中美 CHINA • US Joint Research Center for Ecosystem and Environmental Change

绿色合作伙伴计划 ecopartnerships

The 2012 China–US Joint Symposium

"Land Use, Ecosystem Services, and Sustainable Development"

Conference Program

September 17–19, 2012, Shenyang, China

2012 China-US Joint Symposium

Land Use, Ecosystem Services, and Sustainable Development

September 17-19, 2012

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INTRODUCTION OF PARTNERSHIPS

The economies of the US and China are the globally dominant drivers of energy consumption, agricultural productivity, land use change, urban waste generation, and greenhouse gas emissions. Thus, despite their differences in terms of natural resources, economies, energy use, political structure, and culture, these two countries are linked in their concern over global climate change and in their goal of sustainable development of renewable energy sources and bio-industry. Both countries are shaping ambitious long-term plans for addressing environmental and energy problems at multiple levels in the areas of policy, science, and the economy. However, innovative and transformational science, engineering, and technology will require collaboration between the public and private sectors and mutually beneficial policies and incentives to help actualize solutions tailored to the economic and social needs of both nations.

China-US Joint Center for Ecosystem and Environmental Change (JRCEEC)

In 2006, in parallel with the creation of the China-US Strategic Economic Dialogue (SED) created by Presidents Hu Jintao and George W. Bush, scientists in China and the US signed a framework agreement establishing the China-US Joint Research Center for Ecosystem and Environmental Change (http://jrceec.utk.edu). Partnering organizations include: University of Tennessee-Oak Ridge National Laboratory's (UT-ORNL) Joint Institute for Biological Sciences (JIBS), UT's Institute for a Secure and Sustainable Environment (ISSE), Purdue University's Center for the Environment, the Institute of Geographic Science and Natural Resources Research (IGSNRR) and the Research Center for Eco-Environmental Science (RCEES) of the Chinese Academy of Sciences (CAS), and the Anhui Key Laboratory of Biomass Clean Energy at the University of Science and Technology of China (USTC). Among its goals, the Joint Center seeks to promote research collaboration, academic exchange, student education, and technology training and transfer in the areas of environmental concern. Collaborative themes include ecosystem processes and management, bioenergy sustainability, water resources and quality, and technologies for improvement of eco-environmental systems. Since its creation, JRCEEC has engaged more than 1,200 Chinese and US scientists from more than 40 institutions through international workshops, field site visits, and exchange programs for students and junior/senior researchers. Particularly, the regular engagements with governmental agencies (such as National Science Foundation, Environmental Protection Agency, Department of Energy of the US, Natural Science Foundation and Ministry of Science and Technology of China, and the Embassies of US and China) greatly promote the mutual understanding and their awareness of the unique, complementary resources and capabilities possessed by the joint center partners.

US-China EcoPartnership for Environmental Sustainability (USCEES)

In May of 2011 the US Department of State and the National Development and Reform Commission of China approved a proposal to establish a US-China EcoPartnership for Environmental Sustainability (http://www.purdue.edu/discoverypark/ecopartnership) that builds on the success of the JRCEEC. The EcoPartnership's overall mission was summarized at http://blogs.state.gov/index.php/site/entry/us_china_ecopartnerships by the US Secretary of State Hillary Clinton at the 2011 ceremony for the appointment of the most recent EcoPartnership members. The EcoPartnership is a collaboration among Purdue University's Global Sustainability Initiative, UT's ISSE, UT-ORNL JIBS of the US and the CAS institutes including IGSNRR, RCEES, and the Institute of Applied Ecology (IAE). The EcoPartnership serves as a conduit between scientists and decision makers at the highest levels in the US and China, and coordinates scientific activities and accelerates information and technology exchange among the members to generate more effective policy, technology and research solutions for the interconnected challenges of environmental sustainability, climate change, and energy security. Along with existing collaborations within the China-US Joint Research Center for Ecosystem and Environmental Change (http://jrceec.utk.edu), this bi-national partnership includes Centers within Purdue University's Global Sustainability Initiative, the University of Tennessee-Oak Ridge National Laboratory's (UT-ORNL) Joint Institute for Biological Sciences (JIBS), UT's Institute for a Secure and Sustainable Environment (ISSE), Institute of Geographic Science and Natural Resources Research (IGSNRR), Research Center for Eco-Environmental

Science (RCEES), and Institute of Applied Ecology (IAE) of the Chinese Academy of Sciences (CAS), and the University of Science and Technology of China (USTC).

2012 China-US Joint Symposium

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INTRODUCTION

The economies of the US and China are the globally dominant drivers of energy consumption, agricultural productivity, fertilizer utilization, urban waste generation, and greenhouse gas emissions. These two nations are thus strategically linked to the challenges of global climate change, food security, and sustainable development. The US and China share responsibility for developing realistic goals, effective strategies, and practical protocols for the best solutions for global energy, climate, food, and environmental problems that transform the production and use of limited energy and ecosystem resources. Innovative and transformational science, engineering, and technology will require collaboration between the public and private sectors and mutually beneficial policies and incentives to help actualize solutions tailored to the economic and social needs of both nations. A key to sustainable development is the proper management of our supporting ecosystems and their services as they are the foundation of global economic activity and human well-being. More than ever before, these two nations need to exchange perspectives at all levels and develop a joint agenda to benefit the world. US-China collaboration can create new economic opportunities through technology development, transfer and commercialization within the goals of clean and sustainable development—a realization of a series of bilateral environment and energy agreements signed at the annual meetings of the **US-China Strategic Economic Dialogue** (SED).

The US-China Ecopartnership for Environmental Sustainability (USCEES), one of 13 ecopartnerships since 2010, was established within this SED framework among Chinese and US research institutions. USCEES aims to promote bilateral collaboration to address the interconnected challenges of environmental sustainability, climate change, and energy security by leveraging and enhancing the capacity of member universities, research institutes, and industry through the promotion of research collaboration, academic exchange, student education, and technology/business development, and policy enhancement in areas of environmental concern. The partnership also accelerates information and technology exchange to generate more effective policy, technology and research solutions for sustainable development. This initiative was made possible jointly by the US State Department and the China's National Development and Reform Commission. The overall mission of the EcoPartnerships (EP) was summarized by the US Secretary of State Hillary Clinton at the 2011 ceremony for the appointment of the most recent EP members at http://blogs.state.gov/index.php/site/entry/us_china_ecopartnerships.

Along with existing collaborations within the China-US Joint Research Center for Ecosystem and Environmental Change (http://jrceec.utk.edu), this bi-national partnership includes Centers within Purdue University's Global Sustainability Initiative, the University of Tennessee-Oak Ridge National Laboratory's (UT-ORNL) Joint Institute for Biological Sciences (JIBS), UT's Institute for a Secure and Sustainable Environment (ISSE), Institute of Geographic Science and Natural Resources Research (IGSNRR), Research Center for Eco-Environmental Science (RCEES), and Institute of Applied Ecology (IAE) of the Chinese Academy of Sciences (CAS), and the University of Science and Technology of China (USTC).

Symposium Goals and Objectives

The symposium will work to generate an integrated research, policy and economic/business agenda for improving ecosystem services, developing green technologies, securing food production, and producing clean energy. Specifically, conference sessions and panel discussions will be organized around the following topics:

- Biomass Production, Utilization, and Impact
  - with emphases on food security, alternative energy, nutrient cycles, and rural development
- Ecosystem Services and Greenhouse Gas Emissions
  - with emphases on accounting, mechanisms, and vulnerability of ecosystem carbon
- Environmental Pollution and Remediation
  - with emphases on pollution control and contaminated land re-use

- Challenges of Urbanization and Clean Development
  - with emphases on balancing economic growth and environmental sustainability, building eco-city, managing wastes, and protecting groundwater

Organizers

- Institute of Applied Ecology, Chinese Academy of Sciences
- State Key Laboratory of Forest and Soil Ecology

Co-organizers

- Institute of Geographic Science and Natural Resources Research, Chinese Academy of Sciences
- Research Center for Eco-environmental Sciences, Chinese Academy of Sciences
- University of Science and Technology of China
- Shenyang Agricultural University
- Soil Science Society of Liaoning Province
- Shenyang University
- Bureau of Science and Technology, Shenyang Municipal Government
- Purdue University
- The University of Tennessee
- Oak Ridge National Laboratory

Participant

The symposium will invite approximately 30 leading scientists from the US, Japan, and UK and 40 Chinese leading scientists. The organizers also open the conference to other scientists and students (with registration). There will be approximately 60 oral presentations and up to 200 participants including scientists, students, government officials, and industry experts.

ORGANIZERS AND COMMITTEE

This invitation-only China-US symposium, which represents the second annual conference of the China-US Ecopartnership for Environmental Sustainability and the sixth annual conference of the China-US Joint Research Center for Ecosystem and Environmental Change, will be held in Shenyang, Liaoning province, China, September 17-19, 2012, and hosted by the Institute of Applied Ecology, Chinese Academy of Sciences.

Conference chair

Dr. Xing-Guo Han (Director, Institute of Applied Ecology, CAS)

Scientific committee (alphabetical order)

Chairperson: Dr. Tie-Heng Sun (Academician, Chinese Academy of Sciences)

Co-Chairperson: Dr. Gary Sayler (UT-ORNL Joint Institute of Biological Science [JIBS])

Members:

- Dr. Barry Bruce (Associate Director, Center for Renewable Energy and Education, UT)
- Dr. Zu-Cong Cai (Distinguished Scientist, Nanjing Normal University, China)
- Dr. Wei-Xin Cheng (Distinguished Scientist, University of California-Davis, USA)
- Dr. Virginia Dale (Corporate Fellow and Director of Bioenergy Sustainability, ORNL)
- Dr. Otto Doering (Director, Climate Change Research Center, Purdue University)
- Dr. Qing-Xiang Guo (Director of Anhui Key Lab of Biomass Energy, USTC)
- Dr. Terry Hazen (Governor Chair Professor, UT)
- Dr. Xing-Yuan He (Director, Northeast Institute of Geography and Agroecology, CAS)
- Dr. Gui-Bin Jiang (Academician, RCEES, CAS)
- Dr. Da-He Qin (Academician, Chinese Academy of Sciences)
- Dr. Chang-Qing Song (Vice-Director, Department of Earth Science, NSFC)
- Dr. Zhan-Xiang Sun (Vice President, Liaoning Academy of Agricultural Sciences)

Dr. Ronald Turco (Director, Water Resources Center, Purdue University)

Dr. Gerald Tuskan (Distinguished Scientist, ORNL)

Dr. Gao-Di Xie (Vice Director, Resource Science Center in IGSNRR, CAS)

Dr. Yu-Long Zhang (President, Shenyang Agricultural University)

Dr. Yong-Guan Zhu (Director, Institute of Urban Environment, CAS)

Organizing committee (alphabetical order)

Chairperson: Dr. Lan-Zhu Ji (Deputy Director of Institute of Applied Ecology, CAS)

Co-Chairperson: Dr. Jonathan Harbor (Director, Global Sustainability Initiative, Purdue)

Members:

Dr. Yong Jiang (Director, Department of Science and Technology, IAE, CAS)

Dr. Zhi-Yun Ouyang (Deputy Director, RCEES, CAS)

Dr. Mark Radosevich (Professor, UT)

Dr. Guofan Shao (Professor, Purdue)

Dr. Gui-Rui Yu (Deputy Director, IGSNRR, CAS)

Dr. Han-Qing Yu (Professor, USTC)

Mr. Mark Van Fleet (Director, Business Office, Purdue)

Dr. Jing-Kuan Wang (Professor, Shenyang Agricultural University)

Secretariat

Secretary-General:

Dr. Xu-Dong Zhang (Vice Director, State Key Lab of Forest and Soil Ecology, IAE)

Dr. Timothy Filley (Purdue Director of US-China Ecopartnership)

Dr. Jie Zhuang (Research Director, ISSE, UT)

Secretary:

Dr. Zhe Liu (IAE, CAS)

Dr. Wei-Hang Ding (IAE, CAS)

Dr. Hong-Bo He (IAE-CAS)

Dr. Mei-Ling Li (IGSNRR, CAS)

Organizers and Committee

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Email: whding@iae.ac.cn

Registration

Registration fee: free for invited participants

800 RMB for voluntary participants

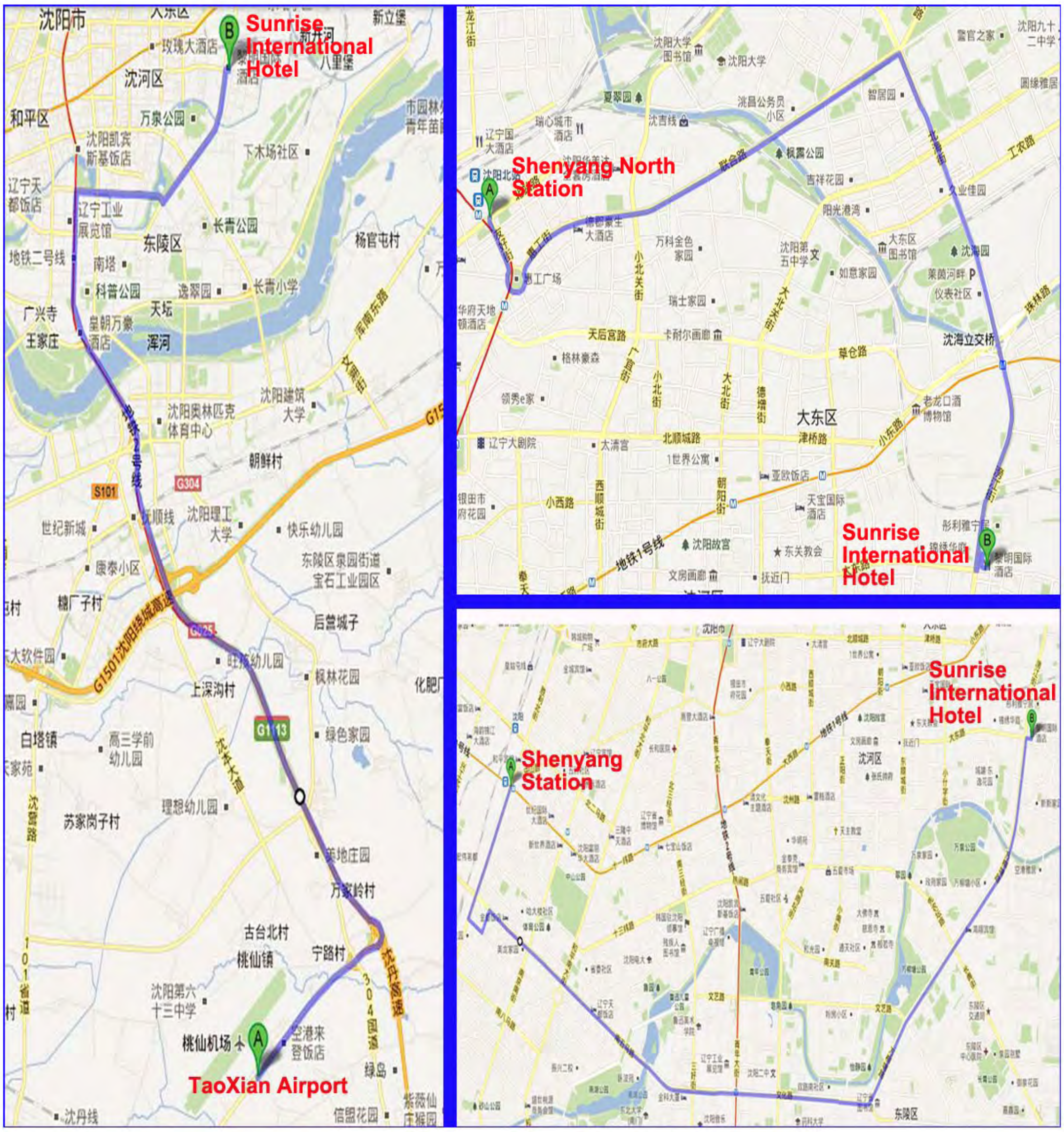
500 RMB for students

CONFERENCE VENUE

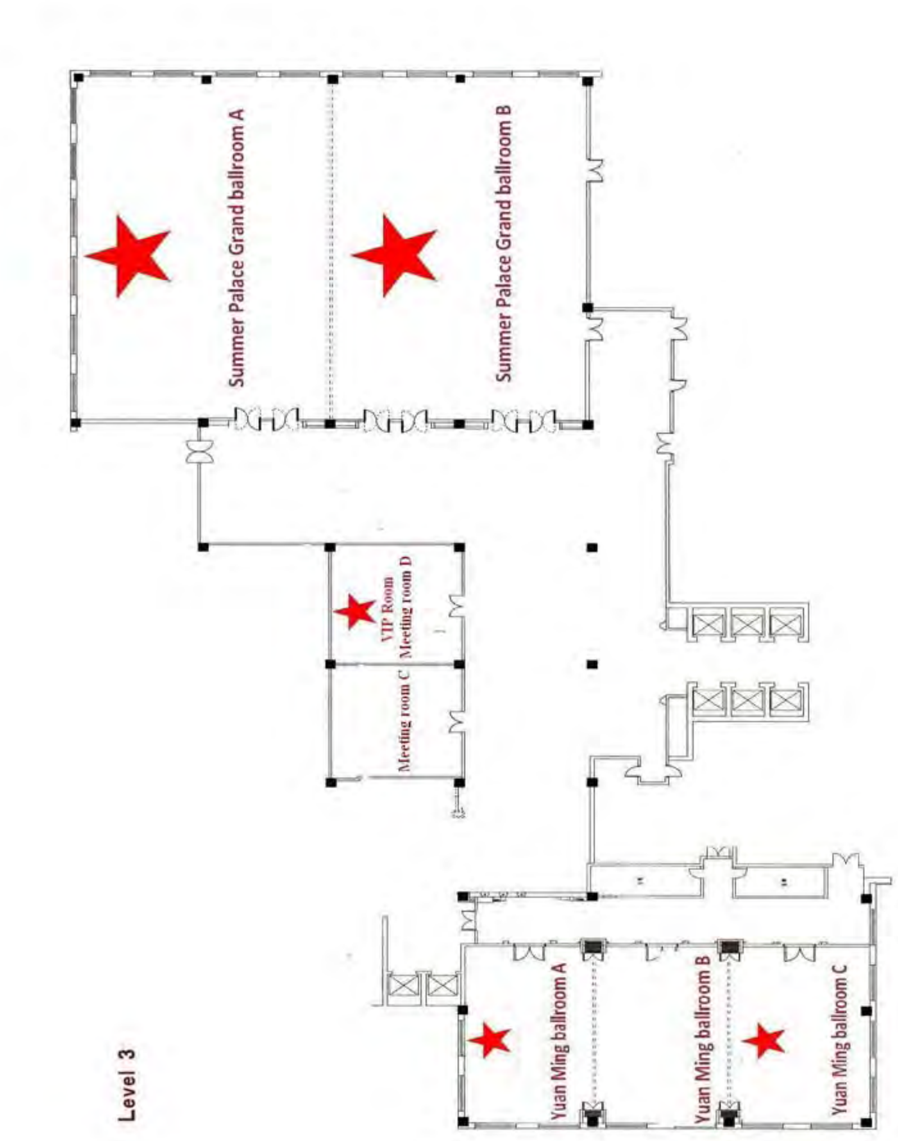
Hotel

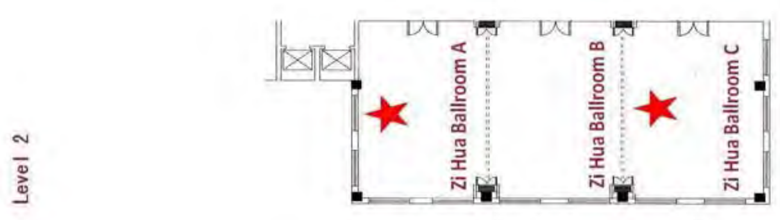
Participants will stay at the Sunrise International Hotel (5 star) located at 10 Chang'an Road, Dadong District, Shenyang, Liaoning Province, China. Non-smoking rooms will be reserved by the conference organizers, and any special request for rooms should be made through the conference contact volunteer persons. Detailed hotel information is available via hotel telephone +86 (24) 2435-9999 and webpage http://www.sunrisehotel.cn.

