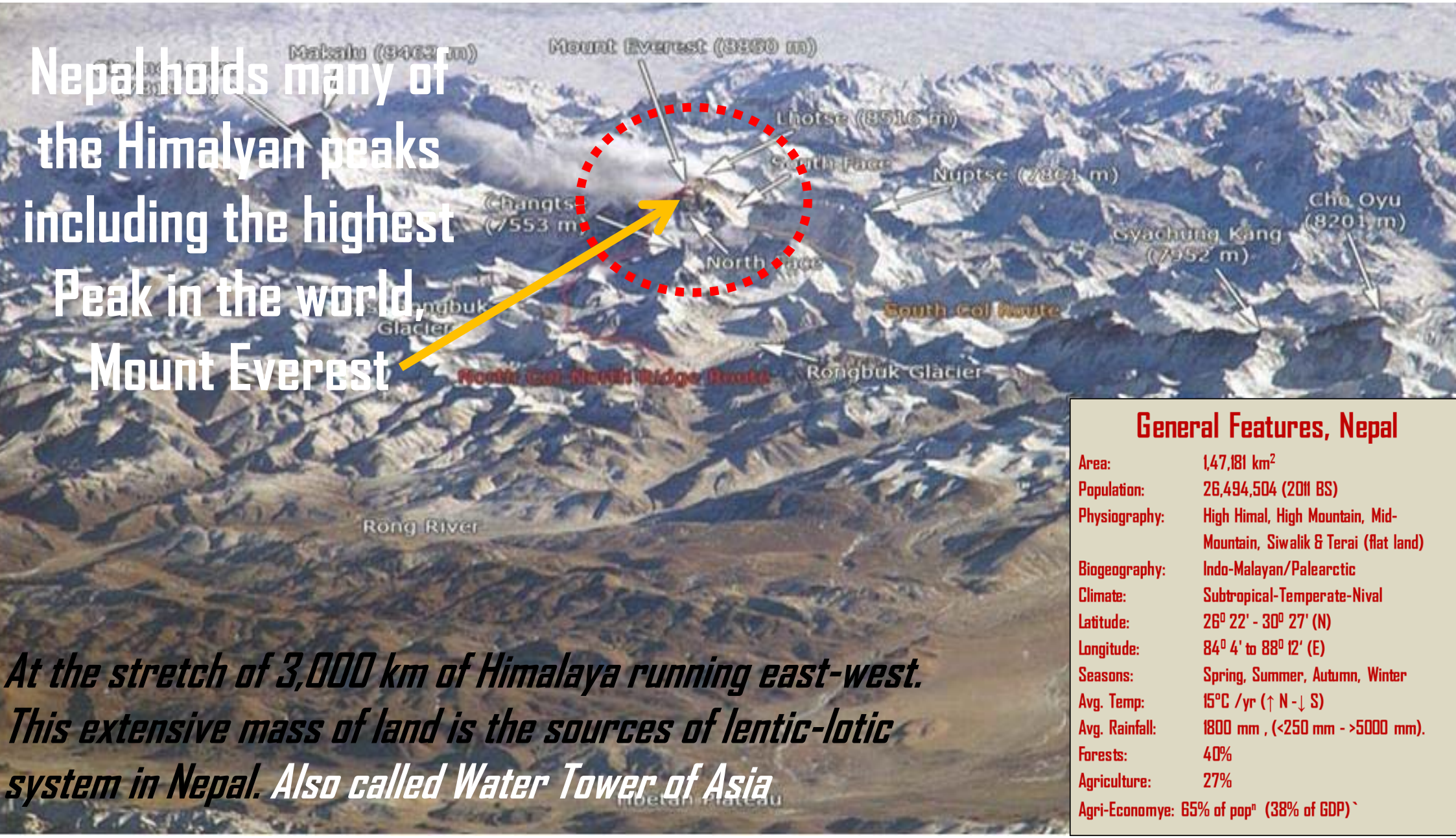
The Lake Cluster Pokhara Valley

An Overview of Lake Basin Environment & Governance Improvement

Shailendra Kumar Pokharel
shailendrapokharel@gmail.com
CODEFUND, Nepal 2020

Photo: Unknown source


North Border: Tibet/China
Nepal
Kathmandu
South, East & West Borders: India
N
200 km



At the stretch of 3,000 km of Himalaya running east-west. This extensive mass of land is the sources of lentic-lotic system in Nepal. Also called Water Tower of Asia

General Features, Nepal

Area:	1,47,181 km^2
Population:	26,494,504 (2011 BS)
Physiography:	High Himal, High Mountain, Mid-Mountain, Siwalik & Terai (flat land)
Biogeography:	Indo-Malayan/Palearctic
Climate:	Subtropical-Temperate-Nival
Latitude:	26^0 22' - 30^0 27' (N)
Longitude:	84^0 4' to 88^0 12' (E)
Seasons:	Spring, Summer, Autumn, Winter
Avg. Temp:	15°C /yr (↑ N -↓ S)
Avg. Rainfall:	1800 mm , (<250 mm - >5000 mm).
Forests:	40%
Agriculture:	27%
Agri-Economye:	65% of popⁿ (38% of GDP)`

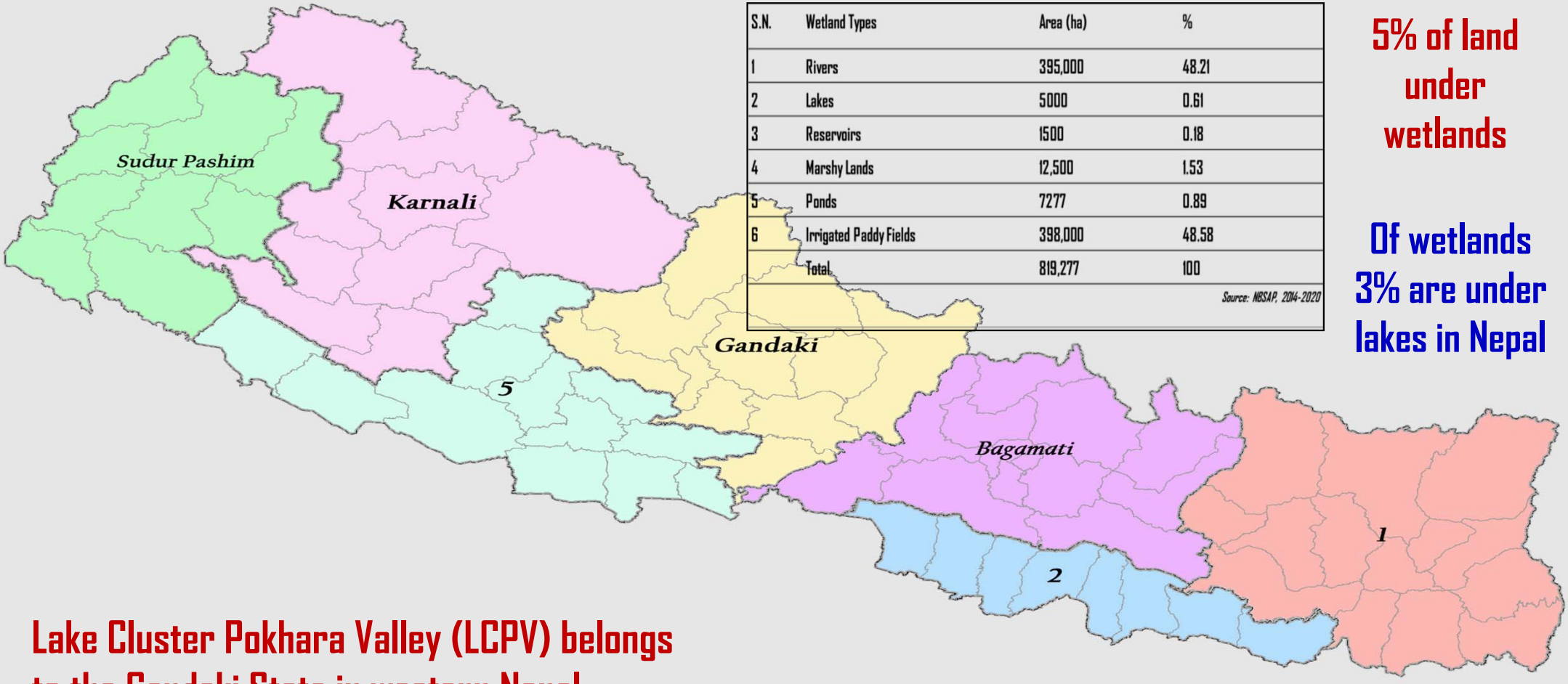
Recently, Nepal underwent federal restructuring into 7 states empowered by the New Constitution of Nepal-2015. Many states are in the process of having their specific name.

S.N.	Wetland Types	Area (ha)	%
1	Rivers	395,000	48.21
2	Lakes	5000	0.61
3	Reservoirs	1500	0.18
4	Marshy Lands	12,500	1.53
5	Ponds	7277	0.89
6	Irrigated Paddy Fields	398,000	48.58
	Total	819,277	100

Source: NBSAP, 2014-2020

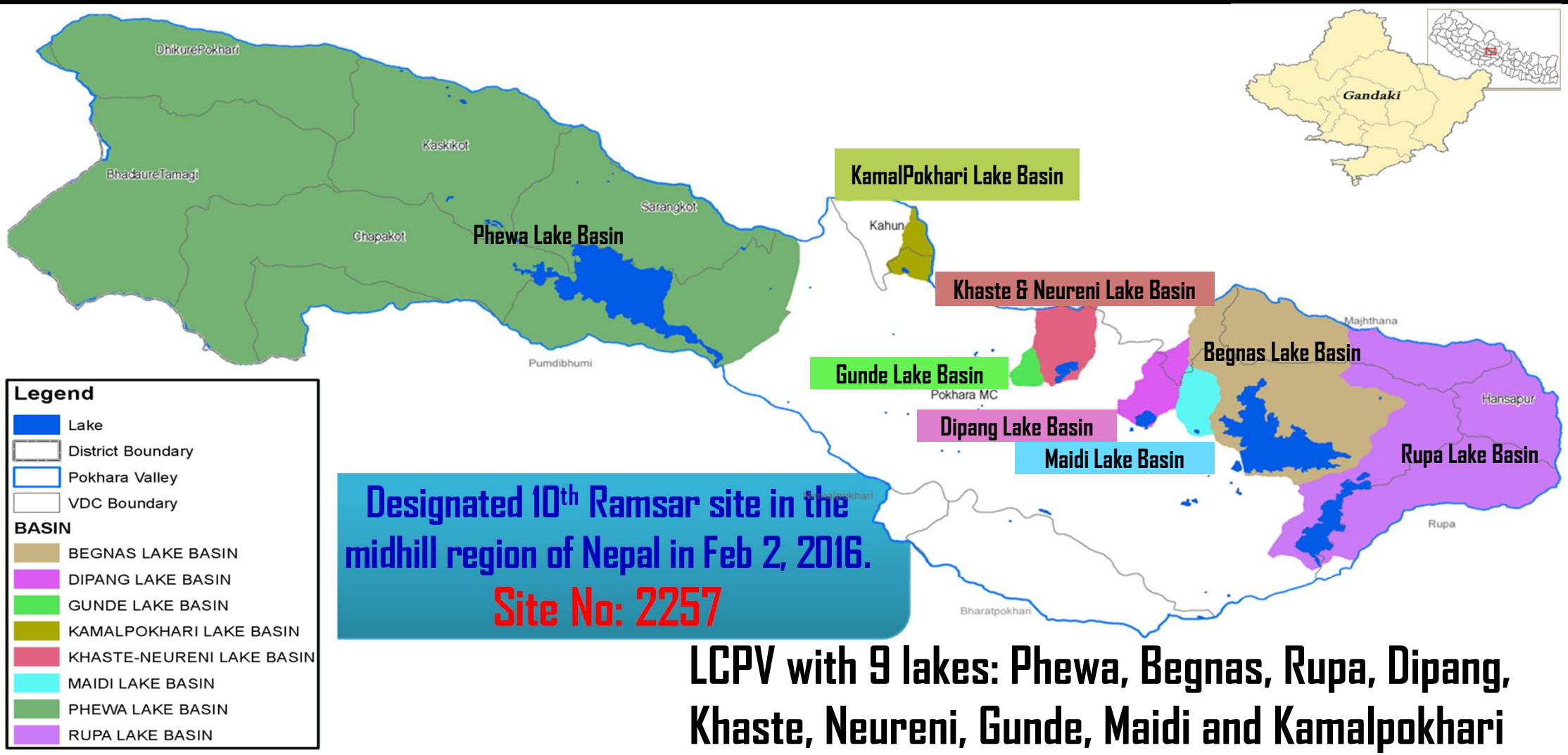
5% of land under wetlands

Of wetlands 3% are under lakes in Nepal



Lake Cluster Pokhara Valley (LCPV) belongs to the Gandaki State in western Nepal.

An Overview of Lake Cluster Pokhara Valley



Designated 10th Ramsar site in the midhill region of Nepal in Feb 2, 2016.

