Implication of Coupled Social-ecological Systems in sustainable rangeland ecosystem management in HKH region

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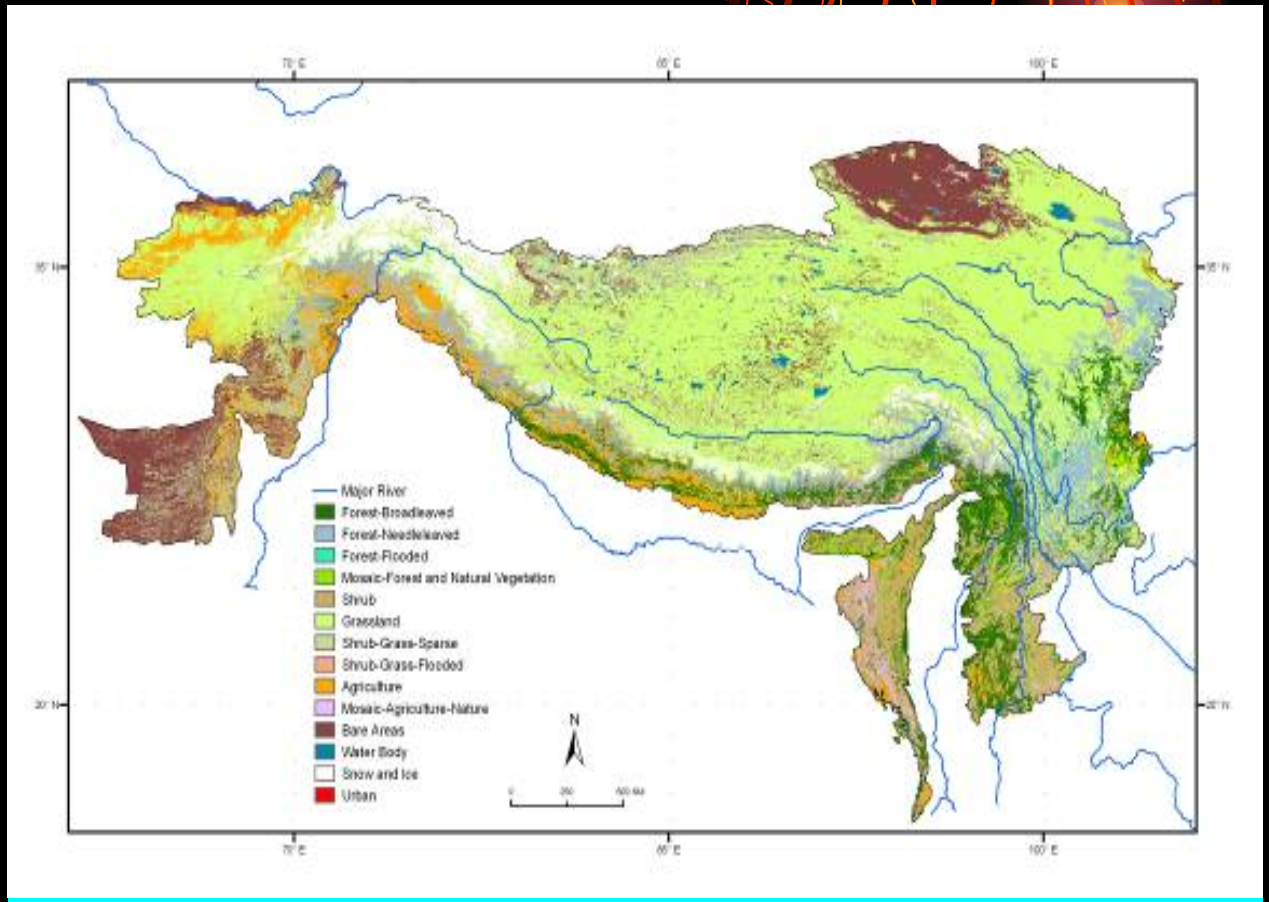
Introduction

