

# EXTENDED PROGRAM



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## Final Version

Chair: Yonas Alem

Research proposals part I 8.45 - 10.45

Forests and Energy and Policy Design

### **Changes in Water Property Rights Regimes: Impacts on Economic Value of Water & Inter-Sectorial Allocation**

Helena Cardenas

Economic and environmental stresses, including population growth, rising food demand, expanded tourism and climate change issues, are causing problems in the availability of water resources from underground and surface sources. Also, water is a resource used in several sectors of the economy: residential, agriculture, tourism, industrial, energy generation. As problems of water availability worsen, inter-sectorial conflicts and challenges of inter-sectorial water allocation are more prominent. In this context, changes on water property rights (WPR), either in formal or customary settings, are becoming more frequent as they are used to coordinate among multiple and competing uses of water. Property rights (PR) have long been analyzed in Resource Economics, including topics of: social dilemmas in common pool resources, impacts of PR on enforcement for conserving the resource, and market mechanisms. In inter-sectorial analysis, WPR have been evaluated in economic models (e.g. hydro-economic models) by including changes in quantities allocated to each sector. However, the impacts of property rights regimes on the demand of the resource and its implications on inter-sectorial allocation still needs further understanding and evaluation from Economic theory. In some water-scarce areas of the world, PR are transferred from the State to users of the resource as concessions. By concessions we mean temporary authorization to use the resource. These de-facto entitlements include rights about access, alteration, transferability and alienation of the resource. To better understand the impacts of changes of WPR for different sectors, this study analyzes PR from the producers lens and asks how different concessions impact producers' water demand and their total benefit. We propose to model these impacts by evaluating three components: endowment of the resource (allowed quantity to use), marginal product of water, and the cost of using water as an input of production under various PR. Changes in these three components will then be used to estimate producers' water demand and profit. This question is relevant for later evaluation of WPR policies' distributional and resource conservation impacts. For this study we use a case in a convenient location of the province of Guanacaste in Costa Rica, a region of limited water availability and distributional conflicts, where three sectors (residential, agriculture and tourism) compete for water resources. This is a timely study as Water Law is being evaluated in Congress for first time since 1942. The methods for this project include estimation of water demand and net benefit in the framework of production functions and profit maximization functions. We will evaluate three sectors: residential drinking water providers, agricultural producers and tourism operators. The data sources will be obtained from secondary data sources and from survey implementation. This is part of a larger project, where the information on impacts on water demand will be used later to evaluate inter-sectorial distribution and welfare impacts of changes in WPR.

## **Forest Tenure and Forest Management: Alternative mechanisms for increasing local and global benefits from forests**

Elizabeth Robinson

Governments throughout lower and middle income countries continue to strive to increase the local and global benefits that forests have the potential to provide. This second phase of the forest collaborative focuses on assessing and evaluating the impact of government forest-oriented initiatives on ecosystem services and forest-dependent livelihoods within a number of themes that build on synergies and contrasting experiences of the different EfD centres. The first phase of the forest collaborative brought together existing research on the impact of forest tenure reforms in Asia and Africa into an edited book that addressed three key themes: Property rights and local level forest reforms; Implications of local forest management; and Issues for the future, with a focus on climate and specifically REDD (Reduced Emissions from Deforestation and forest Degradation). Though the book included synthesis chapters at the beginning and end, with only one or two exceptions each chapter addressed just one country's experiences. A central aim of this second phase is to add value to the expertise and research output in each of the individual centres by building cross-centre synergies, bringing together existing experiences, expertise, data, and modelling skills in novel ways to provide new insights at the intersection of forest management, livelihoods, and ecosystem services. This second phase also broadens the reach of the collaborative by moving away from a focus solely on forest tenure reforms to addressing a broader set of policies that might variously include protected areas and payments for ecosystem services. As such, the experiences and lessons learned from countries such as Costa Rica, that were not reflected in the first phase, can be accommodated and contrasted with those in Africa and Asia. The collaborative programme will focus on enabling researchers from the different EfD centres to work together to explicitly build synergies between the skills, experiences, and particular forest management approaches in the relevant countries. Program implementation will focus on annual coordinating workshops with representatives from each centre, cascading down to bilateral/tri-lateral meetings and centre workshops that focus on particular aspects of the programme. The coordinating workshops will be designed to coincide with EfD annual meetings and/or the annual EAERE conferences. Programme outputs will be at least six research papers and two funding proposals that will exploit inter-centre synergies. Possible topics for synthesis papers might be: comparing the impact on multiple dimensions of ecosystem services of forest ownership and management at the individual versus community level; or combining methodological approaches to re-interrogate existing data sets, such as with respect to spatial aspects of forest management.

## **The Effects of Urban Rail Transit on Air Quality: New Evidence from Multiple Chinese Cities**

Lunyu Xie

Exposure to air pollution has substantial negative effect on health. Automobile exhausts are a major source of harmful pollutants such as nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), and small particulate matter (PM<sub>2.5</sub>). Although transportation infrastructure investments—urban rail transit in particular—are often motivated partly by a desire to improve air quality and public health, little is known of the effects of such investments on air pollution. In this project, we investigate whether urban rail transit expansion improves air quality, compare the magnitude of effects across cities, and explain any variation across cities. We collect and merge five major data sets: (1) hourly air quality data for all monitoring stations in China since Jan 2013 from the Minister of Environmental Protection; (2) timing of subway building/expansion in all cities from various news sources; (3) detailed weather information from China Meteorological Administration; (4) polluting industry activity data from Renmin University of China; and (5) city characteristics data from city or provincial yearbooks. We use a difference-in-differences approach that exploits cross-city variation in the timing of the opening of new subway lines. In addition, we investigate the factors behind the possible heterogeneous effects across cities, such as weather, industrial activities, and city characteristics. We expect this study to help policy makers improve the efficacy of subway lines at alleviating air pollution.

**The Impact of the System of Rice Intensification on Small-holder Farmers' Welfare: Does Partial Adoption Matter?**

Remidius Ruhinduka

The System of Rice Intensification (SRI) is a low-tech but climate-friendly farming system that has been proven to have significant positive yield impacts. The technology comes as a set of complimentary principles that need to be applied jointly to realize such impressive gains. However evidence suggests that some farmers partially adopt the technology by applying only some of the components while objectively leaving out others. Notably the relatively few previous SRI studies assume that farmers either adopt the whole package (the adopters) or none of the principles at all (the non-adopters), which underscores the role of omitted components and hence bias the impact conclusions of the technology. Understanding the drivers of such sub-optimal adoption choices of climate-friendly and yield-enhancing technologies by farmers and its welfare implication is relevant. This study is proposes to assess the determinants of partial adoption and its impact implications on yield and farm profit among rice farmers in Morogoro region of Tanzania using a unique panel data. We intend to build on the previously collected data set from the same farmers to gather additional information on the adoption choices and trends, but also build up a panel data set for a relatively cleaner identification strategy of the impact of SRI.

**Land Certification and Conflicts in the Highlands of Ethiopia: Establishing the long run effects**

Haileselassie Medhin

Conflicts over land are crucial component of farmers welfare in Sub Saharan Africa. This is particularly relevant when individuals fare ore challenging environmental conditions. Lack of property rights is considered to be an important driver of these conflicts. This project will assess if land certification policy may play an important role in reducing disputes. We will use both existing data and a new round of the Sustainable Land Management survey. Of particular interest will be to investigate both the short run and the long run implication of tenure security. The long-term impact of land certification on other important outcomes (e.g. farm investments, tree planting) will be also analyzed.

## **Sustainable Energy Transitions Initiative (SETI)**

Subhrendu Pattanayak

**Problem:** Energy is the golden thread that connects economic growth, social equity and environmental sustainability. For example, improved cookstoves have the potential to deliver household health benefits and time savings, improve local forests and air quality, and reduce emissions of greenhouse gasses and pollutants. Unfortunately, billions of households have not made the transition to sustainable and clean energy sources. We contend that this stems partly from inadequate knowledge and use of research on the economics of energy transitions – tradeoffs, drivers, and incentives. The existing literature is thin, weak and scattered, making it difficult to overcome this ignorance trap – i.e., there is simply too little applied research on energy transitions in poor countries by underserved and under-represented scholars. **Objectives:** We propose to address this problem by (i) taking stock (reviews) of the drivers and impacts of energy transitions; b) testing hypotheses (organizing a coherent strategy of experimentation and statistical analyses); c) generating global public goods (of knowledge and policy advice), and d) building a vibrant community of SETI scholars.

