

## Table of Contents

Welcome Speech.....	1
Guest’s Speech.....	2
Chairman’s Address.....	3
Invited Papers.....	5
Using a Coupled Human and Natural Systems Approach to Better Understand Contemporary Environmental Conservation Issues in Complex Landscapes <i>James Lassoie</i> .....	5
Vulnerability and Resilience of Coupled Social-Ecological System in the Asian Highland of Global Change <i>Xu Jian-chu</i> .....	6
Resilience and Adaptation of Human Ecological Systems in Times of Dramatic Change: Cases from the Arctic and the Pamir Mountains of Central Asia <i>Karim-Aly Kassam</i> .....	7
Sustainable, Integrated and Watershed-based Management of Water Resources <i>Rebecca Schneider</i> .....	8
Community Enhancements of Biodiversity and Ecosystem Services <i>Stephen J. Morreale</i> .....	10
Theme I: Ecological Impacts of Major Construction Projects .....	11
1.1 Impacts of Roads on Wildlife and Their Habitats in Northwest Yunnan: Implications for Conservation in Mountainous Areas <i>Xiao Wen , Ren Guo-Peng, Wang Lin, Huo-Sheng, Fang Peng-Fei, Li Jing-Fa, Wang Zhe,     Zhu Jian-Guo</i> .....	11
1.2 Multi-scale Effects of Road Networks on Ecosystems in the Longitudinal Range-Gorge Region of Yunnan Province <i>Li Xiao-wen, Zheng Yu, Cui Bao-shan</i> .....	11
1.3 Effects of roads on regional vegetation landscape pattern of Xishuangbanna, Southwest China <i>Liu Shi-liang, Dong Shi-kui, DeGloria S D , Fu Wei, Cui Bao-shan</i> .....	12
1.4 Impacts of road networks on biodiversity conservation at the landscape scale in Yunnan province <i>Fu Wei , Liu Shi-liang, DeGloria S D , Dong Shi-kui, Cui Bao-shan, Zhang Zhao-ling</i> .....	12
1.5 Spatio-temporal Analysis of Roads on Soil Erosion: A Case Study of Fengqing County, Southwest China <i>Zhang Zhao-ling, Liu Shi-liang, Dong Shi-kui, Fu Wei, Cui Bao-shan</i> .....	13
1.6 Investigation of the Role of Roadside Ditch Networks as Contributors to Flooding, Droughts and Degraded Water Quality <i>Rebecca Schneider</i> .....	13
Theme II: Integrated Ecosystem Management.....	15
2.1 Integrated Alpine Grassland Ecosystem Management Strategies for Adaptation to Climate Change in Northern Tibet, China <i>Gao Qing-zhu, Xu Hong-mei, Li Yue, Wan Yun-fan, Jiangcun Wang-zha</i> .....	15
2.2 Impact Assessment of the Sloping Land Conversion Project (SLCP) and Proposed Development Models for the Mountain-Gorge Region <i>Zhao Xiao-qing, Dai Jin-hua</i> .....	15
2.3 Implementation of the Guarantee System for Integrated Ecosystem Management in a Typical River Basin of China’s Fragile Mountainous Regions	

<i>Zhang Dawei, Xu Hui</i> .....	16
2.4 Anatomy of Ecological Problems and Management Measures of Estuaries in Northern China	
<i>Suo An-ning, Zhao Dong-zhi, Zhang Feng-shou, Wang Hua-ru</i> .....	17
2.5 Coupled Agro-grassland Animal Husbandry Production Systems on the Qinghai-Tibet Plateau	
<i>Xu Shi-xiao, Dong Quan-min, Zhao Liang, Zhou Hua-kun, Li Ying-nian, Zhao Xin-quan</i> .....	17
2.6 Implications of Coupled Socio-Cultural and Natural Systems in sustainable rangeland ecosystem management in HKH region	
<i>Dong Shikui, Wen Lu, Zhu Lei, Li Xiaoyan</i> .....	18
Theme III: Biodiversity Conservation and Management.....	19
3.1 Sustainable Development and Environmental Planning of Taiwan National Parks – a case study of Yushan National Park	
<i>Chou Ho-shu</i> .....	19
3.2 Population Regeneration and Community Characteristics of <i>Cunninghamia lanceolata</i> and <i>Pinus taeda</i> forests in Kunyu Mountain, Shangdong Province	
<i>Sun Ying-jie, Zhao Ai-fen, Bian Dian-xia, Zhu Lin, Pan Cheng-chen</i> .....	19
3.3 Zone Management Design Using Multi-criteria Evaluation for Meili Snow Mountain National Park	
<i>Zhang Zhi-ming, Ou Xiao-kun, Yang Zi-jiang</i> .....	20
3.4 Vigilant Behavior of and Threats to Przewalski’s gazelle in the Qinghai Lake Region	
<i>Shi Jian-bin</i> .....	21
3.5 Identifying Hotspots and Gaps for Biodiversity Conservation Based on a Systematic Conservation Planning Methodology: A Case Study in Northeast Area of China	
<i>Luan Xiao-eng, Huang Wei, Zhu Chun-quan, Wu Bo, Liu Shi-rong, Liu Min-hao, Li Di-qiang</i> .....	21
3.6 Structure, Diversity and Successional Dynamics of Subtropical Montane Evergreen Broad-leaved Forests, Yunnan, China, and Human Influence on the Forests, with a View to Future Sustainability	
<i>Tang Cindy Q.</i> .....	22
3.7 Impacts of the National Conservation of Snake Island and Laotieshan Mountain’s Regulations on Its Ecological Function	
<i>Zhou Dan, Wang Xiao-ping, Wang Zi-yan</i> .....	22
Theme IV: Ecosystems and Livelihoods Assessment.....	24
4.1 Numerical Modeling and Quantitative Analysis of Soil and Water loss processes in small-medium watershed scale	
<i>Wan Ye, Duan chang-qun, Fu kaidao, Xia ji-sheng</i> .....	24
4.2 Influence of Climate Change on Grassland Succession	
<i>Li Hong-mei, Ma Yu-shou, Bai Yan-fang</i> .....	25
4.3 Forest Landscape Restoration and Livelihood Improvement in Miyun Reservoir watershed	
<i>Zhuang Hao</i> .....	25
4.4 Impact of Land Use and Land Cover Changes on Organic Productivity Values in Karst Ecosystems: a Case Study of Northwest Guangxi, China	
<i>Zhang Ming-yang, Wang Ke-lin, Chen Hong-song, Liu Hui-yu, Yue Yue-min</i> .....	26
4.5 Productivity and Persistence of Cultivated Meadows of Grass Mixtures under Clipping and Fertilization Treatments	
<i>Gu Meng-he, Du Guo-zhen</i> .....	27

4.6 Forestland Change in the Lugu Lake Watershed Using Spatial Data Mining Techniques <i>Dong Ren-cai, Liu Ming, Li Chun-ming, Zhao Jing-zhu</i> .....	27
4.7 Responses of Plant Morphology and Seed Quality to Long-term Overgrazing in <i>Leymus chinensis</i> <i>Shao Xin-qing, Wang Yun-wen, Wang Kun</i> .....	28
4.8 Using a Coupled Socio-Cultural and Natural Systems Approach to Environmental Conservation in High Elevation Mountain Landscapes of Northwest Yunnan, China. <i>Ruth Sherman</i> .....	28
4.9 The Study of Public Participation Pattern in Basin Management: A Case Study from the Baiyang Marsh Basin in China <i>Luan Yun, Liu Jing-ing, Deng Jie</i> .....	29
Theme V: Ecological Compensation and Payments .....	30
5.1 Natural and Social Issues in Grasslands Management Policy: Implications of a Case Study for the Emerging National Grassland PES Scheme <i>Andreas Wilkes</i> .....	30
5.2 The Hehei River: Water Resources, the Eco-environment and Economic Development <i>Zhang Ji-jiao</i> .....	30
5.3 Ecological Performance and Sustainability Problems of the Grazing Forbidden Project in the Resource Regions of the Yellow River <i>Zhao Cheng-zhang, Yin Cui-qin</i> .....	31
5.4 A Review of Social-Ecological Studies on High Mountain Agricultural Systems in the HKH-Tibet Region <i>Yi Shao-liang</i> .....	31
5.5 Ecological and Economic Benefits of Alfalfa Pastures in Sandy-lands in Dalate banner <i>Pu Xiao-peng, Liang Li-ming, Hou Bin-dong, Cao Zhi-zhong</i> .....	32
Theme VI: Human Resilience and Adaptation to Global Change .....	33
6.1 Ecologically Discordant Agricultural Practice Erodes Sustainability of the Loess Plateau, China <i>Mou Pu</i> .....	33
6.2 Eco-migrants' Plight in the Source Area of the Yellow River <i>Du Fa-chun</i> .....	33
6.3 Spatial Quantitative Research of Human Impacts based on Landscape Change in Ebinur Lake Region <i>Xie Xia, Tashpolat•Tiyip</i> .....	34
6.4 Vulnerability Assessment of Land Management Adaptation to Climate Change in Poverty-stricken Mountainous Area <i>Yang Xi-tian, Zhang Ya-li, Huang Jun-chang, Feng Xin-wei, Meng Qing-xiang, Yu Lin</i> .....	34
6.5 Influence of different land use on urban microenvironment in Beijing City, China <i>Liu Jiao-mei, Yang Zhi-feng</i> .....	错误! 未定义书签。
6.6 Impacts of Climate Change on Ecosystems and Adaptation Strategies in China <i>Xuan Ya-lei</i> .....	36
6.7 Characteristics and Influencing Factors of Public Participation in the Small and Medium-sized Towns and Cities: A Case Study from Henan Waste Water Treatment and Water Supply Project in China <i>Luan Yun, Liu Jing-ling</i> .....	36
Theme VII: General Environmental Issues .....	38
7.1 Nitrogen Concentrations in Rainfall in Dalian, China	

<i>Lin Fei, Shi Kun</i> .....	38
7.2 Strategies and Applications of Groundwater Exploitation for Ecological Conservation in Arid Fragile Region	
<i>Chen Yue, Li Yu-Hong</i> .....	38
7.3 Factors Controlling Surface Runoff on the Typical Steppe	
<i>Miao Bai-ling, Liang Cun-zhu, Wang Wei, Wang Li-xin, Yun Wen-li</i> .....	39
7.4 Ecological Reconstruction of Soda Residue Dump in Tianjin, China	
<i>Hao Cui, Meng Wei-qing, Li Hong-yuan, Cai Zhe</i> .....	39
7.5 Feasibility of Extracting Eco-environmental Gradient Information using Hyperspectral Data in Karst Region, Southwest China	
<i>Yue Yue-min, Wang Ke-lin, Zhang Bing, Zhang Ming-yang, Liu Bo, Yu Yi-zun</i> .....	40
7.6 Thin Layer Molecularly Imprinted Composite Membranes for Selective Separation of Erythromycin from Water	
<i>Yu Jin-yang, Hu Xiao-ling, Li Da-peng, Jiao Cui-cui</i> .....	41
7.7 Analysis of Soil Respiration in the Hobq Sand Land	
<i>Asga, Gao Li, Piao Shun-ji, Yan Zhi-jian, Ma kuo-dong</i> .....	41
7.8 Metal Decontamination of Tannery Solid Waste using <i>Tagetes Patula</i> in association with a Resistant Fungus and Mycorrhizal Fungi	
<i>Aisha Nazir, M. Shafiq, Sheza Ayaz, Firdaus-e-Bareen</i> .....	42
7.9 Role of Four Anchored and Floating Hydrophytes in Rhizofiltration of Heavy Metals from the Tannery Sludge	
<i>Sheza Khilji, Aisha Nazir, Mohammad Shafiq, Firdaus-e-Bareen</i> .....	43
7.10 In Vitro Interaction Studies between Different Resistant Fungal Strains Isolated from Tannery waste	
<i>Rashida Qamar, Aisha Nazir, Sheza Ayaz, Firdaus-e-Bareen</i> .....	44
7.11 Changes in Landscape Patterns of Wetlands in the Dadu River Catchment over the Last two Decades.....	44
<i>Huang Laibin, Bai Junhong, Xiao Rong</i> .....	44

## **Welcome Speech**

**Ge Jian-ping**

Vice President of BNU

Chairman, Distinguished guests, Ladies and Gentlemen:

Good morning !

I am much honored to have so many scholars and experts home and abroad to participate the International Workshop in Conservation and Sustainable Development, which is jointly hosted by Beijing Normal University and Cornell University. On behalf of BNU, I would like to extend my warmest welcome to every one.

In 1902, Beijing Normal University was established as the first Chinese university to train teachers. After the growth for over 100 years, she has become a comprehensive and research university. Beijing Normal maintains her strength in many disciplines, e.g. education, psychology and environmental science.

In recent years, environmental science study and research in BNU has made tremendous progress. We have a very strong research team in this field; environmental science of BNU is the national key discipline and BNU hosts the National Key Laboratory of Water Environmental Simulation.

