# Partnering with Nature

## THE CASE FOR NATURAL REGENERATION IN FOREST AND LANDSCAPE RESTORATION

FERI Policy Brief

Convention on Biological Diversity

## Acknowledgements

This policy brief contains findings from two international workshops and a Special Issue of Biotropica (Volume 48, Issue 6, 2016). The workshop "The Role of Natural Regeneration in Large-scale Forest and Landscape Restoration: Challenge and Opportunity was held 19-21 November 2014 in Rio Botanical Garden, Rio de Janeiro, Brazil. The workshop "Promoting the Role of Natural Regeneration in Large-scale Forest and Landscape Restoration: Challenges and Opportunities & Consultation to Operationalize Regional Strategy and Action Plan for Forest and Landscape Restoration in Asia-Pacific" was held in Nanning, Guangxi Province, China from 19 – 21 June 2017. George Gann, James Hallett and Lars Laestadius provided constructive comments on earlier versions of the document.

## Citation

Chazdon, Robin L., Blaise Bodin, Manuel Guariguata, David Lamb, Bethanie Walder, Unna Chokkalingam, Kenichi Shono. 2017. *Partnering with nature: The case for natural regeneration in forest and landscape restoration*. FERI Policy Brief. Montreal, Canada.

**Available online at:**
www.feri-biodiversity.org/resources

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# Partnering with Nature

**Natural regeneration is a cost-effective, nature-based tool for restoration that enhances resilience, supports local biodiversity, and supplies multiple ecosystem goods and services. However, for social, cultural and economic reasons, the potential of natural regeneration for achieving large-scale restoration objectives and climate mitigation targets is often overlooked. This information brief makes specific recommendations for policy changes that could enhance the role of natural regeneration in ecological restoration interventions and as an integral component of forest and landscape restoration.**

**Figure 1**
**Natural regeneration can provide a wide range of ecosystem goods and services that provide local to global benefits**