**Plan of Action:** The overarching philosophy behind this first phase of SETI is that the totality of coordinated contributions is much greater than the sum of those parts and that coordination requires regular interaction. Therefore, first, we will meet regularly, for 2-3 days at a time. Second, we will provide incentives for sub-groups to produce a) reviews and syntheses of existing evidence; and b) robust methods aimed at unifying the applied economics research on household energy transitions. Finally, we will actively engage with local and global stakeholders to define our research agenda around contextspecific needs as well as to communicate final results in accessible and policy-relevant formats. **Outcomes:** In the short run we will write a white paper (potentially publishable) on research needs for economics of energy transitions. In the medium term, we will produce an edited book and a journal special issue. Our ultimate goal is to develop a funding proposal that allows us to recruit a critical mass of scholars and sustain a center-without-walls on sustainable energy transitions in the developing world.

### **How resilient are social ecological systems in the face of climate change? Evidence from rural drinking water in Central America**

Roger Madrigal

Around 23,000 community-based drinking water organizations (CWO) provide water up to 60% of people living in rural and peri-urban areas Central America, playing a key role in poverty alleviation and citizens' participation in decision making processes. Despite this importance little is known about their vulnerability to climate change. Bridging this gap is important because drought events are expected to be more intense and prolonged in this region, with significant impacts on water suppliers. This proposal has multiple objectives, including: a) to determine the effect of institutional, climatic and environmental variables (and their interactions) on the performance and resilience of CWO in dry regions; b) to identify the role of the socioeconomic attributes of communities, as they interact with climatic and environmental conditions on the emergence of successful governance structures for water management at the local level; c) to provide policy recommendations to improve the capacity of CWO to perform under future climatic events. We will use existing survey-based data containing institutional characteristics from 160 CWOs in Guatemala, Nicaragua and Costa Rica. This information also includes 7,000 household surveys administered in 2014 and 2015 to customers served by these organizations (including evaluations about the performance or reliability of water providers). In addition, we will gather census and GIS data containing information about population density, land uses, temperature, precipitation, altitude and other relevant information. With these data we will explore different econometric models to achieve the objectives of this proposal. One journal article and a policy brief produced. We will also disseminate results in a local workshop with policy makers, and at international conferences, among other appropriate means. In addition, the collaboration between scholars from EfD-CA and Duke University will enhance efforts towards capacity building and new research endeavors.

### **Short- and long-term effects of exogenously reducing water collection times on school attendance, hours studying and time use: Meru County, Kenya**

Joseph Cook

Although the time demands of resource collection work in rural areas have long been recognized, efforts to identify the socioeconomic impact of reducing these demands are relatively rare. Because of endogenous source choices and collection decisions, it is difficult to identify the impacts of reduced water collection times. We propose a randomized controlled trial to exogenously reduce water collection times in our field site in rural Meru County, Kenya and measure its impact on school attendance, hours spent studying for schoolaged children, and time use for the main primary water collector. We will reduce collection times in two different ways. First, we will compensate water vendors to deliver water to a randomly-chosen group of households during the worst two months of the dry season. These households will receive "coupons" to receive as much water as they told us they used in a summer 2013 survey, plus 20%. Because households may adjust differently knowing that the treatment is only short-lived, we propose to test "long" vs. "short"-term effects by giving a second, smaller, group of households a rainwater catchment system that should reduce collection times in all dry seasons in the immediate future. We will measure using a novel, custom-designed time use measurement app for smartphones that provides time use data without recall bias. We propose to observe households during August and September 2016, and to follow up with data collection during several weeks in the summer of 2017. Outcomes will include at least two peer-reviewed publications, an EfD policy brief, and presentation at the EfD Kenya's Policy Day. The project will build capacity by involving a current Economics PhD student at the University of Nairobi in all stages of the project.

**The contributions of natural and man-made green open space to property value in Durban, South Africa: a hedonic pricing study**

Jane Turpie

A hedonic valuation approach was used to estimate the value associated with different types of green open space within the city of Durban, South Africa. Data on a total of 16 157 properties that changed hands over a two year period from January 2012 to October 2014 were analysed in conjunction with spatial data on different types of natural open space including forests, woodlands, freshwater systems and grassland as well as man-made public parks and golf courses. The condition of the natural vegetation and aquatic systems was also considered. Sales prices were analysed in relation to the amount and condition of each type of green open space within three distances of each property, as well as sea views and a range of other property, local population and neighbourhood characteristics. The results revealed that both the type and condition of open space have very important influences on property prices, with well-managed natural open space areas attracting significant and positive price premiums and those in a degraded condition resulting in property discounts. Well-managed green open space accounted for about 2.5% of overall property value, or R5.5 billion, while public parks attracted premiums amounting to 8% of property value, or R18.2 billion. These values were mapped to the relevant green open space areas, and suggest that well-managed open space areas and parks within the urban edge have an average asset value of R1.1 million and R20.5 million per ha, respectively, and jointly account for about 5% of the municipal revenue generated by property taxes. As expected, the value of both types of open space areas was particularly high in wealthier neighbourhoods.

**The structure and level of entrance fee in Serengeti National Park in Tanzania**

Gerald Kibira

"Whereas most valuation studies have provided useful insights of protected areas and their benefit in developing countries, they have typically focused more on benefit sharing than on how the adjacent local community will benefit from wildlife conservation and also they have typically focused more on estimating consumer surplus rather than on evaluating user fees as a guide toward designing improved park pricing strategies which is the focus of this paper. Many of the visitors to protected areas, such as national parks, are foreign tourists who incur few of the costs but enjoy many of the benefits stemming from resource conservation efforts. Tourism revenues, rather than being earmarked for park maintenance or resource conservation efforts, are frequently merged with other sources of general revenues.

Funding conservation activities in the Serengeti is a big problem which requires revenue management by national park that will ensure sustainability of the social ecological system. Serengeti National Park is regarded as one of the major attraction to the foreign tourists. We applied a twist in the Contingent Behavior (CB) methodology in the context of a developing country, which has never been applied in literature. We find out that as the entrance fee increases tourists tend to switch to substitute park which is the Maasai Mara Game Reserve in Kenya and the demand is elastic. In reality, the park agency is inept to charge the revenue maximizing price because of the competition from other parks, both locally and regionally. Nevertheless, the fact that we found that the fees could be increased significantly over and above the current fees to maximize the revenue collection is important. "

## **Determinants of riverine households' land use decisions in the Peruvian Amazon**

Matías Piaggio

The Amazon rainforest covers approximately 60% of the Peruvian territory. It is an important spot for conservation, because it provides both local benefit through the provision of ecosystem services to near populations as well as global benefits. This paper analyzes the determinants of riverine households' land use decisions in the Nanay Basin. New settlers' dynamics in this area increased pressure in land use conversion from forest to agriculture in order to meet their self-consumption as well to get cash trading products at closer markets. We combined remote sensing tools with demographic and socioeconomic data from a household survey. The results show that the distance diminish the demand for clear lands in the market-oriented parcels (> 3ha.), while the opposite happens in the self-consumption parcels (<3 ha.). The first is explained by the cost increases jointly with the distance, while the second is a consequence of the lack of access to the market for buying goods. Also, market-oriented parcels are allocated in better quality soils that are mostly owned by local people that has been working as a local authority. This gives insights of the relevance of power and social position to access to more profitable land. Also, non-agricultural income sources looks to be reinvested in agriculture intensification, being related to higher clear land demand both in market-oriented and self-consumption parcels. Moreover, in both cases, protected areas inhibit the proportion of agricultural lands in the households' parcels. The role of local organizations and its implications in land use based interventions in similar contexts are discussed. The above has important implications for understanding how farmers make land-use decisions in the Peruvian Amazon, and how instruments can be designed for alleviating environmental pressure.

## **Spatially Explicit Global Meta-analysis of the Value of Forest Ecosystem Services**

Juha Siikamäki

The purpose of this study is to develop a spatially explicit meta-analysis and predictive model of forest ecosystem service values. Our approach is local in predictions, yet the geographic scope of the assessment is global. We first compile a comprehensive database of the value of non-wood forest ecosystem services, on a per unit areas basis, by deriving 282 comparable value estimates using information from 139 applicable studies. Then, we conduct separate meta-analyses to develop predictive models of the value of four key services: recreation, hunting, and fishing; non-wood forest products; water services; and habitat/species protection. Our key objective is to model local ecological and socioeconomic drivers of the value of forest ecosystem services to enable increasingly robust value predictions outside forests covered by the literature. We use cross-validation and out of sample prediction errors for model selection to further facilitate out-of-sample benefit transfers. We develop them globally by first dividing world's forests into 10 km by 10 km grid cells. Then, we use the meta-regression model results, in combination with local ecological and socioeconomic data, to predict the local value of forest ecosystem services in the four service classes considered. Our study produces the first wall-to-wall global map of estimated value of forest ecosystem services, as estimated using econometric analyses of global literature on the valuation of forest ecosystem services. We include data from a far greater number of studies than any previous forest valuation meta-analysis we are aware of. Moreover, no previous forest meta-analyses have developed spatially explicit value estimates at high resolution. Our results can support local, national, regional, and global assessments of forests ecosystem services and evaluation of different options for ecosystem management.