Importance of rangeland in HKH region

Land cover: 50.5% of HKH

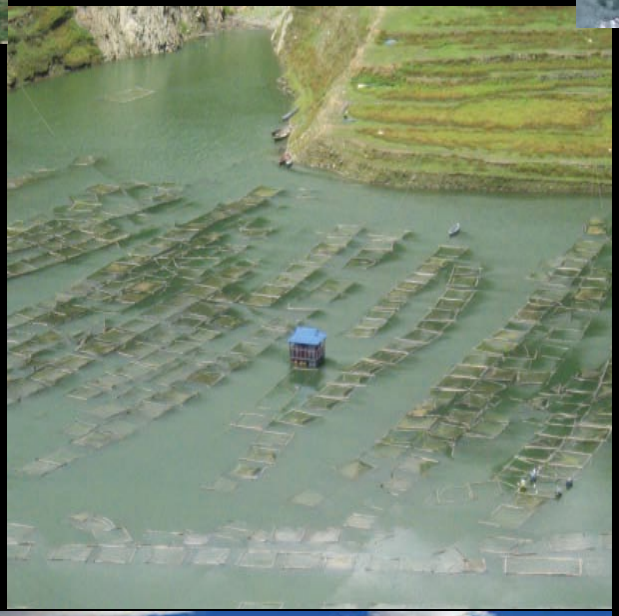
Rich resources: woods, animals, medicinal plants etc.

Important ecological services and functions: headwater environment, biological and cultural diversity, carbon sequestrations etc.



Land use/land cover in Hindu Kush-Himalaya region (from Xu J. C., 2008)

Provisioning: Fibre, food, fuel, minerals, timbers, NTPS, freshwater, biodiversity and landscapes et.



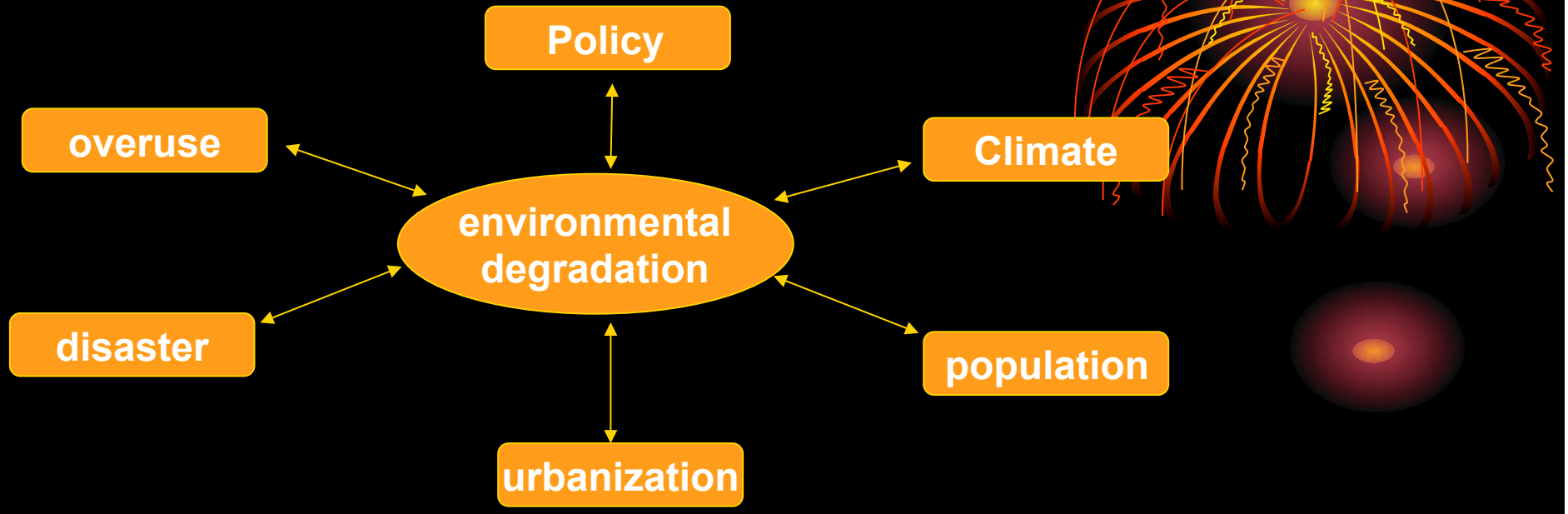
Culture: Ethnic, religion, linguistic-cultural diversity associated with unique tradition and long history