Conference Venue



Conference rooms





Overall Schedule

Time	Presentation	Location
September 16, 2012 (Sunday)		
8:00 -22:00	**Registration**	Sunrise International Hotel, 1st Floor
11:30-13:30	Lunch	
18:00-21:00	Buffet dinner	Yuan Ming Ballroom, 3rd Floor
September 17, 2012 (Monday)		
8:30-12:00	**Opening Ceremony and Keynote Forum**	Summer Palace Grand Ballroom B, 3rd Floor
12:00-13:30	Lunch	Summer Palace Grand Ballroom A, 3rd Floor
13:30-17:20	Workshop 1: Biomass Production, Utilization, and Impact - Environmental Impact and Application	Yuan Ming Ballroom A, 3rd Floor
	Workshop 2: Ecosystem Services and Greenhouse Gas Emissions - Human Impacts on Forest and Grassland Ecosystems	Yuan Ming Ballroom C, 3rd Floor
	Workshop 3: Environmental Pollution and Remediation - Ecotoxicology, Monitoring and Assessment	Zi Hua Ballroom A, 2nd Floor
	Workshop 4: Challenges of Urbanization and Clean Growth - Waste Management and Pollution Control	Zi Hua Ballroom C, 2nd Floor
17:30-20:00	Banquet and Cultural Performance	Summer Palace Grand Ballroom B, 3rd Floor

Note: please submit your slides in the Ballroom 20 minutes before the beginning of workshop

Overall Schedule

Time	Presentation	Location
September 18, 2012 (Tuesday)		
8:30-12:00	Workshop 1: Biomass Production, Utilization, and Impact - Biomass Conversion Technology	Yuan Ming Ballroom A, 3rd Floor
	Workshop 2: Ecosystem Services and Greenhouse Gas Emissions - Microbial Perspectives for Agro-ecosystem	Yuan Ming Ballroom C, 3rd Floor
	Workshop 3: Environmental Pollution and Remediation - Microbial Process and Response	Zi Hua Ballroom A, 2nd Floor
	Workshop 4: Challenges of Urbanization and Clean Growth - Low Carbon Strategy	Zi Hua Ballroom C, 2nd Floor
12:00-13:30	Lunch	Summer Palace Grand Ballroom, 3rd Floor
13:30-17:00	Panel Meeting- Workshop 1	Yuan Ming Ballroom A, 3rd Floor
	Panel Meeting- Workshop 2	Yuan Ming Ballroom C, 3rd Floor
	Panel Meeting- Workshop 3	Zi Hua Ballroom A, 2nd Floor
	Panel Meeting- Workshop 4	Zi Hua Ballroom C, 2nd Floor
17:10-19:30	Buffet Dinner	Summer Palace Grand Ballroom, 3rd Floor

September 19, 2012 (Wednesday)		
8:20-9:30	Transit from Hotel to the new campus of IAE	
9:30-11:00	Workshop Reporting and Future Plans	Conference room in Building A, 4th Floor
11:15-12:00	Laboratory tour	
12:00-13:00	Lunch	Conference room in Building A, 4th Floor
13:00-15:30	Tour on Fuling (Emperor Tomb) of Qing Dynasty	
15:30-16:00	Transit to Shenyang Agricultural University	
16:00-17:30	Roundtable meeting	Shenyang Agricultural University
17:30-19:30	Dinner	Shenyang Agricultural University

2012 China-US Joint Symposium

Land Use, Ecosystem Services, and Sustainable Development

Dates: September 17-19, 2012

Day 1: September 17, 2012 (Monday)

Opening Ceremony and Keynote Forum Time: 8:30-12:00 Place: Summer Palace Grand Ballroom B, 3rd Floor, Sunrise International Hotel	
Moderator	Dr. Lan-Zhu Ji, Chair of Organizing Committee, Vice Director of IAE, CAS
8:30-8:35	Introduction of distinguished guests
8:35-9:05	Welcome addresses by government and partnership leaders
9:05-9:15	Welcome by Dr. Xing-Guo Han, Conference Chair, Director of IAE, CAS
9:15-9:45	Group Picture and Tea Break
9:45-10:30	Keynote Address by Dr. Terry Hazen, Governor's Chair Professor at UT-ORNL Title: **The deep water horizon oil spill: a systems biology approach to an ecological disaster**
10:30-11:15	Keynote Address by Dr. Xing-Guo Han, Institute of Applied Ecology, CAS Title: **Biodiversity and stability in Inner Mongolia grassland: Long-term monitoring and experimental evidence**
11:15-12:00	Keynote Address by Dr. Otto Doering, Director of Climate Center at Purdue University Title: **Reactive nitrogen: an essential resource and an environmental problem for China and the US**
12:00-13:30	Lunch (Summer Palace Grand Ballroom A, 3rd Floor, Sunrise International Hotel)

Day 1: September 17, 2012 (Monday)

Workshop 1: Biomass Production, Utilization, and Impact **Session 1 Environmental Impact and Application** Time: 13:30-17:20 Place: Yuan Ming Ballroom A, 3rd Floor, Sunrise International Hotel	
Chair	**Dr. Indrajeet Chaubey, Purdue University**
Co-Chair	**Dr. Gao-Di Xie, Institute of Geographic Science and Natural Resources Research, CAS**
13:30-13:35	Chair's Introduction
13:35-14:20	Keynote address by Dr. Gerald Tuskan, Oak Ridge National Laboratory Title: **Plant-microbe interactions in the populus rhizosphere**
14:20-14:45	Dr. Gao-Di Xie, Institute of Geographic Science and Natural Resources Research, CAS Title: B**iomass resources and bio-energy in China**
14:45-15:10	Dr. Indrajeet Chaubey, Purdue University Title: **Sustainable watershed management under energy, food, and feed production scenarios**
15:10-15:40	Tea Break
15:40-16:05	Dr. Ronald Turco, Purdue University Title: **Soil process for sustainable systems including improved water quality**
16:05-16:30	Dr. Ren-Jie Dong, China Agricultural University Title: **China's research advance in biomass energy engineering**
16:30-16:55	Dr. Makoto Ooba, Nagoya University, Japan Title: **Ecosystem service assessment for wood biomass utilization for recovering plans of the Great East Japan Earthquake regions**
16:55-17:20	Dr. Qiang Yu, Institute of Applied Ecology, CAS Title: **Ecosystem productivity and biodiversity affected by nitrogen and phosphorus addition in Inner Mongolia grassland**
17:30-20:00	Banquet and Cultural Performance at Summer Palace Grand Ballroom B, 3rd Floor, Sunrise International Hotel Special Speaker: Mr. Mark van Fleet, Director of Business Office, Purdue University Title: **Realizing the business contribution to the mission of the EcoParntership**

Day 1: September 17, 2012 (Monday)

Workshop 2: Ecosystem Services and Greenhouse Gas Emissions **Session 1 Human Impacts on Forest and Grassland Ecosystems** Time: 13:30-17:20 Place: Yuan Ming Ballroom C, 3rd Floor, Sunrise International Hotel	
Chair	**Dr. Sean Schaeffer, The University of Tennessee**
Co-Chair	**Dr. Yang-Jian Zhang, Institute of Geographic Science and Natural Resources Research, CAS**
13:30-13:35	Chair's Introduction
13:35-14:20	Keynote address by Dr. Wei-Xin Cheng, Institute of Applied Ecology, CAS Title: **Significance and implications of rhizosphere priming effect**
14:20-14:45	Dr. Zu-Cong Cai, Nanjing Normal University Title: **Characteristics of nitrogen transformation in humid subtropical forest soils**
14:45-15:10	Dr. Timothy Filley, Purdue University Title: **Impact and legacy of woody plant invasion into a subtropical grassland**
15:10-15:40	Tea Break
15:40-16:05	Dr. Hai-Yan Chu, Institute of Soil Science, CAS Title: **Soil microbial distributions in cold ecosystems and their responses to climate change**
16:05-16:30	Dr. Yang-Jian Zhang, Institute of Geographic Science and Natural Resources Research, CAS Title: **Impacts of anthropogenic activities and climatic change on Northern Tibet grassland**
16:30-16:55	Dr. Takashi Machimura, Osaka University, Japan Title: **Demand-supply assessment of forest ecosystem provisioning services in Liaoning, China by an ecosystem model and remote sensing**
16:55-17:20	Dr. Edith Bai, Institute of Applied Ecology, CAS Title: **A global assessment of pre-industrial and contemporary nitrogen fluxes influenced by cropland conversion**
17:30-20:00	Banquet and Cultural Performance at Summer Palace Grand Ballroom B, 3rd Floor, Sunrise International Hotel Special Speaker: Mr. Mark van Fleet, Director of Business Office, Purdue University Title: **Realizing the business contribution to the mission of the EcoParntership**

Day 1: September 17, 2012 (Monday)

Workshop 3: Environmental Pollution and Remediation **Session 1 Ecotoxicology, Monitoring and Assessment** Time: 13:30-17:20 Place: Zi Hua Ballroom A, 2nd Floor, Sunrise International Hotel	
Chair	**Dr. Terry Hazen, The University of Tennessee and Oak Ridge National Laboratory**
Co-Chair	**Dr. Ling-Tian Xie, Institute of Applied Ecology, CAS**
13:30-13:35	Chair's Introduction
13:35-14:20	Keynote address by Dr. Gary Sayler, The University of Tennessee Title: **High throughput bioluminescent reporter yeast assay for endocrine disrupting chemical screening and fate in the environments**
14:20-14:45	Dr. Han-Qing Yu, University of Science and Technology of China Title: **Online monitoring and alert system for anaerobic digestion reactors**
14:45-15:10	Dr. Jie Zhuang, The University of Tennessee Title: **Virus retention and transport in porous media**
15:10-15:40	Tea Break
15:40-16:05	Dr. Gang Pan, Research Center for Eco-Environmental Sciences, CAS Title: **In situ technology for eutrophication control in shallow waters: removing, converting and recycling nutrients for sustainable food web**
16:05-16:30	Dr. Theodore Henry, The University of Tennessee and Plymouth University Title: **Environmental effects of manufactured nanoparticles: evolution of test methods, interpretation of results, and future research needs within nanoecotoxicology**
16:30-16:55	Dr. Xu-Dong Chen, National Institute for Environmental Studies of Japan Title: **Creating synergistic network by providing solutions to clients**
16:55-17:20	Dr. Qian-Ru Zhang, Institute of Applied Ecology, CAS Title: **Ecological service functions of the polychaete: ecotoxicology, bioremediation and resource utilization**
17:30-20:00	Banquet and Cultural Performance at Summer Palace Grand Ballroom B, 3rd Floor, Sunrise International Hotel Special Speaker: Mr. Mark van Fleet, Director of Business Office, Purdue University Title: **Realizing the business contribution to the mission of the EcoParntership**

Day 1: September 17, 2012 (Monday)

Workshop 4: Challenges of Urbanization and Clean Growth **Session 1 Waste Management and Pollution Control** Time: 13:30-17:20 Place: Zi Hua Ballroom C, 2nd Floor, Sunrise International Hotel	
Chair	**Dr. Yong-Guan Zhu, Institute of Urban Environment, CAS**
Co-Chair	**Dr. Holly Wang, Purdue University**
13:30-13:35	Chair's Introduction
13:35-14:20	Keynote address by Dr. Jonathan Harbor, Purdue University Title: **A practical model for planners to use in assessing and managing the impacts of urbanization on long-term runoff and non-point source pollution**
14:20-14:45	Dr. Guofan Shao, Purdue University Title: **Compact-city considerations on rapid urban sprawls in China**
14:45-15:10	Dr. Minoru Fujii, National Institute of Environmental Studies of Japan Title: **Designing and evaluation of complex recycling system for high-efficiency organic wastes use**
15:10-15:40	Tea Break
15:40-16:05	Dr. Yong Geng, Institute of Applied Ecology, CAS Title: **An overview of regional and sectoral CO2 emission in China**
16:05-16:30	Dr. Joseph Sarkis, Clark University in USA Title: **Flexibility in green and reverse logistics**
16:30-16:55	Dr. Yu Ma, International Ecosystem Management Partnership, United Nations Environment Programme Title: **The role of eco-cities in the development of green economy**
16:55-17:20	Dr. Takuya Togawa, National Institute for Environmental Studies of Japan Title: **Estimation model of regional energy supply and demand management system**
17:30-20:00	Banquet and Cultural Performance at Summer Palace Grand Ballroom B, 3rd Floor, Sunrise International Hotel Special Speaker: Mr. Mark van Fleet, Director of Business Office, Purdue University Title: **Realizing the business contribution to the mission of the EcoParntership**

Day 2: September 18, 2012 (Tuesday)

Workshop 1: Biomass Production, Utilization, and Impact **Session 2 Biomass Conversion Technology** Time: 8:30-17:00 Place: Yuan Ming Ballroom A, 3rd Floor, Sunrise International Hotel	
Chair	**Dr. Barry Bruce, The University of Tennessee**
Co-Chair	**Dr. Qing-Xiang Guo, University of Science and Technology of China**
8:30-8:35	Chair's Introduction
8:35-9:20	Keynote address by Dr. Qing-Xiang Guo, University of Science and Technology of China Title: **Biomass-based energy and chemicals**
9:20-9:45	Dr. Gary Sayler, UT-ORNL Joint Institute for Biological Sciences Title: **Developments of a synthetic yeast platform for direct alkane production from lignocellulosic biomass**
9:45-10:10	Dr. Yao Fu, University of Science and Technology of China Title: **Conversion of lignin to aromatic compounds by catalytic hydrogenation**
10:10-10:40	Tea Break
10:40-11:05	Dr. Ying Zhang, University of Science and technology of China Title: Convert lignin-derived phenols into Liquid Fuels in a two-step process
11:05-11:30	Dr. Barry Bruce, The University of Tennessee Title: Direct solar to fuel production using novel cyanobacteria
11:30-11:55	Dr. Jing Shi, University of Science and Technology of China Title: Synthesis and application of biomass-based oxygenated chemicals
12:00-13:30	Lunch
13:30-17:00	**Panel meeting of workshop 1** Chair: Qing-Xiang Guo; Co-Chair: Indrajeet Chaubey ● Biomass production potential and impacts (Gary Sayler, UT) ● Land use impact on water at multiple scales (Indrajeet Chaubey, Purdue University); ● Strategies for turning biomass-derived oxygenated compounds into motor fuel (Qing-Xiang Guo, USTC)
17:10-19:30	Buffet dinner (Summer Palace Grand Ballroom)

Day 2: September 18, 2012 (Tuesday)

Workshop 2: Ecosystem Services and Greenhouse Gas Emissions **Session 2 Microbial Perspectives for Agro-ecosystem** Time: 8:30-17:00 Place: Yuan Ming Ballroom C, 3rd Floor, Sunrise International Hotel	
Chair	**Dr. Wei-Xin Cheng, Institute of Applied Ecology, CAS**
Co-Chair	**Dr. Timothy Filley, Purdue University**
8:30-8:35	Chair's Introduction
8:35-9:20	Keynote address by Dr. Mark Radosevich, The University of Tennessee Title: **Terrestrial phage ecology: phage-host dynamics in agricultural, native and groundwater ecosystem**
9:20-9:45	Dr. Jing-Kuan Wang, Shenyang Agricultural University Title: **Changes of organic carbon density, storage and sequestration potential on the topsoil of farmland in black soil region in Northeast China**
9:45-10:10	Dr. Holly Wang, Purdue University Title: **Managing agricultural risks under the vulnerable ecosystem in China**
10:10-10:40	Tea Break
10:40-11:05	Dr. Jiao-Jun Zhu, Institute of Applied Ecology, CAS Title: **Mongolian pine (Pinus sylvestris var. mongolica) dieback in semiarid sandy land ecosystem of North China**
11:05-11:30	Dr. Sean Schaeffer, The University of Tennessee Title: **Seasonal drought, microbial threshold responses, and biogeochemical cycles in semi-arid ecosystems**
11:30-11:55	Dr. Xin-Yu Zhang, Institute of Geographic Science and Natural Resources Research, CAS Title: **Effects of fertilizer application on soil enzyme activities related to soil carbon, nitrogen and phosphorus dynamics in paddy red earth**
12:00-13:30	Lunch
13:30-17:00	**Panel meeting of workshop 2** Chair: Xu-Dong Zhang; Co-Chair: Mark Radosevich ● Phage-host interactions in soil (Mark Radosevich, UT) ● Microbial role in soil carbon and nitrogen transformation (Xu-Dong Zhang, CAS) ● Carbon and nitrogen cycling (Gui-Rui Yu, CAS)
17:10-19:30	Buffet dinner (Summer Palace Grand Ballroom)

Day 2: September 18, 2012 (Tuesday)