Site No: 2257

LCPV with 9 lakes: Phewa, Begnas, Rupa, Dipang, Khaste, Neureni, Gunde, Maidi and Kamalpokhari

An Overview of Lake Cluster Pokhara Valley

Region:	Western Development
State:	Gandaki
District:	Kaski
Local Govⁿ:	Pokhara Metropolis
Access:	Road and flight
Drive time:	5-6 hrs from KTM
Flight time:	25 minutes

- Head Quarter of the Western Devⁿ Region
- Capital of the Gandaki State
- Capital of the District
- 2nd largest city, Nepal
- Tourism capital, Nepal

Location specific strategic significance of LCPV

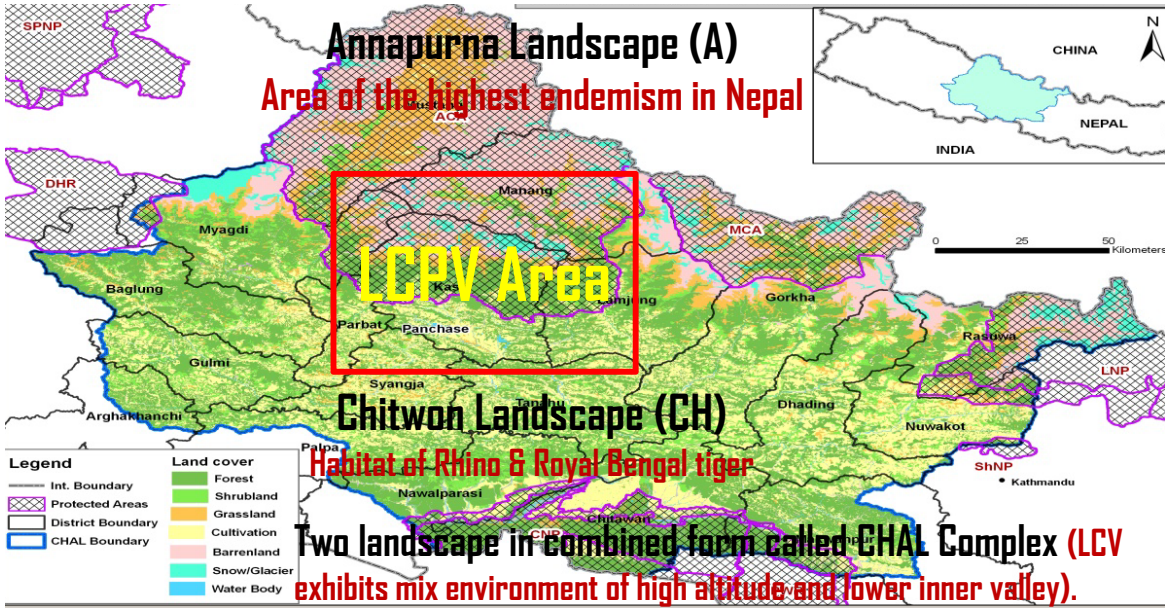
- Lies in the Transition of Palearctic/Eurasia & Oriental/South Asia zoo-geographical realms and Holarctic and Pleotropic phyto-geographic kingdoms

- Confluences of the eastern & western Himalaya regions to the Central Asiatic (South Tibetan) & the Indian (Gangetic) floristic region

- Close of Nepal's 1st community managed biodiversity hotspot: the Annapurna Conservation Area
- Magnificent views against the backdrop of the Annapurna Himalaya Range with 3 out of 10 highest mountain peaks in the world (i.e., Dhaulagiri, Annapurna First and Manaslu)

- LCPV lies in Chitwon & Annapurna Landscape (CHAL)
- 4 climatic regions, and in the Annapurna Circuit trek

- Pokhara city is in LCPV
- Pokhara, the hub for adventure and lake tourism



LCPV: Area and significance

- 43% of Ramsar coverage of Nepal
- Largest Ramsar site in Nepal
- Nepal's contribution by 0.025% in total of the Ramsar cover till date

Area

Core area: 8.97 km^2

Total basin area: 262 km^2

Coordinates

Latitude: 28.139 (Rupa) -28.2902 (Phewa)

Longitude: 83.8004 (Phewa) -84.1699 (Rupa)

Extent Area

Largest core area: 4.33 km^2 (3.6%), Phewa

Smallest: 0.007 km^2 (0.4%), Maidi

Largest basin: 119.39 km^2, (Phewa)

Smallest basin: 0.18 km^2, Neureni

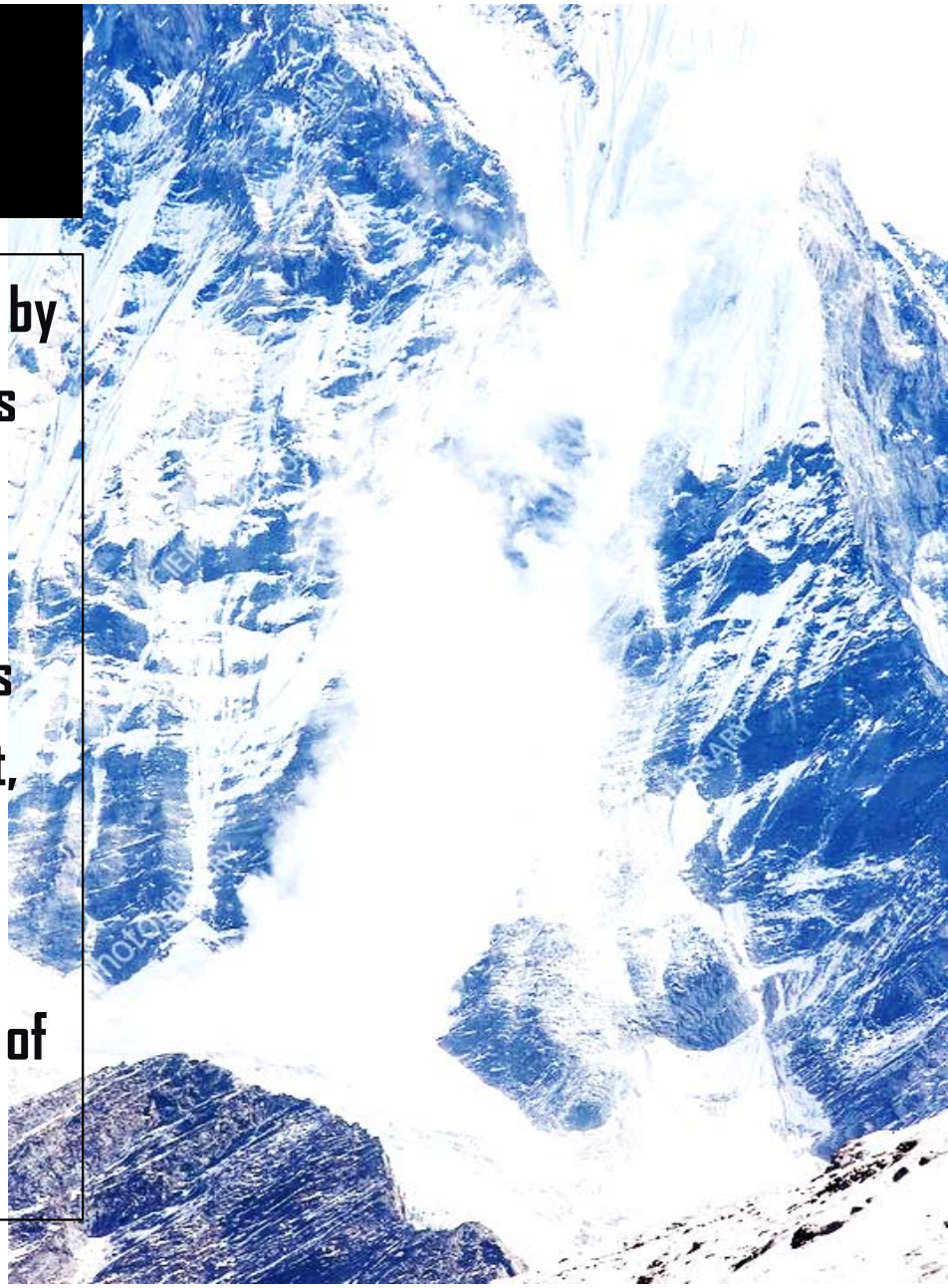
Altitude

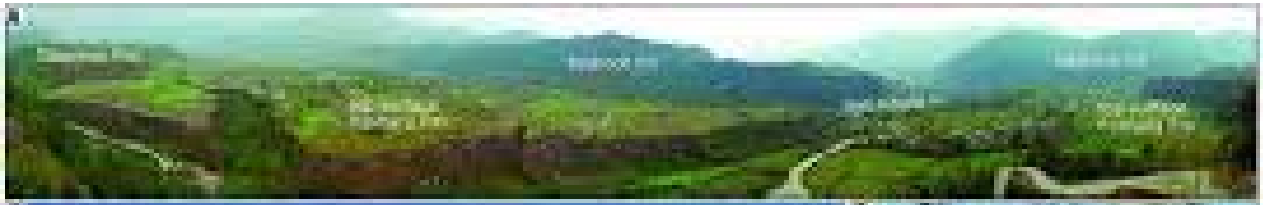
Lowest: 580 masl, Rupa

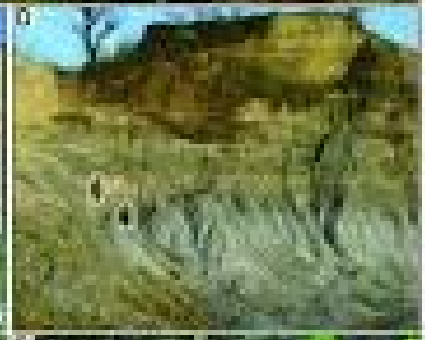
Highest: 2482 masl, Phewa

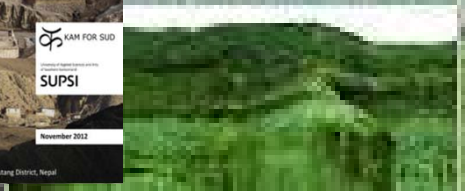
LCPV: Genesis

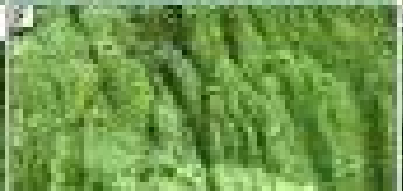
- Gigantic debris fan from a cataclysmic flashflood caused by the Seti River bursting a landslide or avalanche dam in its headwaters below Annapurna IV about 800 years ago
- Para-autochtonous crystalline rock with mostly unfossiliferous sedimentary and meta-sedimentary rocks like shale, sandstone, slate, conglomerate, phyllite, schist, quartzite, limestone, and dolomite.
- Layered clastic deposits with gravel, silt, & clay from Quaternary age eroded from Annapurna range by series of catastrophic debris flow

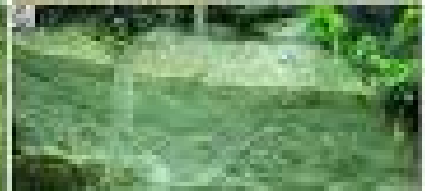












Photos: Google,showing genesis linked to LCPV

Coordinates, Elevation & Area of each lake of LCPV

SN	Lakes	Latitude	Longitude	Altitude (m)	Area (km^2)	Water Body (Km^2)	% Water Body
1	Phewa	28.1943-28.2902	83.8004-83.9898	763-2482	119.39	4.33	3.6
2	Begnas	28.1621-28.2167	84.0814-84.1332	647-1447	18.6	3.13	16.8
3	Rupa	28.139-28.2061	84.1004-84.1699	580-1420	26.02	1.11	4.3
4	Khaste	28.1908-28.2115	84.0449-84.0603	739-1186	2.69	0.13	4.8
5	Dipang	28.1777-28.2025	84.0645-84.0821	687-1269	2.39	0.14	6.2
6	Maidi	28.1753-28.1952	84.0785-84.0895	672-1123	1.6	0.007	0.4
7	Gunde	28.1889-28.2001	84.0392-84.0476	741-948	0.61	0.08	13.1
8	Neurani	28.1889-28.195	84.0465-84.0533	742-866	0.18	0.027	15.0
9	Kamalpokhari	28.2169-28.2377	84.0102-84.0217	822-1440	1.35	0.013	1.0
Note: This table does not cover riparian area of the cluster				Total	172.8	8.97	5.19

Bigger lakes: Phewa followed by Begnas and Rupa

Smaller and shallow lakes

Lekhnath City

Pokhara City

- All lakes sub-surface drainage type, mostly oligtrophic to eutrophic
- Phewa, Begnas and Rupa very productive for Fishery, irrigation and recreation
- All lakes vulnerable to threats, the smaller the more vulnerable

Photos: Maidi Wetlands

A typical marshland Maidi

Upper right: Land conversion for settlements

Photo: Dipang Lake

ILEC team in Dipang 2011.03.21

Community engagement: Cleaning the lake

Photo: Rupa Lake

Ruppa

Lower: ILEC visit to Rupa 2011 March 21

Photo: Begnas Lake

Begnas lake

Lower: Firshery Research Center

Photo: Phewa Lake

Phewa lake

Lake Cluster Photo at Once

LCPV: Physical Environment

Sub-tropical, cool temperate and warm temperate climatic zones

Ranges

15–20^{0}C [in sub-tropical zone (<1000 masl]

10-15^{0}C [in warm temperate (1000-2000 masl) and Cool temperate (2000-2500 masl) zones]

Mean annual air Temp: 20^{0}C-25^{0}C

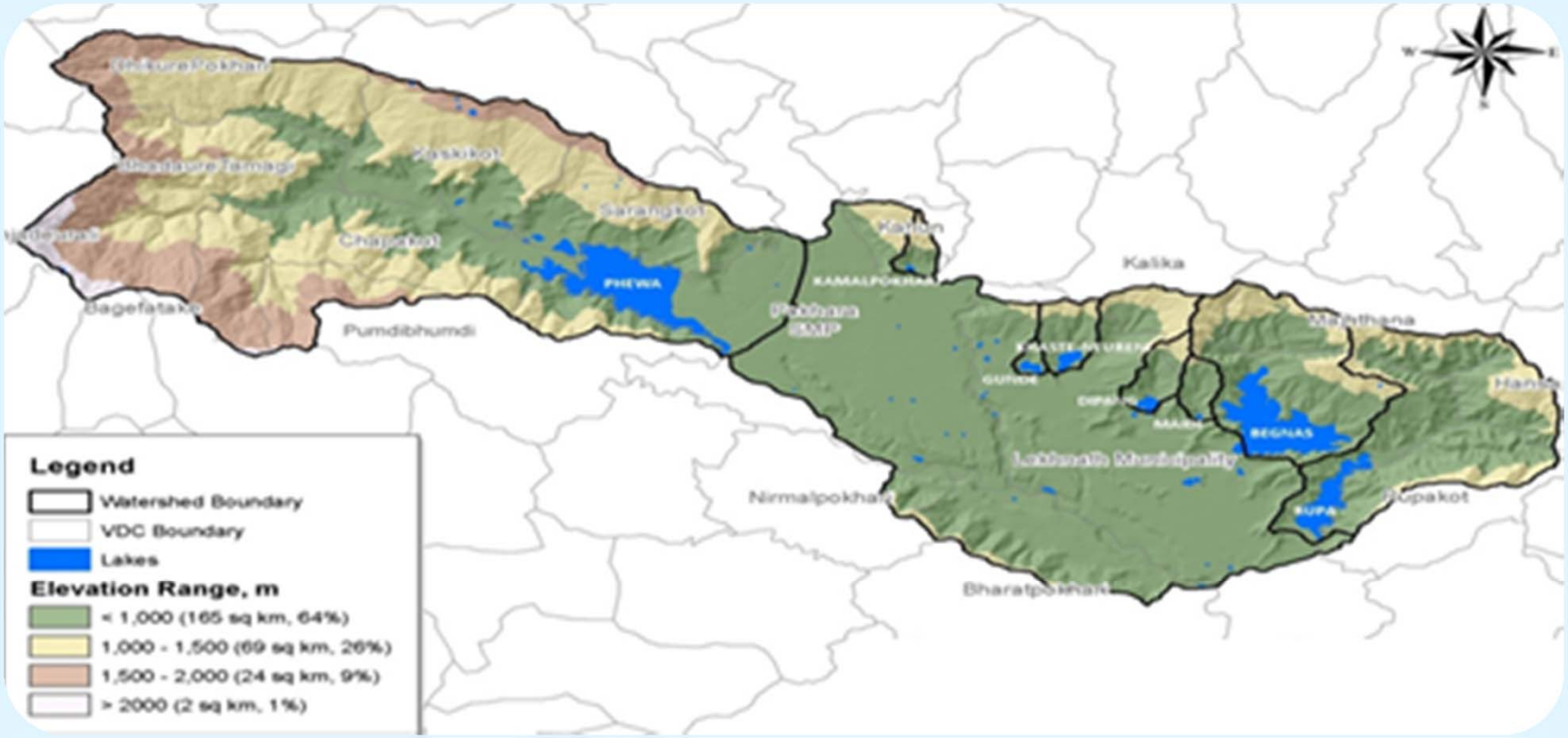
Avg. annual max-min temp: 21^{0}C-11^{0}C

