Special Section Essay

Systemic Conservation, REDD, and the Future of the Amazon Basin

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Introduction

The environmental movement has won hundreds of critical battles, but it is losing the war. The capacity of the planet to sustain life is declining (Brown 2011). In this essay, we introduce the concept of systemic conservation as a response to this global environmental challenge. We define it as the protection and restoration of the ecological, climatic, hydrological, and biogeochemical systems that sustain life. Systemic conservation is global in scope and focuses on the root causes of the damage to and disruption of natural systems. It is based on the premise that conservation must drive a transformation of economic systems to internalize those damages to natural systems that are associated with the production and delivery of goods and services. In tandem, it must also drive improved governance through the strengthening of governments and their institutions, and through building the capacity of civil society organizations to force government to do its job in defending the public good. We illustrate the potential for systemic conservation through a description and analysis of the Amazon Basin at two critical moments in history: 2005 and 2011. We then examine two divergent but plausible outcomes of current trends and conditions in the year 2020. We propose that low-emission rural development could provide an organizing framework and long-term, performance-based funding within which systemic conservation can be realized in Amazonia and, potentially, other regions of moist tropical forest.

Amazonia in 2005

From 2002 to 2004, the first major wave of industrialized agricultural expansion spread into the forests of the Amazon, driven in part by the combination of accelerating demand for vegetable protein in China and other emerging economies and the diminishing potential to meet this demand in the temperate zone (Nepstad et al. 2006*a*). Deforestation rates increased sharply during this period, especially in the southeastern Amazon. By 2005 the wave had ebbed. Nevertheless, approximately 40,000 km^2 of Amazon forest were either converted to cropland and cattle pasture or selectively logged or burned that year, generating 5–6% of global anthropogenic carbon emissions (Soares-Filho et al. 2006; Nepstad et al. 2008; Supporting Information). Commercial fishing fleets had begun to harvest the world's largest freshwater fishery at unsustainable levels (Castello et al. 2011); hydroelectric dams had disrupted fish migrations in some major tributaries of the Amazon River; and several new dams were planned. Recently established industrial farms in the southern Amazon released agricultural toxins into the headwaters of the Araguaia, Xingu, and Madeira rivers with unknown consequences. The chemicals were added to the mercury released from placer mining over the previous 30 years that had accumulated in the tissues of carnivorous fish and, in turn, in humans (Pinheiro et al. 2007). In 2005 the Amazon was still used as a social escape valve. National governments settled tens of thousands of land-seeking families each year in agricultural colonization projects where self-sufficiency was often impossible because of distance from towns, poor soils, and lack of essential infrastructure and services.

The most severe drought in a century desiccated the Amazon Basin in 2005 (Marengo et al. 2008), isolating boat-dependent riverine communities from urban centers and basic services. The drought killed fish, contaminated sources of drinking water, and caused extensive failure of swiddens. The drought killed forest trees, which increased forest susceptibility to fire, and large swaths of forest burned when fires ignited by farmers and ranchers escaped their intended boundaries (Nepstad et al. 2008).

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The dense pall of smoke that accumulated across large areas of the Amazon may have inhibited some types of rainfall, exacerbating the drought. The smoke sent thousands of Amazonians to health clinics with respiratory ailments; hundreds of infants from poor families died (Mendonça et al. 2004). The drought may have been intensified, as well, by the decline in dry-season evapotranspiration caused by the replacement of one-fifth of the forest with cattle pasture. Indigenous groups defended their boundaries against incursions from ranchers and loggers (Soares-Filho et al. 2010), but their resolve was undermined by droughts, fire, and the chronic shortages of food, health services, and resources.

Amazonia 2011

Currently conservation of the Amazon Basin is at a critical juncture. In just 6 years, several processes converged to reduce deforestation in the Brazilian Amazon, feeding a growing optimism that the end of Amazon deforestation is within reach. Annual deforestation in the Brazilian Amazon has declined 67% below the average for the period 1996 to 2005. Peru, Colombia, Guyana, and Ecuador are poised to make similar reductions in the rate of loss of their forests; all have made formal commitments to drastically slow deforestation.

To understand the potential for continuing—or reversing—the precipitous decline in deforestation, we reviewed its possible causes (Supporting Information). The decline can be explained in large part as a result of four interrelated processes: a market-driven reduction in the profitability of deforestation; market exclusion of activities that result in deforestation through moratoria on soy and beef grown on recently cleared lands and international commodity certification systems; governmental interventions, including law-enforcement campaigns (e.g., excluding those who cut trees illegally from rural credit programs) and the expansion of the protected area network by one-half; and the perception among Amazonian farmers and ranchers that standing forests will soon gain value through the carbon market (Nepstad et al. 2009; Soares-Filho et al. 2010). These processes are reinforced by a voluntary registry of ranches and farms whose owners are dedicated to sound land stewardship (Alianca da Terra 2011).