Regulating: flood regulation, disaster control, water purification, climate regulation

Environmental problems and threats on HKK rangelands

- Resource degradation
- Biodiversity loss
- Land desertification
- GHG emission and carbon loss
- Water scarcity and shortage
- Floods and glacier retreat
- Decreased pastoral production
- Food scarcity
- Poverty trap
- .....

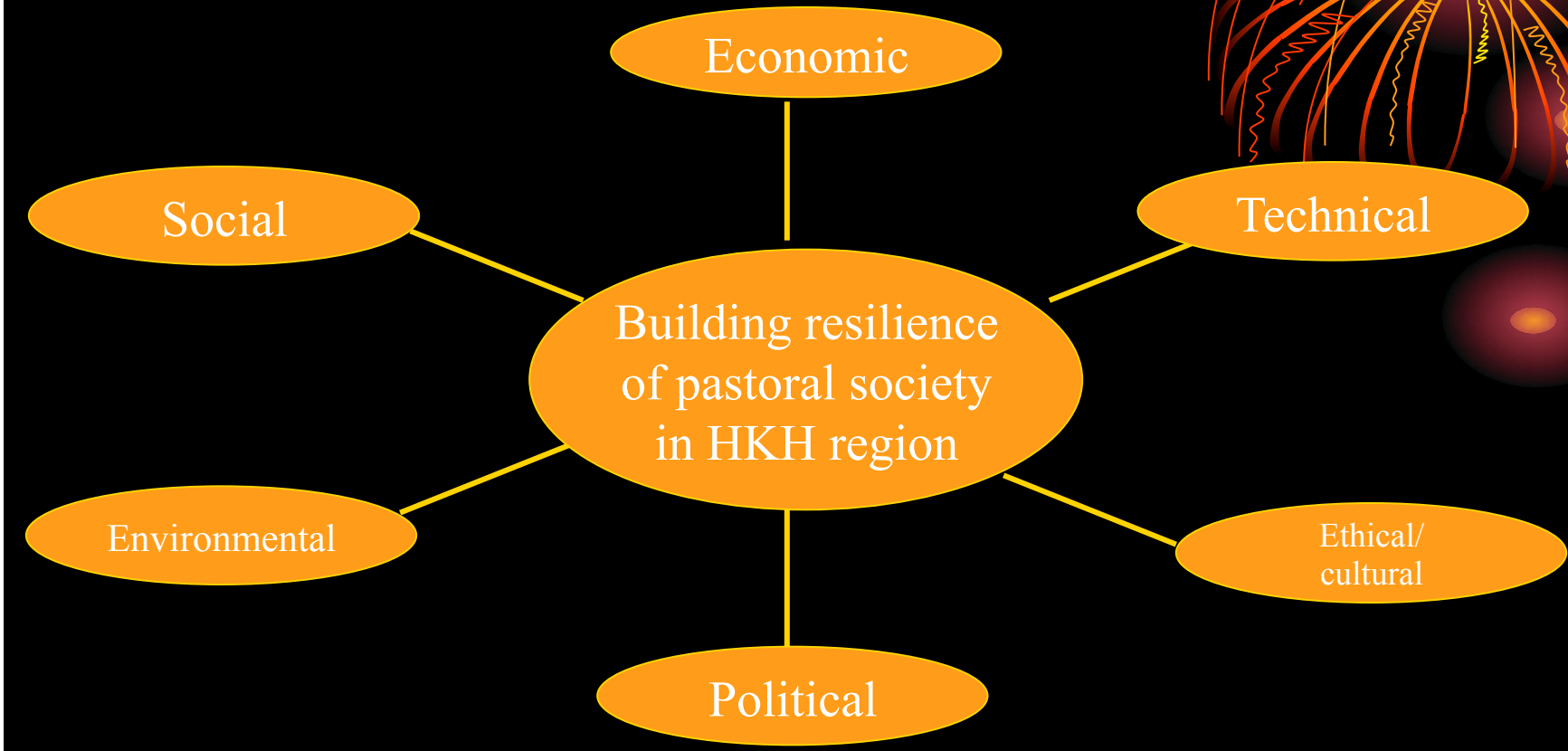
Causes of Environmental degradation for HKH rangelands



