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Himalayan High Altitude Ecosystems with High Carbon Reservoirs

Dr. Wu Ning (nwu@icimod.org)

International Centre for Integrated Mountain Development

Kathmandu, Nepal

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Mountain Ecosystems in Himalayan Region

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The HKH region is the source of ten large Asian river systems which are to a large extent determined by the ecosystems located within the region, providing goods and services directly to a population of 210 million in mountains, and supporting the lives and livelihoods of 1.3 billion people living in the basins.

Mountain Ecosystems in Himalayan Region

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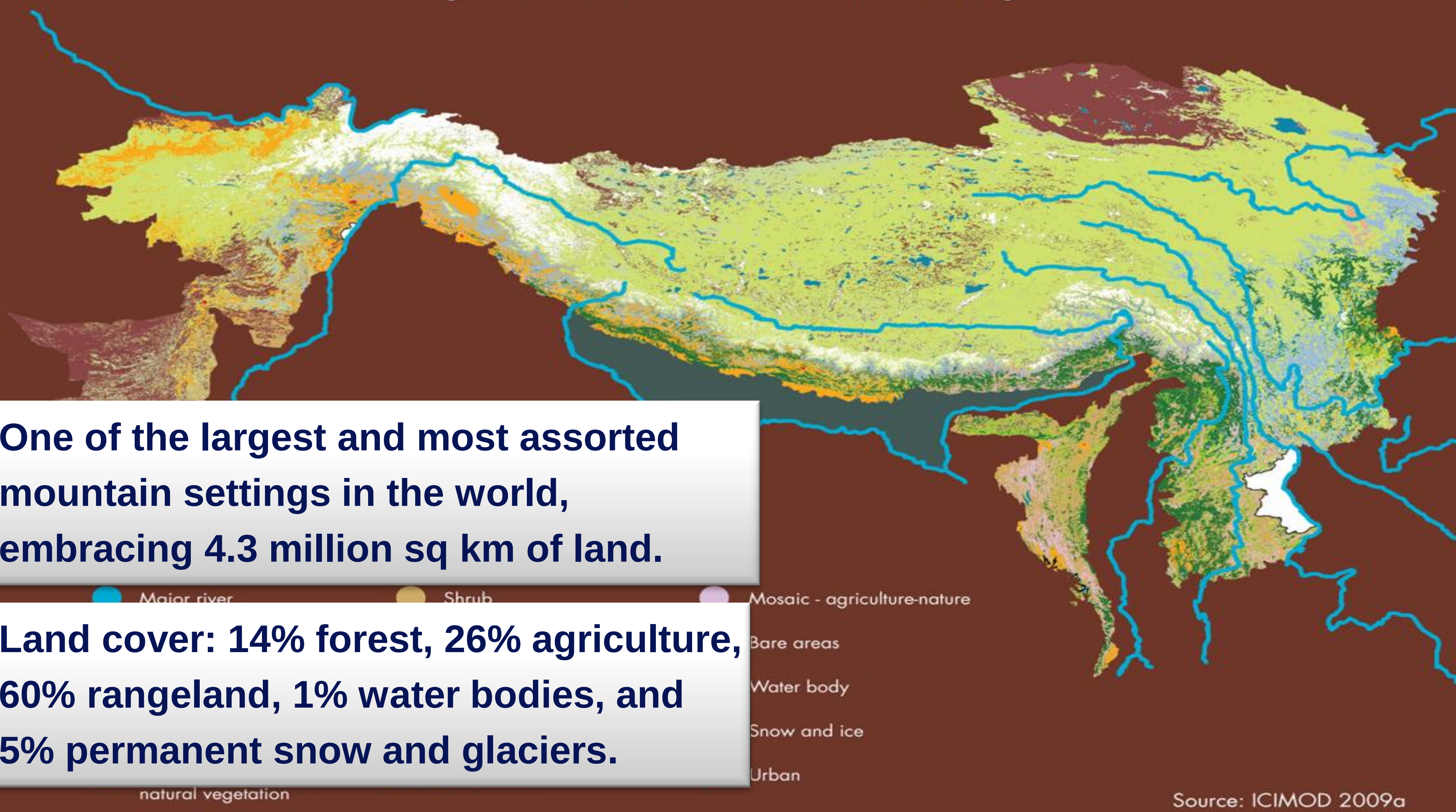
Figure 4: **Land use and land cover in the HKH region**



Source: ICIMOD 2009a

One of the largest and most assorted mountain settings in the world, embracing 4.3 million sq km of land.