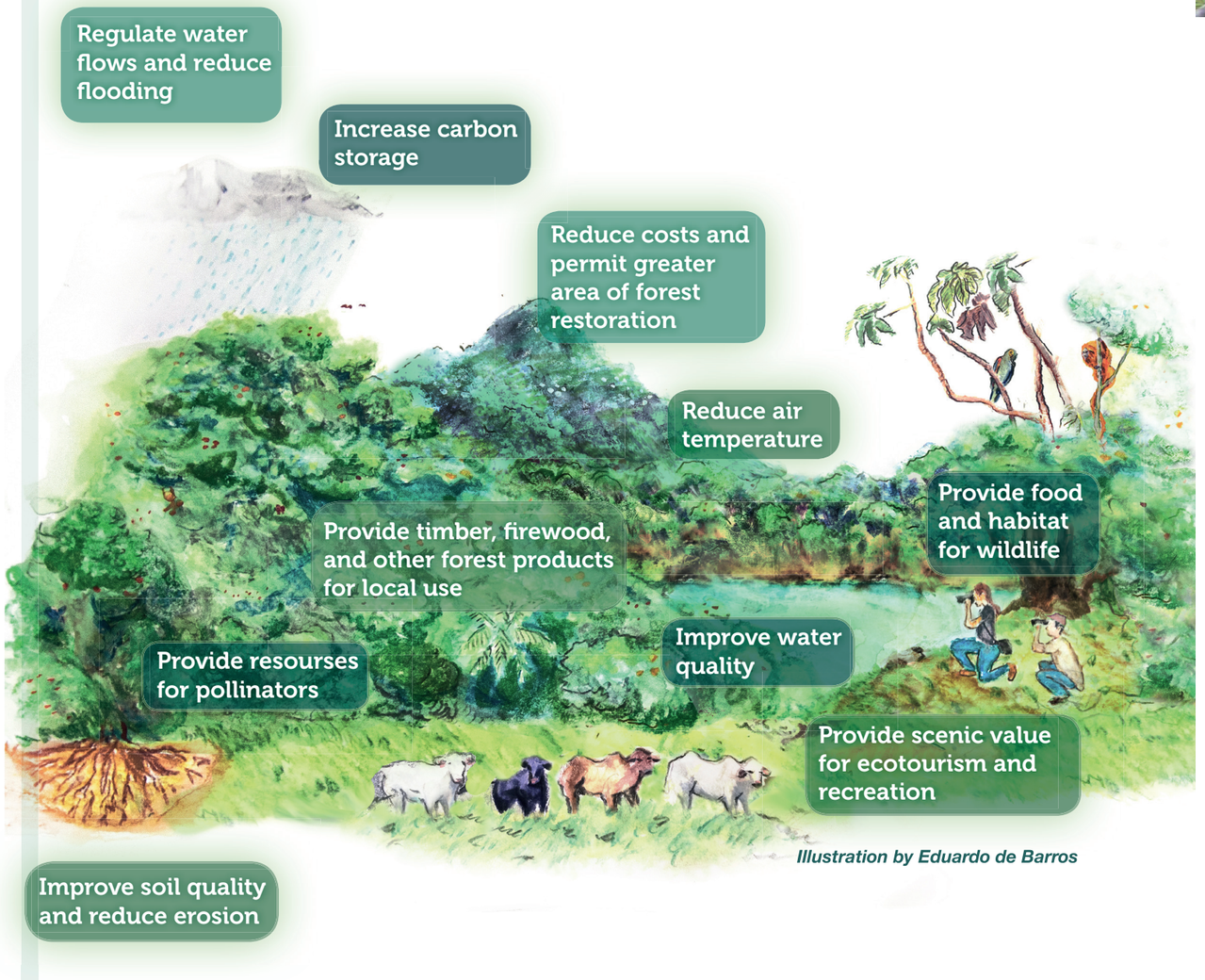


*Illustration by Eduardo de Barros*

# 1. What is natural regeneration and what are its benefits?

Natural regeneration is called by many different names: fallow vegetation, secondary forest, succession, natural stocking, passive restoration, regrowth, second-growth, and scrub. The same process underlies these terms: following deforestation, logging, and land use, new forest cover can emerge—spontaneously or with human assistance—from the ecological memory of the prior forest ecosystem and the surrounding landscape[1]. It may also follow natural large-scale disturbances such as cyclones, floods, and fires.

Natural regeneration is a biological process that can be assisted and managed to increase forest cover and achieve the recovery of the native ecosystem or some of its functions. Ecological restoration relies on natural regeneration processes for achieving forest ecosystem recovery[2]. Natural regeneration can also be a component of forest and landscape restoration, among other types of interventions[3], and a part of national action plans that support ecosystem restoration targets such as Aichi Biodiversity Target 15[4].

In addition to enhancing resilience and supplying multiple ecosystem goods and services, natural regeneration can be highly effective for recovering local biodiversity, species interactions and movement within landscapes[5] **(Figure 1)**.

During natural regeneration local biodiversity is enriched by:

- natural propagation of trees and shrubs by seeds, root sprouts, stumps, or coppices
- regeneration of local genetic sources adapted to local soil and climate conditions
- associated pollinators, herbivores, and seed dispersal agents of colonizing trees

Many of these benefits can also be achieved using direct seeding and tree planting approaches, but at significantly higher effort and costs.[4,5] In tropical regions, spontaneous and assisted natural regeneration are more effective than tree planting at achieving the recovery of biodiversity and forest structure when factors such as forest age, prior land use, landscape conditions, and rainfall are taken into account[6]. Given these advantages, prioritizing natural regeneration in suitable areas allows limited funds, labor, and seed resources to be more effectively allocated for tree seeding or planting interventions in areas where they are critically needed for restoring forest cover and supporting local livelihoods.

# 2. Natural regeneration: where, when and how

A number of social, regulatory, and ecological conditions need to be met for natural regeneration to occur[1,4]. Natural regeneration may occur when the following ecological factors are met.

- low levels of soil disturbance and retention of topsoil
- proximity to forest remnants or reserves that allows colonization of vegetation from dispersed seeds, root sprouts, or stem sprouts
- protection from fires, grazing, and extensive harvesting
- minimal presence of fire-prone grasses, ferns, woody vines and invasive species that can impede tree establishment

Where some of these conditions are not present, enrichment planting, weeding, or intensive planting may be required to restore forest cover and qualities.

