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OPINION ARTICLE

Forest Landscape Restoration: increasing the positive impacts of forest restoration or simply the area under tree cover?

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Restoring forest landscapes is critical in the face of continued global forest loss and degradation. In this article, we explore some challenges underlying the delivery of global commitments to restore forest landscapes. We propose that three fundamental questions need to be resolved upfront for the effective implementation of Forest Landscape Restoration and related commitments: (1) What social and ecological landscape objectives are being sought through Forest Landscape Restoration? (2) How are specific areas being selected for restoration? (3) How is success measured when restoring forest landscapes? We believe that there is an urgent need to adequately answer these questions to successfully implement political commitments for large-scale forest restoration.

Key words: Bonn Challenge, hectare targets, restoration scale

Implications for Practice

- Forest Landscape Restoration (FLR) provides an important approach to restoring both the ecological and social roles of forests in landscapes.
- However, FLR risks being poorly interpreted as simply covering vast areas of the world in trees of limited value to local people and biodiversity.
- Ensuring the effective implementation of FLR will require (1) clarifying specific landscape objectives for FLR; (2) identifying areas to be restored in a careful and collaborative manner; and (3) ensuring that there is a clear means of measuring success.

The Value of Restoring Forests

For many in environmental conservation circles, the 21st century has been hailed as that of ecological restoration. The world is rising up to meet expectations with highly publicized pledges for restoration and Forest Landscape Restoration (FLR) in particular. While planting trees has long been part of development projects, until the late 20th century the concept of restoration had yet to be embraced by conservationists who prioritized the protection of pristine nature (Aronson et al. 2006). However, the tide turned in the late 1990s with the recognition that this was no longer sufficient (Young 2000; Aronson & Alexander 2013). Equally, in the development community, there was a growing recognition that additional hardship is endured by populations living near deforested or degraded areas (Sunderlin et al. 2005; Chomitz 2007). The turn of the 21st century saw an unparalleled enthusiasm for restoration and specifically for FLR which seeks to restore both the ecological and human well-being roles of forests within landscapes. Today, governments from around the globe, as well as companies and influential individuals, are eager to promote and commit to forest restoration as exemplified by the Bonn Challenge, the New York Declaration on Forests, the Latin American Initiative 20×20, or the African FLR Initiative (e.g. Chazdon et al. 2015; Suding et al. 2015).

The need remains, however, to transform positive and encouraging political commitments into beneficial practice, particularly given the scales of commitments and the timeframes involved (Wentink 2015). Our intent in this article is to begin addressing this need so as to support decision-makers—particularly national (but also regional and local) governments, implementing agencies, and donor agencies—as they consider basic questions of where, with whom, how, and why restore forests. This article is complementary to recent articles on restoration (e.g. Chazdon et al. 2015; Latawiec et al. 2015; Suding et al. 2015) and probes specifically the basic questions that decision-makers should consider when engaging in restoration initiatives at large scale.

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Our contention is that simple area (hectare-based) targets are insufficient to obtain the desired FLR outcomes.

Forest Landscape Restoration: Responding to an Urgent Need

Deforested and degraded landscapes characterize much of the world's forested areas with subsequent loss of biodiversity and ecosystem goods and services. The loss and degradation of forest ecosystems have been blamed for numerous ills from species' extinctions to flooding, landslides, famines, human migrations, among others (Runyan & D'Odorico 2016). Reversing this trend can be achieved in many ways (Stanturf et al. 2014*a*), including through natural regeneration (Chazdon 2014), planting different mixes of species (Lamb et al. 2012), or removing disturbances (Goosem & Tucker 2013). Central to this, however, is the necessity to address the drivers of deforestation and degradation, which implies improving the livelihoods of people within the landscape as well as the underlying governance (Runyan & D'Odorico 2016).

Definitional Challenges

Many approaches and terms exist in restoration such as reclamation, rehabilitation, reforestation, rewilding, or ecological restoration (CBD 2012). Clear terminology is particularly important as the world's decision-makers are increasingly interested in restoration and the use of related terms becomes more widespread. Forest Landscape Restoration has been embraced by many decision-makers as it holds particular appeal in addressing today's land use, ecological, and social challenges. Our analysis focuses on FLR, while recognizing that there are other approaches to restoration (Stanturf et al. 2014*a*). The term FLR emerged as a recognition that restoration needed to be expanded beyond small-scale ecological restoration, but that in doing so, it also needed to contribute to multifunctional landscapes and to reconcile restoration with other land uses (e.g. Maginnis & Jackson 2005; Latawiec et al. 2015; Reed et al. 2016).