Land cover: 14% forest, 26% agriculture, 60% rangeland, 1% water bodies, and 5% permanent snow and glaciers.

Climate change

Temperature

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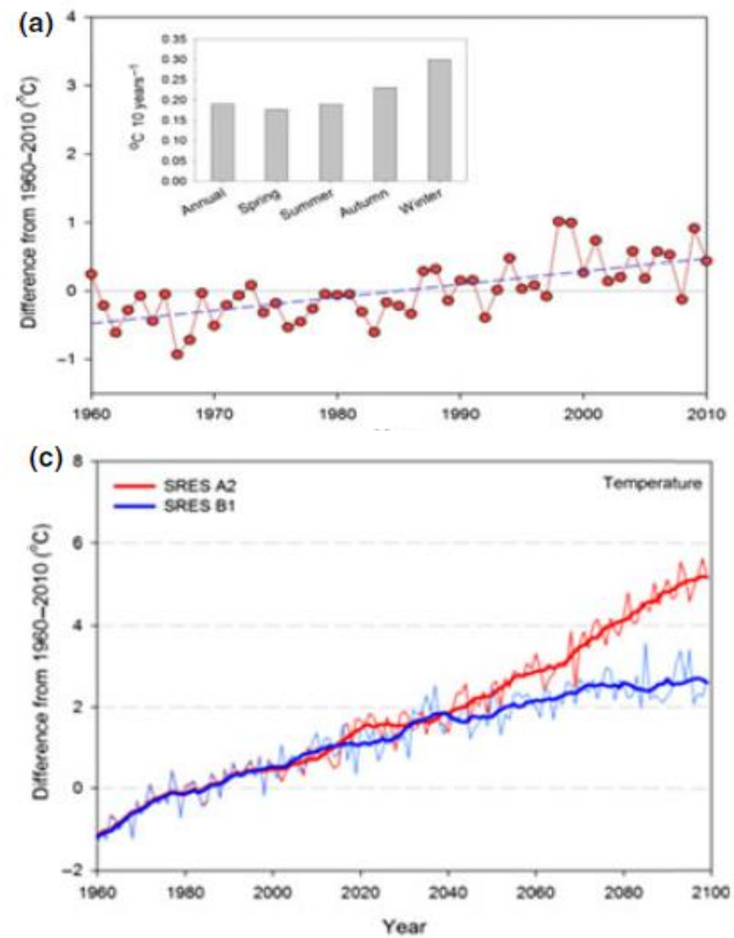
- The temperature has increased by 0.2 °C per decade since 1960, with the warming trend even intensified since 2000;
- The rates of winter and autumn warming have been significantly faster than those of spring and summer;
- The northern TP has shown the most obvious warming, with the rate as high as 0.08 °C yr^{-1}.
- The mean annual temperature is expected to increase by 2.6–5.2 °C by 2100 under two scenarios (A2 and B1).

