4th Open Science Meeting of the Global Land Programme

April 24-26, 2019 | Bern, Switzerland

Conference Agenda

Overview and details of the sessions of this conference. Please select a date or location to show only sessions at that day or location. Please select a single session for detailed view (with abstracts and downloads if available).

Session Overview

Session

204R: Opportunities of farm and landscape level models in land use science for biodiversity and ecosystem service assessment

Time: **Thursday, 25/Apr/2019: 1:30pm - 3:00pm**
Session Chair: **Veronika Gaube**
Session Chair: **Martin Schönhart**
Session Topics: What do people want from land?

Location: **UniS-A -126**
UniS building, room A-126, basement, 80 seats

Session Abstract

Human actions have rapidly growing impacts on terrestrial ecosystems. Understanding the processes of the decision-making process of land users that drive agricultural land management, needs attention in land use science. Responses of land users to changes in broad-scale, underlying drivers are difficult to anticipate because agents quickly change behavior to changes in framework conditions. A range of economic-based models of farmer decision-making in agriculture and land use under future policy and market scenarios exist. At the same time, research on decision-making of farmers shows clearly that many other important - mainly social - factors influence farmers. Consequently, additional modelling approaches occur including beside economic performance other relevant factors e.g. socio-demographic characteristics of the farm household, the wider social milieu, or other factors. With respect to spatial scales, models at farm and landscape level are closest to real-world land-use decision making. Although they are limited to case studies at landscape to regional level due to high complexities and data demand, high-resolution outputs become possible and offer interfaces for subsequent environmental analyses such as on biodiversity and ecosystem services.

In this session, we will explore the diversity of models at the farm and landscape level to analyze land use impacts from diverse future biophysical and socio-economic trajectories, such as climate change or environmental and agricultural policies. By comparing approaches such as bio-economic farm optimization models or agent-based models, the strengths and weaknesses of each option will be revealed in implementing scenario assumptions, translating scenario drivers to land use outcomes, and evaluating land use outcomes by their effects on biodiversity and ecosystem services. We will introduce this session by highlighting the variety of quantitative models at farm and landscape level compared to other spatial levels and scope in order to reveal good-practice options and future research demand.

Presentations

Full talk
ID: 799 / 204R: 1
204R Opportunities of farm and landscape level models in land use science for biodiversity and ecosystem service assessment
Keywords: Integrated modelling, ecosystem services, biodiversity, stakeholder, review

Integrated modelling frameworks as means for assessing ecosystem services and biodiversity at landscape level

Martin Schönhart, Erwin Schmid
University of Natural Resources and Life Sciences Vienna, Austria

Rural landscapes are dominated by agriculture and forestry in many parts of Europe. Competing private and societal demands on particular ecosystem services (ESS) and ecosystem integrity result in land use conflicts. Integrated Modelling Frameworks (IMFs) are one option to quantify trade-offs and synergies of land use choices and to inform land use decision making and policies. IMFs in land use science are diverse with respect to its components and component linkages but typically share bio-physical and socio-economic modules. For landscape level applications, they need to tackle among others a high spatial resolution of input and output data, high system complexities and dynamics, data and knowledge gaps, and conflicts with temporal and spatial scales. Frequently, IMF applications at landscape scale are part of participatory research processes.

In our presentation, we review IMF approaches and results from multiple participatory research projects in Austria that analyzed land use trade-offs and synergies at field, farm, and landscape level. The employed IMFs usually consist of a crop rotation model, a bio-physical process model, and either a regional bottom-up economic land use optimization model or a bio-economic farm optimization model. They quantify relevant ecosystem services and biodiversity indicators. The typical ex-ante oriented research questions require contrasting socio-economic and climate scenario assumptions. By systematically addressing experience-based shortcomings of IMFs, we show opportunities for future model improvements.

While the presented IMFs are state of the art, portray major system components and turn out to be helpful in participatory policy processes, they still face challenges and constraints such as the consistency of interfaces between model components with respect to the dynamics of land management. Furthermore, the selected representation of system components, e.g. mutual impacts of land use, climate change, ecosystem services, and biodiversity can bias conclusions if major trade-offs and synergies remain unobserved.

Full talk
ID: 419 / 204R: 2
204R Opportunities of farm and landscape level models in land use science for biodiversity and ecosystem service assessment
Keywords: agent-based modelling, biodiversity, land use change, climate change, farmers decisions

Sheep, frogs and cows: Modelling spatially-explicit land use and ecosystem impacts under climate change in the French Pyrenees

Andreas Mayer[1], Claudine Egger[1], Veronika Gaube[1], Christoph Plutzar[1], Dirk Schmeller[2], Adeline Louyau[2]

[1]University of Natural Resources and Life Sciences, Boku Vienna, Austria; [2]Ecolab Toulouse

Land-use and climate change are pervasive drivers of global environmental change, posing major threats to global ecosystems and biodiversity. Research to date has mostly focused either on land-use change or on climate change, but rarely on the interactions between both drivers, even though systemic feedbacks between changes in climate and land use will have important effects on livestock, ecosystems and biodiversity. Climate change will not only alter patterns of temperature, precipitation or species pools, it will also motivate land owners to reconsider their land use decisions.