**The Improved Biomass Stove Saves Wood, but How Often Do People Use It?**

Randall Bluffstone

This paper uses a randomized experimental design and real-time electronic stove use monitors to evaluate the frequency with which villagers use improved biomass-burning Mirt injera cookstoves in rural Ethiopia. Understanding whether, how much, and why improved cookstoves are used is important, because use of the improved stove is a critical determinant of indoor air pollution reductions, and reduced greenhouse gas emissions due to lower fuelwood consumption. Confirming use is, for example, a critical aspect of crediting improved cookstoves' climate change benefits under the United Nations Reducing Emissions from Deforestation and Forest Degradation Programme. The paper finds that Ethiopian households in the study area do use the Mirt stove on a regular basis, taking into account regional differences in cooking patterns. In general, stove users also use their Mirt stoves more frequently over time. Giving the Mirt stove away for free and supporting community-level user networks are estimated to lead to more use. The study found no evidence, however, that stove recipients use the stoves more if they have to pay for them, a hypothesis that frequently arises in policy arenas and has also been examined in the literature.

**Deciphering rural households' biomass consumption patterns: evidence from Ethnic Minority region in western China**

Xiaojun Yang

Biomass plays an important role in providing residential energy services such as cooking and heating in many parts of the world. However, biomass consumption behaviour of rural households in developing countries remains poorly understood. Based on a first-hand survey data in two inland western Chinese provinces of Gansu and Yunnan where ethnic minority families are widely spread, this paper uses a Tobit model to examine the residential biomass consumption patterns of rural households. We find that coal is consistently a substitute to fuelwood for residential cooking and heating consumption for lower income rural families, whereas electricity turns out to be substitute to fuelwood only for households earning a higher income. Biogas is also found to strongly substitute for fuelwood across all household categories. However, little evidence supports that household income exerts a statistically significant influence on fuelwood demand, while a larger proportion of off-farm revenue significantly reduces household's demand for fuelwood, especially for the higher income group. Specifically, our results suggest that minority families are more likely to use biomass than Han-majority households. Furthermore, having a more aged head of household would generally imply a higher propensity to consume fuelwood than otherwise, reflecting a lifestyle pertaining to traditional values. It is argued that to achieve double dividend of poverty reduction and environmental quality in less developed western China, policy synergy needs to be harnessed through integrated rural development strategy by reconciling sustainable forestry management, clean bioenergy supply and energy efficiency, and rural development programs.

**Credit, LPG Stove Adoption and Charcoal Consumption in Tanzania**

Yonas Alem

A large proportion of households in urban Africa continue to use charcoal as their main source of cooking fuel even when their income increases. Using biomass fuels like charcoal has been documented to have enormous adverse impacts on forest and other biodiversity, health of household members, and the climate. One major factor which discourages households from switching to clean energy sources - as documented in the stove adoption literature - is the high start up cost of modern cooking appliances. We designed a randomised controlled trial to identify the impact of relaxing households' liquidity constraint and provision of access to a micro-finance loan on adoption of LPG stoves and on charcoal use in urban Tanzania. In collaboration with a local micro-finance institution, we randomly assigned households into a subsidy and credit treatment, which also includes three repayment arrangements (daily, weekly and monthly). We in general find that adoption of LPG reduces charcoal use by households significantly, however, provision of the stoves on credit has a much stronger impact on reduction of charcoal use. We highlight the importance of improving access to credit to urban households to encourage them to switch to clean energy sources and save the remaining forest resources of Africa.

**The Long-Run Effects of Subsidized Housing on Travel Behavior: Evidence from China's Housing Reform**

Zhongmin Wang

Many cities in developing countries are experiencing rapid urbanization along with deteriorating traffic congestion and air quality. A long-term approach to alleviating traffic congestion is to provide subsidized housing for the expanding population near employment centers. We exploit a sharp change in the eligibility for subsidized housing generated by China's market-oriented housing reforms to study the long-run effects of subsidized housing on commuting distance and automobile use and ownership in Beijing. Providing subsidized housing located close to the city center causes individuals to have substantially shorter commuting distances. Subsidized individuals are less likely to drive to work but have similar rates of automobile ownership. The results suggest that providing housing near employment centers can have long-lasting effects on commuting patterns and automobile use.

**Behavioral Patterns of Environmental Performance Evaluation Program**

Wanxin Li

This paper aims to map ten purposively selected environmental performance evaluation programs against the following four behavioral patterns in the form of diagnosis, negotiation, learning, and socialization and learning. Overall, we found that schemes which serve to diagnose environmental abnormalities are mainly externally imposed and have been developed as a result of technical debates concerning data sources, methodology and ranking criteria. In contrast, the socializing and learning classified evaluation schemes have incorporated dialogue, participation, and capacity building in program design. In conclusion we consider the 'fitness for purpose' of the various schemes, the merits of our analytical model and the future possibilities of fostering capacity building in the realm of wicked environmental challenges.

**Environmental Regulation and Firm Location Choice in China**

Min Wang

How environmental regulation may affect firm location choice? While this question has generated great research interest from high-standard, industrial economies, we in this paper turn the spotlight to low-standard, developing countries and use China's Census of Manufactures data during 2003-2008 to explore how firms with different ownership, during different policy regimes as well as from different industries may respond to environmental regulations in different ways. Results show environmental stringency has a positive effect on State-owned enterprises (SOEs)' location choice during 2003-2005, but the effect become insignificant during 2006-2008. Private-owned enterprises (POEs), Foreign-owned enterprises (FOEs) and Collective-owned enterprises (COEs) are more likely to enter areas with less stringent environmental regulations during 2003-2005. However, this pattern is reversed for the period of 2006-2008. Furthermore, the above relationships are more pronounced for firms in polluting industries.

**Effect of climate and weather variability on chronic poverty in Kenya**

Michael Ndwiga Jairo

This essay investigates the effect of climate and weather variability among other covariates on chronic poverty in Kenya. The essay used household panel data for five waves and combined it with climate data interpolated at household level. Transition matrices were used to analyze poverty dynamics and the Chamberlain random effects probit model to analyze the effect of climate and weather variability on chronic poverty. The results show that secondary and post-secondary education, off-farm income and climate variability reduces the likelihood of a household falling into chronic poverty while household heads that were divorced or widowed had higher chances of falling into chronic poverty. The results suggest the need to introduce social safety nets targeting household heads that are divorced or separated, design policies that enhance access to secondary and post-secondary education and promote off-farm employment opportunities. There is need to devise strong mitigating policies, gather, and disseminate climate information to households in order for them to make appropriate adaptation decisions.

**Economic Evaluation of Climatic Change Impacts on Water Resources at River Basin Scale: Insights from the Vergara River Basin – Chile.**

Felipe Vasquez Lavín

This study presents the main results of the “Economic Evaluation of Climatic Change Impacts on Water Resources at River Basin Scale”. We evaluate the economic consequences of climate change at river basin scale using a hydro-economic model, which includes two water demand sectors: residential and agricultural. This analysis is complemented with a social vulnerability analysis. According to our results, climate change will have modest impacts on the agricultural sector, with 1% income reduction but large distributional consequences across both farmers and activities. Nevertheless, urban households will face the largest share of the total impact, with losses 38 times larger than farmers. Additionally, subsistence agricultural communities, some of them with a strong presence of indigenous communities seem to be the most vulnerable groups to climate change impacts. This situation suggests large distributional consequences of climate change for the basin economy, increasing the vulnerability of its inhabitants.

**Weather Shocks and Spatial Market Efficiency: Evidence from Mozambique.**

Cesar Salazar

The aim of this paper is to study the association between weather shocks (droughts and floods) and agricultural market performance in Mozambique. To do so, we employ a dyadic regression analysis on monthly maize prices, transport costs and spatial identification of markets as well as droughts and flooded areas. Our estimates show that, while a drought reduces price differences between markets, price dispersion increases during flood periods, an effect that is mainly driven by increases in transport costs. Finally, floods are found to affect price differences more if markets are closer to each other and if the road infrastructure quality is poor.