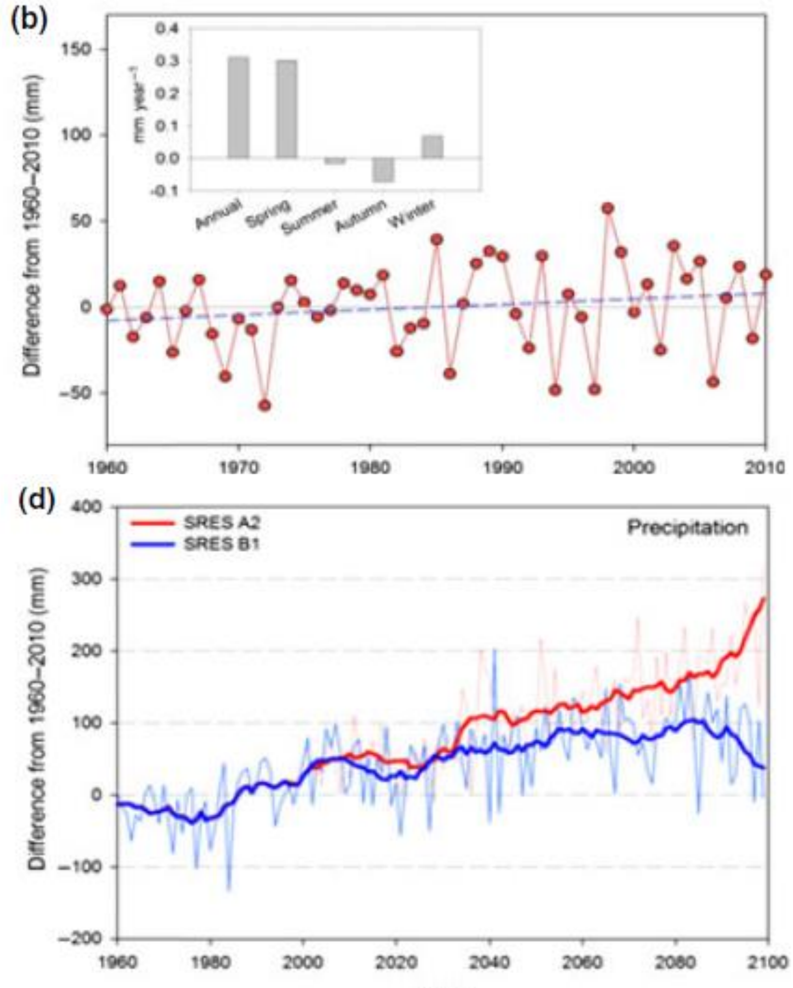


Chen et al. ***Global Change Biology***, 2013, 19, 2940–2955

Climate change

Precipitation

- The precipitation trend since 1960 has shown less seasonal and spatial fluctuation but an overall slight increase and high inter-annual variation at the whole-region scale;
- Showing a significant increase during the winter and spring, but non-significant decreases during the summer and autumn;
- Future projections of precipitation indicate a wetting trend with increases of 38 or 272 mm by 2100 under two scenarios (A2 and B1).



Chen et al. ***Global Change Biology***, 2013, 19, 2940–2955

High Altitude Ecosystems with High-carbon Reservoirs

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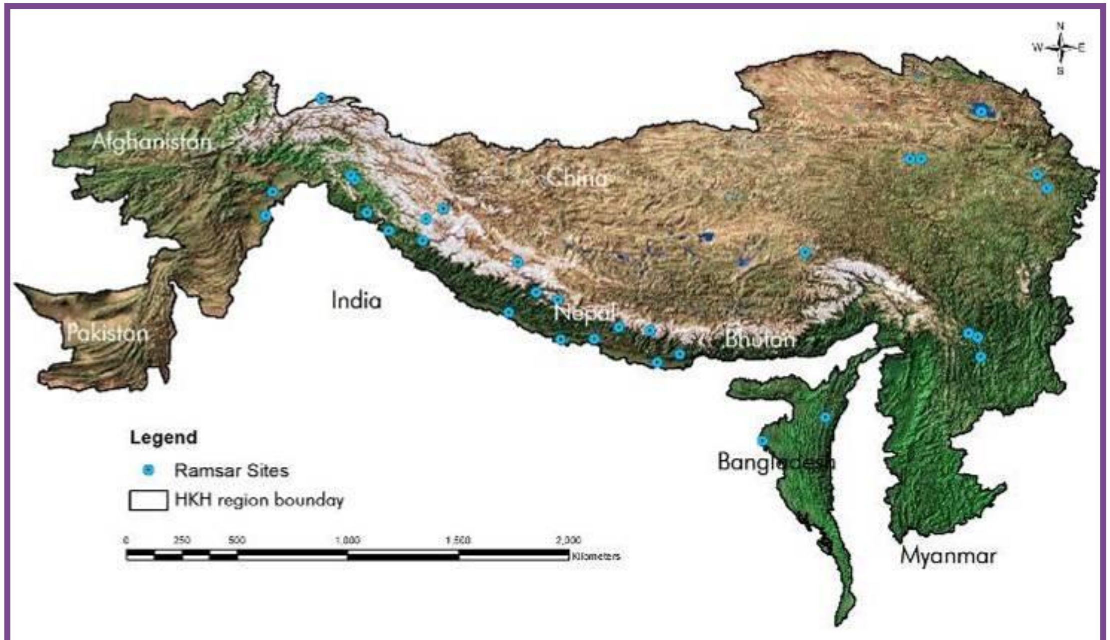
- **Peatlands: transitional (ecotonal) systems with accumulated peat between upland terrestrial (rangelands) and open water systems (lakes);**
- **Permafrost: soil at or below the freezing point of water 0 °C (32 °F) for two or more years.**



