



# My personal and professional work experience in Austria and Nepal

Subodh Sharma, *Dr.nat.techn.*  
Professor and Director





	Nepal	Austria
Area Sq .km.	147,181 (landlocked)	83,855 (landlocked)
Water	2.8%	1.7%
Population (2009)	29,331,000	8,356,707
HDI	0.553 (138 <sup>th</sup> )	0.851 (25 <sup>th</sup> )
Currency	Approx. Rs.100=1 Euro	



# My experience studying in Austria

1990 March to Dec.: International Post Graduate Training Course in Limnology, . Organized by the UNESCO and the Austrian Ministry of Foreign Affairs.

- Culture
- Food
- Others





# Continuous support from Austria

1993 – 1996	OeAD - Dr. nat. techn. from BOKU
2001	BOKU - Post Doctoral Research Fellow
2005 - 2008	ASSESS-HKH - Nepal, Bhutan, Bangladesh, India, Pakistan
2010	BOKU- Visiting Professor
2011	Eurasia Pacific Uninet - Researcher



# Professional work experience

<b>Duration (yrs)</b>	<b>Responsibilities</b>
1996-1998	Consultant for University Grants Commission –taxa inventory
1999	Team Member: Project- Biodiversity and Water Quality Assessment. Ralph Brown Expedition
2000	Project Coordinator: Project- Capacity Building for Community Water Quality Assessment. Supported by AUSAID
2001	Project Coordinator: Project- Water Resources Management. Sponsored by DANIDA.
2002	Principal Investigator: Project- Rainwater harvesting and its quality. Sponsored by FINNIDA
2003	Team Member: Project-Biodiversity. Supported by Zoological Society of London, UK.



# Professional work experience

<b>Duration (yrs)</b>	<b>Responsibilities</b>
2003-2006	Associate project coordinator: Himalayan Agricultural Intensification Project. Supported by NORAD
2003-2006	Project coordinator: Asia Link Project for Networking . Supported by European Commission
2005-2008	Lead Scientist: ASSESS-HKH. Supported by European Commission
2005-2008	Project Coordinator: Pollutants in the Himalaya. Supported by UNEP & Univ of Manitoba, Canada.
2007-2010	Project Coordinator: Promotion of Education, Research & Training in the Himalaya. NUFU - Norwegian support.
2008-2011	Principal Investigator: Climate change in the high altitudes



## Present Affiliation

Employed by Kathmandu University since 1996 at different positions:

1. Director of Research Development & Consultancy Committee
2. Director of Staff and Faculty Performance Monitoring and Evaluation Committee

Full Professor: since 2007

Supervision: 4 Ph.D. (completed), 6 Ph.D. (in progress)

Publications : 103 papers to my credit

## Most memorable occasions

**2008:** *Bisista Sikshya Sewi Samman*  
(Education Excellence Contribution Award)

Awarded by Rt. H. First President of Nepal  
Dr. Ram Baran Yadav.

**2009:** *Interview for the Senior Fulbright Research Scholarship*

Awarded by Fulbright Commission, USA

# Kathmandu University





# BOKU & KU collaboration

- KU has MoU signed with 71 universities/institutions abroad
- The MoU with BOKU was signed on 05/03/1996 to **promote students and faculty exchange in the field which is of mutual interests to both the parties.**
- **First Phase** – with focus on promoting research on biology and hydrology
- **Next Phase** – will focus on forestry, protected area management, applied geology, and high altitude himalayan biodiversity research



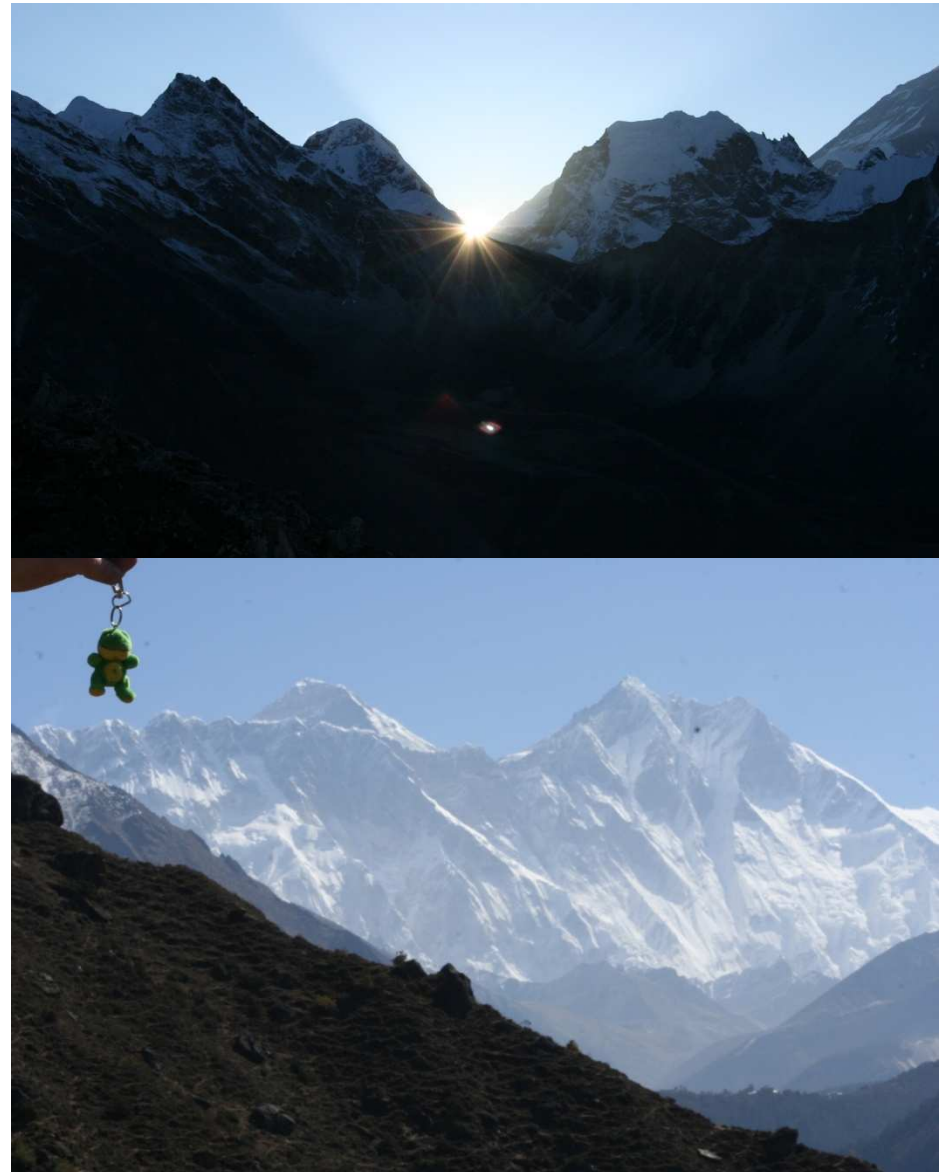


Photos by: Wolfram, Sten, Subodh

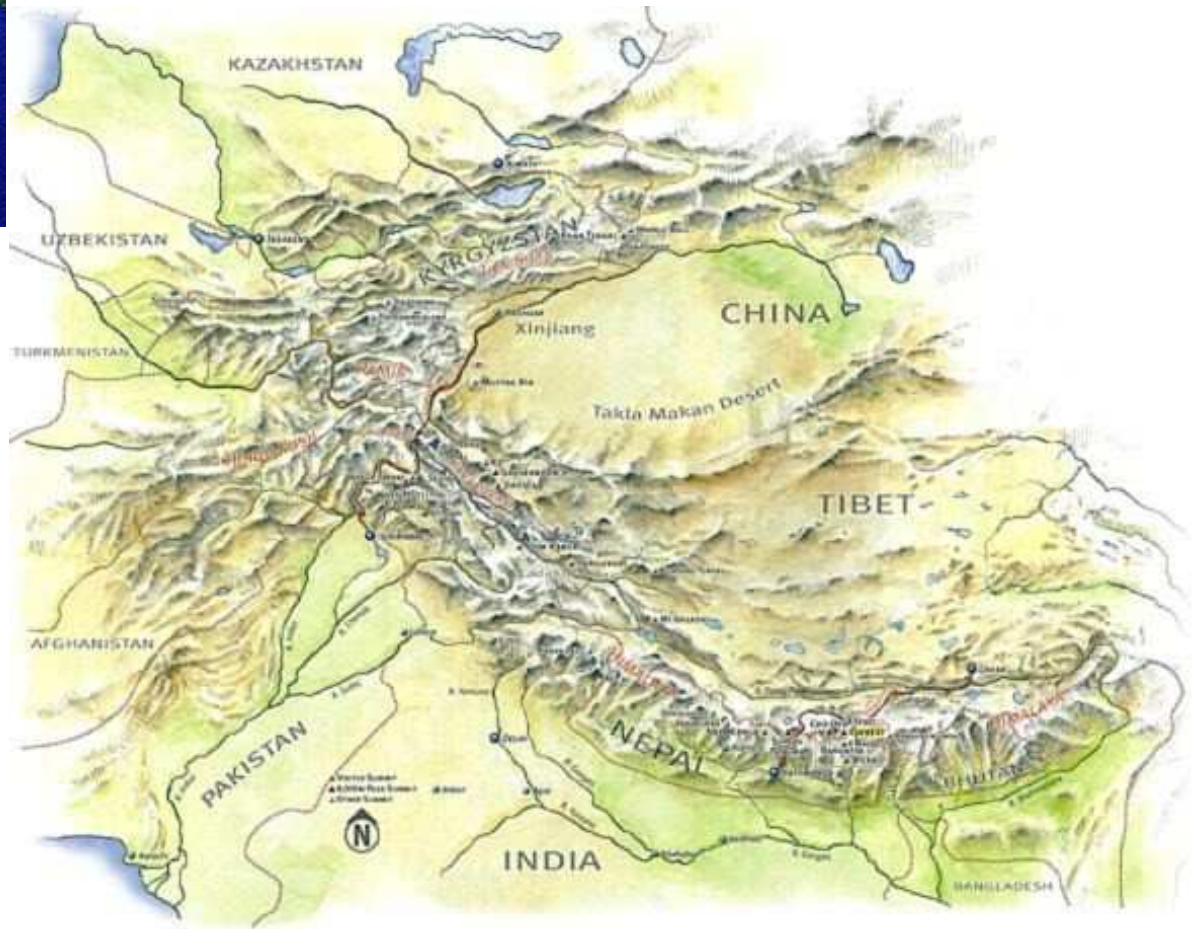
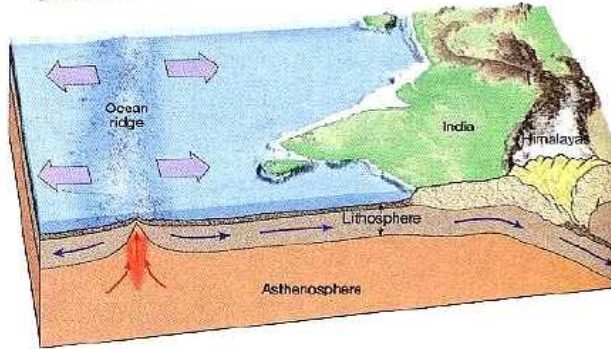
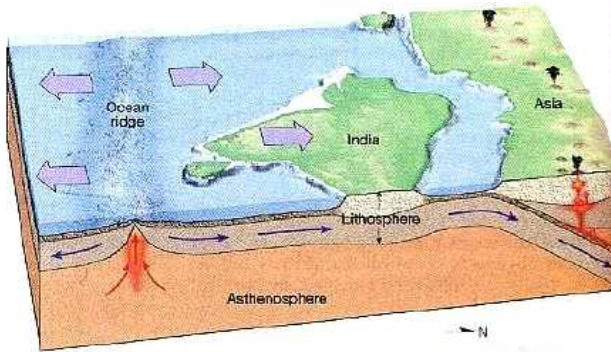
**Alarming signs of climate change & pollution in the Himalayan lakes and rivers**

