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Research, part of a Special Feature on Compensation and Reward for Environmental Services in the Tropics

The Conditions for Functional Mechanisms of Compensation and Reward for Environmental Services

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ABSTRACT. Mechanisms of compensation and reward for environmental services (CRES) are becoming increasingly contemplated as means for managing human–environment interactions. Most of the functional mechanisms in the tropics have been developed within the last 15 years; many developing countries still have had little experience with functional mechanisms. We consider the conditions that foster the origin and implementation of functional mechanisms. Deductive and inductive approaches are combined. Eight hypotheses are derived from theories of institution and policy change. Five case studies, from Latin America, Africa, and Asia, are then reviewed according to a common framework. The results suggest the following to be important conditions for functional CRES mechanisms: (1) localized scarcity for particular environmental services, (2) influence from international environmental agreements and international organizations, (3) government policies and public attitudes favoring a mixture of regulatory and market-based instruments, and (4) security of individual and group property rights.

Key Words: *carbon sequestration; ecosystem services; ecotourism; environmental services; institutional change; payments for environmental services; watershed services*

INTRODUCTION

Current patterns of human–environment interaction are straining the world's ecosystems. The Millennium Ecosystem Assessment (2005) concluded that most terrestrial and aquatic ecosystems have already suffered major degradation and that ecosystem degradation is evident in both industrialized and less-developed countries. Many types of economic activity and production are degrading the environment: agrarian economies are more prone to declines in soil fertility and sedimentation of waterways, deforestation is the major source of greenhouse gas emissions in the humid tropics, and many industrialized economies are beset by problems like air pollution and nitrate loading of waterways.

Over time, human societies have developed institutional arrangements to manage ecosystems at the local, national, and global levels. For the most part, these institutions focus on regulation of individual behavior, protecting public rights to particular resources or ecosystems, and undertaking collective investment in infrastructure to enhance human capture of ecosystem services. An alternative approach that is gaining prominence in many parts of the world is compensation and reward for environmental services (CRES). As described by Swallow et al. (2009), we use the "CRES" to refer to voluntary and conditional agreements that are negotiated among ecosystem stewards, beneficiaries of environmental services, and intermediaries. CRES mechanisms may or may not involve conditional transfers of money from beneficiaries to stewards. CRES mechanisms can be complementary to traditional regulatory approaches, provided that the regulations provide scope for negotiation and agreements among specific groups of ecosystem stewards, intermediaries, and beneficiaries of environmental services.

As part of a pan-tropical scoping study, we present a series of hypotheses about conditions affecting the initiation and operation of functional mechanisms of CRES. We use both inductive and deductive research approaches. The deductive approach considers CRES mechanisms as institutional and

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policy innovations. Theories of institutional change and policy diffusion are used to identify conditions under which CRES mechanisms are likely to emerge and become functional. The inductive approach presents a description of case studies of functional CRES mechanisms operating in specific contexts in Africa, Asia, and Latin America. The case studies are summarized briefly, with emphasis on conditions affecting origin and function.

The pan-tropical approach allows us to draw lessons from Africa, Asia, and Latin America. The focus is on the development and early implementation of functional mechanisms; all of the case studies are at relatively early stages of implementation, providing scant opportunity to assess their environmental performance or sustainability. Readers interested in performance issues are referred to studies of the CRES mechanisms in Central America that have been in place for longer periods of time (Pagiola et al. 2005, Sanchez-Azofeifa et al. 2007, Wunder and Alban 2008). A global review of the state of markets and payments for environmental services is provided by the Food and Agricultural Organization (2007).

THEORETICAL FOUNDATIONS

A number of theories of institutional and policy change are articulated in the economics and political science literature. In this section, we briefly review some of the major theories in order to develop hypotheses about factors likely to shape the origin and function of CRES mechanisms. The theories highlight the role of particular causal factors but are not mutually exclusive. Indeed, multiple causal factors are likely to influence any particular case.

Demsetz (1967) was one of the first neoclassical economists to study institutional change, assembling the elements of a demand-driven theory of institutional change. Central to that theory is the concept of externality that was first developed by Pigou (1920): the effects of an economic transaction by a party or parties on a third party. The demand-driven theory of institutional change postulates that societies will develop new institutions when there is sufficient need to internalize externalities from each other's use of resources, with need changing in response to changes in scarcity of inputs, available technologies, and output markets. The theory is often applied to explain changes in property rights but has been applied to other change processes, including economic growth (Nelson and Winter 1982), regulation (Peltzman 1976), and organization of economic functions (Grossman and Hart 1986). The theory supports the following hypotheses about the conditions for functional CRES mechanisms.