Peatlands in the HKH Region

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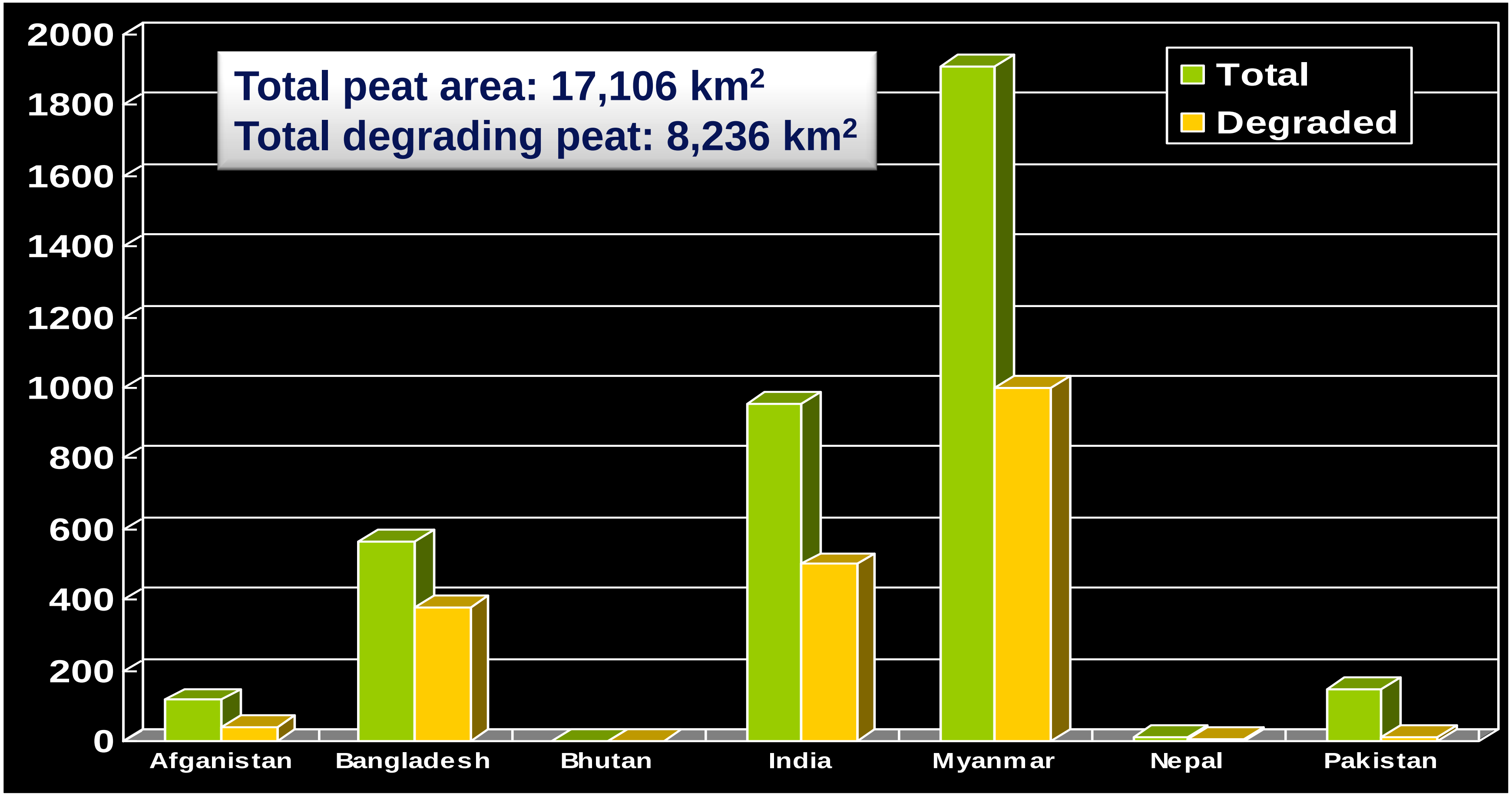

Peatlands Distribution in HKH' RMCs (except for China) in 2008

Note: Data adopted from WI, 2009.

