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Poverty and Environment in Latin America: Concepts, Evidence and Policy Implications

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Summary. — Who is responsible for the ongoing degradation of natural resources such as agricultural soils, rangeland, and forests? Evidence from across Latin America suggests that the nonpoor and the poor are both at fault. While the poor lack the means to invest in protecting natural resources, both the nonpoor and the poor often lack the incentives for good resource stewardship. Policies for agricultural intensification and livelihood diversification can alleviate poverty and its capacity constraint. But incentive policies for good stewardship are critically needed. Such policies should be targeted to specific environmental problems and tailored to the motivations of rural decision makers.

Key words — Latin America, poverty, environment, natural resource sustainability, intensification, policy incentives

1. MOTIVATION AND CONCEPTUAL FRAMEWORK

A broad literature dating back to Thomas Malthus associates natural resource sustainability with human management. Malthus predicted disaster in a world with static production technology, a fixed land resource, and rising population. But such a disaster has not occurred. Several authors cite agricultural intensification as the reason, where rising population density has stimulated productivity-enhancing technological and behavioral change (Boserup, 1981; Templeton & Scherr, 1999; Tiffen, Mortimore, & Gichugi, 1994). Opposing this view, the neo-Malthusian pessimists focus on the "too poor to invest" hypothesis, arguing that population growth without prosperity precludes productivity-enhancing investments, undermining future productivity and leading to a downward spiral of poverty (Figueroa, 1998; Mink, 1993).

Reardon and Vosti (1995) contributed a fresh perspective by examining poverty from the standpoint of rural households' ability and willingness to invest in sustainable natural

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resource management (NRM). They make three key points. First, much of the poverty literature defines poverty as inability to meet basic human needs, which Reardon and Vosti characterize as "welfare poverty." They note however, that even households that are not poor by the welfare definition may still suffer from "investment poverty," in the sense of lacking adequate wealth to invest in sustainable NRM. Second, imperfect markets may prevent assets from being converted from one form to another. For example, lack of employment opportunities may prevent large households with ample labor assets from converting that labor into financial capital. The potential difficulty of converting assets to different forms means that the specific distribution of assets matters for NRM. Households that abound in labor may be forced toward unsustainable, labor-led intensification strategies (e.g., Clay, Reardon, & Kangasniemi, 1998). Hence, the *capacity* of rural households to invest in more sustainable natural resource management depends on both (a) having adequate aggregate assets for investment in NRM and (b) having a distribution of assets that permits capital-led intensification. Third, while the capacity for capital-led investment is a necessary condition for households to change behavior by engaging in sustainable NRM activities, it is not sufficient. Households must also perceive the *incentives* to invest in NRM. Incentives take many forms, including relative profitability, riskiness and the safety of household members. Policies designed to induce sustainable NRM activities must make those choices attractive, as well as ensure that the means are available to undertake them.

The Reardon and Vosti (1995) conceptual framework begged empirical testing to verify how their hypotheses about the importance of incentives and capacity would hold up across different asset levels and distinct eco-regions. That conceptual framework was the basis for a set of studies conducted under an umbrella research project funded by the Inter-American Development Bank and conducted by RIMISP collaborators during 1999–2001. The studies in this special section report results from three distinct eco-regions of Latin America: tropical rainforest, mountain ranges, and coastal desert.

The project participants applied the Reardon and Vosti (1995) framework in three ways: (i) characterizing asset levels and the distribution of asset types, (ii) analyzing the link between natural resource outcomes and household activities, and (iii) analyzing how assets and other factors affected those activity choices. The first step involved measuring capital assets of all sorts, including physical, financial, natural, manufactured, human and social capital. The two analysis steps trace the links between how natural resource outcomes (degradation or improvement) result from human technology and activity choices, and how activity choices result from asset levels and other factors. The two-step model takes the form:

(1) Assets	→	Activity choice (including on-farm activities, common pool resource exploitation, commerce, and emigration)
(2) Activity choice	→	Natural resource outcomes (to soil, biodiversity, natural forests and pastures, and agrochemical pollution)

In synthesizing the results of the evidence presented here, we focus on answers to two broad questions: What unique findings emerge from the particularities of individual studies? What crosscutting policy implications can be drawn from these six studies?

