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Summaries

The distributional impact of climate change on rich and poor countries

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The early impact literature for climate change generally assumed that most regions of the world would be damaged by warming (with the possible exception of the Soviet Union, see Pearce *et al.*, 1996). Poor countries were predicted to have slightly higher damages per GDP from climate change because a greater fraction of their economy was in agriculture and they had far less capital and technology to adapt to climate change but climate damages were presumed to be somewhat universal.

This paper argues that poor countries will in fact bear the brunt of the net damages from climate change. Contrary to the earlier literature, we argue that there is a serious equity issue with respect to the distribution of climate impacts across rich and poor countries. Poor countries are heavily impacted by climate change primarily because they are located in the low latitudes where climate is already hot, whereas the richer countries are located primarily in cooler parts of the planet.

In order to examine the economic impact of climate change on individual countries, the paper integrates climate models, climate response functions, and background information from every country in the world. We do not include non-market impact, because no reliable estimates of the economic implications are available at present. A range of climate scenarios and response functions are tested to give a sense of the range of possible outcomes. The countries are then divided into four quartiles by income per capita so that there is the same number of people in each quartile. We then measure the impact per GDP and the impact per capita (total impacts) for each income quartile from the various climate forecasts. The total impact and the impact per capita are proportional, because each quartile has the same number of people.

In all scenarios tested, we predict that the damages per GDP are much higher for the lower-income groups. The bulk of the net damages to the world's economy will be borne by the poorest half of all countries. In general, the more wealthy countries of the world will suffer little net effect from climate change and, in some scenarios, will actually get a small boost from warming.

Although both mitigation and adaptation remain serious topics for debate, this paper suggests equity should be added to the climate negotiation agenda as well. Specifically, the nations of the world should address whether a compensation program for poor countries is needed. Compensation to poor countries has been discussed to help finance mitigation and adaptation, but the most obvious compensation for poor countries is to invest in economic development.

Spatially correlated rainfall in a protective irrigation system

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Many large irrigation projects in the developing world were designed to provide irrigation supplemental to normal rainfall. Their primary purpose was to offset rainfall variability, protecting against the impacts of drought. Generally, land use plans accompanied the design, plans that required head-end farmers to allow substantial amounts of water to flow past their fields. These farmers are often not content to let this water flow by, and in many cases there are few means to prevent their using the water. Thus, *de facto* riparian water rights have become the norm.

This paper develops a theoretical model of a protective irrigation system. The system is divided into two regions reflecting areas near the water abundant head end of the system and near the water scarce tail. A representative farmer in each region solves a two stage problem, crop selection and water application. It is assumed that water availability is not known at planting time. Farmers apply water to crops progressively, only watering those crops for which net profits are positive. With crop specific minimum water thresholds, the demand for water has perfectly elastic regions, corresponding to prices where each crop becomes profitable.

Rainfall is an important water source in protective irrigation systems. As weather patterns tend to be of a scale larger than most irrigation systems, precipitation levels are likely correlated across a system. Water shortages and water surpluses are therefore also correlated. To explore the implications of this effect, a probability distribution for water availability is specified for the two region model. The expected earnings and volatility of earnings for farmers in each region are calculated, with and without a spot market for water.

Two key results are highlighted by this analysis. First, approximately two-thirds of the gains from tradable water rights are captured with a spot market alone. Permanent transfers and/or long-term contracts (with

perfect foresight) in addition to a water market increase the gains by an additional half. This suggests that market-based reforms in water allocation can generate large efficiency gains even without mechanisms to support long-term rights transfers. The second result is that with rainfall uncertainty, the relative gains to those in the water poor region are greater than those in the water rich region. Tail-enders see an increase in overall earnings and a reduction in volatility with a spot market for water. In the absence of other effective mechanisms to redistribute water, allowing head-end farmers to sell their water may benefit tail-enders at least as much as it does head-enders.

Slash-and-burn cultivation practice and agricultural input demand and output supply

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Slash-and-burn agriculture, commonly practiced as shifting cultivation, in which flash burning and short-term mixed intercropping follow partial clearing of vegetation, generally produces relatively low levels of food and encourages deforestation, as well as global CO_2 emissions. Farmers practice slash-and-burn agriculture for a variety of reasons. First, poor farmers normally view the technology as a low-cost way for cultivating their land. Second, small-scale producers often perceive several advantages when adopting this technology, such as positive fertilizer effect of burned ash (increased levels of Ca, Mg, P, and K in the ash), soil structure improvement, and reduced weed competition and reduced occurrence of pests and diseases. Other explanations for the adoption of slash-and-burn technology range from increased population pressure, land tenure, government policies, and price risk.

Both researchers and policy makers have therefore been interested in understanding the factors that determine farmers' decision making with regard to this farm practice, and how it impacts on productivity and farm incomes. This study contributes to this literature by examining the impact of slash-and-burn agriculture on the application of commercial fertilizer and pesticides, as well as yields and net return, using survey data from Nicaragua. The analysis was conducted separately for farmers who had practiced slash-and-burn agriculture and those who did not.

