ON THE NATURE OF THINGS: ESSAYS
New Ideas and Directions in Botany

Forest and landscape restoration: Toward a shared vision and vocabulary[1]

Robin L. Chazdon[2–5,7] and Lars Laestadius[6]

Our species plays a unique role in the past, present, and future of life on Earth. As primates, we need to eat, drink, sleep, be protected from predators and the elements, socialize, and procreate. As humans, we have the potential to overcome cultural, geographic, social, technical, and political barriers to solve problems that threaten our planet and the diverse forms and styles of life it sustains. Half of the Earth's surface area is now devoted to grazing land or cultivated crops; in this conversion, over half of the world's forests have disappeared (Kareiva et al., 2007). Much of this cleared land has lost or severely reduced its potential for agricultural production due to soil erosion or degradation (Fig. 1). Although many forests demonstrate the capacity to recover spontaneously from catastrophic disturbances, cumulative changes in forests and other ecosystems, coupled with growing human populations, increasing per-capita rates of consumption, disease outbreaks, biodiversity loss, extreme climate changes, and sea-level rise now undermine our planetary life-support system (Steffen et al., 2015).

An urgent correction is needed to reverse the land degradation produced by these trends, return forest cover to barren lands, return productivity for growing food, fuel, and fiber crops, and expand and restore damaged patches of remnant forests. Over 2 billion hectares (7,722,043 square miles) of dysfunctional land (formerly forest and mixed woodland) provide opportunities for forest landscape restoration (Laestadius et al., 2011; Fig. 1). A massive global effort, the Bonn Challenge, has mobilized nations and subnational regions to restore 150 million ha of forest land by 2020 consistent with the principles of Forest and Landscape Restoration (Bonn Challenge, 2011). The New York Declaration builds on this initiative to bring an additional 200 million ha into restoration by 2030 (New York Declaration, 2014).

These global restoration initiatives advocate a regional landscape approach, incorporating large spatial extents with multiple ecosystem types and multiple forms of land ownership and governance, often in landscape mosaics where productive land uses are balanced with areas of different types of conserved or restored forests. A landscape-scale approach includes natural ecosystems, cultivated areas, and passively and actively restored areas enveloping villages, cities, and communities. Restoring and protecting small units of isolated forest ecosystems is not sufficient to reduce biodiversity loss or mitigate climate change (Chazdon et al., 2009).

Working within landscapes widens the latitude for land-use trade-offs to be made in a way that balances the rights and needs of landowners and other stakeholders, including those that live and work there (Sayer et al., 2013). The goal of forest landscape restoration is not to recreate original forest cover across the entire area, but rather to improve ecological integrity and enhance human well-being in deforested or degraded forest landscapes, including active agricultural landscapes (Maginnis and Jackson, 2005). Forest and landscape restoration involves much more than planting trees. It is a collaborative and multisectorial, long-term process to create or recreate biologically rich forest landscapes, strengthen forest-based livelihoods, and sustainably manage tree cover within and outside forests for the benefit of people and their future generations (Laestadius et al., 2015; Sabogal et al., 2015). Restoring landscapes also provides more options for the persistence of populations of threatened and endangered species.

Some conservationists have been reluctant to embrace forest restoration because they fear that recognizing the ability to restore forest ecosystems might be used as a justification for continued exploitation and deforestation. The United Nations Convention on Biological Diversity has captured this view as follows: "Restoration is not a substitute to conservation, nor is it a conduit for allowing intentional destruction or unsustainable use" (CBD, 2011, p. 15). Landscape thinking resolves this conflict. Restoration and conservation are integral and complementary activities that must go hand in hand within a landscape approach. Protecting existing forest areas and encouraging

FIGURE 1 Over the past 60 years, extensive pastures have replaced native semideciduous Atlantic Forest surrounding Morro do Diabo State Park in Pontal de Paranapanema, São Paulo, Brazil, home of the endangered black lion tamarin (*Leontopithecus chrysopygus*). A single standing tree shows the height of the former forest canopy. Pastures are now being restored into forest corridors by a local nongovernmental organization, Instituto de Pesquisas Ecológicas (IPÉ). Involvement of local communities has enabled planning and implementation of forest restoration at a large scale, which is needed to permit movement of wildlife among forest fragments.

and attention to fine details. Politics, in contrast, tends to function through broad approaches with open, inclusive, but often vague language. The job of the scientist is to break down myths and disprove precisely formulated hypotheses using robust experimental designs and statistical analyses. The job of the politician is to inspire and motivate action by highlighting evidence of success and possibility, while downplaying pervasive failures. Scientists follow a crooked path toward the "truth", whereas politicians generally follow a crooked path toward politically acceptable solutions. Scientists work to fill gaps in knowledge and to refine existing knowledge, whereas politicians focus on bridging conflicts of opposing interests in search of workable solutions to urgent practical problems.