H1. Increased scarcities of environmental services, due to population growth, demographic shifts, and/or degradation of ecosystems, will prompt increased demand for restoring and protecting ecosystems, which in turn will prompt greater demand for secure property rights to environmental services.

H2. New market opportunities for selling environmental services or outputs generated by those services will prompt increased demand for environmental services, new demand for compensation for resulting damage to ecosystems, and thus new demand for CRES institutions.

H3. The availability of profitable new technologies for using environmental services to generate economic output will increase demand for environmental services and CRES mechanisms.

The model of demand-driven institutional change is based on a number of simplifying assumptions about the institutional change process. North's (1994) interest group model of institutional change relaxes some of those assumptions, explicitly recognizing the following: (1) economic agents tend to coalesce into interest groups to further their interests, and (2) institutional change is a costly process for both individuals and society. Institutional change is therefore highly path-dependent, with institutions in one period having great influence on institutions prevailing in subsequent periods. The interest group model supports additional hypotheses about the drivers of CRES institutions.

H4. The development of CRES mechanisms occurs in the context of an array of rural institutions and organizations, many of which directly affect the formation of interest groups, transaction costs, and the process by which public choices are made. Self-organized interest groups will tend to exclude the poorest and most vulnerable members of society. Organizations that serve as intermediaries between ecosystem stewards and beneficiaries have their own interests, which may or may not align with one or another de facto interest group of ecosystem stewards or ecosystem service beneficiaries.

Jordan et al. (2003) identify three political science models of institutional change that may also be relevant to an analysis of the development and effectiveness of CRES mechanisms: (1) ideas dominant, (2) settings dominant, and (3) chaos dominant.

The ideas dominant model assumes that policy change occurs as a result of social learning in which groups of policy actors exert influence over policy processes to promote instruments consistent with their ideas or beliefs. Most policy changes occur as minor changes to existing policies, with occasional major shifts. The ideas dominant model supports the following hypotheses.

H5. Functional CRES mechanisms are more likely to emerge and be functional where market and property rights institutions are effective and consistent with common beliefs about the appropriate form of society.

The settings dominant model proposes that policy change occurs within a context of entrenched institutions and power relations. Changes to environmental policies are generally incremental, with significant changes occurring only in response to environmental shocks large enough to significantly change that context.

H6. CRES mechanisms will only develop as a response to a significant environmental disaster associated with ineffectual or inappropriate previous environmental policies.

The chaos dominant model views the policy process as unstable because actors operate under conditions of uncertainty and lack the time for comprehensive searches for information. Kingdon (1984, referenced in Jordan et al. 2003) developed a variant of the chaos dominant model in which the policy process contains three streams: (1) a stream of problems demanding policy solution, (2) a stream of available policies, and (3) a stream of politics where actors compete for position and resources. Interactions between the three streams create policy windows in which a compelling problem opens a window of opportunity for a specific policy solution to seize the agenda.

H7. CRES mechanisms may emerge at unexpected times and situations, and may be strongly associated with the activities of particular individuals or organizations that are able to take advantage of suitable policy windows.

The models of institutional development discussed above are all based on the assumption that institutional change is determined within a particular political context. However, multicountry studies of environmental policy show remarkable convergence across countries. This policy convergence can be partly explained by the development of multilateral environmental agreements that place new expectations and demands on national governments. In addition, it is clear that there has been rapid diffusion of environmental policy instruments from frontrunner countries to others.

The model of policy diffusion presented by Kern et al. (2001) postulates that countries enact new environmental laws in response to domestic pressures and debate, in anticipation of opportunities for international trade and international leadership, and as a result of support from international networks or organizations. Aside from the desire for international prestige, countries may want to position themselves as policy frontrunners in order to take advantage of existing economic capacity or stimulate the development of new technologies.

There are a number of international organizations and networks now supporting the development of CRES mechanisms. For example, the Organization for Economic Cooperation and Development (OECD) is a lead organization in reviewing and assembling best practice on the use of CRES mechanisms among its member states and beyond (OECD 2004, 2005). Other organizations providing support for the development of effective CRES mechanisms include the World Bank, United Nations Environment Programme, Forest Trends, World Agroforestry Centre, International Fund for Agricultural Development, the World Conservation Union, International Institute for Environment and Development, Care International, and the Worldwide Fund for Nature.