# THE HIMALAYA

1. Highest Point on Earth
2. Roof of the world
3. The Home of the Gods
4. Sacred Mountains
5. Holy Lakes
6. Water Tower of the World
7. Ecological panorama
8. Global Biodiversity Bank

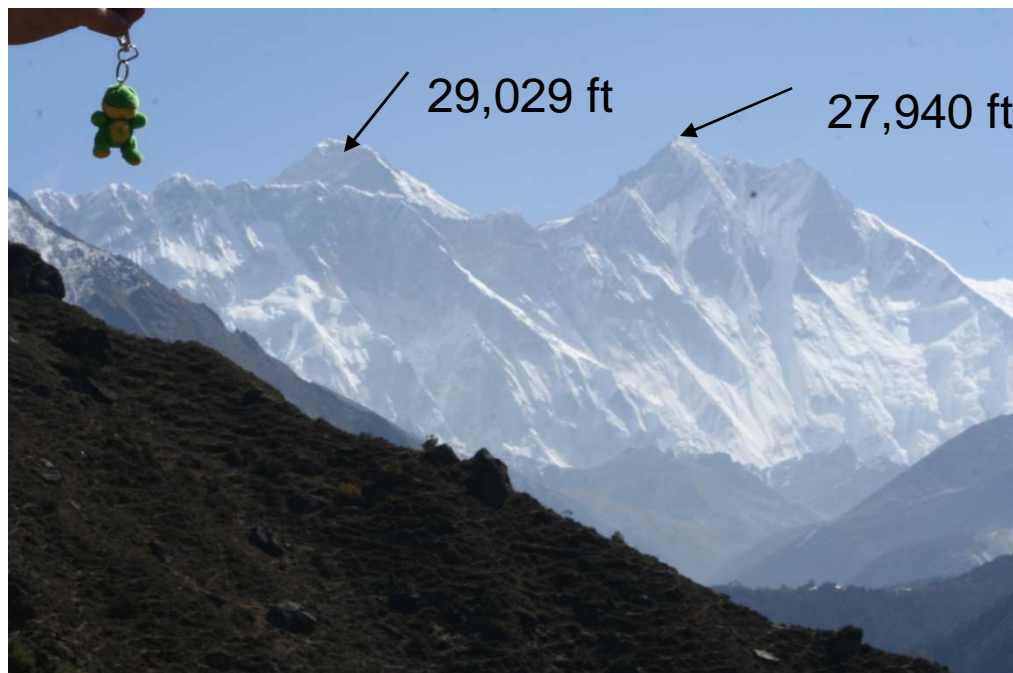
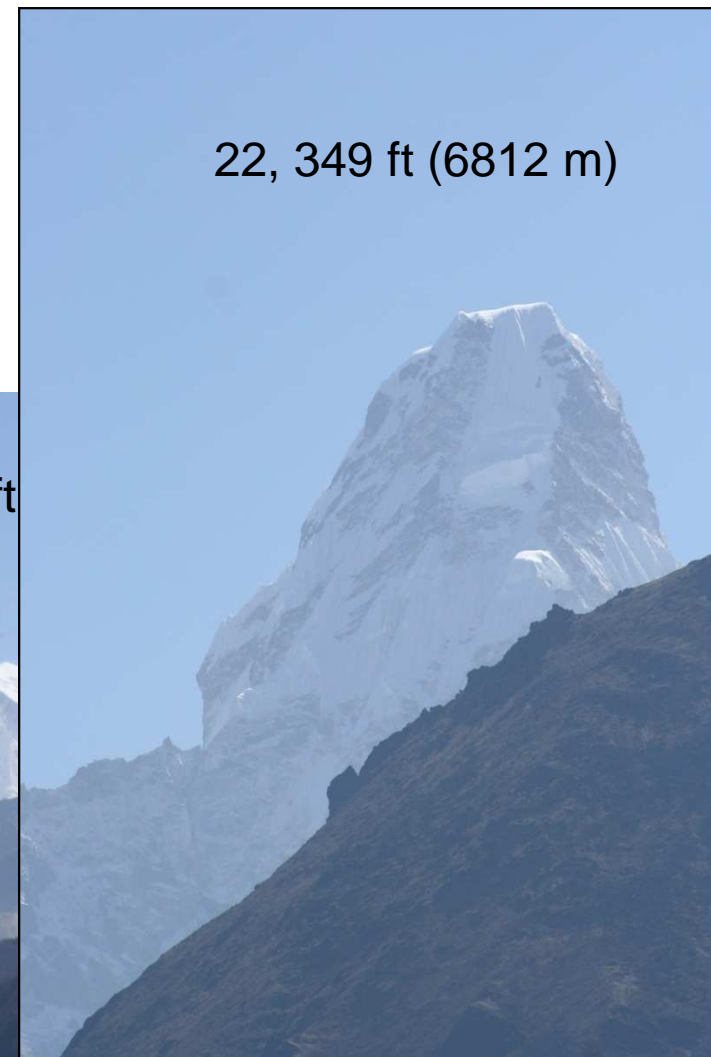


# FORMATION



Mountain peak	Location	Height	
		ft.	m
Everest	Nepal/Tibet	29,035	8,850
K2	Pakistan/China	28,250	8,611
Kanchenjunga	India/Nepal	28,169	8,586
Lhotse I	Nepal/Tibet	27,940	8,516
Makalu I	Nepal/Tibet	27,766	8,463
Cho Oyu	Nepal/Tibet	26,906	8,201
Dhaulagiri	Nepal	26,795	8,167
Manaslu I	Nepal	26,781	8,163
Nanga Parbat	Pakistan	26,660	8,125
Annapurna	Nepal	26,545	8,091

## TOP OF THE WORLD



# ROOF OF THE WORLD

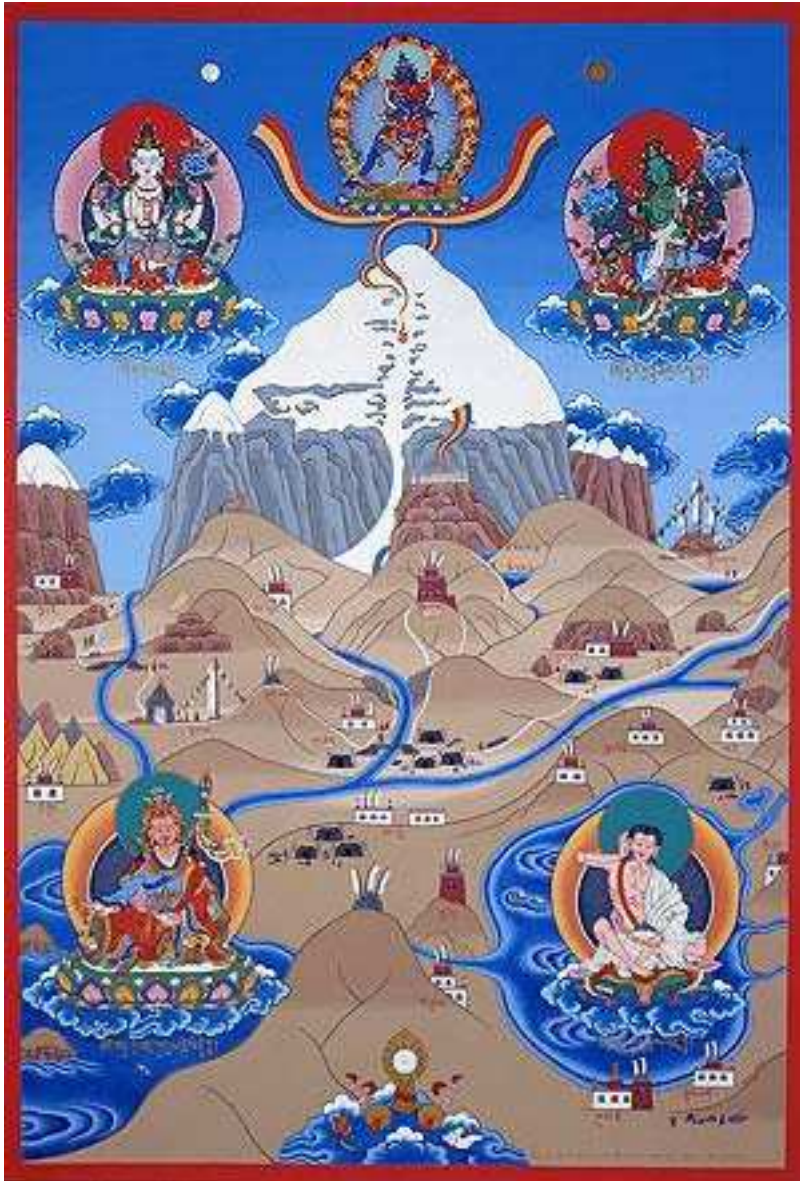
Tibetan Plateau harbors world's

- Deepest gorges
- Largest glaciers,
- Rivers,
- Grassland,
- Forests, and
- Lakes