Horris R. B. (2010) Rangeland degradation on the Qinghai-Tibetan plateau: A review of the evidence of its magnitude and causes. Journal of Arid Environments 74 : 1-12.

Coupled social-ecological systems are needed to facilitate the effective collaboration among social and bio/physical scientists and management practitioners to develop the sound policy formulations and decisions about rangeland ecosystem management in KHK region

Concepts for enhancing sustainable development of HKK rangelands



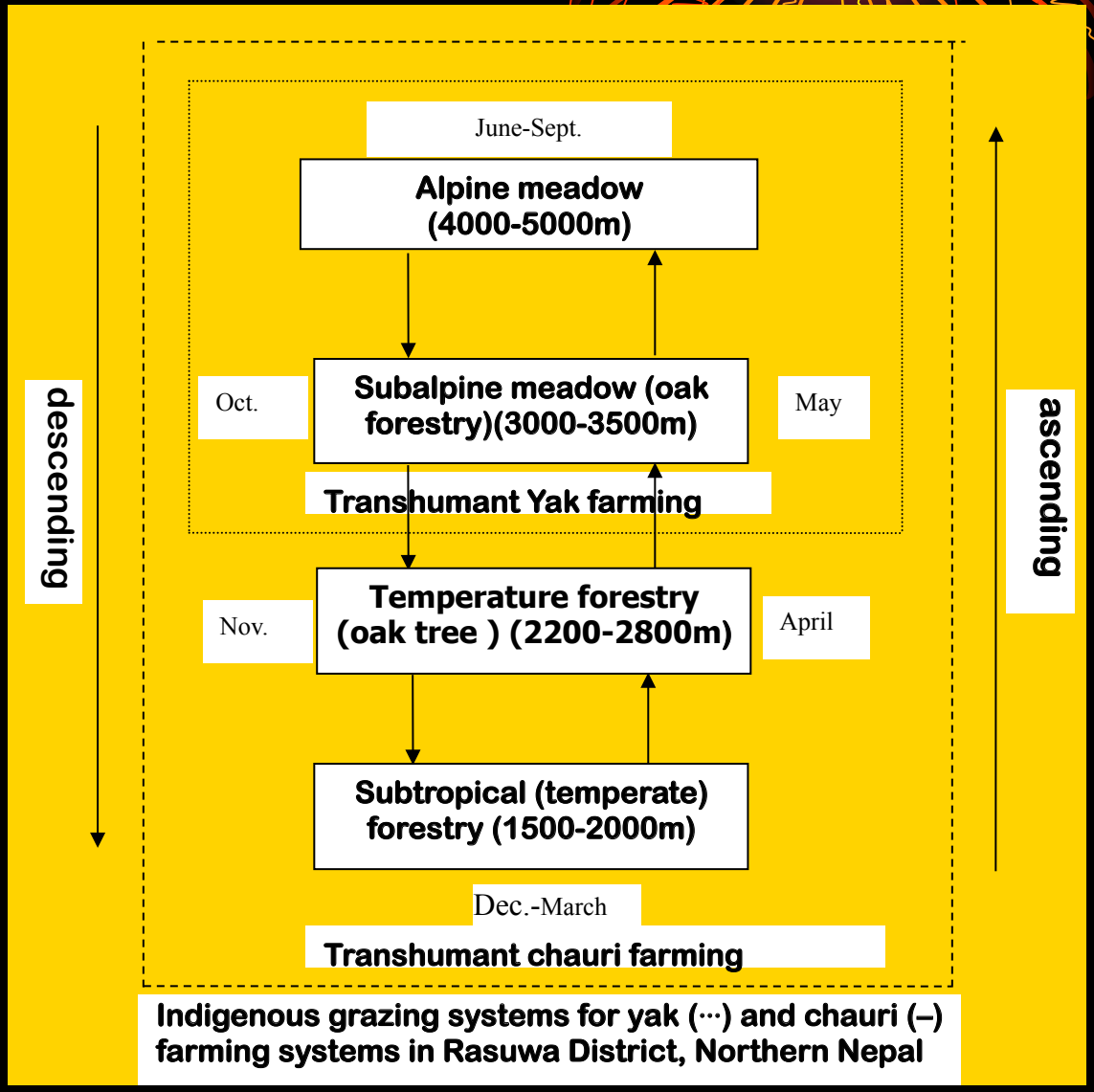
Six-dimension approaches for building resilience of pastoral ecosystems in HKH region