Avg. annual rainfall: 4,000 mm

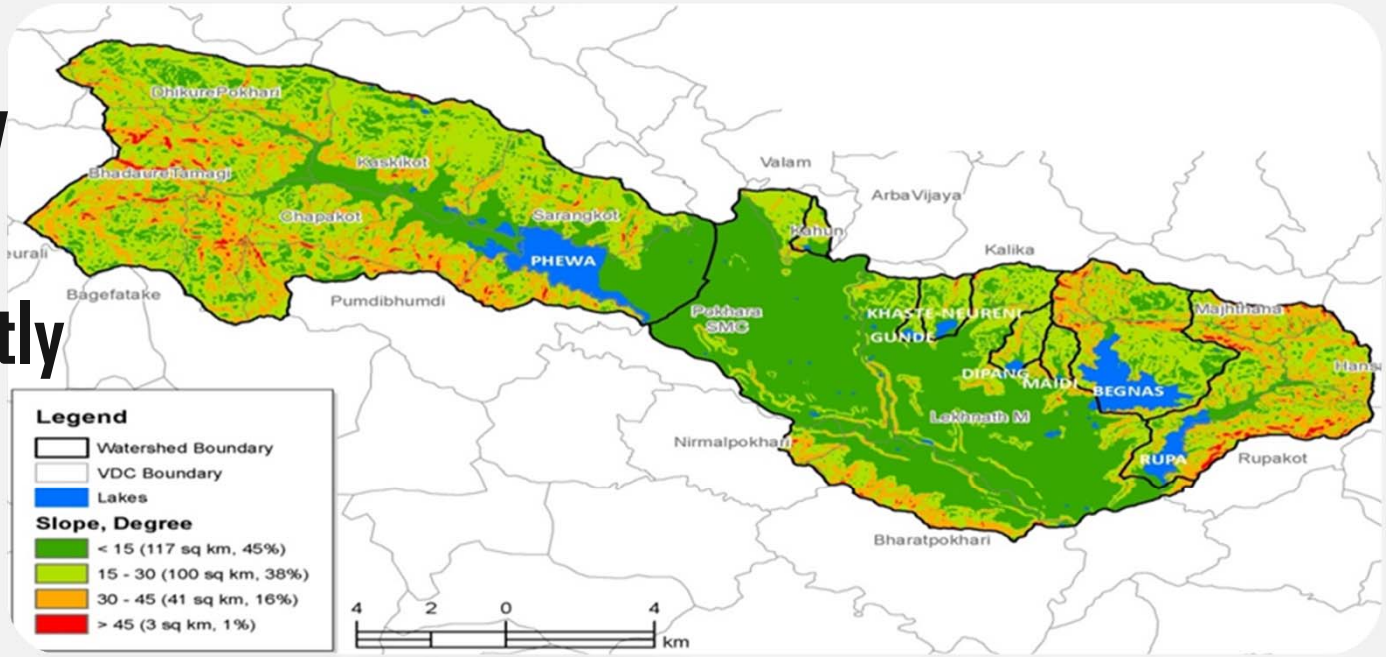
Highest rainfall place regarded as Cherapunji of Nepal

LCPV Physical Environ: Elevation/Slope Feature

Elevation ranges from 580 to 2,482 masl, highest in Panchase of Phewa



- Almost 35% (93 km^2) area in between 1,000 - 2,000 masl
- 1% area above 2,000 m.
- About 64% (165 km^2) below 1,000 m.
- 83% area moderate to gently slope terracing
- About 64% of sloped areas below 1,000 masl.
- Flat valley floors intensely cultivated



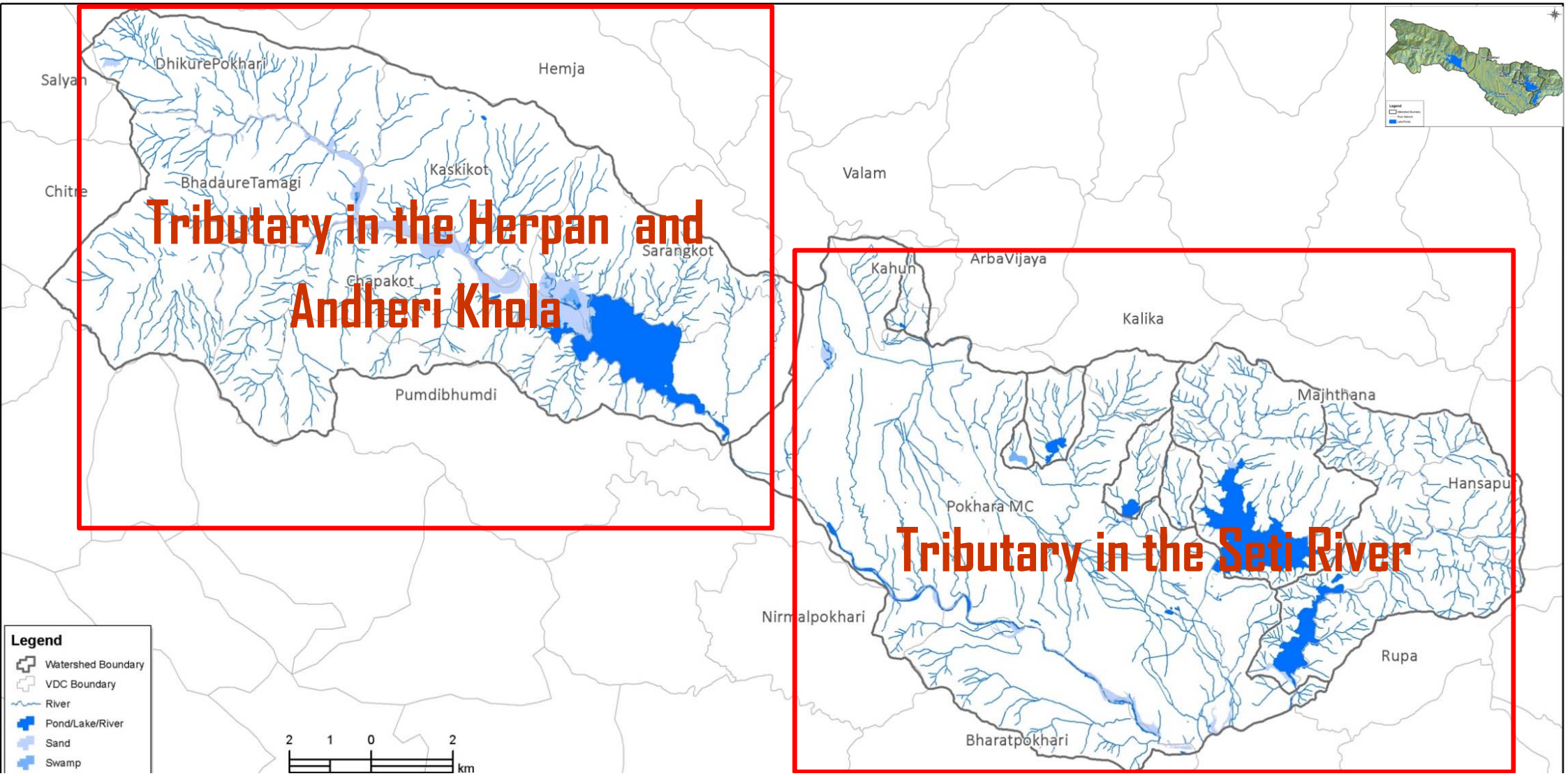
LCPV Physical Environ: Hydrological Nexus

- Perfect reflection of lentic-lotic system
- Complex hydrological network with two hydrologic zones based on climatic features & basin response:
  - Mountain Catchment in the Seti River having headwaters in Himalaya region
  - Pokhara tributary in Harpan and *Andheri Kholas*
- Table river network

Table Key rivers and streams associated with lake system in Lake Cluster Pokhara Valley

Lake Basin	Major River	Major Stream	Others
Phew	Hadi, Marse and Sidhane Khola (Harpan) and Adheri Khola	Khahare. Laurek, Betani, Ghuetro, Kanjire, Khahare (Bhakunde), Khapaudi, Balaudi, Phirke, Machha Pokhari, Bhumdi, Mure, Sasurke, Bhupan Kholas etc	Pardi, and Phusre Khola, and Seti River
Kamalpokhari	Bans Khola	Thado Khola	Kahu Khola
Gunde			Soto
Khaste	Thulo Khola	Nuwara and Rote Khola	Gadua Khola
Neureni			Gadua Khola
Dipang	Khatre and Kusunde Khola	Kahur and Kaure Kholas	Deurali Khola
Maidi		Piple, Bhudrung, Baskot, Raule and Saunne Kholas	Maidi Khola
Begnas	Syangkhudi	Kanmarang, Dud, Dhandhunge, Baguwa, Banspani and Khahare Kholas	Chyanladi and Khudi Khola
Rupa	Dovan	Chisa, Sanophadi, Dholphadi, Bhangara, Karaundi and Kalaundi Kholas	Tal Khola

Hydrological Nexus

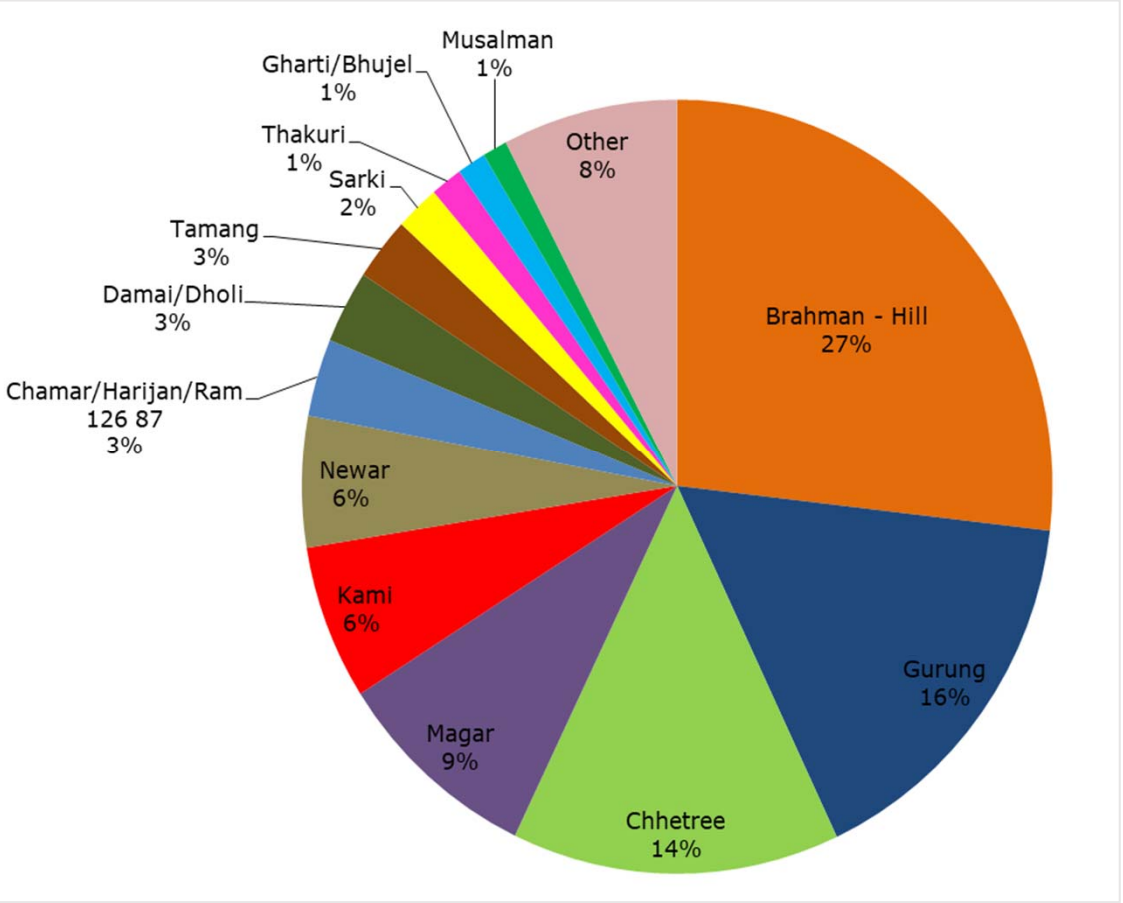


Socio-Ecological Features

Socio-economic

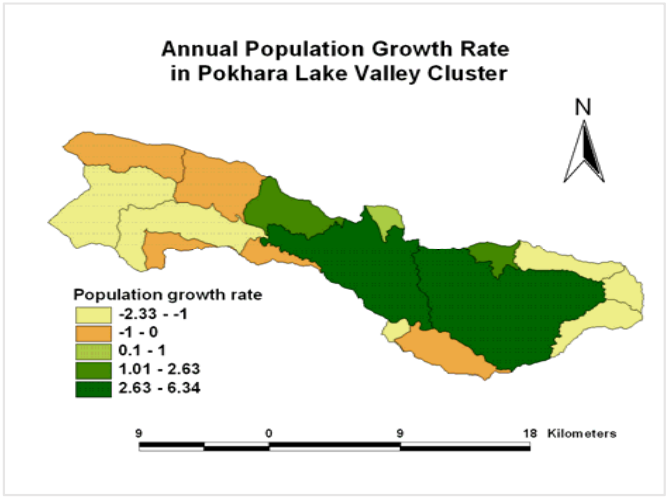
LCPV: Socio-economic Feature

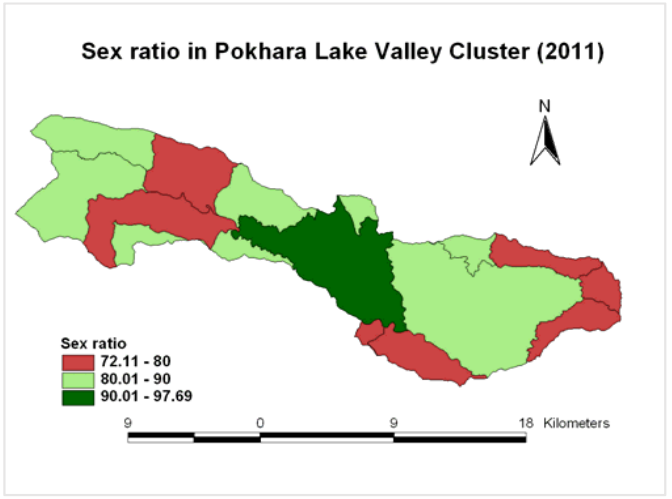
Total Popⁿ:	378,807
Avg. HHs Size:	3.8 people
Popⁿ Growth:	-ve in rural area (-0.31 to 2.33) but +ve in urban areas (6.34 to 4.22)
Sex Ratio:	92, < 94 of National avg
Ethnicity:	101 ethnic groups
Language:	67 spoken languages, Nepali the common.
Livelihood:	53% popⁿ in agriculture.
Ownership HH:	Female-headed 39% HH