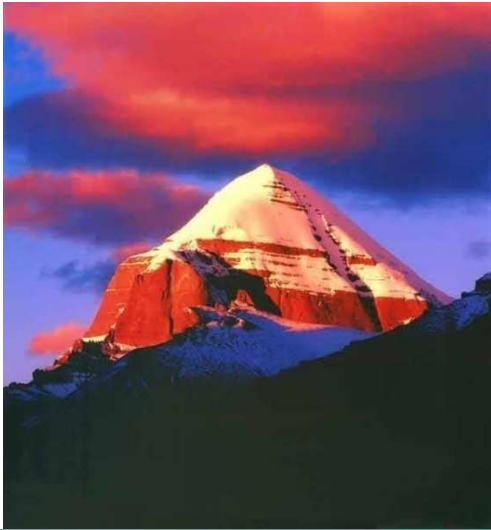
to form one of the most outstanding bio-geographic zones on earth.

# THE HOME OF THE GODS



*“Something unexplained is not unscientific”*

# SACRED MOUNTAINS



- This mountain is also called the axis mundi or the pillar of the universe.
- It is a sacred mountain, referred to by both Hindus and Buddhists.



# HOLY LAKES & DEMON LAKE



Lake Mansarovar and Lake Rakshyas Taal

# WATER TOWER OF THE WORLD



An estimated 46,000 glaciers and hundreds of the world's tallest mountains that feed seven of the biggest Asian rivers, originate in the Tibetan Plateau

# ECOLOGICAL PANORAMA



Nowhere else in the world can one find elevation differences like these!

# BIODIVERSITY BANK



600 indigenous plant species

319 exotic orchids

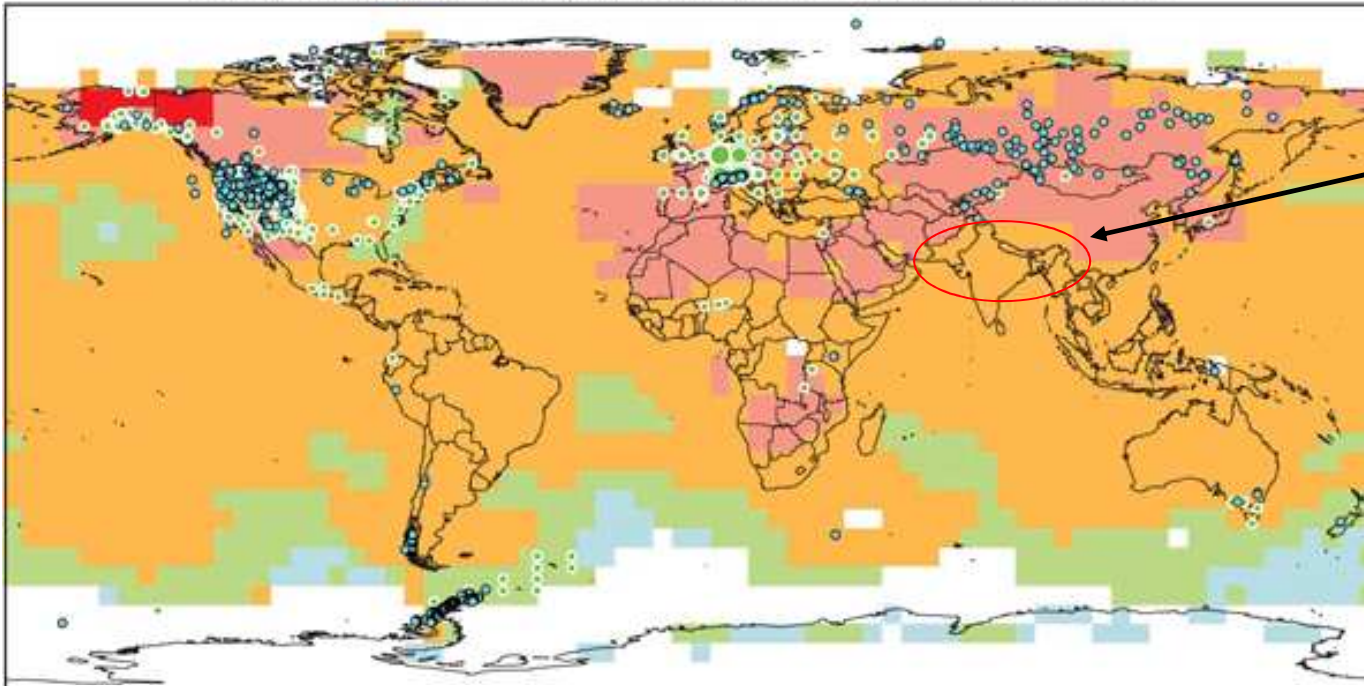
848 species of birds

11 out of 15 fam of butterflies

*Cordycep sinensis* (Yarsa Jomba)

(summer grass winter insect)

Changes in physical and biological systems and surface temperature 1970-2004



Lack of data in the Himalayan region

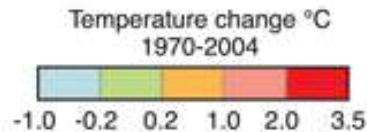
“Arctic, Sub-Saharan Africa, Small Island States, and Asian mega deltas are the most vulnerable in the context of global climate change”

NAM		LA		EUR <sup>28,115</sup>		AFR		AS		ANZ		PR*		TER <sup>28,586</sup>		MFW**		GLO <sup>28,671</sup>	
355	455	53	5	119	28,115	5	2	106	8	6	0	120	24	764	28,586	1	85	765	28,671
94%	92%	98%	100%	94%	89%	100%	100%	96%	100%	100%	-	91%	100%	94%	90%	100%	99%	94%	90%

Observed data series

- Physical systems (snow, ice and frozen ground; hydrology; coastal processes)
- Biological systems (terrestrial, marine, and freshwater)

Europe ***	
○	1-30
○	31-100
○	101-800
○	801-1,200
○	1,201-7,500



Physical	Biological
Number of significant observed changes	Number of significant observed changes
Percentage of significant changes consistent with warming	Percentage of significant changes consistent with warming

\* Polar regions include also observed changes in marine and freshwater biological systems.  
 \*\* Marine and freshwater includes observed changes at sites and large areas in oceans, small islands and continents. Locations of large-area marine changes are not shown on the map.  
 \*\*\* Circles in Europe represent 1 to 7,500 data series.

Source: IPCC 2007

# Climate change in the Himalayan mountains

- **Climate change is a major concern in the Himalayas**

**The Himalayas, often referred to as the third pole of world, account for roughly 30% of global glaciers with 3,252 glaciers and 2,323 glacial lakes in Nepal alone.**



# Warning Signs of Climate Change

1. Most valley glaciers are melting
2. Water level in lakes/rivers changing
3. Extreme events are common
4. Precipitation pattern is rapidly changing

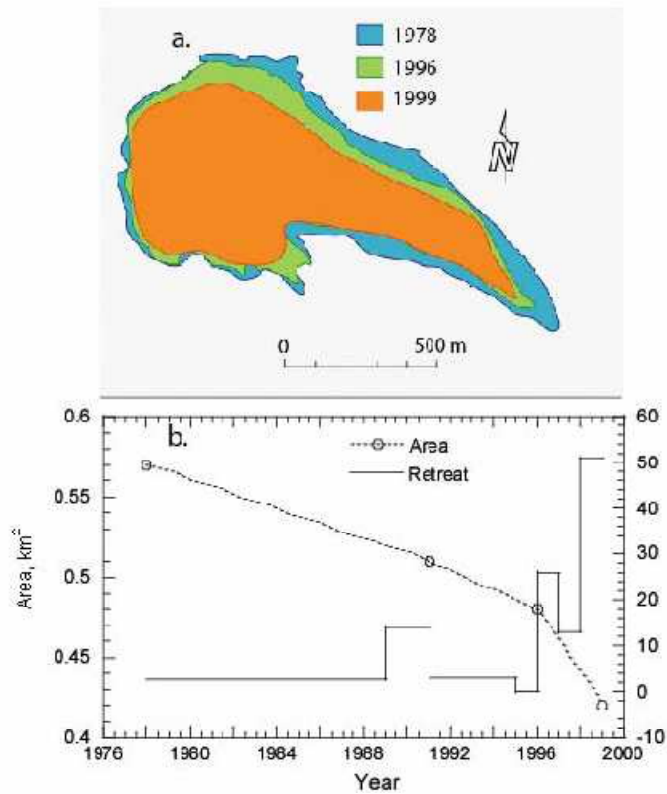


# 1. Large numbers of Epi-glacial Lakes formed

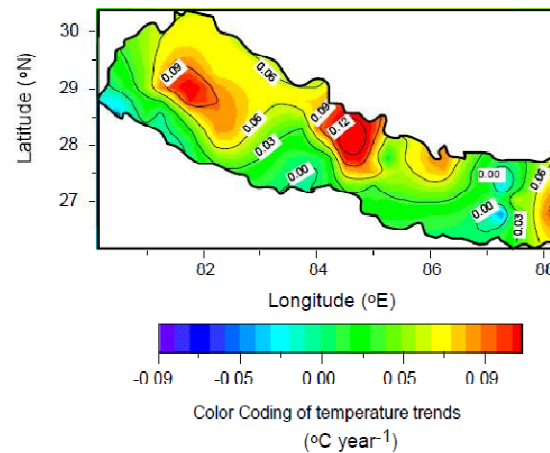


- These epi-glacial lakes are **growing slowly**, but nobody knows how many are close to bursting, and there are no early warning systems in place for the villages downstream.
- There is also the risk of **sudden flash floods** as rapidly expanding glacial lakes burst through their natural dams.