Forest Landscape Restoration was initially defined by a group of 30 scientists in the year 2000 as "a planned process that aims to regain ecological integrity and enhance human well-being in deforested or degraded landscapes" (WWF & IUCN 2000 unpublished data; Mansourian et al. 2005; Lamb et al. 2012). Three aspects worth highlighting in this original definition are intentionality (i.e. rather than an ad hoc labeling of spontaneously occurring natural regeneration as FLR), multidimensionality (i.e. both ecological integrity and human well-being), and scale (i.e. the landscape which provides both a geographical scale—albeit a fuzzy one—and a framework for reconciling human priorities with ecological ones) (Maginnis & Jackson 2005; Sayer et al. 2015).

FLR has been redefined several times, losing some of the initial intent behind the definition. Some definitions omit the intentionality of FLR—that it is a planned process. Some actors in the Bonn Challenge arena talk about forest *and* landscape restoration, perhaps in recognition of the difficulty of applying a narrow definition of FLR. While all efforts to restore forests can be perceived as positive, in practice, many large-scale revegetation attempts have failed and much damage has been done (both socially and ecologically) in the name of reforestation or restoration (Buckley & Crone 2008; McElwee 2009). For example, many large-scale mono-culture plantations with limited or no biodiversity benefits and dubious social benefits have been, and are still being, established under the guise of forest restoration (Brockerhoff et al. 2008; Chazdon 2008; Bennett et al. 2014). Furthermore, historically nonforested lands have been erroneously targeted for restoration commitments (Veldman et al. 2015).

The following four principles have been put forward for good restoration: promoting ecological integrity; establishing systems that are self-sustaining and resilient; being informed by both the past and the future; being beneficial and engaging society (Dey & Schweitzer 2014; Suding et al. 2015). Operationalizing FLR requires translating these principles into specific objectives and activities that are desirable and achievable within a given landscape.

Practical Challenges

Difficulties of operationalizing FLR include the tension in many landscapes between agriculture and forest cover, and definitions of ecological integrity. Deforestation and degradation occur for economic and social reasons because benefits accrue to some people (Runyan & D'Odorico 2016). Reversing deforestation, therefore, requires addressing the immediate and underlying drivers, including recognizing the full costs of degradation and understanding that alternative livelihoods, compensation, or both may be required.

A second difficulty in operationalizing FLR is the often lack of consensus on what constitutes the deforested or degraded state and a sufficiently restored condition. Most of the contention is around timber harvesting and what ensues. To some, any removal of overstory trees is deforestation or degradation, while to others sustainable forest management includes a temporary reduction in the forest canopy followed by adequate natural regeneration. Generally, deforestation means long-term removal of the forest canopy and conversion to another, nonforest land use (Runyan & D'Odorico 2016). In many instances of FLR, producing timber is one objective, and depending on the context and design, a plantation can contribute to other objectives, including biodiversity (Brockerhoff et al. 2008). Degradation is harder to define and requires an understanding of the baseline conditions and desired endpoints (Stanturf et al. 2014*a*, 2014*b*).

Regaining ecological integrity is one of the stated goals of FLR and it is related to concepts of biological integrity and ecological health (Tierney et al. 2009). More narrowly, regaining ecological integrity has been defined as returning to the predisturbance composition, structure, and function of an ecosystem in relation to the natural or historical range of variation (Parrish et al. 2003). It has also been defined in broader terms as restoring biodiversity, stability, resilience, sustainability, and naturalness (Noss 1995) which provides more flexibility given

humanity's footprint. Furthermore, viewing the recovery of ecological integrity narrowly, at the level of smaller units within a landscape it coincides with definitions of ecological restoration (SER 2004), which gives little space for trade-offs and a landscape mosaic (Maginnis & Jackson 2005). The reality in many landscapes is that ecological restoration, without regard to sustaining livelihoods and addressing needs of local communities, is a prescription for failure. An alternative formulation, functional restoration, focuses on restoring the ecological functioning of landscapes that are robust in the face of global change, notably climate change, rather than attempting to return to specific "natural" composition and/or structure (Stanturf et al. 2014*b*, 2015).

Engaging in Forest Landscape Restoration

Three fundamental and inter-related questions need to be resolved for effective engagement of decision-makers in FLR: (1) What social and ecological landscape objectives are being sought through FLR? (2) How are specific areas selected for restoration? (3) How is success measured when restoring forest landscapes?