Workshop 3: Environmental Pollution and Remediation **Session 2 Microbial Process and Response** Time: 8:30-17:00 Place: Zi Hua Ballroom A, 2nd Floor, Sunrise International Hotel	
Chair	**Dr. Ronald Turco, Purdue University**
Co-Chair	**Dr. Gang Pan, Research Center for Eco-Environmental Sciences, CAS**
8:30-8:35	Chair's Introduction
8:35-9:20	Keynote address by Dr. Yong-Guan Zhu, Institute of Urban Environment, CAS Title: **Antibiotic resistance genes: emerging persistent contaminants from animal industry**
9:20-9:45	Dr. Steven Ripp, The University of Tennessee Title: **Illuminating environmental monitoring with living bioreporters**
9:45-10:10	Dr. Ling-Tian Xie, Institute of Applied Ecology, CAS Title: **Resolving discrepancies between laboratory acute toxicity data and field observations in aquatic insects exposed to metals**
10:10-10:40	Tea Break
10:40-11:05	Dr. Hui Xu, Institute of Applied Ecology, CAS Title: **Mitigating nitrous oxide emissions from the maize cropping soils in Northeast China**
11:05-11:30	Dr. Theodore Henry, The University of Tennessee and Plymouth University Title: **Unexpected effects of harmful algal blooms: Microcystis blooms linked to endocrine disruption in fish**
11:30-11:55	Dr. Chun-Jie Tian, Northeast Institute of Geography and Agroecology, CAS Title: **Nitrogen transfer and metabolism in the arbuscular mycorrhizal symbiosis**
12:00-13:30	Lunch
13:30-17:00	**Panel meeting of workshop 3** Chair: Terry Hazen; Co-Chair: Gang Pan ● Oil pollution and natural attenuation (Terry Hazen, UT/ORNL) ● Trade-offs in reducing nutrient pollution from agriculture—economic, farming system and regulation issues (Otto Doering, Purdue University)
17:10-19:30	Buffet dinner (Summer Palace Grand Ballroom)

Day 2: September 18, 2012 (Tuesday)

Workshop 4: Challenges of Urbanization and Clean Growth Session 2 Low Carbon Strategy Time: 8:30-17:00 Place: Zi Hua Ballroom C, 2nd Floor, Sunrise International Hotel	
Chair	**Dr. Jonathan Harbor, Purdue University**
Co-Chair	**Dr. Yong Geng, Institute of Applied Ecology, CAS**
8:30-8:35	Chair's Introduction
8:35-9:20	Keynote address by Dr. Tsuyoshi Fujita, National Institute of Environmental Studies of Japan Title: **Quantitative urban design system for low carbon cities and districts**
9:20-9:45	Dr. Shao-Hong Wu, Institute of Geographic Science and Natural Resources Research, CAS Title: **Future climate change and terrestrial ecosystems in China — case studies on SRES B2 scenario**
9:45-10:10	Dr. James Zhang, FuturaGene Company, Shanghai, China Title: **The future we want: planted forest as a sustainable solution for low carbon growth and global sustainability governance**
10:10-10:40	Tea Break
10:40-11:05	Dr. Noboru Yoshida, Wakayama University, Japan Title: **Multi-scale carbon footprint analysis of steel production in Liaoning**
11:05-11:30	Dr. David Jacques, University of Leeds, United Kingdom Title: **The potential of an inter-provincial CDM as a means to reduce the carbon intensity of China**
11:30-11:55	Dr. Gregor Hsiao, Product Manager, PRI-ECO Company Limited, USA Title: **Understanding carbon and water cycle: using isotopes and field measurements for quantification**
12:00-13:30	Lunch
13:30-17:00	**Panel meeting of workshop 4** Chair: Jonathan Harbor; Co-Chair: Yong-Guan Zhu ● Tools and Policies to Enhance Sustainable Urbanization Efforts (Jonathan Harbor, Purdue University) ● Impact of Urbanization on Urban Environment in China (Yong-Guan Zhu, CAS) ● Building Deconstruction to Green Space (Timothy Filley, Purdue University) ● Urban symbiosis, Urban climate policy and Urban land use planning (Yong Geng, CAS)
17:10-19:30	Buffet dinner (Summer Palace Grand Ballroom)

Day 3: September 19, 2012 (Wednesday)

Workshop Reporting and Future Plan Place: Conference room in Building A, 4th Floor, the new campus of Institute of Applied Ecology, CAS	
8:20-9:30	Transit from Hotel to the new campus of IAE
Convener	Dr. Xing-Guo Han
9:40-9:50	Reporting of Workshop 1: Dr. Indrajeet Chaubey
9:50-10:00	Reporting of Workshop 2: Dr. Wei-Xin Cheng
10:00-10:10	Reporting of Workshop 3: Dr. Terry Hazen
10:10-10:20	Reporting of Workshop 4: Dr. Jonathan Harbor
10:20-11:00	Discussion on Future Plans
11:00-11:15	Closing Remarks: Dr. Gary Sayler and Dr. Xing-Guo Han
11:15-12:00	Laboratory tour
12:00-13:00	Lunch
13:00-15:30	Tour on Fuling (Emperor Tomb) of Qing Dynasty
15:30-16:00	Transit to Shenyang Agricultural University
16:00-17:30	Roundtable meeting with faculty of Shenyang Agricultural University
17:30-19:30	Dinner at Shenyang Agricultural University

Days 4-5: September 20-21, 2012 (Thursday-Friday)

Post-conference Trips

Trip 1: Daqinggou Sandy Land Ecosystem Station, Liaoning province

Trip 2: Contamination site (Zhangshi waste water irrigation site, Shenyang)

2012 China-US Joint Symposium

Land Use, Ecosystem Services, and Sustainable Development

ABSTRACT

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The deepwater horizon oil spill: a systems biology approach to an ecological disaster

Terry C. Hazen

UT/ORNL Governor's Chair Professor at the University of Tennessee in the Departments of Civil & Environmental Engineering, Microbiology, and Earth & Planetary Sciences.

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The explosion on April 20, 2010 at the BP-leased Deepwater Horizon drilling rig in the Gulf of Mexico off the coast of Louisiana, resulted in oil and gas rising to the surface and the oil coming ashore in many parts of the Gulf, it also resulted in the dispersment of an immense oil plume 4,000 feet below the surface of the water. Despite spanning more than 600 feet in the water column and extending more than 10 miles from the wellhead, the dispersed oil plume was gone within weeks after the wellhead was capped – degraded and diluted to undetectable levels. Furthermore, this degradation took place without significant oxygen depletion. Ecogenomics enabled discovery of new and unclassified species of oil-eating bacteria that apparently lives in the deep Gulf where oil seeps are common. Using 16s microarrays, functional gene arrays, clone libraries, lipid analysis and a variety of hydrocarbon and micronutrient analyses we were able to characterize the oil degraders. Metagenomic sequence data was obtained for the deep-water samples using the Illumina platform. In addition, single cells were sorted and sequenced for the some of the most dominant bacteria that were represented in the oil plume; namely uncultivated representatives of *Colwellia* and *Oceanospirillum*. In addition, we performed laboratory microcosm experiments using uncontaminated water collected from The Gulf at the depth of the oil plume to which we added oil and COREXIT. These samples were characterized by 454 pyrotag. The results provide information about the key players and processes involved in degradation of oil, with and without COREXIT, in different impacted environments in The Gulf of Mexico. We are also extending these studies to explore dozens of deep sediment samples that were also collected after the oil spill around the wellhead. This data suggests that a great potential for intrinsic bioremediation of oil plumes exists in the deep-sea and other environs in the Gulf of Mexico.

Bio: Dr. Hazen received his B. S. and M. S. degrees in Interdepartmental Biology from Michigan State University. His Ph.D. is from Wake Forest University in Microbial Ecology. Dr. Hazen was Professor, Chairman of Biology and Director of Graduate Studies at the University of Puerto Rico for 8 years. He was the Head of the Ecology Department and Center for Environmental Biotechnology, Co-Director of the Virtual Institute for Microbial Stress and Survival, and DOE BER Distinguished Scientist at Lawrence Berkeley National Laboratory. He is currently the

Abstract

UT/ORNL Governor's Chair Professor at the University of Tennessee in the Departments of Civil & Environmental Engineering, Microbiology, and Earth & Planetary Sciences. He is an adjunct professor at several universities, including Guangdong Institute of Microbiology, Guangzhou, China and Central South University, Changsha, China. He is a fellow of the American Academy of Microbiology and has authored more than 271 scientific publications, not including more than 1055 abstracts and chapters in several books. Dr. Hazen was also the director of the Microbial Community Section of the Joint BioEnergy Institute at LBNL, specifically on community structure in tropical rain forest soil. He has 5 patents that have been licensed by more than 50 companies and are being used world-wide. He also has received 2 R&D100 awards and the Federal Technology Transfer Medal. His research is focused on microbial ecology as it relates to bioenergy, bioremediation, climate change, and environmental biotechnology.

Biodiversity and stability of Inner Mongolia grassland: long-term monitoring and experimental evidence

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To address the relationships among ecosystem productivity and biodiversity, and how this relationship respond to the gobal change factors such as precipitation and nitrogen deposition, and how rain use efficiency change along the precipitation gradient, we performed a series of investigations either in large temporal scale or in large spatial scale, and also conducted some maipulative experiments to uncertain underlying mechanisms. Our results were as follows: 1) January–July precipitation is the primary climatic factor causing fluctuations in community biomass production, and due to compensatory interactions among major species and/or functional groups, ecosystem/community stability increases progressively along the hierarchy of organizational levels. 2) The predominance of a positive linear relationship in this region defies the commonly held view that a unimodal form of PDR dominates terrestrial ecosystems. 3) With increasing mean annual precipitation, aboveground net primary productivity increased and become more stable across years, plant species richness increased, and rain use efficiency increased in space across different ecosystems but decreased within a given ecosystem. 4) The critical threshold for N-induced species loss to mature Eurasian grasslands is below 1.75 gN Nm-2 yr-1, and that changes in aboveground biomass, species richness, and plant functional group composition to both mature and degraded ecosystems saturate at N addition rates of approximately 10.5 gNm-2 yr-1. 5) As nitrogen addition rate increased, the importance of chance decreased on the whole for all these communities, but it decreased nonlinearly for plants and bacteria, with a local increase at certain intermediate rates. At all treatments, the importance of chance was <0.5 for plants, but >0.5 for ammonia-oxidizing Archaea. Our findings have important implications for understanding and predicting ecological impacts of global climate change and for management practices in arid and semiarid ecosystems in the Inner Mongolia steppe region and beyond.

Bio: Dr. Xing-Guo Han is director of Institute of Applied Ecology, Chinese Academy of Sciences. He is also the director of State Key Laboratory of Forest and Soil Ecology. His research activities focused on biogeochemistry and ecosystem ecology. Under the framework of ecological stoichiometry, he integrate the data of stoichiometry (C : N : P) of 1603 higher plant species, and thereby asserted that fertilization can markedly facilitate the carbon-fixing capacity of grassland ecosystems and that grassland ecosystems in China have tremendous carbon-fixing potential. Moreover, from the viewpoint of evolutionary ecology and ecosystem ecology, he proposed that the dominance of a plant species in an ecosystem should be closely associated with its water-, nutrient- and energy-use efficiency and that redundant species actually does not exist in the ecosystems.

Reactive nitrogen: an essential resource and an environmental problem for China and the US

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People around the world have critical needs that require reactive nitrogen (Nr) and also result in its release into the environment. Food production and fossil fuel burning are the two most important of these. However, we end up adding many times more Nr to the environment than natural processes do. The additional excess Nr is causing increasing environmental problems – lower water quality, increased greenhouse gasses, and human health problems. Excess Nr is a “wicked” problem not solvable by engineering and science alone. This is a different problem from building a railroad or putting a man on the moon. A “wicked” problem has more difficult trade-offs and requires much broader societal agreement on what the problem is and how we manage it. We have recently calculated the stocks and flows of Nr in the United States and it is clear that to attack the excess Nr problem we will have to focus a great deal of our attention on the largest users of Nr such as agriculture. A further difficulty is that Nr changes its forms and can move or cascade between land, water and air and between different sectors of the economy. Knowledge of the stocks and flows will allow us to target our efforts and learn where and how in the nitrogen cascade we might most effectively manage Nr to best reduce environmental damage in the most cost-effective way. We consider a number of possible management options that might be adopted in the United States or in China that range from regulation, to taxation, to market incentives that would change the management of Nr and reduce the amount of excess Nr going into the environment. Most of the options involve at least some negative trade-offs. These may require giving up some of the benefits of Nr or paying higher costs for reducing excess Nr while maintaining the benefits. One example is the trade-off involved in food production where Nr is an essential input that allows us to feed our populations but results in excess Nr. We also have places in the world where there is not enough reactive nitrogen for food production. The Nr problem is made more difficult because we manage it differently depending upon what metrics (economic, physical, etc.) we use and no single metric guarantees the best result for society. We will need much more monitoring of Nr flows and stocks to determine where best to manage Nr and the effectiveness of our management actions. If dealing with agriculture, whatever we do must take account of land type and land use. There is no single set of actions or technologies that will adequately address our excess Nr problem today. Many different efforts will be required

that must be geographically specific in order to reduce the environmental problems caused by excess Nr. The problem will never be solved, but we can reduce the Nr load to the environment and make things better.

Bio: Professor Doering has teaching, research and outreach extension responsibilities in the Department of Agricultural Economics. He is a public policy specialist on economic issues affecting agriculture, natural resources, the environment, and energy. He has served the U.S. Department of Agriculture (USDA) working on the 1977 and 1990 Farm Bills. In 1997 he was the Principal Advisor to USDA's Natural Resources Conservation Service (NRCS) for implementing the 1996 Farm Bill and served NRCS again in 2005. From 1985 to 1990 he was director of Indiana's State Utility Forecasting Group. In 1999 he was the economic assessment team leader for the White House National Hypoxia Assessment of the dead zone in the Gulf of Mexico. He served in 2007 on the National Research Council's committee on the Mississippi River and the Clean Water Act and their committee on the Water Implications of Biofuels Production in the United States. He is on the National Academies' Water Science and Technology Board and the U.S. Environmental Protection Agency's Science Advisory Board and chaired their Integrated Nitrogen Committee. He is a member of the US Department of Interior's Invasive Species Advisory Committee. Since 2009 he has directed Purdue's Climate Change Research Center.

Professor Doering has been a visiting professor at Berkeley, Cornell, and North Carolina A&T State University. He is a National Science Foundation evaluator for the NSF's Industry/University Cooperative Research Program. Dr. Doering has served on Indiana's Commission for Higher Education, the Governor's Education Roundtable, and chaired Indiana's Articulation and Transfer Committee. He was President of the American Agricultural Economics Association, 2007-8, and has received the AAEA's Distinguished Policy Contribution Award as well as its Extension Economics Teaching Award. He was part of the Intergovernmental Panel on Climate Change group of scientists that shared the 2007 Nobel Peace Prize for their work on climate change. He has overseas experience with the Ford Foundation, primarily in Southeast Asia. In previous lives he has worked as a horse wrangler in the Canadian Rockies and as a legal investigator in New York City. He has degrees from Cornell University (BA, PhD) and the London School of Economics (MSC. Econ.).

Professor Doering teaches "The Economic Geography of World Food and Resources" to undergraduates and teaches research methods to graduate students. His publications include books on the 1996 Farm Act and another on the effects of climate change and variability on agricultural production systems. He also has written on agricultural adaptation to climate change, the problem of reactive nitrogen, the importance of the choice of metrics in environmental policy and regulation, US biomass energy policy, integrating biomass energy into existing energy systems, and on the political economy of public goods.

Workshop 1: Biomass Production, Utilization, and Impact

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Plant-microbe interactions in the *populus* rhizosphere

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Successful development of sustainable biomass systems for food, fiber and bioenergy feedstock production will require a fundamental understanding of the interactions that occur among all biological components (i.e., plants bacteria and fungi) found within agricultural and/or forestry systems. We have been examining and characterizing the rhizospheric and endospheric microbial communities associated with *Populus* in both the southeastern and northwestern United States and have focused on mutualistic interactions and signaling between *Populus* and its microbiome. We have collected over 2000 bacterial and 400 fungal isolates from native and plantation-grown *Populus* and have used pyrosequencing to characterize the genetic diversity among isolates. Phylogenetic variation has been partitioned into seasonal, geographic and host genotype differences. Among the 2000 bacterial isolates, 42 isolates have been sequenced, assembled and annotated. These sequenced isolates have been used in mycorrhizal helper bacteria studies, biofilm formation experiments, quorum sensing studies and constructed community experiments. A common garden experiment is being used to identify genes within *Populus* that regulates the diversity of its microbiome. Implication for *Populus* biomass production and long-term stability will be discussed.

Bio: Gerald A. "Jerry" Tuskan, is a Distinguished Scientist in the BioSciences Division of Oak Ridge National Laboratory in Oak Ridge, Tennessee. He has more than 15 years experience leading and working with the US Department of Energy (DOE) on the development of biomass feedstocks. Dr. Tuskan is the DOE lead for the Laboratory Sciences Program at the Joint Genome Institute and is the project leader of the International Populus Genome Consortium. His research interests include genetic advancement of Populus and other woody crops in the deployment of biomass cropping systems for energy.

In 2006, Tuskan led the International Populus Genome Consortium in sequencing, assembling, annotating and publishing the Populus genome, which has been cited more than 1,000 times over the past five years. Tuskan has more than 120 publications in the areas of genetics and genomics of perennial plants, including 45 publications with nearly 800 citations that exclusively relate to biotechnology, biomass production, and bioenergy. Tuskan earned his doctorate in genetics from Texas A&M University, master's in forest genetics from Mississippi State University and bachelor's in forest management from Northern Arizona University.

Biomass resources and bio-energy in China

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Biomass energy is of the most potential for renewable energy, it has been accepted by international community to be the most effective resources and the best alternative to alleviate energy crisis. This study reviewed the current status of China's biomass resources and analyzed the development potential of bio-energy. China has the rich biomass resources, including crop straw, forestry residues, energy plants, animal manure, and organic waste. The development of biomass energy has a broad development prospects, and agriculture and forestry are the main two suppliers for biomass energy production. Taken non-food bio-liquid fuel as an example, seven major species of the most promising non-food energy plants, including Cassava, Sweet potatoes, Sweet sorghum, Jerusalem artichoke for bio-ethanol production, and Pistacia, Sorbifolia, Jatropha for bio-diesel production are selected to investigate and evaluate the suitable distribution of main non-food energy plants and the productive potential of non-food bio-liquid fuel in China using Geographic Information System (GIS) technique. The results indicate that if the marginal lands with the good quality (about 40.9 million hectares) can be fully utilized, the annual production of bio-liquid fuel will be 100.8-179.6 million tons, and the energy plants with bio-fuel potential from high to low in turn are Jerusalem artichoke, Sweet potatoes, Sorbifolia, Sweet sorghum, Pistacia, Jatropha and Cassava.

