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RESTORING THE EARTH – THE NEXT DECADE

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Partial	USD 288 (KRW 340 000)	USD 475 (KRW 560 000)	USD 525 (KRW 620 000)

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CATEGORIES	EARLY BIRD 26 August–30 November 2020	LATE BIRD 1 December 2020–30 April 2021	ON-SITE 20–28 May 2021
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Cover: Women tend seedlings in a tree nursery in the Koyli Alpha village, Senegal, as part of the Great Green Wall initiative

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Contents

EDITORIAL

J.G. Hallett and M. Mumba

Over the last 20 years, forest and landscape restoration (FLR) has developed as an approach to increase the ecological integrity and functioning of degraded forests and landscapes while simultaneously improving human well-being and livelihoods. The impetus for FLR stems from the vast extent of forest and land degradation and loss, which has resulted in declines in biodiversity and ecosystem services, including carbon sequestration for climate-change mitigation.

The first truly global commitment to the recovery of degraded forests and landscapes was the adoption of Aichi Biodiversity Target 15 by the Parties to the Convention on Biological Diversity (CBD) in 2010. This target, which is also included in the European Union's Biodiversity Strategy, sought to restore 15 percent of degraded ecosystems by 2020. Similarly, large commitments on the restoration of degraded forest landscapes underpin the Bonn Challenge and the New York Declaration on Forests, which aim to restore 350 million hectares by 2030. Regional responses include the African Forest Landscape Restoration Initiative (AFR100), Initiative 20×20 in Latin America, commitments within the Asia-Pacific Economic Cooperation forum, and, among Mediterranean countries, the Agadir Commitment. All these seek to increase the exchange of knowledge on FLR, generate emulation across countries, and alleviate barriers to scaling up restoration.

FLR interventions help towards all the Sustainable Development Goals. Ecosystem restoration is also crucial for achieving the 2050 vision for biodiversity under the CBD and is likely to feature in the post-2020 Global Biodiversity Framework. The United Nations Decade on Ecosystem Restoration (2021–2030) will provide momentum by inspiring a global movement that alters societal norms and behaviours.

Countries are working to deliver on their ambitious restoration pledges at the national scale by modifying policies, developing the capacity of government staff and communities, mobilizing resources and engaging the private sector. In combination, these components provide an enabling environment for the planning and implementation of restoration interventions.

Despite considerable progress in the implementation of FLR in the last ten years, however, much more needs to be done. FLR can take considerable time, especially when technical capacity and resources are lacking. Continuous work is required to maintain the long-term engagement of stakeholders. And, although public participation in restoration can achieve great results for communities, ongoing messaging and education is required to ensure that (for example) appropriate trees are planted and nurtured.

FLR is a complex endeavour that works across sectors and involves many stakeholders. One of its challenges, therefore, is ensuring that all those involved in it understand what it is; another challenge is to measure its implementation. To address these challenges and to expand on and clarify previous work, the Global Partnership on Forest and Landscape Restoration has advanced the following principles of FLR: it 1) focuses on landscapes with 2) the active engagement of stakeholders and support for participatory governance that 3) restores multiple functions for multiple benefits while 4) maintaining and enhancing natural ecosystems and 5) is tailored to the local context using a variety of approaches with 6) adaptive management for long-term resilience.

No widely recognized monitoring framework yet addresses all six principles, and no standards are available for assessing FLR implementation. The absence of a monitoring framework limits our ability to determine whether FLR is being conducted and if social and environmental landscape objectives are being achieved. This is in marked contrast to the assessment of progress towards certain goals, such as the area under restoration in Aichi Biodiversity Target 15 and the Bonn Challenge. Nevertheless, as the world navigates the COVID-19 pandemic, FLR approaches – with their inclusivity, adaptability and integrated management – point a way forward for many communities.

This edition of *Unasylva* presents a wide range of lessons learned and opportunities for scaling up FLR to achieve national and international commitments and provides a comprehensive view of the status of and prospects for FLR. The first four articles describe new initiatives and flagship restoration programmes to increase funding, empower local stakeholders and enhance technical assistance for FLR. The following five articles present innovative technical approaches to increase FLR adoption. These have enormous potential to be mainstreamed because of their cost-effectiveness, adaptability, applicability to many ecosystems and contexts, and ease of implementation. The final five articles focus on factors that underpin the implementation of FLR and provides details on the coordination, policy environment, resources, knowledge and capacities needed to enable a global movement.

All these articles demonstrate that progress is being made. Importantly, they also outline the work now needed to scale up efforts – nationally, regionally and globally – to greatly increase the restoration of degraded forests and landscapes by 2030. ◆

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This edition of *Unasylva* was coordinated by FAO's Forest and Landscape Restoration Mechanism under the leadership of Faustine Zoveda and Valentina Garavaglia, supported by Caterina Marchetta and Yesenia Achlim under the overall supervision of Christophe Besacier.

The Restoration Initiative: a new model for partnerships on restoration

J. Schneck, V. Luque Panadero and B. De Ridder

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Elema Godana herds cattle in the fragile Dide Daride community in the Tana Delta, Kenya. The TRI Kenya Tana project is working to protect and restore this landscape through participatory land-use planning and the development of governance frameworks for sustainable resource management

The initiative is generating information on best restoration practices and creating champions among partner governments and other stakeholders.

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The Restoration Initiative (TRI) of the Global Environment Facility (GEF) is at the forefront of efforts to bridge the gap between restoration ambition and tangible progress on the ground. The largest GEF investment in restoration to date, TRI brings together the collective strengths and resources of three institutions – the International Union for Conservation of Nature (IUCN), FAO and the United Nations Environment Programme (UNEP) – and ten Asian and African countries to overcome barriers to restoration.

Key to this transformative programme's approach is a flexible yet comprehensive framework, around which national projects have been tailored to the particular contexts, needs and objectives of countries, while addressing four principal barriers to restoration: 1) insufficient enabling policies and incentives for restoration; 2) the limited implementation of restoration and complementary sustainable land management initiatives at scale; 3) underdeveloped capacity for mobilizing

investment in restoration; and 4) the need for greater learning and stronger partnerships on restoration (Box 1).

Another key innovation is in the delivery of programmatic support for national projects, which is facilitated through a global support project implemented jointly by IUCN, FAO and UNEP. The global support project leverages each agency's strengths and ongoing institutional programmes on forest and landscape restoration (FLR). This includes expertise and support for policy design and integration from IUCN, finance mobilization from UNEP's Finance Initiative, and capacity development and knowledge-sharing on the wide range of tools for, and information on, FLR from FAO. The global support project is also an area in which TRI expects to realize cost savings in the delivery of support and outcomes.

The diversity of project objectives and geographies (Figure 1) offers significant opportunities for knowledge exchange, partnership and scaling. TRI supports and facilitates this exchange, including through annual programme-wide and regional workshops (depending on the demand of the 11 country teams), an online community of practice, and support for harmonized monitoring and learning and the capture and sharing of experiences.

The programme is expected to generate significant global environmental benefits, including a total of 483 245 hectares (ha) of degraded land under restoration, 1.8 million ha of land under improved management practices, and 30.4 million tonnes of sequestered carbon (carbon-dioxide equivalent) (Table 1).

Box 1
The Restoration Initiative at a glance

Ten countries: Cameroon, the Central African Republic, China, the Democratic Republic of the Congo, Guinea-Bissau, Kenya (two projects), Myanmar, Pakistan, Sao Tome and Principe, and the United Republic of Tanzania.
Twelve projects: Eleven national projects and one jointly implemented global support project.
Funding: USD 54 million in GEF grants and USD 201 million in co-funding.
Institutional arrangements: implementation by IUCN (lead), FAO and UNEP. Execution by country ministries/agencies and, in some cases, non-governmental organizations.
Duration: Five-year average, with most national projects starting in late 2018.
The **project component workstreams** are:

- FLR-supportive policy development and integration
- Implementation of restoration and complementary initiatives
- Capacity development and finance mobilization
- Knowledge-sharing and partnerships.

PROGRAMME AND COUNTRY HIGHLIGHTS

Although TRI is only just over a year into a five-year programme of work, there is already much progress to share. All projects are engaged in or have completed the participatory identification and landscape-level planning of restoration work,

1 Country projects and implementing agencies participating in The Restoration Initiative

Source: adapted from IUCN, 2020. Available at https://www.iucn.org/restoration-initiative/about. Conforms to Map No. 4170 Rev. 19 UNITED NATIONS (October 2020)

Table 1. Anticipated global environmental benefits of The Restoration Initiative, by project

TRI project	Area under restoration (ha)	Increased area under improved practices (ha)*	Greenhouse-gas emissions mitigated (tonnes of carbon-dioxide equivalent)**
Cameroon	6 000	6 000	384 218
Central African Republic	3 221	3 221	3 185 597
China	208 919	208 919	3 793 952
Democratic Republic of the Congo	4 800	4 800	1 064 457
Guinea-Bissau	2 700	2 700	520 493
Kenya (ASAL project)	8 700	Not applicable	820 089
Kenya (Tana River Delta project)	10 000	130 000	6 686 291
Myanmar	89 005	1 295 007	861 128
Pakistan	4 400	34 400	2 782 420
Sao Tome and Principe	35 500	35 500	8 034 828
United Republic of Tanzania	110 000	87 245	2 224 846
Total	**483 245**	**1 807 792**	**30 358 319**

Note: * Comprises the area of landscapes under improved management to benefit biodiversity; the area of landscapes that meet national or international third-party certification and that incorporate biodiversity considerations; the area of landscapes under sustainable land management in production systems; and the area of high-conservation-value forest loss avoided. ** Excludes indirect emissions mitigation.

building on previous assessments. Efforts to improve the enabling in-country policy environment for FLR are under way with the establishment of FLR advisory panels, cross-sectoral planning and other enabling environment activities. An online community of practice of TRI practitioners has been established to support FLR knowledge-sharing, learning and partnerships. A new tool[1] that provides practitioners with information on threatened species and links to FLR is being piloted in Cameroon, the Central African Republic, Kenya (both projects) and Myanmar. And partners have obtained training and support on various priority FLR topics and tools through global, regional and national events.

Boxes 2–4 provide a closer look at some country-level projects.

[1] www.iucn.org/regions/washington-dc-office/our-work/species-threat-abatement-and-recovery-star-metric

Box 2
Enhancing ecosystem services in China through forest and landscape restoration and governance innovation

Institutional arrangements: Implementation by IUCN; execution by China's National Forestry and Grassland Administration.

Summary: The TRI China project is working to restore and improve the ecological health of state-owned forest farms (SFFs) to ensure their long-term sustainable provision of ecosystem services, including clean water, productive and stable soils, and carbon sequestration.

There are 4 855 SFFs in China, which together employ 750 000 people and cover 77 million ha (8 percent of the country's total land area), of which about 45 million ha is forest land. Historically, SFFs have been managed for a narrow set of objectives and practices (e.g. timber production through monocultural tree plantations). In some areas, these and other factors have led to soil and land degradation and forest fragmentation, with declines in the quality and quantity of ecosystem services.

Working with the National Forestry and Grassland Administration at three sites and seven SFFs, the TRI China project is piloting new approaches to management, including restoration. If successful, lessons from these experiences will be scaled up and incorporated in the management plans of other SFFs.

Progress to date includes:

- baseline assessments of ecological health and ecosystem services completed in each pilot forest farm;
- FLR-based forest management plans developed for seven SFFs as well as for Bijie City; and
- six international and national-level training events provided for 200 people in three provinces on FLR theory, payments for ecosystem services, FLR-based forest management plans, and more.

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Surveying the Gong Longping State Forest Farm in Guizhou Province in early 2019

Box 3
Improved management and restoration of agro-sylvo-pastoral resources in the Democratic Republic of the Congo

Institutional arrangements: Implementation by FAO; execution by the Democratic Republic of the Congo's Ministry of Environment, Nature Conservation and Sustainable Development.

Summary: South Kivu Province is one of the most densely populated and poorest provinces in the Democratic Republic of the Congo, with 80 percent of the population living below the poverty line. Population pressures and poor land management practices (including overgrazing and unsustainable timber and woodfuel harvesting) have resulted in significant forest and landscape degradation.

Addressing this degradation is a priority for the province. The TRI project is supporting government and community partners in their efforts in several ways, including the development of a provincial-level strategy for FLR; the demonstration of FLR and the sustainable use of natural resources in the Kabare and Ngweshe chiefdoms; and reinforcement of the institutional and financial capacity to scale up FLR approaches at the provincial and national levels.

Progress to date includes the following:

- Project stakeholders have received training in free, prior and informed consent to ensure that project implementation fully includes Indigenous Peoples in landscapes considered for restoration and sustainable management.
- The capacity of provincial authorities to bring partners together and share information on a regular basis has increased.
- A draft provincial FLR strategy has been prepared and is under review by stakeholders.
- Local development plans in the chiefdoms of Kabara and Ngweshe are under revision, with support from Deutsche Gesellschaft für Internationale Zusammenarbeit, to take FLR and sustainable forest management into consideration.
- A road map has been created following a capacity needs assessment for developing the capacity of stakeholders and beneficiaries.

Local people engage in focus-group discussions to identify locally important species for the restoration of degraded landscapes in South Kivu Province, the Democratic Republic of the Congo

Box 4
Enhancing integrated natural resource management in the Tana Delta, Kenya

Institutional arrangements: Implementation by UNEP; execution by Nature Kenya.

Summary: This TRI Kenya project is working to strengthen integrated natural resource management and the restoration of degraded landscapes in the Tana Delta and to systemically scale up best practices and lessons learned to other priority landscapes in Kenya.

Conflicts between land users in the delta have been on the rise in the past decade over access to land, resources and water, driven largely by population and economic growth. Moreover, the absence of a general framework to guide decision-making on development and resource management has limited the effectiveness of efforts to move towards more rational planning and use. The result has been the increasing conversion and degradation of the fragile Tana Delta ecosystem, which is home to endangered species such as the Tana River red colobus monkey and spotted ground thrush.

The TRI Kenya Tana Delta project is working to address these challenges, building on the success of a pilot land-use plan developed by villagers and local authorities in 2014. The project is supporting the development of sustainable value chains, including by facilitating private-sector investment, promoting the adoption of participatory forest management approaches for sustainable forest management and restoration, and advising on policies and strategies to sustainably manage the delta.

Progress to date includes the following:

- The 116 000-ha Tana Delta Indigenous and Community Conservation Area (ICCA) has been established, supported by a management plan and a participatory governance structure. The ICCA is included in the Tana River County Integrated Development Plan II (2018–2022), and the government has allocated USD 179 000 over the next four years to support its implementation.
- Five community forest associations have been established in five forest reserves in the Tana Delta to promote the better management of these lands. In addition, socio-economic surveys and ecological assessments were completed for the Kilelengwani, Kipini and Ozi forests and used to inform the development of three draft participatory forest management plans.
- Green value chains, including nine biodiversity-linked nature-based enterprises, were initiated in the delta, targeting 1 500 beneficiaries. These sustainable nature-based enterprises are expected to reduce pressure on natural resources.
- The Kenya Forest Service has drafted a national FLR action plan with support from both the FAO and Nature Kenya/UNEP TRI projects. Tana River County has developed a draft environment bill and forest restoration strategy.
- The project is one of five TRI projects piloting the application of species threat abatement and restoration assessments, identifying high-priority areas and actions for biodiversity conservation through FLR.

Livestock on the ever-depleting grazing land surrounding Dide Daride village in Kenya's Tana Delta. Home to thousands of species of birds, mammals and freshwater fish, the area has also supported generations of herders and farmers, who depend on its rich soils to nourish their crops and livestock. Population growth and climate change are putting pressure on the delta's 120 000 residents, sparking fierce competition over resources and degrading the fragile ecosystem

TRI GLOBAL SUPPORT PROJECT – PARTNERSHIP IN ACTION

The breadth of TRI – reaching across two continents and ten countries and involving numerous national and local partners – presents significant challenges in the coordination of workstreams. TRI agency partners IUCN, FAO and UNEP are turning these challenges into opportunities for greater learning and stronger partnerships on restoration, and the efficient delivery of technical support. A key means for this is a jointly implemented global support project, the work of which includes the following:

- **Annual and regional workshops.** Annual programmatic workshops presented by the global support project, as well as regional workshops on more localized topics of interest, are a principle means by which the programme facilitates South–South learning and cooperation on FLR. To date, two programme workshops – in Naivasha, Kenya, and at FAO headquarters in Rome, Italy – have been convened with the combined participation of about 130 programme partners, supporting capacity development, the identification of shared areas of learning, and partnerships on FLR. More targeted regional workshops, such as one on the use of payment schemes for ecosystem services held in Beijing, China, have been organized with help from the global support project.
- **Harmonized monitoring.** All national projects use a common set of nine core indicators to track progress and facilitate apples-to-apples comparisons and learning. The global project supports this harmonized monitoring by consolidating information and facilitating course corrections, as required, including through a programme-level advisory committee.
- **Online community of practice and learning.** An online knowledge-sharing community tailored to the needs of TRI partners has been created using a platform designed to work in countries with low-bandwidth Internet services. With help from the global programme, the platform supports learning through, for example, webinars, online training (via a partnership with Yale University's Environmental Leadership and Training Initiative), dedicated message boards on topics of interest, and a programme calendar and library.
- **Enhancing tools for FLR.** In addition to providing countries with direct technical support as needed, the global support project is assisting the development and enhancement of innovative tools, including through piloting in TRI countries. Tools under development are addressing, for example, the evaluation of in-country environments and readiness for investment in FLR; the mapping and assessment of land cover (e.g. using Collect Earth); and the identification of high-priority areas and actions for biodiversity conservation through FLR.

LOOKING AHEAD: SCALING UP RESTORATION EFFORTS TO MEET GLOBAL CHALLENGES

For practitioners and partners, the growing political support for restoration, as shown by country commitments to the Bonn Challenge and international policy developments such as the United Nations Decade on Ecosystem Restoration, is welcome and challenging. It promises additional resources and support for restoration and increases the imperative that investments in FLR meet expectations by addressing global environmental and development challenges.

TRI can help in this effort. Already, the shared implementation approach adopted by the three partnering TRI agencies has been referenced and adopted in recent GEF-7 programming, including the GEF-7 impact programmes "Food systems, land use and restoration" and "Sustainable forest management". TRI investments to enhance partnering-country enabling policy environments and capacities for FLR planning, implementation and monitoring can be further scaled up and serve as road maps for other high-need, high-opportunity countries. TRI investments in tools and innovative approaches, such as those on finance mobilization, biodiversity conservation and online learning, are already available to the wider restoration community through partner knowledge platforms.

As set out by Mills *et al*. in this edition (page 119), the United Nations Decade on Ecosystem Restoration will pursue three major pathways for achieving its goals: 1) building a global movement; 2) generating political support; and 3) building technical capacity. The ongoing restoration interventions under TRI will provide important information on best practices across a wide range of ecosystems. TRI partner governments (both local and national) will be welcomed as restoration champions who can share their valuable knowledge with FLR stakeholders and help foster political will.

The global COVID-19 health crisis has put greater emphasis on the need to "build back better" – to ensure that investments made in response to the effects of the coronavirus disease reduce the likelihood of future shocks and increase society's resilience to them when they occur. Initiatives like TRI have an important role to play in both supporting and helping guide future investment and work in restoration to consolidate existing habitats and rebuild connectivity to prevent further virus spillover events. The partners look forward to the work ahead.

Taking forest and landscape restoration to scale: lessons from China

D. Cassells, Luo X. and Chen X.

The country's success in reversing centuries of forest degradation and loss shows that large-scale restoration is possible given political leadership, multistakeholder involvement and an adaptive management approach.

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Large-scale forest and landscape restoration has emerged as an important global priority. Both the Bonn Challenge and the New York Declaration on Forests call for the restoration of 350 million hectares (ha) of degraded forest land globally by 2030. More recently, FAO has proposed the restoration of 900 million ha of degraded rural lands as a key measure to address land degradation and combat climate change. In March 2019, the United Nations General Assembly declared 2021–2030 as the United Nations Decade on Ecosystem Restoration.

Although the ambition for forest restoration is high, implementation has been slow, with only 26.7 million ha of new forests established since 2000 (NYDF Assessment Partners, 2019). In addition, scientists have warned that forest restoration must be viewed as an additional measure rather than a substitute for action to cut emissions, and also that restoration efforts need to be targeted carefully to produce desired effects (Betts, 2011; Arora and Montenegro, 2011). Scientists have also noted the potential for adverse environmental outcomes when forest planting is extended to areas with low capability to support sustainable tree establishment or to non-forest areas with significant environmental values such as natural grasslands and wetlands (Cao, 2008; Farley and Jackson, 2005; Jiang, 2016).

China is one of only a few countries to have reversed centuries of forest loss and degradation in recent decades and to

Above: China's massive restoration effort has included tree-planting in extraordinary terrain on the Loess Plateau to reduce sedimentation in the Yellow River

have dramatically increased its forest area: forest cover in the country has increased from 8.6 percent of the national land area at the time of the formation of the People's Republic of China in 1949 to 23 percent today (Figure 1). Much of this expansion has been driven by large-scale "eco-forestry" projects designed to restore or enhance ecosystem services, ranging from erosion control and watershed protection to cropland protection, desertification control, landscape amenity and carbon sequestration. This article explores the achievements of China's ecoforestry programmes, which started in 1978, and the challenges they have faced, and it discusses the key lessons learned that may help others in achieving large-scale forest restoration.

CHINA'S HISTORY OF FOREST LOSS AND DEGRADATION

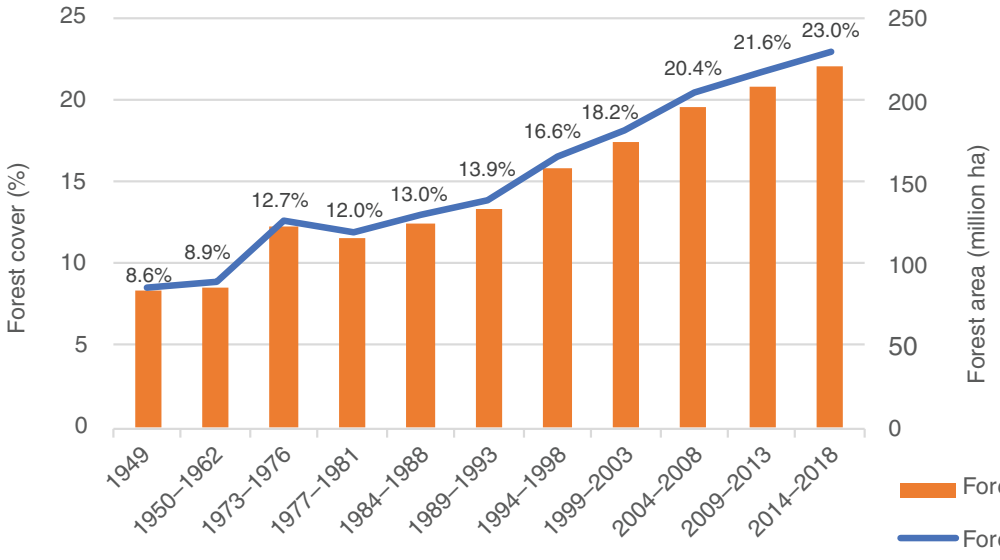
Many of today's global challenges related to environmental degradation, forests and forestry have long been concerns in China. Throughout China's vast history, its forests have suffered as societies have prospered. Elvin (2001) characterized Chinese history as 3 000 years of unsustainable growth; Lamb (2010) described China as an archetypal example of a society that had been unable to prevent almost complete deforestation.

Lamb (2010) also noted that deforestation occurred in China despite a philosophical tradition involving a reverential attitude to nature, rich silvicultural knowledge, an understanding of the functional and protective roles of forests, and a strong political apparatus that had built a unified state. Forest degradation and loss continued for reasons common to many developing countries today: the limited ability of successive governments to use existing knowledge to implement their policies, and the fact that enlightened philosophical views about nature were confined to a small proportion of the population. Most people lived in rural areas and used nature and its resources in a continuous struggle to feed themselves and survive. With an increasing population, peasant farmers needed new lands, fuel, and building materials, and forests were the natural source of these. Over several thousand years, farmers continued to expand into and clear new forest lands until, eventually, the limits were reached. The loss and degradation of forests, wetlands, grasslands and shrublands through landclearing, overgrazing and other agents led to the degradation and loss of ecosystem services and consequently to serious problems with erosion, stream sedimentation, flooding, declining agricultural productivity, desertification, sand storms and biodiversity loss.

EARLY EXPERIENCES WITH FOREST RESTORATION

Although the overall trajectory of net forest degradation and loss continued into the modern era, China also has a long history of people responding to local problems by instigating forest restoration and protection measures. Afforestation in arid and semiarid China can be traced back at least 2 300 years (Wang *et al*., 2010). Miller (2020) charted the rise of timber plantations in China between about 1 000 and 1 700 CE, when natural forests were increasingly replaced by planted forests.

When the People's Republic of China was created in 1949, it inherited both a legacy of forest degradation and loss and historical experience with reforestation. Forest cover was low, with many provinces virtually treeless. The perilous state of the country's forests seems to have been well recognized by the incoming political leadership, with the First Plenary of the Chinese People's Political Consultative Conference



1
Forest area and percent cover, China, 1949–2018

Sources: National Forestry and Grassland Administration (2016, undated); Song and Zhang (2009).

in September 1949 adopting a common programme that contained provisions to protect forests and develop forestry in a planned way (Richardson, 1966; Zhou, 2006).

Similarly to previous administrations, however, China's new leadership was constrained economically and unable to implement its well-intentioned policies or to turn an understanding of the functional and protective roles of forests into practice. Forests were mobilized to meet the immediate needs of economic development and reconstruction following the long years of war.

