Linking Biophysical and Economic Models of Biofuel Production and Environmental Impacts

Conference Presentation Abstracts and Presenter Biographies

12:30 Welcome

Steve Long, University of Illinois, Energy Biosciences Institute
Food, Feed, and Fuel: Can We Have it All?

Biography:
The overall objectives of my research program are as follows:

- To understand mechanisms of plant responses to both rising atmospheric carbon dioxide concentration and tropospheric ozone, with particular reference to photosynthesis and relating changes at the molecular and biochemical level to observations of whole systems in the field;
- To understand crop responses to global atmospheric and climate change.
- Establish the potential of mitigation of atmospheric change through the development of herbaceous energy crops.
- Advance the development of accessible mechanistic mathematical models relating environmental effects on photosynthesis to plant productivity
- To understand the limitations to C4 photosynthesis and the adaptation of the process to cooler climates.

My lab integrates molecular and biochemical studies with physiological studies of photosynthesis, using state-of-the-art and custom built gas-exchange, fluorescence and controlled environment instrumentation. Much of the work involves developing and testing hypotheses on plant environmental responses under controlled conditions and then testing these in large scale multi-partner field facilities.

Keynote Speaker: Catherine Kling, Iowa State University
Linking Biophysical and Economic Models for Environmental Policy Analysis: Methods, Challenges, and Missing Pieces

Abstract:
The complex interrelationship between the production of food, fuel, and environmental goods and services is increasingly being recognized by researchers and the general public. The next administration is almost certain to have climate change legislation and energy policy high on its agenda and will consider those issues with an ever present eye on the economic costs and benefits of any changes. With this backdrop, integrated modeling is being increasingly recognized as a valuable policy tool that can allow decision makers to anticipate the direct costs and benefits of potential policies prior to implementation. Perhaps even more importantly, careful model can help identify unexpected consequences thereby allowing policy makers to simultaneously adopt measure to avoid or mitigate these effects.

However, before models can accurately inform the policy process, they must adequately represent the scale appropriate to the questions being asked, they must include an adequate representation of the key consequences and alternatives that policy will affect, and the findings of the modeling exercise must be presented in understandable and reasonably transparent ways. In this presentation, I discuss a number of the challenges involved in the development, integration, and use of integrated economic and biophysical models. Examples are drawn from watershed based modeling exercises as well as biophysical models based on field scale predictions and are relevant to biofuels and energy, water quality, and carbon sequestration.

Biography:
Cathy Kling, professor of economics at Iowa State University, serves as the division head of CARD's Resource and Environmental Policy Division. She received a bachelor's degree in business and economics from the University of Iowa and a doctorate in economics from the University of Maryland. In her work at CARD, Kling is undertaking research to examine how agricultural practices affect water quality, wildlife, soil carbon content, and greenhouse gasses. In addition, she organizes the annual Heartland Environmental and Resource Economics workshop and is an affiliate of the Iowa State Institute of Science and Society.

1:30 – 3:00 pm Biophysical Models of Yields of Bioenergy Crops

Biofuel Crop Yield Estimation: An Integrated Biogeochemical Cycle Modeling Approach
Dr. Atul Jain, University of Illinois

Abstract:
Biomass crops are becoming increasingly important as the concerns grow about the energy demand and climate change and the need to replace carbon dioxide-producing fossil fuels with carbon-neutral renewable sources of energy. The transition to a biofuel-based energy supply raises many questions in how and where to grow energy crops. To estimate the growth and functioning of biofuel crops from local scale to regional scale, a wide range of models is currently being used, ranging from simple statistical and empirical-based models to more advanced mechanistic-based models. All models have their own advantages and disadvantages. This presentation begins with a discussion of the currently available crop yield models as well as their current strengths and weaknesses, and then discusses the integrated modeling approach which accounts for the entire biophysical, physiological, and biogeochemical system (all the most important processes governing water energy and nutrient cycles within soil-plant-atmosphere system).

Biography:
Atul Jain is an Associate Professor at the University of Ilinois at Urbana-Champaign. Before joining the University of Illinois in 1995, he held research positions at the University of Muenster, Germany, from 1988-1992, and the Lawrence Livermore National Laboratory, Livermore, CA, from 1993-1994. He earned his Ph. D. in

Atmospheric Sciences from the Indian Institute of Technology (IIT), New Delhi, India. His research focuses on understanding how interactions among the climate system and human activities alter the cycles of carbon, a major greenhouse gas (GHG), and to provide useful projections of future changes in global carbon and resultant future climate change. Dr. Jain has served as an invited expert to United Nations Framework Convention on Climate Change (UNFCC) Expert Meetings, and as a lead and contributing authors for major assessments of the Intergovernmental Panel on Climate Change (IPCC).

