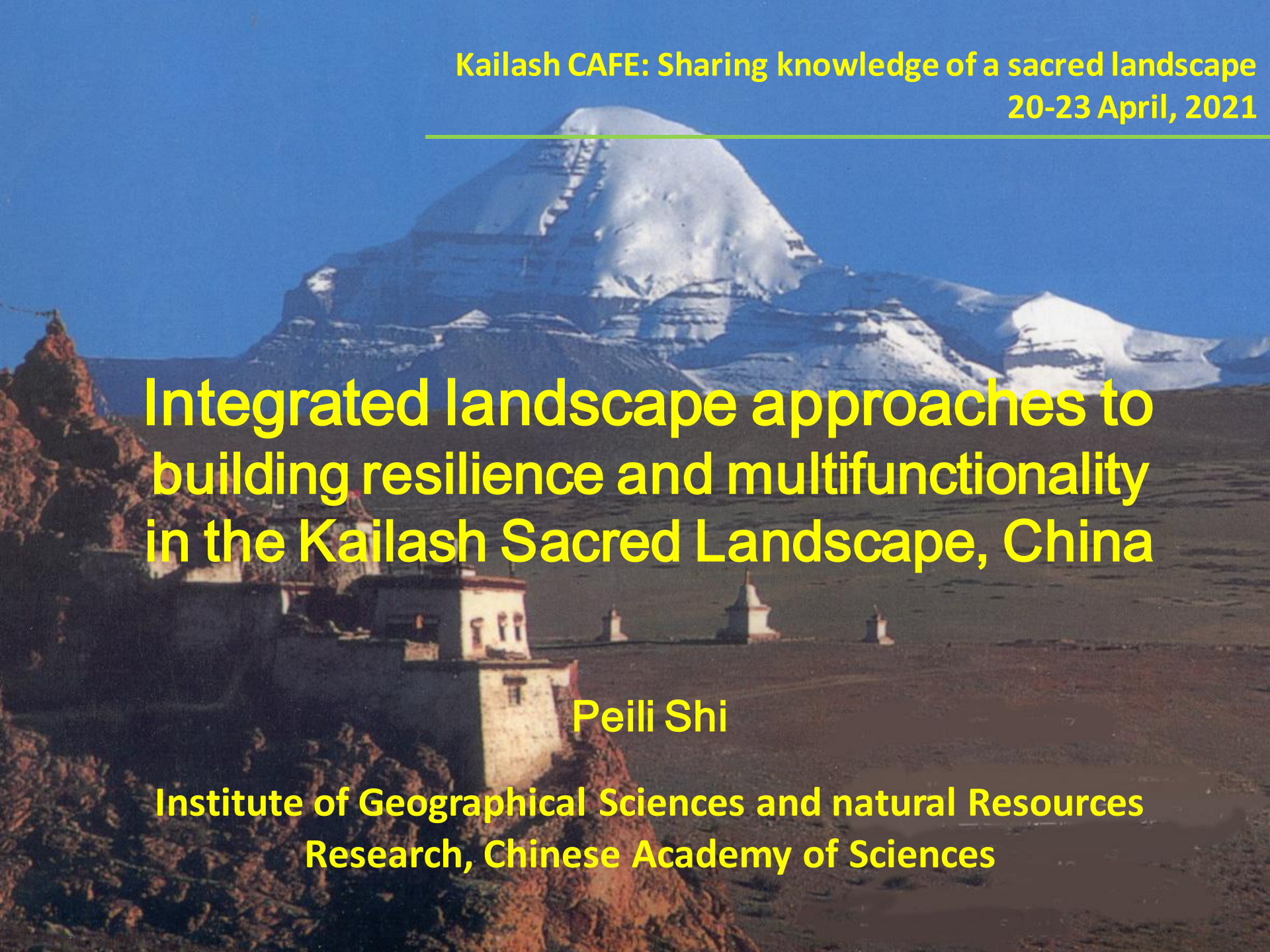
Kailash CAFE: Sharing knowledge of a sacred landscape
20-23 April, 2021



Integrated landscape approaches to building resilience and multifunctionality in the Kailash Sacred Landscape, China

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Outline

- Introduction
- Vulnerability and Ecosystem services
- Landscape ecosystem-based adaptation
- Conclusion

1. Introduction

The dilemma of rangeland development in dryland

- Climate change-induced drought
- Overgrazing
- Rangeland Degradation
- Decrease in livestock production

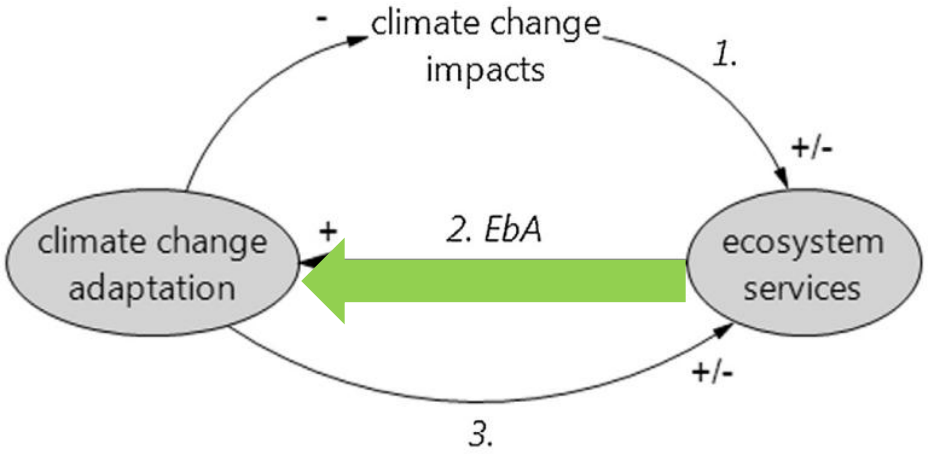
Calling for sustainable rangeland management

- Rehabilitation of degraded ecosystem
- Achieving socio-ecological multifunctionality
- Livelihood diversification