Early afforestation efforts were also hampered by inappropriate incentives, underdeveloped silvicultural techniques and low rates of survival. Nevertheless, by the 1970s, China had amassed considerable experience and success in both afforestation and the use of forest management to support agriculture. Although, overall, forest policy still favoured the unsustainable exploitation of natural forests and some conversion of forests to farmland, afforestation programmes were encouraged along roads, rivers and canals and around houses and villages. By the late 1970s, institutional arrangements were well established that linked political decision-makers, technicians and forest and farm workers. By world standards, the country had already achieved large-scale afforestation, with overall forest cover reaching 10 percent of the total land area (FAO, 1978) (up from 8.6 percent in 1949).

CHINA'S LARGE-SCALE ECOFORESTRY PROGRAMMES

China launched the first of its large-scale ecoforestry programmes in November 1978 following huge dust storms and in light of growing recognition of the costs of environmental degradation. The first programme – the Three-North Shelterbelt Development Programme (hereafter the Three-North Programme) – was vast in both scale and duration (Zhou, 2006; Box 1). The programme made early progress; by its fortieth anniversary in 2018 it had facilitated the planting of 46.1 million ha in challenging environments. Overcoming initial challenges, including low rates of survival, the programme achieved a net expansion of forest cover of 30.1 million ha (CAS, 2018). Carbon sequestration from these forests has been estimated at 5 percent of China's total industrial emissions over the same period.

With the early success of the Three-North Programme, a national tree-planting programme and other shelterbelt development programmes were initiated in the 1980s (Box 2). A series of catastrophic events, including flood disasters in the Yangtze and Sonhuajiang river basins in 1998 and unprecedented dust storms in Beijing and other areas in 2000, prompted a dramatic expansion of China's ecoforestry and associated land sustainability programmes (Bryan *et al*., 2018; Zhou, 2006). Overall, the investment in 16 major sustainability programmes between 1978 and 2015 totalled USD 378.5 billion (in 2015 dollars), with annual programme support growing steadily (as China's economy grew) to more than USD 40 billion per year

Integrated forest and agricultural land use in a restored catchment in Baijun County, Heilongjiang Province

Box 1
The Three-North Shelterbelt Development Programme

The Three-North Programme was established by the Central Committee of the Chinese Communist Party and the State Council of China in November 1978 to improve natural and economic conditions in the country's north, northeast and northwest (hence "Three-North") regions for sustainable development. The programme covered about 4 million km², from Bin County in Heilongjiang Province in the east to the Wuzibile Mountains in Xinjiang in the west – some 42 percent of China's land area; it was 4 480 km in length and 560–1 440 km wide and extended over 551 counties in 13 provinces. The planning horizon was 73 years, and the programme was implemented in eight phases. Its achievements, which had three components (farmland shelterbelt, erosion control, and combating desertification), have matched the scale of its ambition.

Farmland and infrastructure shelterbelts

More than 2.8 million ha of farmland shelterbelts had been established under the programme by 2015. This green infrastructure offered protection to 30 million ha of existing farmland and led to the reclamation of an additional 15 million ha of farmland and pasture. It has been estimated that this has accounted for as much as 20 percent of the increase in the national grain harvest over the last 40 years.

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Farmland shelterbelts have increased agricultural yields substantially

Erosion control on the Loess Plateau

Under this project, which ran from 1994 to 2002, about 9.6 million ha of watershed protection forests were established on the Loess Plateau (see photo on page 9); sediment levels in the Yellow River fell by up to 90 percent; and livelihoods were improved by the incorporation of economic crops such as walnuts and apples in restoration plantings. By 2015, for example, over 6.6 million ha of fruit plantations had been established, producing 48 million tonnes of dry and fresh fruits annually with an output value of CNY 120 billion (USD 17 billion). According to Chen, Wang and Wang (2004), the proportion of people in the area living in poverty dropped from 59 percent in 1993 to 27 percent in 2001.

Sand ecosystem management to combat desertification

Under this project, 3.4 million ha of sand ecosystems have been brought under management and converted to fertile farmland, and China's sand ecosystem is now reducing by 150 000 ha per year. Sand stabilization has enabled the protection of villages and key infrastructure such as roads and railway lines.

© APFNET

Villagers plant grasses in 2018 as part of efforts to combat desertification

Box 2
China's other key ecoforestry projects

National Tree-planting Campaign. The National People's Congress launched this programme in 1981 to facilitate wide participation in tree-planting. It was designed to raise public awareness of afforestation, accelerate the reforestation of barren hillsides, improve ecological conditions in rural and urban areas, and promote ground-level greening in all sectors.

The shelterbelt development programmes in the Yangtze River basin and other regions. These programmes, which began in 1987, extended shelterbelt development to five additional regions covering the Yangtze and Pearl rivers and their coastal areas and plains, and the Taihang Mountains.

Natural Forest Conservation Programme. This programme, initiated in 1998, sought to halt logging and deforestation to protect natural forests for ecological and carbon benefits. It created new business opportunities for traditional forest enterprises as well as jobs in forest management, and it assisted redundant forestry workers with relocation.

Grain-for-Green Programme. This programme started in 1999 to prevent soil erosion, mitigate flooding, store carbon and improve livelihoods by increasing forest and grassland cover on steep hills and by converting croplands, barren hills and wastelands to forests. The programme provided grain and cash as incentives and compensation for not cultivating some types of land and, rather, converting it to forests, woodlands or grasslands.

Fast-Growing and High-Yielding Timber Programme. This programme, which was implemented between 2001 and 2015, was designed to remedy the decline in timber supply due to the withdrawal of natural forests from production. It focused on regions with potential for plantation development.

Sandstorm Source Control Programme around the Beijing-Tainjin Region. The aim of this programme, initiated in 2001, was to reduce desertification and dust storms and improve the environment in the Beijing-Tianjin area through reforestation, grassland management and watershed management.

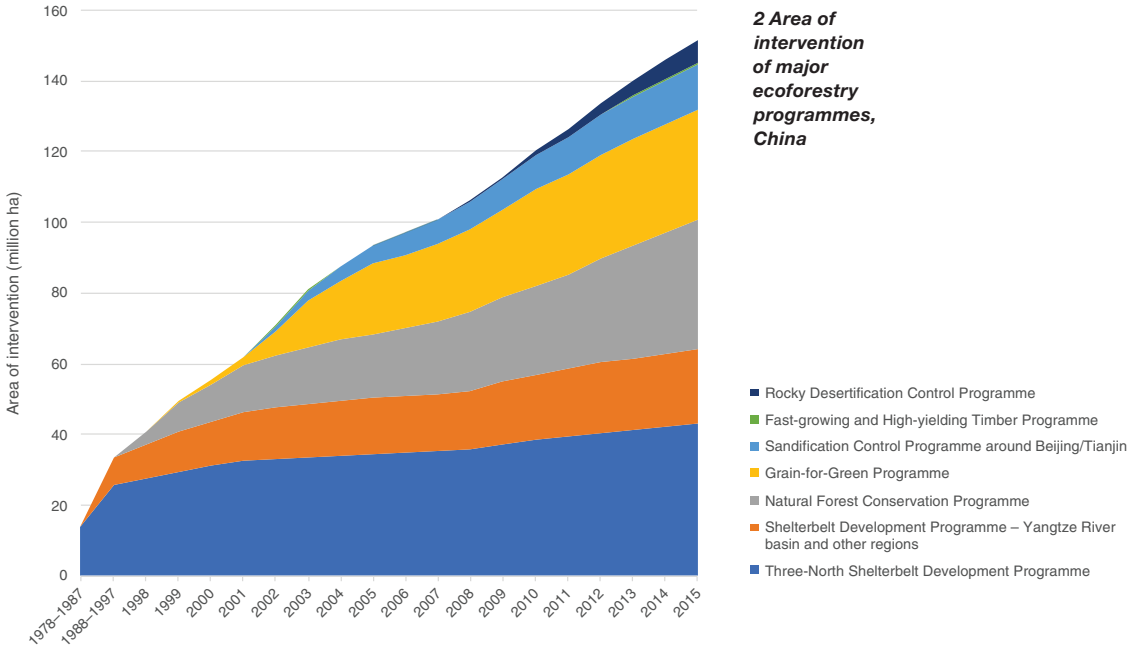
Wetland Conservation Programme. This programme supported projects designed to enhance the conservation and restoration of important natural wetlands. The integration of the programme with other key programmes, such as the Natural Forest Protection Programme and the various shelterbelt programmes, helped significantly reduce sedimentation in key wetland areas.

Rocky Desertification Control Programme. This programme, which began in 2008, was designed to curb land degradation in karst areas in China by improving environmental conditions and increasing local incomes in those areas. The programme focused on protecting and establishing vegetation, encouraging sustainable land use and water conservation, and supporting the relocation of poor people from degraded areas.

Sources: APFNet (2012); Bryan *et al*. (2018).

in 2015 (which was 0.37 percent of gross domestic product) (Bryan *et al*., 2018).

Together, these programmes, combined with other sustainability programmes to address, for example, soil and water conservation, wildlife conservation, grassland protection and the quality of cultivated land, have led to the substantial recovery of land cover and ecological function (Bryan *et al*., 2018). In total, the programmes (including non-forestry programmes) have covered more than 600 million ha or 62 percent of China's land area (see Figure 2 for the coverage of the main forest-oriented programmes). This has dramatically expanded forest and other vegetative cover, reduced sediment loads in major rivers, enhanced habitat restoration and biodiversity and assisted in obtaining increases in crop production and food security. Given that most of the heavily degraded lands also had higher incidences of poverty and slower economic growth, China's forest restoration and land sustainability programmes have generally increased incomes and reduced poverty in programme areas, although the local economic effects have varied greatly (Liu, Yin and Zhao, 2018). To date, no assessment has been made of the national-level economic impacts of the programmes, which were established primarily for environmental and local and regional poverty-alleviation purposes.



2 Area of intervention of major ecoforestry programmes, China

Source: Bryan *et al*. (2018).

© LIANG YIMING

The degraded landscape of Sanguyao village, Tiebian township, Wuqi County, Shaanxi Province, on 24 September 1984

© WU ZONGKAI

The same landscape 28 years later, on 24 September 2012, after restoration

DRIVERS OF SUCCESS

China's success with large-scale ecoforestry, land restoration and resource sustainability is due to many factors. The most important are described below.

Sustained political and budgetary support

All of China's large-scale ecoforestry and land sustainability programmes have operated under multidecadal timeframes and with sustained high-level political and budgetary support. Once the implications of continued forest degradation and loss (and associated land and resource sustainability problems) were fully recognized, national-level programmes were initiated with full policy and legislative support. Sustainable forest conservation, management and restoration, and ensuring resource sustainability, became high-level public-policy concerns similar to health, defence and education, and they were backed with ongoing policy and budgetary support.

Mass mobilization and participation

In the early days of the programmes, the bulk of China's population still lived in rural areas on farms and communes. Planning and management followed norms for the agriculture sector as a whole; and local demonstrations of best practice served as models to enable surrounding farms and farmers to improve management through a process of learning by doing. Planning at the local level was made by "three-in-one formations" comprising technicians, commune members and party cadres. These formations considered the following three criteria for the selection of crops and activities: 1) site conditions and the suitability of the land for agriculture, forestry or animal production; 2) national targets; and 3) local people's needs. Before a plan was adopted and implemented, it was reviewed and refined through a participatory process linking provincial and district planning teams with forest production brigades at the commune or village level.

Broadscale communication and extension efforts convinced a large portion of the national population to support tree-planting because it would, over time, contribute to collective and individual well-being (FAO, 1978). This high level of "tree consciousness" was further developed by later programmes such as the National

Tree-planting Campaign. Incentives were paid to those people and bodies implementing activities – usually farmers and forest-farm units. It was recognized, however, that these incentives would need to increase with the gradual development of the market system and higher levels of labour mobility (Zhou, 2006). For example, tree-planting payments under the Three-North Programme were initially CNY 150 (USD 60 at the time) per hectare. Payments had risen to CNY 7 500 (USD 1 071) per hectare by 2017 (Zhu and Zheng, 2019).

Later programmes such as the Natural Forest Protection Programme and the Grain-for-Green Programme involved retiring land use and the voluntary or involuntary resettlement of farmers away from vulnerable and degraded sites. These programmes had a socio-economic focus on reducing poverty as well as enabling environmental outcomes, which overcame these challenges. A wide range of incentives was paid to affected farmers, and considerable efforts were made to diversify their off-farm incomes through the establishment of orchards and village enterprises such as fish ponds and pig raising (Cao *et al*., 2017). The efforts were greatly assisted by China's rapid economic development; nevertheless, it is recognized that, in some areas, there is a need for ongoing payments for the provision of ecosystem services to secure long-term sustainability (Bryan *et al*., 2018).

Coordinated governance and management

The central government led programme governance and also provided most of the funding. It was supported by partnerships with, and co-investment from, provincial and local governments as well as enterprises and individuals (Bryan *et al*., 2018). With the help of research agencies, the central government designed the programmes, set high-level objectives and delegated responsibilities to relevant agencies such as the National Forestry and Grassland Administration (and its predecessors). These agencies planned the detailed scope and priorities of programmes and coordinated implementation, allocating tasks to provincial government departments. Provincial and local government departments refined and adapted the programmes based on local needs, conditions and priorities and developed and implemented projects and managed funding. Monitoring and quality assurance involved self-appraisal, inspection at the local, provincial and national levels, and verification against accepted performance standards. Underperformance resulted in penalties, including withheld payments.

Development partnerships and learning by doing

China's implementation of its major ecoforestry and land sustainability programmes was supported by bilateral and multilateral assistance programmes offered by the World Bank, FAO and the Sino–German Forestry Programme. This helped accelerate capacity building in forest science and restoration management and, as the programmes developed, to facilitate the documentation and dissemination of lessons learned. Adaptive management based on learning by doing has been a feature of the programmes, with pilots, trials and staged rollouts employed to enhance learning and project success.

A focus on livelihoods as well as ecosystem services

Although most forest plantings and restoration efforts focused on environmental objectives, economic tree crops such as fruit and nut trees were used widely to increase the incomes of participating villages and communes. Pilot sites demonstrating that the establishment of shelterbelts increased crop production inspired their replication across large areas of farmland. Where a programme involved retiring marginal lands from production, compensation payments were made for up to eight years, with an extension of an additional eight years to further reduce poverty and generate alternative employment and income (Liu, Yin and Zhao, 2018).

CHALLENGES

Although the programmes have been impressive in both scale and impact, their implementation has not been without significant challenges, and additional issues are emerging that ultimately will need to be addressed. Some of these are described below.

Low survival rates and inappropriate species selection

In the early days, many of the areas targeted for restoration were barren, with long histories of land degradation. Many sites, particularly in the Three-North Region, were harsh, windy and cold, with short growing seasons; this presented a significant challenge for restoration. The limited availability of planting materials often led to an overreliance on single species and consequent problems with pests and disease. As noted earlier, the Three-North Programme increased forest cover by 30.1 million ha over 40 years, but the equivalent of 46.1 million ha was planted, an effective success rate of just 65 percent.

Tree-seedling survival rates were very low in many areas. Farmers informally told two of the authors in 2019 that today's trees have been "built on the shoulders" of previous dead trees; some cynically described plantings as "green in year 1, yellow in year 2 and brown in year 3". In drier areas, there were instances where reforestation was overused as the prime restoration tool, even in environments that may not have previously supported forest vegetation (Cao, 2008; Jiang, 2016). Over time, there has been greater use of land enclosures to reduce grazing pressure and thereby assist the natural regeneration of grasslands and shrublands in areas where these are more appropriate land cover.

An initial inadequate science base

China's large-scale ecoforestry efforts began just as the country was emerging from the Cultural Revolution, which considerably disrupted many science and resource management systems. The initial science base of the programmes, therefore,

was not well developed, leading to problems such as an overreliance on a relatively small number of species and the use of species that were inappropriate for particular sites.

With the opening of China's economy since the late 1970s, China's capacity in forest sustainability science has developed greatly, and there is growing emphasis on planning and more targeted restoration interventions. Efforts are being made to develop and apply close-to-nature approaches in new plantings and in the ongoing restoration of already-established monoculture plantations (APFNet, 2015, 2019).

Looking beyond the trees to ecosystem function

The need to focus restoration interventions on the right species for a given environment has been alluded to above. Awareness of possible trade-offs is also important, and many authors have shown that successful plantings to arrest erosion on the Loess Plateau and elsewhere caused reductions in streamflow (e.g. Wang *et al*., 2011; Feng *et al*., 2017). China is considering these studies to understand how to integrate lessons learned into future projects.

Developing appropriate monitoring and evaluation systems

The development of China's ecoforestry programmes has occurred at a time of rapid economic, social and environmental change, and it is difficult to ascribe the extent to which changes experienced in the programme areas – both positive and negative – are the result of programme interventions or the confounding effects of broader changes. Programme designs that better enable the monitoring and evaluation of results and address trade-offs will become increasingly important, particularly in arid and semiarid areas where the selection of low-cost, water-efficient interventions is crucial.

Sustainable financing of ecosystem services

China's consistent political and budgetary support has been a key element of programme success, but concerns have been raised that reversals could occur when payment periods for key programmes cease or if a significant economic reversal leads to fewer off-farm labour opportunities or population movements back to rural areas (Liu, Yin and Zhao, 2018). Strategies such as the innovative development of payment schemes for ecosystem services and the realization of the economic potential of the forest and agricultural products produced in restored areas will be important for ensuring ongoing public support for restoration and sustainable forest management.

CONCLUSION

Over the last four decades, China's ecoforestry programmes have extended early successes to dramatically expand forest cover and are now focusing on consolidating the ecological services that the plantings were designed to provide. China's experience gives rise to key lessons about what has enabled the implementation of restoration at such an impressive scale. Consistent and strong political leadership was pivotal for supporting long-term governmental and societal commitment to environmental sustainability. This may not easily be replicable in other places, but China's experience shows that consistent policy support can bring about significant progress in the management, conservation, development and restoration of forest landscapes. Multistakeholder, whole-of-society approaches have also enabled the mobilization of efforts across China and helped secure sustainability. Also crucial has been the integration of economic, social and environmental concerns into restoration strategies. Thus, a holistic approach to restoration can support its sustainability and provide diverse benefits.

Learning by doing has been key throughout China's history of forest policy and restoration. It has been backed by ongoing research and development to enable adaptive management that incorporates new knowledge and responds to challenges. Due to the long timeframe needed for restoration, continuous adaptive learning and implementation is crucial for ensuring the implementation of restoration practices and benefits across landscapes. These key lessons should be taken into account to support the development of sustainable restoration at scale elsewhere.

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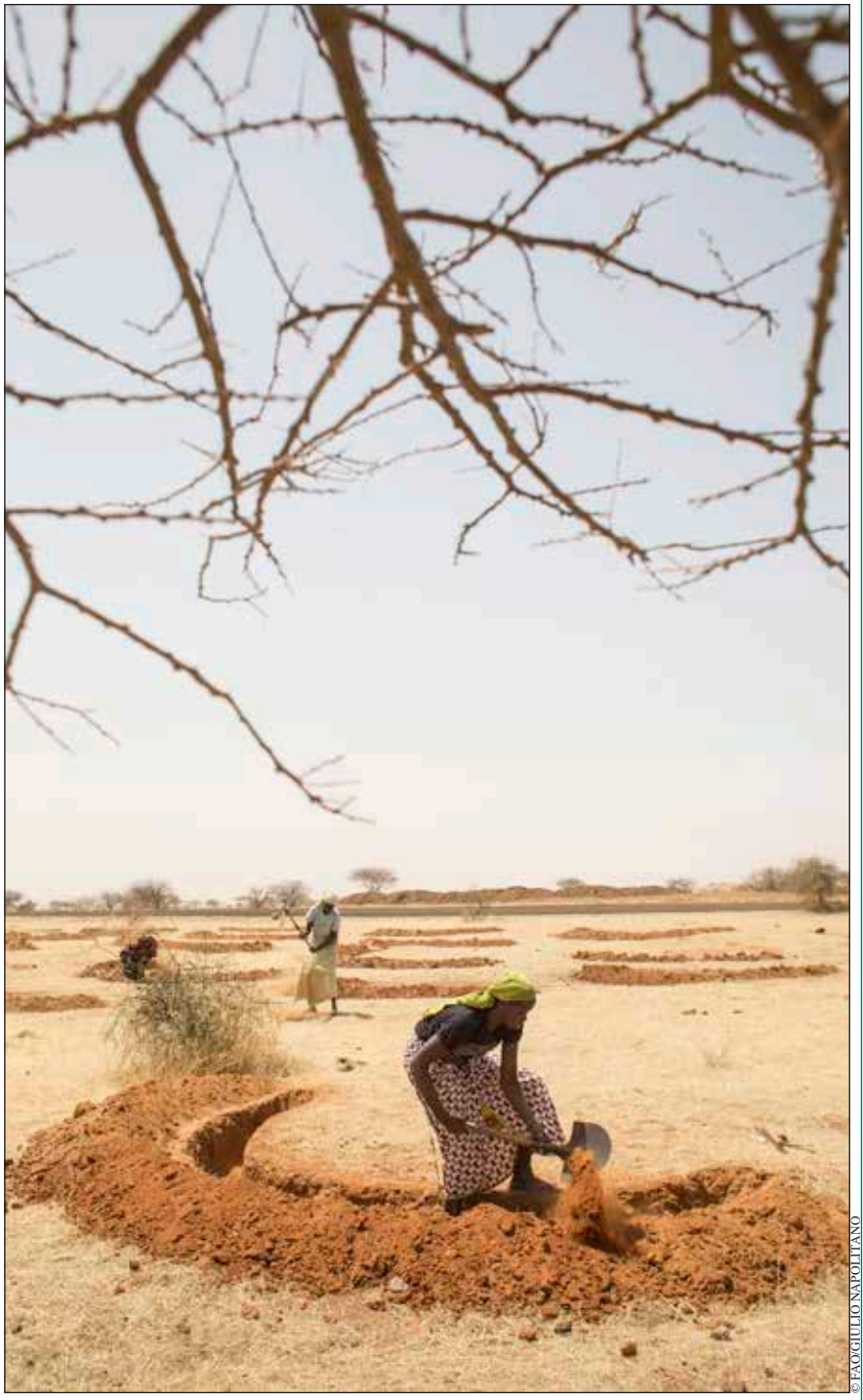
Green investment in the Sahel: the role of local governments and communities

F. Zoveda, N. Berrahmouni, K. Mai Moussa and M. Diakhite

A trend towards decentralization can assist efforts to restore landscapes – provided that local governments and communities work hand in hand to plan, implement and maintain interventions.



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Women prepare a field for the next rainy season by excavating half-moon dams as part of an AAD project

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Africa faces multiple environmental challenges – such as widespread land degradation, climatic fluctuations and change, water scarcity and biodiversity loss – that exacerbate existing food and energy crises. The continent lost a net average of 3.9 million hectares (ha) of forest per year in the previous decade (FAO and UNEP, 2020). Sixty-five percent of its lands are degraded, with soil and nutrient depletion in croplands causing an estimated loss of African gross domestic product of 3 percent per year due to reduced agricultural production potential (DeWitt, Weber and Diakhite, 2015). The African population is forecast to grow to 1.7 billion people by 2030 and to 2.5 billion by 2050 (UN DESA, 2017). To harness this demographic trend and its potential for sustainable development, significant investments are needed to build a "transformed Africa", as envisioned in the African Union's Agenda 2063 (African Union, 2015).

The full array of challenges and opportunities facing Africa exist in the Sahel, a strip of land of several hundred kilometres located south of the Sahara bordered by the Atlantic Ocean and the Red Sea. Sahelian drylands are characterized by high annual temperatures and low but highly variable rainfall (OSS, 2018); the Sahel is expected to be among the planet's most severely climate-change-affected regions (IPBES, 2018). Sahelian countries also face an unprecedented demographic challenge – with population growth among the highest in the world (World Bank, 2018), rural communities that are highly dependent on increasingly scarce natural resources, and considerable insecurity, conflict and intense migrations. Recognizing the depth of the challenges, countries in the Sahel have gathered forces through initiatives to increase food security and people's resilience. For example, the Great Green Wall for the Sahara and the Sahel Initiative (GGWSSI)[1] and the African Forest Landscape Restoration Initiative (AFR100)[2] were launched in 2007 and 2015, respectively, with the aims of helping reverse desertification, land degradation and biodiversity loss and optimizing adaptation and resilience to climate-change hazards and impacts.

Despite multiple pressures on the environment, the Sahel became greener overall between 1980 and 2010 (as evidenced by Normalized Difference Vegetation Index trends captured through remote sensing) (IPBES, 2018). At least partly, this increase was due to the establishment of new vegetation enabled by:

- the use of water- and soil-conservation technologies and mechanical tools (e.g. stone lines, zaïs, half-moons, Delfino ploughs and organic fertilization, some of which are described below); and
- the use of biological approaches (e.g. the control of grazing; site restoration through assisted natural regeneration; the planting of local tree and other plant species; promoting a grass layer; and agroforestry).

Such successful approaches must be scaled up urgently by building on and encouraging local initiatives. This article looks at the instrumental role that national decentralization policies, adopted by most Sahelian countries, can play in enabling local investments in restoration and how targeted capacity development and technical support provided to communities can help ensure success.

DECENTRALIZATION: ENABLING ACTIONS TO ADDRESS THE CHALLENGE OF DEGRADED LANDS

Globally, environmental conservation and restoration policies have been changing recently towards the increased devolution of responsibilities to local governments (IPBES, 2018; Hesse and Trench, 2000). In the Sahel, governments started decentralizing natural resource management to local governments (*collectivités territoriales*) about a decade ago. In particular, responsibility has been transferred to municipalities, which are now in charge of leading environmental-management-related operations, including the planning, financing and management of investments (i.e. *maîtrise d'ouvrage*) for natural resource management.