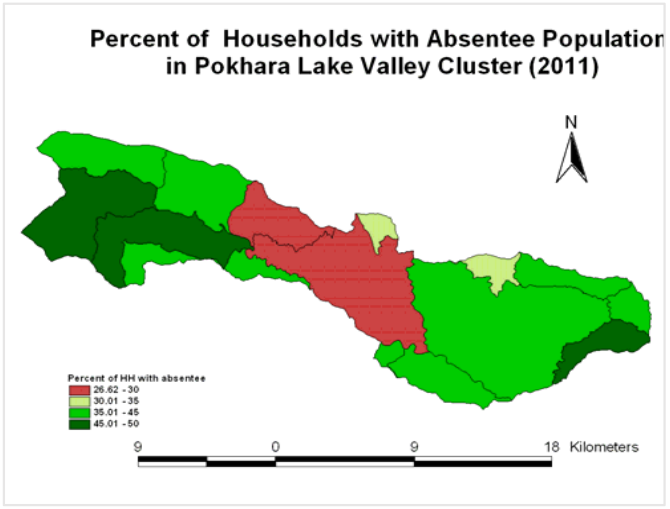


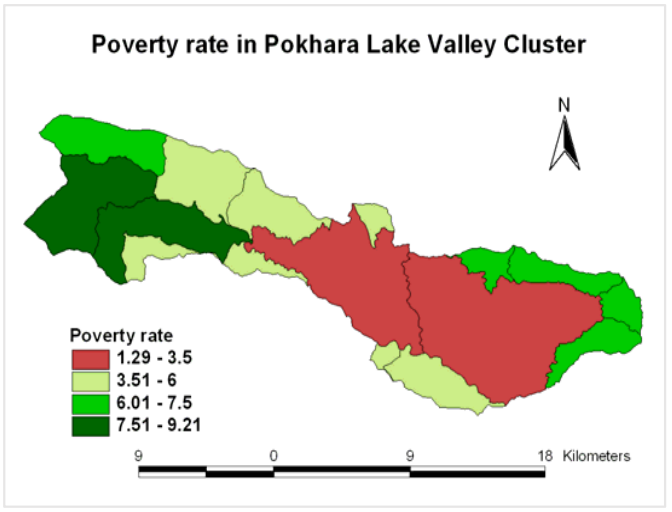
Lake dependent communities: Jalhari, Majhi, & Pode (Phewa, Begnas & Rupa)

Demography changes (2001-2011)

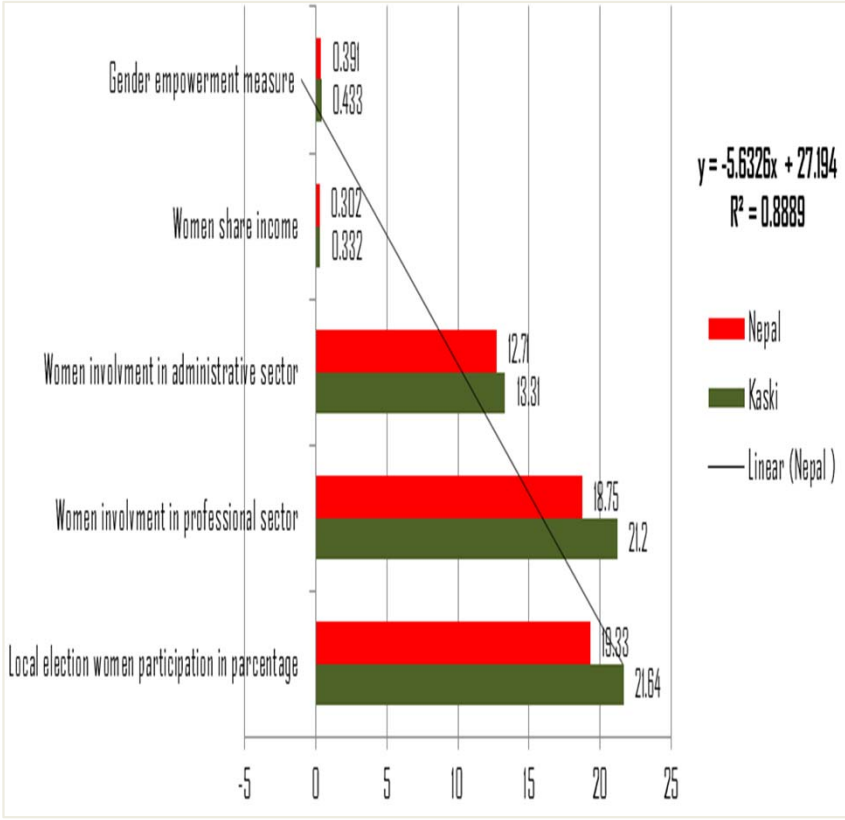






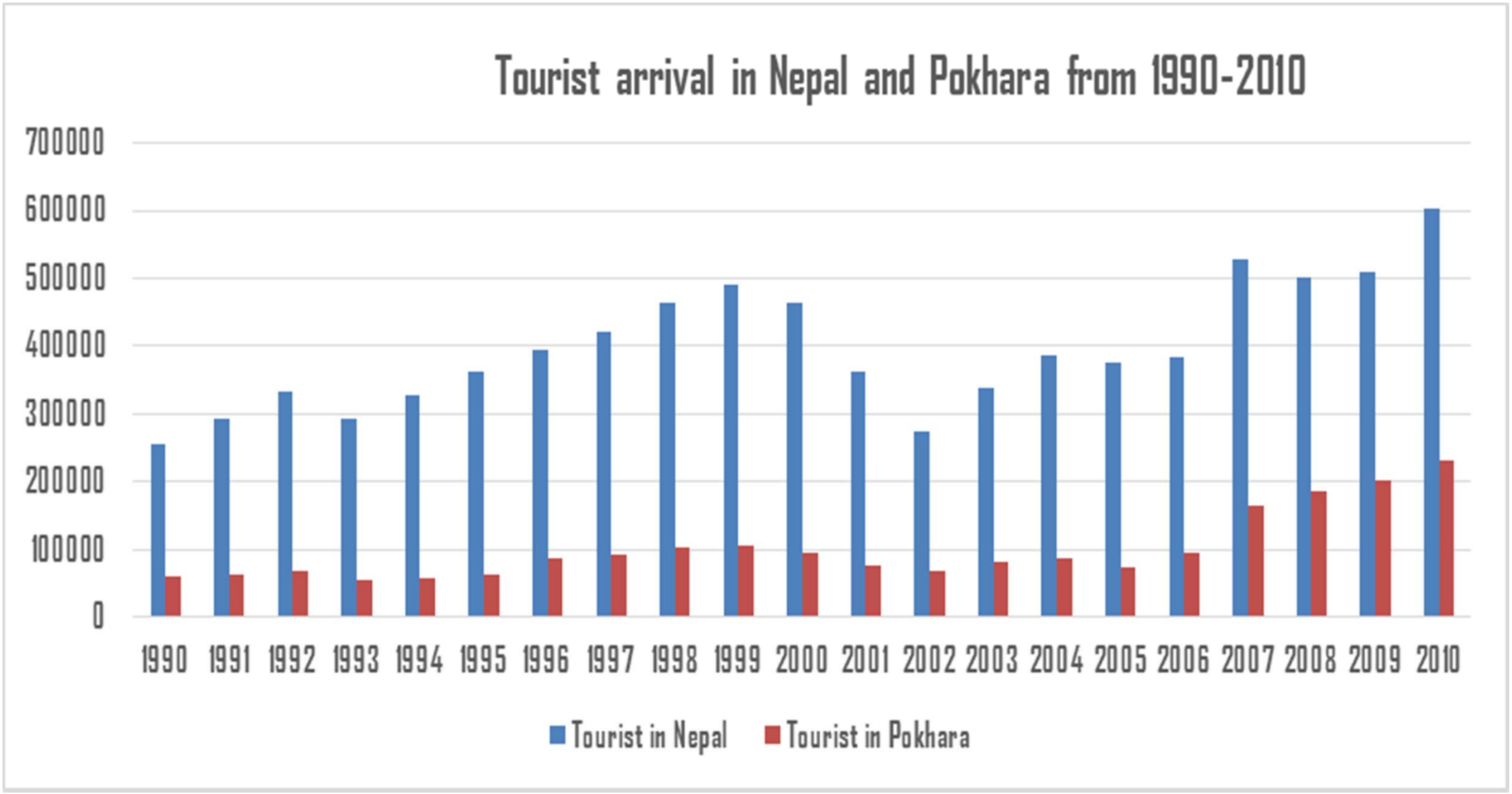


Status of Gender & Social Inclusion in LCPV



Eco-Tourism: Window for the Economic Growth

- Pokhara 10th tourism destination in Nepal
- Famed for lake tourism and adventure tourism (para-gliding and ultralight flying to zip-lining, mountain biking, rock climbing, and white water rafting)
- 20 trekking destinations
- About 40% of foreigners visiting Nepal make Pokhara their choice destination
- No. of tourists increasing at about 5% in the last 35 years from 1976 to 2010), with a dramatic increase of 20% from 2007
- LCPV the Gateway to the Annapurna Circuit
- Tourism engaged 13% of the total number of businesses in Pokhara



Flow of visitors in Pokhara from 1990-2010

Development Index, ICPV

Human Development Index: 0.576

Human Poverty Index: 16.5%

Per Capita income: USD 1,561

Ecosystem and Biodiversity

LCPV: Ecosystem & Habitat Diversity

- Nepal has 12 of the 867 terrestrial ecoregions of the world
- LCPV the conjecture of the Eastern Himalaya Temperate Broadleaf Forests, Himalayan Subtropical Pine Forests, and Himalayan Subtropical Broadleaf Forests eco-regions

- Key natural ecosystems: Wetlands, rivers, forests, and grasslands
- Each lake in the cluster: Diverse habitat mosaic consisting of an open water body, adjacent marshes and swamps, various forest types, and agricultural fields.

Phokra City at the Shoreline of Phewa Lake @Google

LCPV: Ecosystem & Habitat Diversity

- Sub-tropical and lower temperate forests dominated by *Shorea robusta* (Sal), *Schima* spp. *Castanopsis* spp. (Chilaune-Katus), *Daphniphyllum himalense* and *Alnus nepalensis*
- Several aquatic macrophytes, hydrophytes and helophytes
- Vegetation features vary as per altitude, for example: Table

Table 5 Vegetation Type & Distribution in LCPV *(Assessment Study 2016)*

Altitude (masl)	Vegetation			
	Hill Sal	*Schima-Castanopsis*	*D. himalense*	*A. nepalensis*
1000	√	√		
1000-1500	√	√	√	√
1500-2000		√	√	√
>2000			√	

LCPV: Species Diversity (Flora)

- 362 species of plants (286 terrestrial species under 83 families and 184 genera, and 61 aquatic species under 22 families and 26 genera)
- 32 orchids, of which 10 are endemic
- Many endemic plants. Some of the endemic orchids are *Oberonia nepalensis, O. eridifolia, Papilionantheteres sp., Rhynchostylis retusa*, and Arisaema tortuosum, *Cissampelos pareira, Berberis aristata, Asparagus racemosus, Reinwardtia indica* and *Ficus neriifolia*
- New species *Dischidia bengalensis* from Raniban and Harpan *and Phreatia elegans* from Chapakot
- 146 species of NTFPs
- 82 species plants important for agro-biodiversity.