✓ Ecosystem-based adaptation

✓Integrated landscape ecosystem management

1.1 Ecosystem-based adaptation



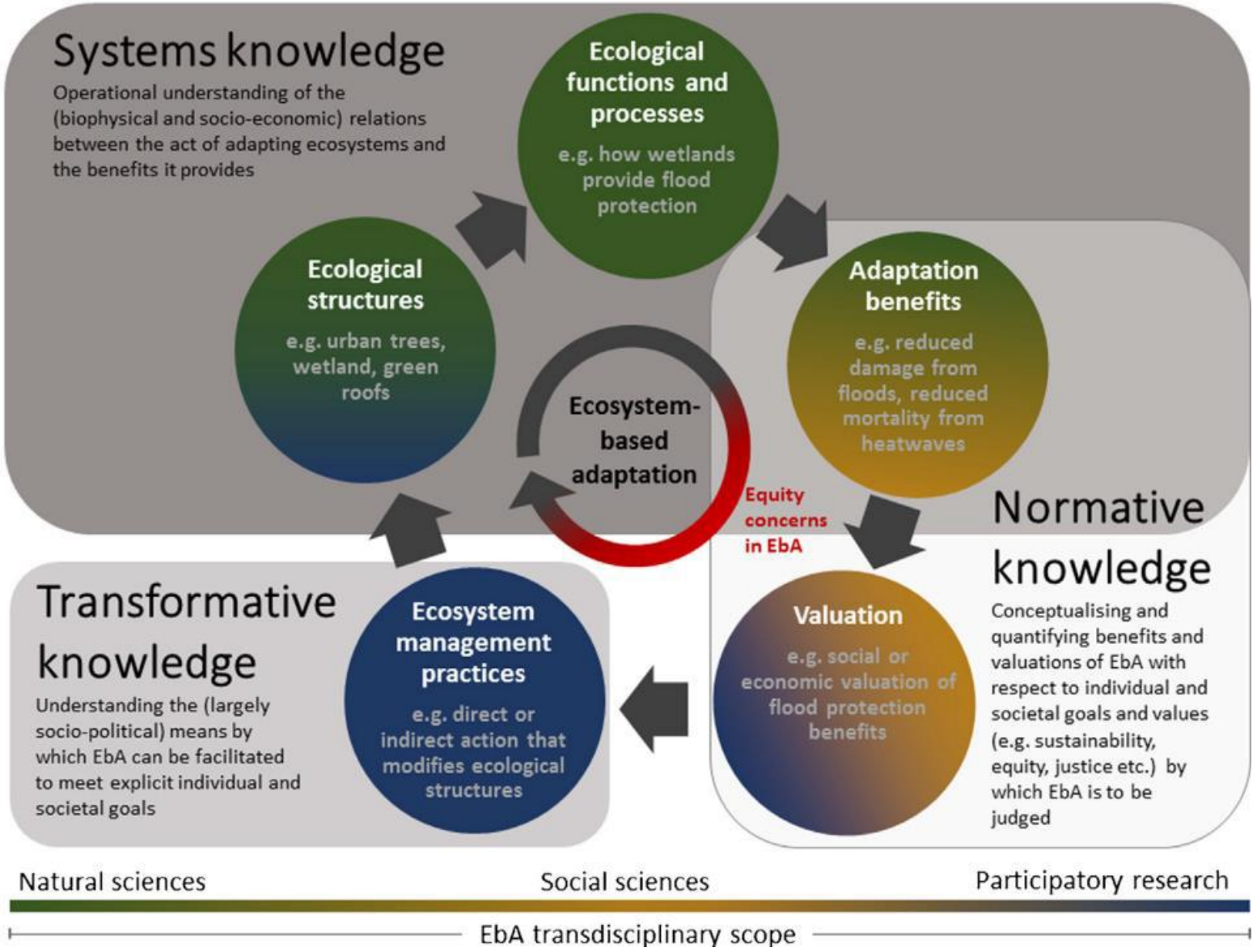
From Brink et al., 2016

Ecosystem-based approaches to adaptation

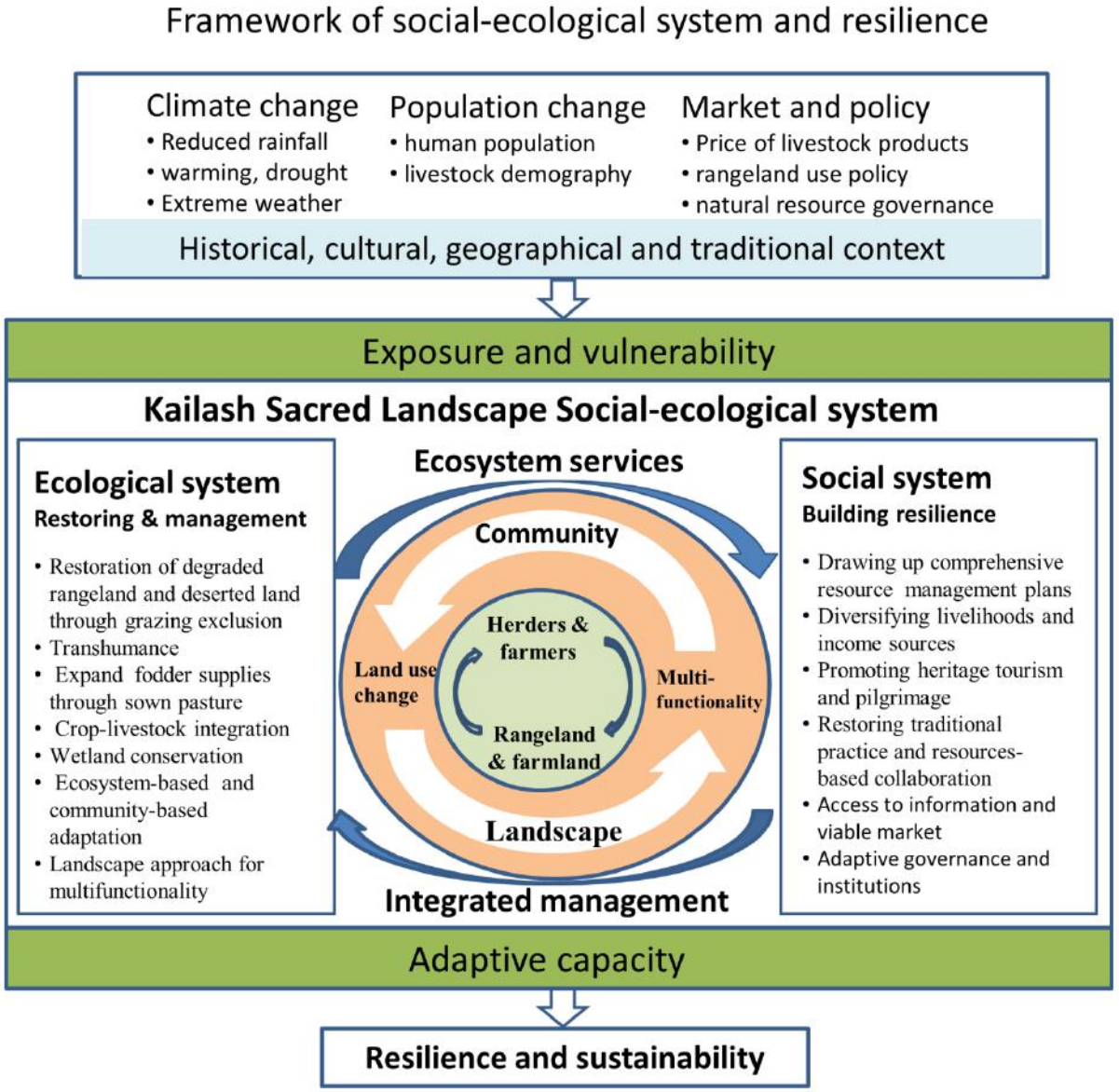
Use of biodiversity and ecosystem services as part of an overall strategy to help people to adapt to the adverse effects of climate change (CBD 2009)