Municipal authorities therefore play a crucial role as unifiers and facilitators in the implementation of land restoration across municipal lands. This is particularly true for lands placed directly under municipality authority, such as grazing lands, rangelands, fallows, riverbanks and community forests. Some countries have developed separate approaches for restoration on private and community lands. In Burkina Faso, for example, Coordination Nationale de la Grande Muraille Verte – the country's national entity in charge of coordinating the GGWSSI – has tested two restoration approaches with the technical support of FAO and local partner non-governmental organizations. Degraded land assigned to family farming is restored through a household-level approach involving the construction, by hand, of half-moons and zaïs.[3] For larger-scale restoration, Delfino ploughs (ploughs equipped to dig microbasins mimicking the traditional half-moons) are used in place of manual digging. The deployment of these two approaches has helped reverse degradation over a short period. Using the two approaches in combination provides flexibility in dealing with a wide variety of situations and the needs of local people.

Successful restoration requires adequate incentives, effective governance, sufficient technical, operational and financial capacities, the sustainability of actions, and continuous monitoring and adaptive management and learning (FAO, 2015; Sacande, Parfondry and Cicatiello, 2020). Local governments, particularly municipalities, play key roles by mobilizing municipal funds for restoration investments; building capacities and promoting

[1] www.greatgreenwall.org/about-great-green-wall
[2] www.afr100.org

[3] Half-moons (also known as eyebrow terraces) are semicircular microbasins designed to supply plants with water runoff. Zaïs, also known as tassas, are planting pits filled with organic fertilizers or compost and surrounded by small ridges to capture water.

community ownership; and establishing fair partnerships with the private sector and other stakeholders in delegating the various restoration actions.

MOBILIZING MUNICIPAL FUNDS FOR RESTORATION INVESTMENTS

The use of integrated land-use plans is key to restoration success (Sabogal, Besacier and McGuire, 2015). In the Sahel, local governments are responsible for including natural resource management activities and related investments in their planning tools. One key tool is local development plans (LDPs),[4] which provide strategic guidance on local development at the municipal level. LDPs are designed in a participatory way by local stakeholders, and they encompass the local government's economic, social and environmental development priorities for the next several years. Municipal councils can also develop and implement annual investment plans based on their LDPs. Municipal budgets complement these tools in planning a municipality's annual revenue and expenditures.

The transfer of responsibilities from the central to the local level is a complex process because, often, municipalities lack the human and financial resources they need to invest significantly in restoration and other activities. Their share of tax revenue is low, they are usually assigned only a small proportion of the budgets of central governments, and they are seldom able to borrow funds (Husson, 2013). Nevertheless, the following three tools – which can be deployed simultaneously or sequentially – are available to help increase municipal functional capacity and investment resources (IRAM, 2019).

1. **Targeted budget support.** Budget support involves direct funding from the central government to local governments for targeted sectors. Although such support is essential, it could hamper the empowerment of subnational authorities by maintaining their dependence on central governments. Nevertheless, it is a major source of funds, which can be made available specifically for restoration.
2. **National funds and agencies that support the financing of local governments.** In many countries, political decentralization has resulted in the development of national funds to support facilities for local governments, such as Agence Nationale de Financement des Collectivités Territoriales (ANFICT) in the Niger, Fonds Permanent du Développement des Collectivités Territoriales (FPDCT) in Burkina Faso, and Agence Nationale d'Investissement des Collectivités Territoriales in Mali. These national funds are sustainable public institutions financed directly by the central government. They can also receive endowments from external partners (Husson, 2013), and they are usually directed at local-government development programmes as capital grants and to build operational capacity.

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A woman draws half-moons as part of a training exercise in the Niger. Local governments can play a key role in building capacities and promoting community ownership

3. **Local development funds.** The United Nations Capital Development Fund (UNCDF)[5] has supported the design and implementation of local development funds (LDFs) in many least-developed countries, including in normal and post-crisis situations. Often, LDF operations are initiated in three steps: 1) the development of a local strategic plan (e.g. an LDP) and a related expenditure framework in a three-year plan addressed in annual investment plans; 2) the design and implementation of funding windows and the transfer and use of funds; and 3) a performance assessment of the local government. LDFs generally have two windows – one for financing

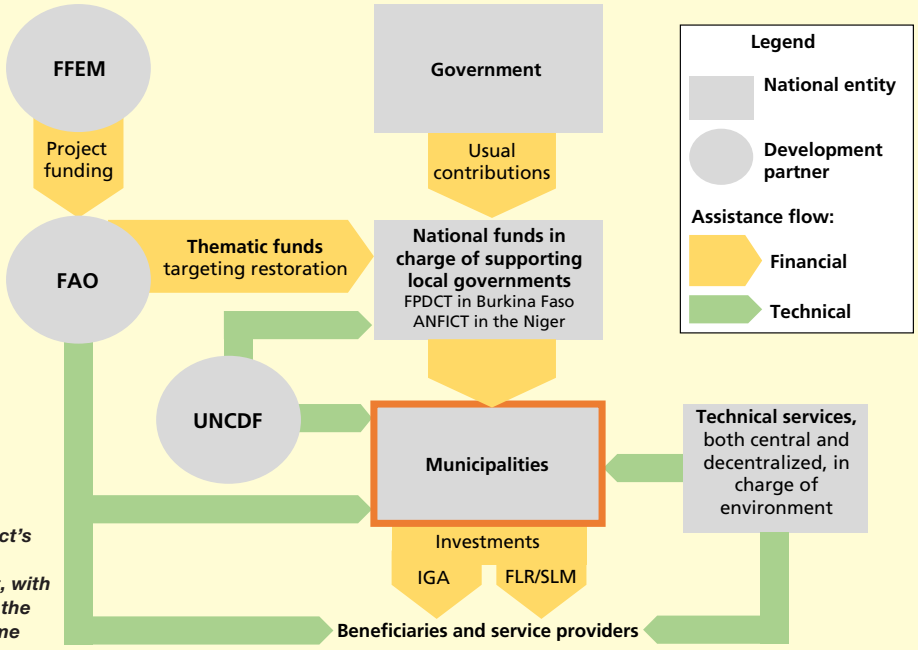
[4] LDPs are known as *plans de développement communal* in Burkina Faso, Chad, Mauritania and the Niger and *plans de développement social, économique et culturel* in Mali (Tieplolo, 2011).

[5] The UNCDF makes public and private finance work for the poor in the world's 47 least-developed countries. The UNCDF offers "last mile" finance models that unlock public and private financial resources, especially at the domestic level, to reduce poverty and support local economic development. See www.uncdf.org for more information.

Box 1
A forest and landscape restoration project in Burkina Faso and the Niger receives funding from a national fund and a local development fund

The FAO project, "Forest and landscape restoration and sustainable land management in the Sahel", began in 2018 with financial support from the French Global Environmental Facility (FFEM). Its aim is to strengthen technical and financial capacities in three municipalities in each of Burkina Faso and the Niger with a view to empowering them in "greening" their LDPs.

Agreements were signed with the national funds in charge of supporting local governments (FPDCT in Burkina Faso and ANFICT in the Niger) to transfer investment funds to the municipalities. With support from FPDCT, ANFICT and UNCDF, investment windows were opened specifically to fund forest and landscape restoration, sustainable land management and green income-generating activities, and the investments were integrated into municipal annual investment plans (Figure 1). Municipalities liaise with local service providers to execute the relevant activities. The ministries in charge of the environment, and their decentralized agents, provide technical support.



1
Flow of the project's technical and financial support, with municipalities at the core of the scheme

Note: FLR = forest and landscape restoration; IGA= income-generating activities; SLM = sustainable land management. Other acronyms are given in the text.

For more information, visit www.fao.org/in-action/forest-landscape-restoration-mechanism/our-work/countries/burkina-faso/fr and www.fao.org/in-action/forest-landscape-restoration-mechanism/our-work/countries/niger/fr

Source: D. Poda, I. Wata, F. Zoveda and C. Besacier, FAO, personal communication, 2020.

basic socio-economic infrastructure with capital grants and the other for financing the functioning of local government through recurrent grants. To support local government in implementing activities related to natural resource management (including forest and landscape restoration), a third window involving earmarked grants can be opened to finance interventions that target specific topics. Ownership of this window by the local government is particularly important given its key role in the planning process for meeting local needs. Box 1 and Box 2 illustrate the use of these instruments by projects.

MOBILIZING LOCAL COMMUNITIES FOR RESTORATION

The engagement, involvement and empowerment of rural communities, including through capacity development, are essential for successful, sustainable restoration. Participatory restoration processes are already under way in the Sahel, but national pledges on the area to be restored will not be met unless all stakeholders

Box 2
Project focusing on local communities for land restoration and green jobs

The Local Environmental Coalition for a Green Union (known as FLEUVE for its acronym in French) project was implemented by the Global Mechanism of the United Nations Convention to Combat Desertification (UNCCD) in the context of the GGWSSI with support from the European Commission. It was built on the idea that local communities are the foundational unit of sustainable development and that, therefore, local stakeholders should be part of the design and implementation of solutions.

The project's activities targeted multiple communities in five Sahelian countries – Burkina Faso, Chad, Mali, the Niger and Senegal – with the aim of building the capacities of local authorities, civil-society organizations, small and medium-sized enterprises and the private sector to raise funds for land restoration and to create "green" job opportunities (the latter involving, for example, the valuation and optimization of non-wood forest product value chains for species such as *Moringa* and baobabs and identifying new niche markets). This decentralized approach was complemented by regional activities focused on increasing capacity in restoration practices and innovative financing mechanisms. To secure the purchase of products, connections were made between local producers and regional markets through sustainable value-chain development, in collaboration with the private sector. This led to the creation of green jobs for thousands of women living in rural areas in the five countries.

Source: H. Khiari and S. Jauffret, Global Mechanism of the UNCCD, personal communication, 2020.

are engaged. Participation must be mainstreamed at every stage of the restoration process – from planning to implementation, monitoring and evaluation. It should be iterative, it should take place before, during and after restoration activities, and it should involve information-sharing, awareness-raising and organizational and operational capacity development in communities. Communities must be at the core of the process. They are crucial for identifying and prioritizing the lands and spaces to be restored, setting restoration goals and contributing to implementation such as by collecting seeds, planting, and maintaining and managing sites. Municipal authorities can contribute to the process by ensuring that rural communities are involved and the impacts are sustainable. Maximizing the impacts of restoration actions requires an assessment of the technical and organizational capacities of stakeholders. Based on this, capacity-development actions can be planned and implemented with communities and other actors. For example, restoration actions may require the improvement of technical and managerial capacities to ensure the timely availability of planting materials and to increase knowledge of plant-propagation and restoration techniques. The successes achieved by the Action Against Desertification programme (AAD) arise from intense efforts to deploy participatory processes, apply science and innovative technologies, and develop capacity (Box 3).

In addition to developing capacity in communities, it is crucial to raise awareness about income-generating activities based on restoration, such as the sustainable harvesting, production and processing of non-wood forest products like fodder, honey, wax, and balanite oil and soap (from *Balanites aegyptiaca*). Communities must see, as early as possible, that the restoration of degraded land offers opportunities to add value to their cropping and pasturing activities and as sources of income. In Burkina Faso, for example, fields being restored using Delfino ploughs were simultaneously planted with seedlings of usable woody species and with species cultivated for woodfuel and fodder, with sites rapidly achieving a dense grass layer (see Box 3). Communities harvested the grass for fodder and sold a portion of it for income. Thus, municipal authorities can help strengthen local involvement in restoration by understanding the preferences of communities and meeting their expectations for short- and long-term benefits.

ESTABLISHING FAIR PARTNERSHIPS IN DELEGATING RESTORATION AND LAND MANAGEMENT

As the authority responsible for natural resource management by virtue of decentralization, a municipality can decide to delegate such management to user associations or private entities. This delegation can enhance restoration efforts.

Delegating to user associations

In addition to ensuring, in their planning, the necessary investments for the restoration and maintenance of sites, local authorities play an important enabling role in structuring the bodies responsible for the management of restored sites. Those communities that benefit from restoration do not always pay due attention to the maintenance of restored sites because of a lack of awareness, training or ownership of the restoration actions (CTB, 2018), or because the incentives are insufficient. It is vital, therefore, to raise awareness among communities about the benefits of long-term site maintenance and their responsibility in the process. The involvement of local communities is key to

Box 3
Participatory science and capacity development: key success factors

The AAD, which began in 2014, is being implemented by FAO and partners in six countries (Burkina Faso, Ethiopia, the Niger, Nigeria, Senegal and the Gambia); it is financed by the European Union and the African, Caribbean and Pacific Group of States. The project acknowledges the central role of communities, men, women and youth in achieving success and having an impact on the ground, and that restoration interventions must benefit both people and the environment.

Communities have led the process for selecting the species to be used in restoration. Consultations and group discussions were organized with communities and municipal authorities to understand their interests, motivations, contributions and needs. The project conducted surveys to better understand community needs in terms of the most suitable species to be planted and to document traditional knowledge, species uses and practices. The results were validated scientifically to ensure that the selected species are adapted to the environment and suitable for addressing socio-economic needs (Sacande and Berrahmouni, 2016; Sacande, Parfondry and Cicatiello, 2020). Local communities chose more than 200 plant species (trees, shrubs and grasses) for their medicinal or animal-husbandry uses, their capacity to provide energy, food or fodder, and their cultural, social or environmental benefits (Sacande and Parfondry, 2018; Sacande, Parfondry and Martucci, 2020).

Consequently, the restoration carried out by communities with the support of AAD has achieved substantial success in grass fodder production (Sacande, Parfondry and Cicatiello, 2020), showing that effective community engagement and participation can deliver early benefits. Within five years, more than 50 000 ha of land had been restored or was under restoration, benefiting 325 communities and nearly 1 million people in the targeted GGWSSI countries.

With the ambition to restore 200 million ha of degraded land in Africa by 2030 through AFR100 and GGWSSI, these AAD outcomes might be considered a mere drop in the desert. Nevertheless, the restoration model is already being replicated in other areas and is ready to be scaled up, bringing additional socio-economic benefits through the development of sustainable value chains for other non-wood forest products such as gum arabic, fodder, honey and seeds (Sacande and Parfondry, 2018).

A training session on raking hay and making bales as part of the AAD project, Burkina Faso

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For more information, visit www.fao.org/in-action/action-against-desertification

Source: N. Berrahmouni and M. Sacande, FAO, personal communication, 2020.

sustainable restoration interventions (FAO and World Resources Institute, 2019). The role of management committees at restored sites in the Niger shows a possible long-term management option that includes local communities (Box 4).

Delegating to the private sector

Given the huge area that needs restoring, all stakeholders, including the private sector, must be involved. Some private partners (such as impact funds) have the resources to cover certain transaction costs arising in the development of restoration initiatives (FAO and Global Mechanism of UNCCD, 2015), and they may be open to engagement in equitable and productive partnerships with communities (FAO, 2015). Decisions to delegate natural resource management (including restoration) to the private sector requires the full participation of local communities to ensure that their rights are acknowledged, respected and protected. Land-tenure security is indispensable in any agreement of this kind; among other things, it will reassure stakeholders that they will benefit from resources derived from private-sector investments as the areas become productive. For example, the business plan of Société Hommes et Terre (which is active in Burkina Faso – Box 5 – and other countries) focuses on the restoration of degraded lands shared by villagers and is built on multistakeholder agreements established with subnational authorities and local communities.

Box 4
Experience in the Niger on the community management of restored sites

In the Niger, management committees for restored sites (COGES) comprise community-owned and self-managed mechanisms for managing restored common property. A COGES represents an entire village or landscape and has decision-making power in fulfilling the community's needs for natural resources. Typically, a COGES's mission is to:

- ensure the maintenance and repair of anti-erosion facilities and the monitoring of construction works;
- enforce bylaws for sustainable use;
- link the community and municipality on all site-related matters; and
- manage resources and equitably share benefits stemming from the collaborative work among communities in the vicinity of the restored site.

A COGES is established through the following steps:

- Community information and awareness sessions are organized before restoration is initiated to raise awareness among the community about the need to put in place a mechanism to guide the work and manage the investment made in restoration.
- An executive office and an audit commissary are established upon decision by the village assembly. Local communities decide how the COGES should be set up. Selection criteria are defined beforehand to ensure that the committee is functional and sustainable.
- Capacity-development activities are offered to COGES members (and to anyone else in the village who is interested), focusing on work in associations and on land restoration techniques.
- The COGES becomes functional. It develops an action plan (for approval by a general assembly of its members) for monitoring restoration works and ensuring the management and guarding of the restored sites.

COGES are financed mainly from the fodder harvested at restored sites, which is sold to the beneficiary community at preferential prices. The method of profit distribution from sales is not subject to a general regulation but to guidelines established by the villagers. The funds are used to cover COGES expenses, provide inputs into village budgets, and pay guards. In addition to fodder, some confederated groupings in the Tillabéry region in west Niger have started selling grass seeds in subnational and national markets.

Grassed half-moons at a restored site managed by a COGES in the Niger

Source: I. Wata, FAO, personal communication, 2020.

Box 5
The restoration of degraded lands in Burkina Faso

Société Hommes et Terre is a private-sector company with a social purpose, whose business model is based on the development and management of forests and agroforestry in collaboration with local communities. It developed an approach to the restoration of degraded land in Burkina Faso through the Forêts Villages Project (PFV). The PFV restores and helps add value to degraded land based on equitable, long-lasting collaboration with villager partners.

The basis of the partnership is the right of access to 250 ha of degraded lands (125 ha for Hommes et Terre and 125 ha for the village) for a 25-year period granted by the village. Collaboration is formalized in an agreement that is binding to the village, local authorities and Société Hommes et Terre. Each agreement has nine subscribers acting on behalf of the village, the municipality and the technical services involved. These agreements comply with Burkina Faso laws on land tenure and secures the right of use.

The positive impacts of the scheme are exemplified in the community of Komtaiguia, in the Bourzanga municipality, where, in 2018, half-moons were built (both mechanically and manually) and zaïs and stone lines were prepared. According to Société Hommes et Terre, success can be attributed to the long lifespan of the partnership, the community ownership of the programme, site monitoring, site restoration, and the correct choice of implementation actions. On the site, restoration provides multiple ecological benefits, including the maintenance of biodiversity, habitats and forest cover and the control of wind and water erosion. Local communities receive economic benefits from the sale of commodities (forest seeds and goat dung) and direct payments for carrying out seeding, re-seeding and the manual digging of half-moons and zaïs.

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The first planting of a degraded site in Gaigou, Burkina Faso

The site at Gaigou, Burkina Faso, restored under the Forêts Villages Project, after two rainy seasons

Source: Y. Savadogo, K. Leue and S. Kalaga, Société Hommes et Terre, personal communication, 2020.

LOOKING AHEAD

Local authorities foster and coordinate local responses to global challenges (FAO and Global Mechanism of UNCCD, 2015). Together with communities, they play key roles in initiating and supporting the implementation of restoration actions at the municipal scale. But barriers exist to the wide-scale replication of successful initiatives, including weak institutional coordination; regulations that hinder or prevent local initiatives; issues in transferring management responsibility to local users; a lack of acknowledgement of traditional tenure systems; and inadequate economic incentives for investment in sustainable value chains.

Public-sector investment is essential to cover the high costs associated with restoring degraded lands. The shift towards decentralization gives hope that municipalities will ultimately be able to generate fiscal revenue from the sustainable use of local public resources (Hughes, 2014), but this will not suffice as the sole funding mechanism for restoration. Land degradation cannot be addressed without unleashing the socio-economic potential of African drylands. Restoration needs to be understood and actions planned and implemented along entire value chains to maximize the economic, social and environmental impacts and benefits while addressing the drivers of degradation (Berrahmouni, Regato and Parfondry, 2015).

Decentralization may benefit the fight against forest and landscape degradation, but considerable challenges loom for societies in which traditional natural resource management systems persist without official recognition. Innovative institutional arrangements are needed that enable local communities to exercise their rights over natural resources and to restore and sustainably manage them while recognizing pre-existing land-tenure systems (Winter, 1999).

The United Nations Decade on Ecosystem Restoration, the Bonn Challenge and other

global, regional and national initiatives such as the GGWSSI and AFR100 provide opportunities to scale up the restoration of Sahelian landscapes and improve living conditions in rural areas – where the need is urgent. Such a scaling up also requires long-term support for local players and recognition of the importance of decentralization processes and capacity development in communities. Much more still needs to be done to restore degraded lands in the Sahel – and countries will only achieve their restoration goals if communities are fully involved and supported.

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Building a restoration movement

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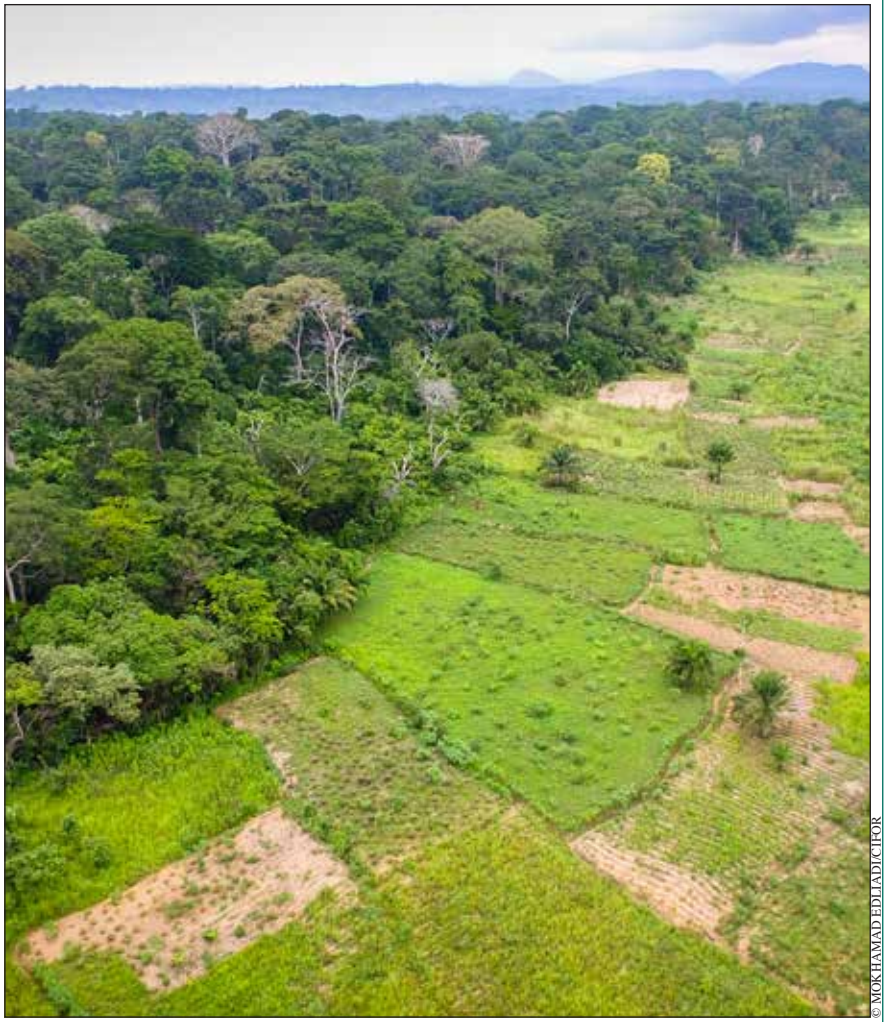
Greater understanding of social network dynamics is providing a road map for spurring collaboration, commitment and action.



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Aerial view of a forest landscape in Bokito, Cameroon

The strategy for the United Nations Decade on Ecosystem Restoration identifies building a global movement to catalyse ecosystem restoration as the first pathway for increasing the area of healthy ecosystems and halting loss and degradation. This article provides an overview of the challenges in building such a movement; explains how an understanding of online and offline social network dynamics has illuminated some necessary foundations for movement-building; and explores initiatives and instruments that are well poised to catalyse interest, commitment and action.

SOCIAL MOVEMENTS AND RESTORATION

Social movement scholarship describes how such movements seek to reframe issues in the public eye, mobilize material resources and set new policy agendas. Each of these is aimed at creating societal alignment and generating and maintaining the support needed to realize and change policies and behaviour in favour of particular

goals (Ghimire, 2005; Snow and Benford, 1988; McCarthy and Zald, 2006).

Movements are collective networks of actors, campaigns and institutions organized to find a shared understanding of a particular problem, communicate and act to solve the problem, and seek to expand their networks. Building a global restoration movement, therefore, requires collective processes to identify a common vision, make decisions, and take actions that are responsive to global agendas and the unique contexts of local landscapes.

Most drivers of global ecosystem degradation cannot be halted with one-off or "band aid" decisions or actions. Instead, drivers emerge from networks of institutions and actors whose behaviour – whether intentionally or unintentionally – has resulted in net global ecosystem degradation. Such causal networks are characteristic of complex adaptive systems (such as ecosystems and economies) that transcend neat temporal and spatial boundaries. Complex adaptive systems present cause-and-effect relationships that elude prediction and control, and they are constantly changing and being affected by other nested and interlinked systems (Westhorp, 2012). This complexity, in addition to practical limitations of knowledge, time and resources, has historically led decision-makers and land managers to tackle drivers of degradation from within sectoral and geographic boundaries.