Bio: Gao-Di Xie, senior resources & ecology scientist and a senior bio-energy expert at IGSNRR (the Institute of Geographical Sciences and Natural Resources Research, Chinese Academic Science), director of the Research Department of Natural Resources, and director of Resource Ecology and Biological Resources Research Office, holding a PhD in agriculture and environmental security from Justus-Liebig University, Giessen, Germany. He has carried out research projects founded by National Natural Science Foundation of China, National Program on Key Basic Research Project, EU and Ministry of Environmental Protection, respectively. His interested study fields mainly include bio-energy, natural resource evaluation, ecological services, and green economy. He has published over 200 research papers in the domestic and international journals and 4 academic books, and grained three science and technology awards.

Sustainable watershed management under energy, food, and feed production scenarios

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In recent years, high US gasoline prices and national security concerns have prompted a renewed interest in alternative fuel sources to meet increasing energy demands, particularly by the transportation sector. Biomass production for meeting energy demand will compete with biomass production for food and animal feed. One of the grand challenges will be to produce biomass for meeting these needs in an environmentally sustainable and economically viable manner. Biomass selection will vary geographically based on regional adaptability, productivity, and reliability. Changes in land use and management practices may have potential impacts on water quantity and quality, sediments, and pesticides and nutrient losses, and these impacts may be exacerbated by climate variability and change. These water related impacts need to be evaluated so that appropriate plans can be implemented to safeguard against or mitigate any potential adverse environmental consequences to natural resources, including biodiversity and associated ecosystem services.

I will discuss the following questions, among others in this presentation: What are the unintended environmental consequences of increased biomass production for meeting food, fuel, and feed demands? What are the broad-scale water quality implications of energy crops, such as switchgrass, grown for bioenergy production on highly erodible soils? I will also discuss the needs for development of new simulation models and improvements in the existing models for developing management strategies for sustainable bioenergy crop production.

Bio: Dr. Indrajeet Chaubey is a Professor of Ecohydrology in the Departments of Agricultural and Biological Engineering and Earth and Atmospheric Sciences at Purdue University. Prior to joining Purdue, Dr. Chaubey was a faculty member at the University of Arkansas.

Dr. Chaubey's teaching and research activities include ecohydrology and water quality with emphasis on watershed scale terrestrial and aquatic water quality processes. He has developed decision support tools using watershed models to evaluate impacts of watershed management strategies on water availability, water quality, crop production, and ecosystem sustainability. Dr. Chaubey has published more than 325 research articles, including 71 peer reviewed journal articles and more than 125 technical papers in various conferences, and has given 36 invited presentations at various regional, national, and international conferences. He has several active research projects funded by U.S. Environmental Protection Agency, U.S. Department of Agriculture (USDA), National Science Foundation, and U.S. Department of Energy (DOE). Currently he is leading several projects funded by USDA and DOE to evaluate the hydrologic/water quality impacts and sustainability of biomass production for advanced biofuels in Midwest and southeast USA.

Soil process for sustainable systems including improved water quality

Ronald Turco

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The potential utilization of plant biomass for the production of cellulosic ethanol has raised concerns over the unintended changes in soil quality, specifically the dynamics of soil organic carbon (SOC) turnover and implications to nutrient cycling. Utilizing the Purdue University Water Quality Field Station (WQFS) we conducted a comparative three year assessment of changes in soil quality and N cycling following the initial plant establishment and introduction of biofuel harvest practices for five candidate biofuel feedstocks: big bluestem dominated tall grass prairie, no-till maize, *Miscanthus x giganteus*, dual-purpose sorghum (hybrid PU8168X), and switchgrass. Soil (Drummer silty clay loam) was sampled to 5 cm, four times over three years (June 2008, November 2008, April 2009, April 2010), capturing the transition from conventional grain production with residue returned, to second-generation biofuel crops and management with above ground biomass removal. We tested the hypothesis that different cropping practices (e.g., plant selection and intensive residue removal) would alter the soil C pools and influence soil microbial biomass and C turnover. The objectives were to 1) characterize physiochemical soil properties, including total organic C (TOC), permanganate oxidizable C (POXC), total nitrogen (TN), and soil pH, 2) characterize the size of soil microbial biomass using total phospholipid fatty acid –phosphate (PLFA-PO_4), and substrate-induced response (SIR), and 3) measure microbial C utilization by basal respiration (BR) and response to glucose addition (C_{mic}). Over the course of the study we observed no significant differences in the TOC or POXC, with mean values ranging from 21.2 – 29.4 g C kg^{-1}, and 720.2 – 933.5 mg C kg^{-1} respectively. Soil pH was significantly lower under continuous corn production than for the other systems. Following initiation of biofuel harvesting practices, declines in BR and SIR were observed under continuous corn, *Miscanthus* and in the prairie surface soils. Surprisingly, we noted a superior resilience in microbial measures of C dynamics in response to aboveground residue removal for sorghum and in the perennial monoculture of switchgrass. Microbial measures of C utilization proved to be sensitive indicators of potential changes in soil C. The rate of basal respiration was the most responsive indicator to changes in labile C, however, strong differences were also noted in the substrate-induced response. Based on the application of multivariate statistics of measured physiochemical (TOC, POXC, TN, pH) and microbial (PLFA-PO_4, C_{mic}, BR) parameters, we highlight the strength of BR as an early predictor of changes in soil C dynamics.

Bio: Dr. Ronald F. Turco is a Professor in the Department of Agronomy, Director of the Indiana

Abstract

Water Resources Research Center and has recently been named Director of the Purdue Water Community. He has B.S. degrees from the University of Idaho in Bacteriology and Soil Science and a Ph. D. from Washington State University in Soil Microbiology. His research has concentrated on understanding how the behavior of environmental microorganism is influenced by human activity. His program is divided across four areas: understanding the fate of introduced *E. coli* in soil and water and the role these processes play in such things as water and food contamination, developing a better predictive capacity to understand the environmental fate of manufactured nano materials (fullerenes, single wall carbon nanotubes and nanometals) in soil and water, defining the unintended consequences of using our soils resources for biofuel production and a long-term interest in the fate and degradation of organic materials introduced to soil, the subsurface and water. He has authored many articles and reports and has delivered numerous invited and volunteered presentations. Dr. Turco teaches two graduate level courses: Soil Microbiology and a course titled Biotransformation of Anthropogenic Molecules. He also teaches an undergraduate course on Soil Ecology.

BioEnergy engineering studies in China Agricultural University

Ren-Jie Dong

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China Agricultural University (CAU) is a leading institution for bioenergy researches in China. Several important biomass research platforms, such as Beijing Key Disciplines of Biomass Engineering, Ministry of Agriculture's Key Laboratory of Clean Production and Utilization of Renewable Energy, and the National Development and Reform Commission's Non-food Biomass Resources Research Center, have been allocated in this university; Non-food biomass resources development, physical property evaluation of biomass resources, biogas engineering, farmland application of biogas slurry, optimal design and performance evaluation of biomass stoves and so on, are the strengths and priorities of bioenergy researches in CAU. Besides that, China Agricultural University also takes the lead in bioenergy international cooperation. The challenges, solutions, and opportunities for bioenergy development in China are also explained in this presentation.

Bio: Dr. Dong Renjie (Mr.), born in December of 1964, is a professor of BioEnergy at China Agricultural University. He assumes the Executive Director of Biomass Engineering Center of China Agricultural University, Executive Director of Ministry of Agriculture's Key Laboratory of Clean Production and Utilization of Renewable Energy, and Director of BioEnergy Engineering and Low Carbon Technology Laboratory of China Agricultural University. In 1997, Renjie received his Ph D degree from China Agricultural University. Since then, he has devoted himself to Biomass stoves and biogas project researches. With support from Chinese and Dutch governments, he led a team to test biomass stoves in five provinces between 2004 and 2007. This has led to an initiative in China Agricultural University for biomass stove testing and Dr. DONG organizes a special Center to promote the development of international standards and protocols. Since a national project of biogas digestates research project was founded in 2008, the nutrients and components of the digestates, the mechanism of digestates' contribution in crop quantity and quality increasing, become the core parts of biogas researches of Professor Dong. Professor Dong is also the Director of International Relations of China Agricultural University.

Ecosystem service assessment for wood biomass utilization for recovering plans of the Great East Japan Earthquake regions

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The Japanese government has proposed to reduce greenhouse gas emissions to 80% of the levels observed in 1990 by the year 2050. According to the proposal, the use of biomass as a renewable energy resource may increase up to 4–6 times its use in 2000. However, the plan of action may need to be revised after the Great Earthquake and the accident at the Fukushima Daiichi nuclear power plant in 2011. The use of wood biomass has not been promoted as compared to the other renewable energy resources, although forests accumulate much carbon steadily in Japan.

The author have proposed an evaluation framework for the available wood biomass using a process-based ecosystem model and related GIS tools. Using various management and harvesting practices, the framework calculates both, the economic availability of timber and the viability of ecosystem services such as carbon sequestration.

In this report, the effect of forest management on the available resources amount in a case study (Kushida river basin) is presented. An assessment of the wood biomass resources is also provided for the region damaged by the disaster, along with an evaluation of the forest ecosystem services, carried out to compare recovery plans provided by the municipalities of the disaster-affected areas. For the disaster-affected areas located on the ocean-side, wood biomass is required to be continuously supplied from both the relatively flatland forests and the mountainous forests within or near the region. The study also observes that more large-scale corporations are required over the municipal borders for a sustainable energy supply from the forests. These corporations also create an economic stimulus by introducing monetary circulation between the Japanese forests and the disaster-affected areas. This also promotes healthy ecosystem services such as increased carbon sequestration in the forests.

Ecosystem productivity and biodiversity affected by nitrogen and phosphorus addition in Inner Mongolia grassland

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Nitrogen (N) and phosphorus (P) biogeochemical cycles have been altered greatly by human population expansion and industrialization. Ecosystem productivity, biodiversity and their relationship affected by eutrophication are focus of ecological studies, however, the results remain conflict. Based on 6 years (2006-2011) studyin Inner Mongolia grassland, here we showed that N addition increased ecosystem productivity and decreased biodiversity.However, the dynamics were regulated by precipitation in growing season. Furthermore, productivity-biodiversity relationship was positive at the beginning 2 years, not significantat the middle 2 years, and negative at the end of 2 years. Phosphorus addition increased ecosystem productivity only in 2011. Opposite with most previous studies, phosphorus addition increased biodiversity significantly in 2006-2008 and 2011, however it showed no significant relationship in 2009 and 2010 because of low precipitation in growing season. We did not find any significant relationship between biodiversity and productivity in phosphorus addition treatments. Our results suggested that biodiversity is a poor indicator of productivity, especially affected by N and P addition.

Biomass-based energy and chemicals

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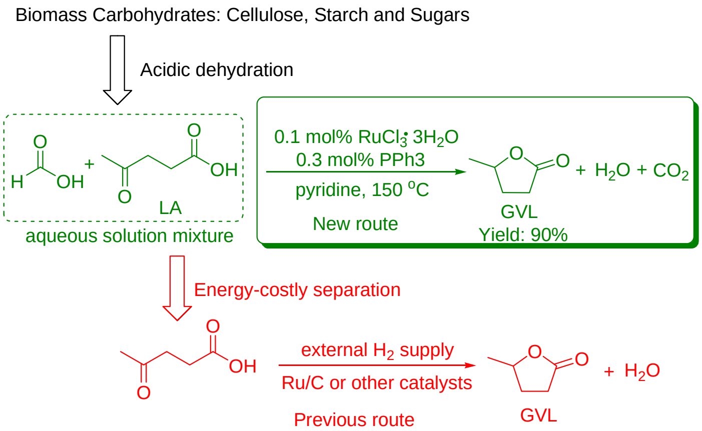
It is known that biomass-derived compound γ-valerolactone (GVL) may be used as a liquid fuel, food additive, solvent, and organic intermediate in the synthesis of fine chemicals. Here we present a novel route to convert cellulose or other carbohydrates to GVL without using any external H_2 supply [1] .



The procedure we developed not only improves the atom economy of the process, but also avoids the energy-costly step to separate levulinic acid (LA) from the aqueous solution mixture of LA and formic acid. To our delight, the experiments show that the conversion of 1:1 LA/formic acid in *ca.* 50 wt% aqueous solution can be successfully achieved with a maximum yield of 90%.

With the aim of the cleaner production of levulinic acid, which is the precursor of GVL, solid acids with ordered mesoporous structure were used to replace the corrosive and wasteful mineral acids. By comparison, mesoporous material bearing sulfonic groups (SBA-SO_3H) is superior to H_2SO_4 for LA production due to the high density of acid sites in mesoporous. To facilitate the process for catalyst recycling, magnetic solid acid Fe_3O_4-SBA-SO_3H has also been synthesized, offering good catalytic performance and easy separation from the reaction mixture.

[1] Deng, L.; Li, J.; Lai, D. M.; Fu, Y.; Guo, Q. X., *Angewandte Chemie-International Edition* 2009, 48, 6529-6532.

[2] Deng, L.; Zhao, Y.; Li J.; Fu, Y.; Liao, B.; Guo, Q. X., *ChemSusChem* 2010, 3, 1172-1175.

Development of a synthetic yeast platform for direct alkane production from lignocellulosic biomass

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World fuel demand is increasing at an unprecedented rate, leading to increases the in cost of fuel and increasing the complexity of oil extraction operations. It is now clear that a continued reliance on fossil-based fuel sources will become unsustainable in future years as these resources are depleted. Therefore, significant effort has been dedicated to developing alternative, renewable and carbon neutral fuel sources that can supplement or displace the use of traditional fossil fuels. The most promising of these is the biogeneration of "drop in ready" liquid hydrocarbons that are compatible with existing storage, transportation, and refining infrastructure. While previous discoveries have highlighted the ability of some cyanobacteria to generate alkane products from aldehyde inputs using a single enzymatic reaction, thus far no single organisms has been isolated that is capable of producing multiple chain length fuel products naturally at industrially relevant levels. To circumvent this hurdle, a systems biology approach has been employed to engineer a platform yeast host based on *Saccharomyces cerevisiae* that can express synthetic hydrocarbon fuel production cassettes. These cassettes, based on a two-component system that first generates an aldehyde precursor, followed by conversion of this precursor to an alkane product, can be tailored to produce various chain length alkane hydrocarbons by exchanging the genes responsible for either aldehyde or alkane production. Through the expression of multiple yeast strains each expressing different production cassettes, it will thus be possible to generate multiple hydrocarbon output blends that are chemically identical to those generated from fossil fuel sources. As a proof-in-principle demonstration of this technique, the aldehyde generating pathway of *Photorhabdus luminescens* and the aldehyde decarbonylase enzyme of *Nostoc punctiforme* PCC73102 have been expressed in a cassette that is capable of generating tridecane, a 13 carbon alkane component of both gasoline and diesel fuels. Computational analysis of the *S. cerevisiae* metabolic network has revealed that targeted mutations to key upstream pathways can further boost hydrocarbon production, and will serve as the basis for development of an optimized platform host for expression of all fuel production cassettes.

Conversion of lignin to aromatic chemicals and fuels by catalytic hydrogenation

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Lignin is one of the three major components of lignocellulosic biomass which consist of lots of aromatic units by various C-C, C-O-C bonds. It could be depolymerized and converted to aromatic chemicals and fuels though various chemical processes. We focused on the design of the catalysts and applied them to the conversion of lignin or lignin derived aromatic phenols to useful chemicals or fuels. Firstly, lignin oligomers were selected as the model compounds of the depolymerized reaction in order to study the mechanism and kinetics of different chemical bonds of lignin. Though different chemical processes such as hydrogenolysis, alcoholysis and oxidation, lignin could be converted to many different aromatic compounds which were subsequently dehydration/hydrogenation to C_6-C_9 saturated hydrocarbons. Besides, these aromatic compounds could be condensed though different C-C bond formation reactions to obtain C_8-C_{15} intermediates for the diesel-range fuel fraction. In particular, we have developed bimetallic catalysts and applied to the selective deoxygenation of aromatic phenols. Aromatics were obtained as the main products which was different to alkanes from previous works which were important industrial chemical raw materials. At last, we developed many bifunctional catalysts and applied them to the dehydration/hydrogenation reaction in order to make the reaction condition milder and greener.

Convert lignin-derived phenols into liquid fuels in a two-step process

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C_6-C_9 alcohols were good candidates for the replacement of fossil fuel: they burn cleaner than gasoline and produce less carbon monoxide and oxides of nitrogen. Additionally, alcohols have higher heat of vaporization which reduces the peak temperature inside the combustion chamber leading to less NO_x emissions and more engine power. Since longer chain alcohol packs more energy per gallon and is more compatible with jet fuel or diesel fuel, the production of higher carbon alcohols through the formation of C-C bonds was of great importance to produce higher quality liquid fuels. While for most existing approaches of the formation of C-C bonds, the presence of C=O (aldehydes, ketones and acids) is necessary, which cannot be applied to the condensation of alcohols directly. Here we present a novel process for converting lignin-derived phenols to long-chain alcohols. The phenols were hydrogenated to produce alcohols at mild conditions in water, followed by self-condensation to form C_{12} alcohols (2-cyclohexyl cyclohexanol and 2-(1-cyclohexen-1-yl)-cyclohexanol). To the best of our knowledge, this is the first time to produce lignin-derived liquid fuels employing the alcohol self-condensation reaction to date. Additionally, the bifunctional catalyst Ru/ZrO_2-La_2O_3 was developed for selective demethoxylation and converted guaiacol into cyclohexanol with an excellent yield of 90.8 %. The process described here opened a new route for producing high quality liquid fuel from lignin-derived phenols.

Direct solar to fuel production using novel cyanobacteria

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World petroleum production rates are predicted to reach its peak before mid-century[1] and the higher cost of recovering recalcitrant deposits is expected to drive up the price of petroleum-derived fuels. Although fossil fuels rely on photosynthesis-driven biomass accumulation from millions of years ago, there is hope that directly harnessing photosynthesis can shorten the cycle time for creating fuels from solar energy. Biomass-derived fuels are potentially a clean, renewable and sustainable source of fuel but several challenges exist. One of the major challenges is the high-energy cost and low yield of cellulosic conversion. This problem of cellulose conversion and lignocelluloses recalcitrance has been the focus of the recently funded DOE Energy Centers. However, there exists a more direct photosynthesis-driven biomass production, using algae and cyanobacteria, that are now becoming actively pursued. We are exploring a novel organism (*Chroococcidiopsis*) that is capable of producing large quantities of complex carbohydrates in an extracellular structure know as a sheath. During their growth cycle of cell division and expansion, the sheath is enzymatically converted into simple sugars that continually accumulate in their media. Analysis of these sugars indicate that they contain both pentoses (rhamnose, arabinose, and xylose) and hexoses (fucose, mannose, galactose, and glucose) in ratios very similar to that produced from higher plant cellulose digestion. Their robust growth, extremely thick carbohydrate-rich sheath, and their process of auto-conversion; combine for a very efficient production of simple sugars that can be used to support bioethanol production via yeast fermentation. Additionally, these organisms are capable of thriving in seawater and tolerate to bubbling very high CO_2 content flue gas, making their large-scale cultivation both inexpensive and a potential low-tech mechanism for carbon sequestration and biofuel production.