H8. CRES mechanisms are more likely to diffuse to places where they are well supported by international organizations and networks.

REVIEW OF CASE STUDY EVIDENCE

The Pan-tropical Scoping Study of Compensation for Ecosystem Services included regional workshops convened in Latin America (Quito, Ecuador, April 2006), Asia (Bangalore, India, May 2006), and Africa (Nairobi, Kenya, May 2006). The results of those workshops are summarized in Poats (2007), Raju et al. (2007), and Ochieng et al. (2007). A number of specific CRES mechanisms were presented and discussed at those regional workshops. This section reviews five case studies, focusing on conditions that appear to have been particularly important in shaping the origin and function of the mechanisms. The following criteria were used to select the case studies: (1) all cases are consistent with the Wunder (2005) criteria of PES and the CRES framework of Swallow et al. (2009); (2) the cases cover a range of environmental services and CRES prototypes as described by Swallow et al. (2009); (3) the cases are novel in their own national contexts, with several being used as templates for subsequent CRES development in those contexts; (4) all cases were operational at the time that the paper was written, with tangible exchanges occurring between environmental service beneficiaries and ecosystem stewards; (5) the cases illustrate different types of government involvement; (6) at least one case from each of Africa, Latin America, and Asia; and (7) the authors had access to relatively complete information available on the origin and function of all of the cases from published and first-hand sources.

The case studies are all presented according to a common framework: context, origin, function, and key conditions for origin and function. All of the case studies were in relatively early stages of implementation at the time this paper was written, preventing any conclusive analysis of their long-term viability.

Case Study 1: Payments for watershed conservation and restoration in Heredia municipality of Costa Rica

Context

The municipality of Heredia is part of the urban area in the central valley of Costa Rica, across the Virilla River from San Jose, the capital city. Heredia municipality obtains water from the Rio Segunda watershed, which drains an area from the nearby Barva Volcano into the Virilla River. Heredia municipality obtains water from a catchment area of 113 km², 34% of which is covered by forest, including part of the Braulio Carrillo National Park. The Heredia public utilities company, Empresa de Sericios Publicos de Heredia (ESPH), provides water to about 49,000 households and does not operate a water treatment facility (Morena 2006, Barrantes and Gamez 2007, Kosoy et al. 2007, Pagiola et al. 2007).

Scoping and negotiation

Concerns about the prospects for maintaining high-quality water led the ESPH to consider whether to invest in constructing a water treatment plant or protecting the watershed with farmers living in the watershed. ESPH was inspired to develop their Pago de Servicios Ambientales (PSA) scheme by the example of New York City–Catskills and was institutionally supported by Costa Rica's national program of payments for environmental services (Postel and Thompson 2005). The Director of ESPH had previously been involved in the implementation of Costa Rica's national PES program (Castro et al. 2000).

A hydrologic study of the Rio Segunda watershed was undertaken. That study identified an area of about 19 km² as highest priority for forest conservation and restoration. Economic studies quantified the opportunity costs of forest conservation as well as the implementation costs of forest restoration (Moreno 2006). In 2000, the ESPH opened a dialogue with landowners in the priority areas and began raising revenue through an environmental levy on water consumers. The PSA scheme began in 2002.

Function

ESPH agreed to give farmers 10-year contracts for forest conservation at a rate of $92/ha/year, and 15-year contracts for forest restoration at a rate of $170/ha/year. The Heredia municipality began making contracts in the year 2002 and added new contracts in 2003, 2004, and 2005. As of January 2007, ESPH had negotiated 23 contracts to cover an area of 12 km².

Key conditions for origin and function

1. A supportive institutional and policy context in Costa Rica.

2. A strong knowledge base to prioritize investments and base payments.

3. A pro-active municipal water company with a clear business case for investment in conservation.

Case Study 2: Rewards for watershed services in the Bakun watershed in the Philippines

Context

The Bakun watershed is a 310-km² area in the Cordillera mountains of the northern Philippines that is the source of water for local communities, irrigation systems, and two hydropower facilities. The watershed is the home for the Bago and Kankana-ey indigenous minority groups. Poverty levels are high, with about 87% of people living below the national poverty line (Espaldon 2005, RUPES Bakun Site Profile: http://www.worldagroforestrycentre.org/sea/networks/rupes/download/SiteProfiles/RUPES-Bakun_FINAL.pdf).