A Biophysical Model of Switchgrass Yields

James R. Kiniry (presenter) and Mari-Vaughn V. Johnson, ARS, USDA

Abstract:

The Agricultural Land Management Alternatives with Numerical Assessment Criteria (ALMANAC) model, has been extensively tested on switchgrass (*Panicum virgatum*) simulation in Texas since 1996 and, more recently, in the northern Great Plains. This presentation describes how meteorological, physiological, and soil parameters function in ALMANAC. The ALMANAC model uses readily available NRCS soils data and NOAA weather data. Further, we will discuss switchgrass parameters derived for a range of sites and populations. Validation data from our published papers include sites in Texas, Arkansas, Louisiana, North Dakota, South Dakota, Nebraska, Wisconsin, Kansas, and Oklahoma. We will discuss the quantification, simulation, and validation of leaf area index, light interception, dry matter production, and nutrient cycling. One of the strengths of the model is its ability to compare various bioenergy crops, including switchgrass, maize, and sorghum, under the same soil, climate, and other site conditions. The ALMANAC model has been extensively validated with these crops as well as other grass and tree species. However, as will be discussed, there is further potential to develop parameters to simulate other plant species, such as *Miscanthus* × *giganteus*. Further, the model provides realistic biomass yields and nutrient inputs and has therefore been utilized in economic analyses related to switchgrass production. The ALMANAC model is a useful tool for bioenergy crop evaluation and management.

Biography:

James Kiniry is a research agronomist at the USDA ARS in Temple, Texas. He received his Ph.D. in agronomy from Texas A&M University. His research focuses on simulation modeling quantifying variability in radiation use efficiency of maize, sorghum, rice, wheat, potato, eastern red cedar, and several warm-season grasses including Alamo switchgrass. Dr. Kiniry is also working on describing processes critical to yield formation of maize and developing a generic plant model, capable of simulating plant growth and development by changing the parameters associated with physiological, morphological, and phenological processes. This model is capable of simulating weeds with crops, crops with crops (intercropping), several grass species competing, or woody species competing with grasses. The model was applied to Alamo switchgrass growth at several sites in Texas.

Discussant: Fernando Miguez, University of Illinois

Biography:
Fernando Miguez was born in Buenos Aires, Argentina, and has been in Urbana, IL, since 2001. He is currently a post-doctoral researcher at the Energy Bioscience Institute (University of Illinois) working on developing general mathematical models for biomass crops with particular emphasis on parameter estimation. He has received a M.S. and Ph.D. in Crop Sciences and a M.S. in Applied Statistics, all from the University of Illinois. The research is integrative, involving crop physiology, agronomy, soils, mathematical modeling, and statistics with the goal of producing reliable crop models that address some of the challenges of the potential of biomass crops as feedstocks for the emerging bioeconomy. His PhD thesis concentrated on analysis of the published literature of Miscanthus x giganteus European research, field experimentation in Illinois (which also included switchgrass), development of a general vegetation model, based on WIMOVAC (http://www.life.uiuc.edu/plantbio/wimovac/homepage.htm), called BioCro which maintains the largely mechanistic processes and also on incorporating optimization routines to crop models as well as developing custom parameter estimation methods based on a Bayesian framework. For more information visit: http://netfiles.uiuc.edu/miguez/www.

3:30 – 5:00 pm Soil Carbon Modeling with Bioenergy Crops

Developing a Model with Soil Carbon Processes for Carbon Sequestration: Modeling Directly Measurable Pools
Wilfred M. Post (presenter), Oak Ridge National Laboratory; Johan Six, Fugen Dou, University of California – Davis; Julie D. Jastrow, Argonne National Laboratory