Bio: Dr. Barry D. Bruce is Professor in the Department of Biochemistry, Cellular and Molecular Biology. He is also an Adjunct Professor of Microbiology and Chemical and Biomolecular Engineering. He is a Founding Member and the Associate Director of the Sustainable Energy and

Education Research Center (SEERC). Dr. Bruce has B.A.s in both chemistry and biology from the University of California at Santa Cruz and holds a MS in Biochemistry/Biophysics from the University of Massachusetts at Amherst. In 1990, he received his Ph.D. in Molecular Plant Biology from the University of California at Berkeley and joined the UT Knoxville faculty in 1994 after completing a National Science Foundation post-doctoral Fellowship in Plant Biology at the University of Wisconsin at Madison.

Professor Bruce's laboratory works on two aspects related to photosynthesis: 1) one group investigates how proteins are targeted and transported to chloroplasts in plant cells. This work is not only fundamental to how plants grow and perform essential processes such as photosynthesis, but has also led to discoveries that enable scientists to engineer plants with higher nutritional content and to grow edible vaccines to help fight the spread of disease. A second group in Dr. Bruce's lab is developing new methods to apply the process of photosynthesis towards new energy sources such as hydrogen and electricity. This work attracted the attention of Forbes Magazine which recently recognized Dr. Bruce's as one of the "Ten Revolutionaries that May Change the World." A prolific researcher, Dr. Bruce has produced a large and important body of work contributing to both of these research fields. His work has been reported in The Plant Cell, Trends in Cell Biology, Plant Physiology, EMBO Reports, Molecular Biology of the Cell, J. Biological Chemistry, Nano Letters and Biochemistry.

Dr. Bruce teaches undergraduate and graduate courses in topics including Plant Physiology, Advanced Cell Biology, and Advanced Protein Chemistry and has been recognized several times for educational mentoring and outreach. Bruce's research is supported by grants from the National Science Foundation, USDA and DOE. He is currently the PI of a prestigious $1.7 million NIRT (Nanoscience Interdisciplinary Research Team) award from NSF to lead a team of researchers who are trying to harness the power of photosynthesis to generate electricity from solid-state solar panels. In 2008, he was a co-PI of a $3.1 million IGERT Award from NSF develop a graduate program in Sustainable Technology through Advanced Interdisciplinary Research (STAIR).

Dr. Bruce's work has been recognized on campus with awards and honors, as well as at the national and international levels. The Faculty Senate Research Council & Office of Research has twice awarded him the Scholarly Activity and Research Incentive Funds Award, and he won the Science Alliance Research Excellence Award three times. Bruce has been invited to give many national and international presentations. In 2007 he was invited to be one of the EMBO/FEBS Lecturers on The Molecular and Cellular Biology of Membranes held in Corsica, France.

Synthesis and application of biomass-based oxygenated chemicals

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Biomass resource is the only renewable resource which could be converted into liquid transportation fuels and chemicals. 5-(hydroxymethyl) furfural (5-HMF), furfural and levulinic acid (LA) were considered the important intermediates and “bridges” molecules connecting biomass feedstocks with fuels and chemicals. Our group developed a efficient and low-cost process of converting bio-based saccharides (especially glucose) to 5-HMF catalyzed by aluminium silicate in water-organic solvent biphase systems. Meanwhile, a new solid acid catalyst was used for catalytic conversion of D-xylose to furfural. Interestingly, levulinic acid could be easily and cheaply produced from biomass feedstocks (such as straw, sugarcane bagasse) through an integrated and robust process. This route achieved an encouraging yield of LA from biomass feedstocks based on the conversion of cellulose and hemicellulose simultaneously. 2,5-diformylfuran (2,5-DFF) was an important intermediate which had been attracting much attention due to its various applications. A one-pot approach for conversion of fructose to 2,5-DFF by combination of heterogeneous catalysts Fe3O4-SBA-SO3H and K-OMS-2 was demonstrated. Furthermore, a sustainable process for the hydrogenation of levulinic acid to fuel molecules (γ-valerolactone (GVL) and ethyl valerate) was established.

Workshop 2: Ecosystem Services and Greenhouse Gas Emissions

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Significance and implications of the rhizosphere priming effect

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Soil organic matter (SOM), a major component of global carbon and nitrogen cycles, largely determines soil quality, greenhouse gas emissions, and ecosystem services to human societies. Among mechanisms that control and influence SOM dynamics, the rhizosphere priming effect on SOM decomposition (defined as the stimulation or suppression of SOM decomposition by live roots and associated rhizosphere interactions) is increasingly recognized as one of the most crucial new mechanisms. Our research results indicate that the magnitude of the rhizosphere priming effect ranges from 50% suppression to as high as fourfold above the unplanted control, therefore, it is as important as temperature and moisture in controlling SOM decomposition.

Results from some CO_2-enrichment experiments further suggest that the rhizosphere priming effect is crucial in regulating soil organic C storage and N mobilization. There has been a major surprise in some recent studies of the effects of elevated CO_2 on soil C and N storage. Based on commonly reported findings of higher net primary production and greater organic C inputs belowground under elevated CO_2, a significant increase in soil organic carbon storage has been widely expected. However, several studies provide opposing evidence, where soil organic C storage declined when ecosystems were exposed to elevated CO_2. All these studies point to the rhizosphere priming effect as a key mechanism causing soil C loss and N mineralization. Global change research requires in-depth understanding of the rhizosphere priming effect, because it is responsive to elevated CO_2/O_3, warming, and N-deposition, and because it matters for the consequences of long-term C & N release or storage in terrestrial ecosystems.

Omitting the rhizosphere priming effect in current C-N models is a critical issue because the rhizosphere priming effect is a major modifier to decomposition processes itself, in addition to material balance in dynamic models. Quantitative formulation of rhizosphere priming under realistic conditions remains a major challenge for future research.

Characteristics of nitrogen transformation in humid subtropical forest soils

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Many subtropical and tropical forest ecosystems are naturally nitrogen (N) enriched while the majority of temperate forests ecosystems are N limited. However, the mechanisms of naturally occurring N enrichment are not well understood. We investigated simultaneously occurring gross N transformation rates in a range of subtropical and tropical acid forest soils by quantifying, taking temperate forest soils as control. Results showed that compared to temperate forest soils, humid subtropical and tropical acid forest soils had significantly high gross rates of N mineralization (2.88±1.03 mg N kg^{-1} d^{-1} vs 1.80±0.50 mg N kg^{-1} d^{-1}) ($p<0.05$) and significantly high turnover rate (550±295 d vs 2519±1419 d) ($p<0.01$). However, humid subtropical and tropical soils had much stronger capacity for retaining inorganic N than temperate forest soils, characterized by significantly lower ($p<0.05$) NH_4^+ oxidation rate (0.15 ± 0.16 mg N kg^{-1} d^{-1} vs 1.07 ± 1.57 mg N kg^{-1} d^{-1}) due to low pH, which also suppressed NH_3 volatilization, and significantly higher ($p<0.01$) rate of NO_3^- immobilization into organic N (0.71±0.45 mg N kg^{-1} d^{-1} vs 0.04±0.11 mg N kg^{-1} d^{-1}) effectively against leaching, runoff, and denitrification, which was demonstrated by our previous investigation to be weak in the soils. Our results suggested that warm and humid climate seems to be an essential condition for forest soils developing the ability of immobilization of NO_3^- into organic N, because the forest soils in warm but dry tropical regions and temperate regions did not develop the ability well.

Impact and legacy of woody plant invasion into a subtropical grassland

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A key research challenge for the Earth sciences is to accurately assess and predict the magnitude, direction, and impact of biological invasion. Invasive species often drive the evolution of landscapes and their ecosystems, while their population dynamics and behavior are simultaneously shaped by the transient environment. It is often challenging, however, to quantify how geochemical, biogeochemical, microbiological, and geomorphic processes are altered by the perturbation. The expansion of woody shrubs into grasslands is a global phenomenon driven by both climatic and land use stresses and can result in altered chemistry and rate of plant input chemistry, microbial community structure, and both invertebrate and vertebrate populations that can significantly perturb ecosystem function. We investigated feedbacks to the litter-soil-invertebrate system resulting from woody shrub expansion into a sub tropical grassland in southern Texas, U.S.A. Soil-bound enzymes, biopolymer concentration and stable carbon isotope composition, and soil particle association, in surface soils and termite feeding tubes were used to document the progressive alteration of the ecosystem and help to explain the dramatic increase in soil organic carbon and nitrogen under the woody clusters and predict what long lasting effects might result.

Bio: Recent Purdue Administrative Affiliations/Activities

- Associate Head (2007-2010), Department of Earth and Atmospheric Sciences (EAS)
- Graduate Program Chair (EAS) 2007-2010.
- Cofounder and Executive Committee member, Purdue Climate Change Research Center (2004-present).

Recent National/International Activities and Honors.

- National Chair and Program Chair -Geochemistry Division of the American Chemical Society (2007-2008).
- Visiting Senior Professorship, Institute of Applied Ecology, Chinese Academy of Sciences. (July –October, 2011)
- Filley's research group studies the fundamental processes controlling carbon and nitrogen cycling in soil, litter, and streams within natural and managed ecosystems and the implications of such biochemistry to the cycling of emerging pollutants. A primary goal of this work is to

develop a stronger scientific basis for understanding soil organic matter dynamics and ecosystem processes with an emphasis on how perturbations to ecosystems (e.g., woody plant encroachment, invasive species, storm events) interact with soil properties to sequester or release carbon and nitrogen. Filley's research involves the development and application of analytical tools designed to unravel the complexities of natural organic matter inherent in natural systems. Through application long standing molecular and isotope techniques, as well as novel techniques he has developed, he attempts to; a) assess the nature, source, rate, and extent of decay of natural organic matter in soil and aquatic fractions, b). determine the response of soil organic matter to natural and anthropogenic perturbations as it is reflected in changes to organic carbon stored in soils and litter or mobilized to streams and rivers, c) assess the extent and mechanisms of the microbial decomposition of plant tissue for ecological and biorefining applications, d) determine how the interaction of a range of environmental exposures possible for emerging pollutants influence their fate.

- Tim Filley has an extensive record of extramural funding and has co-authored over 50 journal papers. He was awarded Purdue University Seeds for Success Award (presented to faculty who have secured a sponsored research grant in excess of one million dollars in one year awarded to Purdue) in 2004. He received his bachelor's degree in chemistry in 1990 from Loyola University of Chicago and his PhD in geochemistry from the Pennsylvania State University in 1997. He was awarded a Carnegie postdoctoral fellowship from 1997-2000. Filley joined the faculty at Purdue University in 2000.

Soil microbial distributions in cold ecosystems and their responses to climate change

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Ongoing global climate change caused by human-induced increases in greenhouse gases represents one of the biggest scientific challenges of the 21st century. The net effect of climate change on terrestrial ecosystems carbon budgets depends on the balance between primary carbon production by photosynthesis and carbon emission (half by autotrophic plant respiration, half by heterotrophic microbial respiration in soils). Microbes play a major role in the carbon balance of terrestrial ecosystems through microbial respiration (breakdown of soil organic matter). Climate warming is widely predicted to be largest and most rapid at high latitudes and high altitudes like Arctic tundra, Tibetan plateau, alpine tundra etc. The impacts of climate change on these ecosystems are critical for the global C cycle because of the large amount of C stored in these cold regions due to long-term low microbial decomposition. Microbial communities in cold ecosystems are exposed to particularly severe environmental stresses and thus these soils may be expected to harbor relatively unique bacterial communities. However, few spatially-comprehensive surveys of soil bacterial communities have been conducted, and it is not known if soils in cold ecosystems harbor bacterial communities that are generally distinct from those found in more temperate environments. We investigate soil microbial community composition, diversity and spatial distributions in cold ecosystems, and microbial community responses to climatic changes (warming, nitrogen deposition). Our studies will provide scientific base to characterize the impacts of future warming in cold terrestrial ecosystems.

Impacts of anthropogenic activities and climatic change on Northern Tibet grassland

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Tibet plateau has fundamental ecological significance to China, Asia and the world. In recent years, mounting grazing pressure, in parallel with climatic change, has led to a series of ecological environmental issues, such as grassland degradation, soil erosion, and desertification, which threaten the regional sustainable development and social stability. The present study put the two primary factors under the same framework and comprehensively analyzed their separate contribution to the northern Tibet grassland degradation. We found that increased livestock is the primary reason causing the grassland degradation. Elevated temperature and enriched precipitation, as a result of climatic change, have been creating an increasingly favorable environment for vegetation, as being demonstrated by a lengthened growing season and improved productivity. But the negative effects caused by overgrazing surmounted the minor positive effects under climatic changes. This study implies that relieving local grazing pressure should be the primary avenue in restoring and reserving local ecological environment.

Demand-supply assessment of forest ecosystem provisioning services in Liaoning, China by an ecosystem model and remote sensing

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Wood production and water supply are the most common and important forest ecosystem provisioning services. Wise and sustainable forest management and use of ecosystem services are key aspects for ecologically harmonized human society. This study aims to assess the present balance of urban demand and forest supply potential of wood and water in Liaoning Province, China for resource and environment management policies.

Potential wood productivity and water outflow from forest area in the study area were predicted by the Biome-BGC ecosystem model. Simulations were performed for a 180-year period, in 30' latitude/longitude grids, for deciduous broad leaf forest (DBF) and evergreen needle leaf forest (ENF), and for different logging cycles (30, 60 and 90 years). Daily temperature, precipitation and VPD from 1981 to 2010 observed in and around the Province were used to generate the gridded meteorological inputs. Both wood productivity and water out-flow were closely correlated to annual precipitation. Wood productivity and water use efficiency (WUE) of DBF were higher than those of ENF.

A 1 km resolution forest coverage map and MODIS LAI images in April and July in 2010 were used to generate DBF and ENF forest coverage maps. Wood production and water supply map of the same resolution were then created by aggregating the coverage maps and productivity maps.

Four cities, Shenyang, Dalian, Dandong and Jinzhou, were selected and demand-supply balance of wood and water was assessed in coaxial circle zones centered at the cities and having radius of 25, 50, 75 and 100 km. Only Dandong can supply sufficient wood and water to demand in all ranges of zones. Demand-supply of wood and water reached balanced in the 100 km zone of Shenyang. In the zones of Dalian and Jinzhou, wood supply showed shortage, however the water shortage was more critical.

A global assessment of pre-industrial and contemporary nitrogen fluxes influenced by cropland conversion

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Cropland conversion is the most important landuse change that influences the global nitrogen (N) cycle. Here we provide a global assessment of N fluxes influenced by cropland conversion from pre-industrial to modern times. An N isotope model was used to partition fluxes of N in natural areas and a mass-balance simulation model was used in cropland environments. N inputs increased from pre-industrial (175.99 Tg N yr^{-1}) to contemporary (341.59 Tg N yr^{-1}) time periods, with 149.61 Tg N yr-1 associated with the global expansion of agriculture. This dramatic increase resulted in the export of 113.68 Tg N yr-1 to the hydrologic system and 111.56 Tg N yr^{-1} of gaseous emissions to the atmosphere, or both more than 1.5 times of pre-industrial values. NH_3, NO, and N_2O emissions increased from 8.55, 18.55, and 12.62 Tg N yr^{-1} , respectively, in 1860 to 17.66, 31.40, and 18.79 Tg N yr^{-1} , respectively, in 2000. The rise in the greenhouse gas N_2O was significantly correlated with cropland expansion and intensification. In geographic areas in which agriculture grew 5% to 20% of the total land area, N_2O fluxes increased by 0.076 Tg N m^{-2} yr^{-1}; from 20% to 40%, N_2O fluxes increased 0.146 Tg N m^{-2} yr^{-1}; and in those areas in which agriculture expanded by more than 40%, N_2O fluxes increased by 0.272 Tg N m^{-2} yr^{-1}. Our study thereby establishes constraints on the effects of agricultural expansion on the flux and forms of N throughout the land surface.

Terrestrial phage ecology: phage-host dynamics in agricultural, native and groundwater ecosystems

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Viruses are the most abundant entities in the biosphere. In aquatic systems viral infections can exert considerable influence on microbial community structure and function. The extent to which viral infection influences biological processes such as carbon and nutrient transformations in terrestrial systems is unknown despite the important role of soil ecosystems on global biogeochemical cycles. To address this knowledge gap our research aims to answer questions about the distributions and dynamics of viral assemblages in soils and groundwater. The work has focused on seasonal dynamics of virus and bacteria in a variety of land management systems (agricultural, successional, and native), arid soils, and groundwater. Though some fluctuations in viral abundance were observed, the overall abundance of viruses in soils was relatively stable. The lysogenic fraction (i.e. the fraction of the host population that possess inducible prophage), however varied considerably across land management systems. Undoubtedly, these variations are due to varying levels of host physiological stress brought about by bottom-up factors such as changes in moisture and nutrient availability, pH, temperature, and aeration among others but we were unable to correlate phage-host dynamics with these or other edaphic factors. Lysogenic interactions also varied seasonally and with land use and the observed values suggest that lysogeny is more prevalent in soil than in aquatic ecosystems. As expected, significant differences in microbial community structure with land Viruses are the most abundant entities in the biosphere. In aquatic systems viral infections can exert considerable influence on microbial community structure and function. The extent to which viral infection influences biological processes such as carbon and nutrient transformations in terrestrial systems is unknown despite the important role of soil ecosystems on global biogeochemical cycles. To address this knowledge gap our research aims to answer questions about the distributions and dynamics of viral assemblages in soils and groundwater. The work has focused on seasonal dynamics of virus and bacteria in a variety of land management systems (agricultural, successional, and native), arid soils, and groundwater. Though some fluctuations in viral abundance were observed, the overall abundance of viruses in soils was relatively stable. The lysogenic fraction (i.e. the fraction of the host population that possess inducible prophage), however varied considerably across land management systems. Undoubtedly, these variations are due to varying levels of host physiological stress brought about by bottom-up factors such as changes in moisture and nutrient availability, pH, temperature, and aeration among others but we were unable to correlate phage-host dynamics with these or other edaphic factors. Lysogenic interactions also varied seasonally and with land use and the observed values suggest that lysogeny is more prevalent in soil than in aquatic ecosystems. As expected, significant differences in microbial community structure with land management and sampling date were observed but a newly developed genetic fingerprinting assay for bacteriophage, randomly amplified polymorphic DNA (RAPD-PCR), was unable to definitively delineate corresponding changes in the composition of viral assemblages over time and in different land use systems. However, metagenomic analyses revealed **i)** substantial differences in the composition of viral assemblages from various land use types, **ii)** soil viral assemblages are extremely diverse, and **iii)** little similarity between the composition of extractable virus and inducible prophage assemblages. The most significant finding to date has been the establishment of the molecular basis for a prophage induction mechanism dependent on bacterial quorum sensing rather than physiological stress or DNA damage. The extent to which this mechanism is operative in soil ecosystems is unknown. The results indicate that phage populations are highly diverse and dynamic but the extent to which viral infection of prokaryotes influences biogeochemical transformations remains unclear.