Currently, the risk of a reversal is high. The profitability of deforestation is rising and could remain high for years or decades as the world enters an extended period of sustained high prices for agricultural commodities (Grantham 2011). As the demand for agricultural products increases, the commitment by commodity buyers to exclude from supply chains those enterprises that result in deforestation may weaken. Farmers and ranchers committed to sound land stewardship (Nepstad et al. 2009) have yet to realize economic benefits for their efforts to conserve forests, and the high cost of complying with international social and environmental certification and the diminishing prospects for a forest carbon market are discouraging participation (Supporting Information).

Brazil's important forest conservation gains are also at risk of being lost because of self-reinforcing droughts and forest fires. The intense drought of 2005 was eclipsed by a more severe drought in 2010 (Lewis et al. 2011) in which vast tracts of forest burned in Brazil, Peru, and Bolivia. The climate-driven dieback of Amazonian forests predicted to begin mid-century may have already begun through positive feedbacks among drought, fire-dependent land uses, and forest fire (Nepstad et al. 2008; Silvestrini et al. 2011).

Amazon 2020 with Accelerated Frontier Expansion

In a hypothetical scenario of accelerated frontier expansion, by 2020 the Amazon Basin's role in supplying the growing global demand for agricultural commodities has increased. Reduced Emissions from Deforestation and forest Degradation (REDD), the United Nations' mechanism for compensating nations that succeed in lowering their carbon emissions from deforestation and forest degradation (Nepstad et al. 2009), was never implemented, and the $1.5 billion in REDD finance that was committed to the Amazon in 2009 and 2010 was not renewed.

The historical tendency of Amazon nations to make environmental policy goals they are not prepared to implement played a prominent role in the environmental turnaround, as exemplified by the Brazilian Forest Code. After increasing the proportion of private landholdings that must be kept in legal forest reserves from 50% to 80% in 1996, the government never implemented mechanisms for facilitating compliance with the law, such as legal forest-reserve compensation systems for farmers who did not meet the 80% mandate. As a result, many farmers and ranchers who had been in compliance before the change were criminalized (Stickler 2009) and were transformed from potential proponents to opponents of conservation, alienated by the corruption and bureaucracy that was bred by poorly conceived policies. Market exclusion of activities that result in deforestation that could have favored these farmers and ranchers failed in part because it was virtually impossible for producers to comply with the law—a basic requirement of any certification system.

The number of landless families that settled in the Amazon region has doubled and includes hundreds of thousands of workers who were drawn to the region by temporary jobs working on large infrastructure projects. Farm settlements across the region continue to rely on swidden agriculture and extensive cattle pastures for their survival. Indigenous lands have been invaded by land grabbers, and this has triggered rural conflict and assassinations. Periodic droughts killed large canopy trees in most of the forests of the Amazon and nearly half of these forests burned. The combined effects of increased deforestation, logging, fire, and drought have emitted 1 billion t of carbon to the atmosphere per year in recent years, twice the emissions of 2005. The chronic smoke from fires exacerbated the droughts and killed thousands of the region's residents. Large numbers of riverside dwellers, discouraged by crop failure and contamination of their fisheries by agricultural chemicals, abandoned their traditional livelihoods and migrated to the periphery of Amazonian cities.

Amazon 2020 with Low-Carbon-Emission Development and Systemic Conservation

In an alternative scenario, a regulated forest carbon market was created when California's cap-and-trade policy was linked to the REDD programs of Amazon states. Within this innovative framework, California electricity companies faced with a mandate to lower their greenhouse gas emissions began buying offsets from the REDD programs of Amazon states that successfully lowered their deforestation rates (Nepstad et al. 2009). The large supply of inexpensive REDD carbon credits created by Amazon REDD programs attracted several types of buyers, including companies regulated under cap-and-trade programs in Brazil, China, Australia, and Canada, retailers, and commodity buyers. This burgeoning market drove the development of a basin-wide program that aligned public policies, infrastructure investments, law enforcement systems, and institutional structures around the flow of carbon revenues that depend on sustained reductions in carbon emissions from deforestation and forest degradation. This basin-wide shift toward low-emission rural development was reinforced by a global commodity market that began to pay premiums for carbon credits bundled with agricultural products. Through this mechanism, farmers who maintained or regrew forests on their lands received a higher price for their agricultural products through state-level REDD programs.