**Nepal has already seen at least five major glacial lake floods since 1970.**



30 m retreat / 12 m thinning  
 1978 → 1989



Glacier AX010 in the Shorong Himal is one of the most studied glaciers in Nepal (Fujita 2001).

The average warming in annual temperature between 1977 and 1994 was 0.06 °C/yr (Shrestha *et al.* 1999).  
**The warming is found to be more pronounced in the high altitude regions of Nepal.**

Source: <http://assets.panda.org/downloads/himalayaglaciersonreport2005.pdf>



## 2. Changing Water Level

Water level in rivers and lakes are drastically changing:



- **Drinking water shortage**
- **No irrigation, crop failure**
- **Reduced electricity, social conflicts, people are forced to migrate**

## 3. Extreme Events

1. Increased landslide, avalanche and mudslide damage
2. Increased summer drying and associated risk of **forest fires**
3. Flood/drought/snow



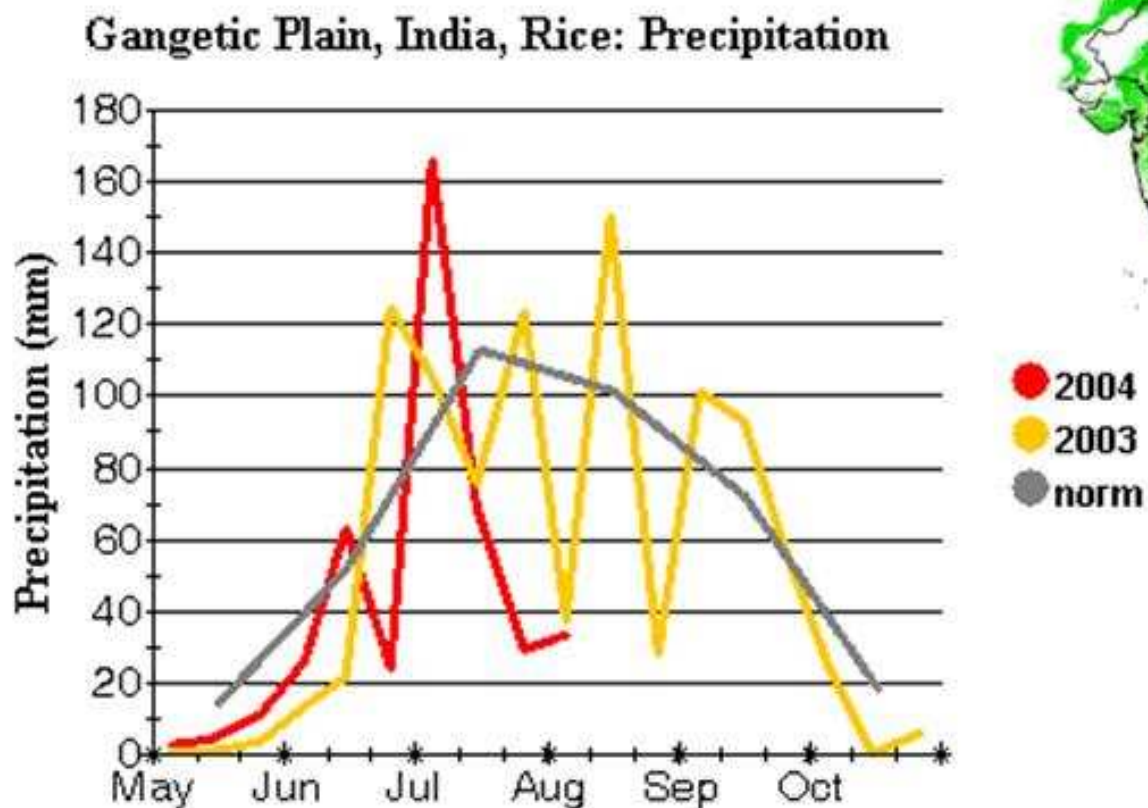
Heavy rain and flooding in parts of northern India, Nepal and Bangladesh in **2004** left **1,800** dead and millions stranded.



Variations in the intensity of **monsoon rains** cause the flooding

## 4. Changing monsoon pattern

India – Rainfall Graph  
Poor Monsoon Rainfall



● 2004  
● 2003  
● norm

# Other signs of climate change

## Snowline is shifting

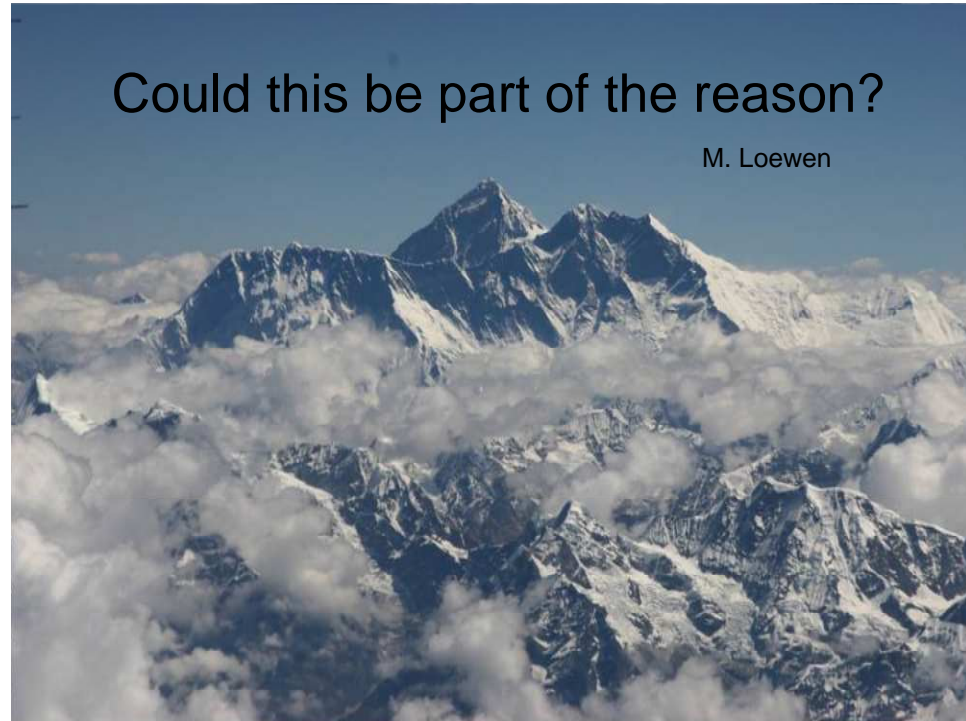


## Rhododendrons bloom 2 months early



Could this be part of the reason?

M. Loewen



*"For the first time in my life I have seen the rhododendrons blooming in mid-January," said 77-year-old Khadak Bahadur Thapa of Bhimpokhara.*

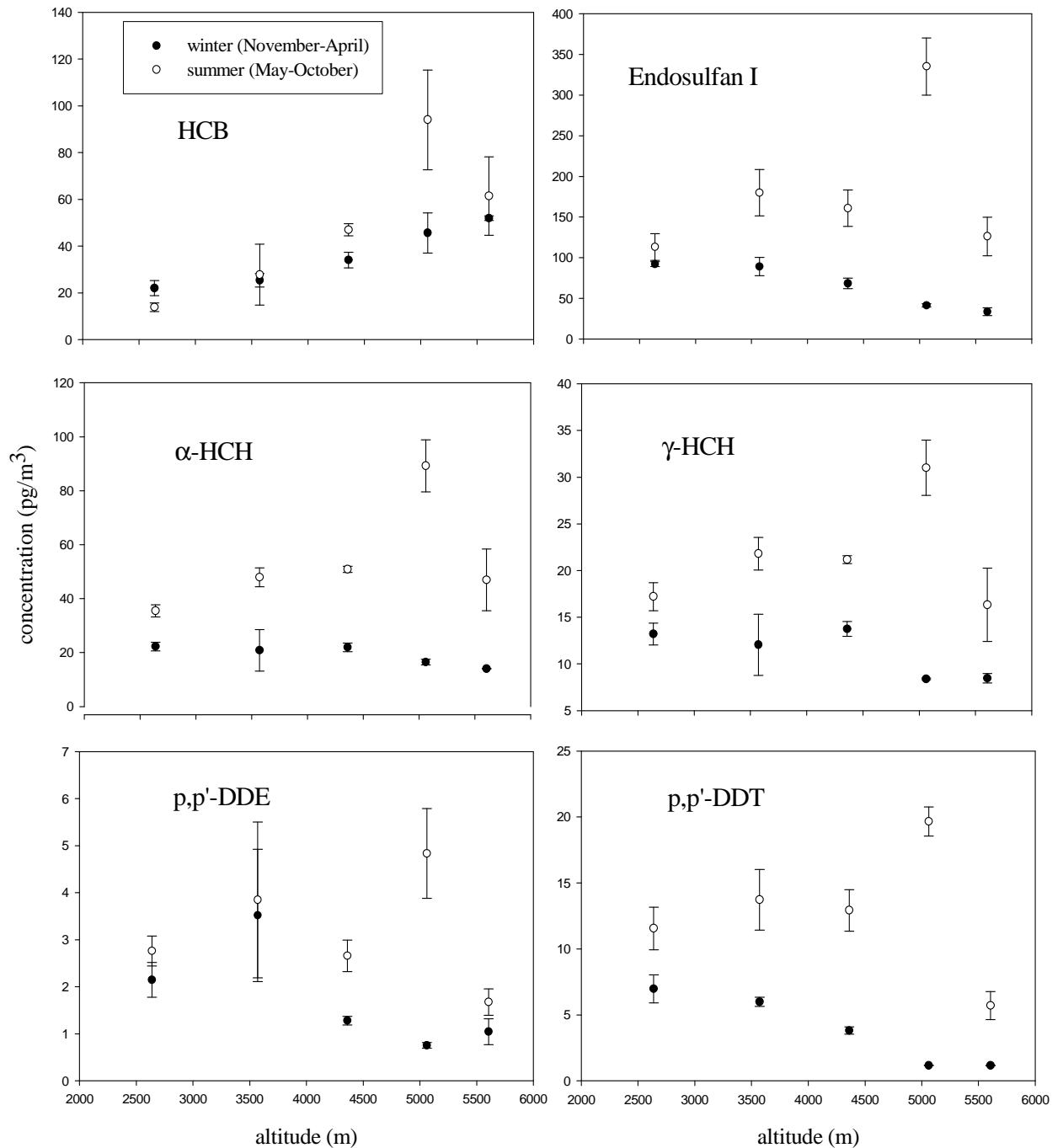
*Source: Republica Jan 21, 2010*

# Micropollutants in the Himalaya

(Loewen et al. 2007)

All compounds increase in atmospheric concentration with respect to altitude in summer up to 5000m a.s.l. then decrease.