Bio: Mark Radosevich, is professor of soil microbiology in the Department of Biosystems Engineering and Soil Science at the University of Tennessee. He has 20 years experience conducting research involving the fate and transport of organic pollutants in soils. During the past ten years he has addressed fundamental questions regarding the ecological role of terrestrial bacteriophage. Recently he was appointed as a research group leader in the area of Water and the Environment within the University of Tennessee Institute for Agriculture. He is responsible for assembling teams and facilitating interdisciplinary research directed at environmental sustainability in agroecosystems. Other recent research topics include the use of biochars as soil amendments, use of phage and phage-encoded proteins as biocontrol agents, and characterizing the ecological role of the Gemmatimonedetes, an abundant but rarely cultivated soil bacterial phylum.

Changes of organic carbon density, storage and sequestration potential of cropland in black soil region in northeast China

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Black soils in Northeast Plain of China are characteristic of high soil organic carbon (SOC) storage and density, and are playing a very important role for carbon sequestration in regional cropland ecosystem. In order to analyze the distribution and variation in SOC storage, density and sequestration potential of black soils between different periods, protect and maintain the quality of black soils, this paper, taken the long-term experimental sites of black soils in Hailun, Shuangcheng (Heilongjiang Province) and Gongzhuling (Jilin Province) as study areas, and with the help of GIS technology, was analyzed and demonstrated temporal and spatial distribution and variation in SOC storage and density of black soils on a large scale during the past 30 years (1980-2011). The SOC sequestration potential of black soils was estimated using the established models of SOC sequestration potential in cropland soil based on the long-term experimental sites. The results, which would provide more reliable basic data for research on SOC of black soils in Northeast China, indicated that: (1) It appeared an overall gradual downward trend with the decrease amount of 0.63 kg m^{-2} in SOC density and 4.6 Tg (4.6×10^{-3} Pg) in storage from north to south in topsoil (0-20 cm) in the three study areas during the past 30 years. Meanwhile, the decreasing amounts of SOC density in Hailun, Shuangcheng and Gongzhuling were 0.68 kg m^{-2},0.18 kg m^{-2} and 1.05 kg m^{-2} respectively, and the SOC storages dropped 2.3 Tg (2.3×10^{-3} Pg), 0.5 Tg (0.5×10^{-3} Pg) and 1.8 Tg (1.8×10^{-3} Pg) respectively. In addition, it appeared different changing rates to SOC density that it decreased faster during 1980 to 2000 in Hailun and Shuangcheng, but decreased fast all the time during the past 30 years in Gongzhuling. (2) It also appeared a downward trend in SOC density and storage during the past 30 years between almost all of soil groups, and the biggest decrease one in SOC density was brown earth (with a decrease amount of 1.95 kg m^{-2}), and the second one was alluvial soil (with a decrease amount of 1.54 kg m^{-2}). Furthermore, the most serious decrease one in SOC storage was black soil with a decrease amount up to 2.9 Tg (2.9×10^{-3} Pg), whose area accounted for 57.92% of the soil groups area in the study areas. And the second one was meadow soil with a decrease amount of 0.7 Tg (7.0×10^{-4} Pg). (3) Taken the data of the year of 2000 for example to estimate the SOC sequestration potential in the three study areas, the mean densities of SOC in Hailun, Shuangcheng and Gongzhuling were 7.32 kg m^{-2}, 3.16 kg m^{-2} and 2.97 kg m^{-2} respectively, and the saturated SOC mean densities were 8.31 kg m^{-2}, 6.02 kg m^{-2}, 4.93 kg m^{-2} respectively. Therefore, the final values of SOC sequestration potential were 0.99 kg m^{-2}, 2.86 kg m^{-2}, 1.96 kg m^{-2} respectively. So for the distribution of SOC sequestration potential, the biggest one was Shuangcheng site and the last was Hailun site.

Managing agricultural risks under the vulnerable ecosystem in China

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Although the year of 2012 has cast several daunting economic issues to China, such as low GDP growth and rising labor cost, one of the most sensitive concerns to Chinese government is still food security.

Food security in China means to provide the 1.34 billion Chinese food of sufficient quantity and good quality in terms of nutrients and variety under stable price. Unlike any other commodities whose prices can move up and down sharply and be considered acceptable, food is a very different commodity with important national security implications. Taking food security as the top priority, the No. 1 Document of the Chinese State Council in 2012 is focused on enhance the capacity of agricultural production through investment in science and technology.

However, Chinese vulnerable ecosystem has exposed farmer with higher risks than other part of the world. Risks in agricultural production will adversely affect food supply so as to directly threat food security. Risks also provide disincentives to invest in new technology that may have higher production potential. Furthermore, risks will cause income loss of farmers and contribute to rural poverty. The spirit of the No. 1 State Council Document is directly targeting all these three effects of risk. Hence, risk management needs to be greatly enhanced in the years to follow.

Chinese government has many subsidizing policies to farmers. Although all aim to improve farmers' welfare, they have different impacts on production behavior and consequently on ecosystem. Ecological impacts from policies related to production and risks will also be discussed.

Bio: Dr. Holly Wang, professor at the Department of Agricultural Economics, has been working as a professor at different ranks since 1997. Dr. Wang's research has covered agricultural risk, insurance, commodity prices, China economic development, food marketing and demand, and food safety. She has published more than 50 journal articles in top agricultural economics journals worldwide and near 100 conference papers, advised dozens of Ph.D. students some of whom are placed at major research institutes as tenured track faculty members, and actively involved in multidisciplinary research teams funded by grants. She is currently a Co-Editor for the journal *China Agricultural Economics Review*, and an Editorial Board Member for *Agricultural Finance Review* and for *China Economic Review*. In addition to research and teaching, Dr. Wang has served on several leadership positions for her profession. She was the Founding Chair of the China Section under the American Agricultural Economics Association. She also served as the President of the Chinese Economists Society.

Mongolian pine (*Pinus sylvestris* var. *mongolica*) dieback in semiarid sandy land ecosystem of North China

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Introduction of the exotic tree species can lead to modification of ecosystem function; in turn, produce feedbacks that drive further changes in environmental conditions. In order to establish the shelter forests in sandy land, Mongolian pine (MP, *Pinus sylvestris* var. *mongolica*) was introduced into semi-arid sandy land of North China for more than half a century. However, the introduced MP forests exhibited declining after about 30 to 35 years of introduction. Three decline traits exhibited: tree dieback and death, shorter lifetime than the natural forests, and no natural regeneration occurred in the introduced MP forests. On the basis of long term observations and a series of intensive experiments, combined with comparing with the natural MP forests on sandy land, we sought to determine (1) the causes induced the dieback, short lifetime and no natural regeneration; and (2) to give the suggestions for managing the introduced MP forests in the semi-arid sandy land. The results indicated that the introduced MP forests grew faster than those in natural forests in the early period of introduction because of good efficiency of growth in the juvenile stage under the conditions of higher heat and more rainfall in the introduction sites. However, the conditions such as water, temperature and nutrient in the introduction sites did not fit the further growth and the development of the MP trees after a certain years since the introduction; plus the inappropriately silvicultural measures, which resulted in tree growth slow down, and the vigor decreased, top, twig and needle withered, diseases and insects occurred. The appearance of no natural regeneration in the introduced MP forests was caused by the failure of seedling survival due to the extreme temperatures destroyed the ectomycorrhizal fungi within root depth of MP seedlings. Management patterns of “patch MP forest” or “MP Savanna”, and management techniques such as lower afforestation density, intensely thinning before water table beyond the root systems reached, for managing the introduced MP forests were suggested based on the results obtained in this study.

Keywords: Introduction, dieback, decline, *Pinus sylvestris* var. *mongolica*, plantation forest, sandy land, regeneration

Seasonal drought, microbial threshold responses, and biogeochemical cycles in semi-arid ecosystems

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Carbon (C) sequestration in soil is a critical issue for scientists, land managers, and lawmakers. Microbes decompose plant litter and soil C, and on the time scales relevant for sequestration, few molecules are so recalcitrant that microbes cannot metabolize them if they have access. Thus, understanding long-term C-sequestration may require understanding what controls microbial access to that C and what they do with it—its fate. One of the key environmental factors controlling microbial activity is moisture; which places a severe physical constraint on microbial access to resources via diffusion, while also potentially subjecting them to direct physiological stress. Thus, the soil hydrological landscape affects not only physical access to soil C via liquid water films, but also how organisms allocate C among growth, stress tolerance, and resource acquisition.

With drought frequency and severity likely increasing in the future, understanding its effect on terrestrial C and nitrogen (N) cycling has become essential for accurately modeling ecosystem response. This water limitation is particularly strong in semi-arid and arid ecosystems such as those found along California's coast and interior range-lands. Cool, wet winters separated by long, dry summers present some the most challenging conditions for microbial survival and growth. We found significant microbial activity during the dry season in several different ecosystems. It is unclear if this activity represents growth of new organisms, or was a result of microbes accumulating internal solutes to avoid desiccation. We found that substantial shifts in substrate availability occur under dry conditions, and can quickly shift with pulses of precipitation. Also, the initial respiration rate after wetting a dry soil can be positively correlated to the duration of soil drought.

These abiotic and microbial dynamics may control the amount and composition of C and N export from these ecosystems. Long, dry summers allow organic compounds and nutrients to accumulate, and then a single large precipitation event can lead to a large pulse being released. We conclude that there are important interactions between the extent and duration of drought that impact ecosystem C and N cycling and how microbes allocate C may be particularly important for understanding the long-term fate of C in soil.

Bio: Dr. Sean Schaeffer is an Assistant Professor in the Department of Biosystems Engineering and Soil Science at the University of Tennessee, Knoxville. He obtained a B.Sc. from the

University of Utah, a M.Sc. from the University of Arizona, and a Ph.D. from the University of Arkansas. Prior to arriving in Tennessee, he was a Postdoctoral Scholar and Project Scientist at the University of California, Santa Barbara. Dr. Schaeffer is a soil biogeochemist with research interests in the coupled cycling of carbon and nitrogen and how they control the long-term stability of soil organic matter. His current research includes NSF-funded projects studying: 1) microbial carbon assimilation and allocation under drought conditions in southern California grasslands, and 2) the effects of seasonal transitions and freezing/thawing on microbial carbon and nitrogen cycling in low and high Arctic ecosystems. His other research interests include: the role of viruses in terrestrial biogeochemical cycles, stability of soil organic carbon fixed by biofuel crops, soil processes in cadaver decomposition islands, and the application of novel stable isotope tracer techniques to study ecosystem processes. Dr. Schaeffer is a member of the Ecological Society of America and the American Geophysical Union.

Effects of different fertilizer applications on soil enzyme activities related to soil carbon, nitrogen and phosphorus dynamics in paddy red soil

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Soil enzymes are the primary biological mechanism of organic matter decomposition and nutrient cycling. The activities of soil enzymes can be proxies for microbial activity, decay rates, and the availability of substrates for microbial or plant uptake. Soil enzyme activities are used as sensitive indicators of soil fertility and agri-ecological system function. The study was conducted in the long term fertilizer application experiment of paddy red soil, which were established in 1998, at the Qianyanzhou Ecological Experiment Station in subtropical area of southern China. The purpose of this experiment was to evaluate whether application of different fertilizers (straw returning (ST) ,manure (OM), chemical fertilizer (NPK)) influence enzyme activities (β-1,4-glucosidase,β-1,4-N-acetylglucosaminidase; Leucine aminopeptidase; acid phosphatase).The results showed that:1) the soil βG, NAG and AP enzyme activities of the manure treatment (OM) were significantly higher than those of the other treatments, and were 1.4 times, 3.2 times and 31% higher than those of the control (CK), respectively. Application of manure also improved the ratios of soil organic carbon to total nitrogen (C/N), soil βG/(NAG+LAP) and βG/AP 2) soil NAG enzyme activity of the chemical fertilizer treatment (NPK) was significantly higher than the other treatments, but soil LAP enzyme activity of the NPK treatment had no significant difference with the other treatments. Soil βG enzyme activity of the NPK treatment was slightly lower than that of the OM treatment. But AP enzyme activity in the NPK treatment was the lowest, with 17% lower than that of the CK treatment. In addition, the NPK treatment improved the soil β G/AP and (NAG+LAP)/AP, and reduced the ratios of soil organic carbon to total phosphorus (C/P), total nitrogen to total phosphorus (N/P).3)The straw returning treatment (ST) showed the trends of improvement of soil βG, NAG, LAP and AP enzyme activities, but no significant differences were observed from the CK. In general, manure application promoted microorganism cellulose degradation and benefited to accumulation of soil organic carbon. It's an effective practice to improve soil fertility and soil microbial function. The treatment of nitrogen, phosphorus and potassium mineral fertilizers caused the accumulation of inorganic phosphorus in the paddy red soil, which may inhibit the microbial function of degrading polysaccharides and phosphate phospholipids. It suggested that the ratio of mineral phosphate fertilizer should be reduced in the future. This study also showed that the amounts of straw returning in the ST treatment, which straw produced from the self plots, were not enough. And it should also combined straw returning with phosphorus application in order to reduce soil C/P ration and to improve soil quality.

Effect of Different Fertilizer Application on the Soil Fertility and Microbial Community Composition of Paddy Soils in Red Soil Region of Southern China

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Appropriate fertilizer application is an important management practice to improve soil fertility and quality in the red soil regions of China. In the present study, we examined the effects of different fertilization treatments [e.g., no fertilization (CK), rice straw return (SR), chemical fertilizer (NPK), organic manure (OM)] on soil pH, soil organic carbon (SOC), total nitrogen (TN), C/N ratio and available nutrients (AN, AP and AK) contents in the plough layer (0-20 cm) of paddy soil from 1998 to 2009 in Jiangxi Province, southern China. Furthermore, microbial community compositions were determined by phospholipids fatty acids (PLFAs) in the long-term located experiment with different fertilization treatments. Results showed that the soil pH was the lowest with an average of 5.33 units in CK and was significantly higher in NPK (5.89 units) and OM (5.63 units) treatments ($P<0.05$). The application of fertilizers have remarkably improved SOC and TN values compared with the CK, Specifically, the OM treatment resulted in the highest SOC and TN concentrations (72.5% and 51.2% higher than CK) and NPK treatment increased the SOC and TN contents by 22.0% and 17.8% compared with CK. The average amounts of C/N ratio ranged from 9.66 to 10.98 in different treatments, and reached the highest in OM treatment ($P<0.05$). During the experiment period, the average AN and AP contents in OM was highest (about 1.6 and 29.6 times of that in the CK, respectively) and second was NPK treatment (about 1.2 and 20.3 times of that in the CK). Unlike AN and AP, the highest value of AK content was found in NPK treatments with 38.10 mg•kg^{-1}.Different fertilizer significantly altered the microbial community composition in our trail region ($P<0.05$). Long-term organic manure and chemical fertilizer significantly increased the amount of total PLFAs, the bacterial PLFAs, the fungal PLFAs as well as the values of actinomycetes PLFAs, but had no effect on the ratio of fungal to bacterial PLFAs. The highest microbial activity was observed in the OM treatment, in which all values of PLFAs were obviously higher than other treatments. Thus, these indicated that organic manure should be recommended to improve soil fertility in this region and K fertilizer should be simultaneously applied considering the soil K contents. Considering the long-term fertilizer efficiency, our results also suggest that continuous straw returning application could improve soil fertility in this trial region.

Workshop 3: Environmental Pollution and Remediation

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High throughput bioluminescent reporter yeast assay for endocrine disrupting chemical screening and fate in the environment

Gary S. Sayler

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Increasing public concern over exposure to Endocrine Disrupting Chemicals (EDC) and estrogenic substances (such as bisphenol A) has amplified the need for methods to rapidly monitor endocrine-active substances in the environment. In countries like Brazil that have had major economic expansion, sanitation has not kept pace with growth. Most environmental monitoring programs have focused on microbial contamination, placing less emphasis on chemicals that could be detrimental to public health. While wastewater treatment reduces the concentration of available EDC substances in effluents, wastewater does represent a significant source of estrogen addition to the environment. We have developed a high throughput bioassay to detect substances that mimic human hormones in terms of receptor activation in EDC bioassays. Bioluminescent *Saccharomyces cerevisiae* strains BLYES, BLYAS, and BLYR were used to detect the presence of potential environmental estrogenic, androgenic, or toxic compounds, respectively. These strains contain the bioluminescent *luxCDABE* genes from *Photorhabdus luminescens* and the *frp* gene from *Vibrio harveyi*, which are expressed on two plasmids either under the control of human estrogen response elements (*S. cerevisiae* BLYES), human androgen response elements (*S. cerevisiae* BLYAS), or are constitutively expressed for the detection of toxicity (*S. cerevisiae* BLYR). These bioreporters have been used extensively to measure endocrine disrupting chemicals in groundwater, drinking water, surface water, and wastewater in both the United States and Brazil. Results demonstrate that these bioluminescent bioreporters are superior to chemical analysis at detecting bioavailable estrogenic substances. In addition, high throughput methods have streamlined the bioassay making it suitable for routine monitoring; it has been adopted as part of the State Environmental Agency of São Paulo's monitoring program and is also being used to monitor all wastewater treatment plant effluents across the state of Tennessee. In Brazilian surface water, values as high as 7.1 ng 17β-estradiol (E2) equivalents per liter have been found in raw surface water and 0.2 ng/L in treated water, while in Tennessee values for surface water are rarely above detection limits and traditional wastewater effluents are typically 6 ng E2 equivalents per liter. These bioassays have also been used to measure estrogenic potential in oil samples from the Deepwater Horizon oil spill, determining that crude oil contains 7,626 ng E2 equivalents per liter and even after weathering, samples

contained 447 ng E2 equivalents per liter. Given that low ng of E2/L are able to cause an upregulation of egg yolk protein genes in male zebrafish (a feminization trait), the amount of estrogenic substances entering the environment is significant.