Beijing Normal University always attaches great importance to internationalization and works hard to build up platform for faculty and students to carry out international exchanges and cooperation. It is under such an atmosphere, we hold this workshop.

I believe that this workshop will promote the development of the research on environmental protection and sustainable development, strengthen the international academic exchanges and collaborations among environmental scientists.

Please allow me once again to warmly welcome all of you and wish the workshop a great success!

Thank you!

## **Guest's Speech**

**Ren Guan-ping**      General Secretary of Chinese Society for Environmental Sciences

Dear Chairman, Distinguished Guests, Ladies and Gentlemen,

Good morning!

Academe, nongovernmental organizations, and government agencies have long acknowledge that sound policy formulations and management decisions about the environment and natural resources necessitate effective collaboration among social and physical scientists and management practitioners.

Chinese Society for Environmental Sciences has experienced 30 years since it was founded in May of 1978. It is one of the oldest non-government, non-profit, scientific organizations involved in environmental protection in China and the first class society of China Association of Science and Technology. Currently, there are over 40,000 members in Chinese Society for Environmental Sciences, which is under the leadership of both China Association of Science and Technology and Ministry of Environmental Protection of the People's Republic of China.

School of Environment, Beijing Normal University, the affiliation organization for Environmental Geoscience Branch of Chinese Society for Environmental Sciences has made great efforts in promoting the development of the society through networking the research, education and communication in environmental sciences in China based on the platform of State Key Laboratory of Water Environment Simulation. I am much honored to attend this workshop co-sponsored by the affiliation organization of Environmental Geoscience Branch of Chinese Society for Environmental Sciences, Beijing Normal University and one of the leading universities in the world, Cornell University. I firmly believe this workshop can create a good opportunity for Chinese scholars to cooperate with foreign scientists to promote the environment protection and sustainable development in China. On behalf of Chinese Society for Environmental Sciences, I would like to express my best regards to all the participants and I sincerely wish a great success for the workshop.

## **Chairman's Address**

**Yang Zhi-feng**

Chairman of School of Environment, BNU

Understanding Coupled Socio-Cultural and Natural Systems in a changing world

Distinguished Vice President of Beijing Normal University, dear friends and colleagues, ladies and gentlemen,

On behalf of the organization and academic committees of the International Workshop in Conservation and Sustainable Development 2009, I would like to express my best regards to all of you. You are warmly welcomed to this small but important workshop co-organized by Beijing Normal University and Cornell University, and co-sponsored by Environmental Geoscience Branch of Chinese Society for Environmental Sciences, the Higher Education Press of China, the International Union for Conservation of Nature, World Agroforestry Centre, and The Nature Conservancy, The China Society on Tibetan Plateau. We are gathered here to talk about the importance of using a coupled human-natural systems approach for solving eco-environmental problems and promoting the sustainable development of fragile landscapes in this changing world.

It is now widely accepted that global change and human disturbances such as global warming, economic globalization, population growth, and government policy changes are putting great pressures on the eco-environment worldwide. The impacts of land degradation, soil erosion, air and water pollution, biodiversity loss, and increased greenhouse gas emissions are damaging our living planet. This is challenging scientists and practitioners worldwide to think about the future sustainability of the global eco-environment. Academe, non-governmental organizations, and government agencies have acknowledged that sound policy formulations and management decisions about the environment and natural resources necessitate effective collaborations among social and bio/physical scientists and management practitioners, as well as a better understanding of the influence of differing scales of biological organization.

Fragile landscapes commonly possess diverse physical, biological, and cultural/social characteristics and serve as important pools of natural resources and raw materials. But they also are very sensitive to global change and are more easily damaged by inappropriate human activities. More concentrated and coordinated efforts and actions are required to promote the sustainable development of fragile landscapes in this changing world. From our past experiences, we can conclude that the eco-environmental problems facing these complex systems involve understanding tightly coupled interrelationships between natural systems and human society. Furthermore, we now recognize that these problems cannot be addressed solely through technical innovations, political reformations, or economic development. To maintain the sustainability of these coupled systems, inter-disciplinary approaches integrating ecological, economic, social-political sciences must be developed and implemented. The newly-developed portfolios of coupled human-natural systems provide important insights into diverse complex systems that cannot be well-understood or effectively

managed within a single dimension.

Coupled human-natural systems are integrated systems where people interact closely with the natural world. The U.S. National Science Foundation in establishing its Dynamics of Coupled Natural and Human Systems Program in 2001 recognized the need for enhancing our understanding of complex systems. This program was established to promote and financially support “quantitative, interdisciplinary analyses of relevant human and natural system processes and complex interactions among human and natural systems at diverse scales.” As a result, there are major changes in progress concerning how the U.S. scientific community develops approaches to addressing interdisciplinary, applied eco-environmental problems. An increasing number of interdisciplinary programs have been integrating ecological and social sciences to study and better understand the dynamics of coupled human and natural systems. It is within this context that we wish to foster and support a meaningful working relationship among professionals and practitioners from China and the U.S., as well as from other parts of this rapidly developing world.

Based on extensive prior experience in the fragile landscapes by key faculties at Beijing Normal University and Cornell University, six major thematic areas have been identified: (1) effects of major construction projects on ecosystem services and functions; (2) strategies and methodologies for integrated ecosystem management in fragile regions; (3) landscape approaches and tools for assessing biodiversity; (4) realistic indicators for assessing healthy ecosystems and viable rural livelihoods; (5) payment for environmental service and ecological compensation for managing large watersheds; and (6) human resilience and adaptation in response to socio-cultural and environmental change. These thematic areas form the basis for this important workshop. In addition, the importance of these areas to serve as models for examining coupled systems worldwide is expected to attract interest from many non-governmental organizations inside and outside China, as well as from numerous Chinese governmental agencies. They are also a platform for building effective, collaborative partnerships. All are welcomed in this important effort, as multi-institutional collaboration is central to successfully addressing conservation and sustainable development in the fragile regions of China and elsewhere.

This workshop has brought together a group of social, biological, and physical scientists from Beijing Normal University, Cornell University, and elsewhere to examine conservation and sustainable development issues in fragile landscapes worldwide. Totally, we have gathered over 70 participants from over 40 Chinese institutions and 6 international organizations. We have received 56 papers on these topics, and 36 presentations are planned for this workshop. I expect that this workshop will be very successful and the beginning of many long-term collaborations. I sincerely wish all the participants a productive and pleasant stay here in Beijing.

Thank you.



## Invited Papers

### **Using a Coupled Human and Natural Systems Approach to Better Understand Contemporary Environmental Conservation Issues in Complex Landscapes**

James Lassoie

(Department of Natural Resources, Cornell University, Ithaca, NY, USA)

**Abstract:** Global climate change, non-point source pollution, watershed and habitat destruction, and unsustainable development are damaging the natural world, threatening the socio-cultural integrity of communities, and jeopardizing livelihood security of peoples worldwide. Despite the past 40 years of progress in addressing environmental damage in the United States and elsewhere, intractable problems have arisen that to date have eluded technological or policy responses. Solutions have been sought by recognizing that these problems are very complex and demand interdisciplinary approaches that require building effective partnerships among relevant academic institutions, governmental agencies, non-governmental organizations, and private business, as well as leveraging various disciplines and Indigenous knowledge systems. Such thinking has evolved to now consider humans to be an integral part of the environment, which is captured in the idea of the “human ecosystem” where critical biophysical, socio-economic, and cultural resources interact together within a complex social system. Within such a context, environmental problems can be viewed as a coupled human and natural system, which affords unique and novel approaches to their solutions. This paper discusses the development of the coupled systems approach and provides examples of how it can be applied to critical environmental conservation issues.

## **Vulnerability and Resilience of Coupled Social-Ecological System in the Asian Highland of Global Change**

Xu Jian-chu

(World Agroforestry Centre, China Program, Email: J.C.Xu@cgiar.org)

**Abstract:** The people who live in the Asian highland are disproportionately vulnerable to risk, dislocation, economic loss, hunger and famine in the face of climate variability, shift and change. How do international agencies, state governments, NGOs and development practitioners evaluate the best strategies and means for reducing poor people's vulnerability while maximizing their ability to adapt to and take advantage of climate trends and events? Understanding vulnerability's causes and structure (the factors that make people vulnerable) enables us to identify the best means for reducing vulnerability. Understanding opportunities for adaptive response allows intervening agencies to identify strategies and means for enhancing adaptive capacities that reduce exposure and enable resilience—minimizing impacts and maximizing gains. Mapping those causes and adaptive opportunities onto responsive institutions at appropriate scales of social, environmental and political-administrative organization gives us an entry point into concerted pro-poor climate action.

This proposed study is to synthesize the highland population particularly the poorest people expose to risks of climate change in the greater Himalayan region. The study will a) map geophysical hazards and risks due to extreme climate events; b) analyse the socio-political marginalized people exposed to such risks; c) compare models of community, landscape and territorial (eco-zones) scale vulnerability; d) discuss potential strategies and means by which those populations buffer themselves against and rebound after climate risks and disasters; e) synthesize the results into policy dialogues for adaptation to climate change.

This analysis will begin by evaluating the insights from climate-related local knowledge, its potential for building resilience of coupled social-ecological system. Most approaches to climate change adaptation tend to focus on people's vulnerabilities and on what people do not know. The focus on local knowledge provides an entry point to try and reverse this tendency. It enables internal and external organizations to explore what are people's strengths and what they actually do know. As such, understanding and appreciating local knowledge, as well as representation of local people and building new relationship between local and outsiders can become a tool of change. First, it can help to adapt external knowledge to local contexts and integrate the 'users or beneficiaries' into projects. As Hutton and Haque (2003) put it: "Little effort has been made to achieve an accurate understanding of how people of different cultures perceive, interpret and respond to natural hazards. [...] Western conceptualizations of natural hazards, human vulnerability and poverty cannot be uniformly imposed on divergent cultures and societies" Second, a better understanding of local knowledge can also help to assess which local knowledge can still be relevant and should be disseminated or transmitted to others. We hope that this study will help to promote change at the level of individual professional practice or at the organisational or sectoral levels.

# **Resilience and Adaptation of Human Ecological Systems in Times of Dramatic Change: Cases from the Arctic and the Pamir Mountains of Central Asia**

Karim-Aly Kassam

(Department of Natural Resources, Cornell University, Ithaca, NY, USA)

**Abstract:** Resilience is effectively studied in action and not abstraction. Where do we find resilience in action? Meaningful examination and understanding of resilience emerges from direct engagement with communities which have faced and adapted to dramatic changes. When communities are subject to the stress of change, these are the best opportunities to observe resilience at work. Resilience is context specific within the complex connectivity of cultural, social, and ecological relations. Resilience is functional and grounded in concrete experience. Indigenous communities in the Circumpolar Arctic and the Pamir Mountains of Afghanistan and Tajikistan have been subjected to dramatic change. Within a span of just a century, only two-to-three generations, these regions have directly experienced colonization; resultant epidemics; cultural and socio-economic dislocation because of their strategic location in the Cold War; penetration of the market system; famine; natural resource extraction; and presently they are at the vanguard of climatic change and the so called “clash of civilizations.” Their survival and continued existence under these conditions speaks to resilience.

The objective is to illustrate, using specific cases from the Circumpolar Arctic and the Pamir Mountains of Central Asia, a context and lens for observing resilience at work. Resilience is behaviour where an individual, a group, or peoples do not conceive of themselves consistently as victims but instead recognize the power of human agency. The communities in the Circumpolar Arctic and Pamir Mountains of Central Asia are both replicates and contrasts. They are replicates because of the nature of the change these regions have faced over a period of 100 years and the current challenges related to climatic variation, natural resource development, and food sovereignty. These cases provide opportunities for contrast because of the cultural and ecological diversity of the regions. The cultural background of indigenous peoples in the Arctic is largely hunting and gathering whereas in the Pamir Mountains it is mostly pastoral and agricultural. The replicate nature of the case studies provides for the basis for identification of resilience, the contrast allows for a methodologically robust examination of its application in day-to-day life of communities under stress.

## **Sustainable, Integrated and Watershed-based Management of Water Resources**

Rebecca Schneider

(Department of Natural Resources, Cornell University, Ithaca, NY, USA)

**Abstract:** Water resources are increasing in scarcity globally due to demands of an exponentially increasing human population. Climate change is further exacerbating the natural variability in the timing and distribution of precipitation patterns. However, a major driver of water scarcity is the non-integrated management of scarce water resources for irrigation, drinking water supply, flood control, hydroelectric power generation, wastewater disposal, and fisheries. All of these uses are occurring simultaneously without consideration of the cumulative impacts on the water itself, resulting in decreases in water quantity and increased water pollution. Ideally, a sustainable water resource management system should explicitly include strategies to protect the natural bio-physical processes that help to sustain the water, and also to protect those water-dependent organisms, including fish, shellfish, waterfowl, and plants, which contribute to the self-sufficiency of the local communities. Such an approach provides additional ecosystem services, or benefits to society, which help improve both economic viability and human health in communities. For example, riparian areas and other wetlands are disappearing globally due to human uses for agriculture, development, and transportation. However, if maintained in their natural, vegetated condition, these wetlands can contribute to reductions in the magnitude and frequency of flooding, to shoreline stabilization and erosion control, to improved water quality through trapping of suspended sediments and filtering of groundwater, to shading and cooling of water temperatures, to protective nursery areas for juvenile fish, and to food and habitat for waterfowl and other wildlife.