- ✓Problem-focused solution
- ✓comprehensive
- ✓Multifunctional
- ✓Potentially cost-effective

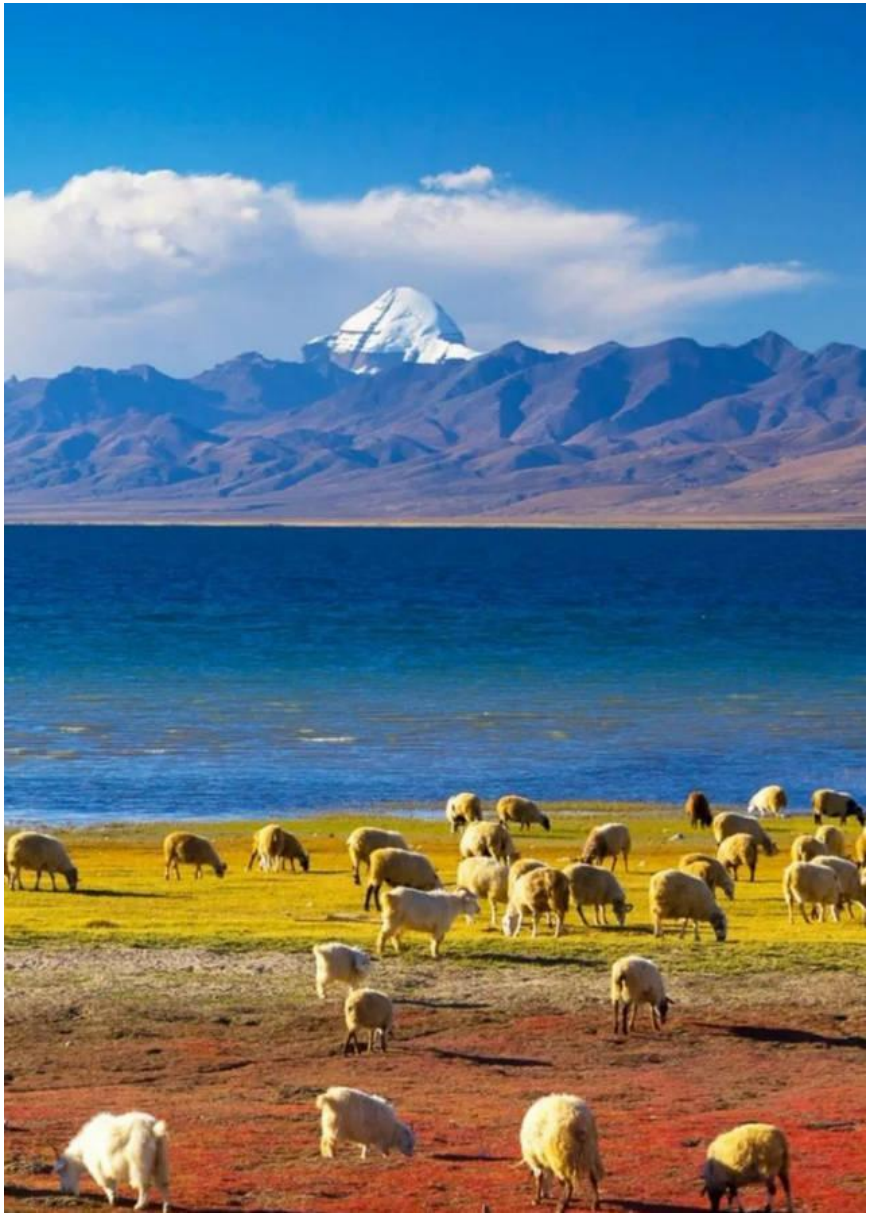
1.1 Ecosystem-based adaptation