Floral Diversity at Different Level in LCPV

Class	Terrestrial Plant			Aquatic Plant			Cultivated Plant		
	Dicot	Monocot	Pteridophyte	Dicot	Monocot	Pteridophyte	Dicot	Monocot	Pteridophyte
Family	83	8	3	22	6	3	33	8	1
Genera	184	48	10	26	16	3	49	16	1
Species	207	65	14	34	24	3	58	17	1

Hydrilla verticillata in Dipang lake

New species record *Oischidia bengalensis* from Phewa lake basin (Yadav Uprety 2016)

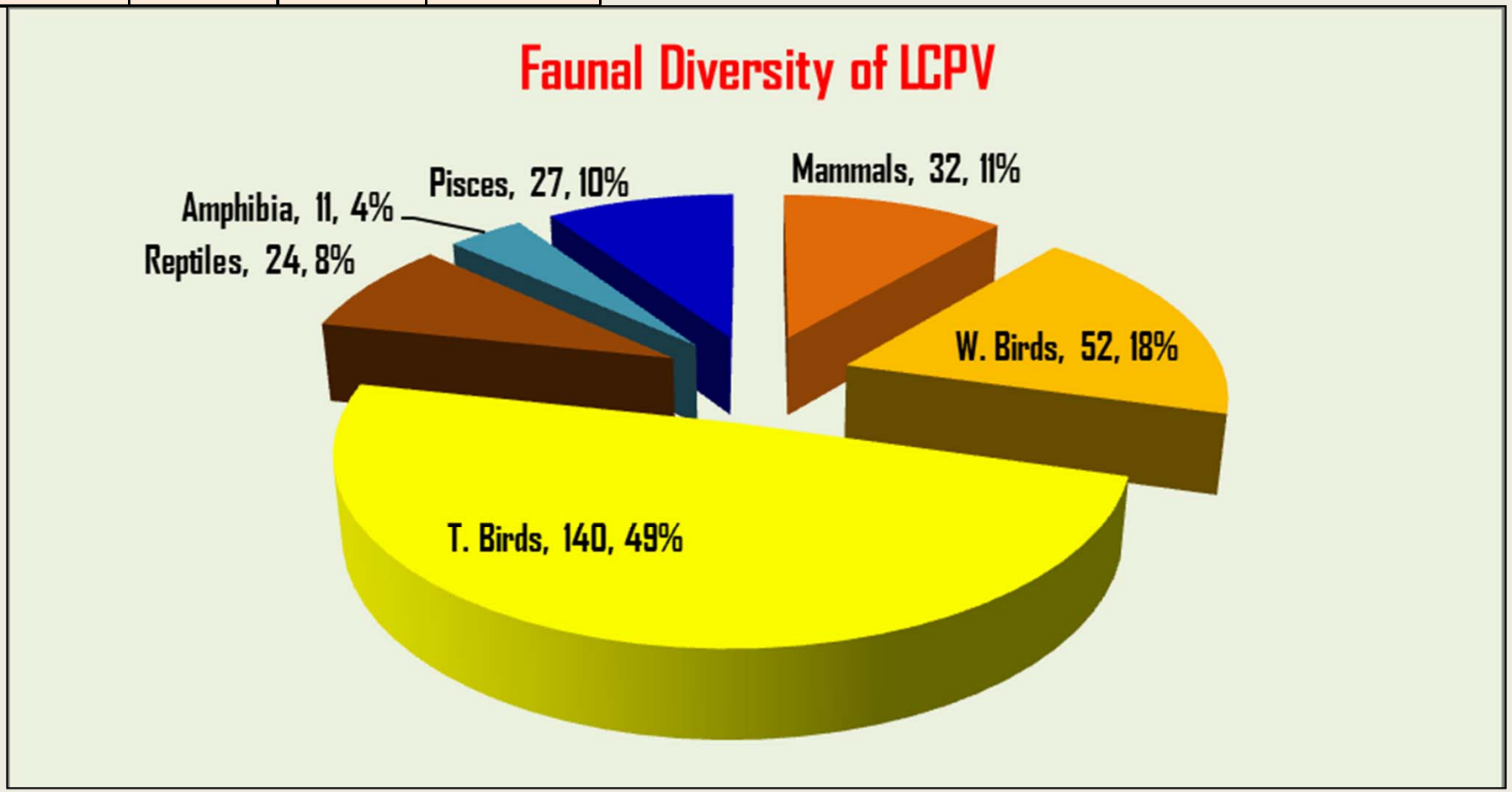
Endemic orchid Oberonia nepalensis(Yadav Uprety 2016)

LCPV: Species Diversity (Fauna)

- 128 species of vertebrates including 32 species of mammals, 24 species of reptiles; 27 species of fish; 11 species of amphibians; and 140 species of birds.
- 21 native fish, 6 alien fish and 13 zooplankton species.

- Of Birds, 52 species are wetland birds (17 families & 38 genera)
- Recently, 49 species of butterfly, 157 species of other insect, and 152 species of birds (13 orders and 51 families with 10 species Globally Threated) reported from Dipang lake basin

Classified Diversity of Fauna in Lake Cluster Pokhara Valley 2016 (T =					
Class	Mammals	W. Birds	T. Birds	Reptiles	Amphibia
Family	17	17	37	10	3
Genera	32	38	101	19	8
Species	32	52	140	24	11



Common sailer (*Neptis hylas*)

Plain tiger (*Danaus chrysippus*)

Neurothemis intermedia

Bright sunbeam (*Curetis bulis*)

Yellow Helen (Papilio nephelus)

Epicauta tibialis

Butterflies and insects of the Dipang lake basin, Pokhara

LCPV: Invasive Species

- All lakes hold alien flora and fauna fishes.
- 6 alien invasive species of fishes
- *Tilapia nilotica* (Tilapia) and *Clarias gairiepinus* (African Catfish) common alien fishes
- Decline 42% of native fish in Begans
- *Parthenium hysterophorus, Mikenia macrantha, Eichornia crasssipes, Leerisa hexandra* and *Pistia stratiotes* are common alien plants

African Catfish

Tilapia

Mikenia macrantha

LCPV: Endemism

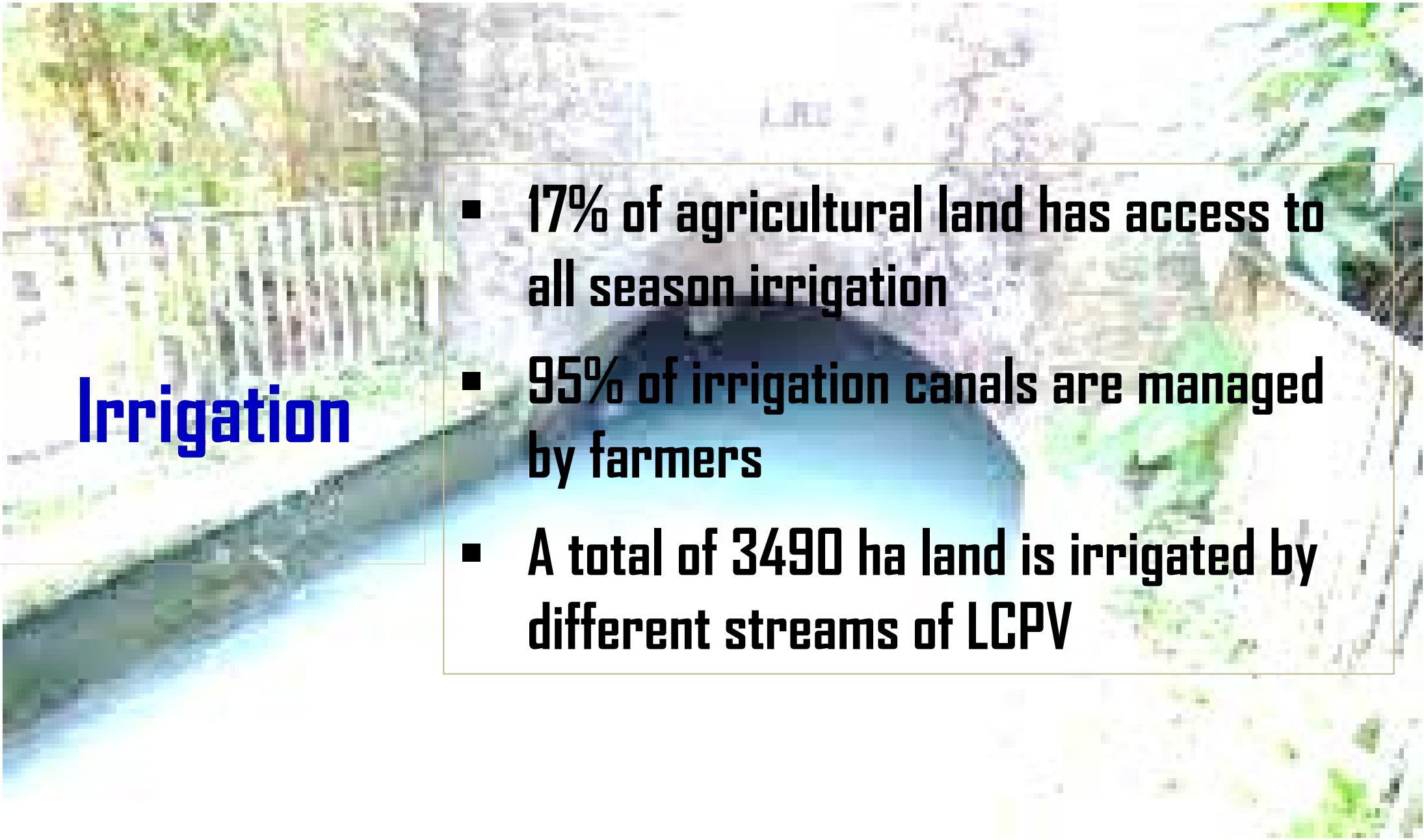
- 10 endemic Orchid
- 2 endemic birds

  Turdoides nepalensis (Spiny babbler) *Panoepyga immaculata* (Wren babbler)

SOCIOECONOMIC USE OF LCPV

Tourism

- Phewa alone provided economic incentives of NPR >3 billion a year
- A community cooperative in Rupa makes >6 million NPR a year from fishery
- Lake base tourism in Pokhara fetched US $ 60 million
- Over 128 species of plants used as medicinal plants and 44 species as wild edibles



Irrigation

- 17% of agricultural land has access to all season irrigation
- 95% of irrigation canals are managed by farmers
- A total of 3490 ha land is irrigated by different streams of LCPV

Freshwater supply

- Phewa, Begnas and Rupa lakes have water storage capacities of 46 x 10^6 m^3; 17.9 x 10^6 m^3 and 3.25 x 10^6 m^3, respectively
- 33% of water from Phewa used for domestic purposes Phewa lake also generates 1 MW of hydropower
- Many hotels from shoreline of Phewa pump water for uses

Fishery

- Phewa alone provides benefits from 98 metric tons of annual turnover
- RLRFC (Rupa Lake Restoration and Fishery Cooperative) practicing community fishery with engagement of >625 HHs, Reaping benefits of about NPR 10 million a year
- Fishery common in Begnas, Khaste, Neureni, Gunde and Dipang lakes

- **Grazing/Fodder**
  - 2.2 km^2 of grassland, with the highest extent in Phewa (1.7 km^2) Begnas (0.3 km^2) and Maidi (0.2 km^2)
- **NTFPs/Medicinal and Aromatic Plants**
  - >360 species of NTFPs/MAPs
  - 8 fiber-yielding species, 23 species natural dyes, 18 wild species with floriculture potential (excluding the 32 species of orchids), and 98 edible fern species.

- **Religio-cultural values**
  - Historical, religious, environmental and cultural values.
  - Key sites : 200-year-old Shraban Kumar temple Barahi temple, Sitaladevi Mandir and Nagdev, Devi Temple, Bindeshari Mandir, Kalika Mandir, Sunapdeli Mandir etc.

Ecosystem Services from Lakes & Basin of LCPV 2-16 (- = No; * = Low; ** = Moderate; ***= High)										
	Type of Services	Phewa	Kamalpokhari	Gunde	Khaste	Neureni	Dipang	Maidi	Begnas	Rupa
Provisional	Drinking water supply	**	-	-	-	-	-	-	**	**
	Irrigating water supply	**	***	***	***	*	**	*	***	*
	Domestic water supply	**	-	*	-	*	-	-	-	-
	Industrial water supply	-	-	-	-	-	-	-	-	-
	Fish supply	**	*	-	*	-	*	-	**	***
	Timber supply	**	*	*	*	*	**	**	**	**
	Fiber supply	-	-	-	-	-	-	-	-	-
	Fuel wood supply	**	*	*	**	*	**	**	**	**
	Fodder/forager/grass supply	***	**	*	**	*	**	**	***	***
	Food (plants and animals)	**	-	-	*	*	*	*	*	*
	Medicine	**	-	-	*	-	*	*	**	**
	Hydropower	*	-	-	-	-	-	-	-	-
	Mining and extraction	**	-	-	-	-	-	-	*	*
	Handicraft material	*	-	-	*	-	*	-	*	*
	Genetic material	**	-	-	-	-	-	-	**	**

Ecosystem Services from Lakes & Basin of LCPV 2-16 (- = No; * = Low; ** = Moderate; ***= High)										
	Type of Services	Phewa	Kamalpokhari	Gunde	Khaste	Neureni	Dipang	Maidi	Begnas	Rupa
Cultural	Aesthetic and scenic service	***	-	-	-	-	*	-	**	**
	Religious/spiritual service	**	*	-	*	-	-	*	-	*
	Historic site	**	-	-	-	-	-	-	*	*
	Recreational/tourism	***	-	-	-	-	*	-	**	**
	Educational resource services	***	-	-	-	-	*	*	**	**
	Festivals/hat bazzar/mela	**	*	*	*	*	*	*	**	**
Regulatory	Water recharge	***	***	***	***	***	***	***	***	***
	Flood mitigation	*	-	-	-	-	-	-	*	*
	Desertification mitigation	**	**	**	**	**	**	**	**	**
	Biodiversity	***	*	*	*	*	**	**	***	***

