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ECONOMICS OF LAND DEGRADATION

The Costs of Action versus Inaction

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In recent years, prices of agricultural land have increased quickly, actually doubling and tripling in many parts of the world. This land value reassessment has been prompted by rising crop prices and perceived land scarcity. But even as the value of land rises, land degradation continues and investments to prevent it are lagging. Awareness of environmental risks has moved to the forefront of global consciousness during the past 25 years. However, this awareness has not translated into comprehensive action to address the problem of land degradation, which poses a serious threat to long-term food security. This inaction is primarily the result of limited knowledge of the costs related to land degradation and of insufficient institutional support. Policy action and research are needed to resolve this paradox of high-value land and low levels of investment.

Past assessments of land degradation have focused on the biophysical impacts rather than on the overall societal and economic costs and benefits of degradation prevention. Additionally, past studies have largely addressed how land degradation impacts on-site productivity while paying limited attention to its off-site costs, which often make it a transnational and global issue. To address these and other gaps, a framework to measure the economic costs of land degradation must be established.

In a new book, *The Economics of Land Degradation: Toward an Integrated Global Assessment*, the authors propose a framework to implement the costs-of-action-versus-costs-of-inaction approach and emphasize the need to take into account direct and indirect costs and benefits of terrestrial ecosystem services in the process. They identify a number of immediate and underlying causes of land degradation and propose prevention methods. The book also highlights why it is more cost effective to implement prevention methods now than to attempt to treat severely degraded land in the future and provides salient examples. The authors put forward a partnership concept for implementing the recommendations in order to deliver the much-needed global, integrated, and peer-reviewed economic and policy assessment of land degradation. They also propose that sustainable land use and the prevention of land and soil degradation become key global initiatives at the upcoming Rio+20 United Nations Conference on Sustainable Development and other forums in 2012.

WHAT IS LAND DEGRADATION AND WHERE DOES IT OCCUR?

Land degradation is the loss of beneficial goods and services derived from terrestrial ecosystems, which include soil, vegetation, other plant and animal life, and the ecological and hydrological processes that operate within these systems. Among the more visible forms of land degradation are desertification,

deforestation, overgrazing, salinization, and soil erosion, all of which can result from either human activities or natural causes.

Past efforts to combat land degradation have focused on arid areas, where it leads to desertification. However, as observed in the Global Land Degradation Assessment study conducted in 2003, 78 percent of the world's land degradation between 1981 and 2003 actually took place in humid and subhumid areas.¹ The study determined that negative correlations between aridity and land degradation existed at the global level, suggesting that the extent and severity of land degradation were even greater in humid and subhumid areas than in arid, semiarid, and hyperarid areas (Figure 1). Thus, land degradation is a global problem affecting many different climates, as well as countries with different income levels.

WHAT CAUSES LAND DEGRADATION?

The immediate causes of land degradation include biophysical causes and unsustainable land management practices. Contributing biophysical causes include topography, which determines soil erosion hazard, and climatic conditions, such as rainfall, wind, and temperature. Unsustainable land management practices, such as deforestation, forest degradation, soil nutrient mining, and cultivation on steep slopes, are also direct contributors to land degradation.

Some of the underlying causes of land degradation include population density, poverty, land tenure, and access to agricultural extension, infrastructure, and markets, as well as policies that promote the use of land degrading practices (for example, bioenergy subsidies that encourage the conversion of land use at the expense of biodiversity). Underlying causes of land degradation often have self-perpetuating characteristics. For example, poverty can lead to underinvestment in sustainable land management practices. At the same time, poverty can be induced or increased by degraded soil

productivity. The relationship between immediate and underlying causes is complex; empirical evidence shows that the impact of underlying factors is context specific.