2. FINDINGS BY ECO-REGION

Eco-regional conditions determine which natural resources abound and which face the greatest threats from human management. The six studies cover three broad eco-regions along an imaginary East-West transect that begins in the heart of the Amazonian rainforest, and proceeds across the mountains to the coastal desert. In the rainforest, biodiversity and forest ecosystem services abound, but are threatened by depletion for wood products and agricultural land clearing. In the mountains, depletion threatens the farmed soils of unprotected hillsides and natural pastures being grazed as a commons, while contamination from excess agrichemical use threatens pockets of intensive production. In the arid coastal plain, extensive grazing of common pastures threatens the survival of the sparse vegetative cover. These natural resource problems and related management practices are summarized by eco-region in Table 1.

(a) *Amazon rainforest*

Virgin rainforest and tropical pasture are the endpoints of the deforestation continuum in the

Table 1. *Eco-regions, natural resource degradation problems and associated management practices in Latin America*

Eco-region	Natural resource problems	Country cases	Management practices
Rainforest	Deforestation	Brazil	Slash and burn farming
		Peru	Building shelters for Brazil nut gatherers
	Biodiversity loss	Peru	Hunting
Mountain	Soil degradation	Colombia, Nicaragua, Peru	Continuous cropping
	Deforestation	Colombia, Peru	Collecting firewood, construction wood
	Biodiversity loss	Colombia, Peru	Hunting, overgrazing
	Pesticide exposure	Nicaragua	Pesticide overuse
Arid coastal	Overgrazing	Chile	Overstocking
	Deforestation		Collecting firewood

Amazon basin. The process is obviously difficult to reverse, so policy proposals focus on protecting virgin forest. For rainforest distant from the agricultural frontier, the leading protective policies proposed have been designation of publicly protected reserves, and development nontimber forest products that make forest conservation profitable.

In the Amazon rainforest, Brazil nuts are the leading nontimber forest product, so Escobal & Aldana (this issue) ask whether fostering Brazil nut gathering can save the forest. The surprising answer is "no." The Brazil nut harvest in Madre de Dios department, Peru, occurs during the three months that are unsuited to farming, but Brazil nut gatherers need to generate income all year round. Although the nonpoor nut gatherers tend to earn more nonfarm income (largely from urban service jobs), the poorest rely on land-based activities like farming, which they often do in the rainforest near their Brazil nut groves. Land-clearing for agriculture and cutting wood for shelters lead to patches of deforestation. Brazil nut harvesters isolated in the forest also hunt for food, endangering several mammal species.

Escobal and Aldana offer two ways to alleviate pressure on the forest. Clearer property rights to specific Brazil nut groves would encourage greater investment in sustained productivity if rights-holders could exclude interlopers from harvesting their nuts and felling trees for farming. Education would help too, by qualifying rural householders for urban service jobs and facilitating agricultural intensification that allows less land to be used for the same level of farm output. Over the long haul, the authors find that alternative income-generating strategies are needed to keep people out of the rainforest, rather than to develop nontimber forest products like Brazil nuts.

As viewed from the agricultural frontier of the rainforest in Brazil, deforestation appears inevitable (Vosti *et al.*, this issue). Vosti *et al.*'s optimization model of a relatively poor representative farm illustrates the power of market incentives to induce conversion of all standing rainforest to annual crops and then to cattle pasture within 25 years. A proposed small-scale managed forestry strategy would postpone by just five years the total eradication of virgin rainforest. In effect, the household exploits its natural resource endowment to escape poverty. While converting natural capital to other forms can raise household incomes, there is no guarantee that future reinvestment in NRM will occur to recoup the rainforest ecosystem services lost (Pearce & Atkinson, 1995). Given current incentives, Vosti *et al.* find that "only effective land use regulation can halt deforestation," implying that extreme changes to current incentives are needed if conserving uses of the rainforest are to become more attractive than conversion to pasture.

(b) *Mountain eco-region*

Population densities in the rainforest are low. At higher population densities, does the poverty–environment relationship generate a push toward sustainable intensification, as the Boserup school would predict? Does sustainable intensification occur at least among those who are not investment poor in the Reardon and

Vosti sense? The mountain ranges that stretch from the Andes up through the Sierra Madre have supported a large share of Latin America's population since pre-Columbian times. Humans long ago cleared most of the virgin forest in this eco-region. With widespread farming and livestock herding, the NRM focus has shifted toward agricultural natural resources: soil depth and quality, native pasture cover and quality, and freedom from agrochemical contamination. Native forests and wildlife matter too, but are less prevalent than in the rainforest. The wide range in altitudes, rainfall levels, slope conditions, infrastructure availability and public laws and institutions creates enormous variety in the feasible rural economic activities as well as the natural resource outcomes possible.