The results obtained show that individual and household characteristics, as well as location-specific characteristics, influence farmers' decision-making processes and output. Specifically, the farmer's education, access to credit, land rights, and visits by extension agents all reduce the probability

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of a farmer practicing slash-and-burn agriculture. Environmental variables, such as soil quality and plot slope, did not appear to significantly impact on the decision to practice slash-and-burn agriculture, but do affect output supply of both farmers who practiced the technology and those who did not.

A major policy implication arising from the results of this study is that efforts to move farmers away from slash-and-burn cultivation should focus on resource-poor households cultivating on steep slopes, in order to help minimize erosion and nutrient losses. These are mostly households that have relatively low levels of education and face liquidity constraints. Extension services and basic education programs should go hand in hand to support farmers in moving away from slash-and-burn cultivation by providing them with information relating to the negative aspects of the technology and building the capacity to understand and successfully apply new cultivation techniques.

Of guns and trees: impact of terrorism on forest conservation

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Many terrorist organizations around the world seek shelter in forests and this paper tries to address the impact of this phenomenon on forest conservation. Since, the terrorist is involved in activities which are considered illegal from the societal viewpoint, we assume the terrorist is excluded from the society and we construct a framework to measure the social loss when a terrorist lives in the forest and has full control over the forest resources. The loss constitutes the entire timber and some of the non-timber benefits like tourism. When the terrorist controls the entire timber resources of the forest, a separation of ownership occurs: having access only to the non-timber benefits, society wants the trees not to be felled at all; while the terrorist wants to cut the trees in regular rotations to maximize his profit. This brings forth a situation of conflict between the government, as a representative of the society, and the terrorist. In this paper, we address this conflict by constructing a game between the terrorist and the government, when the government tries to combat them to recover the social loss. We find, as the government steps up its combat effort, the terrorist becomes more uncertain about his ability to hold the timber resources in future periods. Therefore, the profit maximization objective compells him to more illegal felling of trees, and forest conservation suffers. Similarly, if the government tries to restrict the sale of timber by the terrorist in the market by declaring it illegal,

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the market price of timber rises. But, now there is a difference between the consumers' price and producers' price. The consumers' price is higher than what the market price would have been had there been no restriction. But, the producers' price (the price the terrorist receives) is lower than the market price in a 'no restriction' situation. The retailer expropriates the rent created by the difference between the producers' price and the consumers' price, because he bears the entire risk of selling the illegal timber. So, it is always the case that, if restriction is imposed, the price of timber falls for the terrorists. But, this motivates the terrorist to keep the trees in the forest for a lesser number of periods. Again, forest conservation suffers.

Development assistance and the CDM – how to interpret 'financial additionality'

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In the past decade, development assistance has increasingly flowed into projects reducing greenhouse gas emissions. Decisions of the international climate negotiation process have paved the way for implementation of emission reduction projects in developing countries under the framework of the Clean Development Mechanism (CDM). CDM projects generate emission reduction credits that have a value on an international market. The rule decided by the seventh Conference of the Parties (COP 7) in the Marrakech Accords just says that ODA shall not be 'diverted'. Diversion can take many forms and currently a debate is ongoing at the OECD to define it. We distinguish between diversion of purpose, sectoral and regional types of diversion.

An easy way to address diversion would be to deduct the value of the emission reduction credits from ODA flows, which is actually endorsed by the OECD's Development Assistance Committee. This would however lead to a long-term reduction of ODA as emission credits only accrue over time. A more complex way would be to define ODA baselines, i.e. ODA levels that have to be reached before ODA can go into a CDM project. One could also imagine defining a baseline project financed by ODA and a 'piggyback' CDM project. Finally, only projects where the emission credits accrue to the hosting developing country could be eligible. All options have drawbacks. Even the last one leads to a reduction in purely private sector CDM projects as the host countries will sell the emission credits on the international market and thus reduce the market price of credits.

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Designing integrated conservation and development projects (ICDPs): illegal hunting, wildlife conservation and the welfare of the local people

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Integrated Conservation and Development Projects (ICDPs) are widely put forward as the solution to the problem of biodiversity loss in developing countries. In sub-Saharan Africa, ICDPs are frequently designed to encourage conservation by reconciling the management of protected areas with the social and economic needs of the local people. However, ICDPs have recently attracted negative attention, due to the untested assumptions underlying these projects. For instance, many existing projects lack a direct link between the hunting activity of the local people and the conservation objective. This is the point of departure for this paper.

This paper develops a bio-economic model in order to explore the effect on illegal hunting, wildlife conservation, and the welfare of the local people of two common instruments of existing ICDPs. The instruments analysed are transfers of game meat from managed harvest and money transfers from wildlife tourism. Two regimes are presented. In the first regime, there is no link between the benefit transfers and the hunting activity of the local people. That is, there is no risk of being excluded from the transfers if caught in illegal hunting. In the second regime, the local people are excluded from the transfers if caught in illegal hunting.

The local people are involved in illegal hunting, agricultural production, and formal employment. A market exists for agricultural commodities, whereas illegal hunting is for domestic consumption only. It is demonstrated that the distribution of game meat and money transfers to the local people is likely to fail if not linked to the conservation objective. The analysis shows that ICDPs implemented with such a link may reach the goal of improved wildlife conservation and local welfare. The model is illustrated using numerical calculations with data sourced from the Serengeti in Tanzania.