The peculiar colonial history of the Philippines has shaped the country's institutions for land tenure and natural resource management, with entrenched inequities and biases against indigenous groups living in the upland areas of the country. Policy and institutional changes that began in the early 1990s have gradually reduced inequities and given greater recognition and rights to indigenous people and upland smallholder farmers. The Philippine Constitution (1993) instituted state recognition of land rights of indigenous people, which was further enhanced by the passage of the Indigenous Peoples Rights Act in 1997. The Department of Energy Act (1992) mandated the establishment of the Environment Enhancement Fund to compensate communities for hosting energy generation facilities. Since 1995, hydropower companies have been required to direct part of their tax revenue to the Environment Enhancement Fund.

Scoping and negotiation

Taking advantage of this new institutional environment, the Bago and Kankana-ey people of Bakun organized the Bakun Indigenous Tribes Organization (BITO) to facilitate their ancestral domain development and protection efforts. In 2002, the Kankana-ey was the first indigenous group to obtain a Certificate of Ancestral Domain Title (CADT), which gives the group formal title to its ancestral lands.

Following national law, the hydropower companies operating in the Bakun watershed pay a 2% royalty into the Environment Enhancement Fund. For several years, however, use of this fund for actual environmental protection was minimal. With support from the RUPES Programme (Rewarding Upland Poor of Asia for Environmental Services they provide), BITO facilitated the establishment of an integrated watershed management program. Negotiations between BITO and the municipal government have been aimed at using the portion of the royalties in the Environmental Enhancement Fund to support conservation efforts by local communities. Negotiations with the hydropower company have been successful in gaining in-kind payments from the hydropower company, including (1) diverting only part of the water for the purpose of hydropower and leaving the other part for local irrigation and fisheries, (2) granting scholarships to local students, (3) establishing a tree nursery for training local farmers in tree planting, (4) constructing roads, (5) delivering electricity to nearby villages, and (6) providing a piped water system. The company also promised to pay US$10,000 annually to the villages where the hydropower facility is located as an additional compensation payment. In addition, the company provided tree seedlings and hired labor to plant trees on 144 ha of land.

Conditions determining origin and function

1. Valuable environmental services: The presence of the two hydropower companies shows the importance of the watershed services.

2. Rights and negotiation context: Empowerment of indigenous groups in the Philippines has enhanced the bargaining power of indigenous people who live in the community.

3. Regulatory underpinnings: The Energy Regulation act ensures that some of the taxes paid by hydropower companies are earmarked for catchment conservation.

4. Political will: The municipal government is willing to allocate a portion of royalties from the general municipality budget to the Bakun people for watershed management, although the final allocation of those funds is yet to be agreed.

5. Role of policy support networks: Bakun is one of six core sites in the RUPES program.

Case Study 3: Direct payments as a mechanism for conserving a wildlife corridor in the Kitengela area of Kenya

Context

Kitengela is an area of about 183 km² located near the City of Nairobi and the Nairobi National Park in Kenya. The Nairobi National Park was established in 1946, covers an area of 117 km², and is renowned for providing habitat for charismatic African wildlife at the periphery of a large capital city. The Kitengela area has long served as a livestock grazing area for Maasai pastoralists, a dispersal area for wildlife from the national park, and a wildlife corridor from the national park to the Kapiti plains, an area of about 2,200 km² of rolling grassland to the south of the Nairobi. In 1987, the group of Maasai, who jointly owned the area as a Group Ranch, decided to subdivide the land into designated plots with individual land titles. Landowners responded by further subdividing the land, selling small plots for housing, and establishing fences to demarcate boundaries. Some areas have been converted from grassland to crops, timber production, and commercial horticulture. Human–wildlife conflicts have intensified, and the numbers of large herbivores in both the park and the Kitengela area have declined. The Wildlife Lease Programme was developed as a means of resolving those conflicts by providing farmers with incentives to reduce barriers to grazing and movement of wildlife (Gichohi 2003, http://www.reto-o-reto.org/sites.php?page=kitengela).