In an ongoing project *(MoLUP),* we collaborate in an interdisciplinary research effort with the ongoing Belmont project *(P^3)*. There, we explore anticipated systemic feedbacks between (1) climate change, (2) land owner's decisions on land use, (3) land-use change, and (4) changes in ecosystems and hydrological regimes in the coming decades in selected mountain areas in the French Pyrenees. We explicitly focus on the role of alpine livestock systems and livestock grazing in mountain regions.

We expand and refine SECLAND, an agent-based model which we have developed for the Eisenwurzen Region in Austria, that simulates decisions of important actors, and develop a spatially explicit GIS model that translates these decisions into maps of changes in land cover and land use patterns, which we will implement for the Department Ariége in the French Pyrenees. For MoLUP, the most relevant agents are land managers (e.g. farms) that make land-use decisions dependent on framework conditions (e.g. agricultural prices and subsidies) as well as intrinsic preferences and societal norms (i.e. their farming style), that may change over time. Expert interviews and interviews during field trips allow incorporating regional specifics of the respective sites into the ABM and deepen the understanding of farmers motivations behind their land use decisions. In addition, hydrological data as well as data on pollution and pathogens will be integrated into the model. This integrated socioecological model will allow to explore the option space for future land use under climate change and to assess both the direct and indirect land-use mediated effects of a warming climate on mountain ecosystems.

Full talk
ID: 828 / 204R: 3
204R Opportunities of farm and landscape level models in land use science for biodiversity and ecosystem service assessment
Keywords: Participatory modelling, Shifting cultivation, Land-use change, Farmer resource allocation strategies

Participatory modelling with farmers, exploring the what, how and why of land-use change.

Swen Petrus Maria Bos[1], Tina Cornioley[1], Claude Garcia[1,2]

[1]ETH Zurich, Switzerland; [2]Cirad Montpelier, France

Shifting cultivation is still widespread throughout the tropics, and the main agricultural production system for the rural poor living in forest margins. Though often blamed as a main cause of both forest degradation and deforestation, it is the discontinuation of shifting cultivation, and its replacement by intensified land uses, that results in far larger negative environmental impacts.

Understanding what drives this change requires us to study what motivates farmers to transition away from one system, in this case shifting cultivation (Jhum), into another, such as plantation crops. Given that decisions are made in an environment where resources, such as labour and cash, are often limited, we argue that it is important to put stakeholders in front of these investment decisions, in a safe modelling environment, and to analyse the drivers and impacts of these decisions together.

In this study, we explored the resource allocation strategies of the Jhum farmers of the Karbi tribe in Northeast India. Their forested tribal lands have a very high conservation value, and any major change to the system would have dire consequences for the conservation effort of the adjacent Kaziranga National Park's rhinos, elephants and other wildlife.

Together with the Jhum farmers, we developed an interactive model of the local farming system, in the form of a game. Here farmers allocate labour and cash to meet household needs, to improve their standard of living, or to invest in new opportunities like bamboo, rubber and tea.

Throughout our study, it became clear that the farmers are actively striving to change their landscape, this to harness both existing and emerging economic opportunities, while improving their livelihoods. However, the trajectory of landscape change comes with a twist, investment strategies and priorities are quite surprising and the old practises that ensure food security remains unexpectedly persistent.

Full talk
ID: 548 / 204R: 4
204R Opportunities of farm and landscape level models in land use science for biodiversity and ecosystem service assessment
Keywords: Payment for ecosystem services, Land abandonment, Community partnership, Agent-based modeling

Effects of intercommunity partnership on direct payment for mountain agriculture in Japan: A case study using agent-based modeling

Kikuko Shoyama

United Nations University Institute for the Advanced Study of Sustainability, Japan

Due to depopulation and aging society, land abandonment and under-use of natural resources are now critical concerns threatening sustainable use of ecosystem services in Japan. To maintain agricultural landscapes, with the prevention of further abandonment of farmland, the direct payment program to farmers in hilly and mountainous areas was implemented since 2000. The government has invested over 52,000 million JPY per year, and 52,300 communities have received payment to maintain 662,583-ha farmland throughout the country. The program covered over 80% of target farmland. The program is characterized as community-based enrollment with the payments mainly used for collaborative works to maintain steep paddy and crop fields. However, due to the lack of successors for aging farmers, enrollment in the payment program should decrease, especially in depopulated communities. Thus, the government introduced the intercommunity partnership system into the program in 2015.