Using ecosystem principles as a framework, several guidelines can be identified for achieving sustainable water resource management. (1) The watershed is the appropriate spatial unit for water management because its boundaries define the limited amount of precipitation that is available and also determine the processes that affect the quantity and quality of water as it moves downslope and out of the basin. (2) River flow results from the combination of surface runoff associated with storm events, and also base flow provided by groundwater discharge. Groundwater also contributes to soil moisture availability for plants during droughts. Therefore land uses across the watershed should maximize infiltration of rainwater to recharge the groundwater by reducing impermeable surfaces, soil compaction, loss of soil organic matter, and clearing of vegetation. (3) Fish and many other organisms are adapted to, and dependent upon, the natural hydrologic regime, or long-term pattern of highs and lows in water level fluctuation. Therefore activities which alter this regime, such as dam operations for flood control and hydroelectricity, or river channelization via levees, dikes and dredging, should be modified to restore the natural flow pattern. (4) Wetlands, groundwater recharge areas, and sensitive soils should receive high priority for protection or restoration given the multiple critical functions they perform. (6) Unlike some crops, native plants have many adaptations to address water scarcity imposed by the local climate. All aspects of irrigation design, including selection of crops, should be highly efficient to minimize water waste in arid and semi-arid areas. (7) Human and livestock wastes can be a source of nutrient-rich fertilizer or serious

water pollution depending on how they are processed. The incorporation of these guidelines into an integrated, water resource management plan will have value for improving livelihoods in impoverished, agrarian communities as well as highly-developed, urban settings.

## Community Enhancements of Biodiversity and Ecosystem Services

Stephen J. Morreale

(Department of Natural Resources, Cornell University, Ithaca, NY, USA)

**Abstract:** A common management technique for preserving and maintaining biodiversity is the establishment of large parks. Although extensive sanctuaries can provide crucial protection for such treasured animals as giant pandas, snow leopards and red pandas, along with harboring some of China's botanically richest sites, a few large refuges scattered across a wide region cannot fulfill all of the needs for conservation of biodiversity. An alternative for creating a few large parks and refuges is to create many different habitats across the landscape that enhance and improve local and regional biodiversity. Unlike distant large refuges, localized landscape enhancements can provide immediate benefits to nearby communities in the form of direct utilization of natural resource products and in the form of important ecosystem services. Furthermore, small-area enhancements are easily initiated and maintained by local communities that they service.

Some key landscape enhancements that can be undertaken by communities are the creation or expansion of small forested areas, small seasonal wetlands, areas with increased structural and ecological complexity, and extended transition zones at the interfaces between different ecosystem types. Newly created ecosystems can be inoculated at the outset with soil biota such as seed banks, microbes, fungi, and organic material that can accelerate ecological functioning and balance. In addition to increasing much local and regional biodiversity, locally enhanced areas can provide fuel, plant and animal food and medicinal products, and agroforestry products such as mushrooms and ginseng. Very importantly, these small ecological oases can serve as nesting and overwintering sites for numerous pollinators that are hugely beneficial to agricultural production. Moreover, several ecosystem enhancements may contribute positively to local and regional hydrologic cycles, and prevent prolonged droughts.

Enhancement sites can be selected for their inherent suitability, their ease of creation or expansion, or their proximity to a community. In addition, wider landscape level considerations can be integrated, such as corridors and connectivity of populations. Small landscape enhancements undoubtedly cannot provide for all conservation needs, but they can greatly increase widespread biodiversity, restore local ecosystem services, and can be used to complement the relatively few larger parks.

## Theme I: Ecological Impacts of Major Construction Projects

### 1.1 Impacts of Roads on Wildlife and Their Habitats in Northwest Yunnan: Implications for Conservation in Mountainous Areas

Xiao Wen<sup>1</sup>, Ren Guo-Peng<sup>2</sup>, Wang Lin<sup>2</sup>, Huo-Sheng<sup>1</sup>, Fang Peng-Fei<sup>1</sup>, Li Jing-Fa<sup>1</sup>,  
Wang Zhe<sup>1</sup> and Zhu Jian-Guo<sup>2</sup>

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<sup>2</sup>(Kunming Institute of Zoology, Chinese Academy of Science, Kunming, 650223, Yunnan, China)

**Abstract:** Effects of roads (including highway and trails) on wildlife conservation (*Rhinopithecus bieti* and *Pseudois schaeferi*) in Northwest Yunnan are discussed in this paper. Highway construction could be an important factor contributing to the degradation of *R. bieti*'s habitat and population isolation. Total length of highway has increased from 1642 to 3004 km in 6 counties of Northwest Yunnan between 1982 and 2002. More highways have been constructed in the southern counties, which is consistent with the extinction pattern of *R. bieti*'s subpopulation from south to north. Besides highways, trails also impact the habitat of wildlife. There was a significant difference in trail densities between cells that *P. schaeferi* used and those they did not use ( $Z = -4.394$ ,  $p = 0.000$ ) in Baimaxueshan Nature Reserve. Conservation actions that focus on local community development that include the construction of new roads will have negative effects on wildlife and their habitat. Thus conservation strategies in mountainous area such as Northwest Yunnan should be reevaluated.

**Key words:** road, wildlife conservation, Northwest Yunnan, conservation strategy  
road, wildlife conservation, Northwest Yunnan, conservation strategy

### 1.2 Multi-scale Effects of Road Networks on Ecosystems in the Longitudinal Range-Gorge Region of Yunnan Province

Li Xiao-wen\*, Zheng Yu, Cui Bao-shan

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**Abstract:** Road networks are essential components of widespread socioeconomic infrastructure development. However, road ecology has emerged as a hot topic in the past decade as the ecological impacts of road networks and its scaling effects have been poorly studied. The Longitudinal Range-Gorge Region (LRGR) is characterized by its rich biodiversity, high ecological vulnerability and rapid road network construction. The aim of this study was to examine multi-scaled impacts of road networks and topography on regional ecosystems in LRGR. The independent effects of road network density and their interactive effects with topographic factors (i.e., elevation, slope & aspect) on ecosystems were analyzed by using spatial correlation and ANOVA with scaling from 2×2 km to 20×20 km. The results showed that the correlation between road network density and ecosystem transformation is determined

by the road network category as correlation values decreased with upgraded road systems. In addition, topographic factors showed scale independent impacts, and their interactive effects with topography occurred at most scales. Further, the independent effects of higher-grade road network categories were much more distinct, while the topographically interactive effects of those lower-grade road network categories are notable at most scales, indicating that their extensive ecological impacts are prone to being topographically altered.

### **1.3 Effects of roads on regional vegetation landscape pattern of Xishuangbanna, Southwest China**

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**Abstract:** Roads are a conspicuous component of the landscape and play a substantial role in defining landscape patterns. While previous studies have demonstrated the link between roads and their effects on ecological processes and landscape patterns, less understood is the landscape pattern imposed by different roads classes in relation to landscape factors such as human disturbance, road density and vegetation type, etc. Our study focused on the vegetation fragmentation in Xishuangbanna prefecture in Southwest China to elucidate the effects of road extension on different vegetation types. The results showed that the impacts on vegetation varied with road class. Low level roads affected the most vegetation patches. Cultivated types were influenced by the largest patch area and number in the road effect zone and forests with *Cindica*, *Castanopsis hystrix* A. DC and *Schima wallichii* were second. We also analyzed the landscape metrics of 145 quads and of the whole region with five road development scenarios. The results pointed out that minor roads including class IV and V roads contributed most to landscape fragmentation at different scales. Linear regression was used to examine the relationship between road features, village distribution and environmental factors. The results showed that different road classes had a close relationship with village distribution, while topography fluctuation influenced the road and village pattern. Though strong relationships between landscape fragmentation and roads were found, topography had no direct relationship with vegetation landscape patterns.

**Key words:** ecological effect; fragmentation; forest; road networks; village

### **1.4 Impacts of road networks on biodiversity conservation at the landscape scale in Yunnan province**

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**Abstract:** Biodiversity conservation has become a central issue for the promotion of



sustainable development. The reduction of habitat area and connectivity is currently considered a major threat to biodiversity conservation. Road networks contribute significantly to a decrease in both the quantity and the quality of such habitat. Characterizing the impact of road networks on biodiversity at variable scales is important for understanding threats to species conservation at multiple levels of management. This research focuses on the impacts of road networks on habitat loss, connectivity loss and biodiversity change in a region of the Lancang River Valley in Yunnan province. Our findings indicated that (1) from 1997 to 2007, forest habitat larger than 25 ha decreased in area by 18.3% due to fragmentation; (2) relative forest biomass represented by NDVI decreased by 66.0% due to a 98% conversion of patches from forest to shrubs; and (3) connectivity loss was 91.3% within the road-effect zones. We conclude that road network expansion resulted in habitat fragmentation and degradation and landscape connectivity loss. Forest species under the most severe influence of the road networks were those relying on large forest patches within distances ranging from 360 m to 720 m to roads, altitudes from 2025 m to 2300m, and those in the southern and western part of the study area. The 12-km dispersal movement of those species was disturbed most seriously.

**Key words:** Biodiversity, Road effect zone, Fragmentation, Landscape connectivity, NDVI

## **1.5 Spatio-temporal Analysis of Roads on Soil Erosion: A Case Study of Fengqing County, Southwest China**

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(School of Environment, State Key Laboratory of Water Environment Simulation,  
Beijing Normal University, Beijing, China; \*Corresponding author)

**Abstract:** The presence of roads influences the utilization of natural resources, which has direct and indirect impacts on soil erosion. Quantitative analysis of soil erosion and its relationship to road level and how this varies both spatially and temporally is very important. This paper presents the relationship between soil erosion and distance to the road in Fengqing county, Southwest China for two periods, 1987 and 2004. Average soil erosion values were calculated and transformed into a grid map using USLE model based on GIS and remote sensing. Along the different level roads classified as trunk, county, town, village, and unpaved road, the buffer zones were subdivided into five 200 m wide strips. The average soil erosion modulus of each buffer zone also was counted. Results showed that soil loss generally decreased with increasing distance to the road except for trunk roads which are rare in the region. Also, the decreasing intensity of erosion differed among road type. Soil erosion was more serious along lower level roads than higher ones. During the two periods, soil erosion was more severe for all the level roads in 1987 than that in 2004 due to greater rainfall in 1987.

**Key words:** soil erosion; road buffer; USLE; GIS; Southwest China

## **1.6 Investigation of the Role of Roadside Ditch Networks as Contributors to Flooding, Droughts and Degraded Water Quality**

Rebecca Schneider  
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**Abstract:** The problems associated with floods, droughts, and degraded water quality are increasing worldwide. There is a growing recognition that these problems are caused, in part, by human impacts to watersheds. Land uses throughout each watershed directly influence the pathways and rates of water movement and therefore the hydrologic processes of runoff, groundwater infiltration, and evapo-transpiration. In particular, clearing away natural vegetated communities and replacing them with the impervious surfaces of roads, roofs and parking lots, and by more compacted soils having reduced organic matter, all contribute to increased runoff, greater evaporative losses, and less groundwater infiltration.

Over the past five years, my lab has been investigating the impacts from networks of ditches along roadways for their role in watershed hydrologic processes. We have mapped the roadside ditch networks in six watersheds in central New York, USA, for their lengths, connections to streams, and substrate conditions using hand-help GPS units and ARC-GIS TM. We have monitored total water flow using Tru-Trak TM water level gauges, and measured water quality with automated ISCO TM samplers for total suspended sediment, nutrient, trace metals, and fecal coliforms. Our findings from these watersheds indicate that: (1)  $\sim \frac{3}{4}$  of roadside ditches discharge directly to streams, (2) ditches increase the effective stream channel density by 2-4 fold above the natural system of streams, (3) basins of road ditches intercept approximately 20% of the shallow runoff and shunt it rapidly to downstream discharge points, thereby contributing to downstream flooding, (4) increased runoff via the ditches results in decreased groundwater infiltration and lowering of the water table, (5) ditches that are scraped and left exposed, or incised, transport significant quantities of suspended sediment as well as nutrients and other contaminants to rivers contributing to impaired water quality, (6) ditches draining agricultural fields that have been spread with livestock manure transport viable fecal coliforms at very high concentrations to downstream drinking water supply systems for several months. All of these findings indicate that re-plumbing our watersheds through better management of roadside ditches will result in reduced floods, droughts and improved water quality.

