



BIOdiversity and Economics for CONservation – BIOECON

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**14th ANNUAL BIOECON CONFERENCE ON
“Resource Economics, Biodiversity Conservation and Development”**

BOOK OF ABSTRACTS

18-20 September 2012
Kings College, Cambridge
United Kingdom

*Hosted by the Department of Land Economy of the University of Cambridge and
the Department of Spatial Economics of VU University Amsterdam*

*Supported by the Founding Partners of the BIOECON Network:
UNEP, IUCN, EIB, Conservation International, FEEM and IHEID*

*In Association with the International Institute for Environment and Development (IIED),
London, UK and
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia.*



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Keynote Speech 1

Forest degradation and the role of the state: the case of Himalayan forests in Nepal and India

Prof. Jean-Marie Baland

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This paper summarizes findings from a decade-long project on forest degradation in the mid-Himalayan region of India and Nepal. The analysis is based on LSMS data for Nepal and field work in Indian states of Uttaranchal and Himachal Pradesh comprising sample surveys of forests, households and village communities, besides commissioned anthropological studies for select villages. The purpose was to ascertain the nature and magnitude of deforestation and degradation from ground-level forest measurements, its implications for living standards of local communities, the contribution of different factors commonly alleged such as local poverty, inequality, economic growth, demographic changes, property rights and lack of collective action by local communities. Principal findings, policy implications and questions for future research are discussed.

Keynote Speech 2

Designing payments for environmental services – Selected issues

Professor Stefanie Engel

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Payments for environmental services are increasingly applied as incentive mechanisms to address ecosystem service degradation. Yet, to fulfill its potential, PES programs need to be carefully designed in a context-specific manner. Experience with existing PES programs as well as conceptual contributions from the scientific literature can provide important lessons for PES design. Who pays which amount to whom for what in which form and under what conditions? Following these questions, the presentation reviews selected issues arising in PES design. A particular focus is put on designing payments across space, across time and across group members, as well as on PES design in contexts of weak property rights. The presentation closes with an outlook on future research directions

SESSION A1 - Special session: PES design and implementation: new insights and approaches

Vital Graphics on Payment for Ecosystem Services: Realising Nature's Value

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Anne Solgaard, Ieva Rucevska, Christina Cavaliere, Steven Lutz, Martin Julseth, Marianne Fernagut

PES schemes differ in their form depending on the context to which they are applied. The concept is gaining momentum around the world, and several successful schemes have been implemented. While numerous examples of PES schemes exist, there is potential to be realized to ensure successful development and implementation of PES schemes, particularly when it comes to schemes benefitting the poor. This publication makes a visual introduction into the concepts of Ecosystem Services and PES the variety of PES schemes by focusing on five ecosystem service contexts: Carbon Sequestration, Watershed Services, Biodiversity, Landscape Beauty and Combined Services. Case studies are used to exemplify contexts, present approaches that have been taken and point to opportunities for future applications. The publication emphasises the role natural capital can play in both environmental conservation and in poverty alleviation and highlights the potential benefits of ecosystem-based economic development in an accessible, non-technical manner.

Overall, the publication uses a highly visual communications approach to improve the understanding of PES among policy makers and potential PES scheme partners, promote its application, and to contribute to a general shift towards ecosystem-based economic development.

Monitoring and evaluation of Payment for Watershed Service Schemes in developing countries

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International Institute for Environment and Development, UK.

Bruce Aylward, Jeff Dengel

Payments for Watershed Services (PWS) tap funding from water users (including Governments) to provide incentives to landholders for improved land management, with the intention of addressing chronic problems such as declining water flows, flooding, and deteriorating water quality. These schemes are increasingly looked to and looked upon as a viable policy alternative to watershed management problems. In some places, local governments, donor agencies and NGOs are actively trying to upscale and replicate PWS schemes across the landscape. Yet, despite all this apparent success and progress with launching new PWS schemes there remains the suspicion that lessons have yet to be learned from the formative experiences thus far, and this is nowhere more true than with regard to monitoring and evaluation (M&E).

In this article we discuss the M&E criteria behind compliance, or transactional, monitoring to ensure that the contracts are followed, and effectiveness conditionality, that looks at how the scheme has managed to achieve its environmental objectives regardless of the degree of compliance. Although both are usually linked, a high degree of compliance does not necessarily produce a high degree of effectiveness. A poorly designed scheme, for example, may target the wrong land managers and land

at least risk and, thus, the payments may not generate the desired hydro-ecological or conservation benefits. As the leveraging capacity for demanding payments for better watershed management increases, so does the need to demonstrate the impact of such activities. A better understanding of these relationships is vital for the long-term health of existing initiatives. So far, the growing interest shows that participants believe in the principle of land management. Evidence of impact will be required none the less to ensure that actions are truly additional, and root out those are merely self-serving enrichment at the public trough.

Evidence-based understanding of Payments for Water Ecosystem Services: the Latin American experience

Julia Martin-Ortega
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Elena Ojea, Camille Roux

Latin America has now more than two decades of experience in the implementation of payment for ecosystem services (PES) schemes, including importantly payment for water services (PWS). Existing reviews dedicated to the study of this policy instrument remain mostly theoretical and/or qualitative. This paper presents one of the most comprehensive and up-to-date quantitative compilation of PWS cases in Latin America, and is the first study that systematic analyses this experience. The objective is twofold: i) understanding the key features of reported PWS mechanisms based on quantitative evidence; and ii) identifying information needs for policy design and implementation. A database was constructed with 301 observations from 40 different schemes, starting up to from 1984. The outcomes of this analysis are presented in the form of key messages that serve for the formulation of an evidence-based conceptual model of PWS schemes.

Credit-based Payments for Ecosystem Services: Evidence from a choice experiment in Ecuador

Matthew Cranford
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Susana Mourato

The classical conceptualisation of PES promoted direct payments as the most efficient form of incentivising good environmental behaviour, but both that PES conceptualisation and the acceptance of direct payments as always being the best option have recently been questioned. Depending on the specific market and social conditions, indirect PES may be preferred. Improving access to affordable credit is one such form of indirect PES that is particularly relevant for PES in developing countries. The main issue with such an approach is how to include conditionality. There are very few examples, but credit-based PES (CB-PES) is one such mechanism. A choice experiment was carried out in Northern Ecuador to explore the dynamics of CB-PES, illuminate lessons for its implementation, and comment on its appropriateness as an incentive. It was found to be a promising form of PES that fits multiple criteria recently noted in the PES literature as desirable qualities of an incentive.

SESSION A2 - International issues and nature conservation

Effects of trade barriers on bilateral trade of potable water

Elisabeth Christen

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Andrea M. Leiter, Michael Pfaffermayr

This paper empirically examines the effects of trade barriers on international transfers of potable water. In this context, potable water is defined as natural water that is neither flavored nor contains added sugar or other sweeteners. Based on a structural gravity model we analyze the determinants of bilateral trade flows in potable water by applying Heckman's selection model to control for a potentially systematic selection of trade participating countries. The output shows that bilateral trade barriers crucially determine the countries' probability of trading potable water as well as the volume of water traded. This raises the question of how reduced trade barriers would change the trade patterns and which countries are the beneficiaries or losers of such a trade reform. The subsequent counterfactual analysis provides the answer. It allows us to determine how a specific (hypothetical) reduction of trade barriers between the trading partners influence (a) their world market shares and (b) the average demand and supply prices of potable water. We find that water rich exporting countries that ship water to water poor importers benefit most from reduced trade barriers as they experience a considerably increase in their world market shares. The magnitude of the changes in market shares depends on the indirect price effects associated to reduced distance costs. Furthermore, the counterfactual analysis indicates that specific reductions of trade barriers increase (decrease) the average demand (supply) price of water rich importers (exporters) which points at a possible convergence in average prices between water rich and water poor countries.

Trade and Intellectual Property Rights in the Agricultural Seed Sector

Derek Eaton

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The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) has continued to be fiercely debated between North and South, particularly with respect to its provisions for the agricultural sector. Article 27.3(b) of the TRIPS Agreement requires WTO member countries to offer some form of intellectual property protection for new plant varieties, either in the form of patents (common in the U.S.) or plant breeder's rights (PBR). The expected effects of TRIPS on the international flow of agricultural genetic resources are unclear and complicated by the transition from public to private agricultural research. This paper analyses the effects of the introduction of PBRs in almost 80 importing countries on the value of exports of agricultural seeds and planting material from 10 exporting EU countries, including all principal traditional exporters of seeds, as well as the US. A dynamic fixed effects quantile regression model, based on the general specification for the gravity model for international trade, is estimated using panel data covering 19 years (1989-2007) of export flows in order to assess the effect of International Convention on the **Protection of New Varieties of Plants (UPOV) membership on seed imports. Basing inference on the panel bootstrap, we find no significant effect from UPOV membership on seed imports.**

**The Leak in the System -
Analyzing third country effects of an IEA on Tropical Timber Trade**

Stefan Borsky
**University of Southern Denmark, Department of Environmental and Business Economics,
Denmark**

Andrea Leiter, Michael Pfaffermayr

This paper analyzes the magnitude and distribution of trade leakage due to an unilateral environmental conservation policy. In particular, we estimate the impact of the 1994 International Tropical Timber Agreement on the patterns of tropical timber trade flows. Trade leakage in international environmental agreements increases the ex-ante incentive to free-ride and therefore could lead to an under-provision of the global public good. We use a cross-sectional dataset on bilateral trade flows of tropical timber that additionally contains information on trading partners' economic and geographical characteristics. Our empirical specification is based on a gravity equation, which is estimated using Heckman's selection model to address the potentially systematic selection of trading partners. Overall, we find significant positive effects of the agreement on the propensity and intensity of tropical timber trade. Furthermore, we show that a small share in trade, 0.3%, shifts from the unregulated to regulated countries. The reason for this could be the dampening impact of the trade-measures, which are linked to the ITTA to reduce the extend of leakage