Pursuing restoration pathways that simultaneously respond to local and global needs and social and ecological conditions is no simple matter. Inclusive and sustainable solutions require high-quality, widely accessible information about the drivers of ecosystem degradation and stakeholder needs and, emerging from this, synchronized collective action. Only in this way is it possible to transform a sufficient number of global components of a complex adaptive system to alter its course – that is, achieve transformational systems change (Moore *et al*., 2014; Griswold, 2017). In the context of global ecosystem degradation, the longer the delay in transformational change, the more severe and pervasive will be the difficulties in reversing degradation and its consequences. Now is the time to rise to the challenge of restoring the Earth.

It is difficult, however, to convey complex information efficiently and accurately to mass audiences, especially in an age with unprecedented access to a huge diversity of sources and knowledge (Centola, 2018). This communication challenge has historically impeded the proliferation of a new narrative and the mainstream adoption of mindsets[1] that will foster the kind of long-term and transboundary thinking that creates and sustains restoration systems (UNEP and FAO, 2020).

THE STAGE HAS BEEN SET FOR A GLOBAL RESTORATION MOVEMENT

It is clear that actors at many levels value and are prioritizing restoration, and the United Nations Decade on Ecosystem Restoration builds on a number of existing frameworks and initiatives. At the global scale, the Sustainable Development Goals (SDGs) offer a holistic framework that encompasses ecosystem restoration. Frameworks such as the Bonn Challenge specifically track national commitments on restoration, and networks and platforms such as the Global Partnership on Forest and Landscape Restoration support the implementation and scaling up of restoration initiatives to make progress towards framework goals. Mechanisms such as the African Forest Landscape Restoration Initiative, Initiative 20×20 in Latin America and the Caribbean, the forest restoration goals of the Asia-Pacific Forestry Commission, and the Agadir Commitment in the Mediterranean consolidate regional activities and provide opportunities for regional knowledge-sharing, capacity development and ownership regarding specific opportunities and challenges.

Progress in achieving restoration goals is predicated on the work and ambition of a vast existing network of practitioners, activists, knowledge-holders and decision-makers working at various levels. For example, restorative ecology is – and has long been – a way of life for Indigenous Peoples and local communities, which maintain traditional knowledge systems that reflect and transmit information for their survival and for sustainable resource use in landscapes.

INSIGHTS FROM NETWORK SCIENCE

To better understand how to create a new mindset to foster restoration, it is useful to examine network science, a field that describes how networks experience and create change (Box 1). Computational simulations of how information spreads across networks, digital social media analysis, and participatory social mapping can all shed light on how existing networks might be transformed to bring about a universal restoration movement that is sustained at multiple levels.

Information diffusion studies are used to understand how information moves under what conditions, and the effects of this movement. This can help identify the barriers and necessary conditions for communicating information in ways that foster the acceptance and proliferation of new narratives – a crucial step in changing mindsets and behaviour.

A key recent development in sociology is the widespread adoption of agent-based modelling, which uses principles akin to those of game theory to explore contagions (among other phenomena). By controlling the initial conditions and network structure, these computational experiments can shed light on which factors are significant for transformational systems change in ways that are not limited by existing data.

Figure 1, for example, portrays the results of simulations carried out to illustrate how complex ideas spread. The circular lattice structure approximates a neighbourhood

[1] "Mindset" is defined in the United Nations Decade on Ecosystem Restoration Strategy as "a set of assumptions, views and philosophies that influence how societies organise themselves, take decisions and set long-term goals" (UNEP and FAO, 2020).

Box 1
Network science

Networks can be thought of as individuals and their relationships, which can be represented by nodes (dots in Figure 1) connected by edges (lines in Figure 1). The lattice structure approximates a neighbourhood in which individuals are connected. A contagion is the movement of information along a lattice. If new information is communicated successfully, actors can be considered to have been influenced by a contagion. Contagions, like problems, can be simple and need only be communicated from a single source to influence an actor, or they can be complex, needing multiple sources (Centola, 2018).

Much of the theory on which network science is based originated in the study of disease, and it is still common (albeit problematic) to compare the transmission of ideas, messages and images across a network to the spread of a virus. Here, "contagion" is used as shorthand for the "viral" spread of information between individuals. The analogy with disease is limited because, although some pieces of simple information can be passed from one individual to the next as easily as, say, influenza, more complex ideas and beliefs require that more conditions are met before they spread, such as validation from different sources (Centola, 2018). The ideas that the restoration movement is concerned with – restoration, climate change and ecosystem degradation – fall into the complex contagion category. It is essential, therefore, that the movement grasps the particular patterns of complex contagions to optimize the spread and uptake of its concepts and knowledge.

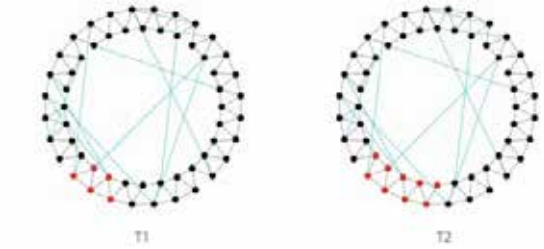
in which individuals are connected to a limited number of adjacent others (such as a house and the surrounding houses on the same road). In Figure 1, parts (a) and (b) represent two models – one in which information is diffused only from neighbour to neighbour (a); and the other in which information can also be sent between distantly located nodes (b).

In (a), T1 and T2 can be thought of as looking specifically at how information travels with and without the quintessential components of globalization, such as mass communication platforms and migration. The blue lines represent connections between people who share no neighbours – akin to people who meet on the Internet among whom there are likely no mutual connections. Crucially, the long-distance ties (in blue) are assumed to replace the local ties (in black) – perhaps similarly to someone leaving their hometown to go to a university, making new friends there with whom they share no mutual friends and losing touch with those back home. The model with no long-distance ties (b) can be thought of as people who have never left their hometown and who live in a close-knit community in which many of their friends and family know each other.

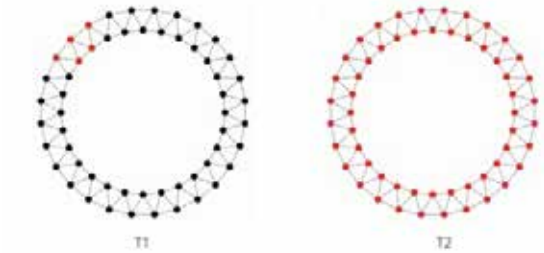
How do these different structures influence the spread of information, beliefs and behaviours? The answer is that it depends on the type of information being conveyed. For simple contagions, in which the only condition for the information to move from one person to another is adjacency, the globalized model is far more effective. However, the picture is different for complex contagions, in which a person adopts the behaviour (i.e. the node turns red) if – and only if – two or more of its connections have adopted it first. As the simulation demonstrates, the complex contagion can stall when it reaches the blue ties. Why? The absence of mutual friends means that individuals are much

1 Comparison of the diffusion of complex ideas across different network structures

(a) In this "globalized" model, information can be sent between both neighbouring and distantly located nodes



(b) In this model structure, information is diffused only from neighbour to neighbour



Note: Lines in blue represent long-distance ties; lines in black represent local ties. Nodes in red indicate instances where a person adopts a certain behaviour. T1 and T2 represent a progression over time.
Source: Modelled by G. McGann using Netlogo.

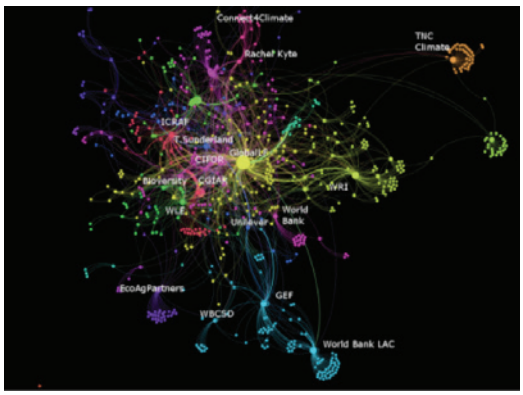
less likely to be exposed to more than one source. This can be envisaged as the difference between the peer pressure exerted in a small community and the pressure applied on an individual with connections from around the world.

These examples reveal that lasting changes in networks requires a combination of diverse actors to engage different communities and mindsets and communities whose members exert pressure on others to change. Connecting distant clusters is crucial for the acceptance of new ideas, and connecting actors who have not historically been connected is important for spreading them. Actor connection needs to be thoughtful, however, to avoid doing more harm than good: creating connections arbitrarily can risk the shutting down – rather than acceptance – of new ideas if the information is too incompatible with local contexts. This insight is consistent with findings from social and environmental psychology literature, which suggest a similar relationship between social exposure, group norms and cognitive dissonance in changing attitudes (e.g. Ajzen, 2002; Crandall, Eshleman and O'Brien, 2002; Lee 2010; Hjerm, Eger and Danell, 2018), especially with the theory of transformational change conveyed through the concept of "landscapes of practice", discussed below (and see Omidvar and Kislov, 2014).

SOCIAL MEDIA ANALYSIS: VISUALIZING ONLINE COMMUNITY CONNECTION

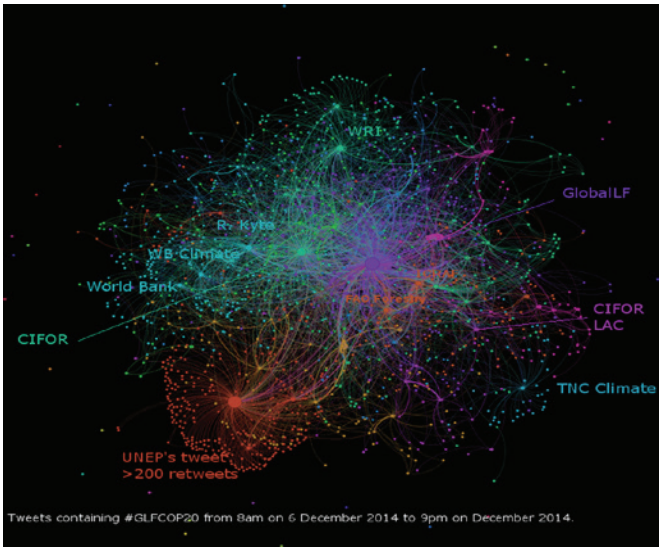
Although looking at how information flows in imagined networks is worthwhile, social media platforms offer real data for the restoration context. Hashtags on Twitter are useful for tracking topics of conversation over time and the relative popularity of, and audiences for, these topics.

A series of analyses of Twitter use during the first few Global Landscapes Forum (GLF) events held during conferences of the parties to the United Nations Framework Convention on Climate Change help reveal how an evolution of narratives can be visualized.



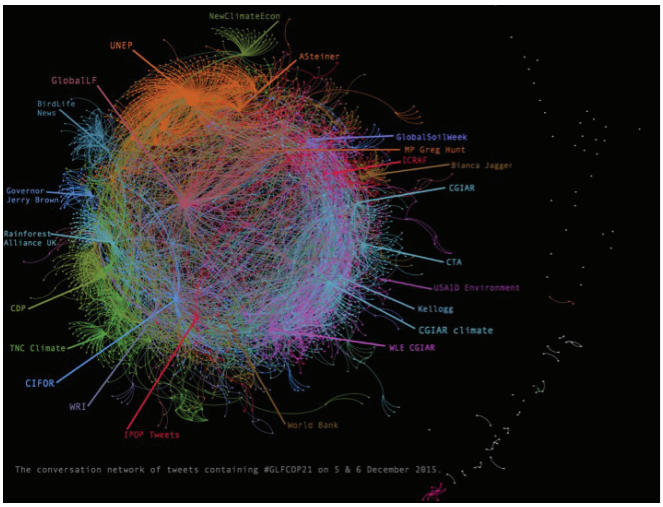
2 Visualization of Twitter cloud, Global Landscapes Forum, Warsaw, Poland, 2013

Source: Global Landscapes Forum (2015).



3 Visualization of Twitter cloud, Global Landscapes Forum, Lima, Peru, 2014

Source: Global Landscapes Forum (2015).



4 Visualization of Twitter cloud, Global Landscapes Forum, Paris, France, 2015

Source: Global Landscapes Forum (2015).

Gephi software was used to create an algorithm to help find the "conversation network" of tweets containing the #GLFCOP21 hashtag over the two days of the 2013 GLF conference held in Warsaw, Poland (Figure 2). Similar exercises were conducted at GLF events in Lima, Peru, in 2014 (Figure 3) and Paris, France, in 2015 (Figure 4). Nodes in the three figures represent Twitter users and the lattices represent the transmission of a tweet to another node. Node size reflects the volume of conversation originating from or directed towards that account – that is, it indicates which users are most active in the conversation. The lattice length represents the degree to which accounts connect, and the lattice colour represents the account that sent the tweet.

The conversation in 2015 involved substantially more users (who communicated more closely) than those in 2013 and 2014. Notably, both the tightness of the conversation and the number and diversity of users increased between 2013 and 2014 and from 2014 to 2015. Central to this convergence appears to be the connection of key change agents – influential people within distinct communities – whose involvement gives the GLF more credibility and shareability. This is due to strategic considerations by GLF organizers, which caused them to take deliberate steps to engage new audiences and networks with each GLF event. While the first GLF in Warsaw 2013 served to connect the forest and agriculture sectors, the organizing team and scientific committee increasingly identified new networks to target due to their impact on the health of landscapes worldwide. In 2014, the Lima GLF brought in the consumer goods sector, as reflected by increasing network ties to influencers like Unilever and Paul Polman. From 2015, the finance sector was deliberately brought into the discussion. Figure 4 contains other examples of such gateway connections between the broader network and other communities (e.g. former California Governor Jerry Brown and the BirdLife News account, both of which are on the edge of the map but with many external connections).

This analysis helped the GLF assess the success of its efforts to connect diverse landscapes and consolidate communities by bringing together key change agents. Groups of people with a common topic of interest and who meet regularly to collaborate, improve skills and advance knowledge are referred to as "communities of practice". The results of the analysis support the possibility of creating a conglomeration of digital communities of practice (what Etienne Wenger-Trayner has referred to as a "landscape of practice") at a global scale involving holistic approaches to achieving the SDGs and climate goals (Omidvar and Kislov, 2014).

This social media network analysis yields further insights for building a restoration movement. To create transformational change in networks, information cannot simply be broadcast in an untargeted way. Existing communities become connected to movements more easily if a key change agent among them becomes engaged. Platforms to connect key change agents representing diverse communities therefore hold tremendous potential. Building, aligning and coordinating communities of practice around restoration with newly connected actors is crucial for facilitating sustained knowledge-sharing and calls to action. Transformational systems change is possible if the emergent landscape of practice achieves a critical mass and reach and remains grounded in local realities.

PARTICIPATORY SOCIAL NETWORK MAPPING: VISUALIZING ON-THE-GROUND CONNECTIONS

Although global dynamics like consumer behaviour are major drivers of global degradation, restoration must ultimately be implemented through action on the ground in local – often rural – communities. It is crucial, therefore, to map and understand offline actor networks. Developing maps of social networks offers insight into local governance that digital tools alone cannot do by identifying the needs, values, resource access and communication channels of actors. Participatory mapping conducted in various locations across regions helps reveal important differences in local realities.

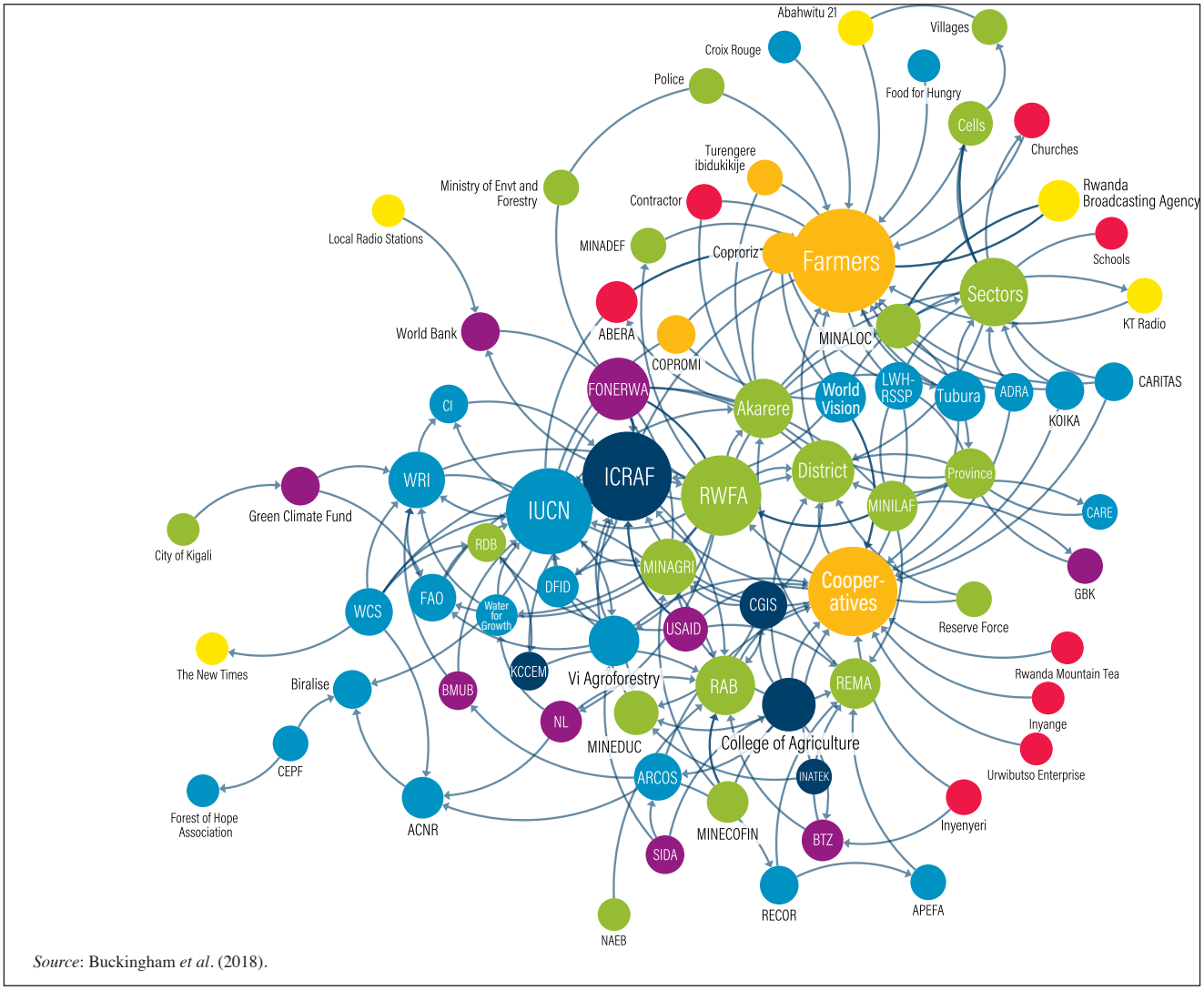
Participatory social mapping conducted by the World Resources Institute in Rwanda's hilly Gatsibo district provided insights into why farmers were unable to procure the seedlings they needed to support their livelihood aspirations and mitigate erosion. Using a participatory mapping approach whereby farmers and stakeholders sketched their seed-exchange channels, key flows of resources and organizations were captured in a map (Figure 5). The study revealed that the inability of non-governmental organizations (NGOs) – the primary seed providers in the area for decades – to ensure access to formal seed channels and seed choices meant that farmers' seed needs were not being met and the use of indigenous trees was discouraged. The analysis also revealed that the inability of seed-supplying NGOs to provide a long-term presence meant that farmers needed to engage with many such NGOs, with the result that they could not always get the seeds they needed or wanted.

The findings of this study suggest that, to be sustainable, a restoration movement must ensure that resources, communication channels and decision-making structures are all accessible, given differing local realities. The alignment of aspirations and objectives at the various scales of governance, and determining which platforms and intermediary bodies – such as district-level decision-makers – can facilitate such alignment, are vital next steps in creating resilient and equitable networks (Buckingham *et al*., 2018).

BUILDING A SUCCESSFUL GLOBAL RESTORATION MOVEMENT

A new narrative to enable pro-restoration mindsets needs to accompany conscientious connection among new and diverse actors and their networks. Restoration is a complex global issue that disproportionately

5 Map of the local seed procurement network in the Gatsibo district, Rwanda



Source: Buckingham *et al*. (2018).

affects local communities and it therefore requires new communities and a commitment to inclusivity across sectors and scales – particularly local, rural and young voices and especially those of women. Translating connections and common understandings into behavioural change will require support for existing online and offline communities of practice, which can connect local needs and solutions to global change processes. Where these communities do not exist, their emergence needs to be facilitated. Below, we explore initiatives and platforms that can provide a template for this kind of movement-building.

The Global Landscapes Forum

In the early 2000s, the international community increasingly recognized the absence of cross-sectoral and multistakeholder approaches. Institutions such as the United Nations Environment Programme, the World Bank and the Center for International Forestry Research saw the importance of designating space alongside major climate negotiations where advocates could discuss the mainstreaming of landscape approaches.[2] The two major existing global land-use conferences at that time, Forest Day and Agricultural and Rural Development Day, merged to create the GLF, which is now the largest knowledge-led platform for sustainable and integrated land use, with a designated secretariat and 29 charter member organizations.

The GLF network seeks a paradigm shift around development that promotes greater cross-sectoral collaboration, transboundary thinking and inclusivity. The GLF community, including the

[2] Landscape approaches can be described as collaborative approaches that facilitate the essential balancing of often-competing demands on ecosystems in ways that work for both human well-being and the environment (Sayer *et al*., 2013).

charter members and other partners and stakeholders and their communities, connects through physical and digital means such as conferences, national dialogues and summits. These provide space for dialogue and knowledge-sharing around five main themes that together represent a holistic approach to development topics: 1) rights; 2) finance; 3) food and livelihoods; 4) measuring progress; and 5) restoration. A knowledge hub, with scientific and traditional knowledge at its core, underpins the GLF by curating and sharing knowledge products. Learning activities strengthen the capacities of young, current and future restoration professionals for forest and landscape restoration (FLR) and governance through offline training events, open online courses, and curriculum design that integrates landscape approaches.

The platform for the new GLFx initiative – which represents self-organized, local chapters of the GLF – serves as a means for decentralizing learning, connecting to local landscapes, scaling local initiatives and their best practices, and creating a supra community-of-practice structure for restoration. GLFx seeks to help scale landscape restoration initiatives at the local level by sustaining partnerships for restoration and facilitate knowledge-sharing that is decentralized and among diverse stakeholders.

To help direct and focus the narrative, the GLF offers media workshops to engage journalists with significant landscape issues and provide knowledgeable sources, contacts and story ideas. For example, the "Reporting on Rights in Landscapes" media workshop that ran alongside the GLF Bonn conference in 2019 provided an opportunity for journalists and communication specialists to improve and expand their understanding and coverage of rights issues, which are often highly complex and sensitive. Workshop participants engaged with experts and their peers in practical exercises and discussions and later had the opportunity to liaise with and interview change-makers among youth, Indigenous Peoples and local communities, as well as with leading figures in environmental fields who were part of the global conference.

Communities of practice

Online communities of practice can support ecosystem restoration by creating awareness, promoting capacity building and developing partnerships and innovation to facilitate implementation on the ground. The World Wide Fund for Nature (WWF) Landscape Finance Lab and FAO's Forest and Landscape Restoration Mechanism (FLRM) have been working together to build a community of practice on finance for FLR with the aim of supporting members in the use of diverse finance mechanisms to implement FLR. Both WWF and FAO have built on their existing experience in supporting communities of practice. The WWF Landscape Finance Lab contributes to several communities of practice, such as by holding "sustainable landscapes" events, and FLRM coordinates the Online Community of Practice for FLR as well as The Restoration Initiative Online Community.

Each community of practice aims to build a network of practitioners to showcase examples of restoration implementation and financing mechanisms; connect members; and build capacity through e-learnings, webinars, forum discussions, publications and the sharing of innovative experiences and good practices. Such networks bring together decades of experience and learning in a virtual space through online exchanges. This gives practitioners a head start, and landscape-level programme design can build on lessons learned to accelerate the process.

When opportunities for face-to-face meetings are limited, online communities can open up access to diverse groups of practitioners, making it more cost-effective for capacity-building activities. Cross-organizational collaboration is crucial for opening up communication channels among diverse networks, promoting innovation and technological support, and facilitating space for the sharing of experiences and inspiring examples on the ground. Such collaboration has the potential to contribute considerably to the global restoration movement, especially during the United Nations Decade on Ecosystem Restoration.

The development and provision of platforms such as communities of practice on FLR finance and inclusive community engagement can be challenging. The restoration and sustainable management of landscapes requires a deep level of trust-building that cannot readily be replicated in the digital world. By making knowledge accessible, communities of practice work towards building this kind of trust. But simply creating a community of practice does not necessarily mean that people will participate. For example, the community of practice on FLR finance is now placing more emphasis on marketing to increase awareness of its work. Internet bandwidth and connectivity also need to be taken into account because not all practitioners and community members have equal online access in all regions. The community of practice for finance has experimented with various platform trials to ensure it provides equal accessibility in the face of connectivity limitations and challenges.

Dimitra Clubs Initiative: including rural women and men

Despite the crucial role that rural women play in agriculture, food security and natural resource management, they are often excluded from technical knowledge and innovations in ecosystem restoration. Even when programmes do focus on rural women, they tend not to address the gender-discriminatory social norms that perpetuate inequalities in access to knowledge, information, resources and decision-making processes related to ecosystem recovery. Increased stakeholder engagement requires tailored approaches that empower rural women and men to realize their potential as agents of change. Approaches that focus solely on the symptoms of gender inequalities, such as unequal access to resources, are insufficient to trigger sustainable change.

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Dimitra club participants in the Democratic Republic of the Congo

Instead, approaches are needed that seek to transform unequal gender roles and relations and to facilitate pathways in which rural communities take ownership of their own development.