Bio: Dr. Sayler is the Beaman Distinguished Professor in the Department of Microbiology, Ecology and Evolutionary Biology at the University of Tennessee, Knoxville; director of the University of Tennessee-Oak Ridge National Laboratory Joint Institute for Biological Sciences; adjunct professor at Gwangju Institute for Science and Technology, South Korea; and Honorary Professor at East China University, Shanghai. He is the founding Director (1986) of the University of Tennessee Center for Environmental Biotechnology. His research interests include microbiology, toxicology, and molecular biology of biodegradation, of toxic pollutants such as PCB and PAH. He pioneered the development of environmental molecular diagnostics including the extraction and analysis of nucleic acids from the environment and wastes, environmental gene probe analysis, bioluminescent bioreporter/sensor technology, and conducted the first field release of a genetically-engineered microorganism for remediation process monitoring and control. Over his career, Dr. Sayler has built and directed programs of approximately $100 million in environmental research, edited five books, and contributed over 300 publications and 500 invited presentations. He holds 16 patents on environmental gene probing, genetic engineering for bioremediation, biosensor technology, and environmental gene expression. He received the NIEHS' Research Career Development Award (1980-1985); was named a Top 100 Innovator in Science by Science Digest (1985); received the American Society for Microbiology, Procter and Gamble Award for Environmental Microbiology (1994), the Distinguished Alumni Award of the University of Idaho (1995), the DOW Chemical Foundation SPHERE Award (1998-2000), as well as the Chancellor's Research Scholar Award and the Arts and Sciences Senior Researcher award from the University of Tennessee . He was elected to the American Academy of Microbiology in 1991. Dr. Sayler has served on numerous of councils and committees for the National Research Council, DOE, EPA, NIEHS, NSF, NASA, and WERF. He is currently a member of the U.S. Environmental Protection Agency's Science Advisory Board, Chair of the Board of Scientific Counselors for EPA's Office of Research and Development, and is a member of the DOE/OS Biological and Environmental Research Advisory Committee. Dr. Sayler is a member of five professional societies and currently serves on five editorial boards and is associate editor of *Environmental Science and Technology*. Dr. Sayler has directed graduate research of approximately 50 doctoral and 15 master's students in microbiology, ecology and evolutionary biology and engineering.

Online monitoring and alert system for anaerobic digestion reactors

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Development and application of effective monitoring and diagnosis of anaerobic digestion processes is a great challenge for their stable operation. In this work, an online monitoring and alert system for the operation of upflow anaerobic sludge blanket (UASB) reactor is developed on the basis of a set of novel evaluating indexes. The two indexes, i.e., stability index *S* and auxiliary index *a*, which incorporate both gas- and liquid-phase parameters for UASB, enable a quantitative and comprehensive evaluation of reactor status. A series of shock tests are conducted to evaluate the response of the monitoring and alert system to organic overloading, hydraulic, temperature and toxicant shocks. The results show that this system enables an accurate and rapid monitoring and diagnosis of the reactor status, and offers reliable early warnings on the potential risks. As the core of this system, the evaluating indexes are demonstrated to be of high accuracy and sensitivity in process evaluation and good adaptability to the artificial intelligence and automated control apparatus. This online monitoring and alert system presents a valuable effort in promoting the automated monitoring and control of anaerobic digestion process, and holds a high promise for application.

Virus retention and transport in porous media

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Viruses in general survive longer than enteric bacteria in the natural environment. They have been found to be more resistant to disinfection during wastewater treatment processes. Viruses are capable of traveling greater distances in the subsurface. Many environmental factors have been found to influence virus survival and transport in the subsurface, such as temperature and solution chemistry. Soil properties (e.g., CEC, SOC, metal oxides) also affect virus behavior. This research focuses on the effect of water content. Studies have shown that viruses are usually removed more extensively during unsaturated transport than during saturated transport. It's been postulated that both electrostatic and hydrophobic interactions are responsible for the removal. Another probable mechanism is sorption and/or inactivation at the air-water interface, which is unique to an unsaturated system. We used reactive sand (water-washed sand) and non-reactive sand (metal oxide-removed sand) to isolate the effect of the solid-water interface from the effect of the air-water interface. Experiments were run at three water contents. Significant virus removal was observed at all water contents in the water-washed sand and lower water content led to removal of more viruses. However, water-content effect was much less significant in oxide-removed soil, suggesting that the enhanced interaction at the solid-water interface was the main mechanism for increased virus removal under unsaturated conditions. We further tested five sandy soil materials under saturated and unsaturated flow conditions. Significant difference between saturated and unsaturated experiments for both viruses was observed in two Delaware soils. MS-2 (relatively hydrophobic) was removed more extensively than ΨX174 (relatively hydrophilic). However, no significant difference in virus removal was observed in the soils collected from California, Arizona, and Georgia between saturated and unsaturated transport. It is not clear what caused the lack of water content effect in these three soils. Our results showed that colloids and dissolved organic matter might facilitate the virus transport and offset the water content effect.

Bio: Dr. Jie (Joe) Zhuang is a research director for the Institute for a Secure and Sustainable Environment (ISSE) and a research associate professor in the Department of Biosystems Engineering and Soil Science at the University of Tennessee. He is also the coordinator of the China-U.S. Joint Research Center for Ecosystem and Environmental Change. Over the past two decades, Dr. Zhuang has worked on many challenging scientific research projects in the United

States, Japan, and China. His research is focused on the fate and transport of contaminants (viruses, radionuclides, colloids, and munitions constituents) in the environment; soil carbon management; soil hydrology; and carbon-water-nitrogen fluxes of terrestrial ecosystems. He has published more than 50 research papers on high-profile international journals. Dr. Zhuang was a research fellow of Japan Society for Promotion of Science from 1998 to 2000. Currently, he is an editorial board member for four international journals, *Ecotoxicology*, *Environmental Management*, *Pedosphere, Journal of Resources and Ecology*. Dr. Zhuang also contributes a significant amount of his time to the China-U.S. Initiative launched by the University of Tennessee/Oak Ridge National Laboratory's Joint Institute of Biological Science and ISSE, with the aim of promoting U.S.-China collaborations in the areas of global environmental change, bioenergy sustainability, and international education.

In situ technology for eutrophication control in shallow waters: removing, converting and recycling nutrients for sustainable food web

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Eutrophication control depends on the reduction of excess nutrients in the aquatic environment, which is naturally a very slow process depending on the external and internal nutrient loads control. A “modified local soil/sand induced ecological restoration” (MLS-IER) technology was developed, which can reduce nutrient levels in the water quickly by removing and transferring algal blooms into the sediment and convert them into submerged vegetation in shallow waters, the latter is further turned into marketable fish proteins through a balanced food web triggered by MLS-IER (Pan et al., Ecol. Eng., 2011). The technology uses commercially available sands or local soil modified by a small amount of biodegradable natural polymer/protein to flocculate algal cells and the nutrients in the cells into the sediment (Pan et al., Environ. Pollut., 2006a; Pan et al., Environ. Pollut., 2006b; Zou et al., Environ. Pollut., 2006; Pan et al., Harmful Algae, 2011). The MLS capping layer can quickly reverse the anoxic condition of the sediment and keep the overlying water clear by reducing the re-suspension and nutrient flux/diffusion from the sediment (Pan et al., Environ. Sci. Technol., 2012). The buried algal cells in the sub-layer of the sediment are biodegraded and the nutrients released are utilized by the growth of submerged macrophytes (Pan et al., Ecol. Eng., 2011). The increased water clarity and the improved sediment quality due to the MLS treatment make it possible for a quick restoration of submerged macrophytes in eutrophic shallow waters. The recruitment of the algal bloom can be reduced after the “seed bank” is sealed and decomposed in the sediment. Once the nutrients are redistributed from water to sediment and from algae to vegetation that is further distributed into the food web, the recycling of excess nutrients may be achieved and eutrophication controlled by using in situ nutrient redistribution technologies.

Bio: Dr Gang Pan is a professor at the Research Center for Eco-environmental Sciences, Chinese Academy of Sciences. He is the Chairman of the Global Phosphorus Recycling Initiative (GPRI), SCOPE, chief scientist of a Sino-EU governmental cooperation program on water science (Ministry of Science and Technology), and vice president of Chinese Association of Aquatic Environment. He has published more than 150 peer reviewed papers and issued more than 40 patents. Dr Pan pioneered in cost-effective and safe technologies for toxic algal blooms and water pollution controls as well as nutrient recycle/reuse technologies in natural water systems. He also developed fundamental physicochemical theories and methods to study environmental and geochemical interfacial reactions (adsorption, flocculation, and nano science). He has a track record in developing multidisciplinary studies in chemical, environmental, ecological, water, and nano areas, ranging from fundamental science to applied engineering.

Environmental effects of manufactured nanoparticles: evolution of test methods, interpretation of results, and future research needs within nanoecotoxicology

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The application of nanotechnology and incorporation of manufactured nanoparticles (NPs) into consumer products has led to the emergence of nanotoxicology, a discipline that is evolving to enable assessment of the toxicity of NPs. Particles in the nano size range are present naturally in the environment and human activities have increased their presence in surface waters for a long time (i.e., prior to development of nanotechnology). However, the application of nanotechnology allows production of engineered NPs with novel properties, and these NPs may present some toxicological hazards in organisms when environmental contamination occurs. Nanoecotoxicology is charged with investigating toxicity of NPs, and the development of suitable test methods that produce toxicity results that are repeatable and provide environmentally relevant information for ecological risk assessments of NPs are underway. In some cases, the science around the issue of NP toxicity has been confounded by speculation, application of inappropriate methodology, and failure to adequately consider relevant studies conducted prior to the emergence of the field of nanotechnology. The toxicity of the C_{60} fullerene and TiO_2-NPs are among the NPs for which there has been considerable disagreement in the literature regarding their toxicity in fish. We have conducted numerous experiments that have employed a variety of techniques to investigate the toxicity of C_{60} and TiO_2-NPs in fish exposed via aqueous, dietary, and injection (intravascular and intramuscular). Results of these investigations will be presented with the intention to clarify misconceptions that exist within the literature regarding their toxicity and to address inappropriate speculation that has surrounded toxicity of these two NPs in fish. Other aspects of the environmental effects of these NPs will be discussed including their potential to influence the fate, behavior, and bioavailability of other substances (i.e., co-contaminants).

Bio: Theodore (Ted) B. Henry is a Research Council of the United Kingdom Academic Fellow at the University of Plymouth, Plymouth, United Kingdom; and a Research Assistant Professor in the Center for Environmental Biotechnology and Department of Forestry Wildlife and Fisheries at UT. Dr. Henry directs zebrafish research facilities at UT and at UoP and uses the zebrafish model to investigate effects of environmental toxicants including algal toxins, metals, endocrine disrupting substances, and nanoparticles. Research investigations target effects at cellular levels (gene expression), tissue (histopathology), and whole organism (reproduction, behaviour) levels of biological organization. Over the past ten years he has published over 40 scientific articles and delivered numerous invited presentations at the national and international level. He is a member of various professional societies and regularly reviews manuscripts for numerous prominent journals focused on environmental science research.

Influences of Cu or Cd on neurotoxicity induced by petroleum hydrocarbons in ragworm *Perinereis aibuhitensis*

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Ecotoxicological effects of heavy metals and petroleum hydrocarbons (PHCs) on ragworms are still vague. Relationships between toxicological indices (mortality and AChE activity) and concentrations of toxicants (Cu, Cd and PHCs) were examined in the keystone species *Perinereis aibuhitensis* in laboratory conditions. The results of single contamination indicated that three pollutants had potentially physiological toxicity to *P. aibuhitensis*. LC_{50} of three contaminants were derived from the relationships between mortality and contaminant concentrations after 4-day and 10-day exposure. Notable changes in morphological signs and symptoms of *Perinereis aibuhitensis* exposed to PHCs were observed. AChE activity of *N. diversicolor* was more sensitive to the toxicity of PHCs than others. The results of combined toxicants implied that the combined toxicity of Cu or Cd and petroleum hydrocarbons to *N. diversicolor* was related to concentration combination of toxicants. Compared to single PHCs-treatment, the addition of Cu or Cd significantly mitigated the neurotoxicity of PHCs to AChE activity in *Perinereis aibuhitensis*, which showed an antagonistic effect.

Illuminating environmental monitoring with living bioreporters

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Microorganisms intimately interact with and react to their environment and are well skilled at meticulously sensing and continuously responding to the chemical, physical, and biological stimuli that constantly impact their habitats. The ability of microorganisms to perceive their world serves as a powerful tool towards our understanding of ecosystem and environmental change, if we can effectively interpret the information the microbes are trying to convey. One approach for doing so is the application of reporter gene technology. Genetic engineering techniques permit the strategic labeling of microorganisms with reporter genes that link biological activity to easily measured signaling outputs. These outputs, typically centered on colorimetric, fluorescent, or bioluminescent signals, provide the cues and information necessary for monitoring, understanding, and describing complex environmental ecosystems. The science, applications, and advances of reporter gene technology will be discussed to better reveal what the microbial world is trying to tell us and how we can apply that information towards improved ecological monitoring.

Bio: Steven Ripp, Ph.D., currently serves as a Research Associate Professor at the University of Tennessee Center for Environmental Biotechnology and as the Chief Operating Officer of the life sciences company 490 BioTech, Inc. His research focuses on the design and use of bioreporter and biosensor systems for environmental, food safety, and biomedical sensing and monitoring applications, primarily using engineered bacterial luciferase (*lux*) genes as bioluminescent signaling elements in bacteria, yeast, and human cells. He participated in one of the first U.S. field release demonstrations of bioreporters applied as bioremediation process monitoring tools and has contributed towards advanced integrated circuit biosensor architectures that merge living bioreporters with silicon substrates for deployable, on-chip chem/bio sensing. Dr. Ripp earned his B.S. in Bacteriology at the University of Wisconsin-Madison and his Ph.D. in Microbiology and Molecular Genetics at Oklahoma State University.

Resolving discrepancies between laboratory acute toxicity data and field observations in aquatic insects exposed to metals

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Insects are the dominant invertebrate faunal group in most lotic systems and play critical ecological roles. Aquatic insects accumulate metals directly from water and from their diets. It is important that the bioaccumulation of metals in aquatic insects is well understood, both in terms of toxicity issues to the insects themselves, and their contribution to the diets to animals at higher trophic levels. Traditional toxicity testing methodologies relying on dissolved exposures have failed to provide be informative about the toxicity of trace metals to aquatic insects. This has resulted in a major disconnection between laboratory toxicity data and field observations. Standard laboratory toxicity data suggest that insects are tolerant to trace metals, while field observations demonstrate that insects are highly responsive to metal pollution. Our recent studies have shown that (1) dietary metal exposure may be the dominant pathway for metal accumulation in most aquatic insects. (2) the length of time required for insect species to reach steady state is substantially longer than the typical 4-day toxicity test duration. Therefore, inadequate exposure duration in traditional toxicity assays could contribute to the disconnection between laboratory and field data for metal toxicity to aquatic insects; (3) dissolved and dietary metals may elicit different physiological stress and toxicity in aquatic insects. Taken together, our results suggest that diet is an important route of exposure and dietary metal exposure pathway may help explain the vast discrepancies between observations of insect sensitivities to metals in nature and the apparent insensitivities of insects in standard laboratory toxicity tests. Our results also suggest that as our understanding of dietary trace element bioaccumulation advances considerably, it is important for us to shift our approach to toxicity testing and to develop new protocols that include more realistic exposures. These efforts could improve the scientific basis for generating ecologically important environmental standards (i.e., development of new water criteria).

Mitigating nitrous oxide emissions from the maize cropping soils in Northeast China

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Nitrous oxide (N_2O) is the third important long-living greenhouse gas. N_2O emission from the upland soils (non-irrigated farmland) was reported to contribute to about 41% of Greenhouse gases (GHG) emission from the agroecosystems in China. The increasing use of synthetic fertilizer is a key factor for the growing agricultural N_2O emission. More than half of arable land are non-irrigated farmland located in the northern part of the country. Therefore, in this study, N_2O emissions from the maize fields at 4 sites in northeast China were monitored, and the nitrogen fertilizer management for nitrous oxide mitigation was also investigated.

The application of nitrification inhibitor(s) is an effective measure for N_2O reduciton, where 24.4% to 50.3% of N_2O emission could be reduced, but no negative impact on crop yield was found. However, the different respones of different soils (or different conditions of a soil) to the inhibitors was detected. In meadow brown soil, both of the two nitrification inhibitors (DCD and DMPP) reduced the N_2O emission by 54. 1% -75.9% in a incubation experiment. In a cinnamon soil, the DMPP had a significant inhibitory effect on the N_2O emission under both lower and higher soil moisture contents. However, the DCD in cinnamon soil showed a weak inhibitory effect on the N_2O emission under lower soil moisture content, and no N_2O redcution under the higher soil moisture content. The result suggests that application of nitrification inhibitors to N fertilizers is a feasible option to mitigate N_2O emission from upland crop fields in northeast of China.

The increase in cumulative N_2O-N emissions was proportional to the increase in chemical fertilizer-N application, whereas it was independent of the amount of manure when the manure was applied in Autumn, instead of in Spring. This implied that reducing the amount of fertilizer N and simultaneously raising the amount of autumn-applied manure could aslo help to decrease N_2O emissions from upland soils in Northeast of China

Bio: Dr. Prof. XU Hui is from Institute of Applied Ecology, Chinese Academy of Sciences. He is mainly engaged in the research field of environmental microbiology and microbial ecology, especially the emissions of greenhouse gases (N_2O and CH_4) from soil microbial processes in agro-ecosystems and the mitigation techniques of greenhouse gases from terrestrial ecosystems.

He was the principle investigator of several projects financially supported by National Natural Science Foundation of China, such as "The bidirectional interrelation between microbial processes of CH_4 and N_2O emission/consumption in soils" and "The interrelation between N_2O and CH_4

emissions from forest ecosystem and its mechanism. He is also the principle investigator of a key Project in the National Science & Technology Pillar Program "Study and demonstration on techniques for increasing carbon sequestration and decreasing nitrous oxide emission from upland soils".