In this brief, the authors focus on land degradation's underlying causes, which lend themselves more to modification and intervention (Figure 2), and pay particular attention to the relationships between land degradation and three of its major underlying causes—population density, poverty, and government effectiveness. Some of their findings challenge conventional wisdom: for example, at the global level and in certain regions (including East Asia and the Middle East), the negative correlation between population density and land degradation reflects the idea that more people means less erosion (Figure 3). Other results, such as the positive correlation between poverty (measured by the mortality rate of children under five) and land degradation, were expected. Also, the strong correlation between government effectiveness and land degradation underscores the important role institutions play in land management (Figure 4).

HOW DO WE PREVENT OR MITIGATE LAND DEGRADATION?

Biophysical scientists have designed methods to address different forms of land degradation, but persuading land users to adopt these methods remains a challenge.² In order to achieve some meaningful results, policies and programs should focus

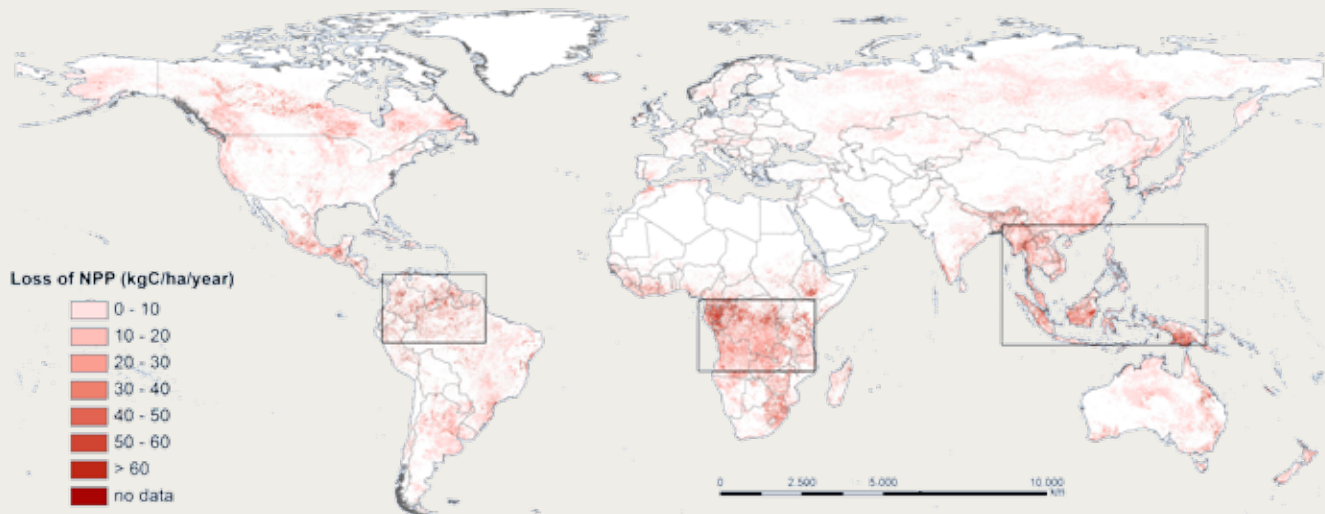
on addressing and changing the behavioral patterns that lead to land degradation.

Land users must receive direct benefits from preventing or mitigating land degradation. Empirical evidence shows that land users are more likely to prevent or mitigate land degradation when they benefit directly from the necessary investments and when those benefits outweigh the benefits of continuing current practices that degrade the land. For example, farmers in Niger started actively protecting or planting trees once they were given a mandate to own the trees.

Integrated local, national, and international institutions and policies increase land investments. Institutions mediate the causes of land degradation. Strong local institutions vertically linked with national and international institutions will empower local communities to manage natural resources more sustainably. Studies have shown that people are more likely to comply with regulations enacted by local councils than with regulations imposed by higher authorities, so national-level policies should support local institutions in managing their own natural resources. For example, communities in India and Peru made significant progress when they used bottom-up approaches to manage natural resources.

National-level policies that promote land investment can also have a direct influence on land users' decisions. China's and Costa Rica's payments for ecosystem services are examples of the impact of good policies. Land-tenure policies that give formal or perceived tenure security also enhance long-term investment in land improvement.