Dimitra clubs, which FAO has been pioneering for more than a decade, constitute a gender-transformative approach that uses community mobilization and collective action to promote community-led local development. They are informal groups of rural women and men of all ages that meet in person on a voluntary basis to discuss the problems they face in their daily lives and to implement local solutions using their own resources and collective efforts.[3] Because Dimitra club members decide on the themes they tackle and act on, impacts have been achieved in various domains, both technical (e.g. related to climate-change adaptation and mitigation, sustainable agriculture, and health and sanitation) and behavioural (e.g. on women's leadership and empowerment, gender equality, social cohesion and peace). More than 5 000 Dimitra clubs exist in sub-Saharan Africa, with actions arising from them estimated to have benefited the lives of more than 6 million rural people. The Dimitra clubs approach is embedded as a key component in more than 30 United Nations joint initiatives and programmes, including initiatives funded by the Global Environment Facility.

In the Sahel region, where climate change has disrupted livelihoods and increased the risk of poverty, hunger and conflict, Dimitra clubs have been instrumental in implementing climate-resilience measures to conserve arable land and water reserves while also empowering rural women and

[3] There are usually five Dimitra clubs per village (two of women, one of men, one of young women and one of young men). This distribution is decided by the communities themselves and for cultural reasons (in particular in the Sahel region) because people (especially women and youth) feel more comfortable in discussing issues when they are with their gender–age peers. After discussing in their own gender–age group, the community meets in a village assembly, and the floor (and a voice) is given to each club in turn (the young women first), whose leader explains the club's analysis of the problem and its proposals for solving it. Finally, the village traditional leader and the community decide on the best solutions, with the support of the community members.

men and promoting social cohesion. In the fight against erosion in Senegal, for example, Dimitra clubs mobilized the community of Saré Boubou (in the region of Tambacounda) to build stone lines, a mitigation practice to reduce land degradation. Dimitra clubs in Ofienso, a village in Mali's region of Ségou, explored the same solution to conserve water reserves. Afterwards, the women's Dimitra clubs planted a paddy field to experiment with an improved variety of rice seed, increasing food security for their families.

In the village of Tinkirana in the Tahoua region of the Niger, women have gradually gained access to reclaimed land through Dimitra clubs. They decided to rehabilitate degraded land in the area, thus raising awareness in the community of the importance of land rehabilitation and the need to act together. The clubs mobilized community members to create half-moons[4] over an 8-hectare area on the village outskirts. As a result, landowner farmer Idrissa Moussa harvested 800 bales of millet in one year without using fertilizers, compared with 150 bales the year before. The village chief recognized the positive results and subsequently granted vacant degraded land to the women.

The examples demonstrate the Dimitra clubs' effective facilitation of community engagement and highlight the important contributions of rural women and youth to ecosystem restoration. Thanks to the clubs, and to rural radio stations that broadcast their discussions and good practices, more people have been reached and the results of climate-resilience projects have been amplified.

CONCLUSION

Global ecosystem degradation has emerged from vast networks of causes; addressing it requires comprehensive networks of engaged restoration actors sharing a new mindset that informs behaviour and policy change. To cultivate such restoration networks, a global movement is needed that:

- works to normalize radical but conscientious transformational collaboration among actors across sectors, governance levels and places;
- creates and strengthens communities of practice and partnerships that create positive peer influence and motivate sustained knowledge exchange, alignment, commitment and action; and
- transfers ownership over restoration decision-making processes to those most directly affected by, and yet traditionally excluded from, such processes – Indigenous Peoples, local communities and rural people, and especially youth and women among these groups.

The initiatives described in this article provide compelling examples of how these aspects can be addressed. Despite this promise, however, several cross-cutting challenges are expected to persist as we enter the United Nations Decade on Ecosystem Restoration.

The methods used to monitor progress on the ground will determine the ability to observe cause-and-effect relationships among restoration strategies, policies and interventions – and to change course as required. Investing in upscaling participatory monitoring approaches that focus on community empowerment and solidarity networks in rural communities will help advance local solutions and promote the ownership and full engagement of rural actors in ecosystem restoration and conservation.

Although Internet accessibility is improving, the divide between those with strong and those with weak information technology infrastructure will continue to grow, as will disparities in people's access to information and their capacity to engage in global conversations. Building a strong offline movement remains crucial for involving those with the most at stake in restoration. In addition to focusing on technical knowledge, developing the organizational capacities of local stakeholders – particularly those who are often left behind, such as women and youth – is essential for increasing their critical awareness, analytical skills, agency, leadership and participation in decision-making. Focusing on civil-society and citizen initiatives can also strengthen actions built from the grassroots up.

Finally, sustaining a continuously growing movement over the coming decade will require a marathon – rather than sprint – mentality. Communication and capacity-development strategies must speak to local contexts, even as these change. Involving the custodians of social norms – such as local authorities and village chiefs – can help promote and support changes in behaviours and practices, such as discriminatory gender roles and relations, and in local accountability in land restoration. Understanding the flow of resources is key. Networks allow for the flow of finance, information and seeds. Creating a movement requires the elimination of bottlenecks in the flow of resources. Regularly showcasing options that work and ways to overcome obstacles in different contexts can inspire initiatives that maximize appropriate and culturally respectful socio-ecological benefits and minimize trade-offs. The private sector and governments globally must commit to supporting sustainable livelihood options based on a restoration economy.

Pathways that emphasize long-term planning and participatory decision-making might appear too slow to confront the urgency of mitigating the acute and devastating impacts of current environmental, social and health crises. But collaborating to restore ecosystems at scale is an unparalleled opportunity to build back landscapes that are more resilient, more equitable and safer, in both the short and long term. This opportunity must be seized to ensure lasting and equitable systems change.

[4] See article on page 18 for a description of these.

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The importance of holistic approaches for spreading restoration

S. Harrison and B. De Ridder

Northern Kenya's community conservation movement is showing that land degradation will be most successful when peace, governance, enterprise and wildlife conservation are also addressed.

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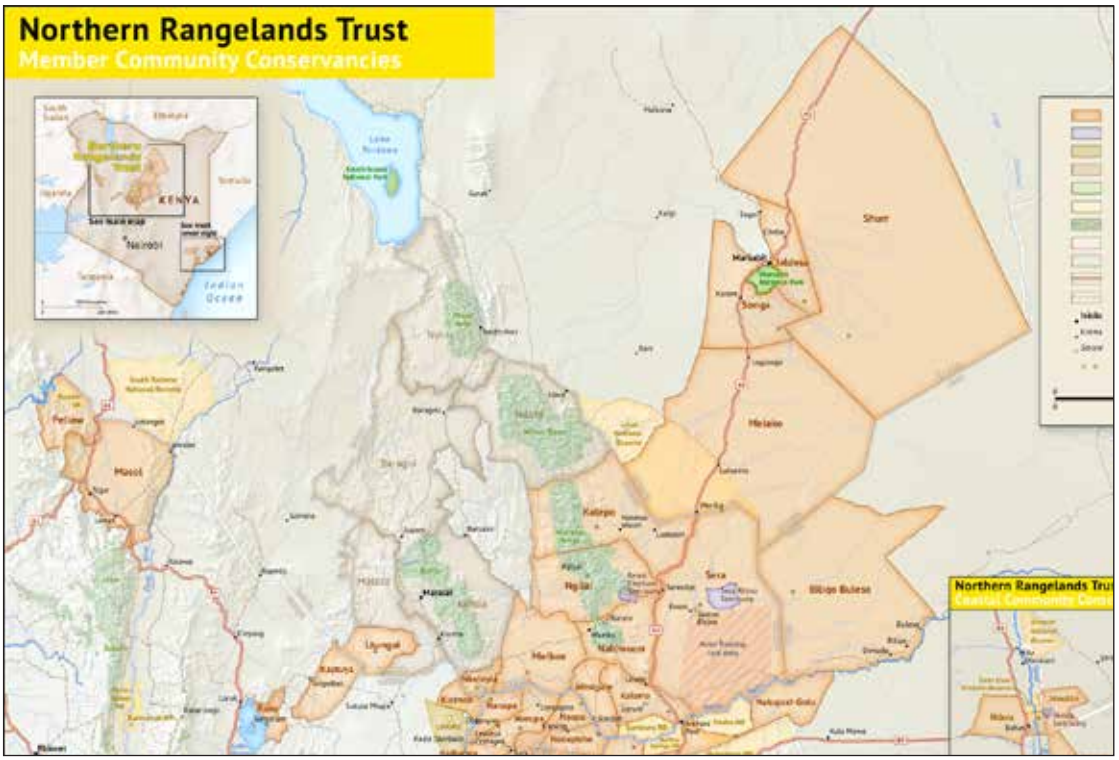
In the harsh, semiarid environment of northern Kenya, pastoralist communities have long struggled with ethnic conflict, marginalization, sparse government services and landscape-level insecurity – particularly elephant poaching and livestock theft. This has not only disrupted and destroyed lives, it has also hindered development. Moreover, increased pressure on the grasslands and forests that underpin local pastoralist economies has led to widespread landscape degradation, threatening biodiversity and livelihoods.

Kenya's northern rangelands are home to more than ten seminomadic ethnic groups, almost all of which have cultures, traditions and livelihoods deeply rooted in rearing, herding and marketing livestock. They share their rangelands with a diverse array of wildlife, including lion, giraffe, buffalo and elephant.

Climate change, growing human populations and unplanned settlements are exacerbating grassland degradation, deforestation and resource-based conflict between wildlife and people and among ethnic groups. At the same time, the traditional tribal governance structures best placed to navigate these issues have often

Above: A member of the Westgate Community Conservancy spreads grass seeds as part of a community-led restoration exercise



1 The 39 NRT-member community conservancy institutions in Kenya covering an area of 4.4 million ha

Source: Northern Rangelands Trust.

struggled to adapt to a rapidly changing social and political climate.

But a grassroots movement based on community-led conservation is starting to drive real and significant transformation in Kenya's north, united by an umbrella organization, the Northern Rangelands Trust (NRT).[1] In the past ten years, the number of NRT-member community conservancy institutions has grown from 18 to 39. Collectively, these now manage more than 4.4 million hectares (ha) of primarily arid and semiarid grasslands and equatorial, montane and coastal forests (Figure 1). Across these landscapes, community conservancies are leading restoration and conservation programmes, building peace and security, promoting sustainable businesses and implementing development projects.

[1] NRT receives core funding for community conservancies from USAID, The Nature Conservancy, Danida, the European Union, and many others.

CREATING THE ENABLING CONDITIONS FOR COMMUNITY-BASED LAND RESTORATION

Community conservancies are community-based organizations created to support the management of community-owned lands for the purpose of improving livelihoods. They are legally registered entities, governed by locally elected boards of directors and run by local management teams, which include various subcommittees such as on grazing, peace, finance and tourism. Community conservancies do not fence land to exclude grazing or other migrating pastoralists, and the conservancy institutions work in support of the landowners – either in "group ranches" or under "trust land" tenure agreed with county governments. In some cases, several group ranches have come together to form single large conservancies. Where multiple ethnic groups live in a conservancy area, the board must be ethnically representative.

As indigenous-owned and -run institutions, community conservancies provide an inclusive and participatory framework for community-led decision-making. NRT-member conservancies focus on four key, mutually beneficial pillars:

1. strengthening conservancy governance;
2. building peace and security;
3. supporting livelihoods and businesses; and
4. conserving wildlife and natural resources – including rangelands, forests and marine ecosystems.

Each conservancy has developed, or is in the process of developing, a conservancy management and community development plan. This is a fully participatory process (designed through traditional governance structures and community meetings) to define the conservancy's challenges, five-year priorities and communally agreed actions – many of which focus on land restoration, given the close interdependence of livelihoods and natural resources. Innovative outreach methods are helping keep stakeholders informed and involved (Box 1).

Increasingly, conservancies are providing the institutional entry point for donor and county-government support for livelihoods and development. It is a game changer: for the first time, communities are democratically identifying and steering conservation and development projects to where they are needed most – rather than projects being led by donor agendas.

Recognizing that good institutional governance underpins successful programmes, NRT has invested in a bespoke leadership and management programme for conservancy leaders. It provides access to scientific tools and expertise from a network of partners so that traditional knowledge can be integrated with research and best practice for a more empowered, resilient and holistic approach to conservation, land management, peace and sustainable enterprise.

Guided and funded by their democratic institutions, communities are becoming coordinated and empowered in their approach to land restoration. In 2019, 3 000 community members took part in rangelands rehabilitation activities across 7 000 ha of degraded areas in conservancies that were once productive grazing lands but are now degraded (NRT, 2019). Coastal conservancies planted 30 000 mangrove seedlings in degraded coastline forests in 2019.

STABILIZING GRASSLANDS

Stabilizing and improving the productivity of community grasslands is crucial for livestock and for the health and diversity of the wildlife and natural resources that underpin the economy of northern Kenya.

In pastoralist societies, culture, business and the location of settlements are deeply rooted in livestock. Seminomadic lifestyles that follow seasonal rainfall mean that thousands of young men (typically referred to as warriors or morans) traverse the vast northern Kenyan rangelands throughout the year. But, with an increasingly unpredictable climate and a growing human – and therefore livestock – population, the threat of conflict over grass and water is constant, both between pastoralist groups and between pastoralists and wildlife. Despite the huge progress made by the peace, wildlife, security and rangelands teams of the conservancies, grassland stabilization and restoration remains perhaps the toughest and most complex challenge in the landscape.

In 2017, Soils for the Future carried out rangeland-health monitoring using remote sensing in collaboration with NRT as part of a soil-carbon project covering 14 NRT-member conservancies in the Ewaso Nyiro River landscape. This enabled the classification of the vegetation and the identification of degraded areas, areas vulnerable to further degradation, and areas that have improved in condition over 15–20 years. The remote sensing data were verified by field data from 168 sampling sites across the 14 conservancies and by data from 121 sites at which conservancy rangeland coordinators carry out twice-yearly vegetation monitoring.

A grazing plan drawn up by and for the Kalama Community Conservancy

Among the findings were:

- A decline in the Normalized Difference Vegetation Index (a measure of greenness and land productivity) of more than 30 percent in 40 percent of the landscape between 2002 and 2016. This is thought to have been a consequence of more frequent droughts and escalating grazing pressure.
- Evidence that 53 percent of the land is either experiencing ongoing erosion or is at high risk of erosion. This increased to 78 percent in the southern and southeastern conservancies and approached 85 percent in a band 30 km either side of the Isiolo-Marsabit highway (see Figure 1).

These findings came after a particularly dry few years, in which conservancies struggled to manage large-scale livestock movements and grazing plans on an individual basis. NRT and the conservancies are now moving away from supporting individual conservancy grazing plans towards regional and county-level land-use planning. A large part of this process will depend on strategic county-government engagement, and solutions will require massive support from communities, county governments and other partners.

For many conservancies that try to enforce the grazing plans they develop, there is a constant risk of violent conflict from incursions by heavily armed herders (from outside the conservancy community). Months of hard work building up communal grass reserves for the dry season can be wiped out in a few days. This shows that successful landscape restoration can only be achieved when effective peacebuilding and alternative enterprise are also supported and achieved. In supporting young warriors to diversify their incomes and rely less on livestock, conservancies are starting to help communities build economic

Box 1
Changing attitudes with cartoons

The NRT rangelands team has developed a three-part cartoon animation series with the support of the United States Agency for International Development (USAID) Kenya and the technical assistance of the US Forest Service. Developed in English, Swahili and Samburu, the series looks at how the northern Kenya landscape has changed in recent years and examines (through the memories of a wise elephant) the causes and potential solutions. The series is designed to trigger discussions among largely illiterate audiences; they are shown to groups of pastoralists, elders and young warriors as rangelands teams go about their duties in the field. Each episode is about five minutes long.

The cartoons have received an unprecedented response from communities and other organizations in the region, who have praised and requested to share the videos. The episodes have indeed been shared widely on social media and among community WhatsApp groups (making the total number of viewers hard to quantify). The next series – focusing on the specifics of rangeland management (soils, plants, water, livestock, wildlife, people and the climate) – is under development, and there are plans to translate the first series into more languages.

A screenshot from the cartoon animation series depicting the causes of, and solutions to, land degradation in northern Kenya

resilience and become less dependent on natural resources. In 2019, conservancies dispersed USD 284 000 in business loans to 803 conservancy members, and 741 people accessed vocational training through their conservancies – many of whom have gone on to open up businesses such as mobile-phone-repair or vehicle-maintenance workshops.

The Soils for the Future study also revealed that the prolific and damaging *Acacia reficiens* tree occurs in all 14 conservancies surveyed and warrants attention. This is becoming a priority for communities because *A. reficiens* spreads across degraded grasslands and prevents new grass growth and worsens soil erosion.

Since 2017, communities across the member conservancies have rehabilitated nearly 8 000 ha of land by cutting *A. reficiens* trees, spreading their branches across the bare earth, and scattering perennial grass seeds among them. The thorny branches protect grass seedlings from herbivores and help keep the soil intact during rains. The branches are also packed into eroded gullies to help heal them. Some of this work has been carried out voluntarily by conservancy members; in other cases, conservancies have used grants to pay workers as casual labourers.

PARTICIPATORY PLANNING AND IMPLEMENTATION IN FORESTS

NRT-member conservancies with forest cover are developing forest management plans and establishing community forest associations (CFAs) in collaboration with the Kenya Forest Service. The Kenya Forest Act 2005 legally entrenches participatory forest management in Kenya. In recognition of the crucial role that local communities play in managing forests, the Act provides for the creation of CFAs to act as legal entities for community engagement with the Kenya Forest Service in forest management. A CFA is defined as a group of persons registered as an association under the Societies Act and who are resident in an area close to the specified forest.

Community conservancies are finding that developing forest management infrastructure using participatory processes involving the community, other stakeholders and the public sector is the only way to ensure an indigenous-led, collaborative and sustainable approach to forest management and conservation. And this is exemplified by the Ngare Ndare Forest Trust, which is a member of the NRT. With an expanding forest canopy cover, good tourism operations and meaningful community impact, Ngare Ndare is leading the way in CFA best practice in Kenya.

It has three tree-planting programmes. In the forest rehabilitation programme, communities plant indigenous seedlings in degraded forest areas. Since 2013, the programme has planted more than 120 000 indigenous seedlings, all germinated in the conservancy's tree nursery. Seedlings planted in the last five years have had a survival rate of 70 percent.

The second is the One-for-One Seedling programme (buy one seedling from the community nursery and get one free). The aim is to support agroforestry on farms in the communities to reduce pressure on the forest for woodfuel and building materials. The Ngare Ndare Forest Trust has established nine community tree nurseries, which distributed 23 150 seedlings under the one-for-one programme in 2019 for planting on farms.

The third programme is Adopt-a-Tree, whereby primary schools and other institutions plant seedlings on their properties, thereby contributing to clean air, environmental awareness and healthy soils.

Ngare Ndare raises funds for these programmes through the sale of seedlings, tourism income, and grants from NRT and others. Since its inception, Ngare Ndare has planted over 600 000 indigenous seedlings in forests within the conservancy – now widely thought to be home to the only indigenous forest in Kenya with an expanding canopy cover – as well as more than 2 million exotics on surrounding farms.

CONCLUSION

Participatory planning and the implementation of collaborative land restoration initiatives through indigenous institutions are now driving conservation in northern Kenya. Given the historical, cultural and geographical context of the landscape, there is no other way such restoration could be achieved.

Community conservation shows that landscape restoration must be tackled holistically and can only be achieved when peace, governance, enterprise and wildlife conservation are also addressed. Holistic, community-based approaches will ensure that new-era African conservation is delivered in the right way, at the right time, by the right people. ◆

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Mobilizing restoration finance at the local level

J. Gheyssens, L. Garrett and M. Iweins

Blended-finance approaches and robust business plans will help ensure the financial well-being of forest and landscape restoration projects.

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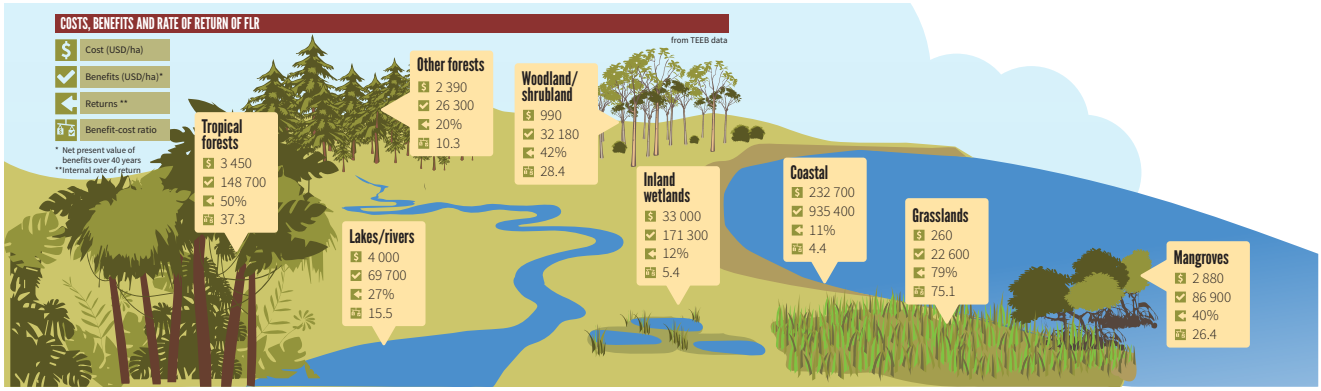
Significant investment is required to reach ambitious international forest and landscape restoration (FLR) targets; for example, it is estimated that more than USD 35 billion and USD 300 billion are needed per year to achieve (by 2030) the Bonn Challenge (IUCN, 2011) and land degradation neutrality (UNCCD, 2016), respectively. Restored landscapes can themselves offer substantial internal rates of return (e.g. 11–79 percent; TEEB, 2009) (Figure 1), which indicates the potential for sustainable financing for FLR. Recent momentum in the implementation of FLR has seen an increase in the number of funds and donor-financed programmes targeted explicitly at integrated restoration objectives.

FLR is a relatively new investment arena, and potential investors are still navigating their engagement in it. Bottlenecks for the adoption of FLR-specific investments often arise because of a perceived lack of viable business plans and a shortage of projects that are sufficiently well-prepared to meet the due-diligence criteria of potential investors. At the same time, there is a lack of knowledge among FLR project developers on how to engage with funders and how to access financial mechanisms to meet project needs.

A view of Kusad Mountain from Saddle Mountain ranch, Savanah, South Central Rupunini, Guyana. Obtaining finance for FLR at the local level is a pressing challenge

1 Estimated costs, benefits and rates of return of restoration projects, various biomes



Source: FAO and Global Mechanism of the UNCCD (2015).

This article provides guidance and recommendations to FLR developers planning to mobilize local private finance to support their activities. It addresses the importance of understanding and capitalizing on the enabling environment; expands on the need to overcome capacity problems related to funding discovery and business models; examines how public–private collaborations can reduce private-sector risk and create blended-finance mechanisms; and presents case studies of projects that successfully unlocked finance at scale.

THE ENABLING ENVIRONMENT

To ensure that FLR projects are "ready for investment" with viable and credible business cases, it is crucial to have an appropriate enabling environment that lays the institutional and policy foundations for investment and provides supportive landscape-scale coordination. Governments, non-governmental organizations (NGOs) and bilateral and multilateral organizations have important roles to play, in collaboration with the private sector, in building this enabling environment by developing the capacity of landscape stakeholders, clarifying the costs and benefits of FLR investments, establishing marketplaces and developing risk-mitigation strategies. Optimal economic, social and environmental outcomes are most likely to be achieved when investment is applied in a coordinated approach throughout the restoration process. Innovative "blended finance" mechanisms that combine diverse investments can enable projects to address multiple restoration issues and meet the needs of local stakeholders. The development of business cases for FLR projects, support for the creation of adapted marketplaces, and building blended-finance mechanisms of public–private financing can enable a snowball effect of investor interest in restoration.

Investing in forest and landscape restoration

Multiple forms of investment from various investors will be required at different stages of the restoration process (FAO, 2020). The nature of the investments needed to achieve FLR in a given landscape will vary depending on the landscape's agro-ecological, economic, social, legal and political characteristics and the needs of those implementing FLR. Investments can be categorized broadly as either asset investments, which directly finance physical components of the landscape or activities that contribute to landscape restoration; or enabling investments, which create and support the institutional and policy conditions required to facilitate and attract asset investments and landscape coordination.

In the early stages of restoration, funds are needed to develop goals, gather information, determine investment priorities and address the enabling environment through (for example) stakeholder coordination, policy reforms (e.g. on policy coordination, tenure security and land zoning), opportunity assessment and planning, capacity development and incentives. Given the high-risk, low-return nature of investments at this stage, such enabling investments are most likely to come from public sources or as soft loans to provide initial support for high-risk commercial investments. In later stages, the sources of finance may diversify and include market mechanisms designed to increase asset investment, such as payments for ecosystem services (PES), catalytic loan facilities, and domestic bank loans. As landscapes increase in function through FLR, the investment risks decline and a wider range of incentives and investments is likely to emerge for smallholders, cooperatives and companies that are implementing restoration activities at the local level.

ADDRESSING FUNDING DISCOVERY

The development of economically viable and financially attractive FLR project and business proposals is essential for identifying and accessing appropriate and sufficient funds. The crafting of such proposals only addresses half the challenge in generating growth, however, and an equally important consideration for project developers is locating and accessing funds appropriate for each restoration stage. Here lies a dual challenge: how to meet the requirements of funding instruments related to financial returns while also ensuring that the project achieves its intended social and environmental objectives and addresses project management costs associated with (for example) monitoring, reporting and evaluation.