**The Impact of Climate Change on Food Calorie production and Nutritional Poverty: Evidence from Kenya**

Jane Mariara

In this paper we investigate the effects of climate variables on food and nutrition security and the probability of a household being food and nutrition insecure. Panel data methods on three waves of the Tegemeo Institute Household survey data (2004, 2007 and 2010) are used. Climate change is measured by long term averages of the Standardised Precipitation-Evapotranspiration Index (SPEI), temperature and rainfall, all measured at the peak precipitation month. The results suggest non-linear effects of climate variables on kilocalories produced and the probability of being food and nutrition insecure. They further suggest that increased moisture is beneficial for kilocalorie production, but excess moisture will be harmful. Overall, the results portray the vulnerability of small holder farmers to climate change. Technology adoption and adaptation to climate change, as well as household/farm assets increase kilocalorie production and reduce the probability of being food and nutrition insecure. The results point at policies related to mitigation and adaptation to climate change, adoption of improved farming technologies, and improved market access.

### **State and Carbon Market - The Political Economy of Climate Finance Implementation and Effectiveness in the Least Developed Countries and Transition Economies**

Mark Purdon

One of the crucial questions for international climate change politics is whether market mechanisms or donor subsidies is the better overall strategy for scaling up the massive financial volumes necessary to unlock mitigation opportunities in the developing world. Despite a decade of experience with the Clean Development Mechanism (CDM) and other climate finance instruments, debate on this topic remains mired between opposing ideological camps. The polarization is abetted by a surprising lack of field-based empirical research, particularly into the fundamental issue of whether these instruments have been effective or not in driving emission reductions. The proposed book cuts through the noise by first presenting empirical findings from an unparalleled comparative evaluation, drawing on extensive 2009 fieldwork and analysis through 2012, of the effectiveness of the CDM to deliver real emission reductions from projects in Tanzania, Uganda and Moldova. Given the current crisis of international carbon markets, the book then contrasts the CDM experience with original research undertaken in 2013 and 2014 into the implementation of new climate finance initiatives in each country, reducing emissions from deforestation and forest degradation (REDD+) and nationally appropriate mitigation actions (NAMAs)—initiatives where donors currently play a lead role. At a time when there is great uncertainty about how the climate change regime complex will unfold, the book provides important insights into the conditions when market- or donor-led approaches are the more effective for achieving emission reductions and promoting sustainable low-carbon development.

At carbon prices fetched during the Kyoto Protocol's first commitment period, CDM projects were most effective when the state demonstrated a "liberal developmentalist" political economy orientation and was poised to engage with market mechanisms in the extension of existing state development initiatives. In Uganda and Moldova, such a combination of developmental and market interests was manifest in state agencies, though limited to economic sectors where the state perceived itself to have a comparative advantage. Adhering more to classic "developmentalism", the Tanzanian state was less inclined to engage with the CDM despite retaining the capacity to do so. Differences in state political economy also explain variation in the implementation of REDD+ and NAMAs, which have become largely donor-driven affairs as carbon prices have further dropped. A more donor-friendly country, Tanzania has provided more fertile terrain for these initiatives than Uganda and Moldova—though effectiveness in terms of emission reductions remains to be seen. My emphasis on domestic political economy does not mean that international factors are irrelevant. Because the price of carbon has never risen high enough to serve as the sole basis for CDM projects, the instrument has been effective only under a much narrower range of conditions than anticipated, while the current drop in carbon prices have prompted donors to play a larger role in REDD+/NAMAs. With practical implications for climate policy by identifying a constructive role for the state in low-carbon development, the book also makes an important contribution to the emerging field of comparative environmental politics and endeavors to integrate theories of domestic and international politics.

### **How does the payment schedule affect the willingness-to-pay for new technologies? Experimental evidence on solar lamps in rural Rwanda**

Jörg Peters

The goal of the United Nations Sustainable Energy for All (SE4All) initiative is to reach universal energy access by 2030. As an alternative to investment intensive on-grid electrification, small solar technologies exist that target single households with low energy consumption. In this paper, we examine households' willingness-to-pay (WTP) for such solar technologies and the effect different payment schedules have on this WTP. Using the incentive-compatible Becker-DeGroot-Marschak method with a real purchase offer we elicit the WTP of 325 rural Rwandan households for three different solar technologies, i.e. a lamp, a lamp including a cell phone charger and a full-fledged 20 W solar home system. In addition, we randomly assign three different payment schedules to the surveyed households: a payment period of one week, six weeks and five months. In order to account for further heterogeneity and drivers of WTP, we administer a socio-economic questionnaire including measures for risk aversion, consumer resistance, present bias, and liquidity constraints. Our work contributes to the academic literature on technology adoption and the role of credit constraints. On the policy level, we contribute to the debate about whether SE4All can expect the poor to pay cost-covering prices for off-grid technologies or whether subsidies are required.

### **One child policy and preferences for cooperation and trust**

Peter Martinsson

In this paper we investigate the role of China's One-Child Policy on people's behavior. In 1979, the law was introduced that most parents were allowed to have one child only, and the law was further tightened in the following years. By selecting people born the years before and after the introduction of the One-Child Policy, we focus on how people are affected by growing up in a world where nobody from one's own age group has siblings. By using economic experiments we specifically investigate if preferences for cooperation, trust, discounting and risk differ between people born before and after the reform. After discussion our empirical results, we discuss broader implications of our findings.

## **Triggering cooperation**

Haileselassie Medhin

We propose and experimentally test for the relevance of voluntary participation in the form of opt-out option as a policy tool that could potentially trigger the establishment of cooperative institutions after devolution of forest rights to community members. The basic idea is that community members choose between joining a (devolved) forest user group or an opt-out option. The opt-out option provides some benefits to those who choose it, but potential benefit is higher if one joins a forest user group, provided that there is cooperation among the users. By framing the social dilemma game after devolution as a multiplayer prisoner's dilemma game, we hypothesize that that such an opt-out options could serve as a coordination tool in the presence of social preferences and forward induction. We conduct a lab-in-the-field experiment in Ethiopia to test this. Our results show that, not only do most people reject opt-out options that provide a significant amount of money to play the game (i.e., join a forest user group), the level of cooperation is higher among those who reject opt-out options than those who were not offered an opt-out option. Opt-out options can therefore serve as cheap policy tools to institute cooperation among forest user groups after devolution reforms.

**The Net Emissions Impact of HFC-23 Projects from the Clean Development Mechanism**

Clayton Munnings

Ideally, carbon offsetting programs issue each project a number of offset credits equal to the number of reductions in carbon emissions it achieves. Realistically, any one project likely receives more or less offset credits than the emissions it reduces. In this paper, we provide the first empirical and comprehensive quantifications of the net emissions impact of a type of offset project that has traditionally dominated the supply of credits within the Clean Development Mechanism (CDM): hydrofluorocarbon-23 (HFC-23) projects. We base our empirical quantifications on a preexisting analytical carbon offsets model that differentiates between credited offsets and realized emissions reductions. We extend this model and use this extension to empirically quantify the impact of two economic phenomena that lead to overcrediting of offset projects: moral hazard and adverse selection. In addition, we account for aspects of CDM methodologies for HFC-23 projects that lead to undercrediting, including conservative approaches to assigning emissions baselines. We estimate under a variety of scenarios and cases that CDM HFC-23 projects have resulted in emissions impacts ranging from a 147 MMTCO<sub>2</sub>e -net emissions increase to a 555 MMTCO<sub>2</sub>e net emissions reduction between 2006 and 2013. We also find it likely that the supply of undercredited emissions reductions equals the supply of overcredited offsets, meaning that CDM HFC-23 credits maintain their environmental integrity on average. This finding suggests that critiques regarding the environmental integrity of CDM HFC-23 projects that have inspired regulators in Europe and New Zealand to ban offset credits associated with these projects should be revisited. Given that HFC-23 emissions are expected to substantially increase in developing countries, especially China, over the next decade—despite efforts under the Kyoto Protocol and Montreal Protocol—we explore whether there is a role for expanded use of HFC-23 offsets. We conclude by exploring offset designs that might further encourage undercrediting of HFC-23 carbon offset projects, as well as policy alternatives—such as direct financing—that might replace carbon offsetting.

**Biofuel Investments and Implications for the Environment in Ethiopia: An Economy-wide Analysis**

Zenebe Gebreegiabher

Biofuels production has received increasing focus by developed and developing countries due to rising fossil fuel prices and the need to mitigate greenhouse gas emissions. The net economic and environmental impacts of these biofuel programs have become an important question of public policy. In particular, the anticipation that biofuels may have a lower environmental footprint than fossil fuels is one of the important drivers. This study investigates the economy-wide impact of biofuels investment in Ethiopia with the focus on greenhouse gas (GHG) emissions and the forest sector. In order to capture the intersectoral linkages between biofuels, crops, and livestock as well as energy activities, this study uses a recursive dynamic computable general equilibrium model calibrated on the revised version of the 2005/06 SAM that includes GHG emissions, energy and forestry products. The results suggest that an increase in biofuel investments would lead to an increase in GHG emissions, although the effects varied by biofuel crop/feedstock types. These results have important implications for policies related to mitigation of climate change as well as forestry.