## **Theme II: Integrated Ecosystem Management**

### **2.1 Integrated Alpine Grassland Ecosystem Management Strategies for Adaptation to Climate Change in Northern Tibet, China**

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**Abstract:** Northern Tibet is the headstream region for the Yangtze, Nu (Salween River), Lancang (Mekong River), and numerous other inflowing rivers and high mountain lakes. As the source of many rivers, sustaining the environmental conditions in the region is vital for Tibet and the whole of China. Alpine grasslands are not only the most important and largest ecosystem in this area, but also a key resource for supporting local people's subsistence in Northern Tibet. Being a fragile ecosystem, the alpine grassland ecosystem in Northern Tibet is extremely sensitive to climate change and human activity. In recent years, serious alpine grassland degradation has been detected in Northern Tibet with diverse annual fluctuations. This trend of rising temperatures and precipitation is likely to continue in the future with temperatures rising faster than the country average. In order to adapt to possible climate change in the future, we developed integrated management strategies to adapt to future climate change, control grassland degradation and promote the sustainable use of alpine grassland resources. These strategies will lessen the negative impacts of climate change on the alpine grassland ecosystems of Northern Tibet.

**Key words:** Climate change, Adaptation strategies, integrated ecosystem management, Alpine grassland, Northern Tibet

### **2.2 Impact Assessment of the Sloping Land Conversion Project (SLCP) and Proposed Development Models for the Mountain-Gorge Region**

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**Abstract:** Using the mountain-gorge region of the Nujiang River as a case study, we evaluated the influence of the SLCP on the livelihoods of local farmers, socio-cultural and industrial structures, etc. using semi-structured interviews and field surveys. The results are as follows:

1. The project has provided a better economic foundation to local people and has had a greater influence on farmers living in low-elevation regions than on those living at middle-high elevations.

2. The project has led to a transformation of production models from crop farming and animal husbandry to forestry and sideline work, and the income structure

has changed from animal husbandry as the main income source to state subsidies and sideline work as main income sources.

3. Household income and size is decreasing due to the project.

4. The living habits of the local people have changed and the traditional fire-ponds culture has been lost.

5. Energy utilization has changed from firewood to methane and electricity.

These results indicate that the SLCP has had a significant impact on the production systems and livelihoods of local farmers. Thus research on development models of the SLCP that will help resolve farmer livelihood issues is critical.

We present two main development models based on the characteristics of the natural and cultural environments: 1. Reforestation of cultivated land management models, including three sub-models, namely: farmer stock forestry farms model, individual contract model, companies + farmers model; 2. Reforestation of cultivated land planting models that includes two main categories. One is topography change models, which includes three sub-models: along the valley area model, middle-elevation zones model and high-elevation zones model. The second is a mixed agriculture and forestry model, which also includes three sub-models: forest-fruit model, forest-grass-domestic animal model and forest-medicine-wild vegetables model. These results offer a framework for the sustainable development of the mountain-gorge region.

**Key words:** The Mountain-gorge Region; the Sloping Land Conversion Project (SLCP); Influence on the livelihood of farmers; Development models

### **2.3 Implementation of the Guarantee System for Integrated Ecosystem Management in a Typical River Basin of China's Fragile Mountainous Regions**

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**Abstract:** The mountainous regions of China are characterized by fragile ecosystems with weak environmental regulations, underdeveloped economies with high levels of poverty and large ethnic minority populations, and are highlighted by growing conflicts between environment and development. This, combined with global climate change and rapid regional economic growth, has resulted in a serious environmental situation. It is urgent to develop an effective environmental management system guided by state-of-the-art science and ideas to ensure the sustainable development of the region. We discuss how to develop the guarantee system for integrated ecosystem management and its implementation in a typical river basin in China's fragile mountainous regions. We discuss ideas concerning the framework, a scientific and technological support system, policy and legal system, administrative implementation system, cultural integration systems, capacity building system, monitoring and evaluation system, etc.

**Key words:** Fragile mountainous regions, typical river basin, integrated ecosystem management, guarantee system

## 2.4 Anatomy of Ecological Problems and Management Measures of Estuaries in Northern China

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**Abstract:** Estuaries form the interface between marine and terrestrial ecosystems. They are characterized by their plentiful biological resources and the many important ecosystem services they provide. However, there has been severe degradation of estuary ecosystems in northern China due to anthropogenic disturbances, including water pollution from upstream areas, changes in marine hydrologic dynamics, habitat loss, and exploitation in the estuary region. To provide a scientific basis for the restoration and conservation of estuary ecosystems, we compiled data from the published literature to point out ecological problems in several main estuary regions of northern China, such as the Yellow River estuary, the Liaohe river estuary, the Haihe river estuary, the Yalu river estuary. The main ecological problems identified for the estuaries of northern China were a decrease in fresh water inputs from the river, increased sediment inputs, destruction of the wetland ecosystem, environmental pollution, erosion, seawater encroachment, biodiversity loss, and depletion of the fish resources. The driving forces for these ecological problems in the estuary region also were assessed. Based on the analysis of these driving forces, we propose several suggestions for the integrated management of estuaries in northern China: the development of a management system for estuary conservation; strengthening of environmental laws and a better means for their execution, an increase in the investment of scientific research on estuary ecosystems, enhanced public awareness and participation in estuary conservation, and the development of an estuary monitoring system.

**Key Words:** estuary, ecology and environment, anatomy, management

## 2.5 Coupled Agro-grassland Animal Husbandry Production Systems on the Qinghai-Tibet Plateau

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**Abstract:** In recent years, researchers have focused on the theory of agro-grassland system coupling. System coupling, however, usually occurs simultaneously with system discordance which results in imperfections in system operations. The discordance is mainly reflected in disharmony between livestock production and pasture development, and it can be regarded as a major factor in grassland degradation on the Qinghai-Tibet Plateau. The total area of degraded grassland in the Qinghai-Tibet plateau is estimated to be approximately  $4.0 \times 10^7$  to  $6.0 \times 10^7$  ha. Under the irrational management of grasslands on the Qinghai-Tibet Plateau, the inverse relationship among sub-ecosystems further curbs development of animal husbandry, sustainable development of grasslands and social harmony. Utilization of the theory of ecosystem coupling in the grassland system will help us develop sustainable and effective grassland-agricultural ecosystems. In this article we propose a simple

coupling model which could be used to relieve disharmony between livestock production and pasture development on the Qinghai-Tibet Plateau. Results of our study and practice demonstrate that it is effective with ecological rationality, economical feasibility and social acceptability to carry out coupled agro-grassland animal husbandry production systems within the farming-pastoral zone on the Qinghai-Tibet Plateau.

**Keywords:** agro-grassland system coupling; animal husbandry; Tibetan sheep; fattening; Qinghai-Tibet Plateau

## **2.6 Implications of Coupled Socio-Cultural and Natural Systems in sustainable rangeland ecosystem management in HKH region**

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**Abstract:** Rangelands are the most important ecosystem in the Hindu Kush-Himalaya (HKH) region in terms of ecosystem services and functions they provide and the millions of humans they support. Sustainable development of rangeland resources and ecosystems in the HKH region is presently confronted with a number of problems. Coupled socio-cultural and natural systems are needed to facilitate effective collaboration among social and bio/physical scientists and management practitioners, so as to develop sound policy formulations and decisions about rangeland ecosystem management. In this paper, the results and findings of three case studies on rangeland management across the HKH region, Himalayan Nepal, eastern Qinghai-Tibetan Plateau and central Qinghai-Tibetan Plateau, are summarized to highlight how important coupled socio-cultural and natural systems are to formulate a more integrated understanding of nature and society, and how narrative the interdisciplinary work is to promote the sustainable development of these resources. Local herders in Himalayan Nepal represent a repository of rich indigenous knowledge essential for sustaining rangeland management; indigenous practices need to be integrated into modern technology development and public decision making. Tradition and custom in pastoral societies needs to be considered in decision analysis for selection of (cultivated) grassland production systems in eastern Qinghai-Tibetan Plateau, in addition to internal factors of economic and ecological benefits. Understanding social-cultural human attitudes towards new rangeland conservation policies and promoting scientifically feasible rangeland restoration strategies are both critically important in implementing the Grassland ban Projects in central Qinghai-Tibetan Plateau. The implications of socio-cultural and natural 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. Comprehensive programs of integrated basic and applied ecological, social, and economic research should be developed to provide an improved information base for decision making.

## **Theme III: Biodiversity Conservation and Management**

### **3.1 Sustainable Development and Environmental Planning of Taiwan National Parks – a case study of Yushan National Park**

Chou Ho-shu

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**Abstract:** A narrow land base with high mountains and steep slopes has created a diverse terrain and landscape with many life zones and species in Taiwan. For the past three hundred years, humans have lived and spread across this splendid domain to form a complex and fragmented landscape. The National Park system was introduced into Taiwan over thirty years ago and it has achieved the objectives of conservation through the propagation of several parks, but there still remains conflicts between management of conservation and recreation. Because of the global recognition of the needs for “sustainable development” and “eco-tourism”, this paper suggests that Taiwan’s National Park system should establish an integrated sustainable development mechanism of “conservation, recreation and research”. A new conservation concept and suitable technique for sustainable development of environmental resources is needed. This paper suggests shifting the traditional planning paradigm of resource benefit guidance and resource valuation framework to a “Sustainable Planning” theory and technique suitable for sustainable development. Landscape Ecology concepts combined with Geographic Informational Systems could be an effective tool. This paper points out that landscape ecology concepts should form the basis for developing sustainable development management plans. A GIS model also is necessary for this planning process due to the dynamic nature of the situation. Finally, this paper will develop an operational definition of sustainable development planning methodology to represent the interlacing framework of ecology (conservation) and humanities (recreation, research, life etc) system of Taiwan’s National Parks.

**Keywords:** National Park, Sustainable Development, Landscape Ecology

### **3.2 Population Regeneration and Community Characteristics of *Cunninghamia lanceolata* and *Pinus taeda* forests in Kunyu Mountain, Shangdong Province**

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**Abstract** *Cunninghamia lanceolata* and *Pinus taeda* were introduced to Kunyu Mountain in the early 1950s and 1970s, respectively. After a long period of adaptation, these two species have survived at elevations < 500 m on Kunyu Mountain. To understand the species adaptations to this new habitat, the population and community characteristics of the habitats where these two species have successfully established were investigated. The results showed that: (1) *C. lanceolata* grows well and produces

seeds and seedlings and has formed a mixed-age stand indicating that *C. lanceolata* has natural regeneration ability. *Pinus taeda* grows well too but had fewer seeds and seedling; (2) The soil seed bank in the *C. lanceolata* community was 398.5 seeds/m<sup>2</sup>, including 3.35 seeds/m<sup>2</sup> of *C. lanceolata* seeds, while there were only 10.4 seeds/ m<sup>2</sup> in the *P. taeda* community with no *P. taeda* seeds; (3) The species richness and species diversity index showed that the tree layer > herb layer > shrub layer in *C. lanceolata* community, whereas species richness in the *P. taeda* community decreased from the herb layer > shrub layer > tree layer. It is inevitable that the *P. taeda* population will decline because natural regeneration in Kunyu Mountain is limited. In addition, there is lower tree diversity and stability in the *P. taeda* community. We suggest that local evergreen conifer trees such as *P. thunbergii* and *P. densiflora* be introduced into the *P. taeda* community in order to stabilize community structure that favors water-soil conservation of the mountain area.

### 3.3 Zone Management Design Using Multi-criteria Evaluation for Meili Snow Mountain National Park

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**Abstract:** Meili Snow Mountain (MSM) is in the northern Hengduan Mountains. Two parallel rivers run along the east (Lancang River) and west sides (Nujiang River) of MSM. The eastern part of MSM is located in Deqin County, Yunnan Province whereas the west side belongs to Tibet. It is not only one of the richest areas of biodiversity in Yunnan but also in the world. Moreover, cultural resources also are very rich in this area. The peak of MSM (Kawagebo) is one of the eight holy peaks in the region of Qinghai-Tibet Plateau and is the only male holy peak.

According to the IUCN categories of protected areas, National Parks (NP) are in the second tier of protected areas. NPs are protected mainly for ecosystem conservation and recreation. One of the objectives of the NP is to protect ecosystems and provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible. The management of MSM NP is a combined management system that includes the management of NPs according to US specifications as well as specific natural management systems of China. One important management concept of the MSM NP is management zones. However, the current management zone classification system, such as the managing zones of nature reserves, scenic spots, tourism areas, and forest parks are not suitable for NP. Therefore, a new logical and reasonable zone management design method or system needs to be developed.

The general goal of the MSM NP is for sustainable development and thus has two objectives: conservation and development. In this work, conservation focuses primarily on biodiversity targets. Development includes eco-tourism and local community development. In order to accomplish the first objective, conservation targets, including ecosystems, species, and cultural targets, were identified by experts. The impacts or threats to the conservation targets also were identified. Afterward, a GIS fuzzy set membership function was used to generate gradient effects of each impact or threat on conservation targets. A pairwise comparison matrix was used to weight the different impacts or threats. A map of conservation suitability was then derived by using multi-criteria evaluation (MCE). In addition, two suitability maps of



eco-tourism development and community development were generated by using MCE. The three suitability maps were overlaid to generate a final suitability map both for conservation and development. This map was reclassified by using cluster analysis. Finally, five management zones were classified which link to different management strategies.