Figure 1—Loss of annual net primary production (NPP), Global Land Degradation Assessment, 1981–2003



Source: Authors.

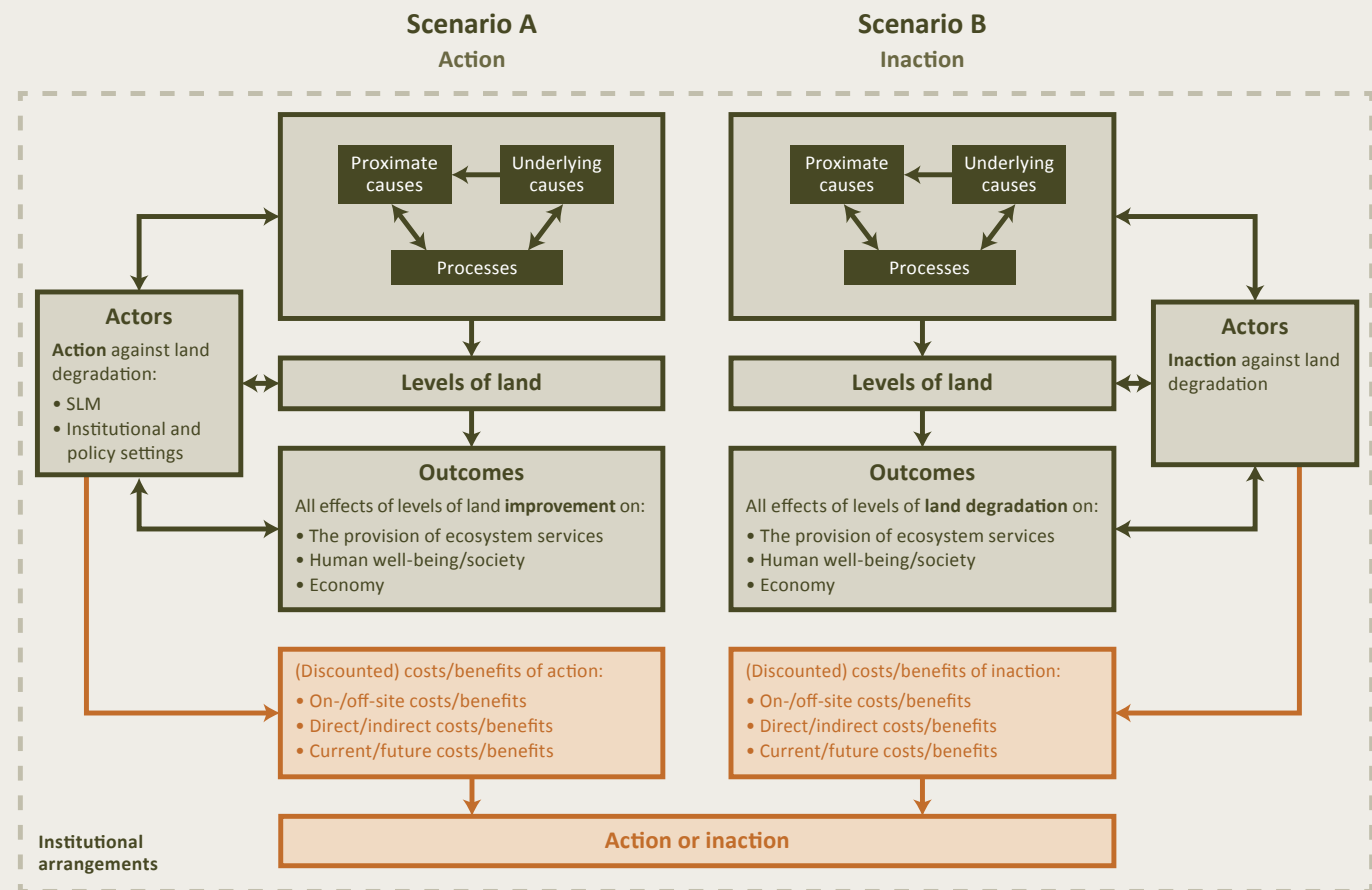
THE ECONOMIC COSTS OF ACTION VERSUS INACTION: PREVENTION OR CLEANUP?