The Climate Policy Hold-Up: How Intellectual Property Rights turn International Environmental Agreements into Buyer Cartels for Abatement Technologies

Timo Goeschl
University of Heidelberg, Germany

Grischa Perino

This paper studies the interaction between intellectual property rights for 'green' innovations and international environmental agreements in a climate change context. Extending standard models of international environmental agreements (IEAs), we study how the presence of perfectly enforceable intellectual property rights (IPRs) on green innovations impacts on the formation of an IEA, on aggregate abatement, on global welfare, and on the welfare of countries that host innovators. We find that the presence of IPRs leads to fewer IEA signatories and a strategic reduction of their abatement commitment in anticipation of rent extraction by the innovator, under certain circumstances below that of non-signatories. The reason is the presence of a hold-up problem in abatement commitment: Mitigation efforts committed to during the negotiation of the IEA change the demand elasticity of countries with respect to new technologies and hence pricing. In response, IEAs change their character and signatories act as a buyer cartel. This leads to the surprising result that global aggregate abatement can decrease when a second, proprietary technology becomes available alongside a competitively provided one. Contrary to the notion that 'green patent rents' are desirable, the country in which the innovator is located is worse off under IPR enforcement compared to providing the IP for free

SESSION A3 - Valuation of Ecosystem Services

Economic valuation of forest fire programs in Andalusia (Spain): Social preferences and willingness to pay

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Marek Giergiczny, Pere Riera, Pierre-Alexandre Mahieu, Mario Soliño

The risk of forest fires has been relatively insufficiently studied from an economic perspective while it has been largely addressed by different academic disciplines like biology, ecology or physics. This study reports on an economic valuation survey of alternative fire prevention programs in the province of Malaga, southern Spain. Its main objective was to elicit social preferences and willingness to pay for several aspects related with forest fire management, such as: (i) fuelbreak cleaning technique (controlled grazing, prescribed burning and mechanical treatments), (ii) fuelbreak design (from traditional lineal unshaded firebreaks to more landscape and environmentally friendly structures such as shaded fuelbreaks) and (iii) fuelbreak density (linked to annually burned area). Results show respondents' preferences are namely influenced by fuelbreak cleaning techniques and by the density of the fuelbreak network. Furthermore, estimations on the welfare change for the population were analysed for several alternative fire prevention programs that could eventually be launched in the region. Lessons learned from this study could be relevant for the development of fire prevention policies and specific prevention campaigns in Mediterranean forests.

Valuing the Willingness-to-pay for Ecosystem Service Benefits from Integrated Multi-trophic and Closed Containment Aquaculture in British Columbia, Canada

Duncan Knowler

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Winnie Yip, Wolfgang Haider

Globally, the aquaculture industry is associated with a range of environmental problems. Many of these issues have significance for the conservation of biodiversity and ecosystem services and have stimulated interest in developing more sustainable aquaculture methods. Integrated Multi-Trophic Aquaculture (IMTA) combines the culturing of fish and extractive aquaculture species at one site to simulate a balanced natural system and reduce some environmental issues of monoculture systems. In contrast, Closed Containment Aquaculture (CCA) separates farming from the natural marine environment by using closed water tanks on land or in water. This paper explores consumer preferences for IMTA and CCA. Two questions are posed: (1) how do salmon consumers in the US Pacific Northwest perceive the products of IMTA and CCA, with or without eco-certification, and in comparison to salmon products from other sources (wild or farmed); and, (2) what are salmon consumers in the US Pacific Northwest willing to pay for salmon produced by IMTA or CCA and is there significant evidence of preference heterogeneity? Results of a Discrete Choice Experiment (DCA) combined with a Latent Class Analysis (LCA) revealed a willingness to pay a price premium of 9.8% and 3.9% for IMTA and CCA, respectively, over conventionally produced Atlantic salmon.

Results of the survey also revealed that 44.3% and 16.3% of the respondents preferred the adoption of IMTA and CCA to conventional salmon farming, respectively.

Ramsey Discounting of Ecosystem Services

Stefan Baumgärtner

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Alexandra M. Klein, Denise Thiel, Klara Winkler Most ecosystem services which are essential for human well-being are globally declining, while the production of market goods and services, measured by GDP, is still continuously increasing. To adequately address this opposite development in public cost-benefit analyses, it has been proposed (based on an extension of the classical Ramsey model) to apply good-specific discount rates for market consumption goods and ecosystem services. Using empirical data for ten ecosystem services and five countries as well as the world at large, we estimate by how much discount rates for ecosystem services should deviate from the discount rate for market goods and services. In a conservative estimate, we find that ecosystem services in all countries should be discounted at rates that are significantly lower than the ones for market consumption goods. On global average, ecosystem services should be discounted at a rate that is 0.9 ± 0.3 %-points lower than the one for market consumption goods.

An empirical review of cultural ecosystem services measurements

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Berlin-Brandenburg Academy of Science and Humanities, Germany

Tobias Plieninger, Claudia Bieling

Over millennia human wellbeing has benefited from ecosystems not only from their natural tangible features but also from intangible assets currently known as cultural ecosystem services. Despite growing research during the last decades, cultural services valuation still remains arbitrary and focuses on marketable services such as tourism. Evidence difficulties for standardizing definitions and measurements have challenged the accounting of cultural services in decision making processes. However, the imminent formation of the Intergovernmental Platform on Biodiversity and Ecosystem Services offers an opportunity to counterbalance this misrepresentation by establishing the scientific basis for consistently assessing cultural services. In that regard, the current review intends to facilitate the discussion investigating the current state of cultural services accounting and offering an appraisal of the existing evidence pertinent to cultural services indicators quality. Between the indicator types found in the review, the benefit indicators were the most frequently used for measuring inspirational, educational and overall recreational services. In addition, measures on the processes by which ecosystems deliver cultural services were used in all the MA categories and in particular for measuring the recreational capacity of ecosystems. The quality of cultural services assessments could be greatly enhanced by simply using the existing frameworks and investing more effort to involve relevant stakeholders in the definition and conceptualization of the measurements.

SESSION A4 - Biodiversity conservation and public good provision: theory

Which compensation for whom?

Pascal Gastineau

Ifsttar, Transport and Environment Laboratory, France

Emmanuelle Taugourdeau

This paper examines a situation where a central planner owes compensation for an ecological damage. We consider that the central planner can use either or both money and natural units to meet three goals: i) no aggregate welfare loss, ii) minimization of its cost, iii) minimal environmental compensation requirement. We provide a simple two-period model to analyze the problem faced by the central planner. The findings suggest that - in some cases - providing both monetary and natural compensation can be the best option. Some comparative statics and welfare implications are analysed.

Income heterogeneity and common provision of public goods

Dafna M. DiSegni

University of Haifa, Israel

The present study outlines the characteristics in which a cooperative contribution to provide a public good depends on the a-priori distribution of income among the contributors. The analysis considers a Nash bargaining solution for the cooperative behavior of the agents in the system. The agents' individual preferences towards public goods are represented by a family of functions, including homothetic and non-homothetic ones, to analytically represent the various contributions of natural resources to individual's welfare. The theoretical implications are discussed in the context of the international involvement and agreements among nations to control for provision of global environmental goods and natural resources.

The biodiversity conservation game with heterogeneous countries

Sarah Winands

Institute for Food and Resource Economics, University of Bonn, Germany

Karin Holm-Muller, Hans-Peter Weikard

Biodiversity is an essential resource, which we classify as conditionally-renewable. In order to achieve conservation and sustainable use of biodiversity virtually all nation states signed the United Nations Convention on Biological Diversity. In this paper we investigate how the heterogeneity of countries in regard to ecosystems and wealth influences the stability of international biodiversity conservation agreements both without and with transfers. We further examine the effect of different degrees of ecosystem substitutability. We model a coalition formation game with players that have a continuous conservation choice. The conservation benefit is dependent on wealth and ecosystem quality. Aggregation of global benefits respects differences in ecosystem substitutability. In case of transfers, a fund redistributes coalition benefits according to a sharing rule. The main finding is that in the absence of transfers, compared to the homogeneous situation, heterogeneity in ecosystems and wealth reduces the size of a stable coalition. The destabilising effect is stronger the higher the ecosystem substitutability. Optimal transfers facilitate a large stable coalition.

Gamma Discounting and the Combination of Forecasts

Ben Groom

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Mark C. Freeman

The term structure of social discount rates that results from surveys of expert opinions is shown to be highly sensitive to the nature of the responses elicited. If variation between respondents arises from irreducible differences in normative value judgements, the term structure declines rapidly. If variation occurs because respondents are estimating appropriate rates under uncertainty from a positive standpoint, the term structure is much flatter since additional experts provide new information and reduce uncertainty. A normative approach more than doubles the social cost of carbon compared to the positive, making the motivation for the survey critical for intergenerational policy making.