Abstract:
Current models of SOC decomposition dynamics are based on the use of conceptual SOC pools described by first-order kinetics. A considerable amount of experience has been gained in using models based on conceptual SOC pools especially in regard to rate coefficient relationships with soil temperature and moisture conditions as well as in interactions with N dynamics and microbial N transformations. Although this approach to modeling C and N transformations in soil has been successful and useful we still have not resolved several important issues. First is the question of model initialization—we know that the initial distribution of the C pools has a strong influence on short-term dynamics but we cannot accomplish this by using direct measures. The second issue follows directly from the first, and is the question of how carbon is actually stabilized in soil and whether we can model it using directly measurable pools and parameters? The third issue concerns the representation of microbial biomass. Several lines of evidence have started to suggest the need for a more detailed representation of the microbial biomass pool. In this presentation we will concentrate on the second question by considering the developing new paradigm of soil C modeling which explicitly takes into account soil organic matter interactions with mineral particles and the formation and turnover of soil

aggregates. This approach offers some advantages that include more data points for calibration/validation, initial pool sizes can be directly measured; and a serious disadvantage – there are many more fractions to measure and parameters to estimate. We present recent progress, and highlight research needs.

Biography:

Wilfred Post has over 90 open literature publications in terrestrial ecosystem ecology. Particular emphasis is in the area of global terrestrial ecosystem carbon cycling and relationships of ecosystem dynamics to environmental, edaphic, and biological conditions. He is a recognized expert on soil carbon dynamics, nutrient relationships between soil and vegetation, and the impact of species composition on ecosystem processes. He has developed new approaches to representing the impact of land-use change, and climate change in terrestrial biogeochemistry models and also developed global data sets for the evaluation of global terrestrial biogeochemistry models. His current work now centers on developing data-assimilation methods to confront terrestrial ecosystem models with data from a variety of sources (atmospheric trace gas measurements, eddy-covariance networks, soil and biomass inventories) to estimate model parameters and initial conditions and to improve ecosystem models.

Education: 1978 Ph.D. Ecology, University of Tennessee, Knoxville
1975 M.S. Botany, University of Wisconsin, Madison
1971 B.S. Mathematics, University of Wisconsin, Madison

Linking Economic Models to Ecosystem Biogeochemistry Models: Biofuel Examples

William Parton (presenter), Steve DelGrosso, Sarah Davis, Steve Ogle, Bruce McCarl, and Steve Williams, Colorado State University

Abstract:

Ecosystem models have been linked to economic models to yield a coupled system that allows us to evaluate economic decisions in ecological terms and vice versa. The two main ways agricultural economic models have been linked to ecological models include: 1) generating response surfaces of ecosystem output variables as inputs into the economic models and 2) using results from economic models to predict land use changes that then are input into ecosystem models. Here, we present recent results from a study where the DayCent ecosystem model was linked to the FASM US agricultural economics model. DayCent results show that current biofuel systems result in a net decrease in greenhouse gas fluxes. The use of biomass from switchgrass and native grasslands to produce ethanol results in much larger (two-fold) reductions in greenhouse gas fluxes compared to the use of grain corn to produce ethanol. The DayCent model was used to simulate trace gas response surfaces for corn, wheat, soybeans, and alfalfa as a function of soil texture and fertilizer additions. These ecosystem response surfaces were then used as input to the FASM economic model. In addition, we show how FASM model-predicted land use changes were used by the DayCent model to determine net greenhouse gas fluxes from biofuel cropping systems in the United States. Model results show that using conservation reserve program land and native grasslands to grow corn grain for ethanol

production greatly reduces the net greenhouse benefits compared to use of current cropland. DayCent was also used to simulate net greenhouse gas fluxes for corn, switchgrass and Miscanthus grown in Illinois, USA, with the greatest reduction in net greenhouse gas fluxes for Miscanthus, followed by switchgrass, and corn.

Biography:
Dr. Parton has experience working on the development of Ecosystem models during the last 30 years. His computer models are currently being used extensively in the US and the world to evaluate the impact of land use, climatic and environmental changes on natural(grassland, forest, and savanna) and agricultural ecosystem dynamics. His DayCent ecosystem model is currently used by EPA to estimate N2O and soil carbon emissions from agricultural ecosystems in the US.

Discussant: Mark David, University of Illinois

Biography:
Research conducted in the biogeochemistry laboratory of Dr. Mark David is focused on the biogeochemistry of nutrients in agricultural, forested, and aquatic ecosystems. Interdisciplinary research has been used to study complex systems from a variety of approaches. Using field research, his laboratory examines the transformation, transport, and effects of nutrients in agricultural and forested landscapes, including aquatic systems. Research areas have included nitrogen and phosphorus biogeochemistry in agricultural ecosystems (see more on agricultural landscape we study); transport of nutrients to surface waters at scales ranging from fields to regions; fate and effects of nutrients in aquatic systems, including denitrification and role of phosphorus in algal production; use of constructed wetlands to reduce agricultural nutrient losses to surface waters; acidic deposition effects on soils, including sulfur biogeochemistry; forest nutrient cycling; sewage waste disposal; and herbicide transport.