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Moringa *seedlings in a tree nursery in the highlands of Kiroka, United Republic of Tanzania. In the early stages of restoration, funds are needed to develop goals, gather information, determine investment priorities and address the enabling environment*

In general, based on the desired scope and intended level of ambition of an FLR initiative, project developers should determine whether accessing external finance is likely to be an important condition of success. Not every FLR initiative needs to unlock additional external capital. Doing so has pros and cons, which should be weighed carefully and with a clear sense of the benefits and challenges that come with having external investors. By virtue of relying solely on their own funds, self-financing FLR initiatives will likely have more control and resilience than those that count on financial support to get going, to the extent that they have identified a clear path towards scalability.

For those project developers who have determined that an FLR initiative cannot achieve its objectives without external funding, the following steps may be taken:

- Develop a realistic, data-driven business model (further explored below) that describes the restoration goals of the project, which of the four FLR returns it intends to produce (i.e. financial, environmental, social and inspirational – after Brasser and Ferwerda, 2015) and its intended long-term impacts.
- Clarify at which investment stage of the development process the project is situated. This may be the readiness/upfront investment stage; the implementation investment stage; or the long-term sustained-financing stage. Each stage may have different goals and involve different investment requirements, which may require working with different types of investors, donors and financing instruments.
- Proactively map and rank funding opportunities by ease of access and proximity in terms of scope, needs and targets. Become familiar with the funding mechanisms most likely to support FLR, such as donor-funded climate finance structures (e.g. the Global Environment Facility and the Green Climate Fund); NGOs with a focus on sustainable land management; public programmes with FLR outputs; impact investors; and private-sector companies whose supply chains may benefit from or contribute to FLR.
- Gather information on available funding opportunities. This is increasingly easy to do, thanks to the work of leading research institutes and NGOs. The Climate Policy Initiative annually publishes a report, *Global Landscape of Climate Finance*, which tracks and analyses climate finance flows, including for FLR (Climate Policy Initiative,

Box 1
Mapping public and private resources to finance restoration efforts

To mobilize adequate financial resources for forest restoration, a thorough understanding is required of existing public and private spending patterns in land-use activities. By mapping and tracking financial flows that affect forests, countries can identify funding gaps and opportunities, reflect on the effectiveness of existing instruments and increase accountability and trust with partners. They can also assess the alignment of broader land-use investments with restoration objectives with a view to redirecting resources to support sustainable landscapes.

The Land Use Finance Tool was developed by the European Union's REDD Facility and Climate Policy Initiative to help countries, subnational jurisdictions and partners better understand investments affecting forests at the national and subnational levels. The tool is helping policy-makers understand who finances what and the extent to which finance is aligned with policy objectives.

Côte d'Ivoire, for example, used the tool to assess the potential to redirect part of existing agricultural investments towards forest restoration objectives and initiated a strategic dialogue with donors on that basis. In Papua New Guinea and Viet Nam, the tool was used to analyse the effectiveness of existing financial instruments in supporting forest protection and to identify reforms that could help scale up finance for sustainable land-use objectives.

Source: https://landusefinance.org.

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Researchers measure tree diameter at Back Kan, Viet Nam, for the national forest assessment. The Land Use Finance Tool was used in Viet Nam to analyse the effectiveness of existing financial instruments in supporting forest protection and to identify reforms to help scale up financing

2019). Another valuable resource is the Ecosystem Marketplace, maintained by Forest Trends, which provides a comprehensive overview of available market mechanisms for FLR. FAO published a review of sustainable financing for FLR in 2015 (FAO and Global Mechanism of the UNCCD, 2015).

- Establish a good rapport with government authorities and agencies and, early on, evaluate whether a redirection of existing public expenditure towards FLR is possible in the context of your project. The land-use finance tool co-developed by the Climate Policy Initiative and the European Forest Institute (Box 1) provides a framework for cost-efficiently identifying and visualizing which domestic finance flows could be directed towards enabling FLR.
- The heightened risks of FLR (whether real or perceived) make it especially important to offer a balanced approach to risk-sharing. The investment burden

must be fairly and equitably shared among investors and FLR beneficiaries (OroVerde, 2019). This implies early engagement with all those stakeholders who will be affected by the project to determine their ability to contribute funds or assets towards implementation. Commercial beneficiaries of FLR products and services should be targeted as a priority because they have an economic incentive to see the project succeed and are likely to have a relatively strong financial standing.

FLR activities are highly sensitive to their local context and are therefore likely to require bespoke solutions. They are also often investment-intensive. It is crucial, therefore, that project developers embrace the unique features of their plans and do their best to match the various benefits arising from FLR with corresponding financing sources. For example, the restoration of a watershed that improves the quality of water for clearly identified downstream users could lend itself to a PES scheme. Conversely, improvements in agricultural supply chains, which are inherently risky, are often better matched with risky capital structures (e.g. equity or shareholder participation in a cooperative or an agribusiness). Thus, it is important for FLR project developers to have a clear understanding of the benefits, costs, risks, scope and scale of their initiatives.

ADDRESSING BUSINESS-MODEL CAPACITY

A significant element in the successful mobilization of finance for FLR lies in the capacity of project developers to develop attractive and credible investment proposals. The aim is to convince investors that investments in FLR are worth their time and money and an effective means for achieving economic, social and environmental goals.

Investors – both public and private – are risk-averse and selective. They tend to prioritize initiatives that offer credible assurance that the capital they manage (or own) will be well used by trustworthy people who understand their needs, requirements and concerns, with the lowest possible risk.

Capital holders with an interest in FLR are a relatively small group courted by many others vying for the same capital. This competition compounds the difficulty of unlocking finance for FLR projects. Capital is rarely the only bottleneck; donors and financiers often have limited ability to meaningfully engage in prospective projects, especially when these are at an early stage of development.

The consequences for the FLR sector are twofold. First, project developers should make their projects easy for investors to discover, understand and evaluate. They should prepare concept notes, business cases and term sheets summarizing the key economic and finance parameters of their projects. Ideally, these documents should be supported by actual data substantiating a proposal's main assumptions, especially around its intended economic, social and environmental impacts. Where assumptions cannot be grounded in even anecdotal evidence, they should at least strive to be realistic, sound and reflective of the operational context.

Second, project developers should ensure the credibility and trustworthiness of their proposals. This can be achieved in various ways, such as by adopting a robust governance system, a sound monitoring and evaluation architecture, and best practices in participation and consultation (such as application of the principle of free, prior and informed consent for Indigenous Peoples). In general, ensuring that the individuals and organizations involved in a project have good reputations increases the likelihood that potential investors will give it serious consideration. This is especially true for private financiers, who are likely to demand the involvement of corporate actors with good financial standing as a means to reduce perceived commercial risks.

Crucial questions that project developers should address to inform and guide proposal formulation include the following:

- Is the project designed and intended to generate income?
- Is the income expected to result from the commercialization of new products or services for which no market currently exists or from goods or services that are already marketed and for which competition exists?
- In the case of traded goods, what is the estimated market size? Are sufficient data available to support the estimate? What is the quality and availability of logistical chains for transport, storage and distribution? In situations where FLR products must be transformed before they can be sold, is the transformation chain fully functional? Does it require additional investment?
- Is the project intending to derive income from a PES scheme? Is the PES scheme intended to be an integral part of the profitability model?
- Is there an expectation that the project will be financially self-sufficient (capable of reaching break-even on its own), or will it be partly or fully reliant on public support in the form of grants, subsidies or tax exemptions?
- Have the project developers been in contact with financial institutions, either public or private, in the context of the project? What is the project team's degree of familiarity with financial concepts?

Project developers able to convincingly answer these questions and put together well-conceived, credible and data-tested business proposals will be in a strong position to attract funds, not just from public sources but also increasingly from private ones (Box 2).

PAVING THE WAY TO BRING THE BEST PROJECTS TO SCALE

Given that governments face increasing funding shortages and therefore have limited potential to increase development cooperation, long-term financing solutions must involve engagement with the private sector. Despite the rapid increase in the

Box 2
The Seed Capital Assistance Facility

The United Nations Environment Programme is launching the Seed Capital Assistance Facility (SCAF) in 2020 for FLR projects. The aim of the facility is to increase the number of projects receiving investment and the amount of private investment dedicated to activities aligned with the objectives of FLR. It will do this by supporting fund managers (i.e. those people responsible for implementing a fund's investment strategy and managing investment trading activities) and investment advisers (i.e. finance professionals who make investment recommendations or conduct security analyses) to raise new funds and develop their pipelines of investment projects dedicated to FLR.

Generating new funds to target FLR-aligned activities is challenging. This is because of a lack of familiarity among investors with this type of investment, the long timeframes until FLR projects generate returns, and the need to demonstrate strong pipelines to attract investors.

The biggest challenge identified by many fund managers in this area is, however, the screening and vetting of projects for investment. The pipeline and project development process is highly time- and resource-consuming for fund managers, mainly because most of the proposals they receive lack the quality and level of detail necessary to easily ascertain a project's underlying potential. Project proposals, therefore, need to be screened carefully. They also often require the significant involvement of fund managers to bring them from the early development stage to the point when they can be turned into potentially investable propositions. The need for this intensive involvement by fund managers creates a bottleneck in deploying investments to FLR-aligned activities because fund managers typically only have limited resources to draw on for financing this pre-investment stage. As a result, fund managers can only consider a small number of project opportunities at any given time.

The aim of the SCAF is to help overcome these barriers by providing co-financing through three support lines:

1. **Fund development** – co-financing for fund managers and investment advisers raising new funds focused on FLR-aligned investments. Support will be provided on a co-funding basis (up to a maximum of 50 percent of eligible costs) and will be repayable to the SCAF following the successful financial close of the fund (i.e. the fund's full capitalization by investors).
2. **Pipeline development** – co-financing for fund managers and investment advisers to identify project opportunities and determine whether these have the potential to become investable propositions. Support will be provided on a co-funding basis (up to a maximum of 50 percent of eligible costs) and will be delivered as outright grants.
3. **Project development** – co-financing for fund managers and investment advisers to help them bring promising individual projects to financial close (i.e. approval for investment). For specific projects assessed to have genuine investment potential, fund managers will still need to carry out extensive due diligence and ensure that stringent social and environmental standards are met. Support will be provided on a co-funding basis (up to a maximum of 50 percent of eligible costs) and will be repayable to the fund following the successful financial close of the project.

number of impact funds interested in the social and environmental co-benefits of investment in FLR, mainstream finance has been slow to respond.

Significantly, in addition to uncertainties over future cash flows, traditional barriers such as mismatch risk[1] still act as major constraints to scaling up finance for FLR. Additionally, local banks may face a time-gap problem caused by the short-term nature of deposits versus the longer-term credit needs of borrowers. For international sources of finance, country risks and political risks may be perceived as too high or the legal system inadequate, particularly regarding land tenure. Moreover, capital markets have limited ability to assess risks in land-use restoration and to mobilize funds due to an insufficiency of information at the necessary scale (United Nations Environment Programme, 2019).

Overcoming these traditional barriers is perhaps a long-term endeavour. It may require a reappraisal of how value is ascribed and involve the establishment of regulatory regimes or guidelines aligned with appropriate incentives that reward stewardship and therefore support the adoption of sustainable practices. For example, investment standards or guidelines can incentivize FLR investments by reducing investment risks while also providing the public with assurances that the social and environmental impacts will be minimized and the benefits optimized.

In the medium term, public–private collaborations can reduce private-sector risk and create blended-finance mechanisms and investment partnerships (Box 3). De-risking or risk-sharing facilities can support initial transactions using public sources of concessional capital or through credit guarantees and reduce the cost of capital in upfront financing, thereby mitigating the costs and risks of FLR. A new example in sustainable agriculture and forestry is the AGRI3 Sustainable Agriculture and Forestry Fund, a blended-finance fund hosted by Rabobank that will be seeded with USD 150 million. The fund has three sections: junior equity, senior equity and senior debt. Half the USD 150 million

[5] Mismatch risk for an investor can be generated by a longer investment period, a smaller investment size, or a higher investment risk compared with the needs of the investor.

Box 3
Blended-finance instrument for sustainable agroforestry and carbon sequestration

Projects that combine a robust and diversified business model with measures to effectively address the main challenges of implementation have the best chance of attracting investments.

A good example of this is Althelia's Tambopata and Bahuaja-Sonene project in the Madre de Dios region of Peru. The aim of the project, using a protection–production approach, is to improve the management of two protected areas and simultaneously promote agroforestry in cocoa cultivation through the rehabilitation of degraded land on the periphery of the protected areas. This combination required multisectoral and jurisdictional engagement, presenting an arena for diverse financial instruments and institutional support.

The project – a collaboration between the Althelia Climate Fund (ACF), Asociacion para la Investigacion y el Desarrollo Integral (AIDER) and Servicio Nacional de Áreas Naturales Protegidas por el Estado (SERNANP) – developed over time, combining several features and financial instruments to meet diverse challenges on the ground. It drew on the presence of complementary partners with a long history of working in the region, including:

- AIDER, an NGO responsible for the co-management of the nation's protected areas under an administrative contract with the Government of Peru;
- Ecotierra, a sustainable agroforestry project developer active in Peru with expertise in climate-smart agriculture and sustainable forestry;
- SERNANP, Peru's protected-areas government authority, which has authorized AIDER, under the above-mentioned administrative contract, to use voluntary carbon finance as an innovative financial mechanism to ensure funding for the participatory management of protected areas. SERNANP is involved in project activities related to biodiversity monitoring, research management and control and surveillance; and
- Coopaser, which was established during project development as an organized, well-functioning smallholder-farmer cooperative able to guarantee the participation of local farmers and their commitment to the conservation of protected areas.

The investment developed a new cocoa agroforestry plantation and supply chain to provide alternative and sustainable local livelihoods. Smallholders in the buffer zone of the protected areas received planting material and technical assistance worth USD 1 500 per hectare (ha), half of which (USD 750 per ha) is to be repaid through a discount mechanism to farmers at cocoa collection.

Each participant has a clear role and mandate: AIDER received Althelia's investment and oversaw the implementation of Ecotierra's strengthening of Coopaser's organizational capacity. Among other things, they ensured that the loans were distributed and managed efficiently and repayments were made on time.

The cocoa project was developed as part of a holistic landscape approach that built on an existing REDD+ project that will be fully integrated into the national REDD+ programme. As the project evolved, an innovative financing model was developed to attract private investors to meet implementation needs. Financing was made possible by a loan of USD 7 million from ACF to AIDER. ACF was able to offer an interest rate of 6.5 percent per year, well below the market interest rate at local banks of up to 18 percent per year, as a result of the collateralized carbon loan, which also includes profit-sharing on the sale of the carbon credits. AIDER also obtained a three-year grace period regarding the cocoa revenues, which provided greater flexibility in implementing the measures.

Two guarantee mechanisms enabled this level of concessionality: the collateralization of the rights to the project's REDD+ carbon-dioxide certificates (up to 4.5 million tonnes of carbon-dioxide-equivalent by 2020), and a shared-loss portfolio guarantee mechanism offered by the United States Agency for International Development that covered 50 percent of the investors' capital.

At the local level, AIDER established an agreement with Coopaser for the loan repayment for 50 percent of the equivalent value of the in-kind support received. A deduction of 50 percent from the cocoa premiums (expected to be USD 500 per tonne from FairTrade™ and organic certifications) enables Coopaser and farmers to repay their loans. AIDER was able to repay the investment through the sale of voluntary carbon offsets to private companies ahead of the cocoa revenues flowing at scale, which in turn have the potential to provide long-term revenue streams for the project and local communities.

The project's evolution to meet the changing needs of the landscape and local communities has built on key enabling factors coordinated through Althelia and AIDER to combine diverse sources of finance at different stages of the restoration process. The project is now aiming to integrate fully into the jurisdictional/national REDD+ scheme and, over time, to reduce reliance on carbon finance as cocoa production reaches long-term sustainability and profitability on the ground for local communities.

Together, these investments enabled the financing of diverse activities and stakeholders to restore the buffer zones of the protected areas, reduce the threat of deforestation, support biological monitoring, promote research and enhance control and surveillance. As of March 2020, 339 smallholder families were involved and 1 250 ha of improved cocoa agroforestry systems had been established. A second phase is now under way (2019–2023) with the aim of expanding the project to 4 000 ha and reaching out to at least 500 more farmers with additional funds.

[2] Althelia Funds is an asset manager with an impact-driven approach to investment, aligning strong financial returns with measurable social and environmental impacts. It delivers financial returns aligned with the conservation of nature and sustainable social development.

A woman carries a bowl with water on her head in front of an old baobab tree near Bolgatanga, Upper East Region, Ghana. Not all FLR initiatives will require additional external funding but, where they do, project developers should pursue financial pathways that reflect the local context

required to seed the fund will come from government and equity investors and the other half will be made up of commercial bank debt. This leverage ratio will enable the issuance of USD 300 million in partial credit guarantees to commercial banks and development-finance institutions. This will potentially unlock up to USD 1 billion in commercial loans by absorbing a portion of the lender's losses in case of default and thereby de-risking the loans.

The Tropical Landscape Finance Facility plays a similar role, leveraging public capital to crowd-in private finance for sustainable land use, including in agriculture and ecosystem restoration, and for investments in renewable energy. The facility securitizes project loans into bonds, which are sold to investors as medium-term notes (MTNs). MTNs offer investors an option between traditionally short-term and long-term investments, which can be ideal when there is a mismatch between an investor's timeframe and typical project needs in FLR. Projects can benefit from MTNs based on their ability to provide consistent cash flows from investors.

A recent survey of FLR-focused funds conducted by the United Nations Environment Programme's Land Use Finance Unit found that, for nearly all the funds surveyed, pre-investment project development costs presented a significant financial risk for investors. Typically, these are investments involved with pre-feasibility assessment and business-case development that occur before the counterparty (i.e. the opposite party in a contract or financial transaction) is a legal client of the investor and is therefore not secure. Financial support can be provided to FLR-mandated funds through seed capital and catalytic funding. These low-cost instruments can help provide the resources and incentives for FLR actors to initiate engagement with counterparties and begin to apply standards for investment.

On the demand side, the recent reference to market-based approaches to climate-change mitigation in the Paris Agreement signifies a potentially viable funding stream for nature-based solutions such as those offered through FLR. A precursor of this new trend, the Carbon Offsetting and Reduction Scheme for International Aviation, seeks to offset all emissions from the aviation sector above 2020 levels. The International Air Transport Association forecasts that this alone could generate more than USD 40 billion in climate finance between 2021 and 2035 (Adam, 2019). If this estimate is accurate, it would go a significant way to achieving

the investment needed to reach global restoration goals. Such estimates will likely be re-evaluated given the COVID-19 crisis and its significant impact on the international air-travel sector.

CONCLUSION

The diversity of financial mechanisms available to support FLR processes can be an advantage given the diversity of FLR-specific finance requirements. It represents an opportunity, therefore, for project managers to develop business plans capable of accessing several financial mechanisms and thereby increase the impact of FLR initiatives at the local level and help ensure their sustainability. The early identification of potential pathways for scaling up the financing of FLR activities is key to the development of viable bankable projects that can be investment-ready to attract greater investment. Not all FLR initiatives will require additional external funding but, where it is needed, project developers should pursue appropriate financial pathways that reflect the local context. In the short term, much can be done to facilitate investments that themselves enable asset investments in promising FLR projects.

The investment arena is likely to change in light of the many implications of the COVID-19 pandemic. Opportunities for FLR may arise because of its capacity to provide multiple economic, social and environmental benefits that will support recovery from the crisis and increase the resilience of communities by ensuring stable ecosystems, sustainable food production systems and secure value chains and livelihoods. With public funding focused on recovery, government investment in FLR may be limited, and a more significant role may emerge for the private sector. Equally, the private sector may be more cautious with its investments – making it even more important that FLR projects ensure robust financial planning to attract the funds they need to succeed in meeting global restoration objectives.

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Priorities, challenges and opportunities for supplying tree genetic resources

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Producing the right tree seeds and seedlings is imperative for achieving resilient forest and landscape restoration at scale.

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Seedlings prepared for distribution by the National Tree Seed Center, Burkina Faso

Agricultural practices and population-induced land-use change are increasingly undermining the Earth's capacity to sustain biodiversity and maintain stable climate systems and the equitable provision of goods and ecosystem services (IPBES, 2019). Forests and trees play pivotal roles as important terrestrial carbon sinks (Ellison *et al*., 2017; Doelman *et al*., 2020) and supply many other ecosystem services. The political commitments articulated in the New York Declaration on Forests and the Bonn Challenge include unprecedented targets for the restoration of degraded land and the return of billions of trees to previously forested or tree-dominated landscapes through forest and landscape restoration (FLR) (Brancalion *et al*., 2019).

Tree-based restoration as a strategy for global climate-change mitigation has received much attention (Bastin *et al*., 2019). Although its feasibility and efficacy remain debated (Lewis *et al*., 2019), there is little doubt that tree-based FLR can deliver considerable benefits for societies (Chazdon and Brancalion, 2019).

FLR project success requires suitable high-quality and genetically diverse tree seed delivered through natural regeneration or brought in as planting material for agroforestry, plantations and other restoration interventions (Jalonen *et al*., 2018). Genetic diversity among this reproductive material will provide adaptive potential and help in resisting pest and disease outbreaks and coping with the effects of climate change, including increased drought and extreme weather events. The genetic diversity of trees is a pillar of higher-level biodiversity because genetically diverse tree communities support more diverse and resilient populations of associated organisms (Hughes *et al*., 2008). A failure to take genetic diversity and the quality of reproductive materials into account in FLR, however, will have serious consequences because it will undermine the growth and survival of trees (Tito de Morais *et al*., 2020) as well as the future productivity of tree crops and the ability of restored sites to support overall biodiversity. Governments and some organizations have committed to greatly increasing the area of degraded land subject to restoration, but this requires corresponding investments to ensure sufficient supplies of high-quality seeds and seedlings. Thus, the ability of countries and regions to scale up the delivery of seeds and other reproductive material to meet national and international commitments will be essential for FLR success.

In this article we highlight the challenges involved in delivering seeds at a large scale and the policy initiatives that could be put in place to ensure functional, well-tracked tree-seed delivery. We discuss the need to link the conservation of tree genetic resources (TGR) with their sustainable use and livelihoods in FLR and provide case studies from Burkina Faso, Ethiopia and Tunisia. We give examples of recently developed support tools and innovations to help scale up the delivery of TGR to support FLR goals. Finally, we discuss the opportunities for equitable benefits that can arise from the better integration of TGR into FLR, and we briefly synthesize the current situation as a basis for proposing priority areas for policy and capacity development.

CONSTRAINTS IN TREE-SEED SUPPLY SYSTEMS

Despite growing global commitments on FLR and the accumulation of experiences from the past decade in the implementation of the Bonn Challenge, there is a substantial mismatch between the supply of and demand for tree seeds, especially for native tree species. For example, a lack of attention to tree germplasm sources and delivery systems was evident in a review of larger-scale restoration programmes in tropical regions (considering 38 Clean Development Mechanism afforestation/reforestation project design documents in Africa, Asia and Latin America) (Roshetko *et al*., 2018).

A global survey of 139 FLR projects worldwide indicated that at least part of the seed supply in most FLR projects is collected by the project itself, typically from nearby remnant forest patches (Jalonen *et al*., 2018). The survey found that FLR practitioners preferred to collect seed themselves partly because they felt that seed markets were unable to meet their needs for species and provenances and fulfil their expectations regarding seed quality, but also because they may have had only limited understanding of the importance of seed quality.

Although it is a common practice in FLR and other restoration programmes, sourcing germplasm locally does not necessarily improve the adaptive capacity of the resultant tree populations under current or expected future climate conditions (Hancock, Leishman and Hughes, 2012; Prober *et al*., 2015; Bucharova *et al*., 2017), nor meet desirable quality standards. On the contrary, obtaining germplasm locally may negatively affect seedling survival, growth and resilience if the forests used as seed sources are fragmented or degraded (Kettle *et al*., 2007; Bacles and Jump, 2011; Mimura *et al*., 2017). Insufficient and ineffective seed supply systems also pose problems for smallholder tree-planting farmers, who depend (at least partially) on tree products for their livelihoods and who would benefit from wider access to and availability of planting material (Nyoka *et al*., 2014).

The failure to supply high-quality planting material relates both to the diversity of species used and to their intraspecific genetic diversity, which enhance resistance to stresses. FLR projects often use poorly adapted germplasm from a small number of tree species (Bozzano *et al*., 2014; Thomas *et al*., 2014), with limited information on or understanding of what species to plant or the importance of germplasm sourcing.

Cost may be one of the most important criteria for seed procurement in government-led tree-planting programmes (Dedefo *et al*., 2017; Gregorio *et al*., 2017). In an effort to accelerate tree-planting schemes, governments and non-governmental organizations may (well-intentionally) try to boost planting

by donating seedlings that, however, may be of unknown quality and origin (Lillesø *et al*., 2011; Jalonen *et al*., 2018).

POLICY AND REGULATORY INITIATIVES FOR FUNCTIONAL TREE-SEED SYSTEMS

Atkinson *et al*. (2018) identified 15 indicators across five key components of a functional seed system: 1) research to inform and guide species and provenance selection; 2) seed harvesting and production; 3) market access and demand; 4) quality control; and 5) enabling environment. They then conducted a detailed review of tree-seed supply systems in seven Latin American countries. Although the results varied widely, most countries were found to struggle with similar challenges. Most had large networks of nurseries able to produce suitable species for diverse ecosystem contexts, yet the supply of native high-priority tree species was often limited and gave little consideration to the genetic origin or diversity of the seed used. Most countries already had strategies and initiatives in place to support seed supply, but often these were inadequately integrated for effective scaling up (Atkinson *et al*., 2018). Similarly, a recent survey of signatory countries to the African FLR initiative AFR100[1] revealed that national capacity to produce high-quality planting stock of a variety of native species at scale is a serious constraint to meeting restoration targets.[2]

Efforts to scale up the supply and use of appropriate seed for restoration must be supported by clear policies and regulatory frameworks, and adequate investment. There is a need to incentivize the private sector to manage and market improved seeds and seedlings and to empower users to make informed decisions on TGR by providing them with relevant know-how and information (Lillesø *et al*., 2018).