The Altiplano between Peru and Bolivia has supported dense human population since pre-Incan times. Near Puno, Peru, investment poverty remains widespread, despite recent emigration flows toward the coast and rainforest (Swinton & Quiroz, this issue). In the densely populated areas around Lake Titicaca, soil degradation is reducing crop yields. At higher, drier altitudes where range-fed livestock prevail, overgrazing is robbing common pastures of preferred forage species, and cutting fuel wood steadily diminishes the remaining shrub forest cover. Because investment poverty is endemic, financial and physical assets influence natural resource degradation in only two cases: Herders with more animals caused more pasture species loss (the nonpoor at fault), while poor households cut more firewood for sale (the poor at fault). In both instances, the motivation for natural resource depletion appears to arise more from skewed incentives than from lack of capacity, although both contribute in the firewood case.

Altiplano crop farmers rely on rotational fallow to restore soil fertility, while herders rely on rotational grazing to maintain pasture quality (Swinton & Quiroz, this issue). Both are extensive systems that substitute land, labor, and social capital for scarce financial capital to maintain the natural stock of soil fertility. The system functions on a slowly declining, low-productivity trajectory. Limited government assistance, remoteness from markets, and steady emigration conspire to prevent the intensification processes observed in certain other regions. Intensification has failed to occur as households prefer to diversify assets by supporting the emigration of family members to more promising destinations in cities or the rainforest frontier. Traditional NRM practices and slow net population growth are preventing rapid natural resource degradation, but the capacity—and often too the incentives—to invest in capital-led intensification are lacking.

In the warmer and wetter hillsides of Caldas, Colombia, the natural resource base offers more diverse and remunerative options to farmers who have occupied the land much more recently than those in Peru's Altiplano. Natural resource degradation takes the forms of soil erosion, deforestation, and biodiversity loss. Despite large differences in household wealth, Agudelo *et al.* (this issue) find that degradation is not linked to asset levels *per se*, but rather to certain farm types. Livestock ranches, whether large or small, cause serious erosion and deforestation (due to land clearing and cutting timber for fence posts); they also destroy more wildlife by hunting. By contrast, coffee farms, whether large or small, cause little natural resource degradation of any kind (except for modest pesticide use).

As capacity to invest in NRM is not lacking among many farm households in Caldas, Agudelo *et al.* examine what incentive payments would reduce natural resource degradation, while also aiding the poorest. Unique among the six studies here, they recognize that a cost-effective policy will bring greater environmental benefits, so they examine which farm household types would require the smallest payments to make meaningful changes in NRM. Using an optimization model, they conclude that the poorer ranchers and diversified farmers would most readily respond to incentives to conserve soil and protect forests. Unfortunately, they also find that even these easily bought farmers would require larger payments than prior research—even in wealthier donor countries—has found that taxpayers are willing to pay.

In the hillsides of northern Nicaragua, Ravnborg (this issue) explores similar natural resource themes in a setting of greater socio-economic inequality. She paints a picture of starkly unequal wealth levels where the non-poor plunder natural resources for profit, causing deforestation, overgrazing, pesticide overuse, and water depletion. Although the poorest are linked to soil erosion, most are sharecroppers who lack the incentive to invest in land improvements. Overall, she finds farmers that face incentives severely distorted from what would advance the welfare of society as a whole. Ravnborg's chief policy concern is that

the "narrative" of a poverty–environment vicious circle allows the wealthy to distract public attention from the environmental problems they cause. By focusing the natural resource sustainability debate on lack of capacity rather than distorted incentives, the too-poor-to-invest-in-NRM narrative advanced by the rich serves to attract outside project resources for the dependent poor, rather than to change the incentive structure that both perpetuates their poverty and encourages careless exploitation of natural resources.

(c) *Arid pacific coast*

A refreshingly upbeat counterpoint to the other five studies comes from the arid rangeland of central Chile's Region IV, which is experiencing a rare ecological recovery (Bahamondes, this issue). Despite rising goat and cattle populations, overgrazing of the common rangeland declined during 1991–99. Diversification and publicly subsidized credit provided the means for capital-led intensification, as small farmers invested in irrigation for intensive forage production. Higher forage productivity has reduced pressure on the native rangeland, allowing recovery of vegetative cover while total livestock population in the three communities has grown. Two external factors were key: During the 1980s, the Chilean government passed an irrigation law that subsidized irrigation investments for all farmers, but was especially generous to small farmers. Second, the grape boom sharply increased off-farm work opportunities for smallholders in the area. Both factors made financial capital available to smallholders for agricultural intensification. Even those who did not invest in irrigation have benefited indirectly, as reduced grazing pressure on the common rangeland has made available more pasture to other small-scale ranchers. The net effect has been a virtuous circle of rising incomes with environmental recovery.