In recent years, he is also engaged in the projects on the waste water/solid treatments, such as biotechnology in treatments of wastes from industrial fermentation.

Nitrogen transfer and metabolism in the arbuscular mycorrhizal symbiosis

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As one of the most important symbiosis for environment, the arbuscular mycorrhiza (AM) brings together the roots of over 80% of land plant species and fungi of the phylum Glomeromycota. The arbuscular mycorrhizal symbiosis plays an key role in ecosystem and environment through fungal networks-based connection between soil and plant, especially for the recycle of nitrogen and carbon in the ecosystem. Here, we focus on nitrogen flux in the AM symbiosis to clarify the mechanism of nitrogen transfer and metabolism in the AM symbiosis.To understand the mechanisms and regulation of N transfer from the fungus to the plant, 11 fungal genes putatively involved in the pathway are identified from Glomus intraradices, and for six of them the full-length coding sequence is functionally characterized, as well as glutamine synthetase isoforms found to have different substrate affinities and expression patterns, suggesting different roles in N assimilation. The spatial and temporal expression of plant and fungal N metabolism genes are followed after nitrate is added to the extraradical mycelium under N-limited growth conditions using hairy root cultures. In parallel experiments with (15)N, the levels and labeling of free amino acids are measured to follow transport and metabolism. The gene expression pattern and profiling of metabolites involved in the N pathway support the idea that the rapid uptake, translocation, and transfer of N by the fungus successively trigger metabolic gene expression responses in the extraradical mycelium, intraradical mycelium, and host plant, which supported the current model of N handling in the AM symbiosis includes the synthesis of arginine in the extraradical mycelium and the transfer of arginine to the intraradical mycelium, where it is broken down to release N for transfer to the host plant. In addition, the possible connection between nitrogen and carbon metabolism as well as the ecological implication are discussed.

Workshop 4: Challenges of Urbanization and Clean Growth

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A practical model for planners to use in assessing and managing the impacts of urbanization on long-term runoff and non-point source pollution

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It is well known that changing land use, in particular urbanization, can significantly increase surface runoff and nonpoint source pollution, and decrease groundwater recharge. Careful planning of land use change, taking in to account soil conditions, can significantly reduce these impacts if planners have the information they need to make informed decision. Although there are many complex hydrologic models available, city planners often do not have the data or expertise to run these models, and do not need the high precision that these models provide to make basic planning decisions based on the relative impacts of different land use options. The L-THIA (Long-Term Hydrologic Impact Assessment) Model has been developed by Purdue researchers to provide a simple-to-use model for land use impact assessment using basic input data that are widely available, including rainfall data, land use, and soil characteristics. L-THIA is based on the widely-used curve number approach, which is the core of many storm water models and regulations in the USA. Originally developed as a spreadsheet-based model, L-THIA is now available as a GIS application and a web-based model. It is widely used in the USA in planning and for watershed management. Chinese scholars have shown that the model can be adapted to work with data commonly available in China, and concluded that "L-THIA was a quick, accessible tool to use in assessing the long-term impacts of land use changes, because it can produce results with minimal data and user expertise. ... it overcomes the limitation of traditional hydrologic models, which are too complex, data intensive timing consuming and expensive. ... The result of this study has significant implications for urban planning and decision making in effort to protect and remediate water resource of Xitiaoxi river basin." (Li et al. 2007, p.352).

Research Area; hydrology, urbanization

Bio: Professor Jon Harbor specializes in geomorphology and applied hydrology, and has degrees in geography from Cambridge University and the University of Colorado, and a PhD in geological sciences from the University of Washington. He has authored and co-authored over a hundred peer-reviewed journal articles in geomorphology, applied hydrology and science education research. As an outgrowth of his time as an environmental consultant, his hydrologic research has a strong focus on applied problems, in particular related to land use change and construction. Professor Harbor is an award winning teacher, a Fellow of the American Association for the Advancement of Science, a Fellow of the Royal Geographical Society, and has been collaborating with Chinese scholars for over a decade on research and education projects. He currently serves as Interim Director of Purdue's Global Sustainability Institute, and head of the Department of Earth, Atmospheric, and Planetary Sciences.

Compact-city considerations on rapid urban sprawls in China

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By 2012 the rate of urbanization in China has just exceeded 50%, nearly tripled the urbanization rate in 1978 when China started economic reform and open-up policy. The urbanization in China will continue to be an opportunity as well as a challenge to China's effort to sustain rapid growth and maintain harmonious development. Because China has extremely low per-capita habitable land area, the concept of Compact City is an important promise to the sustainability of land resources in China. Compact City can help better utilize public transport services, strengthen urban community multifunctionality, increase the quality of city life, reduce energy consumption, and improve the urban environment. To understand the status of compact city development in China, we assessed the compactness of China's 35 major cities in 2000 and 2007 by using a spatial-data based, normalized compactness index (NCI) ($0<NCI<1$), which is defined as a ratio of Thinh et al. (2002)'s compactness (T) for a given city over the maximum compactness (Tmax) for a hypothetical round-shape city. There was a slight increase in the mean of NCI values for the 35 cities, suggesting that China's major cities were becoming more compact over time. At the same time, the geographic extents of the 35 cities ranged from 34 to 550 km^2 in 2000 and 65 to 1,289 km^2 in 2007; the populations of urban-district residents in the 35 cities ranged from 0.57 to 11.36 million in 2000, and from 0.75 to 17.69 million in 2007. The increase in compactness in those cities was an important achievement but an acceleration in the compactness of China's cities is still needed in the future to ensure that land is used more economically and sustainably.

Bio: Dr. Shao has a broad experience in applying computer models and geospatial technologies in forest management, biodiversity conservation, and forest carbon quantification. He has also studied forest programs/policies and economics in relation to sustainable forestry and carbon sequestration. He has developed KOPIDE and ROPE forest dynamic models, ForCAM forest carbon accounting model, FORESTAR decision-support system for multi-purpose forest management, and DALA algorithm of automated remote sensing imagery classification. He is a co-author of 134 journal publication, books and book chapters. He serves as associate editor, guest editor, and editorial board for seven academic journals. He has devoted much attention in forestry development and forest conservation in developing countries. His cross-disciplinary expertise has allowed him collaborate extensively with international and interdisciplinary experts from a number of countries.

Designing and evaluation of complex recycling system for high-efficiency organic wastes use

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Carbon reduction in rapidly growing material industries and thermal electric power generation plants in Asian countries is a critical issue. To cope with this, not only the energy saving of industrial processes but also the fuel shift to low carbon energy sources such as biomass and recyclable wastes are required. Utilization of urban wastes in material industries (urban symbiosis) also contributes to promote effective use of wastes with maximum efficiency and, as a result, leads to cost saving of waste disposal.

To optimize such an urban symbiosis system, efficient utilization of whole household wastes in which several kinds of wastes with different quality are contained is important. For instance, mixed waste plastics and papers which have high heat value can be used as an alternative raw material and fuel in material industries or coal fired power plants while kitchen wastes which has low heat value is considered appropriate to be used via drying process or biochemical treatment such as methane fermentation. Thus, waste separation and appropriate use suitable for each waste is important.

Meanwhile, to improve the efficiency of recycling facilities, integration of different recycling processes has potential advantages in terms of energy saving and cost reduction through shared usage of facilities and expansion of scale. These apparently-contradictory goals, namely the separation of wastes and integration of waste treatment and recycling processes, should be handled appropriately. So we have investigated an optimized recycling system of household organic wastes which consists of urban symbiosis using wastes with relatively-high quality and a complex recycling base for the residual waste with relatively-low quality. We will show a result of our preliminary study and discuss about a design principle of a complex recycling system.

This research was supported by the Environment Research and Technology Development Fund (K113002) of the Ministry of the Environment, Japan.

Key words: organic waste, household waste, complex recycling system, urban symbiosis, material industry

The role of eco-cities in the development of green economy

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The unprecedented growth of urban areas around the world, coupled with the unknown future effects of global change, has created an urgent need to increase ecological understanding of human settlements, in order to develop inhabitable, sustainable cities in the future. People have become aware that the economy, the environment and human settlement are part of the sustainable development equation. The term 'Eco-cities' refers to the kind of city design that works in harmony with the surrounding ecosystems. It is thought that Eco-cities to be a way to solve the shortage of housing in urban areas and also is an initiative during the process of urbanization in developing countries. The goal of Eco-cities research is to promote the sustainable development in urban areas, in which economic development, social development and environmental protection as interdependent. Specific objectives are:

- To promote sustainable building practices with reduced carbon footprint and lower energy needs;
- To promote the affordability for urban poor people.

Eco-cities provide us an opportunity to showcase that poor people can provide appropriate, affordable and sustainable housing for themselves in partnership with city authorities. The term 'Eco-cities' comprises of environment friendly and energy efficient buildings, sustainable construction practices, and healthy and productive indoor environment, with lower natural resources use. Eco-cities will save money by conserving electricity and water, save time through low maintenance, improve health by reducing exposure to synthetic chemicals, and help to preserve the environment in the process. Solid waste management will also form a part of this process. By engaging in effective and construction partnerships to develop housing and infrastructure, poor communities illustrate their capacity to undertake successful initiatives, and as such, define themselves as central stakeholders in urbanization process and key to the decision making processes which affect them.

Estimation model for regional energy supply and demand management system

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In order to reduce global environmental impact, low-carbonization of cities has become an urgent issue, and a movement toward "low carbon city" has become active not only in developed countries but also in developing countries. To build a low carbon city, it is important to utilize renewable energy and unutilized energy which potential is not sufficiently demonstrated due to demand-supply mismatch, to say nothing of the improvement of individual energy technology. In other words, the elimination of spatially, temporally and qualitatively mismatch between energy supply and demand is a key factor for low-carbonization. Therefore, it is important to identify technology packages that match energy demand and supply based on the urban spatial characteristics. Furthermore, it is necessary to support the practical planning of local municipalities that face such problems.

In this study, we develop planning support system for eliminating energy demand-supply mismatch. In the system, to deal with the complexity of integrated evaluation step, a two-stage method which is composed of macro and micro viewpoint are applied. In the first stage, spatiotemporal distribution of energy demand and supply is visualized with established GIS database. It enables stakeholders to easily understand the status of mismatch between energy demand and supply distribution and its totaled of an entire city, and a rough sketch of technology and policy combination could be examined from macro viewpoint. In the second stage, the simulation system is developed to identify the detailed potentials of local energy supply such as co-generation systems or green energy systems as well as local energy demand patterns. The system enables to identify the priority sets of energy supply and demand technologies, which include land use reconfiguration, with appropriate social systems. By applying this framework to the case cities, the CO_2 emission reduction as a result of appropriate energy system is evaluated quantitatively. Then, further development and implementation are discussed.

Quantitative urban design system for low carbon cities and districts

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After serious destruction in coastal cities in 2011 Great Earthquake, Japan has taken a leaping step to pomote green innovation through the national future city initiative. National initiatives for eco-cities in Japan are reviewed and analyzed based on the socio-economic grounds and key features for urban restructuring to attain multi goals for low carbon and rapidly aging society with steady green growth. Innovative practices such as eco-industrial cities and smart energy communities are secondly provided and analyzed. Finally, a planning support system for eco-cities is discussed focusing on the efficient combination of supply and demand of local energy system. After key concepts for system development are discussed, the system structure is provided as are developed to support legitimate global warming prevention local plans by municipal governments. The system consists of a series of subsystems, such as population prediction by cohort estimation model to identify the future spatial distribution of population changes, material circularization model to identify the environmental effects of industrial symbiosis, and energy supply and demand management model to identify the potentials of local energy supply. The system enables the decision stakeholders for the priority sets of possible policy options and technology applications with appropriate social systems.

Key words: eco-future city initiative, low carbon city, geographic information system

local energy management system, decision support tool for planning

Future climate change and terrestrial ecosystems in China — case studies on SRES B2 scenario

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Appling climate change scenarios of the B2 scenario of the SRES projected by PRECIS (providing regional climates for impacts studies) system introduced to China from the Hadley Centre for Climate Prediction and Research at a high-resolution (50 km×50 km) over China. A biogeochemical model "Atmosphere Vegetation Integrated Model (AVIM2)" was applied to simulating ecosystem status in the 21st century. Case one, eco-vulnerability: Vulnerability of ecosystems was assessed based on a set of index of mainly net primary production (NPP) of vegetation. Results show that climate change would affect ecosystem of China severely and there would be a worse trend over time. Extreme climate even would bring about worse impact on the ecosystems. Open shrub and desert steppe would be the two of most affected types. When the extreme events happen, vulnerable ecosystem would extend to part of defoliate broad-leaved forest, woody grassland and evergreen conifer forest. Climate change could also be of some benefit to cold region during the near-term. However, for mid-term to long-term negative impact on ecosystem vulnerability would be dominantly. Case two, eco-impact by different warming levels: NPP of the terrestrial ecosystem of China was re-calculated by different warm levels of 1 to 4 °C. The results show that, as projected temperature increases, the average net primary productivity (NPP) is likely to decrease in China as a whole. The Tibetan Plateau is the only ecoregion with increasing NPP as the climate becomes warmer. The terrestrial ecosystem NPP in China would be impacted as: 1°C warmer, favorable or adverse impact on ecosystem would be equivalent with regional variation; 2°C warmer, slight adverse impact would be significant; 3°C warmer, moderate adverse impact would take priority and 4°C warmer, moderate adverse impact regions would increase significantly. Case three, ecoregion shifting: temperature zone is one of the most important ecoregion units. Number of days of mean daily temperature above 10℃ and mean temperature of January were taken to indicate temperature zones. Calculating from the B2 scenario indicated that the ranges of Tropical, Subtropical, Warm Temperate and Plateau Temperate Zones would be enlarged and the ranges of Cold Temperate, Temperate and Plateau Sub-cold Zones would be reduced. Cold Temperate Zone would probably disappear at late this century. North borderlines of temperature zones would shift northward under projected future climate change, especially in East China. The farthest shifts of the north boundaries of Plateau Temperate, Subtropical and Warm Temperate Zones would be 3.1°, 5.3° and 6.6° latitude respectively, compared with that of baseline period (1961–1990). Moreover, northward shift would be more notably in northern China as future temperature increasing.

The future we want: the role of the planted forest sector in low carbon growth and global sustainability governance

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Forests are of vital importance for maintaining and preserving our climate, for biodiversity and for the livelihoods of the societies and cultures that depend upon them. A robust plantation forest sector, developing side-by-side with natural forests, based on sustainable, scalable business models is needed if the goal of zero net deforestation in the early part of this century is to be realistic. To enable this, the industry must make substantial investments in advanced breeding, silviculture and biotechnology to create the scientific and technological foundations for improving and protecting yield so that the plantations of tomorrow produce more biomass with fewer inputs on less land and have the resilience to withstand future environmental shocks and stresses.

In parallel, investments in biotechnologies for the targeted modification of the chemical composition of woody biomass and the enhancement of downstream conversion technologies will create an unprecedented diversity of sustainable industrial products, from plastics to specialty fibres, for the needs and benefit of citizens and communities of the future.

Whilst this transformation will herald the beginning of a large scale break in our dependence upon fossil fuels, it will only be possible if the sector can forge close partnerships with public sector research, closer and more efficient linkages along the value chains of the future and a world wide web of research co-operations and germplasm exchanges.

The role of governments and the multilateral system as active and permanent partners is of paramount importance in creating and sustaining this long term commitment. There are four critical areas where clear policy developments will play a vital role in delivering the full scope of this scientific and technology-driven change: policies that stimulate greater public sector funded research, technology development incentives, policies to promote payment for environmental services and critically, science-based regulatory mechanisms.

What is of great interest from the point of view of the objectives of sustainable development is the fact that any large scale initiatives that raise primary productivity can have immediate and long-term benefits for rural development and rural social protection through the generation of incomes and stabilization of rural employment prospects – and directly scaled

up and applied to some of the most vulnerable communities in the least developed countries.

The plantation forestry industry and the downstream pulp & paper, fibre and bioenergy industries have a collective opportunity and responsibility to not only respond to market demands and climate change – but to forge deep links with governments and communities to drive and enable lasting change in a manner which preserves todays resources for tomorrow.

Bio: Mr. James (Hui) Zhang, Vice President China. Mr. Zhang had worked in the Department of Agriculture of Gansu Province, China for more than 16 years and held a position of deputy director in the International Cooperation Division. He had been the principal official for developing international and bilateral cooperation relationships to enhance the technology and personnel exchanges in the department. He had served as Vice President of eSolux Software (Shanghai) Co., Ltd. for three years before he joined FuturaGene. He initiated FuturaGene China business in 2005 and jointed FuturaGene after then. He is the Vice President China of FuturaGene Group and also the Managing Director of FuturaGene Biotechnology (Shanghai) Co., Ltd. Mr. Zhang received his B.Sc. from China Agricultural University (CAU) and has two years visiting scholar experience in the University of California at Davis.

Multi-scale carbon footprint analysis of steel production in Liaoning

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This study focuses on low carbon technological renovation in steel industry in Liaoning province and China. Since the enforcement of the Kyoto Protocol in 2005, China has promoted energy efficient technological renovation in existed industrial zones as well as construction of new environmentally-aware industrial zones. On the other hand, geographical fragmentation of production in China and the East Asia has deepens the interdependency in regional transaction of goods and services in the process of spreading global value chains or vertical specialization.

Based on the above background, we attempt to evaluate multi-scale multi-scale carbon footprint of steel production with steel-related eco-technological renovation by using input-output analysis. First, we create dataset for input-coefficient changes in I-O table, corresponding to energy saving technologies which are implemented in "global sectoral approach" of steel industry. Secondly, we set up scenarios to implement a set of energy saving technologies into the steel sector. Finally, we evaluate backward and forward linkage effects of low-carbon technologies transfer in terms of carbon footprint.

As a result of the analysis, it revealed that: 1) large amount of steel demand due to agglomeration of various machinery industries in Shenyang city induced carbon dioxide emission to steel production areas such as Anshan etc.; 2) carbon dioxide emission related to steel production in Liaoning province increased 40 MtC in 2002-2007, due to industrial structure change (increase of machinery industries) and final demand change (construction demand of urban infrastructure); 3) carbon dioxide emission in North East China including Liaoning was caused by final demand sectors not only in its own region but also various regions such as North China, East China, Japan, US etc.; 4) Basic Oxygen Furnace gas recovery, Coke Dry Quenching, Top pressure Recovery Turbine and Waste Plastics Recycling for chemical raw material substitution at Cokes Oven, gave great contribution on carbon foot print reduction in steel production.

2012 China-US Joint Symposium

Land Use, Ecosystem Services, and Sustainable Development

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