1.2 Integrated landscape management

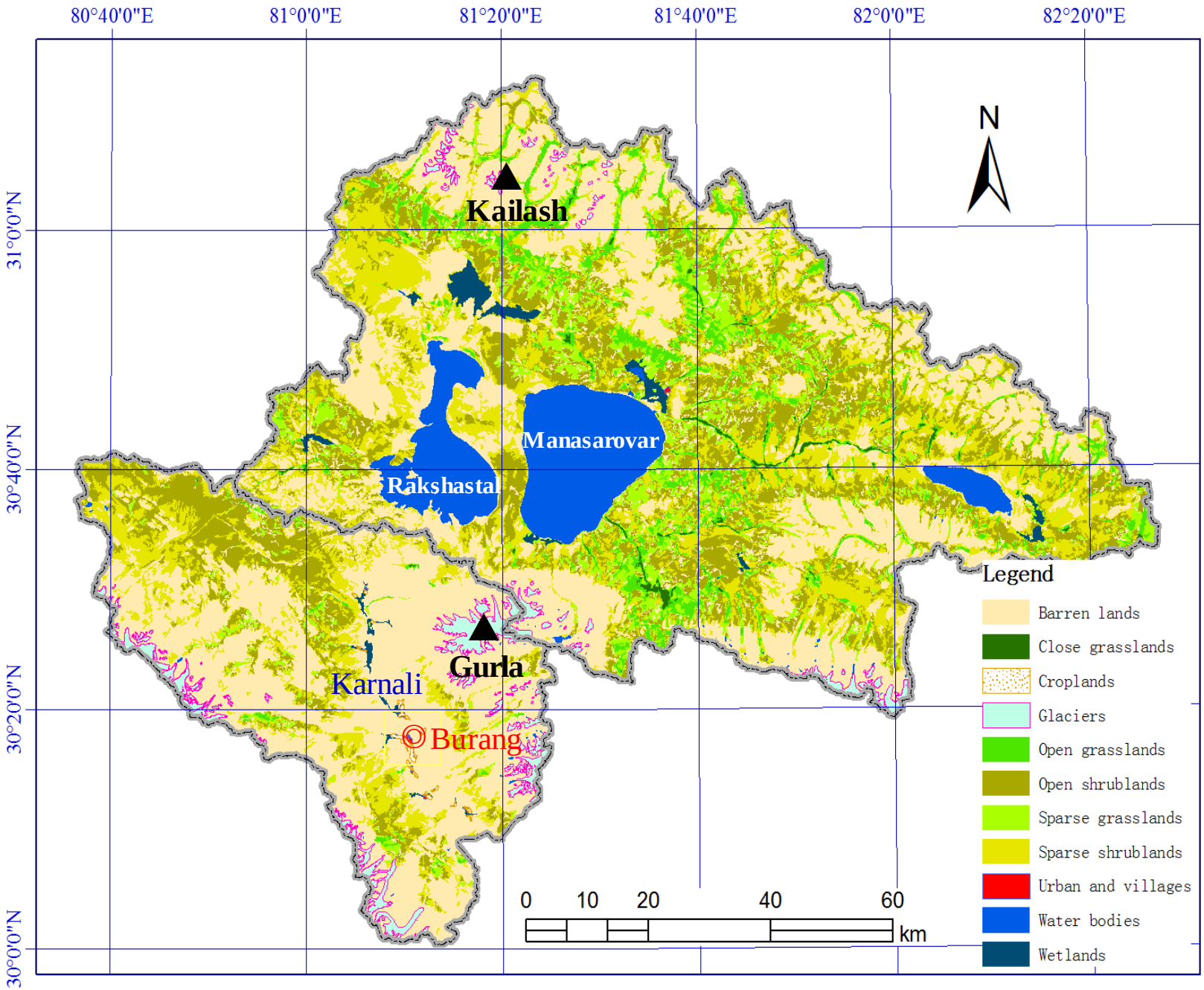


2. Ecosystem vulnerability and services



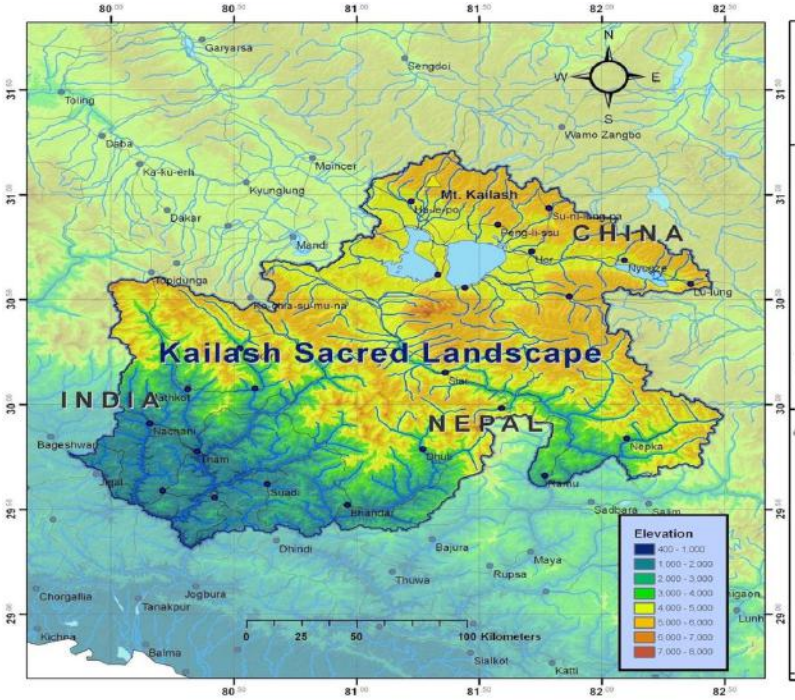
Manasarovar watershed (>4200 m)