Case I: Indigenous rangeland management in Himalayan Nepal

Major findings

(1) Indigenous grazing practices:

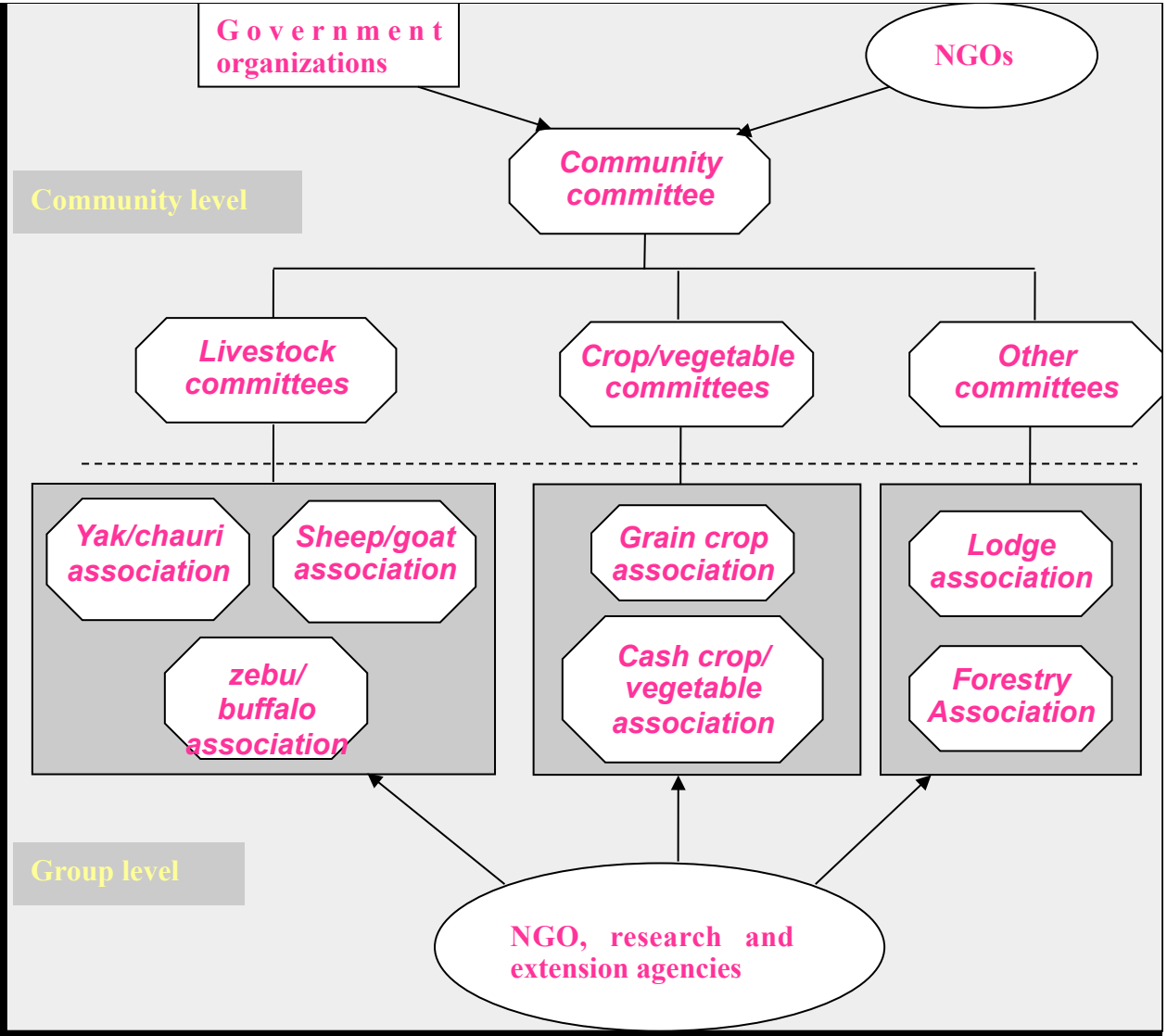
- ✓Upland meadow – lowland forestry Transhumance
- ✓Rotational grazing
- ✓Carrying capacity estimation
- ✓Grazing intensity control