Nov. 14, 8:30 – 10:00 am Linking Yield Models with Economic Decision Making

Challenges of Integrating Biophysical Information into Agricultural Sector Models
Daniel De La Torre Ugarte (presenter), Burt English, Chad Hellwinckel, and Lixia Lambert, University of Tennessee

Absract:
A number of studies have addressed various agronomic, economic, and environmental issues associated with use of biomass feedstocks for transportation fuels, bioproducts, and power. Economic modeling of bioenergy feedstocks has examined environmental impacts, such as carbon displacement potential and has analyzed long-term and intermediate-run outcomes. However, short-run adjustment costs resulting from implementation of new technologies and/or policies are not considered by these studies. Agricultural sector models are useful for analyzing the interaction between energy feedstock production and water resources including policy changes across commodities,

regions, and production systems. In addition, the representation of production activities can be delineated in biophysical simulation models to generate the interaction coefficients between production and the environment. Biophysical models will project the yield index, water use, fertilizer application rates, soil erosion, chemical runoff, carbon emissions, and carbon sequestration for each production activity in each region of the model. Then, the projected aggregated regional outcomes are generated using an economic simulation.

The Policy Analysis System (POLYSYS) is a model capable of simulating regional land use dynamics at the county level; the model has a supply module disaggregated to 3110 counties representative of the contiguous US states. Similar to other sector models, POLYSYS has been integrated with other agronomic models for environmental parameters. EPIC/ALMANAC, developed by USDA, compiles soil erosion, economic, hydrological, weather, nutrient, plant growth dynamics, and crop management information.

The integration of agricultural sector models and biophysical models requires a great deal of data, and brings significant challenges to the analysis. Some of the key underlying issues are: geographic resolution, physical and economic data, long and short-term weather impacts, and the potential need for adequate calibration. This presentation discusses the implications of different choices and the route implemented in the POLYSYS model.

Biography:

Dr. Daniel De La Torre Ugarte is a professor of agricultural economics and associate director of the Agricultural Policy Analysis Center (APAC) at the University of Tennessee. He received a B.S. in economics from the Universidad del Pacifico (Lima, Peru), and a MS and PhD in agricultural economics in 1991 form Oklahoma State University.

Dr. De La Torre Ugarte has more than 15 years of experience in the areas of agricultural policy, international trade, and bioenergy. He helped established and developed APAC into a highly respected center that has developed working relationships with government agencies, national federal laboratories, other universities, non-government organizations (NGOs) in more than twenty countries.

His agricultural policy analysis worked has provided stake-holders with reliable analysis of issues affecting primarily the performance of the US agricultural sector, the issues researched range from alternative policy proposals for farm legislation to the analysis of the potential interaction between changing agricultural practices, carbon sequestration and climate change.

Dr. De La Torre Ugarte's work on bioenergy, has focused on the synergism between agricultural and energy policies, and how a bioenergy program based on agricultural feedstock could contribute to a national and international energy strategies to support farm and rural incomes in the US and abroad. The work done under this program has lead to the development of analytical capabilities that are unique in the country.

Land Use and GHG Implications of Meeting Biofuel Targets: Linking Biophysical and Economic Models
Madhu Khanna, Environmental Economist, University of Illinois

Abstract:
We develop a dynamic micro-economic framework to determine the outcomes for land use allocation, crop choices, and prices of meeting a mandated level of corn ethanol and cellulosic ethanol over the 2007-2022 horizon. This framework incorporates the spatial heterogeneity in yields, costs of production and land availability within a region. Cellulosic feedstocks considered here include corn stover, miscanthus and switchgrass. Spatially heterogeneous yields of switchgrass and miscanthus are obtained from a biophysical crop growth model and used to examine the heterogeneity in the viability of biofuels from alternative feedstocks across geographical locations and the mix of feedstocks that is likely to be economically viable. We analyze the impact of these mandates for the price of food crops that will be displaced from cropland and for the cost of producing biofuels to meet given mandates. The diversion of corn needed to meet the mandate for corn ethanol raises the price of corn and thus the cost of production of corn ethanol. Rising corn prices also raise the opportunity costs of cropland to be converted to energy crops and thus the costs of producing cellulosic biofuels from these energy crops; resulting in considerable use of corn stover for biofuel production. We also investigate the effects of biofuel mandates for nitrogen use and lifecycle carbon emissions.