3. CROSSCUTTING POLICY LESSONS

Although investment poverty was encountered in all six studies here, these articles find that the rural poor are no more responsible for natural resource degradation than the nonpoor. Too often, the right incentives are missing to induce good natural resource stewardship. When proper incentives are lacking, the capacity for responsible NRM becomes irrelevant. So the policy implications coming from these studies have as much to do with incentives to undertake NRM as they do with poverty alleviation.

Six policy lessons emerge from this rich mix of natural resource and socioeconomic settings. The *sine qua non* is that environmental policy must be tailored to the specifics of the problem. Next, we identify two familiar policies for alleviating poverty and its constraints on the capacity for sustainable NRM. Recognizing that too often the incentives for NRM are missing or distorted, we move on to principles for how to design environmental policy incentives. Finally, we look at how to ensure cost-effective policies for sustainable NRM.

(a) *Policies must be tailored to the problem and target the decision-maker*

Effective policies must be tailored to the environmental problem and target the decision maker whose behavior causes the problem. Targeting and tailoring go hand in glove, because environmental problems are linked to human incentives and capacity to act. When households lack the means to protect natural resources, capacity factors (poverty) are at fault. When households lack the desire to protect natural resources, incentives are at fault. Either way, targeted, tailored policies require a lucid understanding of the behavioral mechanisms behind observed environmental problems, whether in rich countries or poor ones (Batie & Ervin, 1999).

Even for a single natural resource degradation symptom, there is no "one-size-fits-all" policy. Consider deforestation. Trees may be timbered due to hugely different motivations. The impoverished Peruvian Altiplano herder selling bundles of firewood seeks minimal cash to buy necessities; he or she might readily accept a small payment not to chop the sparse, scrubby trees on land with no profitable alternative use. But the Brazilian farmer on the Amazonian frontier envisions broad cattle pastures where virgin rainforest now stands. To persuade that farmer not to transform that vision into reality would be quite difficult. A fundamental restructuring of incentives to clear land—probably by severely limiting property rights—would likely be required to protect that rainforest.

The targeting and tailoring of environmental policies call for understanding both decision-maker motivations for behavior and the alternative NRM practices that could contribute to more sustainable outcomes. Table 2 presents the

Table 2. *Alternative management practices to address underlying motivations of behavior causing natural resource degradation*

Natural resource problem and practices	Motivation	Alternative practice	Direct cost of alternative(s)	Opportunity costs of alternative(s)
Deforestation				
Slash and burn clearing	Enhance soil fertility	Fertilizers, manure, fallow	Moderate—high (fertilizers)	Low: unused land (fallow)
Firewood cutting	Cooking	Gas, electric stoves	Public infrastructure	
	Cash income	Wage employment	Job opportunities	
Construction wood	Building, cash income	Reforestation	Low	Moderate: replant time
		Wage employment	Job opportunities	
Soil degradation				
No fertility renewal	Lack of land, poverty	Fertilizers, manure, fallow	Low (manure)	Moderate: foregone
			Moderate (fertilizers)	harvest (fallow)
Cultivating steep slopes	Lack of flat land	Terracing	Low	High: much labor
Biodiversity loss				
Overgrazing	Common pastures	Private pasture, buy feed, forage production	Institutional change, high cash costs	
	Overstocking	Herd reduction		Moderate: foregone sales
Hunting	Obtain food	Buy domesticated meat	Moderate	
Pesticide exposure	Pest control, lack of protection	Pest scouting, Better protection	Public information, Low cash cost	Moderate: discomfort

major environmental degradation problems encountered in these articles, showing how they emerge from different human motivations and how they might be addressed by different alternative practices.

(b) *Intensification to exit poverty can relieve pressure on natural resources*

Agricultural intensification is a classic route out of agricultural poverty that is well illustrated by the Chilean case (Bahamondes, this issue). The win–win experience of Chile's goat herders shows how a policy that targeted irrigation investments helped to raise incomes and alleviated grazing pressure on the common rangeland. The root of the problem was lack of means: investment poverty that prevented smallholders from intensifying on their own. Targeted credit and off-farm employment overcame the capacity barrier. Because the overgrazing problem was linked to poverty, alleviating poverty alleviated overgrazing.