Indigenous grazing systems for yak (···) and chauri (–) farming systems in Rasuwa District, Northern Nepal

(2) Well-organized civil institution arrangement:

- ✓Elected body-community committee
- ✓Self-recognized association
- ✓ Well-designed civil regulations
- ✓Rules evolved from tradition and reality



local rangeland institution arrangements and its linkage with other organizations

Implications

✓Integrated rangeland management approaches built upon the best aspects of the indigenous systems are generally effective on the promotion of rangeland development.

✓Elaborate organizational measures and regulatory social control mechanisms have been evolved to minimize the risk and maximize the benefit of livestock production and local resource management.

✓Institutional responses include organizations that represent the households of the community in sustained pasture management.

✓The use of local pasture resources is regulated by the enforcement of well-defined and mutually agreed upon rights and rules, backed by various social controls and sanctions.

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Case II: Cultivated Grassland Systems in Eastern Qinghai-Tibetan Plateau

Project background

Perennial grass mixtures are being developed to replace the oat cultivation in the Qinghai-Tibetan Plateau:

- ✓**to combat the rangeland degradation.**
- ✓**to increase the economic benefit.**
- ✓**to diversify the farming systems.**
- ✓**to sustain pastoral production systems**

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Soil-plant interface process for restoration

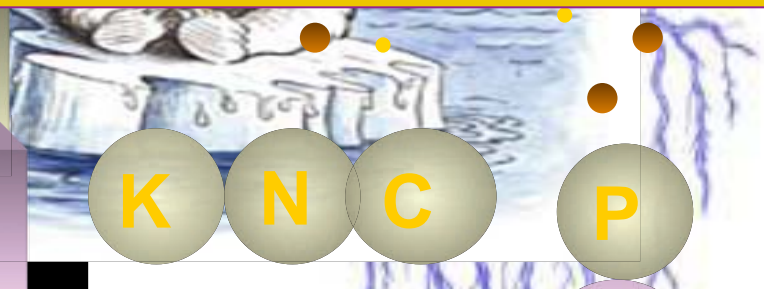
Vegetation s
Biodiversity
Plant bioma

Soil-plant interface

ed
pool
er

Potential generators for new plant generation

soil
Soil structure



soil microbe

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Major findings

(1) Economic return from grass mixtures

Item	Native grassland	Cultivated grassland				
		Forage oat	Annual ryegrass	BI + EN	BI + ES+ AC	BI +ES + EI +AC
Operating expenses	53.42	211.89	180.05	72.24	72.24	72.24
Allocated overhead Land rent (US$ ha^{-1})	34.5	50	50	34.5	34.5	34.5
Establishment/reseeding costs (US$ ha^{-1})	31.02	0	0	38.38	31.04	33.72
Total costs (US$ ha^{-1})	118.94	261.89	230.05	145.12	137.78	140.461
Output						
Total revenues (US$ ha^{-1})	338.35	567	696.9	445.5	553.5	558
Breakeven price (US$ t^{-1})	17.77	20.78	16.67	14.66	11.20	11.32
Economic benefit						
Output/input ratio	2.84	2.16	3.03	3.07	4.02	3.97
Net profit (US$ ha^{-1})	219.41	305.11	466.85	300.38	415.72	417.54