**Key words:** National Park; MCE; Zone management classification

### **3.4 Vigilant Behavior of and Threats to Przewalski's gazelle in the Qinghai Lake Region**

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**Abstract:** Przewalski's gazelle (*Procapra przewalskii*) is an endangered species and is endemic to the Qinghai Lake area of China. Understanding the vigilant behavior of and the threats to the gazelle is a key to the conservation and restoration of Przewalski's gazelle. A study was conducted from October 2005 to August 2006 to investigate the behavior of and threats faced by Przewalski's gazelle. The results showed that female gazelles were more vigilant than males while feeding as expressed by the rate of looking-up (Mann-Whitney test,  $Z=2.475$ ,  $p=0.013$ ,  $n_1=20$ ,  $n_2=17$ ), which may have implications for the different feeding strategies adopted by the two sexes. The group size had marginally negative effects on individual vigilance levels ( $r=0.296$ ,  $F=3.362$ ,  $p=0.075$ ,  $n=37$ ), and the gazelles were very alert to human disturbance and were ready to escape into the deep sand areas. Fences in pastures are believed to be a major threat to the survival and restoration of gazelle populations in the Qinghai Lake region. A social survey demonstrated that it was possible and feasible to modify the fences (e.g. lowering the fences, removing thorn, etc.) and even to remove some fences with necessary compensation and support from the government. Some measures and actions were proposed accordingly to conserve the populations of Przewalski's gazelle.

### **3.5 Identifying Hotspots and Gaps for Biodiversity Conservation Based on a Systematic Conservation Planning Methodology: A Case Study in Northeast Area of China**

Luan Xiao-eng<sup>1</sup>, Huang Wei<sup>2,3</sup>, Zhu Chun-quan<sup>5</sup>, Wu Bo<sup>3</sup>, Liu Shi-ong<sup>3</sup>, Liu Min-hao<sup>4</sup>, Li Di-qiang<sup>3</sup>,

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**Abstract:** A systematic conservation planning method using irreplaceability (Ir) values of conservation planning units were calculated using C-plan software for northeast China. Four hotspot areas were identified, including the Changbai mountain area, northern Daxinganling mountain area, the transitional area between western

grasslands and Daxinganling mountain forests, and the wetlands around the center of Songnen plain. Based on the results of the hotspot analysis, a GAP (Geographic Approach to Protect Biological Diversity) for biodiversity conservation was conducted in this region. The results showed that there are three evident protection gaps between the priority planning area and the existing national Nature Reserve. Based on our results, we provide suggestions for establishing new protected areas and eco-corridors in Northeast China.

**Key words:** biodiversity, conservation, hotspot, GAP

### **3.6 Structure, Diversity and Successional Dynamics of Subtropical Montane Evergreen Broad-leaved Forests, Yunnan, China, and Human Influence on the Forests, with a View to Future Sustainability**

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**Abstract:** Subtropical evergreen broad-leaved forests (EBLF) of Yunnan, China, including mid-montane moist, monsoon, and semi-humid categories, were studied in terms of structure, diversity and dynamics. The vertical structure of primary subtropical EBLF in Yunnan was multilayered, including canopy, subcanopy, shrub layer and understory. Most of the dominant canopy tree species of the forests had the multimodal type of frequency of size distribution. The monsoon EBLF yielded the highest indices of the Shannon-Wiener  $H'$ , Equitability  $J'$ , Simpson  $D$  and Fisher's alpha, followed by the mid-montane moist EBLF, then by the semi-humid EBLF. As a result of long-term human activity in the area, the plant communities ranged from pioneer deciduous broad-leaved and/or pioneer coniferous stands to late-successional evergreen broad-leaved stands. In central Yunnan, the secondary successional pathways were from pioneer deciduous stands of *Alnus* and *Platycarya*, accompanied by stands of pioneer coniferous *Pinus* and *Keteleeria*, through broad-leaved and coniferous mixed stands, to late-successional evergreen broad-leaved forests of *Cyclobalanopsis* and *Castanopsis*.

In the subtropical mountain area of Yunnan, the EBLF is commonly replaced by plantations of exotic fast-growing *Eucalyptus* to produce industrial wood, oil, pulp and fuel. The result has been reduced plant diversity, with low canopy interception and great loss of soil nutrients by erosion, as compared to the EBLF.

Eighty-one plant species in the area have been ranked as rare, endangered, or threatened. Their condition is seen as largely attributable to habitat degradation.

A clear understanding of ecological features and successional pathways of the EBLFs provides a basis for evaluating the sustainability of the forests in relation to human activity, and can lead to more effective conservation and management of these fragile forests and the mountain ecosystems.

### **3.7 Impacts of the National Conservation of Snake Island and Laotieshan Mountain's Regulations on Its Ecological Function**

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**Abstract:** The National Conservation of Snake Island and Laotieshan Mountain is mainly to protect a rare snake called *Gloydius shedaoensis* Zhao, the only place in the world where it is found. It is highly valued by academic researchers and has medical application. This area also plays an important role in bird conservation as a place of temporary rest and food supply for large numbers of migrants. In this study, we examine regulations concerning the range and functional area of the National Conservation of Snake Island and Laotieshan Mountain since it was established in 1980. We also investigated the number of protected species, status quo of the ecological environment, and social and economic development around the area over the last thirty years. Primarily, we analyze the impacts of the regulations on the nature reserve's ecological function and reasons behind them. Finally, we propose some suggestions on how to rationally and scientifically adopt regulations that benefit both conservation and economic development of these areas.

**Keywords:** National Conservation of Snake Island and Laotieshan Mountain; Regulation; Conservation of Natural Resources; Economic Development

## Theme IV: Ecosystems and Livelihoods Assessment

### 4.1 Numerical Modeling and Quantitative Analysis of Soil and Water loss processes in small-medium watershed scale

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**Abstract:** We have revised some of the parameters of the classical USLE model, through 3S technology, and conducted a numerical simulation and quantitative analysis of soil loss in the Longchuangjiang River watershed in the upper reaches of the Yangtze River valley. The main soil loss model was calculated as,  $Q=Cr \cdot Re \cdot Ke \cdot LG \cdot VcP$ , and the predicted intensity of soil erosion was estimated by the model,  $Sp=VcP-Vc'P'$ .

Some parameters, such as  $Re$ -value,  $Ke$ -value,  $Vc$ -value,  $LG$ -value and  $Re$ -value, were revised according to monthly rain fall data of one representative hydrological station and nine ordinary hydrological stations during the flood season. The  $ke$ -value was revised by investigating the soil characteristics of 111 soil profiles, and the determination of  $Vc$  -value types were revised using the distinguished rate  $ETM$  images and calculating the values of slope degree and slope length ( $LG$ ) using imagery pixel methodology.

The simulated results were as follows: 1) The amount of soil erosion in 1998 (drought year) was 840069.19 t, the erosion area was 2293.7841 km<sup>2</sup>, the amount of soil erosion in 1999 (water-logged year) was 8690182.6 t and the erosion area was 2293.7841 km<sup>2</sup>. The A value of 1998 was 55.7% of 1999. Severely eroded areas in 1998 and 1999 occupied 66.80% and 85.20%, respectively, of the total valley area; 2) Moderately eroded areas were 35.2% of the total area in 1999 and 26.0% in 1998; 3) Areas in immediate need of soil erosion control and management occupied 16.27% in 1999 and 14.63% in 1998 of the entire watershed; and 4) we compared the simulated value with observed values. In 1999, the simulated A-value was 8690182.6 t, but the observed value at Xiaohekou hydrological station was 991000 t, only 1/8 of the simulated value. Because the amount of sedimentation at Daguoba, Xiakouba, Chushuang, Lanniqing, Maobanqiao, Jiulong Dian, Fengtun and Qingfeng stations have not been measured, the amount of silt loss monitored at Xiaohekou station did not represent the amount of silt loss for the whole valley (research area). Quantitative monitoring and numerical prediction of the mosoon-red soil region of Southwest China using these methodologies produced rapid and practical results. However, comparison between numerical simulations and monitoring at hydrological stations will be further investigated in the future.

**Key words:** Soil and water loss process; 3S technology; Usle and Rusle; Quantitative

mathematic model analysis and calculation; China; Small valley in the upper reaches of the Yangtze River

## 4.2 Influence of Climate Change on Grassland Succession

Li Hong-mei, Ma Yu-shou, Bai Yan-fang  
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**Abstract:** The distribution of grasslands is determined by climatic conditions, but climate has changed under the background of constant warming. Climate trends in Qinghai were analyzed based on data from fifty meteorological stations from 1961 to 2007. The analysis was divided into two periods: pre and post 1987. Differences in temperature and precipitation pre and post 1987 were significant. The rate of temperature increase was 0.16°C/10a before 1987 and 0.64°C/10a after 1987. The change in precipitation was 0.14 mm/10a before 1987 and 3.92 mm/10a after 1987. The grassland distribution was determined according to the Comprehensive and Sequential Classification system. Thirteen grassland types were identified from 1961 to 1987, and eleven types from 1988 to 2007. The tendency of types based on data from 1988 to 2007 compared with types based on data from 1961 to 1987 was warming and drying. Under a doubling of CO<sub>2</sub> concentrations, temperatures were higher, but there was no obvious increase in precipitation. Grassland was divided into nine types, and the tendency was towards warming and drying. This analysis showed that the number of grassland types has decreased in response to climatic warming and drying.

**Keywords:** climatic change, Comprehensive and Sequential Classification, vegetation succession

## 4.3 Forest Landscape Restoration and Livelihood Improvement in Miyun Reservoir watershed

Zhuang Hao  
(IUCN)

**Abstract:** This presentation will introduce the Forest Landscape Restoration (FLR) concepts and the Livelihoods and Landscapes Initiative (LLS) of IUCN. Forest Landscape Restoration, or FLR, tries to work at the landscape level for achieving an optimal balance of the ecological, social and economical benefits of forests through dialogues and negotiation between different stakeholders. In China, IUCN has been applying the FLR concepts in Miyun reservoir watershed. Research results show that while the percentage of forest area in the watershed has increased from 44.39% in 1970s to 65.10% in 2008, fragmentation of all landscape patches have worsened and one fourth of the forests are younger than 10 years old. In the mean time, water storage of Miyun reservoir continues to suffer from competing demands for water and low precipitation (average 450 millimeters per year). Additionally, the significant difference between income levels of populations in different landscape types imply risk of over-exploitation of natural resources, threats to social stability and the ignorance to the ecological benefit/values of forests.

In light of the role of forests in watershed management and livelihood

improvement, IUCN China started the implementation of the Livelihood and Landscape Initiative (LLS) to respond to these challenges through interventions at both site level and landscape level. At the site level, the project pursues to improve forest management to enhance watershed values and increase forest-based incomes for local residents; implementing participatory close-to-nature forest management plans; assisting alternative livelihood options. This include efforts to influence a 30-year-old logging ban, improve forest quality through close-to-nature forest management, re-define local fuel wood use pattern, and improving the efficiency of local energy use. At the landscape level, it supports a multi – departmental, cross-boundary platform for integrated watershed management.

The presentation also explores how to use Payment for Ecosystem services (PES) schemes in the Miyun reservoir watershed to achieve a landscape level balance of ecological, social and economical functions and benefits. A number of existing PES schemes and more results from project studies are introduced. It is found that areas of lower income and greater vulnerability to environmental risks largely coincided. Based on research on the potentials of economic development, carbon and watershed values of the forests in the watershed, recommendations for improving the PES systems are suggested.

#### **4.4 Impact of Land Use and Land Cover Changes on Organic Productivity Values in Karst Ecosystems: a Case Study of Northwest Guangxi, China**

Zhang Ming-yang<sup>1,3,4</sup>, Wang Ke-lin<sup>1,3</sup>, Chen Hong-song<sup>1,3</sup>, Liu Hui-yu<sup>2</sup>, Yue Yue-min<sup>1,3,4</sup>

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<sup>4</sup>(Graduate University of Chinese Academy of Sciences, Beijing 10049, China)

**Abstract:** Karst areas are one of the most fragile regions in the world. The karst environment is very common in southwest China where poverty and environmental degradation are prevalent. Thus, it is necessary to monitor karst ecosystem conditions and its ability to provide goods and services for society. In this paper, we analyzed the spatial distribution of organic productivity values (OPV) in Northwest Guangxi, China in 1985, 1990, 2000 and 2005, with Landsat TM images using remote sensing and geographic information system (GIS) techniques. Results showed that the OPV first decreased and then increased over time but the OPV of 2005 was less than that of 1985. The OPV was 184.85 million Yuan, 117.53 million Yuan, 163.66 million Yuan and 177.25 million Yuan in 1985, 1990, 2000 and 2005, respectively. Woodlands and shrubs were the two largest contributors to total OPV with total ratios of 70.51%, 69.13%, 73.92% and 66.23% in the four years. The OPV of residential and barren rock were low with total ratios of only 0.70%, 0.56%, 0.57% and 0.90%. The OPV declined from west to east, from mountain to peak-cluster depression areas, and increased in typical karst areas, but distinctly decreased in non-karst areas. Our study indicates that ecosystem conditions are improving because of the application of rocky desertification control policies, such as ecological migration and returning farmland to forest.