Favorable ecological conditions for natural regeneration are associated with particular social and regulatory contexts for land use. For example, recent forest clearance followed by a short period of land use that did not heavily disturb the soil creates favorable conditions. Farmland that has been abandoned because of agricultural intensification, declining agricultural profitability or more favorable employment opportunities for farmers will typically undergo natural regeneration, if the land is not overly degraded.

In protected areas or private reserves where forest restoration objectives focus on recovery of biodiversity and supply of ecosystem services, spontaneous natural regeneration is often the most cost-effective approach for restoring forest cover within reserve boundaries and in buffer zones. Priority zones for biological corridors can also be restored at low cost through spontaneous and assisted natural regeneration.

**Figure 2** illustrates where ecological conditions are likely to be favorable for spontaneous and assisted natural regeneration within a forest landscape with some remnant forest cover.

*Socio-economic factors can create conditions that enable natural regeneration. Natural regeneration in the Canton of Hojancha, Nicoya Peninsula, Costa Rica followed migration out of the region and abandonment of pastures due to water shortages and falling beef prices. Forest cover and water flows have returned to the region, including 13,120 ha of naturally regenerated forest, A forest-based economy replaced a cattle-based economy[7].*

***Photo credit: Robin Chazdon***



## Figure 2
**In landscapes with some remnant forest cover, specific social and environmental conditions are more likely to lead to successful natural regeneration**

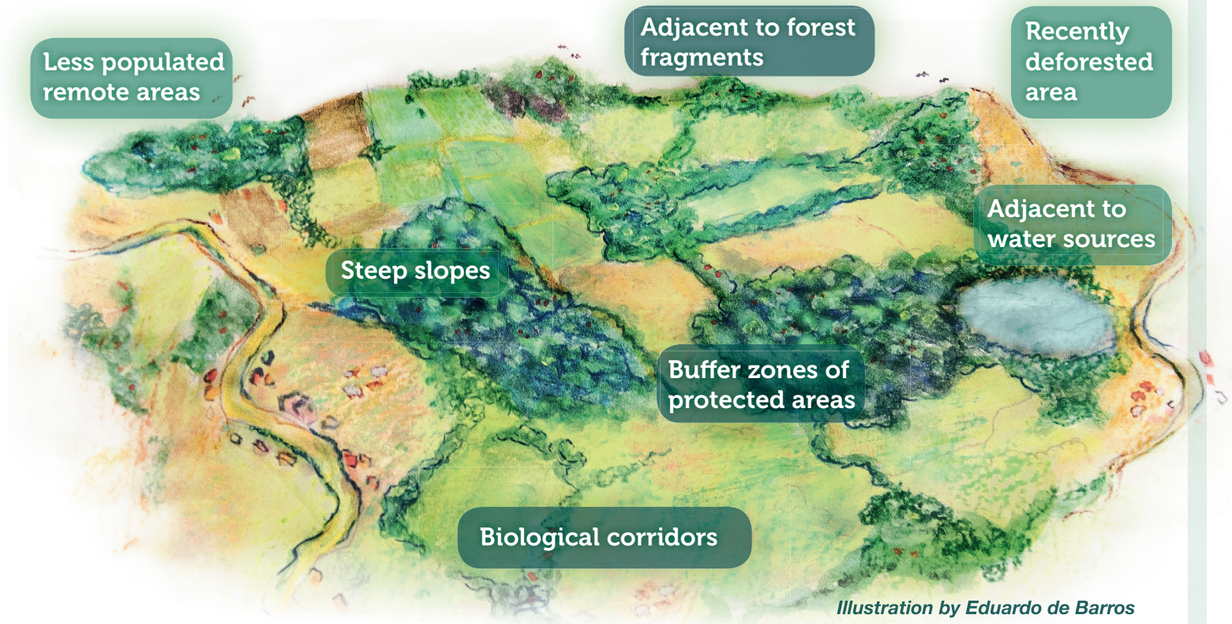


*Illustration by Eduardo de Barros*

Restoration interventions vary in direct cost (labor, materials, maintenance), level of intervention (modification of soil, use of exotic species, extent of planting), similarity to native biodiversity, and extent of integration with agricultural and forestry production systems[3]. **Spontaneous natural regeneration** occurs without human intervention. During **assisted natural regeneration**, establishment of native species is encouraged through weeding, fire prevention, attracting seed dispersal, excluding grazing animals or other disturbances, and enrichment planting of ecologically or economically important plants. **Farmer-managed natural regeneration** is an agroforestry practice based on the protection and management of rootstocks and seeds already present in the soil, leading to more complex, productive, and drought-resilient farming systems in dryland zones.