Deforestation of primary forests has nearly ended, and 80% of the original forest remains standing. These surviving forests store 80 billion t of carbon (8 times the amount emitted globally through human activities), have continued to stabilize the regional climate in the Amazon and in some regions elsewhere in the world, and provide habitat to nearly one-fourth of the world's species. Self-enforcement of deforestation policies among landholders emerged when farmers and ranchers realized their neighbors' forest clearing threatened their forest-carbon revenues. The recognition and compensation of forest maintenance created a new class of farmers and ranchers who formed a powerful political block. The group organized dozens of fire brigades and outfitted crop-dusting planes to douse the fires that are an annual threat to pastures, crops, forests, and carbon credits (Aliança da Terra 2011).

With fire under control, forest regenerated in one-fourth of the Basin's cleared, abandoned land. Another fourth of this cleared land was planted with oil palm (*Elaeis* spp.); *Eucalyptus,* which supplies charcoal for the pig-iron smelters of the east; rubber (*Hevea amazonicas*); parica (*Schizolobium paraense*) for plywood; and other commercial species. This expansion of forest regeneration and plantations reestablished year-round transpiration along the eastern, upwind margin of the Amazon Basin (Nepstad et al. 1994), reducing the risk of deforestation-driven inhibition of rainfall (Silva Dias et al. 2002) and diminishing the negative effects of periodic droughts. These tree-based industries provided jobs with profit-sharing and negotiated contracts. The positive incentives for forest stewardship acted synergistically with progressive logging companies to create forest-product centres that integrate natural forest management with plantations (Merry et al. 2009). Landless farmers settled in peri-urban farm belts to grow produce for the nearby towns and cities and have access to schools, health care, and other civic services.

Fisheries rebounded because commercial fishing fleets were excluded from floodplain lakes by communities who worked with government agencies to implement rules regulating fishing in floodplain lakes (McGrath et al. 2008). Most of the hydroelectric dams planned for the region were postponed or cancelled and were replaced by aggressive energy-efficiency policies in Brazil and Peru and electricity generation from biomass. Potentially dangerous agricultural chemicals are prohibited. Hunting of selected species of mammals and game birds is allowed, but is carefully regulated by government managers in collaboration with rural landowners. Forest corridors were created across these landscapes through forest regeneration and restoration, and they connect forest fragments with indigenous lands and biological reserves.

The formal recognition of the land claims of indigenous groups and traditional populations, such as rubber tappers and Brazil nut collectors, that was achieved in Brazil and Colombia in the 20th century spread to Peru, Ecuador, Guyana, and Bolivia. Private investment flowed into the states and countries of the Amazon, in large part on the basis of their social and environmental performance, which was monitored rigorously and reported publicly online. In the context of planning for low-emission development, reinforced by carbon-market revenues and by greater access to markets and private capital, investments in the management and patrolling of protected areas increased. Levels of education, water supplies, health, and technical support for indigenous and traditional populations also increased. This changed the dynamic of political elections from the rhetoric of jobs versus environment to that of jobs through environmental conservation. Politicians remained in office largely through successful social and environmental programs that generated jobs and prosperity.

In 2020 systemic conservation of the Amazon Basin was achieved. The climatic, hydrological, fire, and biogeochemical systems that sustain life were protected or restored, and some of the ecosystem services provided by Amazon forests—such as carbon storage and, with it, hydrological functions—were built into the regional economy through the flow of carbon-market payments and through improved market access for high-performing producers, municipalities, and states.

A dark cloud is rising on the horizon, however. A global climatic disruption driven by accelerating emissions of greenhouse gases is changing patterns of rainfall, temperature, and windstorms sufficiently to displace one-third of the forests of the Amazon by the end of the 21st century. The long-term success of systemic conservation in the Amazon Basin still depends on effective mitigation of the global climate disruption.

Systemic conservation in the Amazon is within reach. This important goal can be achieved by focusing on transformation of the region's economic systems and improvements in the region's governance capacity. The most important new mechanism to achieve these systemic changes is rural development that links the incentives of long-term, performance-based revenues for reductions in greenhouse gas emissions with improvements in governance capacity within government and civil society. Low-emission rural development has already mobilized more than one billion dollars in finance for the Amazon through REDD and has stimulated national and state governments to begin the essential process of developing programs that align policies with law-enforcement capacity and economic incentives for forest conservation.

Carbon storage by forest trees is the only ecosystem service for which a global market could emerge in the near term. We must seize this opportunity and usher in a new paradigm in rural development that can carry a more systemic approach to conservation into a turbulent future.

Supporting Information

Current and planned infrastructure and statements on the factors that contributed to the decline of deforestation and the transformation of markets in the Amazon (Appendix S1) are available online. The authors are solely responsible for the content and functionality of these materials. Queries (other than the absence of the material) should be directed to the author.

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