## 4.5 Productivity and Persistence of Cultivated Meadows of Grass Mixtures under Clipping and Fertilization Treatments

Gu Meng-he, Du Guo-zhen

(Key Laboratory of Arid and Grassland Agroecology at Lanzhou University, Lanzhou University, Lanzhou 730000, Gansu, P. R. China)

**Abstract:** The meadow ecosystems of the Qinghai-Tibetan plateau, the largest rangeland in China, has been degrading recently due to over-exploitation and natural hazards which has resulted in a decreased carrying capacity and vegetation coverage. A field experiment was designed to test the effects of four treatments (density, fertilization, clipping, and species mixture) on the performance of an artificial meadow to reduce degradation caused by heavy grazing pressure. The results showed that species mixture was the best treatment to increase meadow productivity and community stability. There was a 28% increase in target species yields in a two species mixture compared with a monoculture and a 103% increase in a three species mixture. Fertilization yielded a 63% increase in the target species yield and a 54% increase in weed yield, but decreased weed abundance. Clipping had an adverse effect on meadow productivity and weed growth (abundance and yield). It decreased the target species yield by 46% relative to no clipping and decreased the weed yield by 6%. A three-way ANOVA showed that the three species mixture was the optimal method for establishing a cultivated meadow. Clipping had no significant effect on the meadow yield but significantly decreased the weed abundance. The three species mixture not only had a high yield but also a high ability to resist weed growth and was the best choice for developing stock breeds and enhancing vegetation cover thereby providing benefits for both local economic development and environmental protection.

## 4.6 Forestland Change in the Lugu Lake Watershed Using Spatial Data Mining Techniques

Dong Ren-cai<sup>1,2</sup>, Liu Ming<sup>2</sup>, Li Chun-ming<sup>2</sup>, Zhao Jing-zhu<sup>1,2</sup>

<sup>1</sup>(Research Centre for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085, China)

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**Abstracts:** The Lugu Lake watershed is home to the Mosuo people in Yunnan province, China. Recently, the Lugu Lake area has gained ecological and economic significance due to the relatively unique matriarchal system and the success of tourism development. Using satellite images, we compared changes in forestland from 1990 and 2005. Using spatial data mining techniques, the geometric characteristics of forestland patches were analyzed by applying spatial association rules and adapting statistical analyses and cluster analysis methods. The minimum, maximum, mean, variance, and mode of the objective geometric characteristic eigenvalues, the spatial distributed discipline and association rule of variation patches were analyzed, as well as the inner disciplines in forestland variation process. This analysis provides a foundation for understanding the driving forces of land use change and the management of forest ecosystems in the Lugu Lake scenery district.

**Keywords:** spatial data mining, Lugu Lake, ecosystem changes, ecosystem

management, Mousuo people

#### **4.7 Responses of Plant Morphology and Seed Quality to Long-term Overgrazing in *Leymus chinensis***

Shao Xin-qing, Wang Yun-wen, Wang Kun

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**Abstract:** *Leymus chinensis* (Trin.) Tzvel. is a perennial Gramineae species and an important forage species. During grazing succession, individuals of *L. chinensis* become miniaturized and cannot be restored to normal size without grazing stress. To explore the miniaturization mechanism, we compared the morphological characteristics and asexual reproduction of miniaturized *L. chinensis* and normal *L. chinensis* from 2002 to 2004. The results showed that the 1000-seed weight, germination percentage, plant height, fiber root length, height of first ramet, individual biomass and seed weight of a single spike decreased significantly ( $p < 0.01$ ), but the tiller number increased ( $p < 0.05$ ) between the miniaturized and normal ones. We consider overgrazing to be the main factor causing individual miniaturization of *L. chinensis*. We hypothesize that miniaturization is a negative feedback mechanism and protective adaptation to stress. This work is an important step towards understanding restoration of succession in the typical steppe, and provides a baseline towards a sound steppe management plan.

**Keywords:** *Leymus chinensis*; Grazing succession; Individual miniaturization; Tiller number

#### **4.8 Using a Coupled Socio-Cultural and Natural Systems Approach to Environmental Conservation in High Elevation Mountain Landscapes of Northwest Yunnan, China.**

Ruth Sherman

(Department of Natural Resources, Cornell University, Ithaca, NY, USA)

**Abstract:** The alpine habitats of northwest Yunnan (NWY) are identified as a conservation priority within the Yunnan Great Rivers Project because of their high species richness, endemism rates, threat status, and value to the economic and cultural well-being of local communities. However, because the alpine zone, covering roughly 12 % (8200 km<sup>2</sup>) of NWY, is such a large and widely distributed habitat type and our knowledge of these systems limited, additional information was required before geographic priorities could be established for conservation actions. It was recognized that effective conservation strategies would require an understanding of the ecology of the alpine, how local people use and manage this resource, and how climate change might impact these relationships. To address these issues, we used an integrated approach whereby conservation practitioners, sociologists, climate change experts, and plant ecologists worked together to design and implement a study to identify priorities and strategies for conservation of alpine areas across NWY. I will present this case study as an example of how coupled systems research in environmental conservation can be successfully implemented.



## 4.9 The Study of Public Participation Pattern in Basin Management: A Case Study from the Baiyang Marsh Basin in China

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**Abstract:** The effective public participation is the key aspect of successfully integrated basin management. This article focuses on public participation in the basin management, and takes Baiyang Marsh basin as a case study. It simultaneously considers the dual factors: “the spatial level” and “the related benefit”, and analyses the stakeholders of basin management. It also affirms the importance of ecology-residents in the basin area, because the residents in the ecological sensitive area not only understood the local ecology background extremely, but also they were the direct victim. On the other hand, their behavior would directly affect the basin environment. Therefore, the residents in the ecological sensitive area have a big influence with the implement of basin decision-making. Environmental awareness of ecology-residents and the way of public participate are actually the weak links of basin public participation. This paper proposes to take the ecology sensitive area as the core, integrate the overall resources in the basin area, and input the information and strength of each level in basin area, in order to promote the public participation in the ecological sensitive area. Through the “inputting” process, we can hold the ecology characteristic of the ecology sensitive area, use the process of public participation in other interest groups of other levels, and promote the implement of public participation in the whole basin. It also proposes to promote making the law and detailed regulations of basin public participation through the practice of public participation, in order to give legal guarantee to the basin public participation.

**Keywords:** basin management, Baiyang Marsh basin, public participation, stakeholders, participation mode

## **Theme V: Ecological Compensation and Payments**

### **5.1 Natural and Social Issues in Grasslands Management Policy: Implications of a Case Study for the Emerging National Grassland PES Scheme**

Andreas Wilkes  
(ICRAF-China)

**Abstract:** Grassland degradation is highlighted as a priority in China's environmental and climate change adaptation plans. There is a general consensus among officials and scientists that overgrazing is the main anthropogenic driver of grassland degradation in China. A range of laws, regulations, programs and approaches have been developed and applied to address this driver. Following clarification of user rights (grassland contracting), agreements were supposed to be signed with users to limit stocking rates. In many areas these have not been signed or if they have they have been found to be unenforceable. Recently the government has begun to develop pilot payment for ecosystem service schemes to provide incentives for maintaining sustainable stocking rates. This paper provides an analysis of the drivers of high stocking rates based on one case study in NW Sichuan. High stocking rates are driven by a high dependence of household income on sales of livestock products. The paper also describes the emerging grassland PES scheme. Proposed pilot schemes include incentive payments for destocking and maintaining low stocking rates, a compensatory payment for lost rural energy sources, and indirect payments in the form of grass seeds, rat poison and other material support. Drawing on insights from the case study, the paper discusses implications for approaches to the design of a voluntary, equitable and effective PES scheme in grassland areas of China, and highlights significant gaps in the understanding of pastoral household economies that present obstacles to design of voluntary and effective PES schemes.

### **5.2 The Hehei River: Water Resources, the Eco-environment and Economic Development**

Zhang Ji-jiao  
(Institute of Ethnology and Anthropology, Chinese Academy of Social Sciences)

**Abstract:** Since the late 1990s, a growing number of scholars have become interested in water resources, such as the eco-environment and economic development in the Hehei River in China, as well as other rivers around the world. In this study, nine counties/districts, four economic areas, and seven interviewee groups were surveyed from late 2003 to early of 2004 in the Hehei River Valley. The results of this project indicated that the eco-environment of the Hehei River valley is seriously degraded (land deterioration and desertification) due to water deficiencies and agriculture overdevelopment.

This survey project was supported by the Research Institute for Humanity and Nature (RIHN), Japan and carried out by the Institute of Ethnology and Anthropology,

Chinese Academy of Social Sciences, China.

**Keywords:** The Hehei River, Water Resources, Eco-environment, Economic Development

### **5.3 Ecological Performance and Sustainability Problems of the Grazing Forbidden Project in the Resource Regions of the Yellow River**

Zhao Cheng-zhang, Yin Cui-qin

(College of Geography and Environment Science, Northwest Normal University, Lanzhou 730070, China)

**Abstract:** The Grazing Forbidden Policy is a great measure to restore degraded pasturelands, but the perspectives and behaviors of local herdsmen also are very important for the policy to be successful in the resource regions of the Yellow River. This study used participatory interviews to understand the perspectives of local herdsmen in regards to how their livelihoods have been impacted and the ecological benefits of the policy. The results showed that herdsmen have come to realize the severity of degradation of the natural grasslands. However, there were many negative aspects of the policy, such as the lack of the herdsmen's participation, the lack of flexibility in the government's compensation policy, low compensation standards, and the resettlement policy and substitution industry policy were problematic. Although the grazing forbidden policy has attained positive ecological benefits, it has affected the livelihoods of the herdsmen, and most of them thought that their Government benefits were not guaranteed and hoped to return to herding. To ensure the sustainability of the grazing forbidden policy in the resource region of the Yellow River, the government needs to establish a diversified compensation policy for the herdsmen.

**Keywords:** The resource regions of the yellow river; grazing forbidden project; ecological performance; herder's response, herder's livelihood

### **5.4 A Review of Social-Ecological Studies on High Mountain Agricultural Systems in the HKH-Tibet Region**

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**Abstract:** High mountain agricultural systems in the HKH-Tibet Region represent typical examples of interactions between co-evolution of human beings and their environment. Although several studies have been carried out around Korakoram and a few studies have been made in the rest of the region, almost all of the studies are concentrated either on economic, social or cultural aspects and hardly any research has treated high mountain agricultural systems from the perspective of social-ecological systems. Impacted by globalization, modernization and climate change, these systems are facing new problems and opportunities. A systemic approach to understand the dynamics, resilience, adaptability and transformability of high mountain agricultural systems is urgently needed to help local communities, development agencies and governments to effectively tackle problems and grasp opportunities.

## 5.5 Ecological and Economic Benefits of Alfalfa Pastures in Sandy-lands in Dalate banner

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<sup>1</sup>(Grassland collage of Gansu Agriculture university, GanSu, LanZhou, 730070)

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**Abstract:** The milk contamination scandal revealed a fundamental problem in China - the lack of a super forage for the husbandry industry. It is important to develop an alfalfa industry to improve milk quality and farm incomes. The BangChen Eco-agriculture Limited Company, located in Dalate Banner, Inner Mongolia, near Kubuqi sandy-lands, has planted more than 300 ha of alfalfa in the sandy-land since 2006. Hay yields reached 7350 kg/ha by 2008 and has been used as feed for cattle and goats. The sandy land development strategy for alfalfa uses advanced machinery, proper fertilizer and spray irrigation systems, which not only fulfilled the sand development theory, but also ensures economic and ecological benefits. Management techniques include a spray irrigation system that has replaced a flood irrigation to save water, machines were used to flatten sand hills, organic fertilizers were utilized, and maintaining high stubble height helps reduce sand erosion in spring.

## **Theme VI: Human Resilience and Adaptation to Global Change**

### **6.1 Ecologically Discordant Agricultural Practice Erodes Sustainability of the Loess Plateau, China**

Mou Pu

(Life Science College, Beijing Normal University)

**Abstract:** Loess soils are found on some of the most productive and widespread agricultural lands around the world, but the sustainability of these areas are increasingly threatened by soil erosion. The Loess Plateau – the largest and most severely eroded loess region in the world – was the cradle of Chinese civilization where agriculture has lasted for nearly 7500 years. Based on more than 20-yr datasets, our study indicates that the asynchrony of dominant agricultural practice with the local ecological rhythm is a primary driver for large-scale soil erosion and landscape modifications in this region. The long summer fallow period concurrent with the heavy-rainstorm season greatly accelerated soil erosion and undermined the sustainability of the region. Our finding challenges the conventional belief that traditional land use practices that have lasted for thousands of years in countries like China tend to be ecologically sustainable. To contain soil erosion and achieve sustainability on the Loess Plateau, therefore, it is necessary to fundamentally change the traditional agricultural regime based upon the ecological rhythm, and promote multifunctional landscape planning that simultaneously facilitates environmental, economic, and social processes in the region.