SESSION B1 - Special Session: Conservation tender design and performance

Talking with the sellers: Communication in an auction for public good provision

Nora Vogt,
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Andrew Reeson, Kilian Bizer

Reverse auctions are an established policy instrument for allocating conservation contracts to landholders. While the auction mechanism has been the subject of a number of studies, less attention has been paid to the post-bidding contract phase and its interdependencies. As contracts involving natural resource management are usually incomplete to some extent, trust becomes crucial for the effectiveness of the programme. We test the effect of communication between auctioneer and bidders on bidding behaviour and subsequent contract fulfilment using an experimental economics approach. To this purpose we combined a repeated reverse auction with an effort-level game and used a bilateral chatting tool as our treatment variable. We report that communication encourages bidders to submit higher bid prices. However, an overall higher price level did not lead to efficiency losses, since contractors realised higher effort levels in return, establishing a “social gift exchange”. Moreover, we found communication to have the strongest impact if introduced after an auction phase without communication. Finally, stable consecutive contract relationships showed higher effort levels than short-term contracting. Our results demonstrate the great importance of trust-based relationships between the auctioneering institution and participants in conservation auctions.

Are auctions for ecosystem service provision likely to suffer with repetition?

Andrew Reeson
CSIRO Ecosystem Sciences, Canberra, Australia

Tim Capon, Stuart Whitten

Repeated discriminatory price auctions are now routinely used in Australia for the procurement of ecosystem services from landholders. Whilst such auctions have been demonstrated to be highly efficient in a one-shot setting, it is less clear whether this efficiency will be maintained with repetition, particularly as information about previous auction results is disseminated amongst participants. This paper presents the results of laboratory experiments designed to test the performance of repeated discriminatory price procurement auctions (reverse auctions) under three different levels of information (about own and others' bids and values) and two levels of competition (with different budgets resulting in different proportions of participants being successful in each auction).

In the more competitive auction we found that average offer prices declined with repetition, suggesting participants were learning to be more competitive. Participants with higher environmental values tended to maintain or increase their offer prices with repetition, while those

with lower environmental values tended to decrease offer prices over time. Increasing information about others' offers led to faster declines in average offer prices. In the less competitive treatment average offer prices did not decline between rounds. Auction efficiency was found to be higher when more information was available to participants, but tended to decline with repetition, particularly in the less competitive setting. However, the auctions still remained relatively efficient.

The results suggest that repeated procurement auctions can remain efficient provided competition can be maintained. Information about previous auctions is not sufficient to inhibit competition, and actually leads to increased efficiency as participants learn to be more competitive. We compare the results of these laboratory experiments to experience in a case study region where multiple ecosystem service auctions have been run over the last few years. Again there is no evidence of any decline in the performance of discriminatory price auctions with repetition. Overall these results suggest that repetition per se need not be a problem with auctions for ecosystem services, provided that the auction is competitive. If competition is limited then an auction is unlikely to be the most appropriate mechanism

Money for nothing or payments for biodiversity? Design and performance of the Australian Government's Environmental Stewardship Program conservation tender metric

Stuart M. Whitten

CSIRO Ecosystem Sciences, Australia and Australian Government Department of Sustainability, Environment, Water, Population and Communities

Charlie Zammit, Art Langston, Veronica Doerr, Emma Burns, Erik Doerr, Simon Attwood

Biodiversity markets are reliant on an effective metric to discriminate between the relative biodiversity value offered in the market. The construction and performance of these metrics is a critical element in the performance of payment for ecosystem service schemes such as conservation tenders as well as trading markets such as biodiversity offsets. Despite the growing popularity of such schemes relatively little attention has been paid to the design and performance of the metric component of such schemes. In this paper we explore the design and performance of one such metric applied within the 2010-11 round of the Australian Government's Environmental Stewardship Program. The metric design incorporated a number of advances over existing biodiversity metrics intended to better represent the relative value of investments to the Australian Government. Field performance evidence suggests that the metric consistently and robustly discriminated between the biodiversity return offered by alternative tenders.

SESSION B2 - Institutions, Development and Nature Conservation

Economic Drivers of the α -Index of the Species-Area Curve: Evidence for an EKC?

Merle Wiese

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We study for the case of vascular plants the contribution of economic drivers towards explaining the so-called α -index of the species-area curve. This index provides a measure of observed deviation from predicted species richness. Employing explanatory variables commonly used in the empirical literature on the Environmental Kuznets Curve, we find evidence for the presence of a standard EKC-type relationship between the α -index and GDP per head. There is also evidence for a positive relationship between the α -index and the quality of political institutions. Population density and the relative size of the agricultural sector on the other hand do not have explanatory power.

From Rites to Rights: The Co-evolution of Political, Economic and Social Structures

Brooks A. Kaiser

University of Southern Denmark, Department of Environmental and Business Economics, and Gettysburg College, Gettysburg USA Dept. of Economics, University of Hawaii, U.S.A.

James A. Roumasset

We attempt to illuminate both the nature and causes of growth and institutional change by using both archeological and historical evidence from natural resource use during the settlement and modernization of the Hawaiian economy to develop a candidate theory of the natural co-evolution of production systems, organizational forms and authority structures. Hawaii's resources are first controlled by hierarchy, which intensifies over time, until decentralization occurs after Western contact (1778). Changes in relative governance requirements over time inform a more general theory of second-best resource use in a dynamic setting that allows for institutional change to minimize governance costs.

Corruption and the Curse: The Dictator's Choice

Timothy Swanson

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Mare Sarr

We develop a dynamic discrete choice model of a self-interested and unchecked ruler making decisions regarding the exploitation of a resource-rich country. This dictator makes the recursive choice between either investing domestically to live off the productivity of the country while facing the risk of being ousted, or looting the country's riches by liquefying the resources and departing. We demonstrate that important parameters determining this choice include the level of resources, liquidity and indebtedness. An empirical analysis on available data relating to dictatorships demonstrates that the dictator's choice regarding the timing of departure is significantly related to external lending, investment and debt. We then argue that this looting phenomenon and the factors

that contribute to it, provides an explanation for the generation of corrupt economies in resource-rich countries. An empirical analysis of the available corruption indices demonstrates that irregular turnover provides a more fundamental explanation of perceived corruption than do various social and cultural indicators or the economic theory of internal political competition. The policy implication is that external agents should be very careful about presenting outside options to autocrats in resource-rich countries. Corruption is endogenous to the availability of outside options to dictators of resource-rich economies.

SESSION B3 - Adaptation to climate change

The economics of sheep farming at northern latitudes. Potential effects of climate change

Anne Borge Johannesen
Norwegian University of Science and Technology

Anders Nielsen, Anders Skonhoft

The paper studies the economy and ecology of sheep farming when climate change and uncertainty may affect vegetation quantity. The analysis is at the farm level and includes two different categories of the animals, ewes (adult females) and lambs. The model is formulated in a Nordic economic and biological setting with the crucial distinction between the outdoors grazing season and the winter indoors season. During the outdoors grazing season, animals may face limited grazing resources so that the animal density in addition to temperature, precipitation and other weather conditions determine the weight and hence the value of lambs. The model is analysed in two steps, without taking uncertainty into account and with uncertainty. Because empirical evidence suggests that climate changes, e.g. increased spring temperature, would have contrasting effects on lamb weights, we compare the impact of such changes across specific sites.

How African Agriculture Can Adapt to Climate Change? A Counterfactual Analysis from Ethiopia

Salvatore Di Falco
London School of Economics

Marcella Veronesi

We analyse and compare the impact of different adaptation strategies on crop net revenues in the Nile Basin of Ethiopia. To this end, we implement a counterfactual analysis, and estimate a multinomial endogenous switching regression model of climate change adaptation and crop net revenues. We combine data from 1,000 farm households with spatial climate data at the farm household level in Ethiopia. We find that adaptation to climate change based upon a combination of strategies -opposed to strategies adopted in isolation- increases farm net revenues. In particular, the combinations of changing crops with water or soil conservation strategies deliver the highest pay off.

SESSION B4 - Fisheries

Does the optimal size of a fish stock increase with environmental uncertainties?

Ute Kapaun

Department of Economics, University of Kiel, Germany

Martin F. Quaas

We analyse the effect of environmental uncertainties on optimal fishery management in a bio-economic fishery model. Unlike most of the literature on resource economics, but in line with ecological models, we allow the different biological processes of survival and recruitment to be affected differently by environmental uncertainties. We show that the overall effect of uncertainty on the optimal size of a fish stock is ambiguous, depending on the prudence of the value function. For the case of a risk-neutral fishery manager, the overall effect depends on the relative magnitude of two opposing effects, the 'convex-cost effect' and the 'gambling effect'. We apply the analysis to the Baltic cod and the North Sea herring fisheries, concluding that for risk neutral agents the net effect of environmental uncertainties on the optimal size of these fish stocks is negative, albeit small in absolute value. Under risk aversion, the effect on optimal stock size is positive for sufficiently high coefficients of constant relative risk aversion.

Sharing a Fish Stock with Density-dependent Distribution and Unit Harvest Costs

Xiaozi Liu

Norwegian School of Economics, Norway

Leif Sandal, Marko Lindroos

We study cooperative and competitive solutions for managing a fish stock that has stock-size dependent distribution, using Norwegian spring-spawning herring (*Clupea harengus*) as a case study. Three players in our game can be asymmetric in stock ownership, efficiency (cost of harvesting) and stock concentration profile. The special feature of Norwegian spring-spawning herring is that it comes under sole ownership of Norway when stock is sufficiently low. In some important ways, our model is more realistic than earlier game-theoretic harvesting models: catch function in our model is density-dependent, implying unit harvest cost is no longer a constant; we use a reference fishing mortality as the control parameter that determines annual catch quotas, making fishing effort a dynamic variable that reflects changes in stock biomass. We find that the likelihood of a stable grand coalition increases with the degree of asymmetry in the players' efficiency levels. When Norway, the player with the largest stock share and inherently the highest fish density in her zone, is the least efficient player, she is not guaranteed to receive the largest shares of grand cooperation benefits. Low initial stock level increases Norwegian share of the grand coalition benefits. In the present of dynamic stock distribution, it is not the interest of any players to drive stock down below the biomass level in which Norway becomes the sole owner.