International seed-stand registers (which document the origin of specific seed sources) and provenance zones (which delineate the bioclimatic conditions of provenances) should be identified and established for priority tree species. The establishment of provenance zones should consider the potential for climate change to influence the natural distribution of tree species to ensure that seed zones are adaptive to future conditions. Seed-stand registers would be particularly useful for supporting collaboration among countries that share the natural distribution of a species, thereby enabling access to broader genetic variation in planting material. FLR could be a useful framework for implementing gene-transfer techniques (i.e. the movement of planting material beyond current natural ranges) such as assisted gene flow (the movement of seed sources of specific adaptive capacity) or – in some extreme cases where the risk of extinction or rapid genetic erosion is evident – assisted migration (the planting of novel genotypes) (Ducci, 2015; Fady *et al*., 2016).

International trading regulations for TGR, such as the Organisation for Economic Co-operation and Development Scheme for the Control of Forest Reproductive Material and similar regulations for the European Union (e.g. its directive on the marketing of forest reproductive material and the European Union Council directive on external quality standards for forest reproductive material marketed within the Community), already provide rules on how TGR should be documented for international trade. These mechanisms enable monitoring of the movement of forest reproductive material and the harmonization of certification and identification systems between countries. In practice, however, the movement of forest reproductive material across borders is poorly documented. Improved knowledge and practical advice will become increasingly necessary in view of the limited experience of the many new actors likely to emerge in response to major international commitments on FLR and other restoration approaches. Collaborative and inclusive actions to develop supportive national strategies for conservation and the supply of high-quality TGR featuring native tree species for use in FLR programmes must be encouraged.

LINKING THE CONSERVATION OF TREE GENETIC RESOURCES WITH SUSTAINABLE USE

Globally, there are some 60 000 tree species (Beech *et al*., 2017). The vast majority of these are native to tropical countries and occur in regions with high rates of deforestation and land-use change. These same countries also have high potential for FLR (Brancalion *et al*., 2019). Because seed must be adapted to the (current and future) environmental conditions found at a given restoration site, diverse seed sources are needed covering a range of environmental conditions. The progressive reduction in the availability of genetically suitable seed sources due to forest degradation and loss means there is an urgent need to conserve critical seed sources and to identify how best to deploy these in restoration.

Despite the important ecological and economic value of thousands of tree species, conservation status has been documented for only a fraction – although efforts are under way to assess all known species (e.g. through the Global Tree Assessment – GTA, undated). Given the speed with which species and especially intraspecific variations are being lost (ter Steege *et al*., 2015; Stévart *et al*., 2019), there is a need to identify the conservation status of all species and to conserve and mobilize their remaining intraspecific variation for future use in restoration and other tree-planting programmes (Graudal *et al*., 2014, 2020). For example, a recent study of 65 native tree species across 15 Asian countries indicated that two-thirds of the species are losing natural habitat in parts of their

[1] See the article on page 82 of this edition for an outline of this initiative.

[2] The survey was presented at the Regional Workshop on the Conservation and Use of Forest Genetic Resources in Sub-Saharan Africa: Strengthening Tree Seed Systems, which was convened by the sub-Saharan African Forest Genetic Resources (SAFORGEN) Programme on 9–11 April 2019 in Kumasi, Ghana.

ranges due to climate change, with some tree populations set to be completely wiped out in certain ecoregions as soon as 2050 (Gaisberger *et al*., in prep). For some species and geographical locations, anthropogenic pressures may pose larger threats to their *in situ* conservation than climate change. A study of 50 tropical dry-zone forest tree species in Ecuador and Peru found that all species face considerable threats across half their distribution ranges and that habitat conversion, overexploitation and overgrazing pose larger and more immediate threats than climate change to most of the studied species (Fremout *et al*., 2020).

Existing protected-area networks can help maintain adaptive variation, but these often provide poor coverage of the broader environmental gradients of tree species and consequently of intraspecies variation, and they are not immune to the impacts of climate change (Gaisberger *et al*., in prep.). National laws often restrict access to TGR; for example, it is often illegal to collect seed in protected areas except for research purposes, thus reducing their role as sources of genetically diverse and site-adapted germplasm. Seed production areas such as seed orchards have been established for a few commercially important tree species but not for the vast majority of tropical and subtropical native tree species. Building up seed supplies to enable planned large-scale restoration requires both the urgent identification and conservation of remaining natural seed sources and a major effort to establish additional seed sources for a larger number of tree species; moves towards this end are under way in some places (Box 1). Such efforts should be supported by the establishment of adequate nursery networks for managing and deploying the available planting material effectively.

APPROACHES AND TOOLS TO GUIDE TREE SPECIES SELECTION AND SEED SOURCING

The selection of the right tree species and planting material is crucial for the success of FLR initiatives. Species selection requires that the environmental requirements of species match the conditions at the restoration site; the uses and products of the species match the needs and desires of local and other stakeholders; and the species are resilient to future change. FLR may occur on degraded soils that differ considerably from original forest soils due to factors such as erosion, compaction and even toxicity (e.g. caused by mining). This can limit the suitability of the original native tree species in restoration efforts because restoring soil fertility will be a major prerequisite (Chazdon, 2003). Therefore, it may be necessary to rehabilitate planting sites through the initial use of carefully selected non-local species with the capacity to improve soil fertility (Chazdon, 2008).

There is a need to identify suitable tree species for FLR programmes in different agroecological zones and to ensure that these are available to a large number of diverse users (Lillesø *et al*., 2018). New decision-support tools covering thousands of tree species are being developed – including suitability maps to ensure that the restored sites are adaptable in the face of future climatic conditions (Gaisberger *et al*., 2017; Kindt, 2018). Such maps can also guide the identification and development of improved seed sources.

Information on tree species biology and key traits is needed to support tree species selection. This is increasingly available in databases such as the Vegetation Map for Africa (van Breugel *et al*., 2015), the Priority Food Tree and Crop Food Composition database (Stadlmayr, McMullin and Jamnadass, 2019; Stadlmayr *et al*., 2019), and the Agroforestry Tree Species Switchboard (Kindt *et al*., 2019), which links information on more than 172 000 plant species and almost 4 000 intraspecific taxa across 35 web-based

Box 1
Provision of Adequate Tree Seed Portfolios: supporting farmer-planting with optimal tree genetic resources

Provision of Adequate Tree Seed Portfolios (PATSPO), an initiative under way in Ethiopia, conducts studies on tree species prioritized for farmer-planting to meet ambitious national forest restoration commitments. PATSPO supports biodiversity conservation in Ethiopia's restoration programmes by providing suitable (site- and purpose-matched) seed of a range of indigenous trees. PATSPO field trials help identify productive planting material matched to restoration sites to effectively support farmer livelihoods and enhance establishment success. After evaluation, the trials are converted into seed sources for use in on-farm planting. PATSPO is also designing a functional system for delivering tree-planting material in Ethiopia with the capacity to provide seeds and seedlings to smallholder growers. This requires ensuring the right mix of public- and private-sector involvement in the system and the assigning of appropriate responsibilities to the various stakeholders involved. Research to design optimal tree-planting-material delivery pathways for smallholder farmers has demonstrated the importance of supporting small entrepreneurial germplasm-suppliers in delivery. Existing seed- and seedling-delivery systems for restoration projects are often ineffective, with insufficient outreach, and projects such as PATSPO offer lessons that can be widely applied.

Source: World Agroforestry (undated).

Box 2
Tree-planting choices and selection of tree-seed sources in Burkina Faso

Research in central Burkina Faso investigated the tree-planting choices and selections of tree-seed sources made by farmers engaged in various planting practices and FLR approaches, including the establishment of small-scale fenced tree plots (Valette *et al*., 2019). It showed that the use of fencing supports a more diverse portfolio of tree species compared with other small-scale efforts by promoting the spontaneous establishment of tree seedlings regenerating from the soil seed bank and by enabling enrichment planting and farmer-assisted natural regeneration. Farmers tend to engage directly in the collection of the planting material they need, mainly from woodlands near their villages, trees growing in their cultivated agricultural lands and pastures, tree plantations, and fenced plots. The majority of farmers, however, do not undergo specific training on best practices in tree-seed collection. Of the 15 most commonly planted tree species, ten supply edible products. Priority food tree species with potential for inclusion in nutrition-sensitive restoration have been identified in Burkina Faso, and threats to them have been documented and mapped (Gaisberger *et al*., 2017). Traditional water-management techniques, such as building stone contour bunds and digging zaï pits and half-moons to capture rainwater run-off (Nyamekye *et al*., 2018), and the use of compost, should be employed to overcome soil degradation.

Compost is prepared before planting trees at a restoration site in Burkina Faso. Half-moons, excavated in the fields to collect surface runoff, are visible in the background

information sources. The Diversity for Restoration (D4R) tool[3] developed by Bioversity International goes beyond species choice – it enables practitioners to choose appropriate species and seed sources for given project sites that meet desired restoration objectives based on the characterization of tree-species functional traits (Thomas *et al*., 2017). D4R also takes into account climate change in proposing options for plant reproductive material and includes information on the propagation of hundreds of native tree species. Originally developed for the dry forests of Colombia, D4R has been expanded recently to include northwestern Peru and southern Ecuador and is also being deployed to support FLR in Burkina Faso (Box 2) and Cameroon.

Other tools have been developed to support both the tracing and monitoring of TGR from seed collection through to planting. SeedIT, for example, is a user-friendly smartphone application designed to enable the documentation and tracking of tree-seed sources by a wide range of users, from community seed collectors to commercial nurseries. The app is being piloted in community restoration projects in the Lao People's Democratic Republic and Malaysia.

In the future, climate-dependent traits (such as pest and disease resistance, drought resistance, cyclone resistance,

[3] www.diversityforrestoration.org

salt tolerance, and phenotypic plasticity) need to be more strongly selected for in domestication and breeding efforts (Alfaro *et al*., 2014; Stanturf *et al*., 2015).

OPPORTUNITIES FOR OPERATIONALIZING EQUITABLE BENEFIT-SHARING

Although it is probable that spontaneous natural regeneration on abandoned agricultural fields will bring about considerable increases in tree cover (Gilroy *et al*., 2014), meeting the ambitious restoration pledges of countries will require support for tree-planting on smallholder lands. The level and type of engagement of rural people, particularly the poor, will hinge largely on the direct benefits that smallholders can reap from FLR (Galabuzi *et al*., 2014; Baynes *et al*., 2015; Fox and Cundill, 2018).

Tree-based restoration offers several income-generating opportunities for smallholders, including those involving the production, processing and marketing of wood and non-wood forest products and arising from the provision of ecosystem services (e.g. through payments for ecosystem services, including for carbon sequestration) (Aronson *et al*., 2010; Newton *et al*., 2012). Small-scale producers can diversify their incomes and reduce their risks by planting multiple native species to produce timber, woodfuel, foods and medicines, thereby catering to different markets (Vieria *et al*., 2010) and seeking a balance of seasonal and inter-annual production cycles. But producers need early returns because waiting years for trees to mature may be impossible or undesirable in resource-limited communities (Etongo *et al*., 2015). Encouraging both slow-growing hardwood species and fast-growing high-value species will help maintain interest in tree-based restoration. Local women and men, who hold different, overlapping and complementary knowledge of tree species and ethnovarieties (Karambiri *et al*., 2017), can guide the identification of appropriate native tree species (Box 3). It may also be necessary to address community norms that discourage the planting of diverse native tree species because decisions on land use and species are also a function of what is socially acceptable at a given locality (Pannell, 1999).

The availability and quality of tree germplasm and seedlings further shape decisions on species and provenances (Brancalion *et al*., 2017). Hence, it is necessary to strengthen not only the technical capacities of small-scale farmers to grow diverse tree species (and bring their products to market) but also those of seed collectors and nursery owners in collecting and producing high-quality, genetically well-adapted seeds and seedlings. Pricing structures that are sensitive to product quality and enable price premiums for high-quality seed, and access to lucrative markets, are needed to incentivize investments in high-quality germplasm. Building

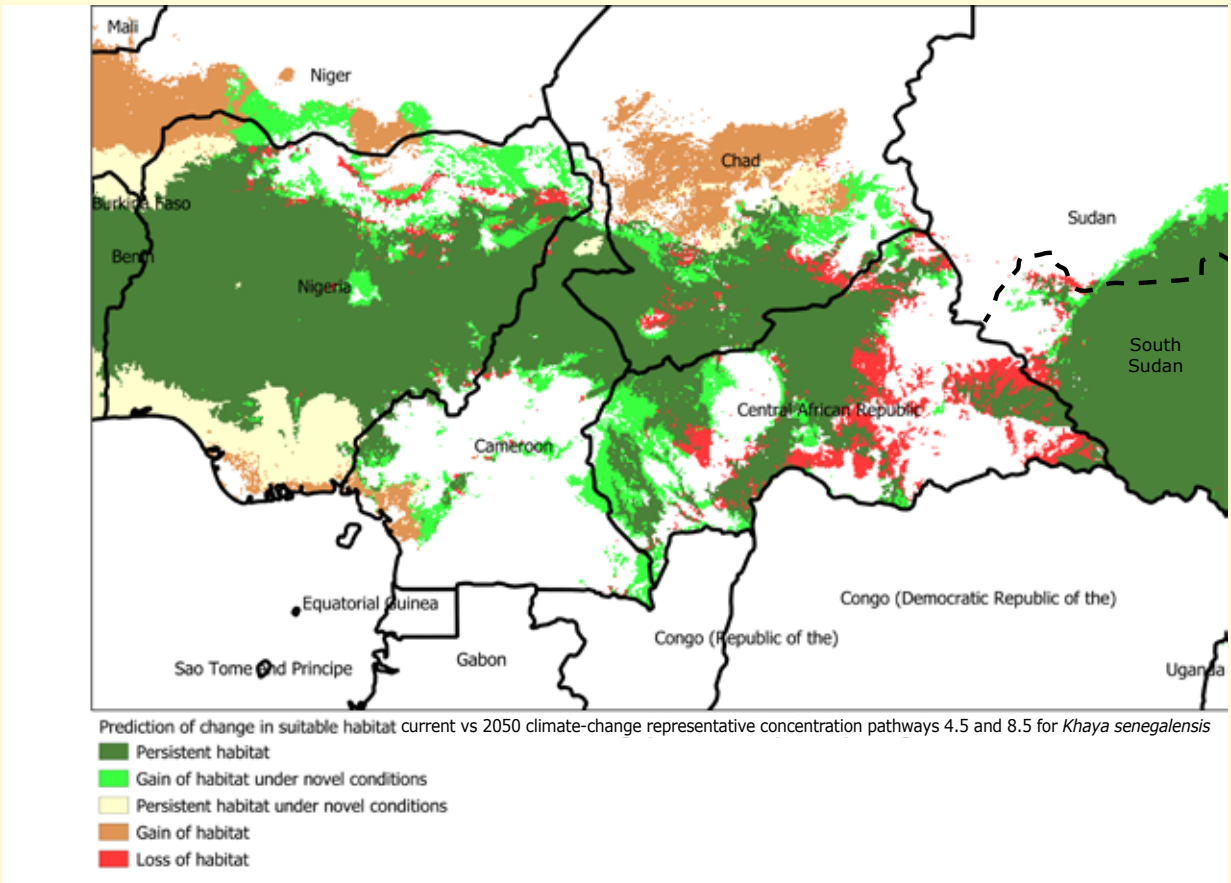
A small-scale fenced restoration plot established with support from the Tiipaalga association in Burkina Faso and managed by a women's group. The perimeter is delimited by metallic fences bordered by a line of* Acacia senegal *trees that will progressively replace the fence and provide an ongoing income from the sale of gum

Box 3
Ensuring the best climate data to model threats to native tree genetic resources across Central Africa

Bioversity is working with partners to support climate-sensitive decisions related to biodiversity and ecosystem services, focusing on priority TGR in the Congo Basin in Central Africa and the Guinean forests in West Africa. These subregions face the multiple threats of unsustainable land use, industrial pollution and climate change (IUCN, 2015). Central African countries have pledged (through the Bonn Challenge and AFR100) to bring more than 38 million ha of deforested and degraded land under restoration by 2030. Achieving this transformation will require overcoming constraints such as those posed by the poor quality and limited diversity of planting materials. This project is helping identify appropriate planting material that is adapted to local restoration sites and resilient to future climatic conditions.

A total of 58 native tree species common to Central and West African countries were selected by a diversity of stakeholders for their inclusion in FLR interventions, based on criteria such as habitat (e.g. savannah or forest), uses (wood and non-wood) and conservation status. Climate-suitability maps were produced for each species using historical climate data and the best available future climate projections (Figure 1). Species distribution models, maps of climate change and other threats, and genetic and ecogeographic diversity assessments will be combined to define appropriate seed-sourcing strategies for successful restoration, at the same time helping conserve the genetic diversity of the tree species used. The results will be made available as part of the D4R platform (see above).

1 Prediction of change in suitable habitat for* Khaya senegalensis *from current to 2050 climatic conditions in Central and West Africa



Source: adapted from Marius R.M. Ekué, Bioversity International, 2017. Conforms to Map No. 4170 Rev. 19 UNITED NATIONS (October 2020)

capacity and ensuring the availability of documentation and verification tools such as SeedIT could help enable this change.

Brancalion *et al*. (2017) argued that, to realize its potential to generate jobs and income, reduce poverty and deliver valuable ecosystem services to society, restoration should receive the same attention from state decision-makers and markets as they give to agricultural commodities. This means creating incentives, including financial incentives such as low-cost finance, and supporting producers to gain access to markets for their products.

CONCLUSION

The global ambitions for FLR have never been greater. The Bonn Challenge, the New York Declaration on Forests and the United Nations Decade on Ecosystem Restoration have mobilized extraordinary political commitments to reverse landscape-scale degradation to achieve multiple environmental and societal benefits. The implementation of these commitments will require the effective deployment of TGR via approaches involving assisted natural regeneration, direct seeding and tree-planting in plantations, agroforestry systems and ecosystem restoration. In many developing countries, the capacity to scale up the supply of TGR for FLR remains a major limiting factor on success. Key priorities must be to:

- improve the national and local-level conservation of TGR for priority species by building capacity to identify and map threats to TGR and to safeguard critical seed sources;
- adopt existing decision-making tools to support the choice of the right tree species for given environmental conditions and established purposes;
- gather additional information on the requirements and traits of presently underused native species from a broad set of forest ecosystems;
- raise awareness at all levels of the importance of seed quality for plantation and restoration success while simultaneously developing policies, strategies and regulations that support the establishment of operational seed-supply systems. Any legislation should include requirements to document seed quality and origin and specify quality requirements for the TGR used in publicly funded FLR projects;
- initiate national assessments of the TGR needed to meet FLR targets to inform the development of seed systems and markets capable of meeting seed requirements in terms of both quantity and quality;
- invest at the national level in the development of databases of existing TGR and the infrastructure required to ensure the sustained supply of improved planting material;
- obtain information on the medium- and long-term socio-economic benefits of using appropriate species and high-quality seed sources in FLR programmes;
- put in place incentives and enabling policies to support smallholders in producing, trading and using high-quality genetically diverse reproductive materials; and
- promote educational campaigns, extension, knowledge-sharing and enabling institutional, policy and regulatory frameworks and, crucially, ensure the availability of adequate land and fair and equitable tree-tenure regimes so that diversity-rich FLR (and the products and ecosystem services it provides) is perceived as more attractive than alternative land uses, thereby strengthening economic activities based on native tree diversity.

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Measuring progress in forest and landscape restoration

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Effective monitoring at the global, landscape and project scales is essential for keeping restoration on track, and promising tools are emerging.

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Land-based approaches to improving the productivity of degraded areas can help address the triple challenge of our times: ensuring a stable climate, food security and space for nature (Baldwin-Cantello, 2018). Forest and landscape restoration (FLR) is a set of land-use strategies such as agroforestry and natural regeneration implemented to achieve management goals related to soil and biodiversity conservation, water, carbon sequestration, energy and food production, and community needs (FAO and WRI, 2019). FLR can help mitigate climate change, increase landscape health and connectivity, and reduce pressure on natural forests by producing raw materials such as timber, woodfuel and non-wood forest products.

Momentum for FLR has been building for some time, starting with the Bonn Challenge and the Aichi Biodiversity Targets launched in 2011 and reiterated in the New York Declaration on Forests (NYDF) in 2014. Endorsers of the Bonn Challenge have pledged to restore 150 million hectares (ha) of degraded landscapes and forest lands by 2020 and to significantly increase the global rate of FLR thereafter, which would restore at least an additional 200 million ha by 2030 as a result of the NYDF (NYDF Assessment Partners, 2019). To date, 63 countries and other entities have committed to restoring 173 million ha – an area half the size of India – and have joined various regional initiatives for intergovernmental collaboration at the national scale (Bonn Challenge, 2020). Although such initiatives demonstrate political will towards FLR, and progress is being assessed through the Bonn Challenge's Barometer (discussed below), no systematic study has yet been conducted to verify outcomes. To ensure that the wide-reaching benefits of these

Above: Godfrey Mutero measures the diameter of a young* Eucalyptus *seedling at the Chesa Forest Research Station in Bulawayo, Zimbabwe. Measuring progress on forest and landscape restoration, including in the field, is essential for its success

Table 1. The geographic scales of restoration monitoring

Scale	Objectives	Audiences	Example indicators
Global	• Measure progress relative to a globally consistent index of improved/degraded land cover • Provide international context and "discover" new successes and lessons	• Bilateral and multilateral donors • International non-governmental organizations	• No. of hectares restored towards Sustainable Development Goal 15.3, the Bonn Challenge, the NYDF and other global targets • Comparative assessment of positive, neutral and negative progress on a jurisdictional scale
National/ Landscape*	• Measure progress towards the goals specified in an FLR strategy or shared vision in a landscape • Provide data for FLR zoning and spatial planning and resultant investment plan	• National and subnational governments • Non-governmental organizations • Regional initiatives	• No. of hectares with increased tree cover • Assessment of positive, neutral and negative progress at the landscape scale
Project	• Measure progress within a specific project boundary relative to the goals or tree-cover targets outlined at the project planning stage • Provide context for the "intentionality" of FLR and for the level of investment	• Project funders • Project implementers • Corporations • Local communities	• No. of trees planted or regenerated, and survival rates • Estimated carbon sequestration (carbon-dioxide-equivalent per year) • Risks to trees and jurisdictional trends

Note: * Although "landscape" is generally not a jurisdictional entity in countries, it is an important unit because ecosystems do not follow human-created boundaries.

commitments are obtained, there is a need to identify where successful FLR interventions can be reported and where further efforts and resources need to be directed. It is time to pause for thought – how much FLR has happened already, and what needs to be done to achieve the ambitious goals of the Bonn Challenge and the NYDF?

By tracking progress, systematic monitoring can play an important role in helping achieve targets. Major barriers to the monitoring of FLR persist, however, including a lack of globally consistent data and baselines and standard methodological approaches for assessing progress. Without standardized and harmonized methodological processes to provide data, it is difficult to assess FLR's impact on climate and ecosystems, compare restoration efforts across jurisdictions, and identify where more effort and investment is needed.

This article presents the latest developments in methods and best practices for measuring progress in FLR. FLR is about much more than trees, and there is a concurrent need to monitor its economic and social impacts. Nevertheless, most work to date has been on measuring vegetation change (primarily tree-cover change) as a first step, and this is the main (but not exclusive) focus of this article. There are many ways to conceptualize monitoring methods, and we use a framework that categorizes monitoring by scale. For each of the three scales shown in Table 1, we review recent developments in monitoring and examine emerging tools and technologies to assist in measuring change over time. We conclude by identifying three key challenges for the effective monitoring of FLR.

THE GLOBAL SCALE

It is important to accurately monitor and compare progress in the implementation of FLR towards global targets. Because FLR typically involves the establishment or re-establishment of tree cover (either through intentional planting or natural regrowth), tracking both gains and losses of trees is essential for monitoring FLR.

A barrier to the effective monitoring of FLR at scale is the lack of globally consistent data for tracking tree-cover gains. Global maps of tree-cover loss have been produced annually for almost a decade, but this is not the case for tree-cover gain (Hernandez-Serna *et al*., 2019). Monitoring tree-cover gain is more complex than monitoring deforestation for two main reasons:

1. **Temporal differences.** Deforestation is often a near-instantaneous event, but FLR typically occurs over much longer timespans in the order of years to decades (Chazdon, 2008). Measuring progress from seedlings to saplings and from young to mature trees requires a long-term monitoring system. Therefore, it is important to determine what can be detected within the monitoring timeframe of an FLR project to ensure that realistic goals are set.