International efforts to achieve sustainable development heavily influence national laws and policies. For example, international conventions, such as the United Nations Convention to Combat Desertification, have spurred efforts to prevent or mitigate land degradation in dry areas. The clean development mechanism and other global sustainable development efforts have also catalyzed a rapid rise in the global carbon trade. The international community should take advantage of its influence by creating a global initiative to prevent degradation of the world's land and soil.

Access to rural services is key to increasing benefits from investment in land management. Access to rural roads, extension services, communication infrastructure, markets, and other rural services helps increase returns on land investment since these rural services link land users to markets and reduce transaction costs. For example, improved access to roads and markets in Machakos, Kenya, led land users to increase investments in soil erosion prevention methods.

The 2005 Millennium Ecosystem Assessment estimated that 60 percent of the earth's ecosystem services were degraded, largely due to human causes.³ Forty-two percent of the world's poor depend on degraded lands for nutrition and income. With such a large portion of the world's land and population affected, the cost of land-based ecosystems degradation could amount to US\$66 billion per year. National-level studies have also been conducted to determine the cost of land degradation as a percentage of the gross domestic product (GDP). A review of the costs of land degradation in Sub-Saharan Africa revealed that they can be as much as 10 percent of national GDP. This underscores the seriousness of land degradation and its impact on human welfare and food security.

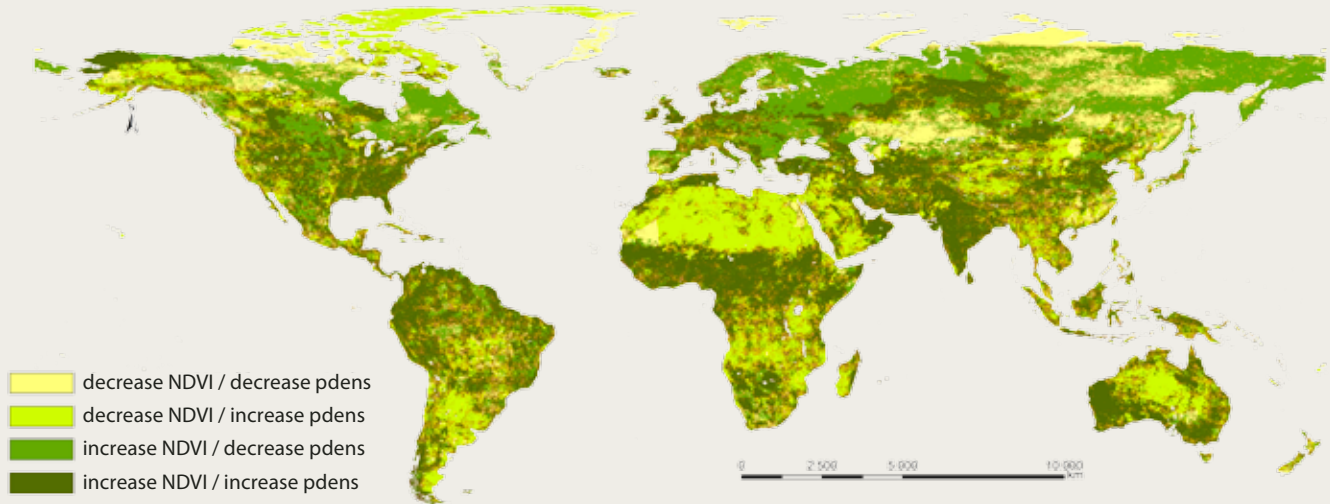
Figure 2—Conceptual framework of action versus inaction to prevent land degradation



Source: Authors.