The Optimal Management of a Natural Resource with Switching Dynamics

Michele Baggio

Chair of Environmental Policy and Economics, ETH Zurich

This paper analyzes the optimal management of a natural resource, such as a fishery, where the dynamics of the resource shift between different states at random times due to the effect of external forcing such as climate. This means that the parameters describing the biological relationships are different under different states. Using a classical linear control model I investigate how the switching behavior influences the optimal exploitation of the resource. The optimal switching conditions are used to identify the thresholds determining the status, opening/closing, of the fishing industry. The model is applied to the Peruvian anchoveta fishery located along the north-central coast of Peru. The optimal management policy that is constituted by four thresholds defining the stock levels at which the industry switches status under each state of the stock dynamics. Further, I show how such thresholds are influenced by the probability of a regime shift and other key parameters of the model, e.g., the maximum capacity of the fishing industry. This analysis gives important indications for the management of a natural resource with alternating dynamics, which can be used to design policies that adapt to the variability of the physical environment.

SESSION C1 - Agri-environmental schemes

Co-viability of farmland biodiversity and agriculture

Lauriane Mouysset
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Luc Doyen, Frédéric Jiguet

Significant declines of farmland biodiversity have been reported in Europe since several decades. Agricultural changes have been identified as a main driver of this erosion. Although different agri-environmental schemes have been implemented, their positive role on biodiversity remain controversial. This questions the way to reconcile farming production and biodiversity conservation in order to operationalize a sustainable and multifunctional agriculture. To deal with such issues, the present paper proposes a bio-economic model and an analysis based on a co-viability perspective. The model couples stochastic dynamics of both biodiversity and farming land-uses selected at micro level with public policies at macro level based on financial incentives (taxes or subsidies) for land- uses. The co-viability approach allows to evaluate bio-economic risks for these public incentives through the probability to satisfy a mix of biodiversity and economic constraints throughout time. The model is calibrated and applied to metropolitan France at SAR (small agricultural regions) scale using a community of 34 common birds. The viable kernel allows to identify different public policies and scenarios with tolerable agro-ecological risk. It suggests how some combinations of taxes on cereals and subsidies on grasslands could be relevant. Moreover, the flexibility and multi-criteria viewpoint underlying the approach can be fruitful for decision makers in the perspective of adaptive management.

The costs of policy simplification in conservation incentive programs

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Incentive payments to private landowners provide a common strategy to conserve biodiversity and enhance the supply of goods and services from ecosystems. To deliver cost-effective improvements in biodiversity, payment schemes must trade-off inefficiencies that result from over-simplified policies with the administrative burden of implementing more complex incentive designs. We examine the effectiveness of different payment schemes using field parameterized, ecological economic models of extensive grazing farms. We focus on profit maximizing farm management plans and use bird species as a policy-relevant indicator of biodiversity. Common policy simplifications result in a 49-100% loss in biodiversity benefits depending on the conservation target chosen. Failure to differentiate prices for conservation improvements in space is particularly problematic. Additional implementation costs that accompany more complicated policies are worth bearing even when these constitute a substantial proportion (70% or more) of the payments that would otherwise have been given to farmers.

An ecological-economic modelling procedure and a software-based decision support for cost-effective agri-environmental schemes for biodiversity conservation in grassland

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In the EU each year several billion Euros are spent on payment schemes which compensate farmers for carrying out land use measures which are costly to them but have a positive impact on biodiversity conservation. It is of great importance to make such payment schemes ecologically effective (i.e. intended goals like the improvement of habitat quality of endangered species are actually achieved), and cost-effective (i.e. payments are designed in a way that for the available financial budget the level of goal achievement is maximized). For this purpose, we developed an ecological-economic modeling procedure and, based on this, a decision support software (*Ecopay*) for grassland conservation in the German Federal States of Saxony and Schleswig-Holstein. *Ecopay* consists of a database with species and habitat characteristics for 15 birds, 15 butterflies and 7 grassland types, 475 land use measures, and land use information. It further contains an ecological model to assess the impact of measures on species and habitats and a cost assessment module to estimate the spatially differentiated costs of the measures. The optimization process is carried out through simulated annealing. Using the example of grassland conservation in Saxony we demonstrate how *Ecopay* can be used to design cost-effective agri-environmental payment schemes in specific landscapes. Preliminary results indicate that cost-effectiveness gains are substantial.

SESSION C2 - Species interactions, biological invasions and wildlife

Managing Biological Invasions: The good, the bad, and the ambivalent

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What can economics say about the management of ambivalent biological invasions? Contrasting with the usual assumption according to biological invasions are necessarily a public bad to be prevented or eradicated, the key of this paper is to ask, from an economics standpoint, how positive and ambivalent ecological and economic impacts affect policy making. Reviewing the literature, we highlight the gap between ecological and economics perspectives and discuss the importance of ecological and economic functioning in designing an appropriate policy response to biological invasions. In order to derive methodological insights, we describe a typology of ambivalences and discuss the economics of bio-invasions in the light of this typology presenting a road map for future researches.

Predator-Friendly Farming: Efficacy of Livestock Guarding Dogs in South Africa

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Human-wildlife conflict between carnivores and livestock is unsustainable, imposing large financial costs upon livestock owners, resulting in persecution of threatened carnivore populations. Livestock guarding dogs (LGDs) may provide non-lethal mitigation by protecting stock from depredation but their cost-effectiveness has not been thoroughly studied. This paper assesses the costs and benefits of 97 LGDs held on farms in South Africa between 2005 and 2011 by measuring depredation loss prior to and during LGD placement, rates of LGD behavioural problems, removals, and pre-senile mortality. Livestock depredation ceased entirely in 91% of LGD placements, creating mean annual financial savings of U.S. \$3,189 per farm. However, 28% of LGDs studied had behavioural problems, with inattentiveness being the most common. A total of 17% of LGDs were removed from the programme, predominantly due to behavioural problems. Premature death was observed in 22% of LGDs, mostly caused by accidents such as snake bite. If these problems can be addressed, LGDs offer an alternative to lethal methods of control and could potentially contribute to the long term avoidance of human-carnivore conflict in the region.

A Bioeconomic Analysis of Disease Transmission between Wildlife and Livestock Populations. Conservation vs. Livelihoods. An illustration from Limpopo Province, South Africa

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Dee Sikhweni

The establishment of national parks and other protected areas has noticeably conserved wildlife that could nearly be extinct and has certainly preserved biodiversity. However, for most countries in Africa, and developing countries in general, conservation policy has been received with resentment by the local people as this policy has alienated wildlife from them and threatened their main source of livelihoods. In addition, wildlife often escape from parks and protected areas into adjacent areas where they interact with the livestock of small-scale farmers, competing for grazing pastures as well as transmitting diseases such as foot-and-mouth disease (FMD), to livestock. This disease transmission and its impact on the livelihoods of small-scale livestock farmers is the main focus of this paper. Thus, this study develops a bioeconomic model which seeks to analyse the trade-offs between keeping wildlife in the park as a conservation value and the livestock that support the livelihoods of small-scale farmers in an overall optimal way in the presence of such disease transmission. This scheme is compared to the situation with no unified resource management policy, and also when there is no disease transmission. Data from Kruger National Park and livestock farmers living in the adjacent areas will serve as an illustration.

SESSION C3 - Deforestation and land use change

Brazilian Amazon Protected Areas' Forest Spillovers

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Most evaluations of protected areas (PAs) focus on within-boundary habitat or forest impact. Among them some recent evaluations raised the question 'Are PAs half full or half empty?' by confirming statistically significant impacts but yet estimating substantially lower impacts in comparing PAs' forest outcomes to those of lower-pressure areas more like PA locations. This paper applies that approach to inference in evaluating local spillovers from protection. We compare deforestation near PAs' boundaries with locations similar to those buffer areas, as did Robalino et al. 2011, who found 'leakage'(higher clearing) around Costa Rican PAs. Yet in this setting our spillover results raise the estimate of protection's net forest impact, i.e. matching reveals 'blockage' or lower 2000-04 and 2004-08 deforestation in the PAs' buffers. In a frontier setting like the Brazilian Legal Amazon, public protection may serve as a signal that 'the other hand of government' will not subsidize more local development infrastructure. To explore this novel interpretation and in part address effects of unobserved factors, next we rerun our analyses for subsamples and find more reduction in clearing closer to prior roads, which may be where new development is most likely to go, generating 'blockage' potential.

Dynamics of Indirect Land-Use Change: Empirical Evidence from Brazil

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The expansion of a given land use may affect deforestation directly if forests are cleared to free land for this use, or indirectly, via the displacement of other land- use activities from non-forest areas towards the forest frontier. Unlike direct land conversion, indirect land-use changes affecting deforestation are not immediately observable. They require the linking of changes occurring in different regions. This paper empirically estimates these indirect effects for the case of Brazil. It presents evidence of a positive relationship between sugarcane expansion in the south of the country and cattle ranching in the Amazon, suggesting that the former is indeed displacing the latter towards the forest frontier. This displacement effect is shown to be a dynamic process materializing over 10 to 15 years.