All compounds except HCB decrease in atmospheric concentration with respect to altitude in winter





Tracking environmental changes using  
chironomids head capsules

Tracking climate change using  
chironomid head capsules from  
high altitude lake sediments.



*always expect the unexpected ...*





## Plane crash in Lukla kills 16 tourists, 2 crew

**October 8, 2008, 11:33**

<http://thirdpolephoto.blogspot.com/2008/10/18-people-killed-in-lane-crash-in.html>





# Tenzing - Hillary Airport, Lukla



**World's Most Dangerous Airports: Lukla Airport, Nepal**

One of the most busiest airports in the world! [Landing and Take-off at Lukla](#) are very interesting!





# MONTHLY TOURIST RECORD S.N.R. JORSALLE SINCE VISIT NEPAL 98"

MONTH	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
JAN.	553	594	474	579	235	427	592	426	486	566	643	576							
FEB.	708	781	876	682	496	518	751	524	455	592	852	659							
MAR.	1863	2255	2883	2540	1995	1802	2696	2343	1977	3029	3688	3041							
APR.	2784	3440	4238	3834	2313	2759	3914	2458	3439	4246	4661	4513							
MAY.	1108	1408	1299	1313	692	1624	1301	937	886	1679	1986								
JUNE.	142	115	61	145	90	221	127	201	110	284	297								
JULY.	94	153	39	114	78	77	160	204	184	209	294								
AUG.	195	315	145	203	126	252	183	260	352	434	450								
SEP.	1103	1521	1196	1160	877	1253	976	1036	1190	1458	2135								
OCT.	5987	7263	7537	6440	3530	5470	6390	6242	6595	7750	9260								
NOV.	3964	4533	4862	3479	2488	3714	3208	3448	3383	4188	4830								
DEC.	1513	2183	1681	1081	866	1183	1098	984	1039	1379	1503								
TOTAL	20014	24561	25291	21570	13786	19300	21396	19063	20036	25814	30599								

EXPEDITION IS NOT INCLUDED  
TREKKERS ONLY.

PRE-(KALI BHADUR RAI)  
G. SCOUT SNP.

**WEL COME TO**

**Sagarmatha National Park**  
World Heritage Natural Site  
(Estd. in 1976)

---

NEPAL Government  
Ministry of Forest and Soil Conservation  
Department of National Parks Wildlife Conservation

**Sagarmatha National Park**  
(A World Heritage Site)  
Jorsalle Entrance Gate, Jorsalle  
(Take Your Entrance Permit before Entering the Park)





**GOKYO RESORT**

SINCE 1991

ELEVATION 4800m (15750ft.)

GOKYO

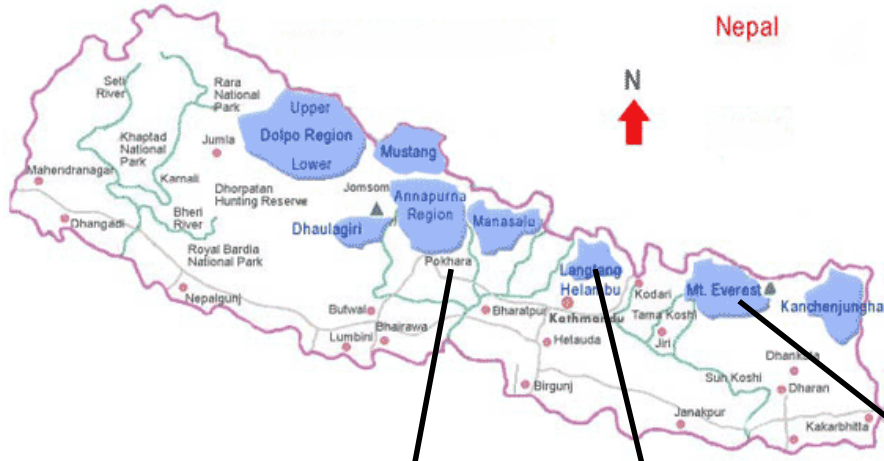
# Food at 15,750 ft elevation !!

Menu	
Tsampa Porridge	Rs. 150
Chapati Plain	Rs. 100
Pancake Plain	Rs. 150
Chapati with Jam/Honey/Butter	Rs. 150
Pancake with Jam/Honey/Butter	Rs. 180
Potato Pancake with Butter	Rs. 100
Plain Toast ( 2 Pcs )	Rs. 150
Cheese Toast ( 2 Pcs )	Rs. 150
Toast with Jam/Honey/Butter ( 2 Pcs )	Rs. 150
Plain Tibetan Bread	Rs. 150
Tibetan Bread with Jam/Honey/Butter	Rs. 150
Tuna Fish Sandwich	Rs. 200
cheese tomato sandwich	Rs. 150
cheese ham sandwich	Rs. 200
<b>EGGS</b>	
Boiled Eggs	Rs. 150
Fried Eggs	Rs. 150
Scrambled Eggs	Rs. 170
Plain Omelet	Rs. 150
Vegetable Omelet	Rs. 170
Cheese Omelet	Rs. 150
Onion Omelet	Rs. 160
Potato Omelet	Rs. 160
Tomato Omelet	Rs. 170
<b>SOUP</b>	
Chicken Noodle Soup	Rs. 150
Tomato Soup	Rs. 120
Vegetable Soup	Rs. 120
Chicken Soup	Rs. 130
Garlic Soup	Rs. 120
Egg Drop Soup	Rs. 130
Mixed Soup	Rs. 150
Mushroom Soup	Rs. 120
Dal Soup	Rs. 160
Tomato & Onion Soup	Rs. 160
Potato Soup	Rs. 120
Rara Noodle Soup (Plain)	Rs. 150
Rara Noodle Soup (Veg)	Rs. 160
Rara Noodle Soup (Egg)	Rs. 180
Pop Corn	Rs. 100
Fried Noodle (Egg)	Rs. 250
Fried Noodle (Meat)	Rs. 250
Fried Noodle (Mixed)	Rs. 280
Fried Noodle (Cheese)	Rs. 250
Fried Potato (Plain)	Rs. 160
Fried Potato (Veg)	Rs. 170
Boiled Potato with Butter	Rs. 160
Fried Potato (Egg)	Rs. 190
Fried Potato with Cheese on Top	Rs. 200
Finger Chips	Rs. 200
Hash Brown with Cheese	Rs. 250
Plain Rice	Rs. 200
Fried Rice (Veg)	Rs. 220
Fried Rice (Egg)	Rs. 220
Fried Rice (Egg & Veg)	Rs. 260
Fried Rice (Mixed)	Rs. 280
Rice with Veg. Curry	Rs. 200
Rice with Veg. Curry & Yak Meat	Rs. 300
Dal Bhat with Vegetable	Rs. 200
Sherpa Stew (Veg)	Rs. 170
Yak Steak with Chips	Rs. 300
<b>Macaroni &amp; Spaghetti</b>	
Plain Fried Macaroni	Rs. 150
Veg. Fried Macaroni	Rs. 180
Cheese Fried Macaroni	Rs. 200
Veg & Cheese Fried Macaroni	Rs. 230
Mixed Fried Macaroni	Rs. 250
Egg Fried Macaroni	Rs. 230
Macaroni with Cheese & Tomato Sauce	Rs. 250
Spaghetti with Cheese & Tomato Sauce	Rs. 250
<b>Pizza</b>	
Veg. Pizza	Rs. 300
Mixed Pizza	Rs. 300
<b>Momo</b>	
Veg Momo (Steam)	Rs. 150



# Sampling (sediments, Water, and macroinvertebrates)





# study area



Lake Phewa	Lake Gosaikunda	Lake Gokyo	Note
785 m	4350 m	4750 m	Elevation
23 m	24 m	43 m	Depth
17.9/28.2 (top/bottom)	9.2/7.5 (top/bottom)	8.0/4.5 (top/bottom)	Temp (°C)
na	1.93/1.80 mg/L	0.37/0.26 mg/L	Na/K 40
temperature taken is of May-June 2009-2010			



# Catchment of Lake Phewatal & major stressors



Land Use	%
Forests land	44
Agricultural land	39
Urban and wetland	5
Pasture and barren land	5
Shrubs land	3
Lake area	4

Source: DSC, 1994



## Major Stressors:

- Tourism
- Eutrophication
- Invasive species
- Contamination
- Overfishing
- Water diversion
- Acidification
- Climate change



## Major Stressors

### Lake Gosaikunda

- Acidification
- Tourism / pilgrimage

### Lake Gokyo

- Climate Change
- Tourism



Land Use	%
Rock and Alpine Rangeland	100

Catchment of Lake Gosaikunda & Gokyo and major stressors<sub>42</sub>

# Sampling Techniques

Sediment:



# Sampling Techniques

Water:



Temperature:





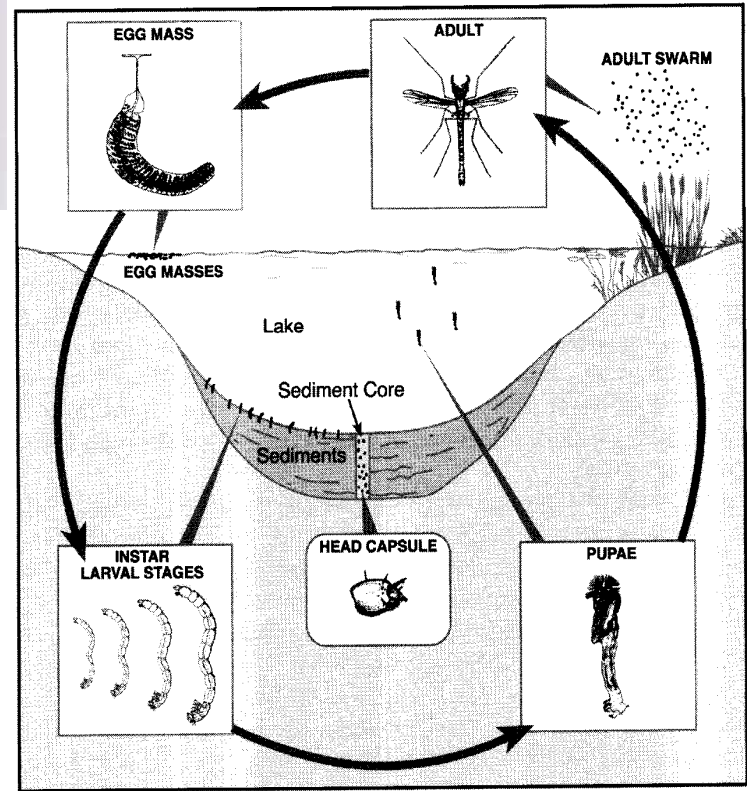
# Theory



Cold water species  
(*Pseudodiamesa* sp)

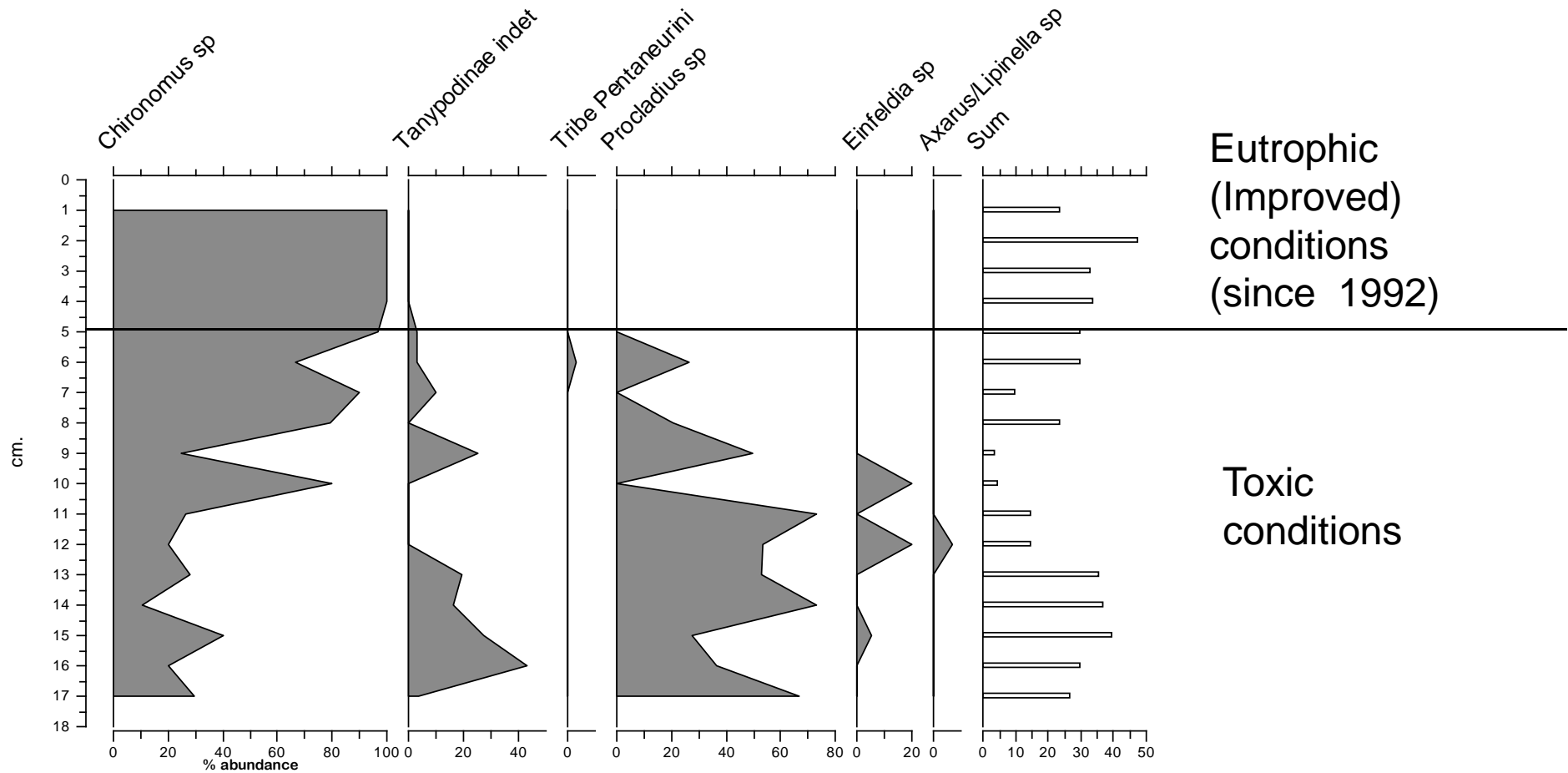


Warm water species  
(*Micropsectra* sp.)