Ecosystem and Biodiversity

Threats & Vulnerability

LCPV Follows Global Trend of Threats & Vulnerability

- ENCROACHED
- CONVERTED
- DEGRADED

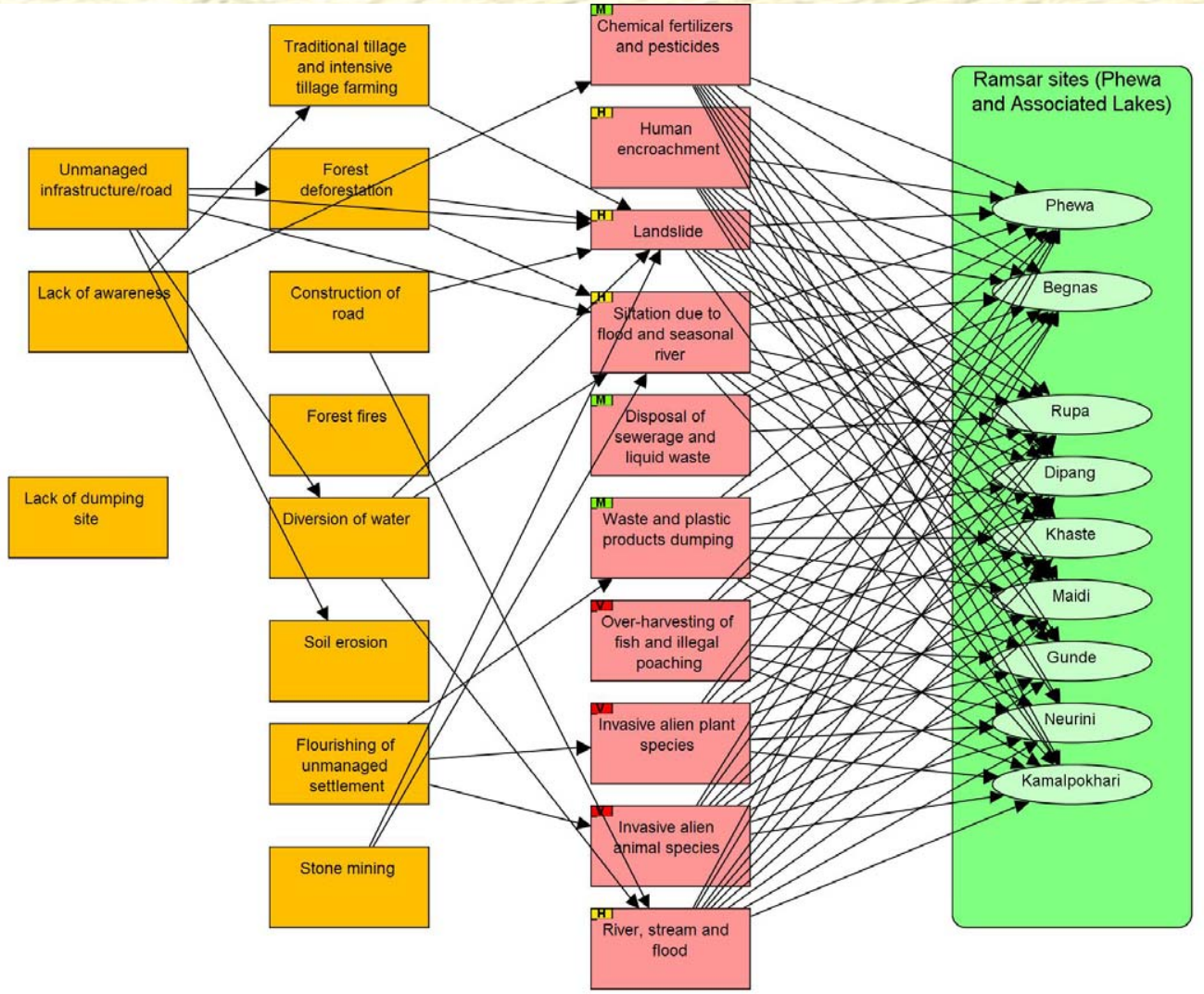
Key Threats in LCPV

ENCROACHMENT

SILTATION

POLLUTION

INVASION BY ALIEN SPECIES



Threats Rank in LCPV

Threats \ Targets	Kamalpokhari	Neurini	Begnas	Khaste	Phewa	Maidi	Rupa	Gunde	Dipang	Summary Threat Rating
Landslide	Medium		Medium	Medium	High	High	High		Medium	High
Chemical fertilizers and pesticides	Medium	Low	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Over-harvesting of fish and illegal poaching	High	High	High	High	High		Low	Medium	High	Very High
Waste and plastic products dumping	Medium	Low	Medium	Low	Medium	Low	Low	Low	Medium	Medium
Siltation due to flood and seasonal river	Medium		Medium	High	High	Medium	High	Low	Medium	High
Human encroachment	Low	Low	Low	Low	High	Low	High	Low	Low	High
Invasive alien plant species	High	High	Medium	High	High	High	Medium	Very High	High	Very High
Disposal of sewerage and liquid waste			Low		High		Low			Medium
River, stream and flood	Medium	Medium	Medium	High	High	Medium	High	Medium	Medium	High
Invasive alien animal species	High	High	High	High	High	High	High	High	High	Very High
Summary Target Ratings:	High	High	High	High	Very High	High	High	High	High	**Overall Project** Very High

Trends of Threats LCPV

SN	Threats	Phew a	K. Pokhari	Gunde	Khaste	Neureni	Dipang	Maidi	Begnas	Rupa
1	Chemical fertilizers and pesticides use	↑	↑	↑	↑	→	↑	↑	↑	↑
2	Human encroachment	↑	→	→	→	→	→	↑	→	↑
3	Landslide	↑	→		→		→	↓	→	→
4	Siltation due to flood	↑	→	↑	↑		→	→	↑	↑
5	Disposal of sew age and liquid w aste	↑							↑	↑
6	Solid w aste and plastic products dumping	→	→	↓	↓	↓	→	→	↑	→
7	Over-harvesting of fish and illegal poaching	↑	↑	↑	↑	↑	↑		↑	→
8	Invasive alien plant species	↑	↑	↑	↑	↑	↑	↑	→	→
9	Invasive alien animal species	↑	↑	↑	↑	↑	↑	↑	↑	↑
10	River, stream and flood	↑	→	→	↑	→	→	→	↑	↑
	Total Threats	10	9	8	9	7	9	8	10	10

Note:	Low	Medium	High	V. high	None
Trend:					
→	Constant	↑	Increasing	↓	Decreasing

Climate Change Impact: Community Perception

Indicators	Scenario	Sensitivity	Impacts	Response
Temperature	Increasing	Increase drought, forest fire, evapotranspiration high, weathering	Water level declined	Ecosystem based adaptation
Rainfall	More erratic, intensive	Decrease water sources, increased erosion and landslides	Quality and quantity of lake water decreased	Water source protection, conservation of upland, forest management and river training
Sediment flow	Likely increase	Highly affected	Decreased lake area and depth	Gully control, stream bank protection
Evaporation	High in dry months	Change in water budget	Decreased water level	Forests and water conservation
Invasive species	Likely to increase	Highly affected	Impact on water quality and aquatic life	Upland farming, city waste management.
Eutrophication	Likely to increase	Likely increased algal population and invasive species	Impact on water quality and aquatic life	Upland farming, city waste management, green enterprise
Non-Climate encroachment	Likely to increase	Decrease lake water from siltation	Impact on lake management	Lake boundary, Strong lake governance

Consequential Impact of Climate Change/Vulnerability

SN	Vulnerability	Phewa	Kamalpokhari	Gunde	Khaste	Neureni	Dipang	Maidi	Begnas	Rupa
1	Enroachment	↑	→	→	→	→	→	↑	→	↑
2	Siltation	↑	→	↑	↑		→	→	↑	↑
3	Pollution	↑	↑	↑	↑	→	↑	↑	↑	↑
4	Invasive alien species	↑	↑	↑	↑	↑	↑	↑	↑	↑

Greater Concern: Landuse Change from 1996-2016 (i)

Lake Basin	Built up area (km^2)				Cultivation				Forest			
	1996	%	2016	%	1996	%	2016	%	1996	%	2016	%
Phewa	0.03	0.02	6.2	5.2	62	52.69	48.58	40.67	45.57	38.15	49.19	41.19
Kamalpokhari					0.85	83.4	1.03	76.07	0.15	14.6	0.21	15.23
Khaste					2.1	78	1.87	69.55	0.42	15.6	0.6	22.51
Neureni					0.1	57.3	0.08	44.54	0.06	34.1	0.07	40.84
Gunde					0.41	67.7	0.28	46.53	0.12	18.7	0.19	30.96
Dipang					1.38	57.4	1.19	[illegible]	0.89	37	0.97	40.45
Maidi					1.13	70.7	[illegible]	56.29	0.46	28.6	0.54	[illegible]74
Begnas					9.53	[illegible]	8.46	45.49	5.3	28.5	6.0[illegible]	32.47
Rupa					10.[illegible]	40.5	8.78	33.74	13.9	53.4	15.65	60.16
Total	*0.03*		*6.2*		*88.04*		*71.17*		*66.86*		*73.47*	

Builtup area increased

Cultivated land reduced

Forest increased

Greater Concern: Landuse Change from 1996-2016 (ii)

	Pond or lake				River/Streams				Sand			
	1996	%	2016	%	1996	%	2016	%	1996	%	2016	%
Phewa	4.52	3.78	4.42	3.7	0.73	0.61	0.09	0.08	1.58	1.32	4.21	3.53
Kamalpokhari			0.01	0.94	0				0			
Khaste	0.1	3.5	0.13	4.82	0				0			
Neureni	0.02	8.8	0.03	14.62	0				0			
Gunde			0.08	13.4	0				0			
Dipang	0.06	2.4	0.15	[illegible]	0				0	0		
Maidi	0.01	0.6	[illegible]	0.44	0				0			
Begnas	3.23	[illegible]	3.13	16.85	0				0		0.04	0.2
Rupa	[illegible]	4.1	1.15	4.43	5.4	0.2			[illegible]	1.4	0.19	0.74
Total	*8.99*		*9.11*		*6.13*		*0.09*		*1.95*		*4.45*	

Lake/ pond's area increased

River area decreased

River bank or sand area expanded

Greater Concern: Landuse Change from 1996-2016 (iii)

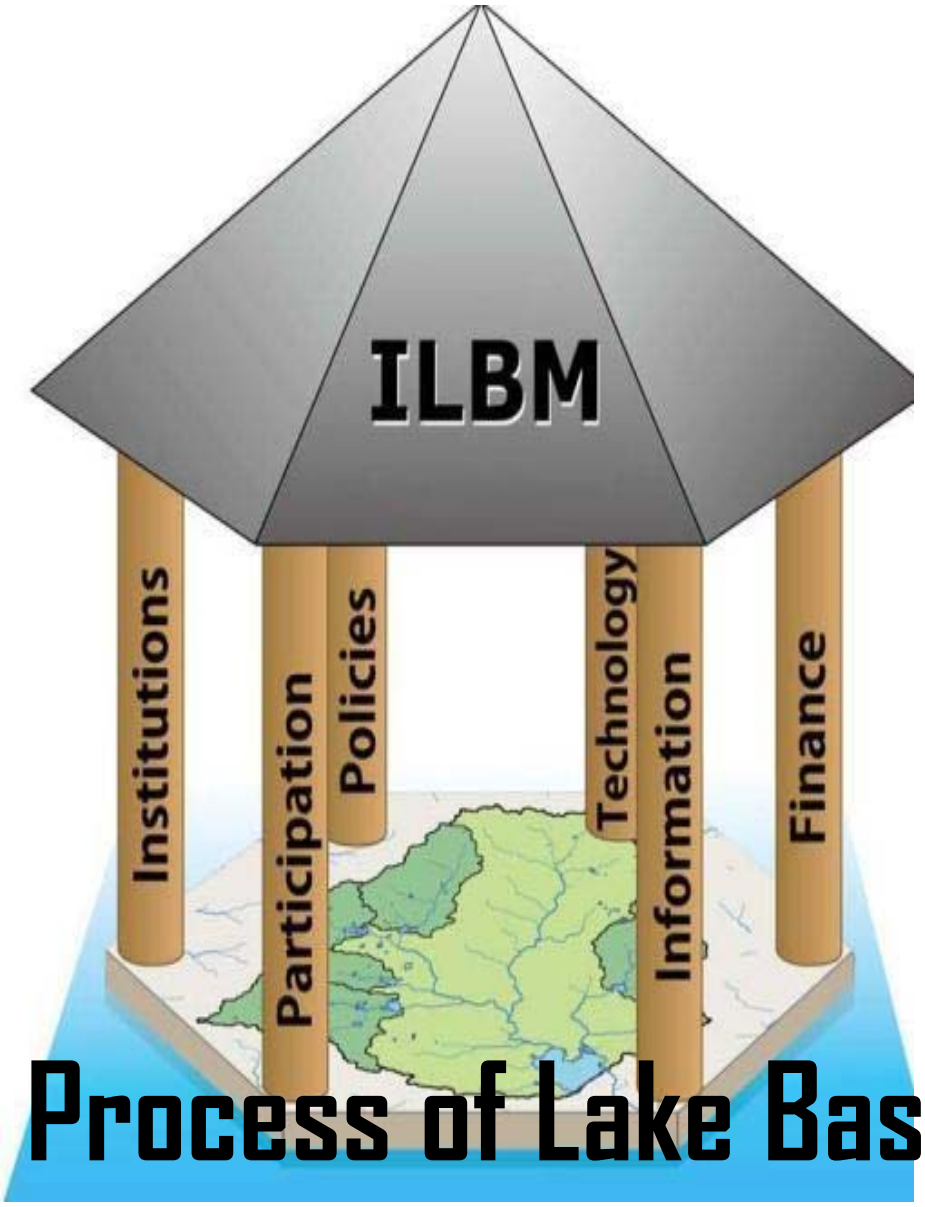
	Grassland				Shrub land				Swamp			
	1996	%	2016	%	1996	%	2016	%	1996	%	2016	%
Phewa	1.15	0.96	1.68	1.41	1.67	1.39	4.93	4.12	1.27	1.06	0.14	0.12
Kamalpokhari	0	0	0.01	0.68	0	0	0.1	7.08	0.02	2		
Khaste	0	0	0.001	0.04	0.08	2.9	0.08	3.08	0			
Neureni					0				0			
Gunde	0	0	0.01	1.74	0	0	0.05	7.36	0.08	13.6		
Dipang	0.01	0.2	0.001	0.04	0.07	2.9	0.09	3.76	0			
Maidi	0	0	0.15	3.14	0	0	0.01	0.38	0			
Begnas	0.16	0.8	0.33	1.75	0.32	1.7	0.59	3.18	0	0	0.01	0.03
Rupa	0	0	0.01	0.03	0.07	0.3	0.23	0.89	0	0	0.003	0.01
Total	*1.32*		*2.18*		*2.21*		*6.07*		*1.37*		*0.15*	