Scoping and negotiation

The Wildlife Conservation Lease (WCL) Program was initiated in the year 2000 by the Friends of Nairobi National Park, a group of active individuals concerned about the future of the Nairobi National Park and the Nairobi–Kapiti ecosystem. The WCL is implemented by a Kenyan nongovernmental organization, The Wildlife Foundation (TWF). The payment and institutional structure for the WCL was informed by economic and ecological research undertaken by the Africa Conservation Centre and the International Livestock Research Institute (ILRI). ILRI estimated that the average revenue from grazing is $8/ha/year, whereas the opportunity cost of foregone grazing is $4/ha/year. ILRI and several universities continue to provide technical support to the WCL through the Reto-o-Reto project (www.reto-o-reto.org). Landowners in the area have formed the Kitengela Iparakuo Landowner Association, which facilitates negotiations with external bodies and internal negotiations among landowners.

Implementation

In return for agreeing not to fence, quarry, cultivate, or subdivide the designated area of land, and to actively manage their land for wildlife and sustainable livestock grazing, TWF pays a fee of approximately $4/ha/year directly to individual landowners. The number of farmers enrolled in the program was 18 in 2000, 65 in 2001, 99 in 2002, about 117 from 2003 to 2007, and 148 in 2008. The average participating household earns $400-800/year, paid in three payments per year, with payments timed to match the time when school fees are due to be paid. Funds are generated through donations from development agencies, the Friends of Nairobi Park, conservation organizations, the Kenya Wildlife Service, and private businesses operating in the Nairobi area.

TWF has adopted a multidimensional approach to encourage farmers to maintain the wildlife habitat value of their land. This includes creating awareness of the disadvantages of subdivision and sale of land and government regulations governing wildlife.

Conditions determining origin and function

1. Kenya has a global reputation for its wildlife resources, with the maintenance of Nairobi Park representing commitment to maintain those resources.

2. Individual landowners in the Kitengela area have freehold title to their land and are free to opt in or out of the WCL. Being involved

in the program means allowing wild animals free access to rangeland, a situation long familiar to the Maasai.

3. The WCL is consistent with Kenya's Wildlife legislation, although it is seen as a novel and pathbreaking application of the law.

4. Research is seen as instrumental for laying and maintaining the foundations for the WCL.

5. Emphasis is put on transparency of the payment mechanism.

Case Study 4: Agroforestry incentives through voluntary carbon payments in Uganda

Context

The Clean Development Mechanism (CDM) of the Kyoto Protocol makes some provision for afforestation and reforestation projects to generate tradeable carbon credits through carbon sequestration. To date, however, the stringent requirements of the CDM have meant that only one or two afforestation/reforestation projects have been registered by the CDM anywhere in the world. Nonetheless, there has been considerable experimentation with small-scale carbon sequestration projects, with the carbon sold on voluntary carbon markets. One such project has been implemented in the Bushenyi District in southwest Uganda (Biryahwaho 2006; Jindal et al. 2008).

Scoping and negotiation

The project in Bushenyi has been led by the environmental foundation Ecotrust and implemented by over 100 local farmers. The project began with a pilot phase in 2003; by 2006, about 40 farmers had received payments for tree planting. Ecotrust has been coordinating the project, developing and maintaining a project-scale database, raising funds, issuing certificates, and administering payments, contracting, documenting, and conducting monitoring and evaluations. The Edinburgh Centre for Carbon Management and the Plan Vivo Foundation developed the modus operandi for the project, based on previous experience in Mexico with a similar "Plan Vivo" project, and has helped to market the voluntary carbon credits. The World Agroforestry Centre (ICRAF) developed technical specifications for the tree planting regime. The pilot phase of the project is now being audited by the Rainforest Alliance for compliance with the Plan Vivo Standards, and a larger implementation phase is being planned.

Conditions determining origin and function

1. Development of the Bushenyi project required considerable upfront and ongoing investment by external agencies with technical experience in tree management, practical experience in the design and implementation of agroforestry projects, and connections to the voluntary carbon market.

2. The voluntary carbon market has proven to be much more accessible for smallholder carbon projects than the afforestation/reforestation window of the CDM.

3. Secure land and tree tenure was considered as a necessary condition for the individual-level carbon contracts to be negotiated.

Case Study 5: South Africa's "Working for Water" program

Context

Nearly 9,000 plant species have been introduced to South Africa over the past 500 years, with 1,000 of those species becoming naturalized, 200 of which are invasive. Invasive alien species have become established on over 100,000 km² of the country's land area, approximately 10% of the total land area of the country. Invasive alien species use 7% of the country's scarce water resources, reduce the ability to farm, intensify flooding and fires, cause soil erosion and siltation, and threaten biological diversity. The Working for Water Program (http://www.dwaf.gov.za/wfw/) was developed to provide community groups with incentives to remove blocks of invasive trees from publicly owned land (Khan 2006, Turpie et al. 2008).