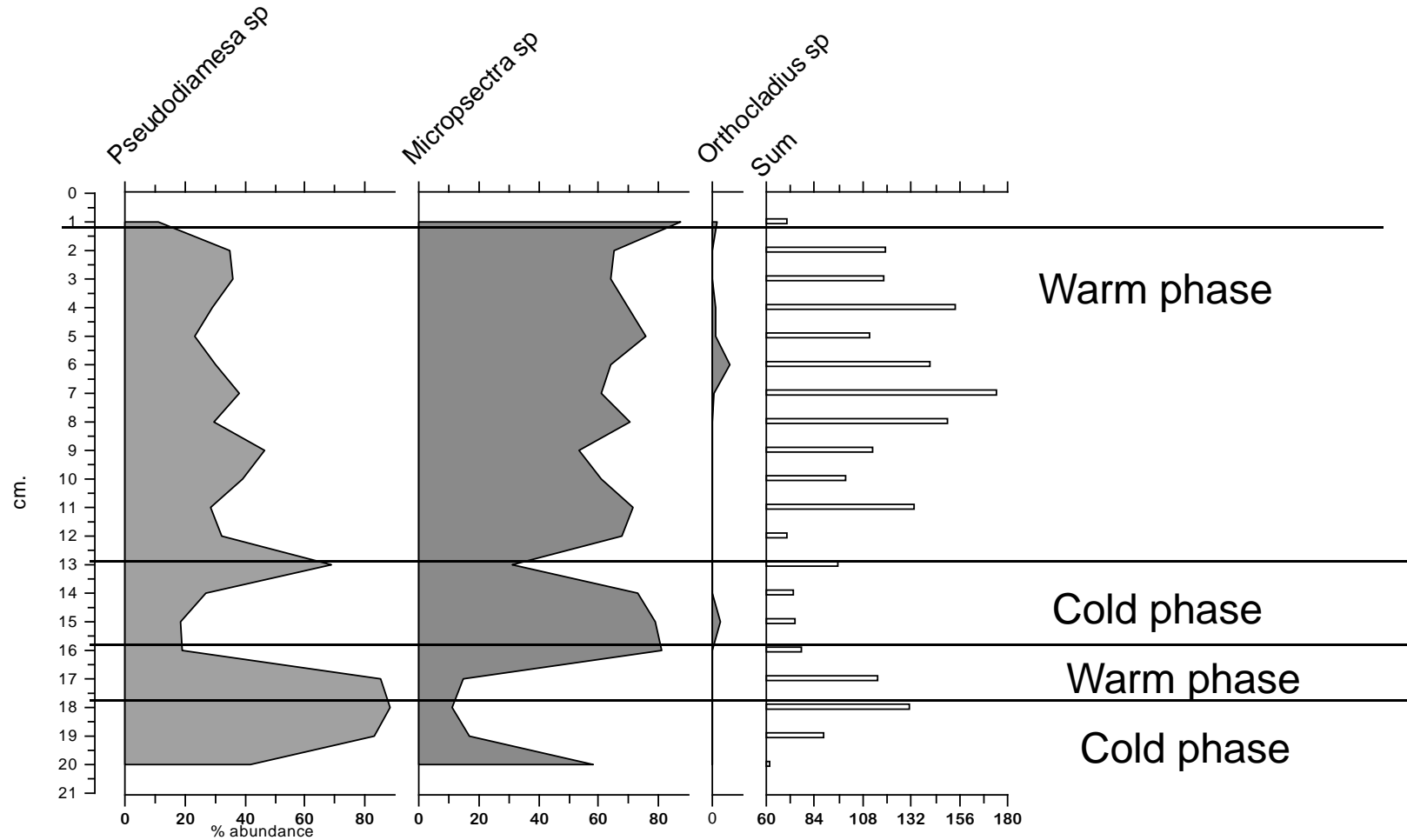


Source: Porinchu and McDonald, 2003

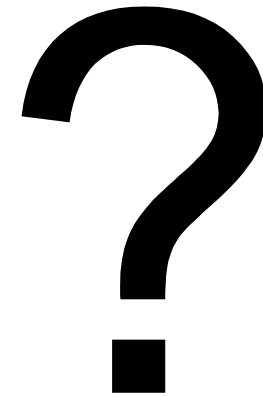
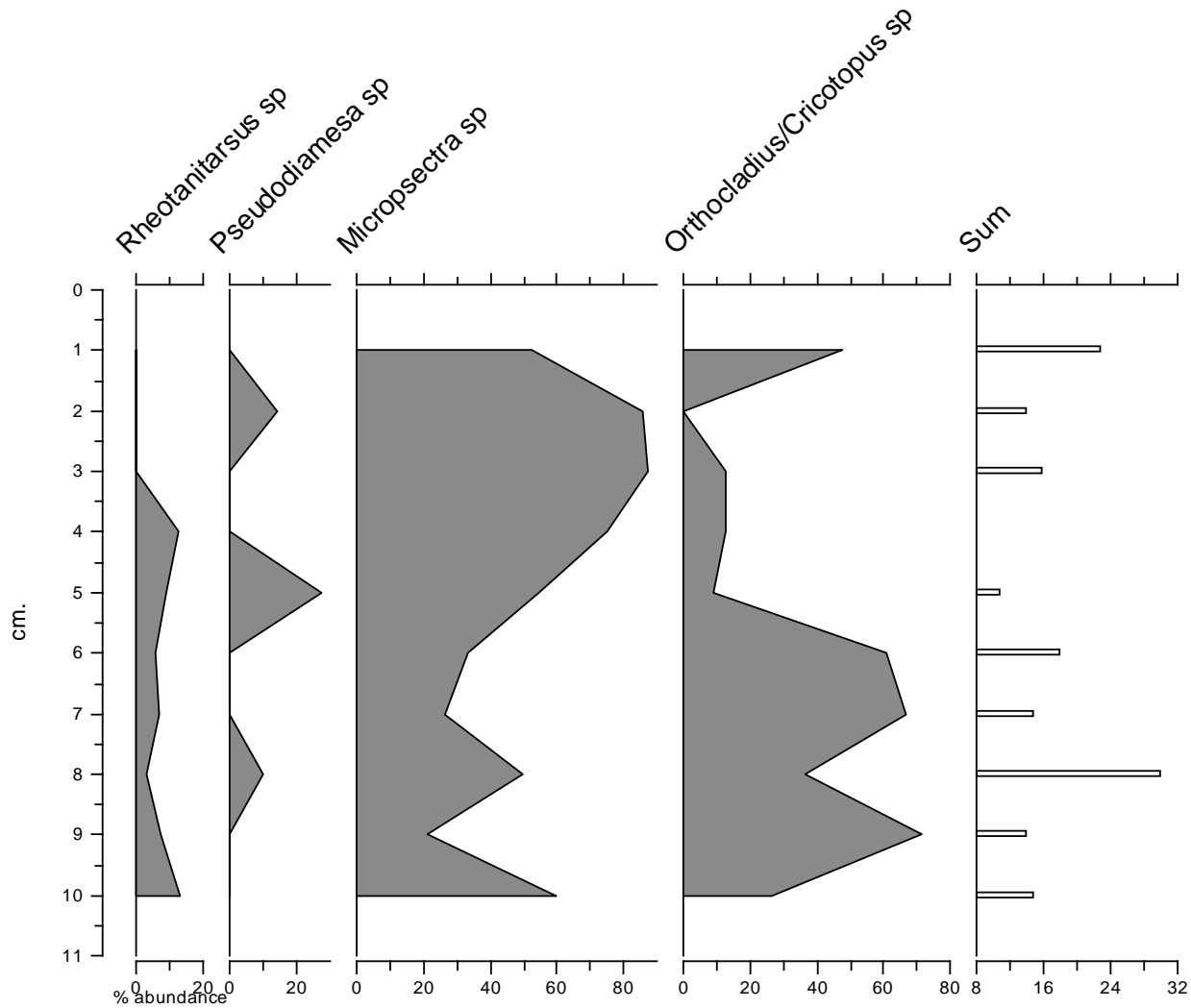
# Results – Lake Phewa (sedimentation rate = 0.38 cm/yr)



# Results – Lake Gosaikunda

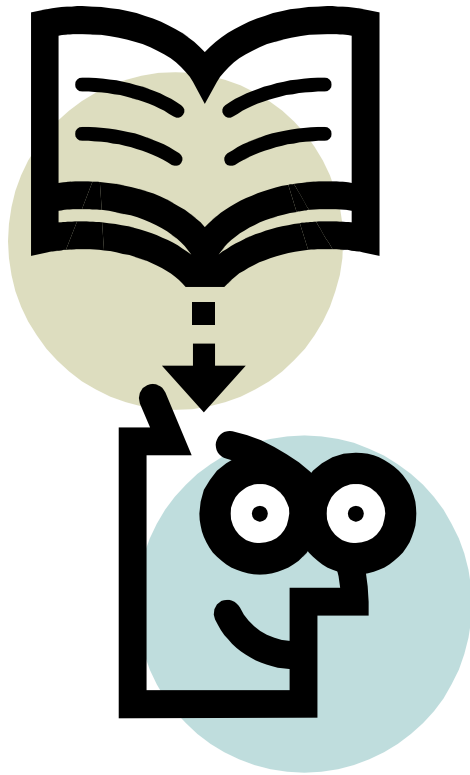


# Result – Lake Gokyo





# Let us try to draw a conclusion !



- Lakes in the Himalaya were subjected to both cold and warm phases in past.
- Cold phases became shorter in near past.
- And now (eg., since 60 yrsBP in case of Lake Gokyo) it may be considered warm phase.
- Lakes in the lower elevation are subjected to accelerating eutrophication.

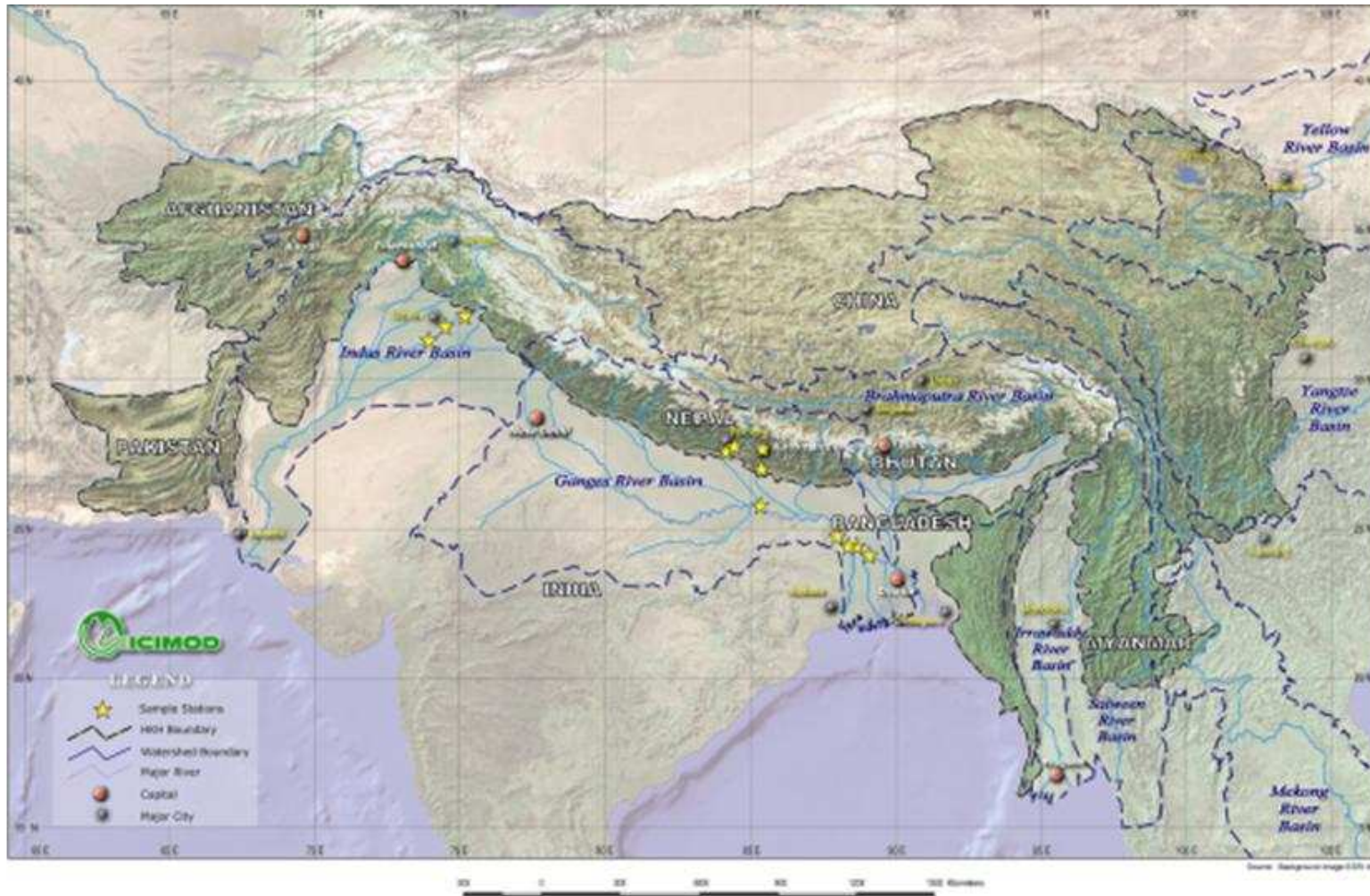
# River pollution in the Hindu- Kush Himalaya



- In total 380 standardized samples of macroinvertebrates taken from Bangladesh, Bhutan, India, Nepal and Pakistan in two sampling seasons.
- At each sampling site 93 environmental parameters were recorded.