Trade-offs between food production and biodiversity conservation: some economic aspects

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Frederic Barraquand

Strategies for biodiversity conservation in agricultural landscapes involve either natural reserves along with small scale intensive production areas (land-sparing), or more wildlife-friendly farming over larger agricultural areas (land-sharing). Green et al. (2005) proposed a model to determine which strategy to choose, depending on the relationship between the relative density of wildlife and the agricultural yield. Much work has followed to relate Green et al. (2005)'s model to empirical data. There has been considerably less emphasis on relaxing some key assumptions of the model. One strong assumption was that of centralised decision making, i.e., agricultural yield at the regional level can be fixed. No link was made to economic instruments such as taxes and subsidies, that influence private land owners decision making. In this paper we introduce such economic elements with a land-use share model including farmers as rational actors, and important agronomic variables such as soil quality and inputs. Green et al. (2005)'s results are related to two key parameters in our model, the relative density of wildlife in wildlife-friendly agriculture, and effectiveness of inputs in modifying agricultural yields. These new elements in the model generated new results: land heterogeneity and efficiency of inputs in modifying the yield are shown to favor the land-sparing solution. When land-sharing is an efficient option, we show that it may be part of an optimal temporal sequence of policies, following the Pareto frontier of the food and wildlife production possibility

SESSION C4 - Livelihoods and participatory management

Do intermediary institutions promote inclusiveness in PES programs? The case of Costa Rica

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Despite dual environmental and social policy objectives, it has been observed that a focus on efficiency in programs of payments for environmental services (PES) tends to exclude small land-owners due to relatively high and largely scale-independent transaction costs. This study seeks to contribute knowledge on the role of local intermediaries in PES programs and how they may bring the reality of PES closer to the dual objective. This is done through an investigation of three non-profit organizations that act as intermediaries in the Costa Rican PES program; an NGO, a producer cooperative, and a county agricultural centre. Based on interviews, household surveys, and reviews of PES contracts, the study examines differences in the inclusion of small-holders in the PES program between the three organizations and focus on understanding the underlying reasons for any observed differences. The results reveal that the cooperative and the agricultural centre are more inclusive of small-holders than the NGO. The ability to include small-holders is influenced by the organizations' level of running operational costs, but also by their pre-existing portfolio of activities and relationships with landowners, as well as the land development history of the local area. Finally, the role of intermediaries is highly influenced by the framing of their working conditions by the PES buyer. This study thus shows the importance of considering the factors that condition the role of intermediaries in securing inclusive and low-cost provision of ES.

What benefits do Community Forests provide, and to whom? A rapid assessment of ecosystem services from a Himalayan forest in Nepal

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The study explored how the transfer of rights and responsibilities under Community Forestry at Phulchoki Mountain Forest (in Nepal) has affected the provision of different ecosystem services to different groups of beneficiaries. We used a recently developed toolkit of ecosystem service methods to gather quantitative information demonstrating the value of a range of ecosystem services. The toolkit is designed to be rapid, practical, accessible to non-technical staff and applied at a site-scale. As such it aims to address some of the challenges that have limited the application and usefulness of ecosystem service assessments to date, such as their cost, requirements for advanced technical expertise, large scale regional or global focus, lack of a comparator to consider the added benefit of conservation versus some other management or policy option, and omission of equity and distributional considerations.

Can Marine Protected Areas Improve Livelihoods in Gateway Communities: An Economic View of the Evidence Base

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Marine protected areas (MPAs) are found all around the globe, occupy a variety of ecological niches, are hoped to serve any number of purposes, and are managed through many distinct institutional governance arrangements. However, a relative dearth of studies exist which quantify the benefits of these reserves at the local community level. It is important to understand if MPAs benefit communities in order to gain their support, reduce management costs, and achieve positive conservation outcomes. Additionally, if a suite of benefits can characterize the economic success of MPAs, policy makers and conservation practitioners can design MPAs that nurture and provide the opportunity to capture these co-benefits of management. This paper synthesizes several diverse bodies of literature on the costs and benefits of MPAs and makes several recommendations to future researchers. We find that MPAs generate net benefits for resource dependent communities under some circumstances. Unfortunately without a reasonably comprehensive database of comparable cost and benefit estimates to derive robust predictors of success, means to create these circumstances remains more art than science. Based on this assessment, we find there are three fundamental gaps in this literature: 1. Future researchers should use internally valid valuation methodologies and an appropriate ecosystem service framework in valuation studies. 2. Studies should include cost estimates when possible, even if this implies added research expense. 3. Significant attention should be paid to the trade-offs of increasing the benefits from one source at the expense of another.

SESSION D1 - REDD+

Simple REDD+: a new compensation mechanism without reference levels based on net carbon sequestration services

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Deforestation in tropical regions causes 15% of global anthropogenic carbon emissions. REDD+ – United Nations program for reduction of emissions from deforestation and forest degradation – is intended to curb emissions due to deforestation by offering compensation for reductions with respect to historical or future deforestation reference levels. Compensation based on reference levels of deforestation has been shown to be politically controversial and unfair to countries with low historical deforestation rates. New mechanisms able to incentivise countries in all phases of the forest transition are necessary. We propose a reference-free, assumption-free and international leakage-immune mechanism based on balancing compensations for carbon sequestration services with capped penalizations for annual deforestation emissions. Using the new mechanism, we estimate that countries with high deforestation rates like Brazil and Indonesia would forgo respectively \$7.5 and \$1.4 billion annually in terms of compensation for carbon sequestration. Countries with low deforestation rates and high forest stocks like Angola and Colombia would receive net annual payments of \$860 and \$740 million respectively. Because of its simplicity and transparency the mechanism could contribute to reach international consensus over the implementation of REDD+ compensation mechanisms.

Modelling political influence on the choice of policies for REDD+

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Reducing Emissions from Deforestation and forest Degradation has recently returned to the spotlight in international climate change negotiations. Through a general equilibrium framework we examine the factors that influence the level and distribution of costs and benefits among sectors from the implementation of various policies, for a country facing an incentive to institute a national REDD+ strategy. We extend the general equilibrium framework in order to explore the implications of sectoral political influence on the scale and distribution of different REDD+ policy instruments. We find that the government factors in the general equilibrium effects of the policy along with the size of the incentive when determining the levels of policy. These general equilibrium effects help to determine the level of REDD+ effort undertaken by the government, and the distribution of returns and effort between sectors. When there is influence on the government we find indeterminate and counter-intuitive results under a direct payments policy. Sectors may lobby for a lower rate of payments to its own sector in order to create a stronger incentive to reduce forest use in the other sector and boost the level of international payment.

Willingness To Accept Carbon Payments Under Different Land Uses In Two Community Forests Of Oaxaca, Mexico

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The reduction of greenhouse gases in the atmosphere is essential for slowing down the climate change. One of the most effective ways to reduce emissions of greenhouse gases is by allowing emissions from land use change and protecting the forests which act as a carbon sink. Paying forest dwellers through a payment for environmental services (PES) program for reforestation, afforestation, forest conservation and management is a novel way to do both of these things. This study focuses on two indigenous communities in Oaxaca, Mexico who have been involved in a payment for hydrological services program and ask what they would be willing to accept (WTA) to participate in a program paying for carbon under two circumstances; paying for conservation on communal lands and paying for reforestation on individually held lands. The study used Heckman Selection Models to determine what factors influenced willingness to participate and willingness to accept and to generate predicted willingness to accept. The results show that WTA was higher for carbon payment programs requiring reforestation on individually owned lands and that WTA and that the prices named were independent of opportunity cost and that the market price of carbon only influenced WTA in the case of conservation. The most influential factors in determining WTA in either circumstance were factors related to the subject's experience and perception of the hydrological PES program in which they are currently enrolled. These results suggest that communities or individuals with positive experiences with PES programs should be targeted for future PES programs and that forest dwellers who manage lands communally, programs that promote forest conservation for carbon mitigation are more viable than reforestation or afforestation programs that may have perverse incentives.

Economic assessment of multiple benefits under REDD+: The challenges of going beyond carbon in REDD+ land use planning

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REDD+ aims for Reducing Emissions from Deforestation and forest Degradation, the conservation of forest carbon, sustainable management of forest or enhancement of forest carbon stocks. REDD+ strategies should account for potential gains and losses in ecosystem benefits (i.e. final ecosystem goods and services that can be linked to human well-being) so as to target those REDD+ options (i.e. which actions to undertake and in which location) that can provide the highest economic values at lowest economic costs. Within the UN-REDD Programme there is an increasing impetus towards more comprehensive economic assessments of the multiple benefits from REDD+ as a contribution to national level strategies and land use plans. Taking multiple benefits into account is important for two reasons. Firstly, narrowing down the complexity of ecosystems to a single commodity (i.e. carbon) veils important ecosystem interactions and functions. Secondly, ignoring non-carbon ecosystem benefits would underestimate the economic importance of many REDD+ options. Among policymakers and conservationists alike there is a demand for a better understanding of ways to

demonstrate and value the multiple benefits from REDD+, as well as of ways to cost their provision. Cost-benefit analyses based on monetary values can provide an analytical framework for the economic assessment of ecosystem services and thus help make the concept of multiple benefits operational in REDD+ planning. This paper will outline a framework for such assessments. Based on the identification of key limitations in the valuation of ecosystem benefits, it will argue that cost-benefit analyses should not be the only decision-support tool, especially not if there is critical natural capital, whose loss would be irreversible. Under these circumstances, economic assessments of REDD+ should combine financial cost-benefit analyses with non-monetary criteria, such as sustainability or risk constraints. This may be a promising means to ensure that REDD+ contributes to national biodiversity conservation goals and integrated land use planning strategies. First insights from national planning processes under UN-REDD in Panama will be discussed.