**Economic and Environmental Implications of Raising China's Emission Standard for Thermal Power Plants: An environmentally extended CGE Model-Based Analysis**

Yu Liu

Thermal power plants are considered as the main source of atmospheric pollutants in China due to their massive emissions of sulfur dioxide (SO<sub>2</sub>) and nitric oxide (NOX). In order to enhance the environmental protection, the Ministry of Environmental Protection of China has recently introduced a new emission standard of atmospheric pollutants for thermal power plants. However, it is still unclear to what extent the new emission standard may impact on China's environment and economy. In this study we apply an environmentally extended Computable General Equilibrium (CGE) model to assess environmental and economic impacts of the new emission standard. Our results show that imposing the new standard may lead to a reduction in SO<sub>2</sub> and NOX emissions by 22.8% and 11.4% respectively, with the absolute amounts being reduced by 5597.3 and 1482.3 thousand tons. This is the result of improvement of the emission removal rate and the sharp decline of the coal consumption. On the other hand, the new emission standard may cause about 0.2% loss of GDP in the target year. In terms of changes in prices and domestic demand structure, the new policy can make contribution to curbing inflation, with the consumption demand reduced. Besides, due to the decreasing price of labor and capital, the new standard also leads to the output increase for industrial sector, and the depreciation of domestic currency would drive the export-oriented industries to expand.

## **Environmental and Economic Effects of Improved Auto Fuel Economy Standard in China: A CGE Analysis**

Qing Liu

"Based on the combination of computable general equilibrium theory and CHINAGEM model, the relevant empirical research on the economic effect and pollutants reductions of limits and measurement methods for vehicle emissions' raise can be shown accurately, along with the updated original economic database and an added database of environmental pollutants quantities. With the adjustment of production tax on the two industries--petrol refine and motor vehicle manufacture, and different shocks on the remove rate of 5 kinds of pollutants (i.e. sulfur dioxide, nitric oxide, smoke, dust and carbon dioxide), the influence on emissions' reductions can be viewed directly.

From the economic analysis, the cost of labor and the trade condition is improved while China's GDP is a little restricted from the improved standard. The emission reductions of sulfur dioxide, nitric oxide, smoke, dust and carbon dioxide are 8.11%(609.2 thousand tons), 5.14%(1537.5 thousand tons), 12.28%(3660.3 thousand tons), 0.96%(181.6 thousand tons)and 1.62%(6090.5 thousand tons).

Besides, 72 industries' developments will be restrained because of the new standards such like construction industry while the other 63 ones such as textile industry may get benefits. Apart from that, the implementation of the new standards may stimulate the replacement of imported motor vehicles to domestic ones which may lead to the decline in domestic motor vehicles production. Along with the strict standards of vehicle emissions and the decrease of vehicle production growth, the air pollution problem in China will be eased at some extent according to this study".

**Crop diversification and child health: Empirical evidence from Tanzania**

Marcella Veronesi

Malnutrition is recognized as a major issue among low-income households in developing countries with long-term implications for economic development. Recently, crop diversification has been recognized as a strategy to improve nutrition and health, and as a risk coping strategy used by farmers in the face of climate change. However, there is no systematic empirical evidence on the role played by crop diversification in improving human health. We use the Tanzania National Panel Survey to investigate the effects of crop diversification on child health. We use fixed effects panel estimation to control for unobserved heterogeneity, and perform several robustness checks including placebo tests to test the validity of our findings. We find a positive and significant effect of crop diversification on long-term child nutritional status, in particular for very young children and children living in households with limited market access.

**Detecting Potential Endogeneity in Households' Decisions to Participate in China's Large Ecological Restoration Program and Reallocate Their Labour Times**

Runsheng Yin

Studies have assessed the socioeconomic impacts of China's largest payments for ecosystem services initiative—the Sloping Land Conversion Program—over the last decade. However, few have addressed the question of whether there is endogenous selection in farmers' decisions to participate and reallocate their labour time. If households have the full freedom to select, their decisions to participate and/or to seek more off-farm jobs could become endogenous, induced by the participating subsidies and earnings from off-farming opportunities. The goal of this paper is to fill this knowledge gap by testing possible endogeneity as reflected in the likelihood and extent of both program participation and labor transfer. Using appropriate testing procedures, instrumental variables, and a panel dataset of more than 1,000 households in western China over 11 years (1998-2008), we reject the hypothesis that there is a significant endogeneity bias in households' decision to participate in the program and generate farming income, but endogenous choice was found in household behavior of generating off-farm income, making the impact of off-farm labor time on income enhanced but the effect of program participation no longer significant. Therefore, it remains valid to use a conventional model to estimate the impacts of program participation as reflected in employment and farming income—without the need to consider possible endogeneity. At the same time, it is essential to remove the endogeneity in assessing the determinants of household off-farm income.

**Risk, ambiguity preferences and adaptation practices: A study with coffee farmers in Costa Rica**

Maria Angelica Naranjo

Farmers in rural areas of developing countries face risky decisions every day (e.g. climate variability and implementation of farm practices), and these individual risky decisions have a remarkable effect on wealth. Understanding the impact of climate change and identification of adaptation strategies is therefore vital. In this paper, we investigate the implications of risk and ambiguity attitudes on the choice of different adaptation strategies. Our empirical research is set in coffee farming areas in Costa Rica. In 2012, coffee leaf rust broke out in Central America with severe consequences for production and farmers' income. Our preliminary results showed risk and ambiguity attitudes explain differently adaptation practices ex-ante and ex-post. We have some evidence at ex-ante practices, that risk aversion decrease the used of fertilizer. This is in line with previous research, where risk aversion provides a disincentive to invest. In contrast, risk-seeking farmers significantly increase pest control applications. We believe this result has to do with some tactic in the implementation of practices. When looking at the ex-post practices, we see both risk and ambiguity attitudes significantly increase farm level practices. On one hand, risk and ambiguity averse farmers significantly increase the use of pest control. On the other hand, risk and ambiguity seeking farmers increase fertilizer applications.

**Selling now or later; Paddy or Rice? Roles of risk, ambiguity, and time preferences in rice farmers' marketing decisions**

Remidius Ruhinduka

In this study, we carry out experiments to measure risk, ambiguity, and time preferences of Tanzanian rice farmers and use the results to explain actual field behavior. In particular, we look into previously unexplored post-harvest decisions of farmers, i.e., whether to sell paddy (unprocessed) or processed rice and whether to sell the harvest immediately or store it for future sale. Processing and storing rice implies processing costs, price uncertainties, and a delay in income. Our results show that estimated risk and time preferences predict farmers' field behavior. Impatient farmers are less likely to store paddy, and risk-averse farmers are less likely both to process and to store paddy for future sales. These results imply that there is scope for improving rice farmers' welfare substantially by addressing the uncertainties and problems associated with rice processing and storage.

### **How Traffic Jams Affect Air Quality?--Analysis of the Nonlinear Relationship between Traffic Congestion and Air Pollution in Beijing**

Shuai Chen

Beijing's government has taken a package of policy measures to curb congestion also as part of the capital's efforts to improve air quality. However, due to both the complex relationships among vehicle emissions, congestion and air pollution and inaccessibility of Chinese data, there is little evidence that how vehicle traffic ease affects air quality. By exploiting a rich data of hourly air quality and traffic congestion index from 2013 to 2014 in Beijing, this paper estimates the link between traffic congestion and air pollution, utilizing the exogenous variation in license plate numbers introduced by one-day-per-week driving restriction policy to control for reverse causality. We find that: (i) traffic congestion has a significant influence over air pollutants in Beijing: a 10 percent increase in traffic congestion level will result in an average increase of PM2.5 by 6.13%, CO by 6.6%, NO2 by 3.7% and PM10 by 6.4%, respectively; (ii) ground vehicle traffic has contributed to 39.8% of the deteriorating air quality, and in particular for CO and PM2.5, 41.42% and 38.37% of which are caused by vehicle traffic; (iii) there exist nonlinear and U-shaped relationships between traffic congestion and air pollutants, indicating the damages is becoming more severe as traffic jams accumulate. Our findings are quite robust to different tests.