Note: SLM = sustainable land management

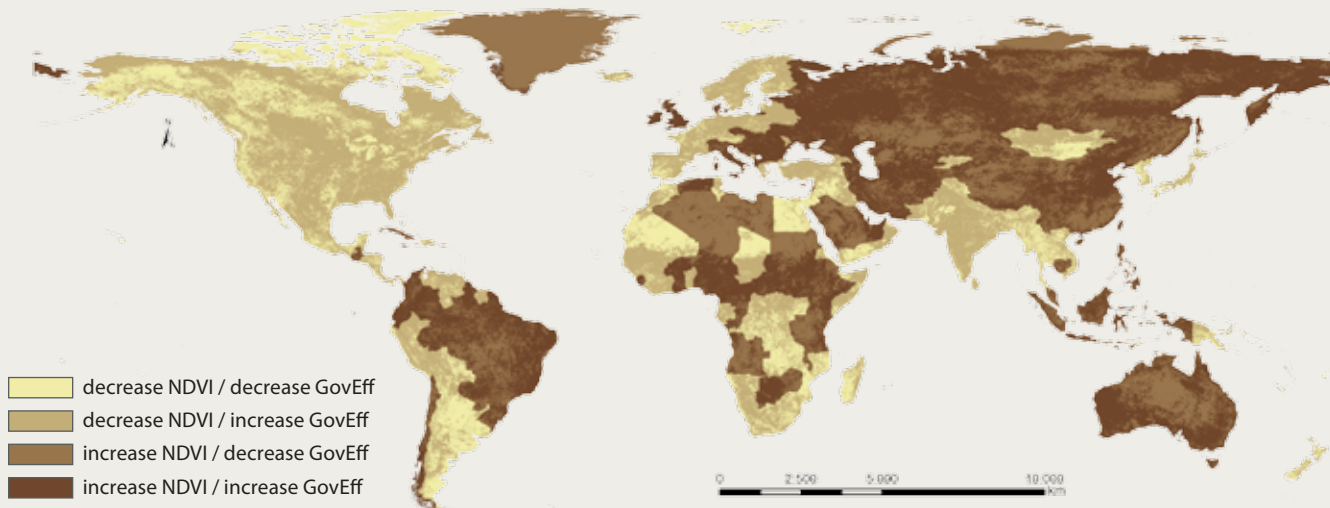
Figure 3—Relationship between change of population density and greenness (as measured by NDVI), 1981–2006



Source: Authors.

Notes: NDVI = Normalized Difference Vegetation Index; pdens = population density. Greenness maps show the health and vigor of plant growth, vegetation cover, and biomass production. Generally speaking, increasing greenness indicates land improvements while declining greenness indicates land degradation. NDVI assigns a numerical ranking to the amount of vegetation shown in the maps.