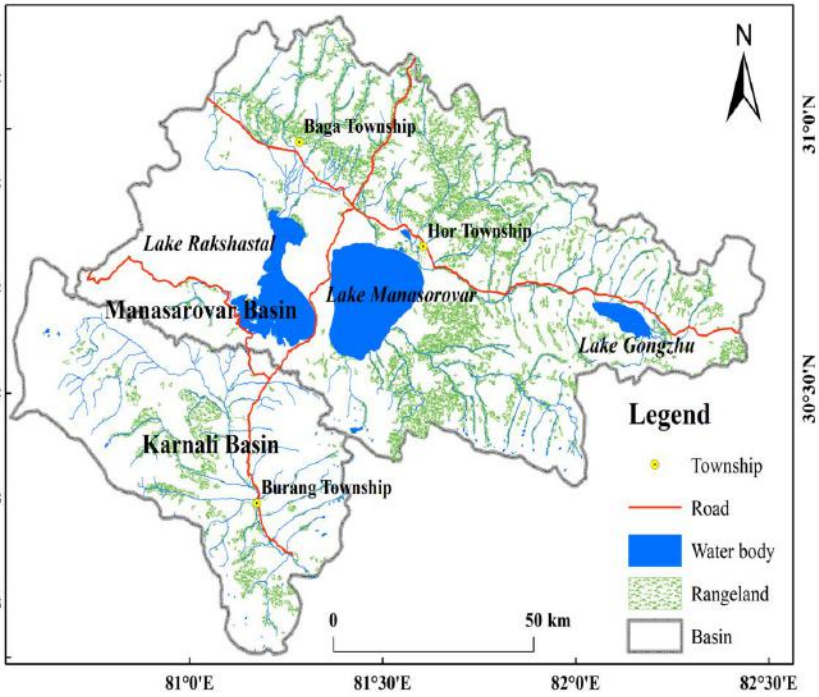
Karnali Watershed 3900-4200 m

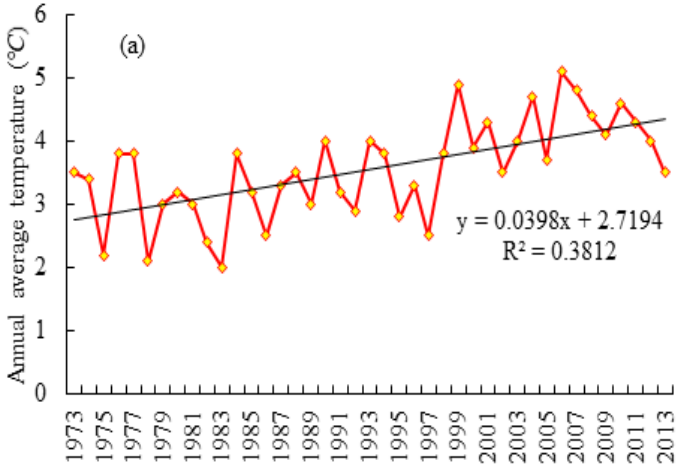


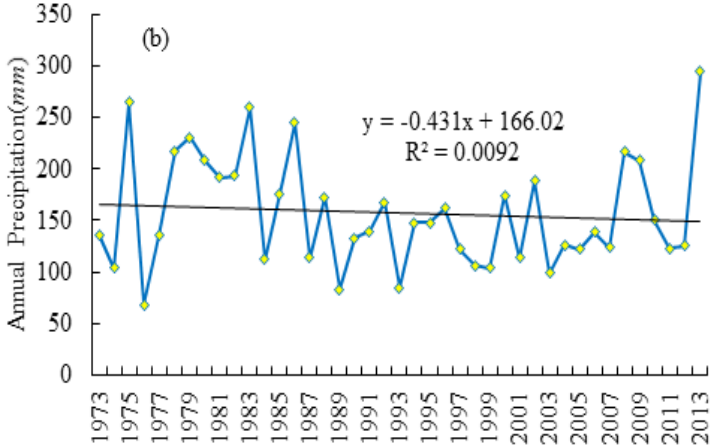
Spatial patterns of land cover in KSL

Kailash Sacred Landscape







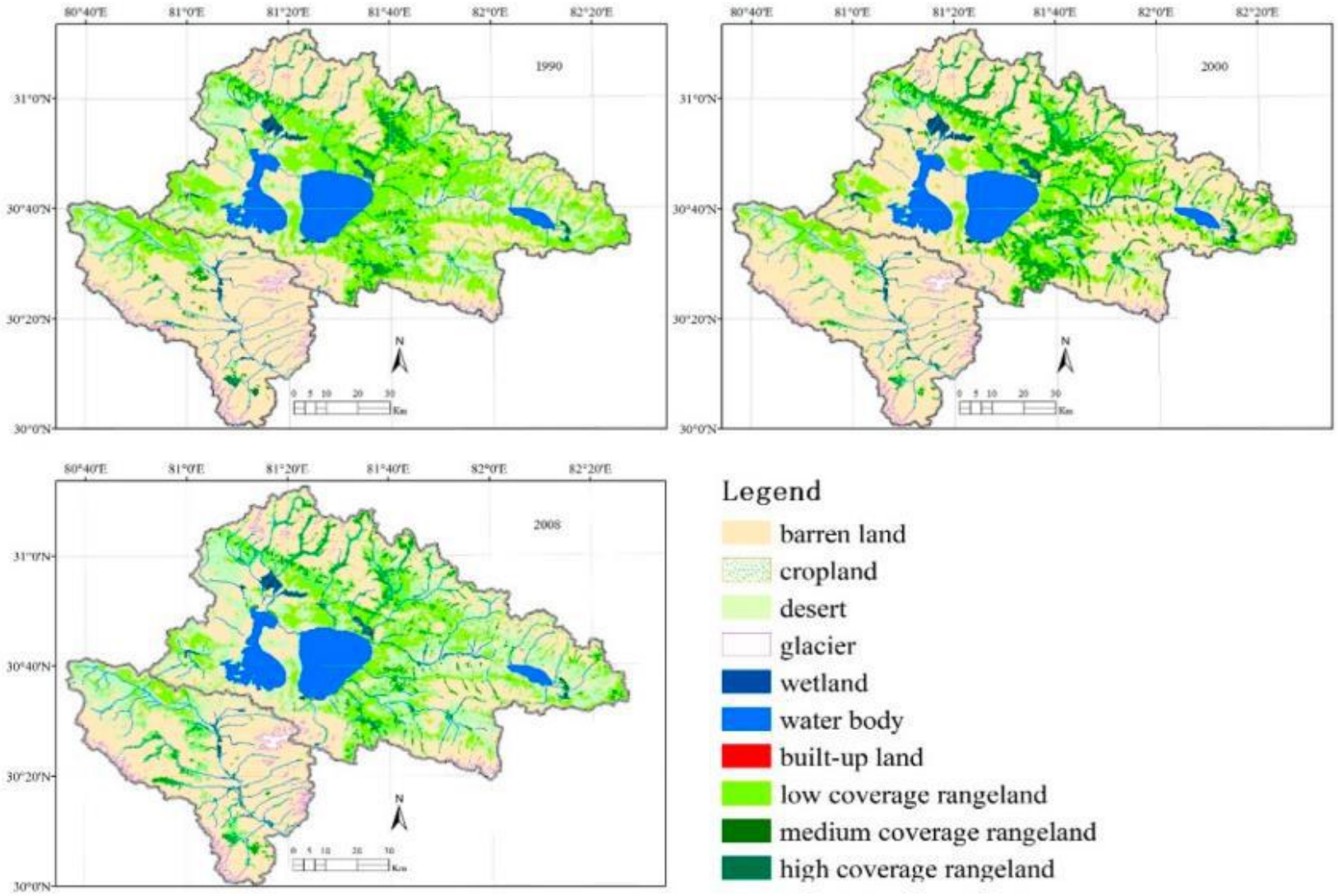


3. Landscape Ecosystem-based adaptation

Building resilience and multifunctionality through integrated landscape ecosystem management

- Livestock number control and degraded ecosystem restoration
- Use of transhumance to adjust grazing pressure
- Wetland and rangeland conservation for biodiversity
- Crop-livestock integration among highland and lowland
- Diversification of livelihoods
- Securing multifunctionality through landscape approach