What are the Ultimate Social and Ecological Objectives of the Restoration Effort?

Although millions of hectares are being committed by governments, at present there is little guidance for what counts as an acceptable commitment under the Bonn Challenge (yet 124 million ha have been committed to date) (Mansourian & Kleine 2013). For example, in mosaic landscapes of intermixed land uses, is it only the area covered in trees or is it the entire landscape area that is counted? Further, how does one count trees outside forests (e.g. agroforestry)? Further still, if the local classification of secondary forests as degraded allows them to be converted to non-native plantations does that count as restoration?

Clear terminology may partially help to overcome misunderstandings, and to advance the practices advocated (Stanturf et al. 2014*b*), but a far more important consideration is the need to clearly explicate aims to focus the restoration effort. In individual landscapes, these long-term and generic goals must be further developed by stakeholders into specific objectives that are shorter-term and measurable.

Area-based objectives provide a quantitative measure but lack a qualitative dimension. Countries such as China and Vietnam have been criticized for having set ambitious hectare-based targets for forest restoration without adequate specification of the human or ecological objectives that have led to the establishment of large areas of exotic plantations with limited ecological and human benefits, while also potentially leading to deforestation in other countries (Sayer et al. 2004; Cao et al. 2011; Xi et al. 2014). Achieving restoration objectives across a landscape means implementing specific measures at smaller units within the landscape to contribute to overarching landscape objectives (Maginnis & Jackson 2005). Such objectives might be to connect habitat fragments for an endangered species, as well as to line water courses for flood protection and soil retention; or possibly to buffer and improve a protected area set up to provide drinking water and habitat for pollinator species that are vital to nearby agriculture. Funding sources that can be used for restoration—notably related to climate change mitigation such as REDD+—may skew objectives towards a singular objective. Yet sustainability is more likely when forest restoration is embedded in landscapes and has multiple objectives that include both social and ecological dimensions (Sayer et al. 2004).

How Are Specific Areas Selected for Restoration?

Given both the real and opportunity costs of restoration, careful selection of areas to be restored is critical. Selection takes place at two levels: first, the priority landscapes, and, second, sites within the landscape to fulfill landscape restoration objectives. Defining priority landscapes for FLR can itself be a complex process, mixing opportunities and urgency; both can be framed from ecological and social standpoints. For example, urgency may be defined by the extent of degradation, loss of biodiversity, and ecosystem services, and opportunity may be represented by new and supportive policies, local stakeholders willing to engage in restoration, and the existence of local-level institutions to facilitate restoration.

Engagement of partners and key stakeholders is essential (Burke & Mitchell 2007; Hallett et al. 2013). Restoration requires planning, effort, investment, and the engagement and coordination of various actors with the support of appropriate institutions (van Oosten 2013). Tenure concerns are critical as forest and land ownership are contested in many parts of the world. Clarifying tenure arrangements has also proven to be a significant challenge for REDD+ implementation. These and other governance issues compound to make the implementation and the sustainability of FLR efforts both complex and precarious (Mansourian 2016).

Mapping opportunities may be useful (Minnemeyer et al. 2011) to identify areas in need of restoration but it does not replace participatory priority-setting. In the Brazilian Atlantic Forest, to guide restoration efforts under the multilevel collaborative Atlantic Forest Restoration Pact (AFRP), four maps were produced and overlaid to indicate hotspot areas: (1) potential areas for restoration; (2) eligible areas for carbon restoration projects; (3) key areas for urban water supply; and (4) priority areas for improving landscape connectivity (Brancalion et al. 2013; Melo et al. 2013; Pinto et al. 2014). However, those efforts do not effectively engage landholders, and remote-sensing often can only identify deforested but not necessarily degraded areas.

Within a landscape, restoration objectives influence the spatial patterning of restoration interventions. For example, Barnett et al. (2016) mapped and quantified trade-offs and synergies of five equal-area, large-scale bottomland hardwood restoration scenarios in the Lower Mississippi Alluvial Valley. Four scenarios (nutrient retention, intact riparian, and floodplain areas, forest breeding bird habitat, and black bear habitat connectivity) were designed to achieve a different environmental objective and compared with randomly placed restoration. Results

showed that targeted restoration out-performed randomly selected sites for restoration by a factor of almost two. Focusing on a single objective, however, may trade off opportunities to obtain other benefits. For example, solely targeting water quality produced a spatial pattern that provided little connectivity for large vertebrates such as black bear.