Peatlands in the HKH Region

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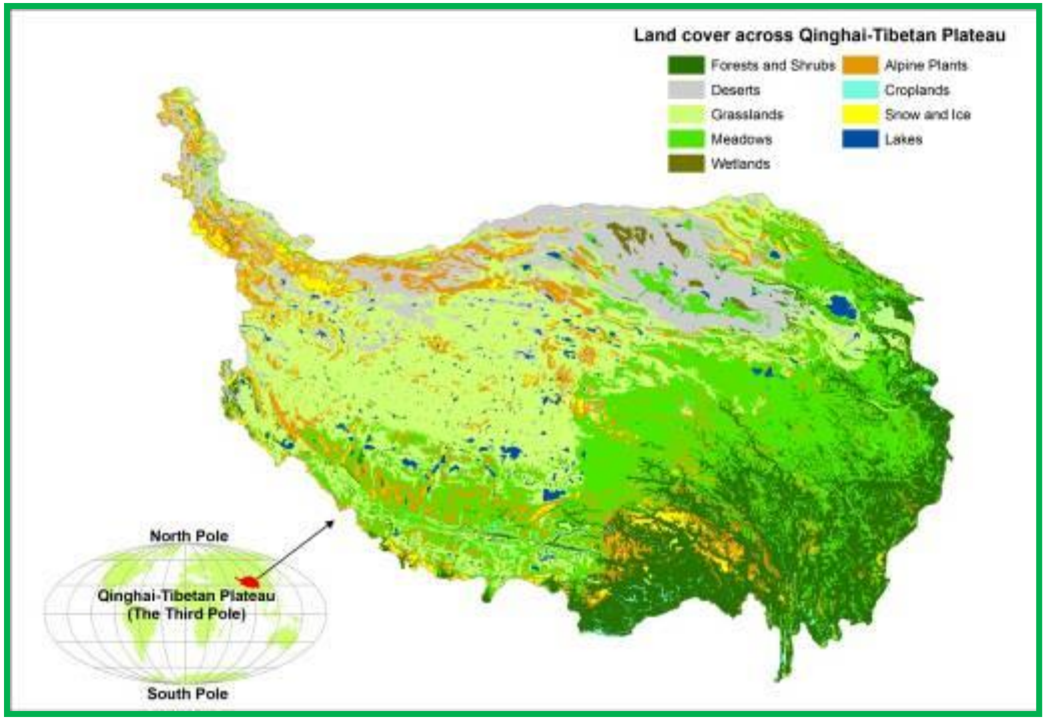
The total area of high altitude peatlands in TP was estimated at 14.4 x 10^3 km^2, making up 43% of total peatlands in China (WI, 2008).



Peatlands within the TP region are mainly dispersed in the south, southeast and eastern part. The alpine climate favors creation of a vast frozen soil layer which is conducive to formation of peatlands.

Peatlands as High Carbon Reservoir

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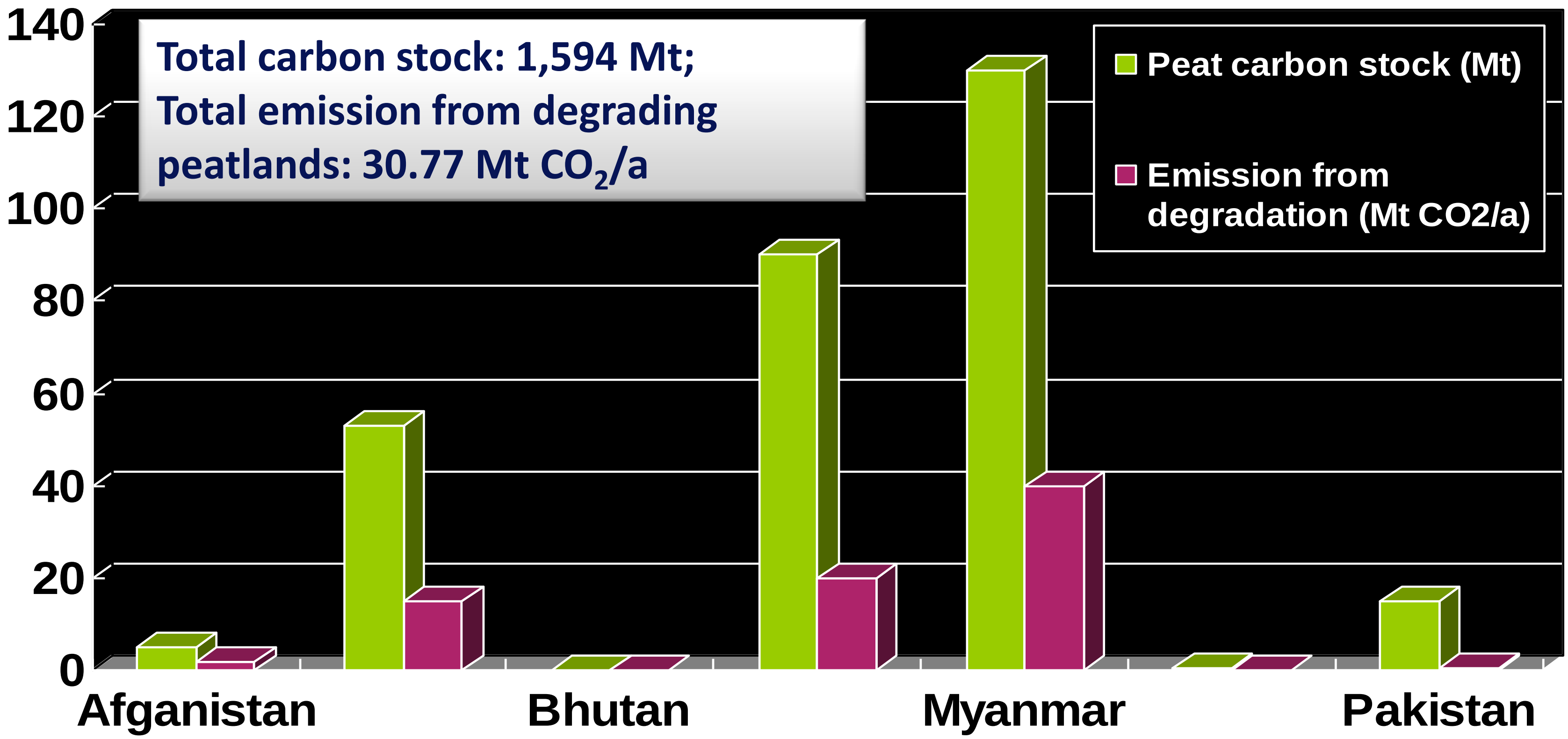