Biography:
Madhu Khanna is a professor in the Department of Agricultural and Consumer Economics and in the Energy Biosciences Institute at the Institute of Genomic Biology, University of Illinois at Urbana-Champaign. She received her Ph.D. from the University of California at Berkeley. Her research focuses on environmental policy analysis and incentives for adoption of environmentally friendly production practices. She is currently examining the land use, market and environmental implications of cellulosic biofuels. She is a member of the Environmental Economics Advisory Committee of the Science Advisory Board of the US EPA. She has served on the Board of Directors of the Association of Environmental and Resource Economists. She holds editorial positions at several environmental and agricultural economics journals.

Discussant: Scott Swinton, Michigan State University

Biography:
Scott M. Swinton is a professor of Agricultural, Food and Resource Economics at Michigan State University. He teaches ecological economics and agricultural production economics. His economic research on agricultural production and environmental management focuses on technology evaluation and policy analysis. He concentrates on problems involving ecosystem services, crop pest and nutrient management, precision agriculture, resource conservation, and management of risks to human health and finances.

Swinton, Biography (cont'd)
Education: Ph.D., University of Minnesota, 1991
M.S., Cornell University, 1983
B.A., Swarthmore College, 1978
Professional Interests
- Design of incentives to induce adoption of environmentally beneficial farming technologies
- Valuation of ecosystem services linked to agriculture
- Spatial data analysis methods
- Environmental economic impact analysis
- Potential of precision technologies to boost profitability and improve environmental performance
- Assessment of alternative pest and nutrient management policies and practices

10:30 – 12:00 Water Quality and Biodiversity Impacts of Biofuel Crops

Water Quality and Biodiversity Impacts of Biofuel Crops
R. César Izaurralde (presenter), Claudio Gratton, Allison M. Thomson, and Douglas A. Landis, Joint Climate Change Reseearch Institute, Pacific National Laboratory, University of Maryland

Abstract:
Plant-based biofuels have been emerging with force during the last few years in national and international markets due to energy security, climate change, and environmental reasons. Currently, the majority of the biofuel commercialized is ethanol derived either from grain corn or sugar cane. In the United States, about 18% of the corn production is dedicated to the production of ethanol. This type of production of biofuels, however, is relatively inefficient with respect to energy and is known to affect water quality and biodiversity. Cellulose-based ethanol is considered to have many advantages over starch-based ethanol from the point of view of energy efficiency and environmental quality but many technological hurdles remain to be conquered. This presentation will examine some of the key water quality and biodiversity issues associated with different methods and types of biofuel production. The presentation will also explore a watershed-based modeling approach to evaluate these impacts and help design landscapes that are optimal from the point of view of provision of feedstocks, provision of water quality, and enhancement of biodiversity (e.g. pest suppression).

Biography:
Dr. César Izaurralde is a laboratory fellow at the Joint Global Change Research Institute (JGCRI), a collaboration of the University of Maryland with the Pacific Northwest National Laboratory (PNNL). He is also an adjunct professor in the departments of Geography and the Natural Resource Sciences and Landscape Architecture. Dr. Izaurralde is a soil scientist with more than 30 years of research experience in agronomy, soil science, and ecosystem modeling. His current research focuses in the areas of modeling the impacts of climate change and variability on terrestrial ecosystems and

water resources and carbon sequestration in and greenhouse gas emissions from agricultural soils. Before joining PNNL in 1997, Dr. Izaurralde served as Chair of Resource Conservation in the Department of Renewable Resources at the University of Alberta, Canada. There he taught courses in soil conservation and conducted research in the areas of soil conservation and nutrient cycling in agroecosystems and environmental-economic modeling. In his native Argentina, he studied at and later joined the Facultad de Ciencias Agropecuarias at Universidad Nacional de Córdoba.

Dr. Izaurralde is Fulbright Fellow and a Fellow of the American Society of Agronomy. Dr. Izaurralde is a member of the Soil Science Society of America, the American Society of Agronomy, the American Association for the Advancement of Science, and the American Geophysical Union.