Scoping and negotiation

A strong base of information was developed on the ecological, hydrologic, social, and economic impacts of invasive alien species over many years,

with many of the papers published in the *South African Journal of Science*. Research organizations have also developed and tested physical and biological control methods for many of the most problematic species. In the mid-1990s, resource managers and scientists developed the idea of Working for Water, a program with the dual objectives of clearing invasive alien species and generating rural employment. After inception, Working for Water was implemented quite quickly, at least partly because its rural employment aspects matched the objectives of the new ANC government. The Minister for Water Affairs was instrumental in promoting the program.

Implementation

Working for Water clears invasive species from public, communal, and private land. Contracts are negotiated between the Department for Water Affairs and private contractors, who submit tenders specifying how invasive alien plants in a particular area are to be treated and the amount of labor that will be used. Contractor staff must have been previously unemployed. Landowners benefit from having the trees cleared from their land and are able to comply with the Conservation of Agricultural Resources Act (2005), which seeks to make private landowners responsible for clearing invasive species from their own land. In practice, the costs of land clearance have proven to be prohibitively high for many private landowners. Investment of public resources in control of invasive species on private land is justified on the basis of the argument that many of the invasions are beyond the control of individual landowners (Turpie et al. 2008). Given that many invasive species have important use values (e.g. food, timber), it can be argued that invasive species control is a mixed public–private good, with the public component being positive and the private component being either negative or positive.

Working for Water is administered through the South African Department of Water Affairs and Forestry, working in partnership with local communities, national and provincial government departments responsible for environment, tourism, agriculture, trade and industry, research organizations, and private companies. Since its inception, Working for Water has cleared invasive alien plants from more than 10,000 km² (10% of the degraded area), each year providing jobs and training to approximately 20,000 people. They currently run over 300 projects in all nine of South Africa's provinces. Funds are generated through South Africa's poverty relief program, public works program, the Department for Water Affairs, and through water resource management fees levied by municipal water companies. Some local authorities have also financed the implementation of Working for Water in their jurisdictions. Since 2002, the annual budget for Working for Water has been in the order of 400 million Rand, roughly equivalent to US$50 million.

Conditions determining origin and function

1. Clear demonstration of an environmental problem worthy of national-level government involvement, with specific action concentrated in areas of greatest need and where local governments are willing to contribute finance.

2. Working for Water simultaneously addresses three national priorities: environmental management, rural employment generation, and poverty reduction.

3. The Government of South Africa considers water to be a national resource and has sophisticated infrastructure for moving it around the country. Reducing water waste, as is achieved by the Working for Water program, is thus seen as a national-level issue.

4. Maintenance of a research capacity in control methods, hydrology, ecology, economics, and social science, with research results used to update and revise the program.

CONCLUSIONS

This paper brings theory and case study evidence together to identify conditions for the origin and implementation of effective mechanisms of CRES in less-developed countries. Here, we seek to draw conclusions by asking the following question: "Which of the hypotheses were refuted or failed to be refuted by the evidence?"

Hypotheses 1, 2, and 3 focus on three demand-side characteristics—technology, scarcity, market opportunity—that can stimulate new demand for CRES

mechanisms. The case studies provided some evidence of demand increase due to scarcity, particularly in the water supply and invasive species cases. Mechanisms of compensation and reward for watershed services are generally quite specific to the circumstances of particular watersheds; the inter-basin water transfer that occurs in South Africa makes water supply more of a national issue. Market opportunity explains the development of the smallholder carbon case, but does not explain why project proponents choose particular countries or areas. We found little evidence of new technology driving the formation of CRES mechanisms, although the availability of appropriate methods for invasive species control was featured in the Working for Water case. More important across all of the cases was a different demand-side element: the availability of credible information about the environmental service problem and solutions to the problem. In practice, all four of the demand-side characteristics—scarcity, technology, market opportunity, and information—interact together to shape demand for CRES mechanisms.

Hypotheses 4 and 5 focus more on the institutional supply and political economy of CRES mechanisms. From the case studies, it appears CRES is still a relatively new area for policy making in most of the developing world, with relatively little formation of interest groups of proponents or opponents. Civil society dialogue and concern is perhaps most advanced in parts of Latin America and India. International networks, donor agencies, and research organizations are still very important for the establishment and continued functioning of many of the CRES mechanisms in place.