(2) Ecological Value of soil erosion control

Soil protection potential of different grassland types in the alpine region of Tibetan Plateau

Grassland types	Soil loss or gain (t/hm²)	Changes of soil nutrients (kg/hm²)						
		Organic matter	Nitrogen	Phosphorus	Potassium	Available nitrogen	Available phosphorus	Available potassium
Fenced native grassland	+2.7	+331.6	+26.7	+1.9	+50.0	+0.2	+0.04	+0.5
Open native grassland	-1.4	-171.9	-14.1	-1.0	-25.9	-0.1	-0.002	-0.3
Perennial pasture	-4.1	-412.9	-36.5	-2.5	-75.9	-0.3	-0.006	-0.8
Annual pasture	-15.4	-1301.3	-129.4	-9.2	-284.9	-0.8	-0.02	-2.8
Waste land	-50.4	-5892	-488.9	-45.3	-932.4	-4.9	-0.08	-9.3

Note: + encroachment – loss

Implications

- ✓Development of alternative grassland cultivation system requires for not only ecological benefits of conserving soil resources and maintaining land productivity, but also economic returns of low production costs and high net profit.
- ✓External driving forces like traditions and customs should also be considered in decision analysis for selection of production systems.
- ✓The tradition-influenced decision-making process acted by local farmers may slow the expansion of these new production systems.
- ✓Training and education need to be stressed to aid local farmers in choosing economically and ecologically sound agricultural production systems.

Case III: Grassland Restoration Projects in Central Qinghai-Tibetan Plateau

Project background

Grassland ban program (GBP) and Stall-feeding program (STP) were launched in the Qinghai-Tibetan Plateau:

- ✓**to restore degraded rangeland.**
- ✓**to maintain the rangeland health.**
- ✓**to improve the local livelihood.**
- ✓**to sustain pastoral society.**

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Major findings

(1) Farmer households' responses

Percentage (%) of farmer households' respondents to questions in the survey

Questions and answers	Northwest (N=4)	Southwest (N=11)	North (N=13)	Middle (N=12)	Average (N=40)
a) Do you know Grassland Ban Policy (GBP)?					
i) Yes	97.3±2.7*	93.3±3.1	90.7±2.2	92.6±4.0	92.6±1.6
ii) No	2.7±2.7	6.7±3.1	9.3±2.2	7.4±4.0	7.4±1.6
b) Why can you accept GBP?					
i) It is a good measure to improve grassland condition	75.8±14.0a	43.8±11.2ab	65.6±3.5a	38.8±10.4b	52.9±5.1
ii) It is a national compulsory policy	23.8±13.8	44.1±11.2	29.4±2.7	47.6±10.3	38.1±4.7
iii) Influenced by neighbors	0.4±0.4	12.1±8.9	5.0±1.7	13.6±8.3	9.0±3.5
c) Why can't you accept GBP?					
i) It is difficult to get new feeds resources	94.4±5.6a	49.1±12.6ab	64.8±8.3b	59.1±11.0b	61.7±5.7
ii) The native feeds resources are wasted	5.6±5.6	48.0±12.4	19.8±8.2	39.2±11.9	31.9±5.9
iii) It is contradictory to pastoral tradition	0a	3.0±1.3a	15.4±5.4ab	10.0±3.6b	8.8±2.2b
d) What is the major problem in stall-feeding of livestock?					
i) High input	50.1±17.8	48.0±11.2	38.9±2.7	60.6±9.9	49.1±4.1
ii) Insufficient forages	29.3±10.6	14.2±4.3	26.7±4.9	23.8±8.8	22.6±3.4
iii) Expensive concentrates	20.0±11.6	20.3±8.7	26.8±3.2	13.1±4.6	20.2±3.2
iv) Labor shortage	0.6±0.4	17.5±8.7	8.6±1.9	2.5±1.3	8.1±2.6