SESSION D2 - Valuation

Landscape Valuation: Choice Experiments or Contingent Valuation?

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Graham Finney, Dave Matthews

Landscapes represent the dynamic interaction of natural and cultural processes acting on the environment. Increasingly human impacts are dominating the natural processes resulting in landscape change and habitat loss. Due to the public good nature of landscapes, no market price exists to indicate their economic value and consequently impacts to the landscape are excluded from decision-making processes. To include landscape change within the decision making process, valuation studies have been undertaken; primarily stated preference methods.

In common with the valuation of many public goods, Choice Experiments (CE), have dominated the landscape valuation literature. However, CE makes the implicit assumption that the value of the good can be captured by the attributes of the good. In CE a landscape would be described in terms of its features i.e. trees, field boundaries.

Drawing from psychology/cognitive research, we explore whether the spatial configuration of those landscape features has an impact on preferences. The findings of a general population based survey indicates that spatial configuration does have an impact on landscape preferences and therefore potentially on economic values. This would indicate that unless CE can incorporate spatial configuration, they may not be an appropriate method for valuing landscapes.

A common bird in your garden is worth two rare ones in the woods: Consumption and altruistic values of local wildlife

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Michael Brock, Robert Sugden

In order to investigate how exposure to and interaction with everyday wildlife is valued, we conduct a discrete choice modelling study on garden birds in Norwich, UK. Our results indicate that wildlife living at people's doorsteps substantially contributes to welfare and potentially more so than protection of endangered species in more remote locations. We also test for different motivations to engage in bird feeding and find that direct consumption is the main motivating factor. Concern regarding the birds' but not neighbours' welfare is a smaller but highly significant driver. This is in line with conjectures on the role of nature connectivity in subjective wellbeing and informs the literature on the private provision of impure public goods.

The impact of individual risk preferences on choices and values: an application to threatened lynx populations in Poland

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Choice experiments have been widely used to study consumer preferences for environmental goods and services. A relatively recent innovation has been to acknowledge the inherent uncertainties surrounding the provision of these non-market commodities. Such uncertainties arise from many sources, including the time scale between policy implementation and outcome, as well as the associated post-policy ecological and environmental characteristics. This paper assesses the impact that the respondents' risk preferences have on the valuation of lynx preservation in Poland in the face of this provision uncertainty. We demonstrate empirically that a link exists between individual risk preferences, which manifests in a tendency to choose the status quo option rather than any of the alternatives, and to offer, on average, a lower willingness to pay for enhanced protection.

More random or more deterministic choices? The effects of information on preferences for biodiversity conservation

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Miko³aj Czajkowski

For many years, stated preference researchers have been interested in the effects of information on willingness to pay for environmental goods. Within the random utility model, information about an environmental good might impact on preferences and on scale (error variance), both between and within samples of choices. In this paper, we extend the G-MNL model to investigate the effects of different information sets on choices over the management of biodiversity in the UK, looking specifically at moorlands managed for red grouse shooting. Specifically, we make the individual scale parameter a function of observable (dataset-specific) characteristics. Our results show that changing information sets results in significant differences in the mean scale between datasets, and in the variance of scale. Respondents are more deterministic in their choices and show lower within-sample scale heterogeneity in the alternative information treatment. Changes in information provision also effect willingness to pay estimates, reducing the value people place on the conservation of two iconic birds of prey. The methods used will also be of interest to researchers who need to combine choice experiment data sets.

SESSION D3 - Payments for Ecosystem Services

Can informational rents ever be avoided? Optimal conservation programs, endogenous investments, and heterogeneity in land owner preferences

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Nature conservation policies are typically voluntary programs in which land owners are paid to provide environmental services. We consider the case in which land owners differ in the rate at which they discount the future. Preference heterogeneity has two important consequences. First, even though there is just one fundamental source of heterogeneity, farmers are likely to differ in several respects that are relevant for conservation programs. They do not just value the same per-period benefit and cost flows differently, their per-period benefit and cost flows are likely to differ too. Decisions like how much to invest in land quality are determined by time preferences, and differences in land quality can make conservation more or less costly. If farmers differ in two or more respects, we may be able to design a mechanism that is able to reduce the program's informational rents to zero. Second, if land quality investments are at least partly driven by farmer preferences, the government should take into account that land qualities may change in response to the introduction of the program. We find that preference heterogeneity can indeed cause the first-best conservation policy to be incentive compatible even in the presence of information asymmetries.

Combining performance-based and action-based payments to provide environmental goods under uncertainty

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Payments for environmental services (PES) are widely adopted to support the conservation of biodiversity and other environmental goods. Challenges that PES schemes have to tackle are (i) environmental uncertainty and (ii) information asymmetry between the provider of the service (typically a farmer) and the regulator. Environmental uncertainty calls for action-based payment schemes, because of the more favorable risk allocation if the farmer is risk-averse. Information asymmetry, on the other hand, calls for a performance-based payment because of the more direct incentives for the farmer. Based on a principal-agent model, we study the optimal combination of both, performance-based and action-based payments. We find that for a risk-neutral regulator a combination is optimal in the majority of cases and that the welfare gain of the combined scheme over a pure action-based (performance-based) payment increases with information asymmetry (environmental uncertainty). We further show that for a regulator who is risk-averse against fluctuations in environmental goods provision the optimal performance-based payment is lower than for a risk-neutral regulator. We quantitatively illustrate our findings in a case study for the enhancement of the butterfly Scarce Large Blue (*Maculinea teleius*) in Landau/Germany.

Evaluating greening farm policy: a structural model of agri-environmental subsidies

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Céline Nauges

A quarter of the European Union utilized agricultural area is enrolled in agri-environmental programs. Despite the prevalence of the programs and increasing demand for environmental quality in the European Union, ex-post assessments of program benefits are rare. This study uses a structural econometric model to evaluate impacts of agri-environmental support through the Finnish Agri-Environmental Program. The program's primary goal has been to reduce agriculturally-produced nutrient pollution, and it is considered the primary solution to Finland's substantive surface water quality problem. We quantify the effects of agri-environmental payments on farmers' decisions on the allocation of land to grain production and grassland and on the intensity of fertilizer use over the period 1996-2005, drawing on a representative sample of individual grain farms. Identification of the effect of agri-environmental payments on production decisions is based on variation in payment rates across regions and over time. We then combine the predicted fertilizer use and land allocation with environmental production functions to quantify the impact of agri-environmental payments on nutrient loading. Finally, we assess the monetary value of reduced nutrient pollution drawing on a valuation study evaluating the benefits of reducing nutrient loading from Finland to the Baltic Sea. Results suggest that agri-environmental subsidies reduced the damage from nutrient loading from grain production by 11 to 12 percent. The benefits in terms of reduced nutrient pollution are approximately on par with the costs of program payments.

Ecosystem service curse: what new or extended problems might emerge if payments for ecosystem services grow big?

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Klaus Hubacek

Payments for ecosystem services (PES) have received much praise and are increasingly perceived as a promising tool to ensure the protection of global ecosystems as well as being able to help alleviate poverty in areas rich in ecosystem services. Given current trends, the scale of payments is likely to grow, creating new circumstances within which ecosystem services will be managed. In this dynamic context, following a precautionary approach, one should focus on establishing systems to handle the risks involved. Based on an analogy to resources which have long been included in the system of market transactions, we suggest that the rapid development of PES can negatively influence regional and potentially national economies. Resource revenues are highly correlated with economic problems in poor countries that are not able to use those revenues to ensure sound development. Problems similar to those that affect resource-rich countries may emerge in the case of economies rich in ecosystem services once PES increase in spatial and monetary scale. The most prominent examples of such problems include rent seeking, unequal bargaining power of buyers and sellers, volatility of payments, which are all related to the quality of institutions. To ensure the long-term positive impacts of PES, such systems should be carefully designed paying particular attention to distribution of property rights and transparency, decentralization of revenues, and capacity building to ensure further development opportunities.

SESSION D4 - EU Policy Impacts

The economic impacts of biodiversity policy for improving the climate regulating services provided by EU Natura 2000 habitats

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Anil Markandya, Paulo A.L.D. Nunes

We adopted the state of the art methodologies to quantify the total carbon stocked by Natura 2000 habitats as well as to project the future changes of carbon stocks influenced by alternative policy options for the management of Natura 2000 habitats by 2020. Our results show that the N2K network currently stores around 9.6 billion tonnes of Carbon, equivalent to 35 billion tonnes of CO₂, which is estimated to be worth between €607 billion and €1,130 billion (stock value in 2010), depending on the price attached to a ton of carbon. Of the different ecosystems the forest habitats contain the highest carbon value in the network, ranging between €318 and €610 billion in 2010. Furthermore, our results also show that in the future these carbon values can be increased. A policy scenario (Policy ON), where full Protected Area coverage (terrestrial PAs + fuller MPAs) with a move to full favourable conservation status is estimated to generate a gain of at least a total of 1.71-2.86% by 2020 compared to a policy inaction scenario (Policy OFF), where no additional action is taken to conserve the current Natura 2000 sites over the next decade.

Agri-Environmental Schemes and Grassland Biodiversity: Another Side of the Coin

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In this paper, the Agri-Environmental Schemes (AES) of the European Union are evaluated on the basis of county-level data (NUTS3 region), the purpose being to disentangle the effects of AES on land-management practice from its effects on biodiversity. One of the major arguments in favour of AES subsidies is that they will promote environmental-friendly land-use, which, in turn, will lead to biodiversity conservation. However, the results of this paper reveal that AES subsidies are more focused on ecological land-use rather than extensive agricultural practice in the first place and, furthermore, the subsidies are predominantly allocated to already biodiversity-rich counties. Moreover, even if these subsidies were directed to biodiversity-poor countries, no clear evidence is found that land-use practices in situ improve the biodiversity status per-se.