### **Pull Is Not Enough: Effects of Subway Expansion on Traffic Conditions ----Evidence from Beijing**

Jun Yang

To alleviate traffic congestion, one of the most pressing urban challenges in developing countries, Beijing's government has been investing increasingly in subway infrastructure. In this study, using fine-scale daily traffic records from 2009 to 2013, we perform a regression discontinuity design to examine the average treatment effects of subway opening on traffic conditions in Beijing from 2009 to 2013. Three findings emerge from our empirical analysis. First, opening of a new subway line resulted in a significant decline of daily passenger bus ridership, by 452,400 on average. Second, there was a significant positive impact on subway passenger ridership, with an average increase of daily passenger ridership by 246,300 after the opening of each new subway line. Third, we did not find any significant impact of new subway lines opening on the traffic congestion index, indicating that new subway opening has not effectively alleviated the traffic congestion in Beijing. Our results are quite robust to different tests. Our findings imply that subway construction might make it possible that car users give up vehicles and shift to subway; however, this "pull" strategy alone is not enough to make this happen.

### **Optimal Environmental Road Pricing and Integrated Daily Commuting Patterns**

Xiao-Bing Zhang

The time of day at which a specific emission takes place is very important for its impact on local air quality. Although road pricing can directly reduce traffic flows, improving air quality depends on the effect of the pricing on vehicle emissions as well as on pollution dispersion. This paper investigates the effect that a time-varying charge might have on the morning and evening commute patterns. For that purpose, we develop an ecological economics model of road pricing that takes account the effects of the charges on both morning and evening commutes and driving decisions. We characterize the optimal road charge when pollution dispersion varies throughout the day and analyze its effects on traffic flows, departure time and the number of commuters by car.

### **The Effect of Owning a Car on Travel Behavior: Evidence from the Beijing Lottery**

Antung Anthony Liu

Countries considering vehicle restriction policies have been concerned about labor market consequences: prior work has found that cars can lower the cost of the commute and expand the set of job opportunities. However, many of these prior studies were limited by the endogeneity of the car purchase decision. We overcome these endogeneity concerns by leveraging a unique instrument: the Beijing vehicle lottery. We find that vehicle ownership does not have a statistically significant or economically large effect on total travel distance and travel time. However, obtaining a car has a large and statistically significant effect on car use. The implication is that the cost of restricting cars is far lower than previously believed.

**Water source decisions in rural Kenya**

Joseph Cook

We add to the relatively thin literature on how households choose water sources using unique data from 384 households in rural Meru County, Kenya. We find the volumetric price and distance to the water source are important predictors of source choice, though self-reported attributes of the source were not. These include the reliability of the source, health risk from drinking water from the source, taste of the source, and likelihood of using the source causing conflict. Our estimates imply a value of travel time of approximately 7 Kenyan shillings per hour, or 25% of unskilled wages. These estimates are broadly consistent but somewhat lower than estimates from a companion paper examining results from a stated preference experiment. We use results to simulate the probability that a household will use a source when user fees or distance change.

**Are mussel seed collectors responsive to economic incentives? Empirical evidence from Benthic Resource Management Areas in Chile.**

Jorge David Dresdner

We specify a model to analyze the participation and supply decisions of coastal producers working in mussel seed uptake activities. We specify empirically and estimate the model for a sample of artisanal fishermen in Southern Chile, using a panel data set between 2008 and 2013. This period presents great changes in producer engagement and supplied quantities. The results suggest that temporal changes in supply are mainly explained by price, cost, and contract variables. Moreover, the socioeconomic variables help to explain differences between different producer groups. We conclude that seed uptake activity is heavily dependent on the development of other links of the market chain, so policies aiming to promote the previous activity should consider the interdependence between markets.

**Collective rights in artisanal fisheries and the trade-offs in fisheries policies: An analysis of distributive policies**

Walter Gomez

This research analyzes the potential effects that a redistributive fish quota policy has on the profits and employment of the artisanal fisher organizations. We use a multi-objective programming model and apply it to the common sardine and anchovies fisheries in the Biobío Region for year 2011. The results indicate the presence of trade-offs between the equity – profits and equity – employment objectives. Moreover, the results suggest the existence of widespread inefficiencies in the effort allocation within the organizations, independently of the weight given to the different objectives.

**Does the Water Spill Over? Spillover Effects from a Social Information Campaign**

Marcella Jaime Torres

We investigate whether a social information campaign aimed at reducing water use causes a spillover effect on the use of electricity. On average, water use decreased by 6% for a treatment group for whom we conducted a social information campaign on their use of water, compared with that of a control group. We identify a further spillover effect on electricity usage among households that had efficient use of water before the campaign. The effect is sizeable; this group has almost 9% lower use of electricity after the campaign compared with the control group. We argue that this is consistent with a model of cognitive dissonance where, before the campaign, the individual held the belief that the moral costs/benefits of consumption are not important despite being an efficient consumer. Due to the campaign, this belief is changed and there is a spillover effect on electricity use.

**Economic modeling of welfare gains from resource recovery from fecal waste**

Yusuke Kuwayama

In this paper, we focus on a set of technologies, collectively referred to as the “Omni-Processor,” that treat fecal sludge to eliminate pathogens and recover valuable resources such as electricity, biodiesel, compost, or fertilizer. Resource recovery may generate revenue that can narrow the gap between the private and social net benefits of wastewater treatment, thus making it more likely for local governments and private entities to invest in these technologies. We develop economic models that characterize how adoption of the Omni-Processor can affect the difference between private and social net benefits and derive analytical results that describe the optimal relationship between technology deployment and parameter values of the economic model. We also explore how government policies can be designed to account for Omni-Processor adoption in such a way as to maximize both private and social benefits. We pay special attention to technologies that can concurrently process non-fecal organic waste, which typically has higher resource content than fecal waste but does not carry as serious of a pathogen concern.

**Will Shale Gas Reduce Carbon Emissions from China?**

Carolyn Fischer

According to the Energy Information Administration, China has the largest shale gas reserves in the world, larger than the United States. While the US has begun an aggressive extraction of its shale gas using new fracking techniques, China has not. In this paper we develop a partial equilibrium model of world energy markets to examine the effects of ambitious shale gas extraction in China. The model incorporates demand growth by major sectors in China, North America, and the rest of the world, and the regional supplies of fossil fuels, as well as nuclear and renewables, projected to 2030. We compare the effects of three energy strategies: a target of meeting 25% of energy demand with gas by 2030, a target on the minimum use share of renewables in total energy consumption should steadily increase to 25% in 2030, and a target of reducing cumulative emissions by 15% from the baseline by 2030. Our preliminary results show that the expansion of shale gas drives up Chinese carbon emissions. Carbon target emissions is met by the development of renewable energy.

**Assessment of the Potential Biomass Supply from Crop Residues in China**

Xiaoguang Chen

Using a mathematical programming model, we estimated the potential biomass supply from crop residues in China at various exogenously-given biomass prices and identified the areas that are likely to produce crop residues. Our analysis indicated that China can potentially produce about 153.0-244.2 million dry metric tons of crop residues per year when biomass prices are larger than \$90 per metric ton. Rice straw is expected to account for about 47% of total residue production across the different biomass prices and residue production scenarios that we considered. Corn stover and wheat straw contribute 28% and 25%, respectively, to total biomass production in China.

**Top-down or Bottom-up? Preferences for Management of Marine Protection Areas**

Sahan Dissanayake

The marine environment of Okinawa, which consists of a large number of coral reefs, provides many ecosystem services such as free recreational opportunities, coastal protection, and habitat for fish and other marine species. The environmental, economic, and social well-being of Okinawa depends on the marine environment's ability to provide a full range of these services. However, the Okinawan marine ecosystem faces a number of threats due to climate change and increasing pressures from human activity. A potential solution is to establish protected areas, though there is a lack of consensus on what is the best management structure (i.e. top-down versus bottom-up) to use for such protected areas. We use a choice experiment survey to estimate the willingness to pay and preferences of residents for establishing protected areas in Okinawa for two distinct management structures: top-down and bottom-up. Additionally, we also evaluate how the value of and preferences for key characteristics provided by the marine environment of Okinawa vary among different stakeholders: residents and tourists. Our results show that residents who believe that marine protection will be identified and implemented through local organizations (bottom-up) have a higher willingness to pay for such protection in Okinawa compared to protected areas implemented through the central government (top down) when the protection targets increase in leisure fish catch or restrictions on coastal development. Similarly, tourists also value placing restrictions on coastal development. On the other hand, marine protection policy that primarily targets conservation of coral coverage and marine biodiversity finds support from tourists as well as residents, irrespective of the management structure used for design and implementation of the marine protected area.