Education: Ph.D. Soils, Kansas State University, 1985
M.Sc. Soils, Kansas State University, 1981
B.Sc. Agronomy, Universidad Nacional de Córdoba, Argentina, 1972

Modeling the Effects of Landscape Change on the Ecosystem Service Value of Biological Pest Control

W. van der Werf[a] (presenter), D.A. Landis[b], M.M. Gardiner[b], A.C. Costamagna[b], J.M. Baveco[d], F.J.J.A. Bianchi[a], N.C. Schellhorn[e] & W. Zhang[f]

[a]Wageningen University, Department of Plant Sciences, Centre for Crop Systems Analysis; [b]Michigan State University, Center for Integrated Plant Systems, Insect Ecology and Biological Control; [d]Wageningen University & Research Centre, Alterra Green World Research; [f]Michigan State University

Abstract:

Landscapes are changing rapidly worldwide. Empirical evidence is mounting that these changes may affect the suppression of pests in agricultural crops. A suite of modelling techniques is available and in development to extend empirical results to realistic spatial images of the distribution of the ecosystem service of biological control over agricultural landscapes and highlight the economic impacts of landscape change on the value of ecosystem services. These models can play a role in functional landscape design and policy support.

Biography:

Dr van der Werf is an associate professor at Wageningen University, in the Netherlands. His focus in research is spatial ecology and epidemiology, as applied in agricultural systems. He received his PhD at Wageningen University in 1988, and has worked at Wageningen University in the Department of Theoretical Production Ecology (1987-1999), The group Crop and Weed Ecology (1999-2008), and currently in the Centre for Crop Systems Analysis. He has published on a wide array of agro-ecological topics, often on the interface of empirical field studies and spatial or epidemiological modeling. Topics include epidemiology of plant and insect viruses, population dynamics and biological control of aphids, spatial ecology of ladybeetles at crop and landscape scale, weed population dynamics, regional studies on locusts, and the ecology and productivity of intercropping and agroforestry systems. Dr van der Werf has long standing collaborations with colleagues in the USA, e.g. at Utah State, Cornell, Michigan State, Iowa State and Penn State University.

Discussant: Douglas Landis, Michigan State University

Biography:
Doug Landis received his BA in Biology from Goshen College in 1981 and his MS and PhD in Entomology from North Carolina State University in 1984 and 1987. In 1988 he accepted a position in the Department of Entomology at Michigan State University where he is currently a full Professor with research and teaching responsibilities in insect ecology and biological control of invasive species. His research focuses on the role of landscape structure in shaping insect-insect and insect-plant plant interactions. His current projects include biological control of invasive plants and insects, the use of native plants to enhance beneficial insects, biodiversity implications of biofuel crops production, and conservation of insects in fire-dependent ecosystems. He is the author of over 100 peer reviewed journal articles and book chapters as well as over 50 Extension bulletins. As co-director of MSU's Invasive Species Initiative, he advises state and federal agencies on invasive species management. He has advised over 75 postgraduate students, served in multiple leadership and editorial positions and won numerous awards for his work. Recently he was named the 2008 recipient of the Entomological Society of America's Recognition Award in Entomology for outstanding contributions to agriculture.

12:00 – 1:30 pm Keynote Lunch Speaker

Incorporating Science Into Economic Analysis
David Zilberman, University of California, Berkeley

Abstract:
Integration of scientific and institutional knowledge to economic research on natural resource problems can lead to useful and relevant outcomes, including "applied theories" of various resource management problems, and more focused and practical empirical findings. Past studies that incorporated science into economics provides valuable insights for modeling and analysis. They emphasize the importance of heterogeneity within natural resource and human systems. Crop and technology choices vary with economic and biophysical situations and policy choices should adjust to variations over space and time. They suggest that modeling of production relationship should recognize the specific roles of inputs, distinguishing between contributions to enhance output potential, reduce pest damage and reduce vulnerability to risk. They indicate that in most systems there is a significant gap between applied and effectives levels of input use, and thus there is vast potential for gains from developing of incentives and technologies that will increase the efficiency of use of inputs such as water, chemicals and energy, leading to increased yields and reduced pollution. They advise that the design and enforcement of environmental protection policies should take advantage of improvement in information technologies. Monitoring practices and financial and other incentives should be updated over time to utilize improved informational capabilities. Finally, past studies suggest that polices affect directly the behavior of resource managers but may also induce

research and innovation efforts to provide improved technologies. The design of resource polices should take into account potential for technological change and innovations, and the long-term impacts of these innovations.