Some of the case study evidence is consistent with the ideas dominant model (H5). That is, countries that have most consistently embraced security of property rights, market exchange, and environmental conservation are most likely to have functional CRES mechanisms. Countries with weak or failed systems of property and markets are unlikely to see the development of robust CRES mechanisms. Within countries or regions with favorable policy conditions, the ideas dominant model may explain the adoption and diffusion of CRES mechanisms.

The case study evidence is not consistent with the settings dominant model of institutional change (H6). We find no evidence of CRES mechanisms developing in response to particular environmental disasters or government policy failures; instead they are more likely to develop in response to dramatic changes in the national institutional context. Changes in national laws that recognize and enhance the rights of local landowners were important to the development of CRES mechanisms in the Philippines and Costa Rica. In South Africa, the formulation of Working for Water was shaped by the dramatic change in governance and the high priority placed on rural employment generation. These experiences are more consistent with the chaos dominant model (H7).

Many of the case studies presented have been and continue to be supported by a number of multilateral agreements, international organizations and research–policy networks (H8). Because they are signatories to a range of multilateral environmental agreements, most developing countries have established similar institutional foundations for CRES, despite very different circumstances of scarcity and threats to their ecosystems. Environmental laws in many developing countries are best understood as framework laws that provide scope for CRES mechanisms. Successful case studies can provide the specific content and operational procedures for those framework laws. Research, monitoring, and evaluation are important to justify the establishment, implementation, and continued operation of public CRES mechanisms. This is particularly important for mechanisms involving larger areas and involving relatively complex cause–effect relationships.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/vol15/iss4/art6/responses/

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LITERATURE CITED

Barrantes, G., and L. Gamez. 2007. *Practical applications in the internalization and payments of environmental services related to drinking water.* Presentation at the Global Event on Payments/ Rewards for Environmental Services. Lombok, Indonesia, January 22-27, 2007. [online] URL: http://www.worldagroforestry.org/sea/portals/2/lombok/material/presentation/day1/session3/LGamez.pdf.

Biryahwaho, B. 2006. *Pro-poor compensation for environmental services: trees for global benefits programme of Ecotrust Uganda.* Presentation to the African Regional Workshop on Compensation for Ecosystem Serivces, May 24-25, 2006. World Agroforestry Centre, Nairobi, Kenya.

Castro, R., F. Tattenbach, L. Gamez, and N. Olson. 2000. The Costa Rican experience with market instruments to mitigate climate change and conserve biodiversity. *Environmental Monitoring and Assessment* **61**:75-92.

Demsetz, H. 1967. Toward a theory of property rights. *American Economic Review* **57**(2):347-359.

Espaldon, V. 2005. *Looking through the eyes of the future: Rewarding Upland Poor for Environmental Services (RUPES) in the Philippines.* RUPES Working Paper, World Agroforestry Centre Southeast Asia, Bogor, Indonesia.

Food and Agriculture Organization (FAO). 2007. *The state of food and agriculture 2007: paying farmers for environmental services.* Food and Agriculture Organization of the United Nations, Rome, Italy.

Gichohi, H. W. 2003. *Direct payments as a mechanism for conserving important wildlife corridor links between Nairobi National Park and its wider ecosystem: The Wildlife Conservation Lease Program.* Paper presented at the Fifth World Parks Congress, Durban, South South Africa.

Grossman, S. J., and O. D. Hart. 1986. The costs and benefits of ownership: a theory of vertical and lateral integration. *The Journal of Political Economy* **94**(4):691.

Jindal, R., B. Swallow, and J. Kerr. 2008. Carbon sequestration projects in Africa: potential benefits and challenges. *Natural Resource Forum* **32** (2):116-130.

Jordan, A., R. Wurzel, A. Zito, and L. Bruckner. 2003. European governance and the transfer of "new" environmental policy instruments (NEPIs) in the European Union. *Public Administration* **81** (3):555-574.

Kern, K., H. Jörgens, and M. Jänicke. 2001. *The diffusion of environmental policy innovations: a contribution to the globalization of environmental policy.* Social Science Research Centre, Berlin, Germany.

Khan, A. 2006. *Working for Water Programme: towards ensuring voluntary payments for ecosystem services.* Presentation at the African Regional Workshop on Compensation for Ecosystem Services, May 2006. World Agroforestry Centre, Nairobi, Kenya.

Kingdon, J. W. 1984. *Agendas, alternatives, and public policies.* Little Brown, Boston, Massachusetts, USA.