**A Bioeconomic Model of Community Wildlife Conservation in Zimbabwe**

Herbert Ntuli

This paper uses a bio-economic model to analyze wildlife conservation in two habitats adjacent to a national park by two types of communities in the context of Southern Africa. One community is made up of peasant farmers operating under a benefit-sharing scheme (CAMPFIRE) while the other is made up of commercial farmers practising game farming in a conservancy (the Save Valley Conservancy). Both communities exploit wildlife by selling hunting licenses to foreign hunters but with different levels of success. The park agency plays a central role by authorizing the harvest quota for each community. We formulate a bio-economic model for the three agents and optimize the market problem for each agent and compare the outcomes with the social planner's solution. Our results show that the level of anti-poaching enforcement by the park agency is suboptimal while anti-poaching effort exerted by the conservancy community achieves social optimality. CAMPFIRE communities exert more poaching effort than what the social planner would recommend. Our model shows that an improvement in community institutions might have a significant impact on growth of the wildlife stock through their role in constraining behaviour. Thus, institutional reforms in benefit-sharing schemes such as CAMPFIRE could see the local community behaving like the game farming communities such as the one in the Save Valley Conservancy.

**Marine Protected Areas in Lower Income Countries: Labor Allocation and Location Decisions, Incomplete Enforcement, and Access Restrictions**

Heidi J Albers

Widespread increases in Marine Protected Areas (MPAs) in lower-income countries rarely derive from insights in the resource economics literature in part because that literature does not incorporate key characteristics of these settings such as labor allocation decisions, incomplete enforcement, and MPAs beyond no-take zones. This paper develops a spatial bio-economic model of a fishery with a village of people who allocate their labor between fishing and off-sea wage opportunities to establish a spatial Nash equilibrium at a steady state fish stock. Villagers' fishing location decisions are based on distance costs, fishing returns, and wages. Motivated by issues of central importance in Tanzania and Costa Rica, this analysis explores the impact of location specific no-take zones with complete and incomplete enforcement, increasing off-sea wages, and restricting access to a subset of villagers on fish stocks, yield, and rural incomes. The optimal location of the MPA depends on the manager's objective function's emphasis on local people, the interaction of biological and economic parameters, and the budget for enforcement.

**Time and risk preferences and adaptation to climate change**

Francisco Alpizar

Our work contributes to the understanding of individual decision-making with regards to their adaptation to climate change by studying a rural population in the western, arid part of Costa Rica. We apply recent developments in behavioral economics research to design an artefactual field experiment that elicits time and risk preferences. Since some investments in adaptation measures are decided by households, we elicit preferences for both individuals and couples. We connect the variation in these preferences to variation in two adaptation measures: investment in private water tanks and savings. Moreover, we explore the implications of the estimated values of risk aversion, probability weights and the discounting function on the design of policies aimed at promoting greater investments in adaptation among at-risk populations. Preliminary results suggest that while a small group of people considers probabilities objectively, the majority of the sample overweighs the probability of occurrence of the better outcomes; as a result they appear (overly) optimistic. Moreover, the same is generally true for the responses given by couples, both real and “fake”. We find small statistically significant differences between individuals and couples. Contrasting the behavior of real couples with the decisions made by the respective spouses individually, we observe that they are less optimistic and less risk averse when responding as a couple. In contrast, “fake” couples exhibit only a reduction in optimism but not in risk aversion, compared to their respective individual responses.

**Poverty Impact of Salmon Growth Centers in Los Lagos’s Region in Chile**

Miguel Quiroga

This study evaluates the impact on poverty produced by the establishment of salmon aquaculture in rural localities of Los Lagos region in Chile in the period 1992 - 2002. For doing this, it employs an impact evaluation methodology. This study is concentrated in a period characterized by high investment in new sites and fast growth in salmon harvest and employment. At the best of our knowledge, it is the first study that intend to quantify the impact of salmon aquaculture on poverty. This study provides evidence that the development of salmon aquaculture did not have any effect on the poverty situation of families in rural localities in Los Lagos region in southern Chile.

**Uncertain Penalties and Compliance**

Carlos Chavez

Using a series of laboratory economic experiments, we study the effect of information regarding the amount of the penalty on the individual decision to violate an emission standard, under two regulatory schemes: one in which the regulator induces perfect compliance and another one in which it does not. Our results suggest that in the case of a regulation design that induces compliance, the presence of uncertainty regarding the amount of the penalty may increase violations in certain cases. When enforcement is not sufficient to induce compliance, the uncertainty regarding the amount of the penalty does not have any effect on the level of transgression. Overall, the results suggest that a cost-effective regulation design should consider including public information on the consequences of an offense.

### **Benefit access and the status of forest health under joint forest management regime in Kenya: community perspective analysis**

Paul Guthiga

"Forest reforms in Kenya that started in 2007 after the enactment of the Forests Act of 2005 ushered in a new era of joint forest management. The reforms allowed local communities to form Community Forest Associations (CFAs) through which they can seek to jointly manage forest with the Kenya Forestry Service upon developing a joint forest management plan. Since the reforms, many CFAs have been formed and local communities in various forest areas have been involved in forest management. A thin body of literature has begun to develop on joint forest management in Kenya particularly on the dynamics of CFA formations; challenges, factors influencing community participation etc. However, literature on community perceptions on the benefit access and changes in forest health status in the post-reform period is rather scarce. This study contributes to knowledge on local community perspectives on the implementation of forest reforms in Kenya and the developing countries in general. The study used primary data collected from a sample of 642 households spread across 5 forests in different regions of the country as follows; Coastal region (Arabuko Sokoke Forest), Central region (Mt. Kenya Forest), Rift Valley region (Mau forest), Western region (Kakamega Forest) and Nyanza region (Kodera Forest).

### **Forest commons, rural saving and investment: Evidence from Ethiopian villages**

Dambala Gelo Kutela

In this paper, we evaluate the impact of Joint Forest Management (JFM) on precautionary saving, investment in child education and participation in off-farm self-employment activities among forest-using households in Ethiopia. We instrumented endogenous program participation by exogenous variation in customary rights experience within communities eligible for the JFM intervention. We also employed alternative identification strategies, including propensity score matching and difference-in-difference (DID) to test the robustness of our results. The analysis was based on the data collected from selected villages in the Gimbo district, in south-western Ethiopia. Our results show strong evidence that participation in the program deters livestock asset holding, suggesting a decrease in demand for precautionary saving. Moreover, we found that the program has spurred investment in child education and participation in off-farm self-employment. Policy implications discussed.

### **Collective Forest Tenure Reform in China: Implications for Allocative Efficiency**

Yuanyuan Yi

This draft uses the unique panel data from 600 households in Fujian province over two rounds survey in 2005 and 2010 to examine the effect of China's collective forest tenure reform on allocative efficiency among farmer households. While the existing literature mainly focuses on arable land, this study contributes to the literature with a brand new piece of empirical evidence from forest land. Forest land distinguishes from arable land in the following: forest land is less labor intensive, requires longer term for returns realization, and as common pool resources demands stronger effort in building local forestland tenure institutions to cope with insecurity concerns. The forest land reallocation effect of the reform is expected to improve allocative efficiency through improved access to credit, mobilized labor allocation decisions, reduced transaction costs, and increased participation in forestland rental markets. And its effect on improvement of equity is believed to be achieved by transferring forest land from households with less labor and more forestland to households with more labor and less forestland, its effect on improvement of efficiency is through more equalized household's forestland-labor ratio, by transferring forest land from households with lower ability to those with higher ability in managing forest land.

### **Does Eco-certification Stem Tropical Deforestation? Forest Stewardship Council Certification in Mexico**

Allen Blackman

Since its creation more than two decades ago as a voluntary market-based approach to improving forest management, forest certification has proliferated rapidly in developing countries. Yet we know little about whether and under what conditions it affects deforestation. We use rich forest management unit-level panel data - including information on deforestation, certification, regulatory permitting, and geophysical and socioeconomic land characteristics - along with matched fixed effects models to identify the effect of Forest Stewardship Council (FSC) certification on deforestation in Mexico, the country with the third-highest number of FSC certifications in the developing world. We test for a variety of different temporal and subgroup effects but are unable to reject the null hypothesis that certification does not affect deforestation. Although these results do not indicate that FSC certification has no effect on forest management, they do suggest that its impact on deforestation may be limited. The study builds on existing literature that draws on community perspectives in understanding dynamics of management of the common resources. An ordered probit was applied to analyse the factors that shaped perceptions on benefit access and forest health. The study found that perceptions of these two aspects are shaped by: participation in community forest governance, household wealth, trust levels, previous access to forest benefits, management agency of the neighbouring forest, education and age, and forest area (location). The study uses the findings to draw policy implications that could inform the next phase of forest reforms in Kenya that is already underway.