| | | Direct cost and intensity of intervention | Similarity between biodiversity at target state and native forest | Agricultural or forestry production value |
|---|---|---|---|---|
| Natural regeneration interventions | Spontaneous natural regeneration | $ | 🍃🍃🍃 | 🌾 |
| | Assisted natural regeneration | $ $ | 🍃🍃 | 🌾🌾 |
| | Farmer managed natural regeneration | $ $ | 🍃 | 🌾🌾🌾 |
| Other types of restoration interventions | Mixed species planting with native tree species | $ $ $ | 🍃🍃🍃 | 🌾🌾🌾 |
| | Agroforestry systems | $ $ $ | 🍃🍃 | 🌾🌾🌾🌾🌾 |
| | Monoculture or plantations using few species | $ $ $ | 🍃 | 🌾🌾🌾🌾🌾 |

# 3. Overcoming social and economic barriers to natural regeneration

Spontaneous natural regeneration on farmland is often discouraged and viewed as poor land management. Early stages of natural regeneration on farms can signal that land is being abandoned or neglected, which can promote invasion by landless people. Land owners or communities managing it may lack the knowledge required to sustain, assist, and enrich natural regeneration. Several actions can overcome these challenges.

- Demonstrate the material and non-material benefits of natural regeneration, such as the ability to use products from managed regenerating forests or regenerating trees, or the ecosystem services that restored forest cover will provide
- Ensure the availability of seeds or seedlings for enrichment planting, through the sourcing of appropriate seeds and establishment of local nurseries
- Build the technical capacity of land owners and managers for applying good practices in forest management and fire and weed suppression, for understanding germination and growth requirements of species used for enrichment planting, and for identification and care of tree seedlings
- Design effective governance and equity measures to sustain the engagement of local communities and their participation in restoration interventions and the management of pressures such as fire or the monitoring of ecosystem recovery and its benefits
- Encourage grassroots natural regeneration movements that involve community organizations in assessing and monitoring areas for natural regeneration, in enrichment planting, or in developing community-based ecotourism in naturally regenerating forest areas.

*Regreening of 5 million hectares of degraded land in Niger using farmer-managed natural regeneration was enabled by political and institutional reforms that decentralized resource management to permit the ownership of trees on farms and granted customary rights for use of forest resources in areas held by local communities[8]. The presence of stumps or belowground rootstocks of previously cut trees in unplowed fields promoted tree regeneration on farms.*

***Photo credit: Chris Reij***

Economic challenges may present major barriers to the wider adoption of natural regeneration. Young regrowth forests are often cleared for agricultural use because they fail to produce sufficient short-term economic returns for farmers or forest communities[9]. Investors interested in financing forest restoration seek projects with well-developed business models and suitable returns on investment. These challenges may restrict natural regeneration to areas within state, community or private nature reserves.

Natural regeneration cannot compete with commercial forestry plantations or agricultural land uses that provide far greater economic returns. Therefore, compensation to farmers and landowners is often required to offset the opportunity costs of foregoing more profitable land uses. Payments for environmental services can tip the economic balance for landowners and communities in favor of natural regeneration. These incentives should recognize and value the full scope of public and private goods and services provided by regenerated forests. For example, it has been estimated that the economic value of ecosystem services such as climate change mitigation and sediment retention covers over 70% of the opportunity costs of maintaining natural regeneration in the Paraitinga region in São Paulo State, Brazil[10].

Economic incentives and strong support from both public and private sectors is critical to ensure that the combined environmental and economic value of natural regeneration surpasses the value of alternative land uses.

*Enrichment planting of economically or commercially important species can enhance the value of naturally regenerating forests by providing revenue and offsetting opportunity costs. In Brazil's Atlantic Forest, harvesting fast-growing Eucalyptus trees interplanted with native tree species after 4-5 years can significantly offset these costs[11].*

***Photo credit: Nino Amazonas***

# 4. Policy changes and keys to unlock the potential of natural regeneration

Despite its pervasiveness, potential benefits and cost-effectiveness, natural regeneration is often overlooked as an approach that can be strongly aligned with national environmental and climate policy, sustainable development goals, biodiversity conservation goals, and global restoration targets.