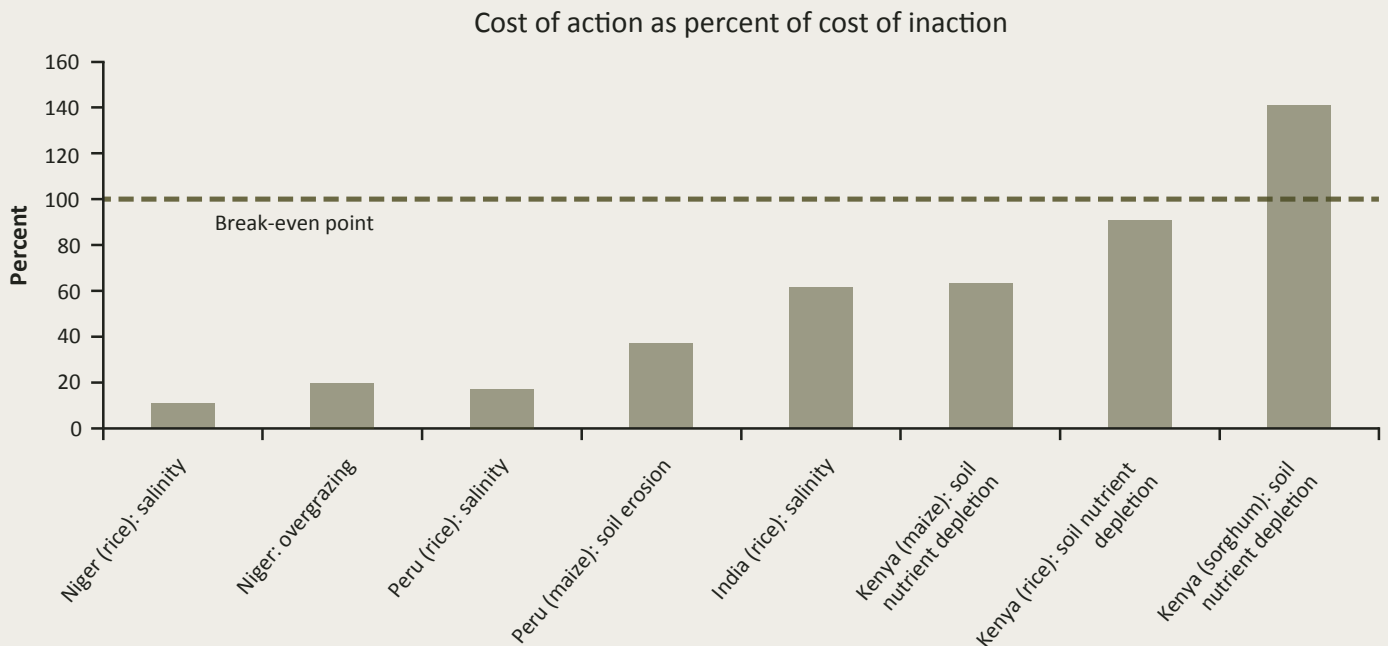
Figure 4—Relationship between government effectiveness and greenness (as measured by NDVI), 1981–2006



Source: Authors.

Notes: NDVI = Normalized Difference Vegetation Index; GovEff = government effectiveness. Greenness maps show the health and vigor of plant growth, vegetation cover, and biomass production. Generally speaking, increasing greenness indicates land improvements while declining greenness indicates land degradation. NDVI assigns a numerical ranking to the amount of vegetation shown in the maps.

Figure 5—Costs of action versus inaction in preventing land degradation in Niger, Peru, India, and Kenya



Source: Authors.

Why do countries not take commensurate action to prevent or mitigate land degradation? Are the benefits worth the additional costs, or are the costs of action greater than the costs of inaction? These questions are the basis of the costs-of-action-versus-costs-of-inaction approach. For the approach's correct application, one must use information about all costs (from society's point of view) related to prevention or mitigation of land degradation (action) and continued degradation (inaction). Actions to prevent land degradation will have to take into account both the immediate and underlying causes of land degradation. Using this method of economic analysis, the authors conducted an in-depth analysis of the costs of land degradation prevention methods versus the projected costs of inaction in several countries, including India, Kenya, Niger, and Peru, which represent major regions in the developing world.

India

About 2 percent of crop area in India is affected by salinity. Salinity reduces crop rice yields by as much as 22 percent, and, based on crop simulation models, the cost of desalinization mechanisms such as staggered leaching (using more water to avoid excess salt buildup) was estimated at only 60 percent of the costs of inaction. This suggests that profit incentive is not the reason for inaction (Figure 5).

Kenya

As is the case for most African countries, soil nutrient depletion is a major problem in Kenya. In the cases of maize and rice, the costs of action to prevent soil nutrient depletion were less than the costs of allowing nutrient depletion to continue. For sorghum, however, the price of prevention was more than the price of nutrient depletion (Figure 5). These results show that most often the cost of prevention is less than the cost of land degradation, but some land management practices to prevent land degradation could cost more than doing nothing to mitigate degradation. In such cases, an effort should be made to find alternative land management practices that are more economically efficient.