### **Determinants of Adoption and Impacts of Sustainable Land Management Practices: Panel Data Evidence from the Ethiopian Highlands**

Abebe Beyene

This paper analyze the factors affecting sustainable land management practices (SLMPs) using two rounds of survey data collected from the North Western part of Ethiopia. Spatial climate data (rainfall and temperature) used in combination with household and parcel level data. We use a multinomial endogenous switching regression model to understand the impacts of SLM practices on crop net revenue. We have conducted a counterfactual analysis to compare the return of the various adaptation strategies. The results show that various types of SLM practices when adopted either in isolation or in combination have a positive return on crop net revenue. We find that tree planting has the best pay off among the various types of strategies considered in this study. Another implication of this study is that adoption of the most complex strategies, combination of tree planting, soil conservation and inter cropping could not give the best return compared to adoption of less complex strategies such as adoption of soil conservation and intercropping simultaneously.

### **Comparative assessment of smallholder agricultural production efficiency between Adopters and Non-Adopters of land conservation technologies in Tanzania**

Onesmo Selejio

Low agricultural production efficiency in Tanzania and other developing countries has led to poor rural farming households constantly seek for more potential and productive land by clearing forest. Promotion and supporting adoption of land management and conservation technologies (LMCTs) among poor farming households has been considered to improve crop yields as well as production technical efficiency. However, the effects of adoption improved production technologies have mixed results. Therefore, this paper compares production efficiency between adopters and non-adopters of LMCTs in Tanzania. The study estimated simultaneously both stochastic frontier and technical inefficiency models using national panel survey data in Frontier 4.1 programme. The findings show that adopters of LMCTs had significantly higher technical efficient (0.73) than their non-adopter counterparts (0.7). Furthermore a good number of factors affect the TE differently of the adopters and non-adopters, e.g. the expenditure on input materials, family labour, hired labour, plot ownership and time. Therefore, promotion and supporting the adoption of LMCTs among smallholder farmers is pertinent for improving their TE as well as increase crop yield, thereby reducing exploitation of environment such as forest clearing. There is a need also to understand how adopters and non-adopter of LMCTs are affected by different factors when designing the policies that promote adoption of LMCTs among the smallholder farmers for sustainable increase of agricultural productivity and TE.

### **Gendered food security in rural Malawi: Why is women's food security status lower?**

Jesper Stage

Gendered food security gaps between female- and male-headed households (FHHs and MHHs) can be decomposed into two sets of components: those explained by observable differences in levels of resource use, and those due to unobserved differences affecting the returns to the resources used. Employing exogenous switching ordered probit and binary probit regression models, this paper examines the gendered food security gap and its causes in rural Malawi. We conduct a counterfactual analysis and find that the food security of FHHs would improve significantly if they had the same levels of resource use as MHHs. However, even if FHHs had the same levels of resource use as MHHs, the gendered food security gap would not be closed because of the differences in the returns to those resources. Such differences in returns to resources explain 40% (45%) of the observed gendered chronic (transitory) food insecurity gap and 54% (19%) of the food break-even (surplus) gap. Further analysis suggests that the intensity with which sustainable agricultural practices have been adopted has a stronger impact on the food security of FHHs than on MHHs.

## **Influence of agro-eco-climatic factors and adaptation strategies on farm productive efficiency in Kenya: a DEA framework**

Richard Mulwa

Climate change and climate variability is affecting weather patterns and seasonal shifts with serious repercussions on households and communities in Kenya. Most of the households depend on agriculture as key source of livelihood and potential adverse impacts of climate change, which include declined production, could lead to food insecurity. To mitigate the negative impacts of climate change as manifested in variability in weather patterns and seasonal shifts, farmers in different agro-ecological zones in Kenya have taken up different adaptation strategies such as adoption of new crop varieties, crop and livestock diversification, water harvesting technologies among others. However, the overall agricultural household productive efficiency and the influence of the different weather factors and agro-ecological zone characteristics on farm productive efficiency is not fully understood.

There have been several studies, which have analyzed efficiency of farm production in Kenya, but most of them have targeted single crops or farming activities, with none of them linking productive efficiency with climate change or its manifestations in weather variability. These studies have used either stochastic frontiers or activity analysis models such as DEA. Using a two stage semi-parametric model, this study assessed the overall farm efficiency; and the influence of climatic factors, and agro-ecological zone factors on farm level efficiency. Results indicate that farming in Kenya is highly inefficient, recording efficiency levels of 15%, 12%, and 18% for the years 2004, 2007 and 2010. This indicates that farmers in the country have a lot of room to improve their productive efficiencies. In the second stage, temperature, rainfall, Standardised Precipitation-Evapotranspiration Index (SPEI), altitude and adaptation strategies all influence farming efficiency in the country negatively and positively and at different magnitudes. These outcomes are important and can be used to inform the government on different policy decision, such as where to emphasize when planning on climate change adaptation strategies to be promoted across the country.

**Potential role of effective adaptation methods in reducing farmers' vulnerability to climate change in Tanzania**

Coretha Komba

This study examined the characteristics of farmers who are likely to be vulnerable as a result of climate change, using 556 households in Tanzania. The study found that vulnerable farmers include those who reside in the plateau zone and large households. There are a few surprising results. First, those who use drought-resistant crops are more vulnerable; this could be because such crops are not preferred for consumption and therefore better-off households might be less likely to plant them. Second, male headed households because female are more risk averse than male. Third households with heads that have high education because many village farmers have low education. Using a binary logit model, the study found that there are some adaptation methods that are vital in reducing current and future household poverty. Farmers who use irrigation as their dominant adaptation method have a 1 percent lower probability of falling below the poverty line while farmers who use short season crops have a 12.1 percent lower likelihood of being vulnerable. Thus, the results of this study confirm that the choice of adaptation method matters in reducing the negative impact of climate change. Therefore, the major role that the Tanzanian government needs to occupy itself with regarding the effects of climate change on smallholder agriculture is to help farmers overcome the constraints they face in adopting appropriate adaptation methods. The results further show that the age of the household head, household size, farm size, access to credit, growing maize and sorghum as major crops, and the fact that the household has non-farm income are important factors in reducing farmers' current and future poverty related to climate change.

**Climate change adaptation: A study of multiple climate smart practices in the Nile Basin of Ethiopia**

Hailemariam Teklewold

Improving farm level use of multiple climate change adaptation strategies is essential for poverty alleviation and improving household food security particularly against a backdrop of high risk of climatic shocks. However, the empirical foundations for understanding how farm households choose multiple climate smart agricultural practices is far from being established. In this paper, the effects of household, farm and climatic factors on farmers' decisions to use multiple adaptation practices are analyzed. A survey of 921 farm households and 4312 farm plots combined with historical climate data in the Nile Basin of Ethiopia is explored using a multivariate and a random effect ordered probit econometric models. Results show smallholder agricultural production can be characterized by complementarities between adaptation practices. Such result is important to design package of adaptation practices. The econometric results confirm that social capital, tenure security and climatic shocks are important determinants on the choice of the type and intensity of adaptation practices. While farm level use of productivity enhancing inputs (fertilizer and improved seeds) is less probable under variable climatic condition, soil conservation, crop diversification and reduced tillage and agricultural water management practices seem well suited to respond to the key agro-ecological constraints of warmer climatic conditions. The asymmetric effects of climate variables on farm level use of different climate smart practices suggest the need for careful designing and empirically examining agro-ecological based combination of adaptation strategies.

**Small-scale Subsistence Farming, Food Security, Climate Change and Adaptation in South Africa: Male-Female Headed Households and Urban-Rural Nexus**

Byela Tibesigwa

This study examines the role of gender of the head of household on the food security of small-scale subsistence farmers in urban and rural areas of South Africa, using the exogenous switching treatment-effects regression framework. Our results show that agriculture contributes to food security of female-headed more than male-headed households, especially in rural areas. We also observe that male-headed households are more food secure compared to female-headed households, and this is mainly driven by differences in off-farm labour participation. We further observe that the food security gap between male- and female-headed households is wider in rural than in urban areas, where rural male- and female-headed households are more likely to report chronic food insecurity, i.e., are more likely to experience hunger than their urban counterparts. Our results suggest that the current policy interest in promoting rural and urban agriculture is likely to increase food security in both male- and female-headed household, and reduce the gender gap.

**Changing Climate in a Changing Land**

Peter Berck

Many of the technologies that will help African farmers increase productivity in the face of climate change are the same technologies that would enhance productivity under current climate conditions. This leads to the issue of barriers to technology adoption. These barriers are related to underdevelopment of human capital, infrastructure, and institutions. As development proceeds in East Africa in all sectors, not just agriculture, some of these poverty-related barriers will change; thus, adaptation policy must look at future as well as present conditions. Another key point is that adaptive strategies must be as heterogeneous as the diverse farming conditions and systems faced by African farmers. Agricultural adaptation cannot be separated from the education, markets, roads, etc. that will help farmers adapt to very specific and local farming conditions and to the changes expected in a changing climate.