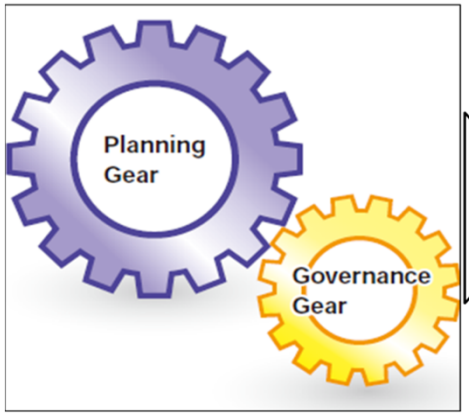
Grassland increased

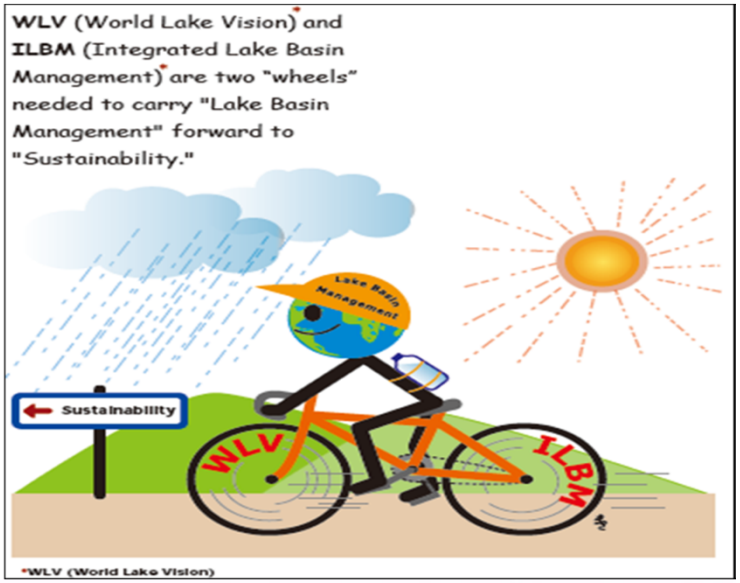
Shrubland drastically increased

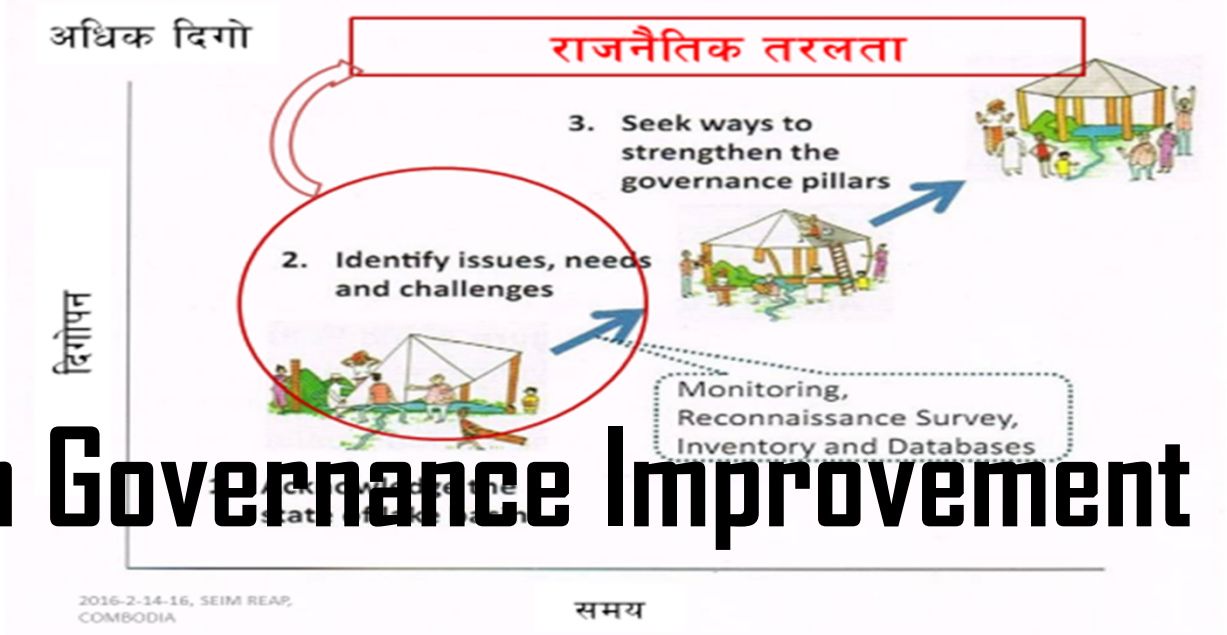
Swampland decreased

Lake Basin Governance Improvement









Process of Lake Basin Governance Improvement

Consolidation of Basin Governance in Nepal

Consolidation of Lake Basin Governance Happened Be Possible After Nepal's exposure to ILBM, and Affiliation with ILEC/RCSE/Sigha University

Gandaki State Proactive for Responding to Lentic-Lotic Ecosystem

- Gandaki State responded in parallel with the central level initiative as comparative advantage and as the stepping stones (i.e., Institution and Legal Framework)
- Continuous voice of citizens of Pokhara as the pulse of establishment of NLDC by erstwhile government
- LCPV designation as the Ramsar Site

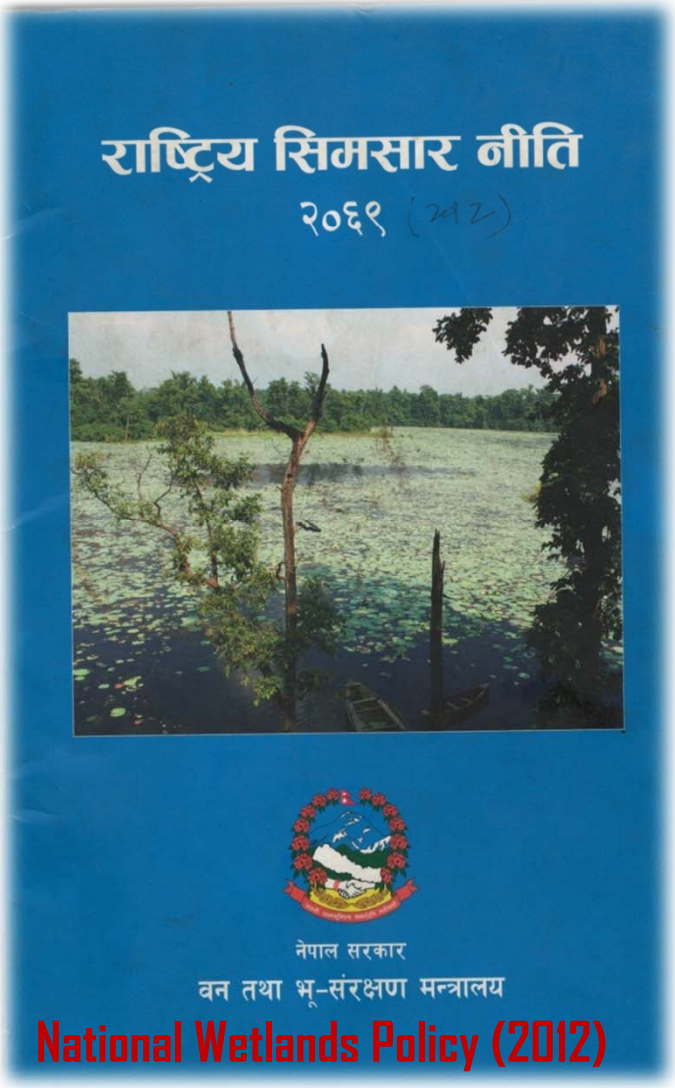
LCPV the Ramsar site designated first time based on a full spirit of the Lake Basin Approach in Nepal

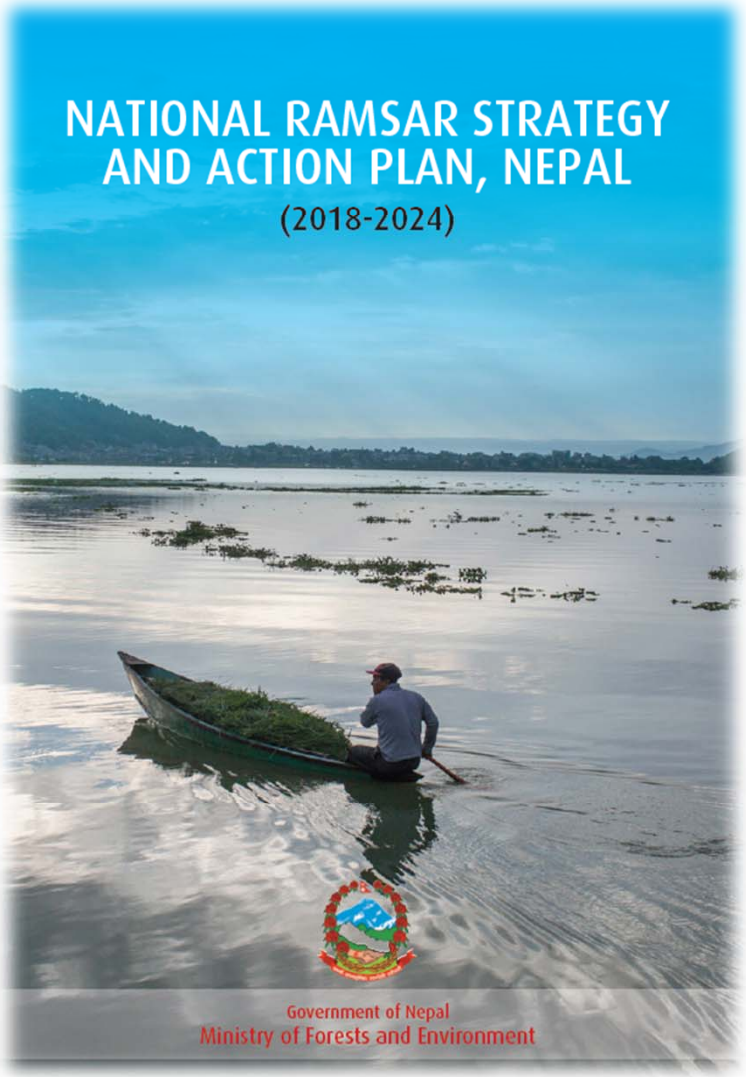
Policy Provisions at the Federal Level: Footprint for LCPV

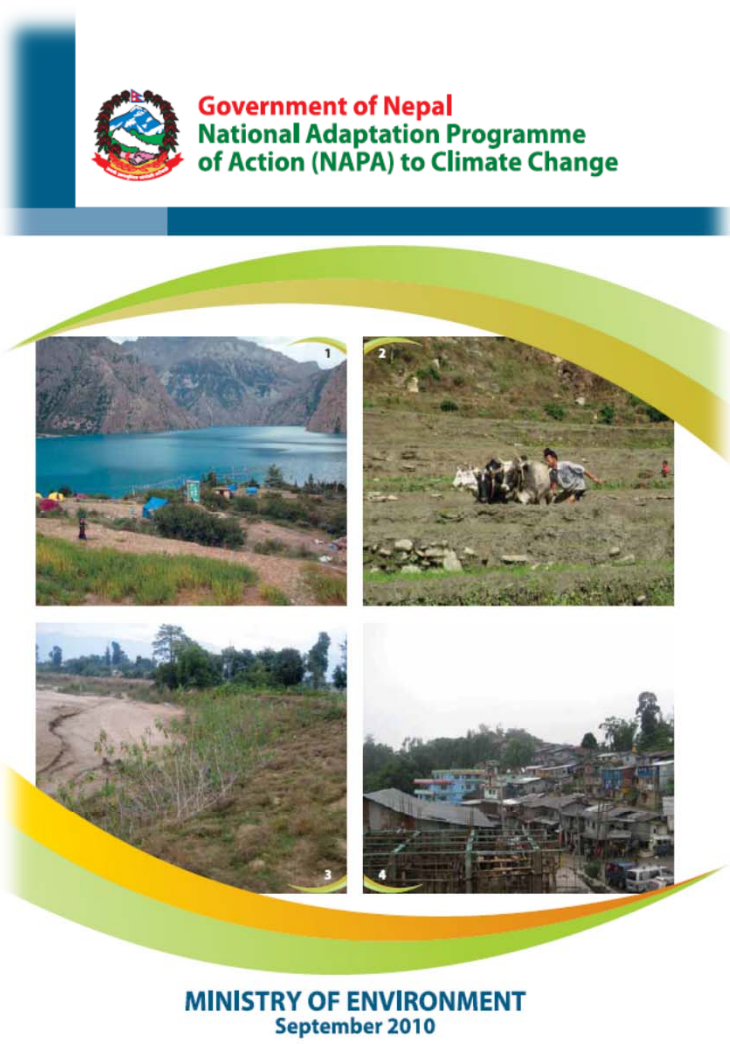
- Constitution of Nepal-2015
- Many strategies, but the most relevant ones:
  - *National Wetland Policy (2012)*
  - *National Biodiversity Strategy and Action Plan (2014-2020);*
  - *Nature Conservation National Strategic Framework for Sustainable Development (2015),*
  - *National Ramsar Strategy and Action Plan (2018-2024)*
- Dozens of Acts but the most relevant ones:
  - *Aquatic Animal Protection Act (1960)*
  - *National Parks and Wildlife Conservation Act*
  - *Watershed Conservation Act (1982) Mines and Minerals Act (1985)*
  - *Pesticide Act (1991)*
  - *Water Resources Act (1992),*
  - *Solid Waste Management Act (2011)*
  - *Irrigation Act ( )*
  - *Self Governance Act*

- *Many Environmental Standards*
  - *Nepal Water Quality Guidelines (2005)*
  - *Industry Specific Tolerance Limits for Industrial Effluents to be Discharged into Inland Surface Waters for Tannery,*
  - *Wool Processing, Fermentation*
  - *Vegetable Ghee and Oil, Paper and Pulp (2001);*
  - *Industry Specific Effluents Standards to be Discharged into Inland Surface Water for Dairy, Sugar, Cotton, and Soap Industries (2003)*
  - *Generic Effluents Standard for Discharging into Open Sewerage (2003);*
  - *Generic Effluents Standard to be Discharged from Treatment Plant to Inland Water (2003)*
  - *Generic Standard Tolerance Limits for Industrial Effluents to be Discharged into Inland Surface Waters (2008) etc.*