On the Environmental Effectiveness of the EU Marine Strategy Framework Directive

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Marine and coastal ecosystems – and thus the benefits they create for humans – are subject to increasing pressures and competing usages. For this reason, the European Union (EU) adopted the Marine Strategy Framework Directive (MSFD), which is to guide future maritime policy in the EU and aims at achieving or maintaining a good environmental status (GES) of European seas by 2020. To this end, the MSFD requires the development of improvement measures, which have to be assessed inter alia by examining their cost-effectiveness and by carrying out cost-benefit analysis (CBA) before their implementation.

This paper investigates the applicability of environmental CBA in the marine context. It identifies and discusses problems that could hamper the environmental effectiveness of the MSFD. For example, the fact that marine ecosystem services are much less tangible than terrestrial ones implies greater challenges for the quantification of benefits for society in a marine context. One finding is that the limitations of environmental valuation methods regarding their ability to capture the whole total economic value of improvement measures are a potential source of problems, as the MSFD allows countries to disregard measures with disproportionately high costs. The trans-boundary nature of the main European seas adds to the complexity of the valuation task, e.g. due to the danger that benefits that occur outside of national territories are neglected. Moreover, the current state of knowledge on the functioning of complex marine ecosystems and the links to socio-economic impacts and human well-being seem insufficient to meet the MSFD requirements.

Largescale conservation and neoliberalism: a UK perspective

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Biodiversity conservation in the UK has until recently been focussed on relatively small scale protected sites predominantly owned by or regulated by government. However, initiatives being led by non-governmental organisations are increasingly concentrating on much larger areas of land under Large Scale Conservation Initiatives (LSCIs), and this approach has recently been endorsed and promoted in England by the government's recent White Paper on the Natural Environment (DEFRA, 2011). This shift in scale is a response to the limited achievements of small scale areas especially under the threat of climate change, developments of thinking in ecology supporting larger scale and better connected areas of habitat, and broader options opened out for the control of land under neoliberal governance. These LSCIs are primarily led by private conservation NGOs and implemented through partnerships in a variety of types of arrangements with other private and public organisations. They now cover a substantial proportion of the country. The government's vision in the White Paper is to restore ecosystems across the country and yet its policy relies on voluntary initiatives supported by small amounts of money. Neoliberalism has opened up a much wider range of mechanisms that can be used in support of public objectives, but the actions of the LSCIs are fundamentally dependent on the agri-environment funding provided under the Common Agricultural Policy (CAP). Biodiversity conservation requires security for management in the long term, but current initiatives are vulnerable to both changes in commodity prices and to changes in the CAP. Government needs to move towards a new post-neoliberal approach that is more interventionist, implementing more formal legal agreements and land purchase to secure conservation land management against serious but uncertain threats.

SESSION E2 - Theory

Regulating ambient pollution when social costs are unknown

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Marc Willingery

This paper offers a new mechanism in order to Nash-implement a Pareto optimal level of ambient pollution. It is well-known that non-point source emissions can only be regulated through instruments that are conditioned on aggregate emission, since individual emissions are not observable by the regulator. The novelty of our mechanism is that it does not require that the regulator knows the agents' preferences as is usually assumed. We show that the regulator can achieve the Pareto-optimal level of emissions under very weak informational assumptions. He only needs to know the number of polluting agents.

Spatial and liability aspects of the formation of GMO-free or GMO clubs

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J. Wesseler

Adventitious presence plays a prominent role in the debate over coexistence of Genetically Modified Organisms (GMOs) and conventional organisms. There are several ways to address this externality and one of them is the formation of GM free or GM only clubs. We model the decisions of individual farmers to cultivate either GM crops or conventional crops and combine this with a game theoretic model of club formation to investigate whether the formation of such clubs is feasible. We consider two liability regimes, one where the GM farmers are liable and one where conventional farmers are liable, in the absence of further regulations. We find that clubs are feasible but that the number of liable farmers willing to join such a club is limited to two. Moreover clubs are more likely to form under a regime where conventional farmers are liable than under a regime where GM farmers are liable.

Community Pressure for Green Behavior

Anthony Heyes (University of Ottawa, Canada)
Sandeep Kapur

The desire to avoid rousing community hostility may encourage firms to behave in an environmentally responsible manner. Firms may engage in corporate social responsibility (CSR) to maintain community support and/or to regain the support of a community where it has been lost. It has been conjectured that such 'informal regulation' could effectively replace formal intervention in some settings, and usefully complement it in others. We explore these conjectures with mixed results. Informal regulation is necessarily less efficient than a well-designed formal alternative and the pattern of green behavior induced by the threat of community hostility may increase or decrease welfare. The existence of community pressure may increase or decrease the optimal calibration of a formal intervention (in this case an environmental tax) and may complement or detract from the incentives generated by an optimally-calibrated tax.

SESSION E3 - Biodiversity Conservation: theory and behaviour

Supporting Conservation and Limiting Elite Capture in Community Based Projects.

**Maarten Voors (Department of Land Economy, University of Cambridge) and
Ty Turley (Department of Economics, University of Chicago)**

Erwin Bulte, Andreas Kontoleon, John List, Ty Turley and Maarten Voors

This paper uses a field experiment in Sierra Leone to investigate elite capture of community projects. In 56 rural communities dependent on slash and burn agriculture we collaborated with a conservation NGO to vary the conditions under which an aid program is managed. In half the villages, the local chief was responsible for the management of the project. In the other half three randomly selected villagers (heads of household) managed the project. Project management entailed storing supplies and managing work crews for a community construction project. We use several indicators, including experimental games and audits of project value by local engineers, to measure elite capture and villager support for the NGO. We find that elite capture is limited in both groups, that committees do worse in managing a community project than chiefs do, and that villagers working under a committee are less motivated to support conservation efforts.

Information and Coordination Failure in Local Networks: An Experimental Investigation of the Agglomeration Bonus

**Frans P. de Vries
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Simanti Banerjee , Nick Hanley, Anthony M. Kwasnica

The Agglomeration Bonus (AB) is a subsidy mechanism intended to induce adjacent landowners to spatially coordinate their ecosystem service supply activities. This paper explores experimentally the nature of coordination failure between players in an AB coordination game on a local network when players only view the actions of their clockwise and anti-clockwise neighbours. We find that in this setting, the limited observability of actions creates anonymity between players on the network reducing the likelihood of coordination to the payoff efficient equilibrium over time - players are more likely to choose the risk dominant action. This implies that with limited information flows in a network setting, the ecosystem service pertaining to the payoff efficient action has an increased likelihood of remaining undelivered. We also observe the co-existence of multiple strategies on the network in the final period unlike in earlier research. This result can be attributed to strategic interactions between directly and indirectly linked players (non-neighbours) on the network and the restricted information flow about indirectly linked players' actions. Co-existence of multiple strategies, however, implies localized spatially coordinated payoff efficient choices

The Identification and Measurement of Behavioural Effects From Agri-Environmental Policies - An Empirical Analysis

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John Walsh, David Zilberman

This empirical study investigates the effects of different agri-environmental schemes on individual producer behaviour. We consider the effects on production intensity, performance and structure for a sample of UK cereal farms for the period 2000 to 2009 and use the policy examples of the Environmental Stewardship Scheme (ESS) and the Nitrate Vulnerable Zones (NVZ). The econometric methodology is based on a directional distance function framework as well as the application of propensity score analysis by the use of matching estimators. We find that both schemes are effectively influencing production behaviour at individual farm level. However, agri-environmental schemes show only very minor effects on the technical and allocative efficiency of farms, hence, we can conclude that farms enrolled in agri-environmental schemes are efficiently adjusting their production decisions given the constraints by the respective scheme. Farms affected by these schemes indeed tend to become less specialised and more diversified with respect to their production structure. A voluntary type agri-environmental scheme seems to significantly influence producer behaviour at a far higher scale than a non-voluntary agri-environmental scheme. The methodological novelty of this research lies in the use of a sound production theory based multi-output multi-input approach to disentangle measures for production performance and structure which are then used as indicators for the robust treatment effects' analyses.

SESSION E4 - Payments for Ecosystem Services 2

The life of transaction costs in a payment for ecosystem scheme: The Evian Natural Mineral Water scheme

Pedro Andrés Garzón Delvaux
ACTeon

Pierre Defrance

Transaction costs (TCs) have been identified as important obstacles in the development of Payment for Ecosystem Services (PES) schemes and in many cases understood as directly responsible for their lack of implementation. By looking at an operational private scheme between the Evian Natural Mineral Water company and stakeholders of a water catchment area to protect the water quality, this study aimed at quantifying the dynamics associated with TCs. Evian company is supporting the development of a modern environmentally friendly agriculture focusing on dairy production linked to cheese making under the protected designation of origin (PDO) as a means to ensure irreproachable water quality in the future. By benefiting from privileged access to the company and managing organisation's records since the inception of the project in the early 1990s, TCs were identified, quantified and analysed through time following a simple project cycle proposed by McCann et al. (2005). Although this scheme is specific given the very large commercial value of ecosystem service and that some gray areas remain with respect to the quantification of TCs, these results shed light on a more precise but changing structure of TCs to guide future PES design. The key elements are that i) the TCs structure changed, ii) TCs remain very important throughout the programme, at times equating the actual costs of the agricultural activities and transfers and that iii) even with a wealth of quantitative details on TCs, they remains difficult to estimate in full.