Peat carbon stock and total emission from degrading peat in HKH' RMCs (except for China) in 2008

Note: Data adopted from WI, 2009.

Peatlands as High Carbon Reservoir

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- **The peatlands on the TP are one of the most important stores of carbon in the mountain regions storing 1,500-4,000 tones per ha or up to 8-20 times more than mountain forests and 50-100 times more than mountain grasslands.**
- **In 2008 the total carbon stock in peat is 1,386 Mt and the total emission from degrading peat is 33.11 Mt CO_2/a.**

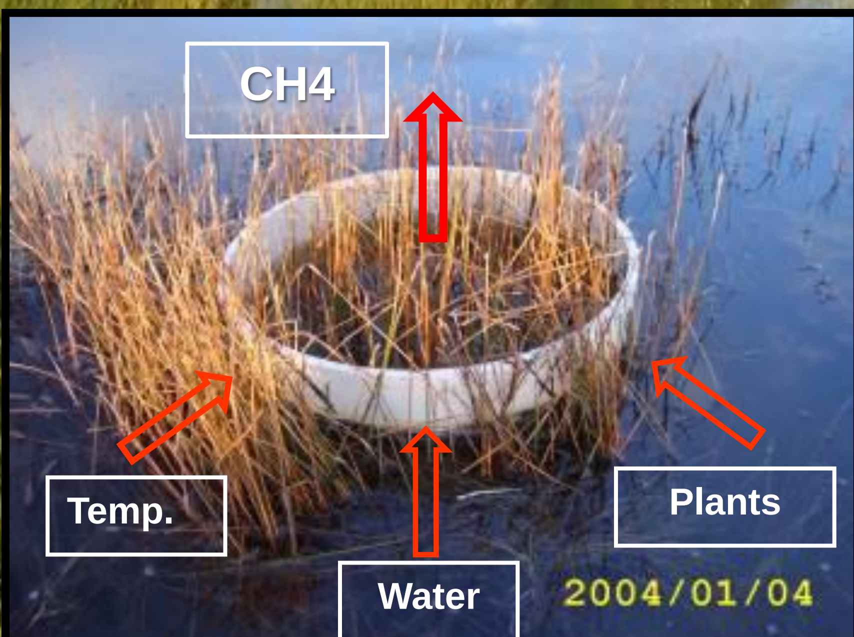
Regional Estimation

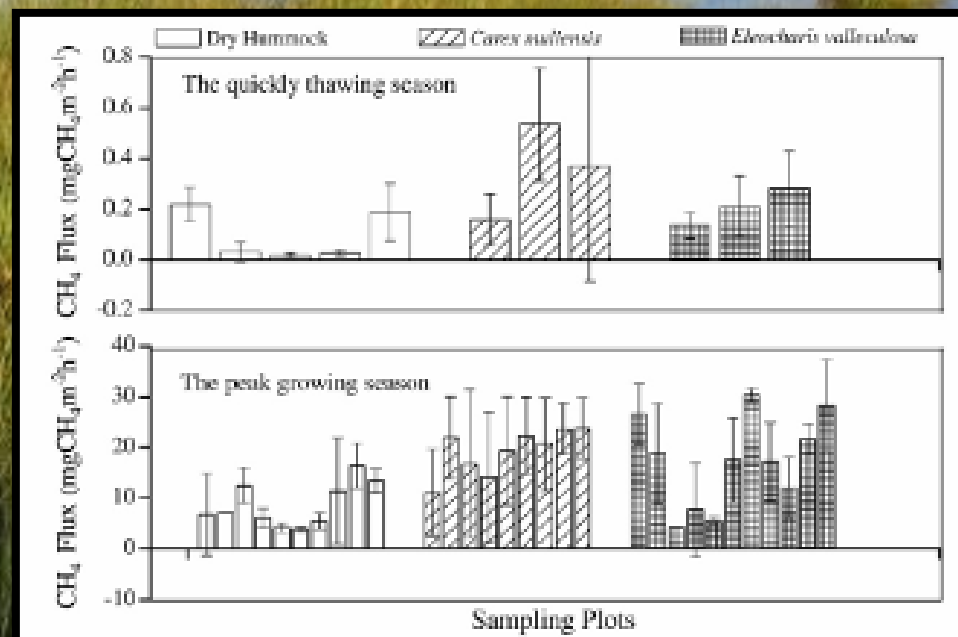
- **The total carbon stock: 2,980 Mt;**
- **The total emission from degradation: 63.88 Mt CO_2/a.**

GHG Emission from Peatlands

Warming-enhanced respiration of subsurface peat may have transformed peatlands from net CO_2 consumers (sinks) into net CO_2 emitters (sources). Furthermore, exported old DOC from peatlands would contribute greatly to CO_2 emissions from nearby aquatic systems (Chen et al. 2013).

As climate warming has continued, the peatlands have become drier or even vanished from 1967 to 2004, which definitely decreased emission of CH_4 (Zhang et al., 2011).