(c) *Diversification to exit poverty can also relieve the natural resource base*

Diversification away from land-based economic activities is another classic route to exit rural poverty. Peruvian Brazil nut gatherers who had transport jobs in the city of Puerto Maldonado spent less time in the rainforest than those without such jobs. They were also much less prone to clear forest for crop farming (Escobal & Aldana, this issue). Likewise, Chilean smallholders who worked on commercial grape farms reduced their reliance on extensive goat herding (and generated funds for intensive irrigated forage production) (Bahamondes, this issue). Indeed, the lack of off-farm employment opportunities is a likely reason that Brazilian rainforest frontier farms are so fixated on clearing land. Escobal & Aldana and Swinton & Quiroz (this issue) point to education as a way to alleviate poverty by creating new opportunities that do not depend on the land—another manifestation of the diversification route.

(d) *When degradation is not linked to poverty, policy should focus on incentives*

When the nonpoor cause natural resource degradation, incentives for sustainable NRM are generally awry. Nicaraguan truckers who buy firewood for resale from the protected Miraflor-Moropotente reserve and Brazilian farmers who fell the rainforest to raise cattle both make money without paying for the environmental externalities of deforestation. Incentive distortions due to environmental externalities are at the heart of environmental policy design in the developed world, where poverty tends to be less responsible for environmental problems (Casey, Schmitz, Swinton, & Zilberman, 1999). But getting the incentives for NRM right is equally relevant in the developing world when capacity to invest in NRM is not the main barrier (Sanders, Huszar, Sombatpanit, & Enters, 1999).

In theory, incentive-oriented environmental policies are most effective when they focus on environmental outcomes, rather than specific technologies or strategies believed to achieve those outcomes (Batie & Ervin, 1999). In this sense, policies like the carbon sequestration credit considered by Agudelo *et al.* (this issue) are theoretically attractive. In practice, however, such "first-best" policies sometimes require environmental information that is costly to acquire in the developed world and may be completely inaccessible in the developing world (Segerson, 1988). Hence, technology-based approaches like Vosti *et al.*'s sustainable forestry management scheme may prove to be viable, despite not focusing directly on environmental outcomes.

(e) *Property rights shape incentives*

One key means to internalize externalities is to ensure that property rights are clear and complete (Coase, 1960). Ill-defined property rights, like the entitlements to harvest specific Brazil nut groves in Peru, fail to exclude some users. Because the benefits from good stewardship are not limited to title-holders, there is less incentive to for them to protect the forest (Escobal & Aldana, this issue). The land rights of sharecroppers in Nicaragua are clear but incomplete (Ravnborg, this issue), hence the weak incentive for soil conservation.

Property rights are difficult or impossible to assign when they involve intangible benefits such as the positive externalities associated with the ecosystem services of a forest (Wunder, 2001), at least without tying those rights to land ownership. In such cases, blunter incentive policies may be required that involve payments or subsidies from public budgets.

(f) *Cost-effective policies can accomplish more*

Cost-effective policy designs achieve more impact from limited public budgets. Targeted,

tailored policies that address incentives may accomplish little if they are costly to administer. Agudelo *et al.* (this issue) illustrate one means to estimate farmers' willingness to accept incentive payments to change their behavior. In so doing, they show where public expenditures would achieve the most "bang for the buck." Equally important, they note that the public (be it taxpayers or foreign donors) must be willing to pay at least as much as it would cost to induce farmers to change their behavior.

As a group, these studies also show that natural resource degradation can be tackled at some level on vastly different budgets. A major environmental turnaround such as the Chilean rangeland recovery requires major public investment. But, at least where the human population remains stable, a low-level sustainable equilibrium can sometimes be maintained by low-cost, cooperative practices, as occurred with the Peruvian Altiplano community crop rotation and rotational grazing practices.

4. CONCLUSION

In most of Latin America, rising rural populations are threatening the sustainability of the natural resource base that underpins livelihoods and provides ecosystem services from local to global in scope. The diverse studies of poverty–environmental linkages presented in this issue advance the debate in two important directions. They illustrate that distorted incentives are equally if not more responsible for natural resource degradation than poverty alone. In addition, they offer fresh policy ideas for how to tackle poverty and redesign incentives for better stewardship in the future.

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