Niger

The majority of the population of Niger depends heavily on the land for food and income. Soil nutrient depletion, overgrazing, and salinity in irrigated plots are major land degradation problems. The country loses about 8 percent of its GDP due to overgrazing, salinity in irrigated rice, and soil nutrient depletion of sorghum and millet. In Niger, the cost of preventing salinity in irrigated rice is only about 10 percent of the cost of not preventing it per hectare, and the cost of preventing overgrazing is just 20 percent of the cost of allowing overgrazing to continue (Figure 5).

Peru

Soil erosion afflicts the Andean region of Peru, which makes up about 30 percent of the country. Soil erosion has been shown to reduce maize yields by 2 percent on plots of sloped land. While the cost of establishing terraces to reduce the effects of erosion is estimated at US\$364 per hectare, the net present value of plots with terraces is about US\$984 per hectare. The cost of action (that is, creating terraces) is actually even lower when looked at as a long-term investment. The cost of salinity in the irrigated crops of the arid and semiarid coastal region (about 34 percent of the land) was also evaluated using rice yields. Crop simulation results showed that salinity reduced rice yields by 22 percent in Peru, which led to a loss of US\$402 per hectare. The cost of desalinization methods was US\$69 per hectare, which is only 17 percent of the cost of not taking any action (Figure 5).

WHAT ARE THE NEXT STEPS?

As the research and case studies demonstrate, the international development community can contribute in numerous ways to prevent or mitigate land degradation (Figure 6). The

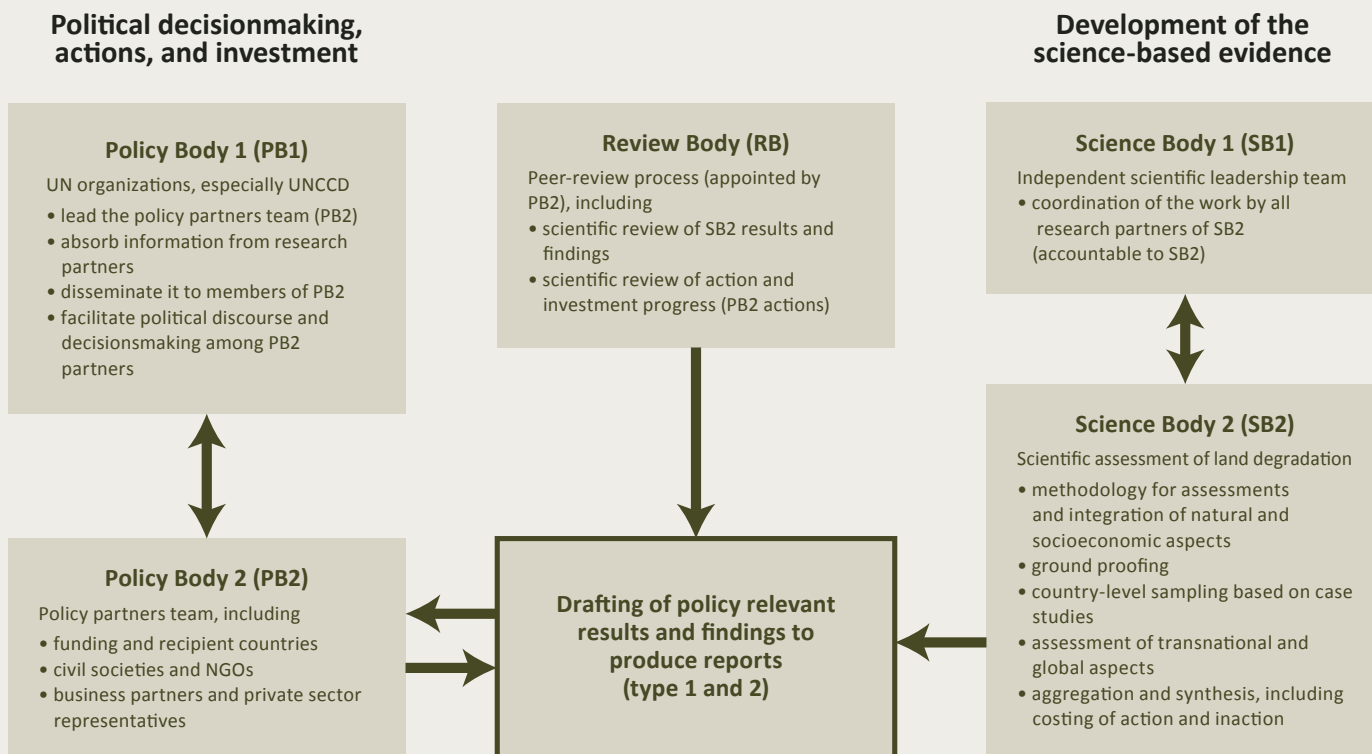
authors have identified the most pressing contributions that should be made based on their research.