In many tropical regions, natural regeneration and naturally regenerated trees are not recognized as legitimate restoration or reforestation interventions and are not eligible for support or economic incentives. Large investments of money and effort support widespread planting—often of a single tree species—regardless of environmental or social conditions. Forest policies that promote commercial forestry and agriculture policies that eliminate shifting cultivation create disincentives for natural regeneration. Legal and operational forest definitions often conform to historical timber management priorities[13], and fail to recognize the management potential of regenerating forests[14,15]. In some cases, young regenerating forest are defined as degraded land, encouraging replacement with other land uses such as expansion of commercial plantations of oil palm or tree monocultures. Policies that promote commercial forestry, forest management and conservation, as well as agricultural policies that discourage shifting cultivation, have created disincentives for natural regeneration or fallow management[14].

Strict forest management policies intended to reduce deforestation and forest degradation restrict the management of regenerating forests by raising transaction costs of selective harvesting. These policies provide perverse incentives for farmers to clear early stages of regrowth so they can maintain active agricultural land use[15]. Clarifying land tenure and harvesting rights for farmers is essential for them to receive economic benefits from spontaneous or assisted natural regeneration.

***Photo credit: Noel Celis***

*In Asia, reforestation of deforested state land favors commercial objectives, and budgetary allocations drive a demand for high-cost forestry plantations. Natural regeneration competes poorly with locally consumed agricultural food crops, export crops, and monoculture forestry. China, Nepal, the Philippines and Viet Nam have developed supportive policies for forest management that encourage forest restoration, including assisted natural regeneration (left), with a shift from state control to community-based management[12]. Clearing overgrowth surrounding a small tree reduces competition for light, water and nutrients as part of the Assisted Natural Reforestation project in the Philippines.*

*This multi-species plantation in Costa Rica is composed of tree species that commonly occur in naturally regenerating forests, and regenerating saplings are carefully managed. Trees in this plantation can be harvested without a management plan, but the same tree species cannot be harvested in a naturally regenerating forest without obtaining a costly forest management plan.*

***Photo credit: Robin Chazdon***

Under suitable conditions, natural regeneration can fulfill legal mandates for restoration, as in the state of Minas Gerais, Brazil where 75% of the area legally mandated for restoration on private farms (1.5 million ha) can potentially be restored using low-cost spontaneous and assisted natural regeneration interventions[16].

Natural regeneration has the potential to make a major contribution to restoring forest cover on a large scale in many countries. Harnessing this potential requires knowing where it is possible in the landscape and where lack of capacity calls for alternative restoration interventions. In many landscapes there are likely to be synergistic relationships among different approaches to ecological restoration.

With careful application of existing tools, it is possible to assess the status of natural regeneration across large areas. Spatial assessments can be used to predict and map natural regeneration capacity in relation to environmental and social factors. Such analysis can minimize conflicts between production and forest restoration objectives by identifying areas with a high potential for natural regeneration that coincide with farmlands with low agricultural productivity.

Regional and continental differences in land-use and land ownership create important consequences for the success of restoration interventions based on natural regeneration. Regionally-based research should be supported to improve and transfer knowledge of their ecology, management, and socio-economic costs and benefits. Research outcomes could be used to develop regionally-based toolboxes including guidelines for identifying successful natural regeneration and locally appropriate methods for its management and enrichment.

## Concluding remarks

It is time to recognize the economically and ecologically beneficial role that natural regeneration can play in large-scale ecological restoration and as an integral component of forest and landscape restoration. Multiple social and environmental benefits of spontaneous and assisted regeneration of forests come at significantly lower costs than planted forests. New policy frameworks can tip the balance for landowners to adopt restoration practices based on natural regeneration processes under suitable conditions. Enhancing knowledge regarding where natural regeneration occurs, its potential to develop, and ways to build capacity to enhance this potential within landscapes will provide critical guidance for incorporating natural solutions into large-scale restoration initiatives.

