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and change, and to explore ways in which conflict-structured adaptation (i.e. climate-adaptation that is conflict-proof; that does not pitch one resource user against another in a context where people are constantly pursuing similar resources at the same time) and climate-sensitive conflict management strategies may be integrated to enhance the resilience of vulnerable populations in high-risk, conflict-prone environments.

**Talk Title**
COOKSTOVE ADOPTION: THE DYNAMIC INTERPLAY AMONG CULTURE, ENERGY AND TECHNOLOGY IN A SOCIO-ECOTECHNOLOGICAL SYSTEM

**Theme**
Thresholds, traps and transformations in social-ecological systems.

**Presenter**
Prof Ilse Ruiz-Mercado

**Organisation**
Universidad Nacional Autonoma de Mexico - IIES

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**Country**
Mexico

**Abstract**
Improved cookstoves and clean fuels have long been identified as promising options to reduce the negative impacts of cooking with traditional open fires and the emission of climate-altering pollutants, while meeting goals of social welfare and increased environmental sustainability. However, no stove program can achieve these goals unless people initially accept the stoves, continue using them on a long-term basis and displace the smoke of the traditional fires. The adoption of clean cookstoves and fuels is one of the transformation processes occurring at the technological interface of socio-ecological systems. Monitoring the drivers, thresholds and critical times of this process is critical to translate implementation efforts into impacts, and to understand the feedbacks between household-level and ecosystem dynamics introduced by these technologies. The aim of this project was to measure stove usage and characterize the adoption and fuelwood consumption patterns to improve monitoring and implementation strategies. The analysis draws from a literature review of studies in several countries documenting that introduction of a single improved stove/fuel often leads to the combination or “stacking” of stoves and fires rather than to complete substitution. We also draw field evidence from a study we carried out in rural Mexico where the stoves and fires of 100 homes in three communities were instrumented during one year with small temperature dataloggers as Stove Use Monitors (SUMs) to obtain cooking durations and number of days and meals in use using custom software tools for data mining. In two communities, we also measured fuel consumption and document fuelwood access rules with household surveys. Based on the SUMs-measured patterns of combined stove-fire use, we classified households into clusters. Stacking occurred because traditional fires fulfill needs that extend beyond cooking. Measured residual use of open fires in households using improved and/or LPG stoves was 1.8-3.9 hours/day, representing a contribution that can still have important negative health effects, depending on the time–location patterns of use. Families with improved cookstoves reported collecting wood of smaller sizes and had 35-50% less fuelwood consumption than those with open fires, but fuelwood access rules were the same for all clusters at the time of surveys. We conclude that complete realization of benefits of clean cookstoves require projects to promote a portfolio of fuels-stoves-practices rather than a single technological solution. Our study shows the usefulness of sensor-based measurements and the critical need for long-term monitoring studies of ecotechnology adoption processes to better capture their ecosystem feedbacks.

**Talk Title**
ECOSYSTEM SERVICE TRADEOFFS AND ECOLOGICAL-ECONOMIC PRODUCTION POSSIBILITIES FRONTIER: A CASE STUDY IN COSTA RICA

**Theme**
Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

**Presenter**
Ms Améline Vallet

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**Abstract**
Understanding interactions between ecosystem services (ES) is a high priority in ES research. Two types of interaction are commonly defined: (1) tradeoffs, in which one service increases while another one decreases in time or space; (2) synergies, in which both services either increase or decrease. Most studies on ES use statistical analysis and descriptive methods to assess ES spatial or temporal correlation. Recently, a new framework for ES interactions based on ecological-economic production possibilities frontier (EEPPF) has been developed, which relies on the production theory branch of microeconomics. Applied to natural capital, this framework considers different levels of ES produced across a broad range of management actions and landscape configurations and describes graphically the nature and intensity of ES interactions by determining the production frontier (i.e. the set of Pareto-optimal values for pairs of ES). This study aims to estimate empirically EEPPF between multiple ES in the Volcanica Central-Talamancan Biological Corridor, Costa Rica, and to discuss the EEPPF framework complementarity with statistical approaches. InVEST software was used to model ES production for carbon storage (C), water yield, sediment retention, nitrogen retention (n) and phosphorus retention (p). Agricultural production (pa) was represented by its economic value. Spatial concordance and temporal covariation between ES were analyzed using statistical correlations (modified t-test) for four observed land-uses (LU) over time. EEPPF curves were constructed using a set of 32 contrasting LU scenarios generated, considering slope and altitude constraints for some LU and assuming different LU proportions and distributions (either random or clustered). EEPPF analysis showed tradeoffs between C and other ES, and between pa and nutrient retention (n and p). The shape of EEPPF curves illustrated the intensity of tradeoffs. The nature and intensity of interactions between C and other ES varied widely according to the methodologies used for evaluating tradeoffs. In comparison with the analysis of spatial and temporal ES correlations, EEPPF
curves brought supplementary information related to tradeoff intensity and identification of optimal LU scenarios.

**Talk Title**
SOCIAL ECOLOGICAL INTERACTIONS OF INLAND RECREATIONAL FISHERIES WITH INCREASED LAKESHORE DEVELOPMENT

**Theme**
Social-ecological dynamics of ecosystem services: synergies, trade-offs and links to human wellbeing.

**Presenter**
Mr Jacob Ziegler

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**Country**
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**Abstract**
Background: Humans are the principal drivers of ecological systems on the planet, yet we lack a basic understanding of how humans are integrated into food webs and how this affects management of natural resources. Recreational fisheries, which are socially and economically important worldwide, are vulnerable to both social and ecological forcing. For example, in North America residential development on lakes reduces available refuge for juvenile fish, increases angling pressure, and increases the likelihood of stocking due to public pressure on fisheries managers. Objectives: We wanted to explore the outcomes of codependent social and ecological pressures on recreational fisheries by examining the interaction between lakeshore development and a common management panacea of stocking. Methods: We created an integrative model with biological, social, and habitat sub models that characterized key components of the socio-ecological system. We tested our model output using empirical data from 61 lakes in northern Wisconsin, USA. Results: Our model and empirical results suggest that loss of habitat associated with residential development on lakes led to decreased angler satisfaction and an increased reliance on stocking of hatchery raised fish in these systems. From an economic point of view, systems that had high lakeshore residential development and stocking rates cost lake users and government agencies more money than tax revenue generated, whereas, systems with low lakeshore residential development and low stocking rates were profitable systems that maintained the ecosystem service of recreational fisheries. Conclusions: These results highlight the importance of considering social and ecological factors in management decisions to create more resilient systems.