3.1 LULC change and ecosystem services

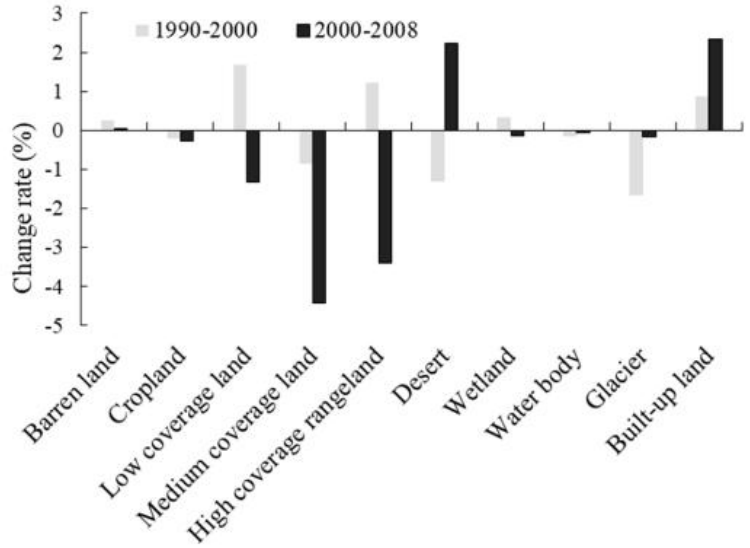


Three phases of land use and land cover change (1990, 2000, 2008)

3.1 LULC change and ecosystem services

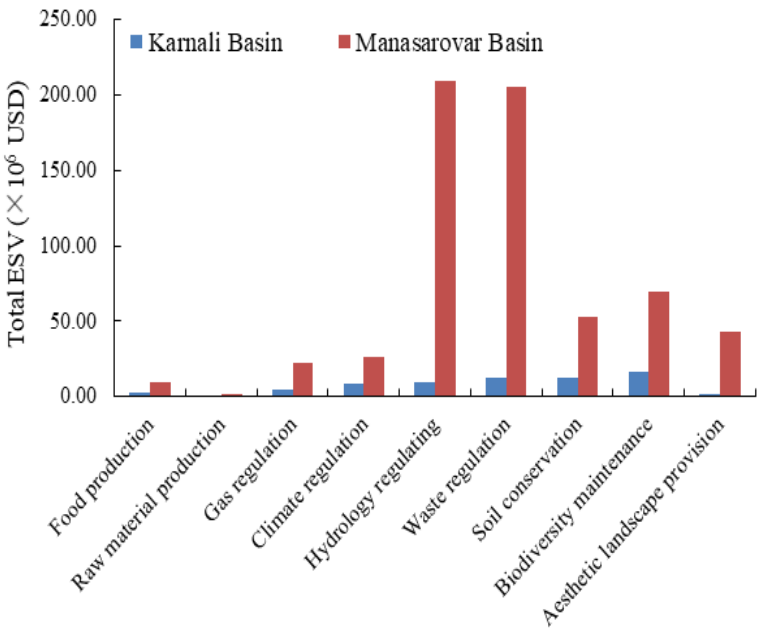
Land use and land cover in 2008

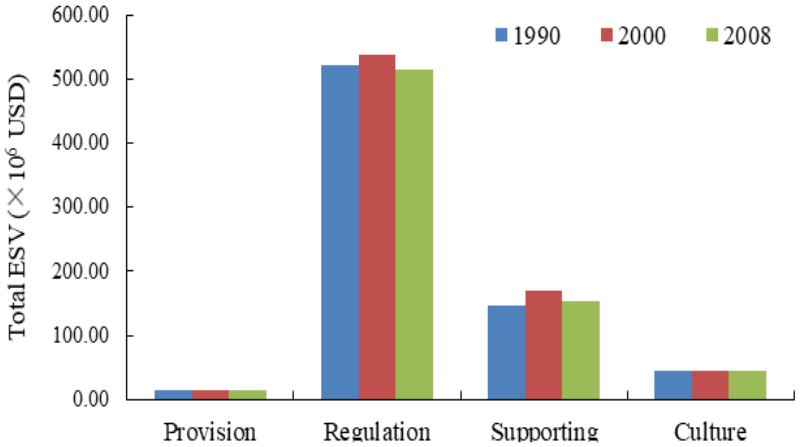
Land Use and Land Cover	Karnali Basin		Manasarovar Basin		Total Region	
	Area/km^2	Ratio/%	Area/km^2	Ratio/%	Area/km^2	Ratio/%
Cropland	10.13	0.33	0.20	0.00	10.33	0.10
Low coverage rangeland	479.24	15.65	1947.94	25.03	2427.18	22.39
Medium coverage rangeland	29.52	0.96	264.21	3.40	293.73	2.71
High coverage rangeland	1.32	0.04	61.86	0.80	63.19	0.58
Desert	789.12	25.77	2257.74	29.02	3046.86	28.10
Wetland	14.78	0.48	80.36	1.03	95.14	0.88
Water body	4.11	0.13	735.15	9.45	739.26	6.82
Glacier	182.60	5.96	79.72	1.02	262.32	2.42
Built-up land	1.92	0.06	0.63	0.01	2.55	0.02
Barren land	1549.16	50.59	2353.04	30.24	3902.20	35.99
Total	3061.89	100.00	7780.87	100.00	10,842.76	100.00



- Remarkable changes due to climatic change and overgrazing
- Dramatic decrease of high- and medium-coverage rangeland
- Conversion of cropland to built-up land for infrastructure