With the financial support of:

산림청
Korea Forest Service

## Endnotes

[1] Chazdon, R. L. 2014. Second growth: The promise of tropical forest regeneration in an age of deforestation. University of Chicago Press, Chicago, IL

[2] McDonald, T., G. Gann, J. Jonson, and K. Dixon. 2016. International standards for the practice of ecological restoration–including principles and key concepts. Society for Ecological Restoration, Washington, DC

[3] IUCN, and WRI. 2014. A guide to the Restoration Opportunities Assessment Methodology (ROAM): Assessing forest landscape restoration opportunities at the national or sub-national level. Working Paper (Road-test edition). IUCN, Gland, Switzerland.

[4] Chazdon, R. L., and M. R. Guariguata. 2016. Natural regeneration as a tool for large-scale forest restoration in the tropics: prospects and challenges Biotropica 48:716-730.

[5] Durst, P. B., P. Sajise, and R. N. Leslie, editors. 2011. Forests beneath the grass. Proceedings of the Regional Workshop on Advancing the Application of Assisted Natural Regeneration for Effective Low-Cost Restoration. Food and Agriculture Organization of the United Nations, Bangkok, Thailand.

[6] Crouzeilles, R., M. S. Ferreira, R. L. Chazdon, D. Lindenmayer, J. B. B. Sansevero, L. Monteiro, A. Iribarrem, A. Latawiec, and B. B. N. Strassburg. 2017. Ecological restoration success is higher for natural regeneration than for active restoration in tropical forests. Science Advances e1701345.

[7] Calvo-Alvarado, J., B. McLennan, A. Sánchez-Azofeifa, and T. Garvin. 2009. Deforestation and forest restoration in Guanacaste, Costa Rica: Putting conservation policies in context. Forest Ecology and Management 258:931-940.

[8] Reij, C., and R. Winterbottom. 2015. Scaling up regreening: Six steps to success; A practical approach to forest and landscape restoration. World Resources Institute, Washington, D. C.

[9] Schwartz, N. B., M. Uriarte, R. DeFries, V. Gutierrez-Velez, and M. Pinedo-Vasquez. 2017. Land-use dynamics influence estimates of carbon sequestration potential in tropical second-growth forest. Environmental Research Letters 12:074023.

[10] Strassburg, B. N., F. S. M. Barros, R. Couzeilles, A. Iribarrem, J. S. Santos, D. Silva, J. B. B. Sansevero, H. Alves-Pinto, R. Feltran-Barbieri, and A. Latawiec. 2016. The role of natural regeneration to ecosystem services provision and habitat availability: a case study in the Brazilian Atlantic Forest. Biotropica 48:890-899.

[11] Brancalion, P. H. S., and J. van Melis. 2017. On the need for innovation in ecological restoration. Annals of the Missouri Botanical Garden 102:227-236.

[12] Appanah, S., D. Lamb, P. Durst, T. L. Thaung, C. Sabogal, D. Gritten, B. Mohns, J. Atkinson, and K. Shono. 2016. Forest landscape restoration for Asia-Pacific forests: a synthesis. FAO and RECOFTC, Bangkok, Thailand.

[13] Chazdon, R. L., P. H. Brancalion, L. Laestadius, A. Bennett-Curry, K. Buckingham, C. Kumar, J. Moll-Rocek, I. C. G. Vieira, and S. J. Wilson. 2016. When is a forest a forest? Forest concepts and definitions in the era of forest and landscape restoration. Ambio 45:538-550.

[14] Dressler, W. H., D. Wilson, J. Clendenning, R. Cramb, R. Keenan, S. Mahanty, T. B. Bruun, O. Mertz, and R. D. Lasco. 2017. The impact of swidden decline on livelihoods and ecosystem services in Southeast Asia: A review of the evidence from 1990 to 2015. Ambio 46:291-310.

[15] Román-Dañobeytia, F. J., S. I. Levy-Tacher, P. Macario-Mendoza, and J. Zúñiga-Morales. 2014. Redefining secondary forests in the Mexican Forest Code: Implications for management, restoration, and conservation. Forests 5:978-991.

[16] Nunes, F. S., B. S. Soares-Filho, R. Rajão, and F. Merry. 2017. Enabling large-scale forest restoration in Minas Gerais state, Brazil. Environmental Research Letters 12:044022.

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