Key Policy Framework at the Central Level



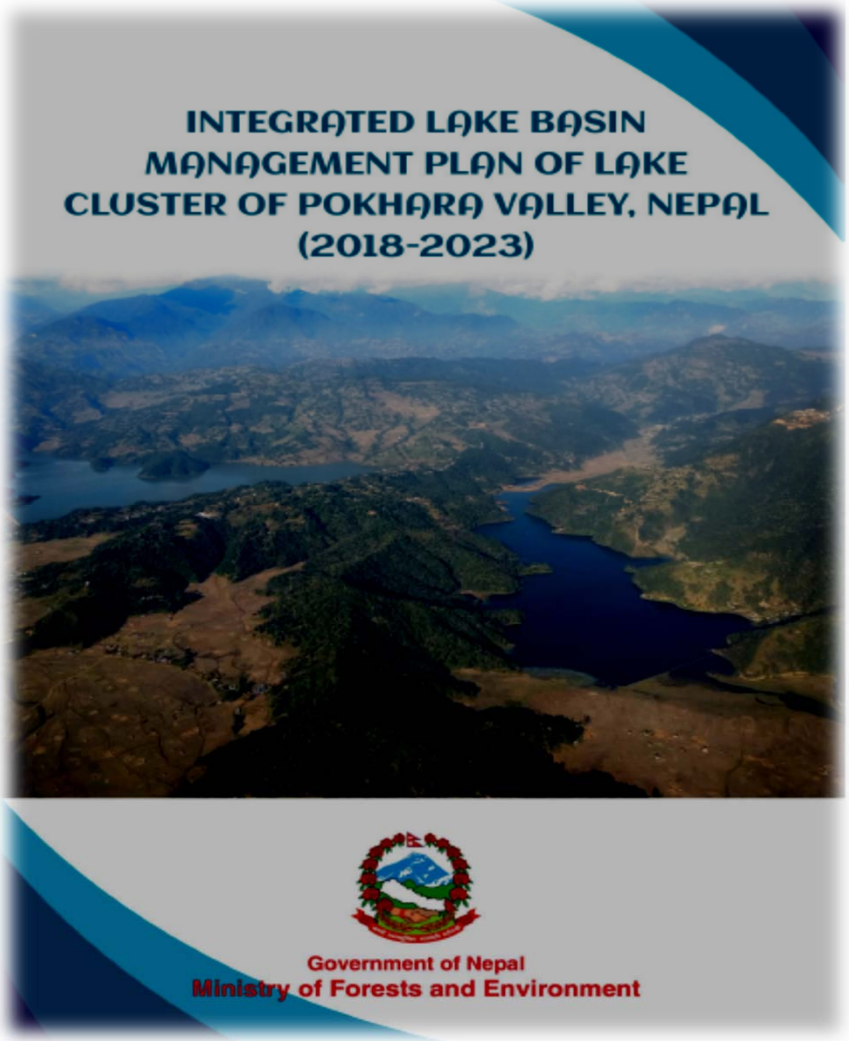




Policy Relevant to the Gandaki State and Specific to LCPV

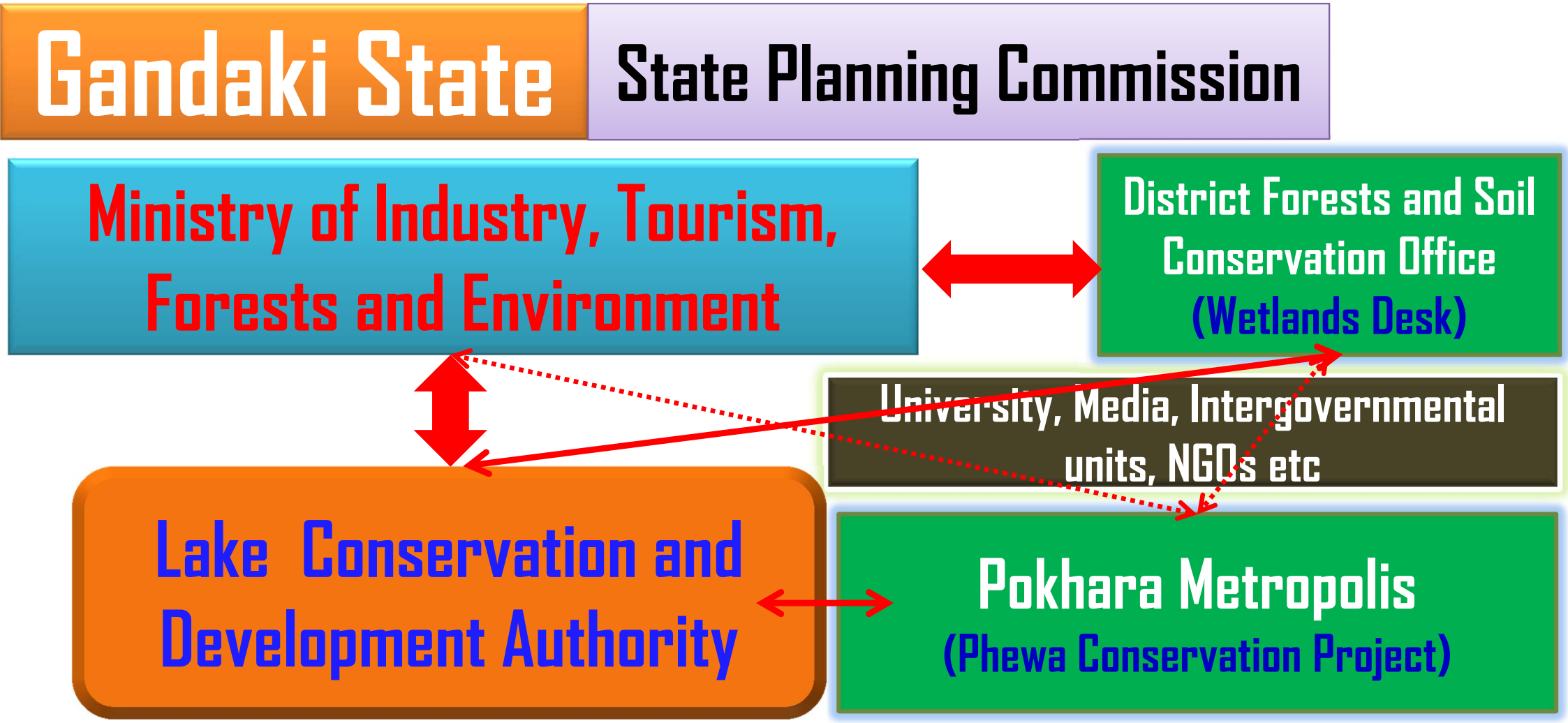
Legal provision dedicated to Lake and Biodiversity in the Gandakai State

- Forests and Watershed Policy of the Gandaki State (2018)
- Lake Conservation and Development Authority Act (2018)
- Bar, Pipal and Chautari Act (2018)



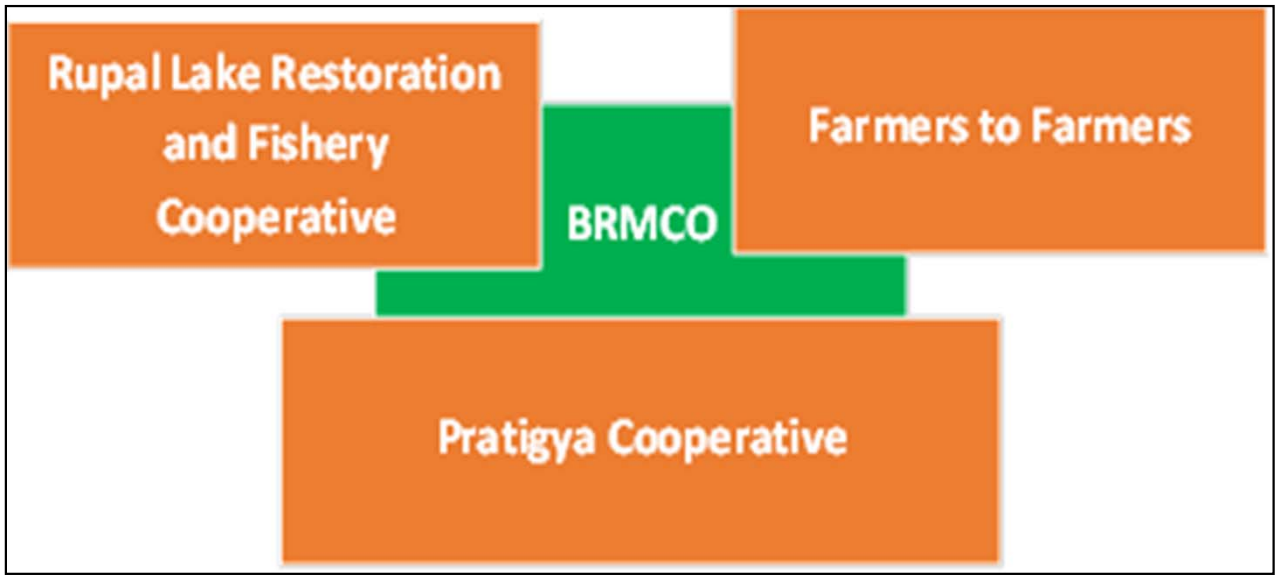
LCPV: Federal Institution (i)

LCPV: State & Local Government Levels Institution (ii)



LCPV: Community Level Institution (iii)

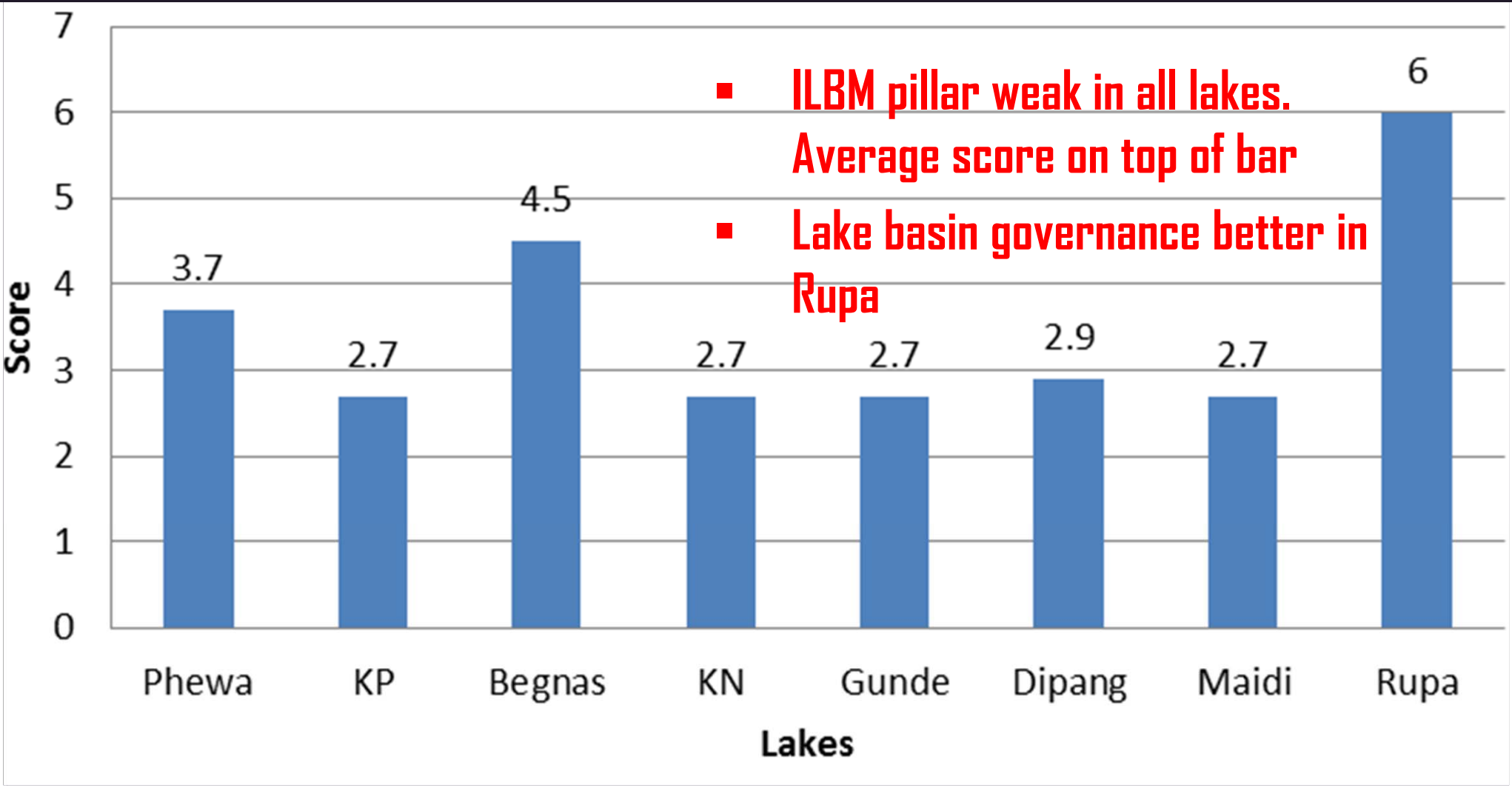
- Some Lake Started organizing into cooperatives



- Each lake has community run cooperatives

Almost all communities are working with some partnering NGO

Lake Basin Governance at Community level



- ILBM pillar weak in all lakes. Average score on top of bar
- Lake basin governance better in Rupa

Participation

LEVELS OF PARTICIPATION

I. Government Level

II.Non Government Level

III. International Partners

IV. Local Communities

Photo: Ramsar designation of LCPV (Feb 2, 2016). Late Dr. Lew Young , Ramsar Secretariat,.

NGO Mobilization: Weak

NGO mobilization helps multiplying resources, reduce cost and deliver synergy

Knowledge, Information and Technology

A. Present Scenario

- Information scattered
- Regular generation of research based knowledge from universities *(Tribhuvan University, Kathmandu University, Pokhara University etc)*
- Knowledge generation very limited by subject, individual interest and no priority based
- Traditional & conventional Technology
- NGOs and media active for Knowledge generation and dissemination

B Future Need

- Himalayan Wetlands Journal
- Wetlands Academy
- Conference capability
- Independent Monitoring

Finance and Other Resources

Every institution, **Fund Based**

No institution, **Finance Rich**

Finance never **Adequate**

Intervention continues despite many constraints

WHAT LCPV NEEDS are

- Plan based intervention
- Scheme based business
- Stakeholder engagement

- Bilateral & multilateral cooperation
- Regional and International cooperation
- Obligation Fund

Conclusion

- LCPV, the 10th and only Ramsar site in the mid-hill region of Nepal, and designated first per the spirit of Lake Basin Governance in Nepal
- Regarded as lake-tourism vantage, *'City of Lake Garden'*, *'Orchids' Treasure Land'* and '*Nepal's Tourism Capital'*.
- Strategic location in biological realms and claims one of the nicest *'Ecological & Habitat Hotspots'* in the world
- Phewa, Begnas and Rupa Lakes the bigger ones; others are smaller and shallower
- Each lake differs in habitat mosaics, water body and species diversity
- Biological diversity rich with conservation significant species including new specimen record and endemic species

Conclusion … (ii)

- All lakes are degrading due to encroachment, siltation, invasion by alien species and over fishing. Other threats prevail including climate vulnerability
- Lake Basin Governance is improving, Many policies and institution prevail, and some overlap in mandate
- The Gandaki State resolved to implement ILBM with the formulation of lake specific Lake Conservation and Development Authority Act (2018) followed by the establishment of Lake Conservation Development Authority also backstopped by the Forests and Watershed Policy of the Gandaki State (2018), and Bar, Pipal and Chautari Act (2018). A GREAT JUMP TOWARD ILBM IMPLEMENTATION

Conclusion … (iii)

- In addition, Pokhara Metropolis has Phewa Project Office with human and financial resources, now making good investment improing lake environment of Phewa
- Initiative of the Gandaki State and Pokhara Metroplis in combined approach now in process of declaring Pokhara Valley and *'Lake City of Nepal': City Pot for Biodiversity and Tourism* which will be the remarkable milestone of ILBM implementation in Nepal
- Strengthening capacities of State, Metropolis and Local Institution needs continuing from a mechanism to enhance knowledge, generate and disseminate information, and ILBM would be instrumental in this regards

Acknowledgement

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