A Meta-Analysis of Livelihood Impacts of Payments for Environmental Services Programs in Developing Countries

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Andreas Kontoleon

Direct Payments for Environmental Services (PES) programs have been increasingly implemented in developing countries to achieve conservation objectives via alternative land-use patterns. Meanwhile, rural livelihood improvement and poverty alleviation are often listed as major side objectives of those PES programs. However, so far a mixed picture has been shown by the growing amount of empirical studies. Based on a sample on studies that explicitly employ more formal policy evaluation tools we undertook a meta-analysis that explored the general magnitude of the impacts of PES programs on livelihood indicators in developing countries. Further the influencing factors of these impacts were explored. A partial proportional odds model was estimated, in which the dependent variable indicates the probabilities of ordered levels of livelihood impacts, and the independent variables include the characteristics of PES programs and impact evaluation methods. According to the estimation results, statistically non-significant positive livelihood impacts are more likely to occur, with a mean predicted probability of 48%. Several institutional characteristics of PES programs are found to render them as having a better chances to achieve significant positive

livelihood impacts, such as providing higher payment rates, voluntary participation schemes and alternative income sources. Certain characteristics of the evaluation methods used by the original studies could influence the measurement of livelihood impacts, such as using baseline data and controlling for selection bias. Our analysis highlights factors that are important for the design, implementation and evaluation of PES programmes.

International Payments for Biodiversity Services: Review and Evaluation of Conservation Targeting Approaches

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Stefanie Engel

The lack of incentive flows between local producers of global biodiversity-related ecosystem services and global service beneficiaries calls for a mechanism to avoid the under-provision of biodiversity services. Payments for ecosystem services (PES) are increasingly being implemented on the local and national scale. The issue of how PES can be upscaled to an international level is currently being discussed. International PES (IPES) will most likely be confronted with a limited budget and attention will have to be given to the issue of how payments are most effectively allocated. The objectives of this paper are to (i) outline the principles of targeting in conservation, (ii) provide an overview of techniques applied in science and practice, (iii) identify some of the specific challenges of an IPES scheme and (iv) analyse the suitability of available global targeting mechanisms for utilization in IPES. The paper is based on a review of targeting literature and uses the framework of a multi-criteria analysis to help organize and quantify strengths and weaknesses of alternative global targeting approaches. Despite growing consensus on the importance of incorporating costs, none of the global targeting approaches under review have so far incorporated costs as a targeting criterion. Data availability is probably one of the main constraints of global targeting. A stepwise selection approach could partly overcome this problem. Existing global targeting approaches could be used for first step selection choices. We identified Biodiversity Hotspots, Crisis Eco-regions and Endemic Bird Areas to be the most suitable approaches for IPES.

SESSION F1 - Biodiversity and Development

Evolving Patterns of Firewood Collections in Nepal: A Household Panel Analysis 1995-2003

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Deforestation poses serious developmental and ecological problems. Most of research has focused on two key issues: the link between economic growth and deforestation and the potential of communities to sustainably manage their forests. We use longitudinal dataset to evaluate changes in the pressures on the forest in Nepal over time and how these related to observed contemporaneous changes. Firewood collection decreased of 12% between 1995 and 2003. Collection time fell by 23%. Evidence indicates that these reductions are not explained by rising living standards, nor by the widespread transfer of state forests to community forest groups. Falling collection owed to a shift away from traditional livestock rearing occupations, as well as the effects of the civil war. The fall in collection times resulted from the civil war and was therefore temporary in nature, rather than reflecting a decline in deforestation.

What Drives Biodiversity Conservation Effort in the Developing World? An analysis for Sub-Saharan Africa

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Biodiversity conservation in low-income economies is a vital issue and hence needs to be addressed for development and poverty eradication. A variety of empirical works exist on the subject, but the focus is often limited on the search for possible causes of biodiversity erosion. Research on the driving forces that influence biodiversity conservation effort is still largely missing, especially for developing countries. In this study, we seek to address this gap. We test, using different models, the impact of some domestic and external factors on countries' conservation effort measured by the Ecoregion score. We examine specifically whether strategic interactions matter in conservation policymaking at the country level. The model is tested on a data set comprising 48 sub-Saharan African countries spanning over the period 1990-2009. Through the obtained results, we give empirical evidence that, in the context of underdevelopment especially in Sub-Saharan Africa, strengthening governance is an effective mean to support the promotion of biodiversity conservation. In addition, we find that countries in Sub-Saharan Africa are influenced by their contiguous neighbors in environmental policy for biodiversity management. Finally, the results suggest that tourism development is a valuable incentive to raise governments' dedication to conservation in Sub-Saharan Africa.

SESSION F2 - Agriculture and Biodiversity

Biodiversity offsets in theory and practice

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Biodiversity offsets are an increasingly popular yet controversial tool in conservation. Their popularity lies in their potential to meet the objectives of biodiversity conservation and economic development in tandem, the controversy lies in the need to accept ecological losses in return for uncertain gains. The offsetting approach is seeing widespread adoption, even whilst methodologies and the overriding conceptual framework are still under development. This review of biodiversity offsetting evaluates implementation to date, synthesizing the outstanding theoretical and practical problems. We begin by outlining criteria that make biodiversity offsets unique, and then explore the suite of conceptual challenges arising from these criteria, whilst indicating potential design solutions. In practice, we find that biodiversity offset schemes have been inconsistent in meeting conservation objectives. This is as much due to the challenge of ensuring full compliance and effective monitoring as it is to conceptual flaws in the approach itself. Evidence to support this conclusion comes primarily from developed countries, though offsets are increasingly implemented in the developing world. This is a critical stage at which biodiversity offsets risk becoming a response to immediate development and conservation needs, without an overriding conceptual framework to provide guidance and evaluation criteria. We clarify the meaning of the term 'biodiversity offset', and propose a framework that integrates the consideration of theoretical and practical challenges in the offset process. We also propose a critical research agenda for specific topics around metrics, baselines and uncertainty.

A double benefit of biodiversity in agriculture

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The objective of this paper is to contribute to accounting for biodiversity goals in the design of agricultural policies. A bio-economic dynamic model is developed with a multi-scale perspective. It couples biodiversity dynamics, farming land-uses selected at the micro level and public policies at the macro level based on financial incentives for land-uses. The public decision maker provides optimal incentives respecting both biodiversity and budgetary constraints. These optimal policies are then analysed through their private, public and total costs. The model is calibrated and applied to metropolitan France at the PRA ("petite région agricole") scale using common birds as biodiversity metrics. The study first shows that the efficiency curves display decreasing concavities for different biodiversity indicators pointing out the trade-off occurring between biodiversity and economic scores. However, the total and public costs suggest that accounting for biodiversity can generate a second benefit in terms of public incomes. It is argued how a regional redistribution of this public earning to the farmers could promote the acceptability of biodiversity goals in agricultural policies

SESSION F3 - Payments for Ecosystem Services III

Adverse or Beneficial Self-Selection? Efficient Procurement of Environmental Services

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This paper investigates participation by farmers in the UK Environmental Stewardship Scheme and how decisions to join the scheme are related to land productivity levels on the one hand and ecological conservation on the other. In particular the paper will explore the extent to which the self selection of farmers onto the scheme influences likely scheme performance using results from previous studies in ecology and economics. The first part of the paper analyses a theoretical model for the provision of ecological services where an uninformed government agency offers to contract to well-informed farmers. The results of this analysis indicate the extent to which self selection by farmers can impair the efficiency of PES schemes and point to possible mitigation of these effects where there is 'beneficial' rather than 'adverse' selection. These results are used to motivate the empirical analysis of a sample of participants in the UK's Higher Level Environmental Stewardship Scheme (HLS). We use a comprehensive dataset for more than 1,000 HLS agreements over different years. The results of these preliminary analyses confirm the potential for 'beneficial selection' and can inform policy makers on a more adequate design of conservation schemes to take advantage of these arguably positive effects of self-selection.

Classifying Market-Based Instruments for Ecosystem Services: A Rough Guide to the Literature Jungle

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Although market-based instruments (MBIs) gained prominence in discourses and practice in the field of biodiversity conservation and provision of ecosystem services, their definition and underpinning theory are yet unsettled matters. A review of MBIs – including Payments for Environmental Services, taxes and subsidies, mitigation or species banking, certification, etc. – clearly shows that this label encompasses an extremely diverse array of instruments. Their only shared characteristic might be that monetary values are associated with nature, yet in different ways and not necessarily in conjunction with economic valuations of the benefits / impacts associated to biodiversity and ecosystem services. Their links with markets are often loose, at least contrasted if not questionable in many cases, and the nature of “markets” differs dramatically. This pleads for a better and theory-based typology of such a large collection of policy instruments in order to better inform policy making. The proposed typology is based on the links between MBIs, economic theory, and markets. It includes six generic categories: regulatory price changes, Coasean-type agreements, reverse auctions, tradable permits, direct markets, and voluntary price signals. Further analysing an extensive review of academic articles on MBIs (146 references found on Web

of Science with selected keywords, and 106 references eventually deemed relevant), we attempted to see if our theoretical categories of MBIs were well reflected in the scientific literature and if some policy lessons could be drawn. We found that the proposed typology could prove useful to classify existing instruments; nevertheless, the analysis of the literature on MBIs also revealed the great diversity in research methods and evaluation criteria, as well as in the terminology used. This lack of a common theoretical and empirical framework in the scientific corpus prevents practitioners to draw robust policy-relevant results on MBIs and thus calls for further research and harmonisation of methods to be applied to better defined categories of MBIs with key shared characteristics.