The international development community should decentralize natural resource management, invest in agricultural research and development, and build local capacity for participatory programs. Clarified property rights and related legal protection and enforcement of rights, including for communal lands, is part of the needed institutional agenda for sustainable land use.

Applied research should be scaled up. To achieve sustainable land use and overcome degradation, one must conduct rigorous assessments of the economic costs of land degradation, which will require collaboration across regions and across sectors, in particular, among biophysical scientists, socioeconomicists, and policymakers. A coordinated international effort is needed to prioritize related research investments efficiently and effectively.

The models of influential global initiatives in natural resource management should be used to tackle the issue of land and soil degradation. Examples of such initiatives include the Economics of Ecosystem Biodiversity study and the Intergovernmental Panel on Climate Change. Involving all stakeholders in the process of global assessment in an open

Figure 6—Institutional set up for a global assessment of the economics of land degradation in a costs-of-action-versus-inaction framework



Source: Authors.

Notes: Reports type 1: science-based findings, under the responsibility of RB; reports type 2: policy reports, under the responsibility of PB1

consultation is crucial. Particular attention should be paid to the independence and transparency of the scientific assessment, while ensuring its close link to the needs of the political stakeholders.

The current awareness of the fast-rising value of land and of the threats of land degradation can catalyze the action that has been needed for some time. Growing international investments in land resources provide potential for mobilizing a partnership to assess the global economics of land degradation and to implement recommended action. Sustainable land use and the prevention of land and soil degradation should become key global initiatives at the upcoming Rio+20 United Nations Conference on Sustainable Development and other forums in 2012 and beyond.

Implementing these next steps is crucial because they create a global, cooperative effort rather than a piecemeal, region-by-region solution. Carefully strategized efforts to reduce land degradation and improve agricultural productivity will have a vast and profound impact on the world's

food supply and the well-being of poor people in developing countries.

NOTES

1. Z. G. Bai, D. L. Dent, L. Olsson, and M. E. Schaepman, *Global Assessment of Land Degradation and Improvement. 1. Identification by Remote Sensing*. Report 2008/01, (Wageningen, the Netherlands: ISRIC – World Soil Information, 2008).
2. For more details, see P. L. Vlek, Q. B. Le, and L. Tamene, "Assessment of Land Degradation, Its Possible Causes, and Threat to Food Security in Sub-Saharan Africa," in *Food Security and Soil Quality*, ed. R. Lal and B. A. Stewart (Boca Raton, Florida, USA: CRC Press, 2010), 57–86; and R. Lal, "Managing Soils and Ecosystems for Mitigating Anthropogenic Carbon Emissions and Advancing Global Food Security," *BioScience* 60, no. 9 (2010).
3. Millennium Ecosystem Assessment, *Living Beyond Our Means: Natural Assets and Human Well-Being* (Washington, DC: Island Press, 2005).

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