Permafrost Thawing

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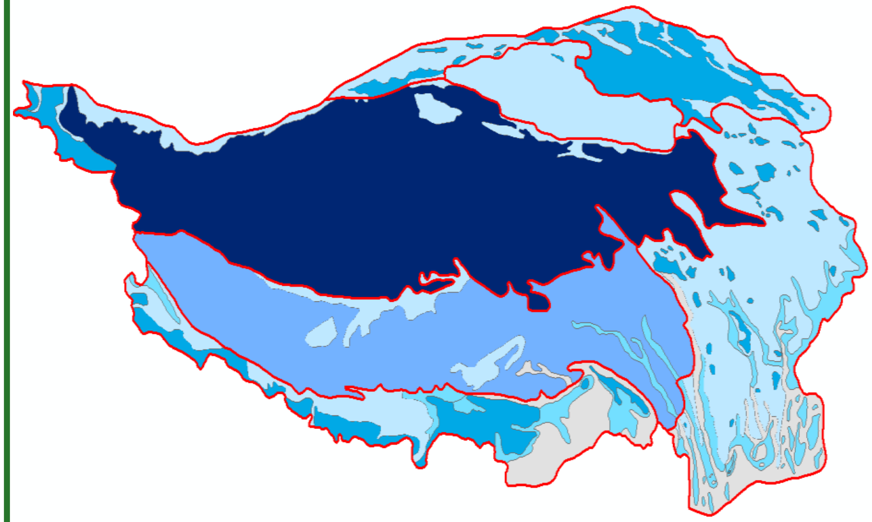
- The extensive permafrost covers a significant portion of TP with the area of 1.4 -1.5 million km^2 (Yang, 2004).
- Since the 1970s, the ground temperature of seasonally frozen soil and areas of some permafrost has increased by 0.3–0.5 °C, with an average about 0.43 °C at a depth of 6.0 m.
- Long-term monitoring has indicated that the lower altitudinal limit of the permafrost has moved upward by 25 m in the north (30 years) and 50–80 m in the south (20 years).



Permafrost Thawing

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- Simulations predict that the Tibetan permafrost will continue to retreat and thaw, and that the area of permafrost may decrease by 8.8–19% by 2049 and by 13.4–58% by 2099.
- Warming-induced permafrost thawing would result in rapid carbon loss through the efflux of CH_4 and CO_2, and leaching of DOC (Chen et al. 2013).
- From 1986 to 2000, the loss of SOC caused by permafrost degradation was estimated at 1.8 Tg C (Wang et al., 2008).