Politicians and scientists have valid professional reasons for their different language choices. Politicians, faced with managing political conflicts and with little power to choose the issues, need to use broad and imprecise terms that are meaningful to different constituencies they must engage while still maintaining political flexibility. Thus, the terms re-

natural regeneration in appropriate areas are essential foundations of forest and landscape restoration.

The path toward forest and landscape restoration presents many challenges (Chazdon et al., 2015). Forest and landscape restoration arises from the unique social and ecological context within a region. Landowners and stakeholder groups need to be actively engaged in the many stages and dimensions of the restoration process, including the mobilization of multiple forms of capital. Culture, economics, history, geology, topography, and climate all shape the process. The task is multigenerational, which means that the world's population will grow and change its spatial distribution and consumption habits as restoration takes place. The challenge is complex because landowners and multiple stakeholders have different and sometimes competing needs, abilities, and hopes for the future. The process must integrate the best available technical, traditional, and practical knowledge within a supportive political, social, and economic framework and generate and operationalize new knowledge and new approaches for knowledge growth and dissemination. The process must be adaptive, able to respond to changing needs, circumstances, and conditions.

When scientists and politicians address the issue of restoration at the scale intended by the Bonn Challenge and the New York Declaration on Forests, clear differences in perspectives, approaches, and language emerge. Scientific work requires precision

greening, tree planting, restoration, rehabilitation, and reforestation are likely to be used as synonyms in a political context, regardless of whether the objective is to recreate "original" forest or enhance productivity, whether the trees originate from planting, seeding, pre-existing plants, or root stock, whether the trees are exotic or native, or whether they grow in commercial monocultures, mixed silvicultural systems, natural regeneration, or agroforestry systems.

Scientists, in contrast, require precise language that permits conceptualization and evaluation of specific hypotheses. The scientist will generally find it abhorrent when policy makers fail to distinguish natural regeneration from multispecies ecological restoration plantings, or to clearly separate these activities from rehabilitation plantings designed to ameliorate soil toxicity following mining, or to recognize diverse native tree plantations as distinct from large-scale, commercial monoculture plantations that now extend over many regions of the tropics (Stanturf et al., 2014). These differences matter to scientists who study the costs and benefits of different forms of land use and assess their spatial and temporal dynamics at regional, national, and global scales.

The stark contrast in the selection of evidence and usage of language by scientists and politicians is, of course, a caricature. But politicians and scientists do use evidence and language differently, and both have valid professional reasons for doing so. But these

differences in language usage are creating major obstacles to progress, and it is important to recognize and overcome these barriers. Only with a common conceptual approach and vocabulary is it possible to break down communication barriers and generate opportunities to work together to define objectives, identify trade-offs and priorities, project costs and benefits, seek synergies with related policies and incentives, and implement effective and long-term restoration and monitoring approaches. Only with a common conceptual approach and vocabulary is it possible to develop a shared, feasible vision for reversing the negative trends of soil degradation, species loss, and declining human well-being.

Mobilizing the global forest and landscape restoration movement requires overcoming these obstacles by building new coalitions that include social and natural scientists and policy makers working across agriculture, forestry, conservation, mining, environmental protection, land-use, science, and education sectors. The private sector, investment community, and nongovernmental organizations also need to be integrated into the movement.

We suggest that the way forward is to identify fertile areas of common ground, i.e., themes and contexts where the need to agree is strong enough to overcome the inertia of entrenched concepts and vocabulary, and to use them as focal points for intensifying the dialogue among policy makers, farmers, landowners, and scientists (both social and natural). Successful and lasting efforts to restore the vitality of forests and landscapes must incorporate political expediency and technical knowledge, in addition to needs and knowledge of all stakeholders, including local stakeholders and traditional knowledge. These dialogues need to happen both at national and subnational levels, so that enabling policies at multiple levels can be linked.

Achieving a common vision and progressing to action will challenge the status quo, requiring that scientists think much more pragmatically and that politicians accept at least some nuances as nontrivial. New partnerships can generate a range of potential forest and landscape restoration scenarios based on existing constraints and opportunities within different geographical regions. Empowered stakeholder groups, including landowners, can then jointly select the most cost-effective approaches for implementation. One example is the Brazilian Coalition on Climate, Forests and Agriculture, formed in December 2014 by business associations, companies, civil society, organizations, and individuals to advance the protection, conservation and sustainable use of forests, sustainable agriculture, and the agenda of mitigation and adaptation to climate change, both in Brazil and worldwide (http://coalizaobr.com.br/en/).

Elucidating a shared vision for restoring forests and landscapes requires working together in new ways and creating new cross-sectoral institutions that are empowered to take on bold new leadership, have the capacity to act, and are willing to learn and adapt as the restoration process unfolds. Creating a shared vision and vocabulary will bring us closer to creating landscapes that will sustain human well-being and forecast a more promising future for all species on our shared planet.

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