Herein we have developed an agent-based model to simulate the effects of intercommunity partnership on enrollment in payment for ecosystem services (PES) program. The study area was the Noto peninsula in Northern Japan. The area consists of nine local municipalities, which have 12,260 farmers in 961 communities. The area is recognized as a typical socio-ecological production landscapes (SEPLs) with an area of 1,866 km^2 registered as Globally Important Agricultural Heritage Systems (GIAHS) in 2011. We conducted household surveys and collected agricultural census data to parameterize the farmers' decision and spatial data to map potentially enrolled farmland to the program.

Our analysis revealed that four types of farmers (full-time farmers, part-time farmers, self-sufficient farmers, and farm organization) have different roles in their communities and contribute to developing intercommunity partnership through interaction with each other. By using an agent-based model, the number of each type of farmer and the area of enrolled and/or abandoned farmland were simulated up to 2050, at each payment level, assuming intercommunity partnership was involved more than at the current level. To develop further activities in the next generation program, strong leadership and partnership beyond environmental and social heterogeneity are required. The findings in this study can be considered in the context of the efficiency of various PES programs in other countries.

Full talk
ID: 281 / 204R: 5
107R Assessing, modelling, and analysing land use and land management impacts on the Earth system
Keywords: paddy expansion; ecosystem service value; land use change; agricultural land; remote sensing

Ecosystem service variations in response to paddy expansion in the Sanjiang Plain, Northeast China

Fengqin Yan[1,2], Shuwen Zhang[1]

[1]Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, China, People's Republic of; [2]Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences

The ecosystem of the Sanjiang Plain in Northeast China has dramatically changed in the past four decades. This study investigated the history of paddy field expansion in the Sanjiang Plain and discovered the ecosystem service variations in response to paddy expansion. Integrating a series of Landsat images, we obtained the land use change patterns as well as the paddy expansion history from 1976 to 2015. Then, we calculated ecosystem service values to estimate the ecosystem service variations caused by paddy expansion in the past four decades. The results indicate that the paddy area increased from 404,789 to 2,598,449 ha during 1976-2015, leading to a decline in the total ecosystem service values by 76,414.39 million yuan. The largest decline in ESVs in response to paddy expansion was caused by wetland reclamation (-67,685.09 million yuan). Apart from agricultural products and gas regulation functions, the ESVs provided by other functions all showed a declining trend. Paddy expansion in the Sanjiang Plain increased agricultural product function at the expense of the decline of other functions. In future management practices, the rational allocation of water resources and paddy distribution are necessary in order to achieve sustainable development of both water resources and agricultural production. Additionally, restoration activities, such as conversion of farmland to wetland, should also be considered in this region.

Full talk
ID: 454 / 204R: 6

107R Assessing, modelling, and analysing land use and land management impacts on the Earth system

Keywords: integrated land use modelling, Western Corn Rootworm, climate change, crop rotation

Integrated modelling of crop rotation regulations to control Western Corn Rootworm under climate change

Katharina Falkner[1], Hermine Mitter[1], Elena Moltchanova[2], Erwin Schmid[1]

[1]University of Natural Resources Vienna, Austria; [2]University of Canterbury, New Zealand

Invasive pests and climate change may have severe ecological and economic impacts on agricultural production. Pests are closely linked to their host plants and climatic conditions are a key driver for pest spread and development. In Austria, the highly mobile Western Corn Rootworm (WCR; *Diabrotica virgifera virgifera*) is an invasive pest. Especially in maize intensive production regions, the continuous spread of WCR challenges farmers. Therefore, developing and assessing management strategies and policy regulations to decrease WCR pressure is important. Particularly, crop rotations with low maize shares are deemed an effective control strategy. In addition to climate change and crop rotations, other management strategies such as fertilization, irrigation and insecticide application may severely affect the environment and net returns and need to be considered when planning WCR control strategies. Hence, we have developed and employed a spatially explicit integrated modelling framework (IMF) that links a regional climate model, a crop rotation model, a bio-physical process model, a bottom-up land use optimization model and a statistical WCR spread and abundance model on 1 km spatial resolution. We have applied the IMF to Austrian cropland to assess the effectiveness of crop rotation regulations with limited maize shares on reducing WCR infestation under climate change. Furthermore, it allows us to analyze net returns and crop yield potentials considering three climate change scenarios and four crop rotation regulations. The model results show that increasing temperatures, especially in winter, and increasing precipitation sums in summer are favorable for WCR spread and development across Austrian cropland. Hotspots for WCR infestation are identified in maize intensive production regions. The results further show that crop rotation regulations with limited maize shares can be an effective strategy to control WCR, regardless of the climate change scenario. The presented analysis may inform the design of WCR policies and control strategies.

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