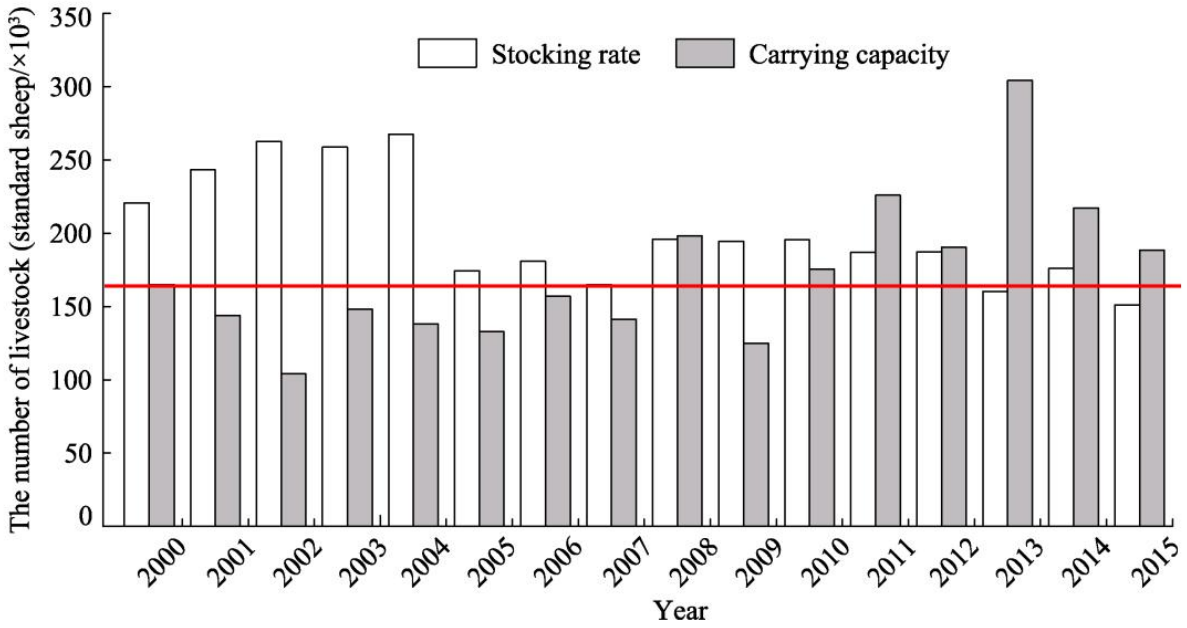
3.1 LULC change and ecosystem services





- Water bodies' regulating services are among the most prominent
- Wetland provides life supporting system for biodiversity
- Culture heritage for cultural ecosystem services, an important avenue for tourism development

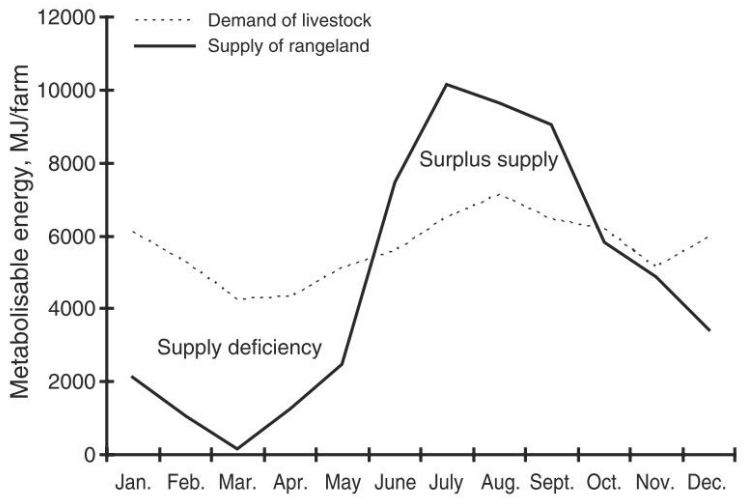
3.2 Rangeland carrying capacity and livestock control

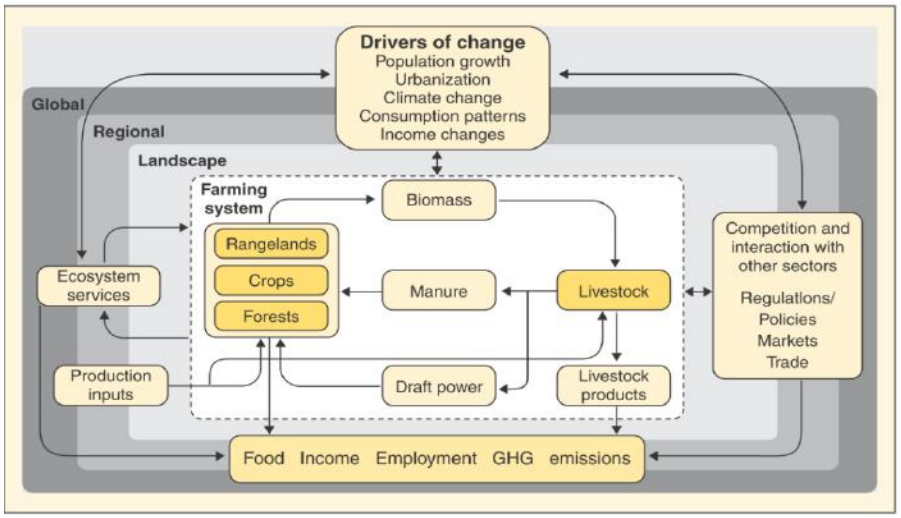


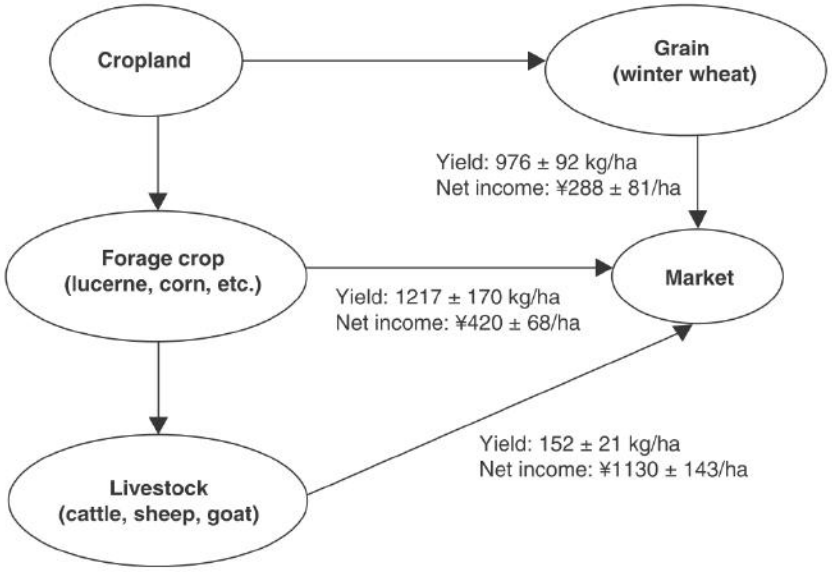
Rangeland livestock carrying capacity and actual livestock number (SU) in KSL-China

Period of time	Karnali Basin	Manasarovar Basin	KSL-China	Carrying rate
Rangeland carrying capacity (2000-2016)	55,000	105,000	160,000	0
Actual mean number before 2005	63,000	168,000	231,000	-0.44
Actual mean number after 2010	20,700	86,500	107,000	0.33