Kosoy, N., M. Martinez-Tuna, R. Muradian, and J. Martinez-Alier. 2007. Payments for environmental services in watersheds: insights from a comparative study of three cases in Central America. *Ecological Economics* **61**(2-3):446-455.

Millennium Ecosystem Assessment. 2005. *Ecosystems and human well-being: synthesis report.* Island Press, Washington, D.C., USA.

Moreno, G. B. 2006. Economic valuation of water supply as a key environmental service provided by montane oak forest watershed areas in Costa Rica. Pages 435-446 *in* M. Kappelle, editor. *Ecology and conservation of neotropical Montane Oak Forests.* Springer-Verlag, Berlin, Heidelberg, Germany.

Nelson, R. R., and S. G. Winter. 1982. *An evolutionary theory of economic change*. Harvard University Press, Cambridge, Massachusetts, USA.

North, D. C. 1994. Constraints on institutional innovation: transaction costs, incentive compatibility, and historical considerations. Pages 48-70 *in* V. W. Ruttan, editor. *Agriculture, environment and health: sustainable development in the 21st century.* University of Minnesota Press, Minneapolis, Minnesota, USA.

Ochieng, B., B. O. Otiende, and R. Rumley, editors. 2007. *Report on the Africa Regional Workshop on Compensation for Ecosystem Services.* World Agroforestry Centre and African Centre for Technology Studies, Nairobi, Kenya.

Organization for Economic Cooperation and Development (OECD). 2004. *Tradeable permits: policy evaluation, design and reform.* OECD Publishing, Paris, France.

Organization for Economic Cooperation and Development (OECD). 2005. *Nutrient trading: a water quality solution?* OECD Publishing, Paris, France.

Pagiola, S., A. Arcenas, and G. Platais. 2005. Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date from Latin America. *World Development* **33**(2):237-253.

Pagiola, S., E. Ramírez, J. Gobbi, C. de Haan, M. Ibrahim, E. Murgueitio, and J. P. Ruíz. 2007. Paying for the environmental services of silvopastoral practices in Nicaragua. *Ecological Economics* **64**(15):374-385.

Peltzman, S. 1976. Toward a more general theory of regulation. *Journal of Law and Economics* **19** (2):211.

Pigou, A. C. 1920. *Economics of welfare.* Macmillan, London, UK.

Poats, S. V., editor. 2007. *Report on the Latin America Regional Workshop on Compensation for Environmental Services and Poverty Alleviation in Latin America.* Corporacion Grupo Randi Randi and World Agroforestry Centre, Nairobi, Kenya and Quito, Ecuador.

Postel, S., and B. H. Thompson. 2005. Watershed protection: capturing the benefits of nature';s water supply services. *Natural Resources Forum* **29**:98-108.

Raju, K. V., S. Puttaswamaiah, M. Sekher, and R. Rumley, editors. 2007. *Report on the Asia Regional Workshop on Compensation for Ecosystem Services.* Institute for Social and Economic Change and World Agroforestry Centre, Bangalore, India and Nairobi, Kenya.

Sanchez-Azofeifa, G. A., A. Pfaff, J. A. Robalino, and J. P. Boomhower. 2007. Costa Rica's payment for environmental services program: intention, implementation and impact. *Conservation Biology* **21**(5):1165-1173.

Swallow, B., M. Kallesoe, U. Iftikhar, M. van Noordwijk, C. Bracer, S. Scherr, V. Raju, S. Poats, A. Duraiappah, B. Ochieng, H. Mallee, and R. Rumley. 2009. Compensation and rewards for environmental services in the developing world: framing pan-tropical analysis and comparison. *Ecology and Society* **14**(2):26. [online] URL: http://www.ecologyandsociety.org/vol14/iss2/art26/.

Turpie, J. K., C. Marais, and J. N. Blignaut. 2008. The Working for Water Programme: evolution of a payments for ecosystem services mechanism that addresses both poverty and ecosystem service delivery in South Africa. *Ecological Economics* **65** (4):788-798.

Wunder, S. 2005. *Payments for environmental services: some nuts and bolts.* CIFOR Occasional Paper No. 42. Centre for International Forestry Research, Bogor, Indonesia.

Wunder, S., and M. Alban. 2008. Decentralized payments for environmental services: the cases of Pimampiro and PROFAFOR in Ecuador. *Ecological Economics* **65**(4):685-698.