(2) Local officials' responses

Percentage (%) of local officials' respondents to questions in the survey

Questions and answers	Northwest (N=4)	Southwest (N=11)	North (N=13)	Middle (N=12)	Average (N=40)
a) Can the local farmers accept Grassland Ban Policy?					
i) Yes	94.6±5.4	98.8±0.8	93.2±2.5	95.1±3.0	95.5±1.3
ii) No	5.4±5.4	1.2±0.8	6.8±2.5	4.8±3.0	4.5±1.3
b) Do you support the program of rearing livestock in shed?	71.5±14.6	81.1±9.3	72.6±5.1	77.5±9.3	76.3±4.2
i) Yes	12.5±12.5	1.5±1.0	4.6±2.4	2.1±2.1	3.8±1.6
ii) No	16.0±13.8	17.4±9.5	22.8±4.1	20.4±8.8	19.9±4.0
iii) Uncertain					
c) What is the major influence of GBP on local farmers?	17.5±6.0	8.6±4.7	21.8±6.2	31.5±9.4	20.7±3.9
i) Losing job opportunity	44.2±11.8	23.7±12.0	41.5±7.9	51.4±11.9	39.1±5.7
ii) Decreased family incomes	38.3±15.5	67.7±12.0	36.7±8.9	19.2±8.8	40.2±5.9
iii) Little influence					
d) What is key limit in spreading the stall-feeding program?	16.3±5.4	8.2±4.7	18.2±3.0	22.2±8.1	16.4±8.9
	2.7±1.6	6.7±3.3	7.7±2.1	10.1±3.7	7.6±1.6
i) Old tradition	38.9±4.1ab	59.4±9.6a	29.9±3.0b	28.3±17.9b	38.4±3.8
ii) Insufficient motivation	30.6±4.5a	9.7±6.0b	29.3±3.9a	21.0±5.5ab	21.6±2.9
iii) Forage shortage	9.8±6.4	6.0±3.2	13.0±2.7	13.4±4.8	10.9±2.0
iv) High input	1.7±1.7	10.0±9.0	1.9±0.8	5.0±2.8	5.1±2.6
v) Lack of skills and technologies					

Implications

✓Policy-oriented projects can not solely act as the solution to restoring the degraded grassland and promoting the sustainable development of pastoral industries.

✓Appropriate, feasible and accessible techniques and services need to be generated from scientific researches and on-the-ground experiments to support policy-oriented rangeland restoration projects.

✓Socioeconomic and human components needed to be stressed to well integrate scientific objectivities with policy priorities and to fairly balance the local people's needs with national strategies in rangeland restoration projects .

Conclusions

(1) Although the research sites and objectives in three case studies in HKH region are very different, these case studies commonly address complex interactions and feedback between socioeconomic and natural systems, and highlight the integration of various tools and techniques from ecological and social sciences as well as other disciplines in sustainable rangeland management. As such, these case studies have offered unique interdisciplinary insights into complexities that cannot be gained from ecological or social research alone.

(2) The implications of coupled social-ecological systems on sustainable rangeland development in HKH region can be found in both policy and research dimensions. Policy decisions must balance the needs of society with the best scientific knowledge. To facilitate this,

✓The interface between social, economic, physical–biological, and ecological models in HKH rangeland management must be improved.

✓Socioeconomic and human components needed to be stressed to well integrate scientific objectivities with policy priorities and to fairly balance the local people's needs with national or regional rangeland management policies and strategies.

✓Comprehensive programs of integrated basic and applied ecological, social, and economic research should be developed to provide the improved information bases for decision making.

Ongoing projects

1. Local adaptation to climate change in pastoral society across in Hindu Kush-Himalaya (HKH) Region
2. Cross-nation Governance of Trans-boundary Biodiversity Conservation in Hindu Kush-Himalaya (HKH) Region
3. Integrated ecosystem management for biodiversity in alpine rangeland of Qinghai-Tibetan Plateau and sustainable rangeland resource utilization
4. Coupled human-natural approaches for wildlife protection in Aerjin Mountain, Western Qinghai-Tibetan Plateau

Thank you very much for your comments!