### **6.2 Eco-migrants' Plight in the Source Area of the Yellow River**

Du Fa-chun

(Institute of Ethnology & Anthropology, CASS)

**Abstract:** Ecological migration, or ecological resettlement, is mainly a government-led initiative to develop the western regions in China, allow degraded landscapes to recover, and improve the standard of living of its inhabitants. One of major policies is 'Grain for Green Project', which means return farmland to forests, and animal breeding grounds to pastures. Since 2003, this project has been carried out in the Sanjiangyuan area (source of Yangtze River, Yellow River, and Mekong River) located in the southern Qinghai Tibetan area. It is characterized by a fragile ecosystem due to the global warming, unrestricted farming and overgrazing. However, the relocation of Tibetan herders from their traditional lands raises several key issues. In particular, the ecological rationale for this policy and the implications for those being resettled require careful examination. Ecological migrants face big challenges, such as resettlement in different places, transition of occupation, adaptation to urban life, and maintaining cultural traditions.

This paper is a case study based on the field research work in Maduo County which is located at the source of the Yellow River. It is focused on some of the critical issues related to eco-migrants, the social, economic, and ecological rationale and consequences of ecological resettlement. Moreover, the author will examine the

differences between the eco-refugees and eco-migrants, possible alternatives that do not involve moving people but control the number of animals so as to achieve a balance between the grassland and animal grazing, and policy improvements of ecological migration.

**Keywords:** Ecological Resettlement, Tibetan Herders, Plight, Socio-Economic Consequences, Cultural Maintaining

### **6.3 Spatial Quantitative Research of Human Impacts based on Landscape Change in Ebinur Lake Region**

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**Abstract:** With current growing problems related to population, resources and environment, landscape change is one of the core topics on the Present World Change Study. With a worsening global environment, depleted energy resources and the population explosion, the controversy between development and the environment has become increasingly acute, and the sustainable development of the oasis economy in the Ebinur Lake Region is particularly challenging. Using remotely sensed images from 2000 and 2005, the Ebinur Lake Region landscape was divided into eight different landscape types using the Support Vector Machine method: farmland, forestland, grassland, water, residential area, sandlot, saline soil and other. We analyzed the relationships between landscape change among the eight land use classes and human impacts. A human impact index was constructed based on landscape change, the spatial distribution of human exploitation and use strength. The weight was calculated by the area of landscape determined through remote sensing making the results more objective. Using the human impact index, a grid sampling method, and geostatistics, the human impact conditions across the landscape were quantified for 2000 and 2005, and the spatial structure of the impacts visualized and divided into different levels of human impact. The results showed that the human impact index ranged from 0.01090 and 0.40199, and that the maximum values occurred in the saline soil land use type. Thus, these results indicate that human impacts have had the most serious impact on the saline soil landscape type.

**Key words:** Remote Sensing Image; Landscape Change; Human Impact; Ebinur Lake Region

### **6.4 Vulnerability Assessment of Land Management Adaptation to Climate Change in Poverty-stricken Mountainous Area**

Yang Xi-tian, Zhang Ya-li, Huang Jun-chang, Feng Xin-wei, Meng Qing-xiang, Yu Lin

(Institute of Resources and Environment, Henan University of Agriculture, Zhengzhou, 450002, China)

**Abstract:** Extreme weather events are the main risk factors in land management in poverty-stricken mountainous areas and can lead to decreased agricultural production, deterioration of land quality, degradation of the eco-environmental, worsened poverty,

and so on. Vulnerability to climate change varies among townships and farmers and also among different coping strategies. The impact factors of vulnerability to climate change for Nanzhao county in Henan province, one of the national poverty counties, were analyzed in this paper, including natural resources, poverty, rural infrastructure, the frequency of extreme weather events and its damage, and labor migration. A vulnerability assessment system is proposed based on *Village resource map*, *Seven balance point matrix* (water resources, crops and forest biodiversity, food, labor, livestock and forage, fertilizer and agricultural chemicals, energy), and *Carbon stock index*. Finally, we put forward some sustainable land management activities for village-level planning to help adapt to climate change.

**Keywords:** vulnerability assessment; adapting to climate change; poverty-stricken mountainous areas; land management

## 6.5 Influence of different land use on urban microenvironment in Beijing City, China

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**Abstract:** The urban air temperature is gradually rising in all cities in the world. Records of the past years showed that the climate of built-up regions differs significantly from rural regions and one of the most obvious and important modifying effects of urbanization on local climate is the urban heat island (UHI). In order to clarify the spatial distribution of urban thermal field and to evaluate the urban environment quality synthetically, 5 sites including Xidan, the commercial center of Beijing district, Mudanyuan, the residential areas, Kunming Lake in Summer Palace, the water body, Chaoyang park, the urban green space and Wenquan Village, the suburb of Beijing were investigated from December, 2007 to February, 2008. The meteorological factors of temperature and humidity of underlying surfaces in these 5 sites were monitored simultaneously in 10h period. The results indicate: (1) the temperatures of underlying surfaces in different sampled landscapes were in the order of suburb < water area < green space < residential area < commercial center in winter, and water area < suburb < green space < residential area < commercial center in summer, while the humidity was in the opposite order in terms of landscape; (2) the largest temperature difference was 6.3°C at 18:00 h in commercial, the largest humidity difference was 25.9% at 8:00 h in residential area compared to rural; (3) Finally, this paper provides a concise and comprehensive understanding for the temporal and spatial microclimatic dynamics of these four kinds of urban ground cover in the five observation sites.

The study concluded that there is influence of urban land use and ground cover on the microclimate of Beijing, monitoring and analyzing urban growth patterns and evaluating their impacts on land surface temperature (LST), provide sound basis for ecological construction, environment improvement, urban planning and management.

**Key words:** Spatial and temporal distribution; Temperature and humidity; Urban land use; Land cover; Urban heat island

## **6.6 Impacts of Climate Change on Ecosystems and Adaptation Strategies in China**

Xuan Ya-lei

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**Abstract:** Climate change is becoming an increasingly severe problem. It is not only a global issue but also a regional problem. One of the most serious impacts of climate change is the effect on ecosystems which differs greatly among ecosystems, nations and regions. China has many unique ecosystems situated within a special society; hence the impacts on ecosystems by climate change are also unique. This paper attempts to map the ecosystem impacts of climate change in China in terms of its potential implications for society. It then considers available strategies, policies, information, and management tools to improve the adaptation capacity of the ecosystem and to decrease uncertainties under the scenario of climate change.

The framework of this paper (1) determines the current state of ecosystems in Chinese society, (2) specifies climate change scenarios in China, (3) assesses the ecosystem impacts under the different scenarios, and (4) identifies the best adaptation strategies for alleviating impacts of climate change.

**Keywords:** climate change; ecosystem; Chinese society; impacts; strategy

## **6.7 Characteristics and Influencing Factors of Public Participation in the Small and Medium-sized Towns and Cities: A Case Study from Henan Waste Water Treatment and Water Supply Project in China**

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**Abstract:** A common characteristic of water utility and wastewater companies in developing countries is management problems and limited commercial vocation. Public participation (PP) is increasingly expected to enhance the effectiveness of water utility and wastewater companies' management. The concept of public participation in the small and medium-sized towns and cities has been evolutionary for the recent years, particularly in waste water treatment and water supply project. Now, the waste water treatment and water supply project is widely developing for alleviating local water pollution in the small and medium-sized towns and cities of China. Participation in environmental protection in these areas was just being at starting stage, environmental propaganda and education which aiming at residents in small and medium-sized towns and cities were few, and the activities of environmental protection lagged, relative to big cities. These made public participation in the small and medium-sized towns and cities has own characteristics. This paper discusses the characteristics of public in the small and medium-sized towns and cities participation in waste water treatment and water supply project, the factors that affect the degree of public participation. It analyses the existing problems, and proposes the corresponding improvement scheme in order to enhance the



effectiveness of project management and better serves for local residents through public participation.

**Keywords:** public participation, the small and medium-sized towns and cities, waste water treatment and water supply project

## Theme VII: General Environmental Issues

### 7.1 Nitrogen Concentrations in Rainfall in Dalian, China

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**Abstract:** Wet atmospheric deposition samples were collected following every rain event that occurred from 2004 to 2008 in the region of Dalian in the northeast of China to monitor nitrogen levels. The volume of rainwater was collected and measured by a rain gauge and each sample was analyzed for total inorganic nitrogen (TIN) concentrations. Mean annual volume of rainfall ranged from 438.25 mm to 850.94 mm, and the mean annual concentration of TIN was 3.47 mg/L which was negatively related to the volume of rainfall. Maximum TIN concentrations of 4.29 mg/L were measured during the smallest rainfall event (438.25 mm) whereas the minimum TIN value of 2.96 mg/L was measured during the largest rainfall event of 850.94 mm. Nitrogen in rainwater originated primarily from the local application of agricultural fertilizers and from more distant and widespread exhaust of automobiles. Variation in TIN concentrations among years were highly significant. The annual precipitation inputs of TIN was positively related to the volume of rainfall, and were surprisingly high with deposition fluxes ranging from 10.24 kg/ha/yr to 25.17 kg/ha/yr. The maximum mean annual flux of 25.17 kg/ha/yr is equivalent to 53.94 kg/ha/yr usage of  $\text{CO}(\text{NH})_2$ , an amount that may have caused changes in terrestrial life. Strong seasonal patterns of TIN also were observed over the course of our study. We found that the majority of TIN deposition occurred during the summer (June-August) which accounted for 56.44% of total annual precipitation and 40.06% of total annual N deposition. Annual TIN fluxes decreased considerably after the rainy season and reached their lowest levels in the winter (1.39 kg /ha/yr) and autumn (2.98 kg /ha/yr).

**Keywords:** nitrogen concentration, rainfall, total organic nitrogen, flux

### 7.2 Strategies and Applications of Groundwater Exploitation for Ecological Conservation in Arid Fragile Region

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**Abstract:** A comparative study of agriculture and groundwater characteristics in a fragile arid region were analyzed to determine the impacts of groundwater use on desertification and salinization and to develop an index for the sustainable development of these arid lands. Reduction of ecological vulnerability was the evaluation criterion used. We used two quantitative coupled indicators, the irrigation guarantee rate and carrying capacity per unit area from groundwater, as the evaluation mechanism and, based on empirical evidence, an ecological warning line and warning interval of groundwater were established. The evaluation criteria can be used to

designate water use areas (such as areas of optimized exploitation, emphasis exploitation, restraint exploitation and prohibited exploitation), and formulate policies for the critical regulation of groundwater use and ecological restoration strategies for these arid landscapes.

### 7.3 Factors Controlling Surface Runoff on the Typical Steppe

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**Abstract:** We investigated ecological processes that control surface water runoff and erosion in typical steppe of Inner Mongolia typical by measuring runoff in the field, simulated runoff in field, and simulated runoff in the laboratory under different conditions. We present several key findings. First, vegetation degradation is the primary factor causing fluctuations in surface runoff. A significant positive correlation was found between surface runoff and level of degradation. Both the surface runoff coefficient and runoff discharge increased with increasing levels of vegetation degradation. Second, plant height and plant density of the vegetation canopy also was a primary factor causing fluctuations in surface runoff. The surface runoff coefficient and the surface runoff discharge decreased gradually with increases in plant height and density. However, the influence of plant height was greater than plant density on surface runoff under certain conditions. Third, litter played an important role controlling surface runoff mainly by a direct interception effect and an indirect barrier effect. The influence of litter was greater than the influence of vegetation on surface runoff under certain condition.

**Keywords:** Surface runoff, Surface litter, community canopy, community height, community density, Permeability of soils

### 7.4 Ecological Reconstruction of Soda Residue Dump in Tianjin, China

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**Abstract:** Soda residue dumps are a special type of urban industrial wasteland which causes serious damage to the environment, but little is known how to restore these wastelands in China and other countries. The main chemical constituents of soda residue are calcium chloride and calcium carbonate, which have serious negative effects on surface water and soil quality. In a solid form, the granules are very tiny with big interspaces and the residue turns to dust and is readily dispersed by the wind causing severe atmospheric pollution that is hard to manage. A soda residue dump located in *Tanggu* district in *Tianjin* was formed by producing alkali using the ammonia-alkali process over the last 80 years. In this project, more than 16,000,000m<sup>3</sup> of soda residues were converted into an engineered soil that was mixed with fly ash calcium from 1996 to 2001. Seven hills were constructed with the engineered soil and converted into a reconstructed park named *Ziyun* Park. Peak height of the dump is 32 m. The surface of the hill-body was covered with 0.8-1.2 meters deep top soil and then planted. More than 40,000 flowers and plants, 160,000

m<sup>2</sup> of lawn and almost 300,000 arbors and shrubs with more than 100 plant species were cultivated in this project. After five-years, the ecological restoration has been successful. The experience gained from this project can offer guidance for other similar ecological restoration projects.