Unplanned restoration may lead to small patches of forest being restored haphazardly in different parts of the landscape by different landholders, possibly with only small-scale scattered benefit because of a lack of coherence. Equally, it may also lead to poor choices by focusing on the number of trees, rather than more specific objectives related to social and ecological outcomes that include, notably, careful species selection, methods applied, and public engagement. Although we admit that even unplanned restoration may have the desired result if the critical areas of the landscape happen to be restored, unplanned restoration is also more likely to lead to social marginalization, poor survival rate of trees (Cao et al. 2011), job displacement for the unskilled (Andersson et al. 2016) and elite capture of restoration benefits (Barr & Sayer 2012).

How Is Success Measured?

Measuring impact is essential to better understand the result of actions taken in order to influence future actions and correct ongoing ones (Stephenson et al. 2015). Monitoring is always a challenge and remains sorely lacking in many restoration efforts (Rey-Benayas et al. 2009). All too often, objectives for restoration are not clear, and therefore monitoring is also hampered (Bautista & Alloza 2009). Equally, with simplistic objectives, monitoring results may yield information of limited value (Hutto & Belote 2013).

When it comes to scaling up forest restoration to the landscape level, we propose that successful restoration be measured on a scale of impact rather than a scale of effort. "Scale of effort" refers to the restoration area measured in hectares. In contrast, the "scale of impact" refers to the magnitude of impact that is achieved by implementing restoration. In other words, whereas the former strictly counts the area covered in new trees, the latter counts the area impacted by ecological and social benefits—such as water purification, soil retention, habitat for wildlife, food for people, and wildlife, among many others—because of the returned trees within strategically selected parts of that landscape (Lamb et al. 2012; Mansourian & Vallauri 2014).

Outstanding questions include: have starting points (or baselines) been identified in the context of specific targets? Are baselines exclusively in hectares, or are they more specific to the desired function (habitat for a given species, water protection, etc.) to be restored? Furthermore, who measures progress? Is there a process to engage local actors in monitoring? Who is held accountable for delivering on commitments? (Rey-Benayas et al. 2009; Menz et al. 2013). Such questions require answers before a monitoring scheme can be designed to measure successful restoration.

The opportunity to extract lessons and to share these should not be neglected. Particularly as restoration is becoming more urgent and more interest is being generated by the publicity surrounding political commitments for FLR. Opportunities risk being missed without specific monitoring procedures and processes in place.

Where to From Here?

Large-scale forest restoration and FLR are much needed given continued forest loss and degradation globally. Decision-makers are making bold statements to restore millions of hectares of forests which presents a unique opportunity for widespread implementation of FLR. However, we caution that it also represents a risk should the three questions we pose here not be effectively addressed. To ensure success, high-level political commitments should be founded on clear and explicit reasons for restoration, broad social and ecological objectives for restoration, possible locations, stakeholders to be engaged, and methods and species to be used. Ultimately restoration is important for a number of very specific reasons, such as food production, water protection, soil protection, adaptation to climate change, species' conservation, etc. These are what should appear at the forefront of commitments. Efforts to operationalize FLR should be underpinned by a realistic implementation strategy which may require a feasibility study before commitments are made. Indeed, where, with whom, why, and how, are all key questions that should be answered upfront.

Consistent and clear terminology is important and we urge the global community to align behind one globally acceptable broad definition for FLR—along the lines of that proposed in the year 2000 which seeks to balance both human and ecological dimensions within a landscape. Financing restoration is challenging and if costs are not to exceed benefits, a common understanding of the motivation for restoration and the ultimate objectives for the effort is essential (Clewell & Aronson 2006). Methods to identify restoration "opportunities" need to be better understood and developed. When selecting large areas for restoration it is critical to ensure that these make the most sense in terms of the extent of degradation and likelihood of successful restoration, and ensure efficient return on investment. In this respect, decision-makers should prioritize landscapes where both urgency and opportunity are present.

In conclusion, governments need to work more closely with other actors (notably landscape-level communities, researchers, NGOs) to define specifically what the objectives of forest restoration might be and to associate them in the delivery of restoration-related commitments. High-level statements referring to hectares in restoration programs should be qualified with explicit human and ecological objectives within the landscape (the area impacted) that can be measured and serve to influence future restoration actions. This implies seeing restoration as a tool rather than an end in itself.

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