Biography:
David Zilberman has been a professor in the Agricultural and Resource Economics Department since 1979. He is a fellow of the American Agricultural Economics Association and the Association of Environmental and Resource Economists. His research interests are in agricultural and nutritional policy, economics of technological change, economics of natural resources and micro-economic theory. He received his B.A. in Economics and Statistics from Tel Aviv University in Israel and his PhD in Agricultural and Resource Economics from U.C. Berkeley.

1:30 – 3:00 pm Modeling Land Use Implications of Biofuel Crops

Biofuels, Food Security and Climate Change: Implications for Land Use Change
Guenther Fischer, IIASA

Biography:
Günther Fischer leads the Land Use Change and Agriculture (LUC) Program at IIASA, which is focusing research on global climate change impacts and adaptation, on regional analyses to support decision-making for sustainable and efficient use of land and water resources, and on development of related methodologies and novel analytical tools.

With an education in mathematics, his main fields of research are mathematical modeling of ecological-economic systems, econometrics, optimization, applied multi-criteria decision analysis, integrated systems and policy analysis, spatial agro-ecosystems modeling, and climate change impacts and adaptation.

Günther Fischer joined IIASA's Computer Sciences Group in November 1974. From 1977 to 1985 he was affiliated with IIASA's Food and Agriculture Program (FAP) as a Research Scholar. He participated in the formulation of a general equilibrium framework and the implementation and application of a global model of the world food systems, known as IIASA's Basic Linked System. He was a key contributor to several major food and agricultural studies: On welfare implications of trade liberalization in agriculture; on poverty and hunger; and on climate change and world agriculture.

In 1993 he became a member of the IGBP-IHDP Core Project Planning Committee on Land-Use and Land-Cover Change (LUCC) and for several years served on the Scientific Committee of the joint LUCC Core Project/Programme of the IGBP-IHDP.

Biofuel Consequences for European Wetland Species: Combining Bottom-up Biophysical Modeling and International Market Feedbacks

Uwe Schneider, Hamburg University

Abstract:

Land scarcity causes competition between agriculture, managed forestry, nature reserves, and other land uses. This competition affects the efficiency of policies which address land use and its externalities. Rising land values hamper the realization of land-intensive bioenergy and biodiversity objectives. To regulate land use in a socially efficient manner, policymakers at national and international level need scientific guidance that accounts both for the complexity and heterogeneity of land use. In this study, we integrate heterogeneous land qualities, diverse environmental impacts, and international agricultural commodity markets, by linking geographical information systems, biophysical crop and tree growth simulation models, a mixed integer program for systematic conservation planning of European wetland species, and the European Forest and Agricultural Sector Optimization Model. These links include data intensive one-directional couplings (biophysical simulation models) and computation intensive iterations between models. For different combinations of wetland and biofuel policies, we quantify the likely impacts on food prices, land management intensities, agricultural commodity trade, and marginal costs of biofuel production and wetland protection.

Biography:

Dr. Uwe Schneider is an agricultural and resource economist who specializes in integrated forest and agricultural sector analysis. He grew up on a farm, worked for large agricultural enterprises in East Germany, and holds a Master degree in soil and crop science from Humboldt University, Berlin and a PhD degree in agricultural economics from Texas A&M University. During his dissertation in Texas and his postdoctoral time at Iowa State University, he worked with the US Agricultural Sector and Mitigation of GreenHouse Gas model to examine economic potentials of agricultural greenhouse gas emission mitigation. In 2002, Dr. Schneider became an assistant professor at Hamburg University and started to develop the European Forest and Agricultural Sector Optimization Model. He coordinated the European Non-Food Agriculture project and participates in several European land use related projects. Dr. Schneider has been involved in the US Forest and Agricultural Greenhouse Modeling Forum, the Energy Modeling Forum, the International Agricultural Trade Research Consortium, the last Intergovernmental Panel of Climate Change assessment, and the International Max-Planck Research Schools for Earth System Modeling and Maritime Affairs. Since 2006, he leads the Research Unit Sustainability and Global Change at Hamburg University. He taught courses in mathematical programming, dynamic optimization, and land use. Dr. Schneider has developed a variety of software tools for data intensive mathematical modeling. His research focuses on all aspects of land use and related market externalities.