Keywords: ecological restoration, reconstruction, soda residue dump, industrial wastelands, China

## 7.5 Feasibility of Extracting Eco-environmental Gradient Information using Hyperspectral Data in Karst Region, Southwest China

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**Abstract:** Because band widths are narrow and the range of spectra wide, subtle differences in spectral features can be extracted and used for mapping physical and chemical properties of bare substrate with imaging spectroscopy. However, the use of spectral characteristics of substrates are not accessible if the substrate is covered by vegetation. In this study, we explored the feasibility of extracting spectral properties of karst substrates across an eco-environmental gradient covered with vegetation.

Eco-environmental factors (slope, aspect, altitude, soil moisture, organic matter (SOC), pH and calcium carbonate content (Ca)) and vegetation biochemical materials were recorded simultaneously with the collection of vegetation reflectance spectra. Data collection took place during May 1-8, 2008, which was the peak growing season. Sampling plots were randomly placed within a relatively homogeneous vegetation community across an eco-environmental gradient. We used *t-tests* and derivative reflectance spectra to analyze the vegetation spectral differences along the eco-environmental gradient, and Canonical correspondence analysis (CCA) was used to explore the relationship between vegetation spectra and eco-environmental factors.

The results showed that there were significant differences between spectral features of the vegetation distributed in karst and non-karst regions. A combination of 1300-2500 nm reflectance bands and 400-700 nm first derivative spectra could delineate vegetation distributed in karst and non-karst regions. The CCA successfully assessed to what extent the variation of vegetation spectral features can be explained by associated eco-geo-environmental variables. It was found that soil moisture and calcium carbonate content had the most significant effects on vegetation spectral features in karst regions. Most sample plots were separated into two groups by the CCA ordination diagram according to the vegetation reflectance spectra. The CCA ordination successfully separated the vegetation spectral features along the main eco-environmental gradient of karst and non-karst regions. Vegetation spectra were thus well illuminated by the eco-environmental gradient in karst regions.

Our study indicates that vegetation spectra is tightly linked to eco-environmental

gradients, and that CCA is an effective method for studying the relationships among vegetation spectral features and eco-environmental variables. Employing a combination of spectral and spatial analysis, it is anticipated that imaging spectroscopy can be used for the interpretation and mapping of eco-environmental gradients covered with vegetation in karst regions.

**Key words:** Reflectance spectra, eco-environmental gradient, Canonical correspondence analysis, imaging spectroscopy, karst, Southwest China

## 7.6 Thin Layer Molecularly Imprinted Composite Membranes for Selective Separation of Erythromycin from Water

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**Abstract:** Molecularly imprinted composite membranes for selective binding of erythromycin were synthesized by means of UV initiated photo-copolymerization method using polysulfone ultrafiltration (PSF) membranes as porous supports. The thin imprinted layers deposited on the surface of the support membranes were formed by copolymerization of acrylic acid (AA) as functional monomer and ethylene glycol dimethacrylate (EGDMA) as cross-linker in the presence of erythromycin as template molecule in acetonitrile solution. Fourier transform infrared spectroscopy (FT-IR) spectroscopy was used to study the binding mechanism between the imprinted sites and the template. Scanning electron microscope (SEM) was utilized to visualize surface and cross-sections of membranes to gain more better understanding in the analysis of imprinted layers deposited on PSF support membranes. The modification degrees for imprinted and non-imprinted membranes are 2.04 and 2.15 mg/cm<sup>2</sup>, respectively. Static equilibrium binding and recognition properties of the imprinted and non-imprinted membranes to erythromycin (EM) and its analogue roxithromycin (RM) in aqueous system were tested. The results showed that saturated binding capacity of imprinted membranes to erythromycin was about 1.85mg/cm<sup>2</sup>, nearly 8 times of that of non-imprinted one, and the selectivity factor of  $\alpha_{EM/RM}$  was 3.24. The results of this study implied that the synthesized molecularly imprinted composite membranes could be used as selective separation materials for erythromycin enrichment from water.

## 7.7 Analysis of Soil Respiration in the Hobq Sand Land

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**Abstract:** With the increasing threat of climate change, understanding sources and sinks of carbon is critical for understanding the global carbon budget. Soil respiration is an important component of terrestrial ecosystem carbon budgets; however, there are

very few studies of soil respiration from sand lands.

This study was designed to measure soil respiration rates in three sand land plant communities in different stages of succession in Hobq sand land of this semi-arid region. Several factors were measured, including soil temperature, soil moisture, soil microbial biomass, aboveground biomass and underground biomass. Soil respiration was measured using a ADC Lci+ soil respiration apparatus, soil temperature (0-30 cm depth) was measured with a soil thermometer, soil moisture (0-30 cm depth) measured using the drying method, soil microbial biomass (0-30 cm depth) was determined using a plate counting method, aboveground biomass measured by cutting and weighing plants, and belowground biomass was determined by excavating roots to a depth of 30 cm.

The results of the study were as follows: 1. The average daily soil respiration rate of the shifting sandy land, semi-fixed sandy land, and fixed sandy land were  $-0.58 \mu\text{mol s}^{-1}\cdot\text{m}^{-2}$ ,  $-0.60 \mu\text{mol s}^{-1}\cdot\text{m}^{-2}$ ,  $-1.00 \mu\text{mol s}^{-1}\cdot\text{m}^{-2}$ , respectively with maximum rates occurring between the time of 10:00 to 12:00 h and minimum rates occurring between 16:00 to 20:00 h; 2. Soil respiration rates were negatively correlated to soil moisture ( $p=0.015$ ) and positively correlated to soil temperature ( $p=0.009$ ) on the sand land; 3. Soil respiration was positively correlated to bacterial populations ( $p=0.033$ ), but had no correlation to the actinomyces population, azotobacter population and fungus population on the sand land; 4. Soil respiration was positively correlated to both aboveground biomass ( $p=0.001$ ) and belowground biomass ( $p=0.001$ ) on the sand land; 5. The Grey correlation degree ranked the five factors related to soil respiration rates as follows: soil temperature (0.29) > underground biomass (0.17) and bacterial population (0.17) > aboveground biomass (0.16) > soil moisture (0.14).

In this study, we found that the soil respiration rates were related to soil temperature and soil moisture and are thus important factors regulating the release of carbon dioxide from the soil. The Grey correlation degree indicated that soil temperature was more important than soil moisture on soil respiration rates.

Our results suggest that, by using information on soil moisture, soil temperature, etc., carbon dioxide emissions by soil respiration can be estimated year round in plant communities at different stages of succession in sand lands. Moreover, the results establish important relationships between soil factors and soil respiration that can be used to study the carbon balance of other ecosystems.

## **7.8 Metal Decontamination of Tannery Solid Waste using *Tagetes patula* in association with a Resistant Fungus and Mycorrhizal Fungi**

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**Abstract:** A greenhouse trial was conducted to investigate the role of mycorrhizal and resistant fungi on heavy metal phytoextraction from different concentrations of tannery solid waste amended soil (10%, 20%, 50% and 100%) by *Tagetes patula*. The four treatments included were, the control (C) without any inoculum, mycorrhizal (M) inoculated with strongly mycorrhizal roots of *Cynodon dactylon*, fungal (F) inoculated with *Trichoderma pseudokoningii* and the combined inoculation with both mycorrhizal and fungal inocula (M+F). The dual inoculation increased plant biomass and phytoextraction ability of plant for metals like Cd, Cr, Cu, and Na. Plants given only fungus (F) and only mycorrhizal (M) treatment also showed significant growth rate as compared with control treatment. The statistical analysis of data indicated

synergistic interaction between mycorrhizal and fungal inoculum promoting high biomass and enhanced metal phytoextraction. Thus using more than one group of rhizosphere fungi in association with a high biomass producing plant may be employed for rendering tannery solid waste free of metals.

**Key words:** Phytoextraction, toxic metals, Arbuscular mycorrhizal fungi, resistant rhizosphere fungi

## 7.9 Role of Four Anchored and Floating Hydrophytes in Rhizofiltration of Heavy Metals from the Tannery Sludge

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**Abstract:** Four hydrophytes, including floating and anchored, namely *Hemarthria compressa*, *Hydrocotyle umbellata*, *Lemna minor* and *Typha angustifolia* were assessed for their growth and metal bioaccumulation capabilities in toxic tannery sludge. Greenhouse experiments were carried out in small plastic pots and beakers with different concentrations of fresh semi-solid (wet) sludge and dry sludge i.e. Control (0%), 20%, 30%, 40%, and 60%. Five plants of uniform sizes were grown in each pot. These experiments comprised of the five treatments with three replicates each, to be analyzed at monthly intervals (3 times). All hydrophytes showed good tolerance for all treatments of tannery sludge concentrations and exhibited good growth and development.

The amount of all metals increased with increasing concentration of sludge. Among the essential metals amounts were in the order of Sodium > Calcium > Potassium. While the heavy metals were in the order of Chromium > Zinc > Copper. Metal uptake was higher in the roots than shoots and was almost double the amount in case of essential metals. The difference in root to shoot translocation was not so pronounced in case of heavy metals showing a better bioaccumulation of these metals in aerial parts. In *Typha*, the maximum metal uptake was observed for Chromium (20,210 mg kg<sup>-1</sup>) after 90 days growth. In *Hydrocotyle*, the amount of the metal Chromium was reduced to 18, 200 mg kg<sup>-1</sup> in roots. The maximum uptake for Chromium was observed in *Hemarthria*, amounting to 11,564 mg kg<sup>-1</sup> while minimum uptake of the same metal was observed to be 10,201 mg kg<sup>-1</sup> in roots of *Lemna*. *Lemna* showed the least bioaccumulation of Chromium and Zinc than all other hydrophytes.

The coefficient of bioaccumulation indicated that the amount of heavy metals was greater in plants than sludge. The coefficient of bioaccumulation of metals in roots of both *Typha* and *Hydrocotyle* were quite high for Cr, 168.91 and 153.73 as compared to other metals. The coefficient of bioaccumulation of Cr in *Hemarthria* was 123.98 and in roots of *Lemna*, 59.20. The least bioaccumulation was observed for Na in all the cases. *Typha* proved to be a better hyperaccumulator plant than all other hydrophytes.

The results of these experiments reveal the efficient hyperaccumulators hydrophytes for commercial and large-scale cleaning and bioremediation of tannery sludge. Critical investigations on small scale experiments could help to develop application strategies of suitable plants to remove metal toxicity on large scale. The plants can then be harvested easily and incinerated. Constructed wetlands offer the treatment benefits of natural wetlands in a more controlled environment. The treatment processes within the system will be self-sustainable requiring little input of

energy, chemicals and operator maintenance.

### **7.10 In Vitro Interaction Studies between Different Resistant Fungal Strains Isolated from Tannery Waste**

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**Abstract:** Four resistant fungal strains namely, *Aspergillus niger*, *Trichoderma pseudokoningii*, *Fusarium* sp. and *Alternaria alternata* were isolated from tannery solid waste from Kasur. The interactions between resistant fungal strains were observed by dual inoculation in the same petriplate. The media used for the interaction studies were Czapek's, 2% Malt Extract Agar (MEA) and Modified Melin Norken (MMN).

The morphological data indicated that *Trichoderma pseudokoningii* was the most dominant among all strains and the order of dominance was observed to be *T. pseudokoningii* > *A. niger* > *A. alternata* > *Fusarium* sp.

**Keywords:** Resistant fungal strains, tannery solid waste, KTWMA, fungal interaction, fungal compatibility.

### **7.11 Changes in Landscape Patterns of Wetlands in the Dadu River Catchment over the Last two Decades**

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**Abstract:** Based on TM images from 1986 and 2000, an index of wetland landscape pattern was calculated using Apack software package to investigate spatial and temporal patterns of wetland change in the Dadu River catchment. Results showed that the wetland area increased 1095.79 hm<sup>2</sup> over the last two decades, which accounted for 6.65% of the landscape area in 2000. The patch density did not change between years, convergence indices were all above 0.99, wetlands showed concentrated distributions and low fragmentation, and the diversity index and dominance index were high. There were five wetland types in this region but the landscape was dominated by marsh wetlands (> 74%). The centroid of the marsh wetland distribution moved 127.6 km to the south and 127.9 km to the southeast, but there were no changes for other wetland types. The centroid of the whole wetland landscape distribution moved 0.09° to the north and 0.01° to the west moving approximately 9.96 km northwest.

**Key Words:** wetland landscape; spatial pattern; pattern indices; Dadu River