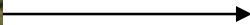
(source: [www.assess-hkh.at](http://www.assess-hkh.at))

# Study area and the location of sites



Source: [www.assess-hkh.at](http://www.assess-hkh.at)

# Theory behind use of macroinvertebrates in river pollution studies (Source: ASSESS-HKH)



**Macroinvertebrates Found in "Good Quality" Water are Sensitive to Pollution**



Mayfly



Beetle Adult



New Caddisfly



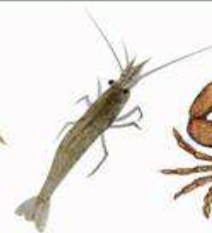
Damsfly



**Macroinvertebrates Found in "Fair Quality" Water are Somewhat Sensitive to Pollution**



Dragonfly



Prawn



Crab



Beetle larva



Clam or Mussel



**Macroinvertebrates usually Found in "Bad Quality" Water are Tolerant of Pollution**



Corbicula



Aquatic worm



Brotia



Leech



Chironomous



Snail

# Major Stressors in Nepal

Sewage discharge & wastes dumping

Sand and gravels extraction

Vehicles washing

Rafting, navigation

Damming

Bathing and washing



# Major Stressors in Bangladesh



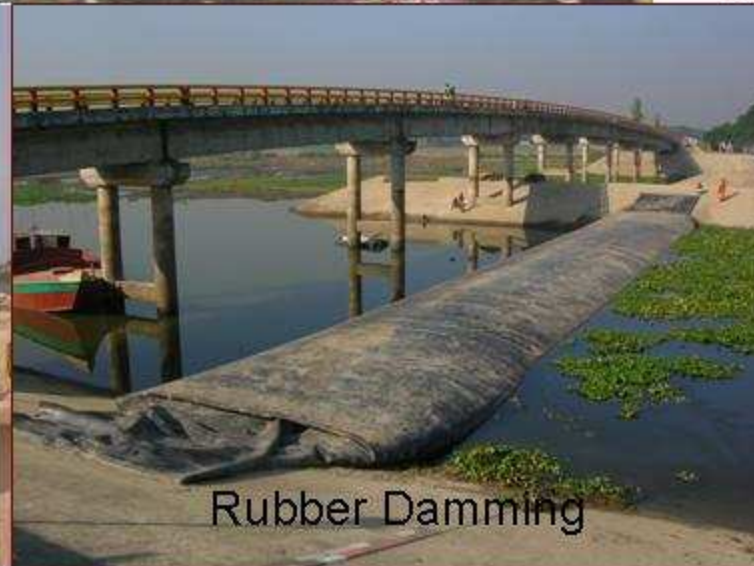
Industrial Effluent



Sewage discharge

Sand extraction

Wastes disposal



Rubber Damming



# Major Stressors in Bhutan



## Urbanization



# Major Stressors in India & Pakistan



Wastes disposal

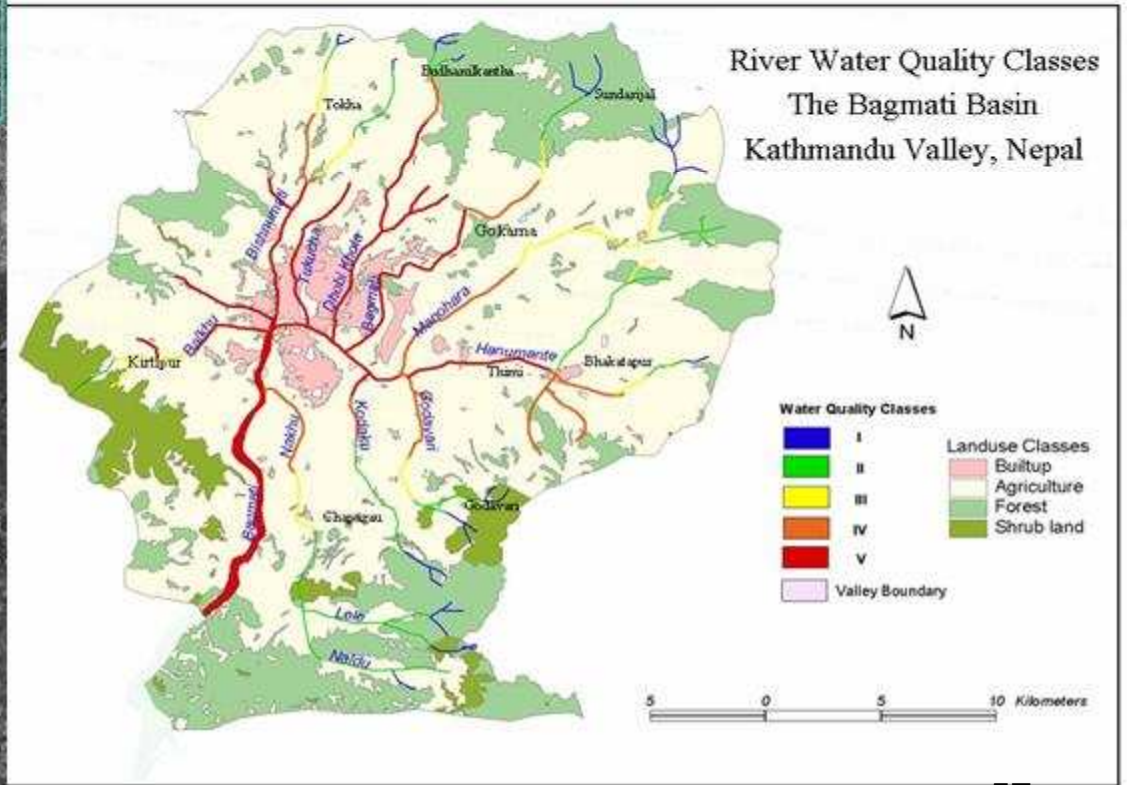
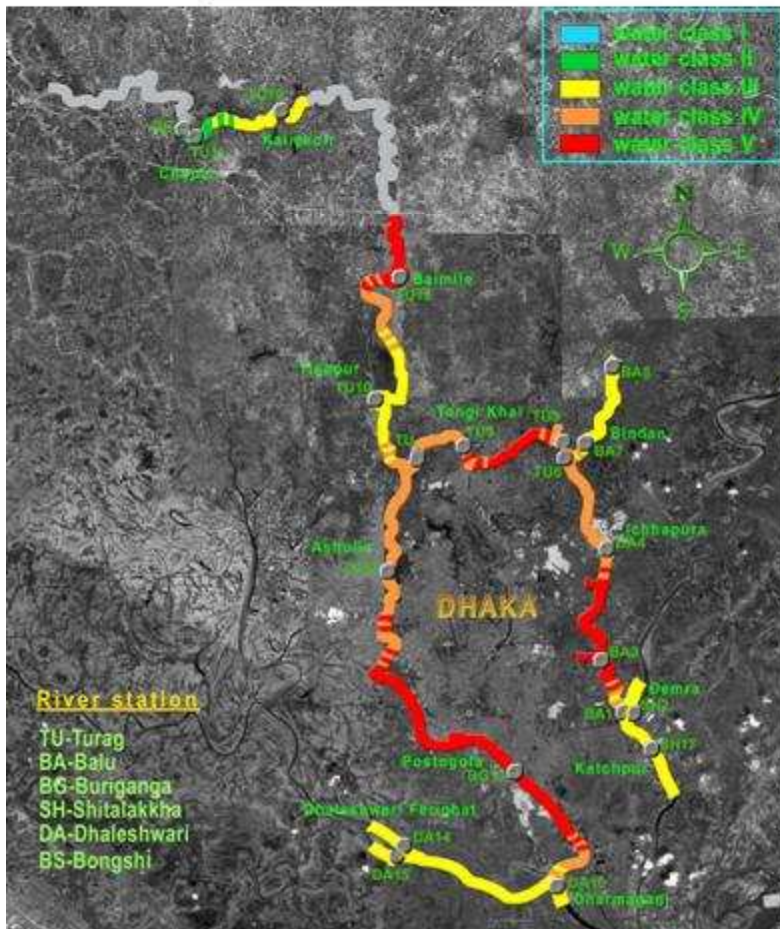
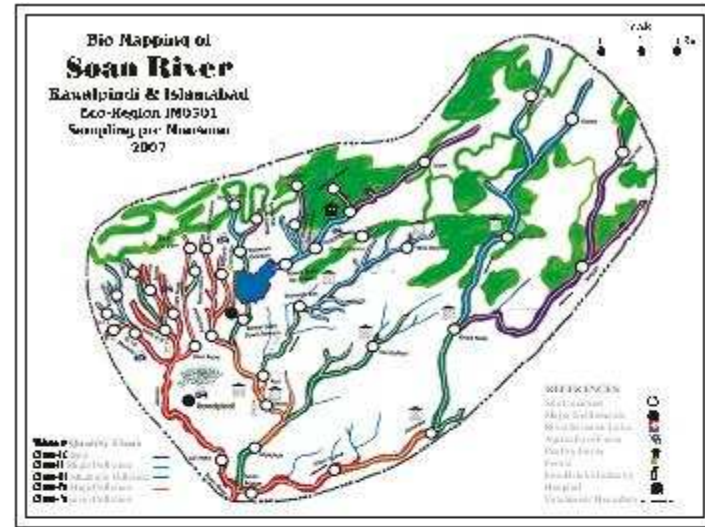
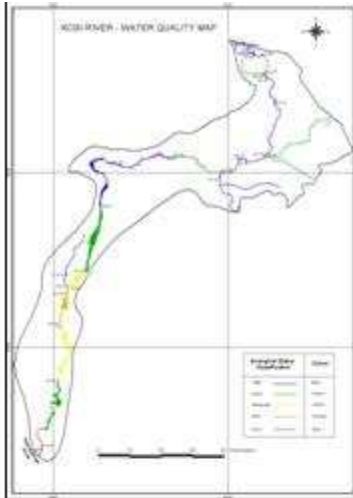


Agricultural runoff



River bed destruction





# Future Directions

1. Past, present and future of climate change variability considering high altitude lakes in the Himalaya & Tibetan Plateau
2. Pollutant transportation and water quality assessment of rivers in the region
3. Adaptive strategies of the local system and sustainable development institutions to global environmental change in the region





**Soot and dust damaging Himalayas, according to a new study by the US space agency NASA, Copenhagen, Dec 16 (IANS):**

**Mitigation:**

**Switching from fuel wood to hydropower.**

**100% Solar electrification in upper Dolpa**

# Responding to change

## Local Initiatives:



*Sherpa, who has set a world record for climbing Everest in the shortest time of eight hours and 10 minutes in 2004, has climbed Everest for 19 times.*



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