Discussant: Andre Faaij, Utrecht University

Biography:
Dr. André P.C. Faaij (1969) is appointed as associate professor at the Copernicus Institute for Sustainable Development of the Utrecht University. He has a background in chemistry and environmental sciences and holds a Ph.D. on energy production from biomass and wastes. He worked as visiting researcher at the Center for Energy and Environmental Studies - Princeton University and at King's College - London University.

He coordinates a research cluster on energy supply and system studies (>20 research staff involved), covering bio-energy, sustainable use of fossil fuels, intermittant energy sources and energy system studies and modelling. Both in 2000 and 2004, external evaluations qualified the cluster as Very Good – Excellent' with respect to 'Productivity, Quality, Viability and Societal Relevance', showing strong international leadership in its' core areas as Bio-energy and CCS.

Education:
M.Sc., Utrecht University, Chemistry & Environmental Sciences (1991)
Ph.D., Utrecht University, Energy from Biomass & Waste (1997)

3:30 – 5:00 pm Integrative Modeling Approaches

Linking Economic and Biophysical Models for Climate Change and Biofuel Analysis
Bruce McCarl, Texas A&M University

Abstract:
The presentation deals with the modeling system that has been used at Texas A&M consisting of the EPIC crop simulator that is used for environmental and yield modeling, the CENTURY crop simulator that is used for soil carbon, nitrous oxide and yield modeling, the FASOM GHG model that is used for sectoral land allocation and welfare, the SWAT watershed model that is used to examine water quality effects of crop land use changes, and the HUMUS linking model that reduces the FASOM land use to the county level for input to SWAT. Experience in using these and plans will be revealed plus the conceptual basis for total system design.

Biography:
Bruce A. McCarl is a Regents Professor and a Distinguished Professor of Agricultural Economics at Texas A&M University, a Fellow of the American Agricultural Economics Association plus is part of the Intergovernmental Panel on Climate Change that was a co recipient of the 2007 Nobel Peace Prize. Dr. McCarl has been on the Texas A&M faculty since 1985 and previously held positions at Oregon State and Purdue. His PhD was in Management Science from Pennsylvania State University. He works on the economic implications of biofuels, global climate change and greenhouse gas emission reduction, as well as environmental, forestry and agricultural policy design. During the last few years he developed the economic parts of the U.S. Global Climate Research Program National assessments for both forestry and agriculture, worked on agricultural and forestry multistrategy assessment of climate change mitigation potential in conjunction

with the US Kyoto Protocol negotiating team and served as a member of the IPCC Agricultural Mitigation chapter writing team while assisting the forestry team. He also works on mathematical programming and risk modeling methodology. He is the author of 193 journal articles and more than 400 other professional papers and presentations.

Bioenergy Life-Cycle Assessment: Paradigm, Pitfalls, and Potential for Low-Carbon Fuels

Paul Meier, Director, Energy Institute, University of Wisconsin

Abstract:

Greenhouse gas implications of expanded biofuel production is the source of recent debate. Greenhouse gas impacts are difficult to estimate due to complicated attribution to co-products as well as the uncertainty and variability in emissions from land use change. The use of cellulosic feedstocks has significant potential to lower the life-cycle greenhouse gas impact of biofuels, but new and improved analysis will be necessary. Three inter-linked systems require analysis: 1) the biological cycle of agricultural and forest systems, 2) the industrial system of feedstock production, fuel processing, and distribution, and 3) the energy system which provides energy to, and receives energy from, the biofuel production system. This presentation will discuss LCA methods and challenges, potential for greenhouse gas mitigation via cellulosic biofuels, as well as methods and considerations to improve analysis.

Biography:

Paul Meier has been working with industry, government, and public interest groups on energy and environmental issues since 1995. As the Director of the Energy Institute at UW-Madison, he coordinates interdisciplinary research, educational, and outreach activities across several campus centers and departments. Paul received his Ph.D. from UW-Madison in 2002, where he used life-cycle assessment to evaluate how climate change policy will impact U.S. electric power generation. He has authored multiple models which simulate long-term electric utility operation and infrastructure expansion. As part of the Great Lakes Bioenergy Research Center, he is currently evaluating greenhouse gas emissions associated with cellulosic biofuel production. He received a B.S. in Civil Engineering from Purdue University, an M.S. in Environmental Systems Engineering from Clemson University, and a Ph.D. through the Nelson Institute for Environmental Studies at UW - Madison.

Discussant: Catherine Kling, Iowa State University
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