Major Issues Facing High Altitude Ecosystems

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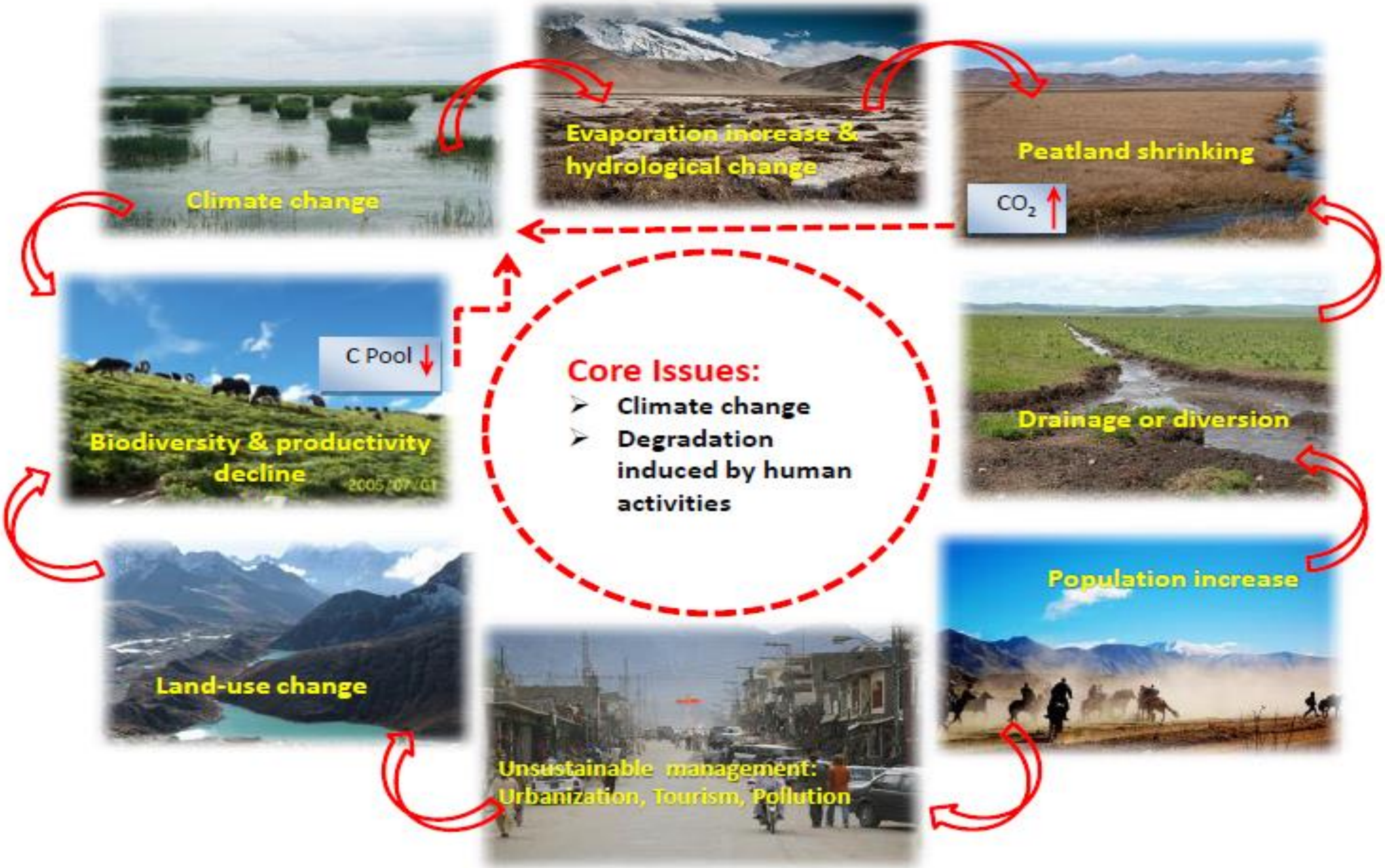

Way Forward

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- Promote research and baseline studies to support scientific understanding, long-term monitoring, conservation and management;
- Promote integration of the conservation, restoration and co-management of high altitude ecosystems into climate change mitigation and adaptation policies and strategies;
- Develop mechanisms to improve the effectiveness and efficiency of communication, education, participation, and awareness.



Thank you

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