3.3 Crop-livestock integration and transhumance



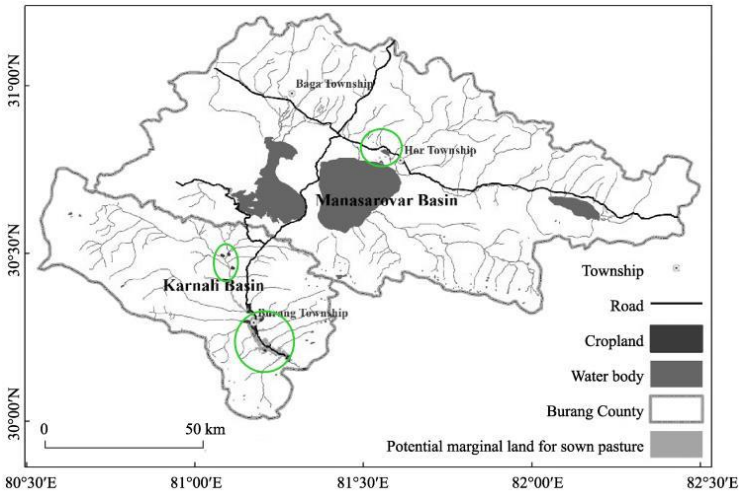




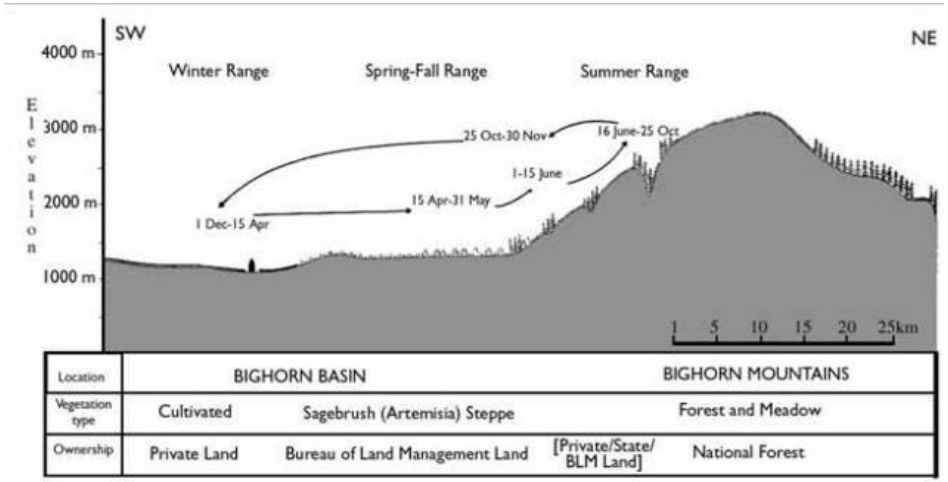
Avenues for forage supply from lowland cropland and sown pasture

- Potential marginal land for sown pasture for silage production
- Crop residues as important feed for animals in winter and in case of snowstorm.

3.3 Crop-livestock integration and transhumance



Green circles indicate land for sown pasture



A schematic map of transhumance as an example

- 560 ha of marginal land suitable for sown pasture, in which 300 ha has been used for forage production.
- Forage from sown pasture provides feed for 11 000, about half of the livestock in the Karnali watershed, 10% of current livestock population in the KSL-China

3.4 Grazing exclusion and reseeding for rangeland restoration

Effectiveness of grazing exclusion compared to free grazing in the KSL-China

Variables	Grazing exclusion	Free grazing
Species abundance	10.2±1.2 [a]	8.6±1.5 [b]
Community coverage (%)	31.67±7.64 [a]	28.33± 5.77 [b]
Aboveground biomass ($g.m^{-2}$)	109.21±6.26 [a]	99.40±11.53 [b]
Belowground biomass ($g.m^{-2}$)	2,782.40±381.41 [a]	2,427.10±221.94 [b]
Soil bulk density ($g\ cm^{-3}$)	1.17±0.12 [b]	1.35±0.09 [a]
Soil carbon storage ($Mg\ hm^{-2}$)	129.47±23.21 [a]	97.24±6.46 [b]
Soil nitrogen storage ($Mg\ hm^{-2}$)	10.94±3.30 [a]	7.35±1.07 [b]

* Different lowercase letters after a certain variable indicate statistically significant ($p<0.05$)

3.5 Manasarovar international wetland conservation

- Manasarovar International Ramsar wetland— an important western migration corridors of black-necked crane
- More than 20 species of CITES protected animals
- Abundant biodiversity protected in Manasarovar Natural Reserve

3.6 Cultural tourism to diversifying livelihoods

Route 1. for Indian people to Burang County, mostly for border Indian

Route 2. for all, from Kathmandu to Lhasa and then to Kailash

Route 3. from Nepal side, route through Karnali, via Burang to Kailash

IEM for multifunctionality and sustainability

Categories	Ecosystem services of watershed	Integrated landscape for multifunctionality
Provisioning services	Lowland Karnali watershed ● Food, edible oil and vegetable ● Feedstuff from crop residue and silage provided by sown pasture ● Forage and livestock products Highland Manasarovar watershed ● Livestock products, like milk, meat butter, cashmere and fur ● Rangeland animal husbandry	● Improving sectoral connection among agriculture, animal husbandry and the tertiary industry for resilience ● Linkage an complementation between lowland and highland watershed ● Crop-livestock integration within Karnali watershed and between watershed ● Diversification of sources of income and livelihood ● Integrated landscape management for multifunctionality and sustainability
Regulatory services	● Natural hazard reduction ● Water conservation and water supply ● Climatic regulation, flood control of Lake Manasarovar and Rhaksastal ● Water purification, waste control ● Biological control of pests and diseases ● Pollination	
Support services	● Habitats and biodiversity conservation ● Soil formation and Nutrient recycling ● Primary production and decomposition	
Cultural services	● Western Tibetan culture and intangible heritage ● Culture and aesthetic ● Border exchange and trade ● Landscape recreation ● Ecotourism and expedition ● Traditional ecological knowledge ● Pilgrimage by religious believers to heritage sites, Kora in Mt Kailash and Lake Manasarovar	

4. Conclusion

- Kailash Sacred Landscape as an social-ecological system (SES), with the framework of SES we illustrates how integrated landscape ecosystem management achieved goods and services from agro-pastoral complementation and cultural heritage.
- Ecosystem-based adaptation is the effective approach to building ecosystem resilience and multifunctionality.
- cultural heritage, offering opportunities to enhance livelihoods and adaptive capacity of SES.


Thank You