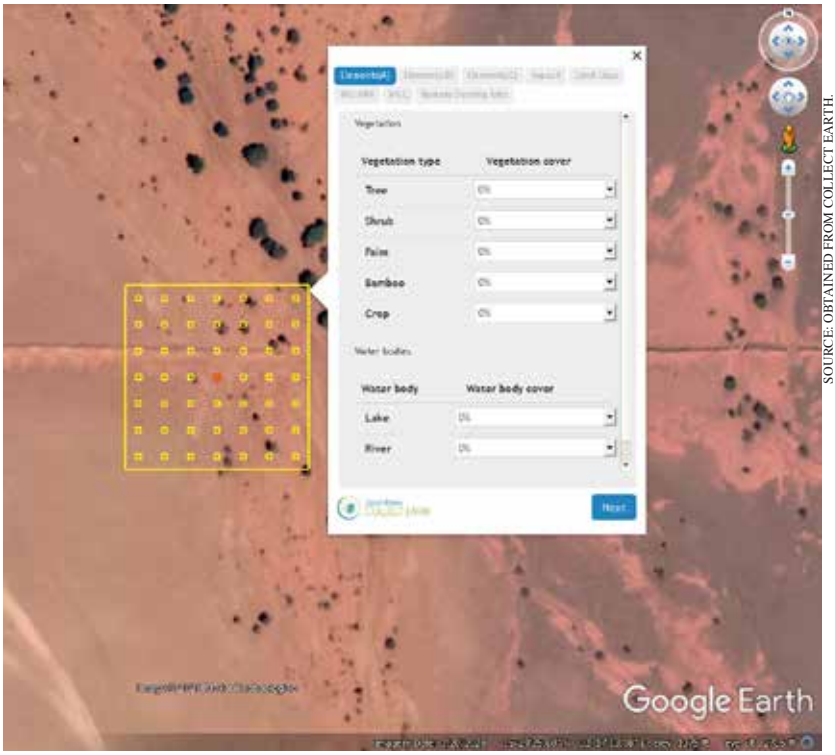
2. **Resolution.** In many areas, deforestation occurs primarily as relatively wide swathes of dramatic change in land cover (although the amount of small-scale deforestation has increased in recent years). Restoration, on the other hand, often occurs in smaller, more dispersed plots, such as when individual farmers plant trees dispersed over a few hectares of farmland (i.e. as "trees outside forests"). A typical FLR project may comprise many individual plots, with the aggregate area of land ranging from a few to hundreds or even thousands of hectares. Although some forms of FLR promote dense tree cover, many others involve sparsely dispersed trees. As a result, high- to very-high-resolution satellite images need to be used, either directly or to perform accuracy assessments of FLR monitoring methods. Such imagery is typically cost-prohibitive for

FLR projects, however, especially those not associated with carbon markets.

Given the relative complexity of monitoring FLR compared with deforestation, doing so at a global scale requires a more nuanced approach geared towards capturing the various types of FLR, from dense forest cover (i.e. trees inside forests) to sparse tree cover (i.e. trees outside forests). Pioneering efforts have been made to develop global datasets on gains of trees inside forests (e.g. Hansen *et al*., 2013), but there is a relative lack of knowledge of gains in trees outside forests over time at a global scale.

Various methodologies are being developed to address the challenge of monitoring tree-cover gain. For example, the World Resources Institute (WRI) developed a pilot-scale application of a restoration progress index that combines data on trees inside and outside forests for the Greater Mekong Subregion in Southeast Asia. The aim of that index was to measure progress on Goal 5 of the NYDF (NYDF Assessment Partners, 2019).[1] In this pilot application, WRI combined earth observation data-collection resources to measure progress in two types of tree-based restoration, defined as: increase in trees inside forests (i.e. dense and clustered trees with tree-canopy cover greater than 10 percent); and increase in trees outside forests (i.e. sparse tree cover on non-forest lands such as croplands and settlements). This approach was applied in five Mekong countries – Cambodia, the Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam – to evaluate progress on NYDF Goal 5 over the period 2010–2017. The datasets used for each of these restoration types are described in more detail as follows:

- **Trees inside forests.** WRI used the University of Maryland's GLAD[2] dataset on tree-canopy cover and height dynamics to measure change in trees inside forests. This dataset is based on 30-m-resolution Landsat satellite data, which is suited to detecting dense, clustered tree cover. WRI defined "restoration" as an increase in tree-canopy cover of more than 20 percent and any increase in tree-canopy height greater than 5 m using a 30-m pixel-by-pixel comparison of data for the baseline (2009–2011) and most recent (2015–2017) periods.[3] The resultant dataset provides a comprehensive picture of forest-cover change in the region – both increases and decreases. Therefore, it is possible to calculate the net impact of forest restoration and deforestation on total forest cover as well as identify patterns in tree-cover change. Identifying these patterns makes it possible to distinguish "long-term" gains and losses associated with restoration and deforestation from "rotational" gains and losses associated with working forests such as tree crops and plantations.
- **Trees outside forests.** WRI used Collect Earth[4] (Figure 1) to measure change in sparse tree cover on non-forest land uses such as croplands and settlements. This involved counting individual trees in more than 14 000 sample plots in the five Mekong countries across varying types of land use for the period 2010–2018. Developed by FAO's Open Foris initiative, Collect Earth is suited to this type of data collection because it relies on very-high-resolution imagery and human interpretation, which can distinguish small differences in tree cover and land use that are often difficult to



SOURCE: OBTAINED FROM COLLECT EARTH.

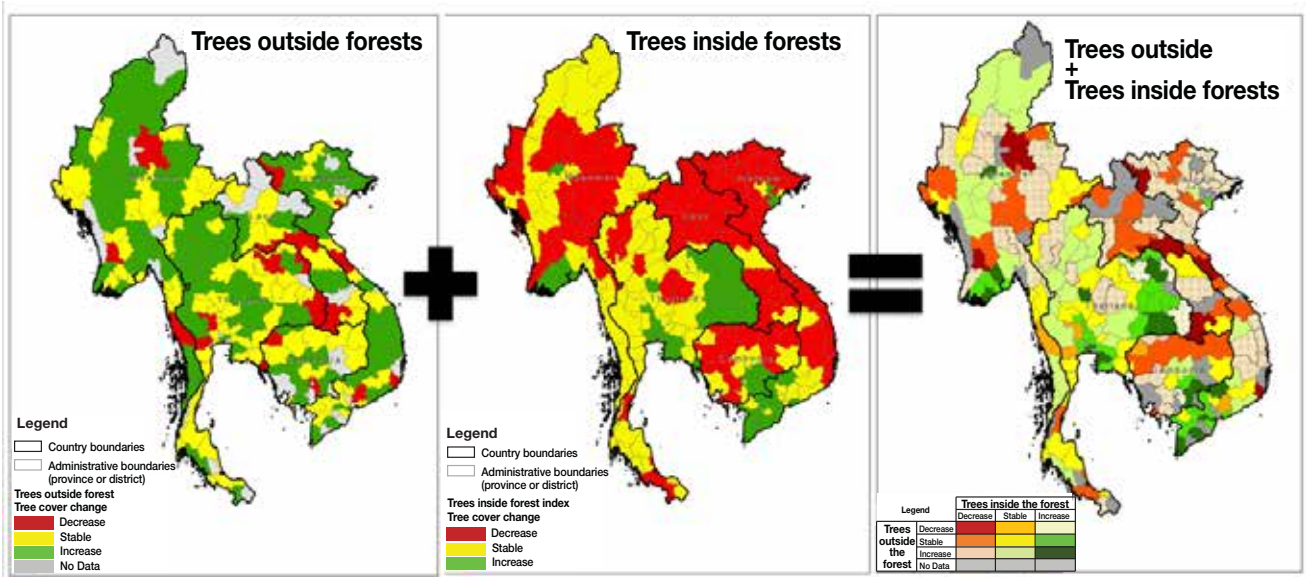
1 Example of a sample plot and survey card in Collect Earth

[1] Goal 5 of the NYDF is to restore 150 million ha of degraded landscapes and forestlands by 2020 and significantly increase the rate of global restoration thereafter, which would restore at least an additional 200 million ha by 2030.

[2] GLAD = Global Land Analysis and Discovery (https://glad.umd.edu).

[3] The average canopy height error using this methodology is 4 m.

[4] Collect Earth is a tool that enables data collection through Google Earth. In conjunction with Google Earth, Bing Maps and Google Earth Engine, Collect Earth users can analyse high- and very-high-resolution satellite imagery for a wide variety of purposes. Collect Earth Online is a web-based, crowdsourcing technology that increases customization compared with the Collect Earth desktop version and adds various imagery resources and processing capabilities.



2 *Tree-cover change in five Mekong countries, combining trees-outside-forests and trees-inside-forests methodologies*
Source: NYDF Assessment Partners (2019).

detect using algorithm-based remote sensing techniques and lower-resolution imagery, such as Landsat (Open Foris, 2020). Trees outside forests are often overlooked in forest-cover assessments – using the Collect Earth methodology, for example, Bastin *et al.* (2017) "discovered" 500 million ha of forest in drylands that had never been counted before.

The two approaches for measuring tree cover inside and outside forests were combined to produce a comprehensive picture of restoration progress based on tree-cover change (Figure 2). The results of the two analyses demonstrate the value of looking at both scenarios, given that trends are not always the same for each. In Figure 2, the results of the trees-outside-forests (far left) and trees-inside-forests (centre) analyses are combined in one map (far right) showing the changes in both. The shades of orange and red show an overall trend towards decreasing tree cover and shades of green show an overall trend towards increase. There is a decreasing trend in (for example) north-central Cambodia and central Lao People's Democratic Republic and an increasing trend in the eastern part of Thailand and in southern Cambodia and Viet Nam. Nevertheless, trends are mixed in much of the study region. In some areas, there have been increases in trees outside forests but decreases in trees inside forests (shown in dotted areas on the map). Both perspectives are important when considering the net impact of restoration on a landscape.

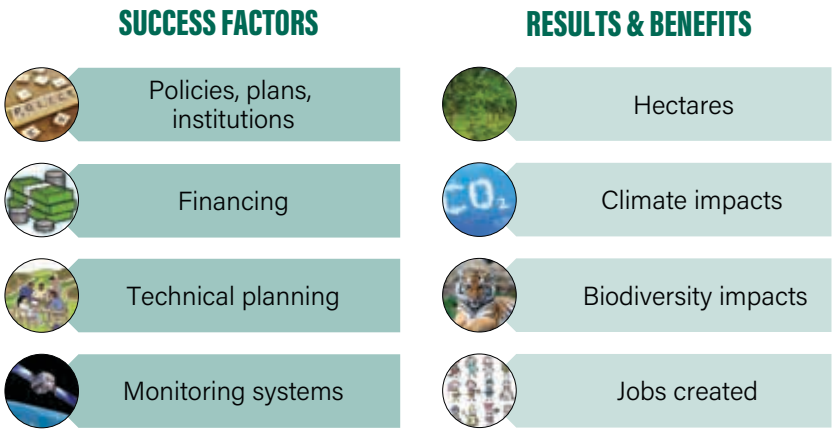
Other approaches are also showing promise for detecting sparse tree cover outside forests. For example, recent developments in the use of supercomputers to analyse commercially available very-high-resolution (< 50 cm) satellite imagery with machine-learning techniques enabled the enumeration of trees outside forests in the western Sahel (Brandt *et al.*, 2020). By mapping non-agricultural vegetation with canopies larger than 3 m^2, Brandt *et al.* (2020) also associated rainfall with crown diameter. This information will help in understanding the drivers of tree and bush establishment and residence time in the hot dry tropics, a potentially important aspect of the carbon cycle. Thus, even small, scattered trees outside forests can now be detected and included in monitoring.

Platforms and frameworks

The International Union for Conservation of Nature developed the Barometer to enable countries that have made pledges to the Bonn Challenge to measure the implementation of FLR. The Barometer, which has been endorsed by more than 40 countries, is a comprehensive, flexible, progress-tracking framework and tool that assesses multiple aspects of FLR planning, implementation and results. The Barometer indicated that the extent to which pledged areas had been brought under restoration by the end of 2018 was 56 percent in the first 13 countries studied. Applying the Barometer enables pledgers to report on the actions taken and to identify obstacles to achieving their pledges. The Barometer's protocol was launched in 2017 and was further refined with in-depth application in five countries – Brazil, El Salvador, Mexico, Rwanda and the United States of America – in 2018. The Barometer has two dimensions and eight indicators (Figure 3) (see also the article on page 82 of this edition).

The Barometer is designed to incorporate data from multiple sources, including spatial data and land-cover maps provided by countries and partners as well as global-level tools such as Collect Earth.

To help improve and expand global FLR monitoring methodologies, experts from several organizations have joined together to form the Global Restoration Observatory (GRO), the aim of which is to support the development of a globally consistent dataset on restoration progress and a platform for



3 The Bonn Challenge's Barometer and indicators

data delivery. Focusing first on biophysical progress in FLR, GRO will identify the most important indicators of restoration progress and develop the best available, globally consistent data to measure progress against those indicators.

The development of a holistic monitoring framework is under discussion in a multipartner dialogue in the context of the United Nations Decade on Ecosystem Restoration.[5] The aim of the Framework for Ecosystem Restoration Monitoring (FERM) is to provide a robust, flexible approach to monitoring that builds on existing systems and better supports restoration practitioners. A core tenet of FERM is to make up-to-date data and robust, standardized methodologies available – across sectors – via innovative platforms such as FAO's Open Foris SEPAL[6] to support high-quality and adaptive restoration actions. The primary function is to provide a clear picture of FLR progress by recognizing successful interventions, providing feedback on unsuccessful interventions, and identifying where further support and investments are needed.

THE LANDSCAPE SCALE

The needs of monitoring for landscapes differ from those at the global scale. Landscapes are complex areas comprising multiple land uses that fulfil the needs of local communities and provide multiple regulatory and provisioning ecosystem services. Understanding a landscape and its functions is essential for directing FLR activities towards priority areas. For the purposes of FLR monitoring, the "landscape scale" is defined as FLR efforts operating at a subnational to national scale. Monitoring restoration at this scale is inherently linked to desired targets (impacts) and the management of FLR interventions (performance). There is a need to go beyond trees and tree establishment to understand the socio-economic and ecosystem impacts and goals of FLR. Stakeholders need nuanced indicators to ensure that tree-growing efforts are contributing to the goals of their overall FLR strategies. Additionally, it is important to monitor beyond tree cover to obtain a focused look at what may sometimes be a granular picture, such as whether tree-cover gains are occurring as monocultural or mixed-species plantations or more naturally (e.g. through assisted natural regeneration). The outcomes of FLR landscape-scale monitoring may have direct impacts on – and therefore will be of interest to – forest-dependent people, landowners, those involved in planning and implementing FLR, and others who are directly or indirectly affected by land-use decisions.

More than trees

Measuring progress towards the many and varied goals of FLR in a given landscape will require the collection of a large and diverse body of data. Thus, for example, Collect Earth, if deployed, should be used to observe not only trees but also land-cover types, water bodies, settlements and other landscape elements.

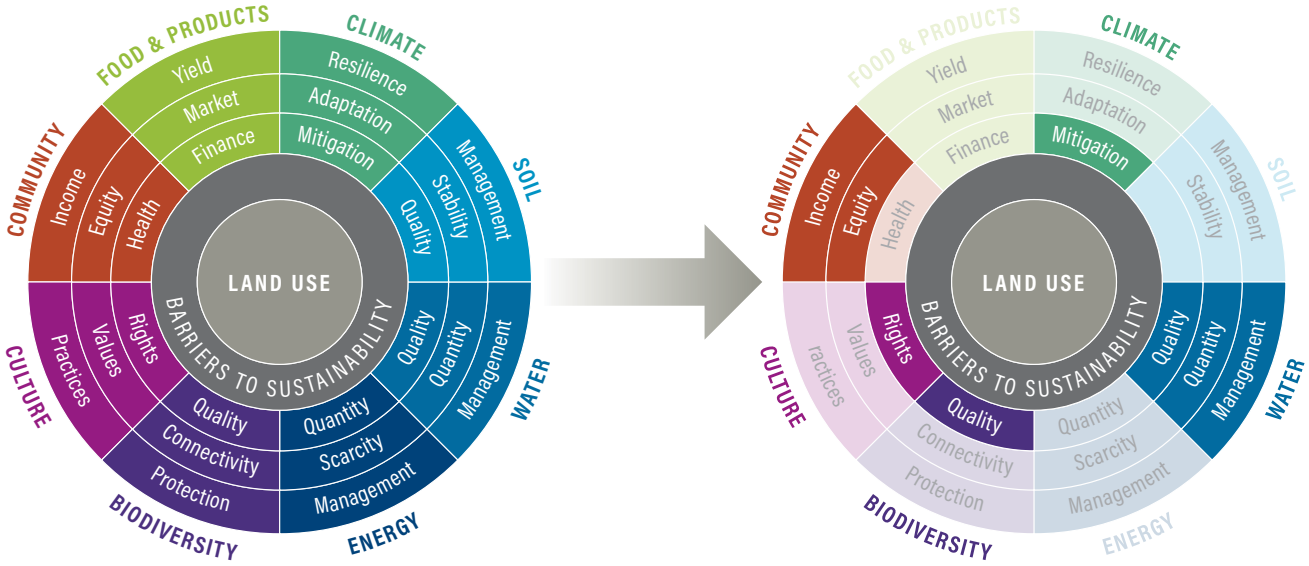
The data should be more precise and more densely sampled in landscape monitoring than for global studies (which might, say, sample 1 in every 25 000 ha). The greater detail and larger number of variables mean that landscape-scale monitoring using Collect Earth will be highly

4 Restoration Mapper using Collect Earth Online and machine learning

Note: A screenshot of the Restoration Mapper prototype, which displays detailed, wall-to-wall maps of the spatial distributions of trees with canopy diameters larger than 2 m. The maps are created using artificial intelligence algorithms and freely available 10-m-resolution satellite data (Sentinel 2). The image on the left shows the pixels of tree cover, and that on the right shows the raw satellite imagery.
Source: Brandt and Stolle (in prep.).

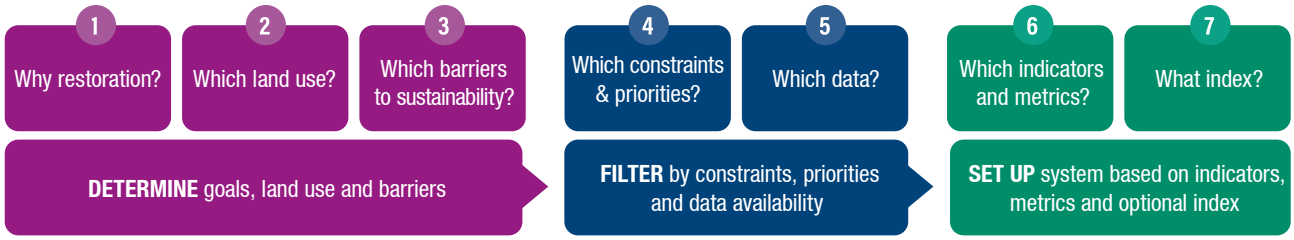
[5] See article on page 119 of this edition.
[6] SEPAL = System for Earth Observation, Data Access, Processing and Analysis for Land Monitoring.

5 *The wheel of forest and landscape restoration goals*



Source: FAO and WRI (2019).

6 *Three steps for identifying priorities and indicators for restoration monitoring*



Source: FAO and WRI (2019).

time- and resource-intensive (Saah *et al.*, 2019). New methodologies that integrate human-annotated data with remote sensing classification methods are being developed to address this. Restoration Mapper,[7] for example, uses Collect Earth Online's capacity to label samples combined with artificial intelligence algorithms and freely available 10-m-resolution satellite data (Sentinel 2) to create detailed, wall-to-wall maps of the spatial distributions of trees with canopy diameters larger than 2 m (Figure 4). The combination of a sampling approach and machine learning enables the rapid assessment of tree density in non-forested landscapes with greater than 95 percent accuracy. Based on the nature of tree distributions, the technology can be used to identify agroforestry areas, riparian buffer zones and crop buffer zones (Brandt and Stolle, in prep.).

Monitoring the impacts of restoration beyond tree-cover gain requires the identification and development of economic and social indicators and methodologies. But practitioners and governments have resource constraints that affect what type of data can and should be collected. For example, many have tended to prioritize affordable and cost-effective indicators suitable for reporting progress on the Bonn Challenge, the NYDF and nationally determined contributions (NDCs) under the Paris Agreement on climate change but, because of funding constraints, they have overlooked monitoring and measuring the benefits of tree-cover gain from social, cultural, health or ecological perspectives. Other constraints on data include availability, the ease and frequency of collection (access), and quality. Considerations include the monitoring period (i.e. the time needed to show effects), the comprehensiveness of indicators, the sensitivity of indicators to change, the ease of classification of indicators, and the ethics of data collection.

To address landscape-scale monitoring challenges, FAO and WRI published a guide to help stakeholders identify indicators and metrics for measuring progress towards social and environmental goals (Figure 5) (FAO and WRI, 2019). The guide emphasizes the need to make choices and understand potential trade-offs and synergies when designing FLR projects and sets out a three-step process for identifying priorities and indicators (Figure 6).

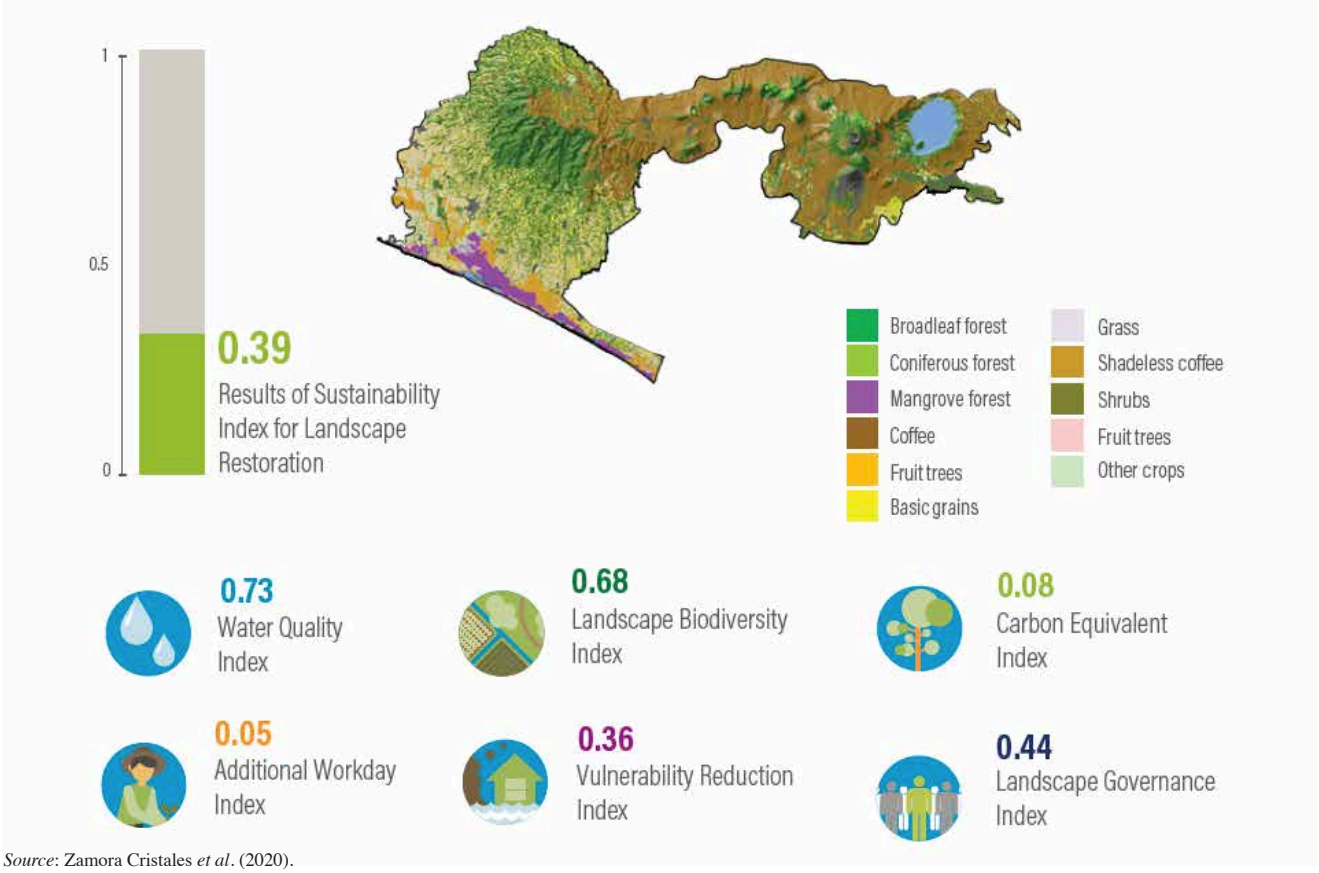
Practitioners generally appreciate a

[7] https://restorationmapper.org

goal-based approach to monitoring. In Malawi, for example, the government's restoration indicator framework (MNREM, 2017) focuses on measuring progress towards the goals identified in the national FLR strategy, enabling the integration of the framework with ongoing national work. Depending on their priorities, however, some stakeholders may prefer a checklist of biophysical and socio-economic factors, and others may want to use ecosystem goods and services as an entry point. Stakeholders concerned with the implementation of United Nations conventions may base their monitoring systems around indicators aligned with, for example, the Sustainable Development Goals, the NDCs, the Aichi Biodiversity Targets, and land degradation neutrality. In Ethiopia, the establishment of a monitoring system for tree-based restoration started by identifying the ways in which trees and forests can contribute to economic, social and environmental goals at the local, regional and national levels. The monitoring system focuses on the ecosystem services that will deliver these contributions and identifies specific restoration options (e.g. the restocking of degraded natural forest, agroforestry, commercial plantations, and buffer zones near water bodies) that would best supply those services. Whatever entry point they use, stakeholders still need to determine key measurements for land use and barriers to sustainability, filter the measurements by their main constraints and priorities, and set up a framework based on the indicators chosen (FAO and WRI, 2019).

The Sustainability Index for Landscape Restoration (SILR), developed by WRI and partners, complements the FAO/WRI guide. SILR is a measure of the biophysical and socio-economic impacts of restoration actions at the landscape level. The index allocates a score (between 0 and 1) to a given landscape based on the degree of compliance with the targets established in restoration plans and strategies with respect to a baseline, with the index comprising various biophysical and socio-economic components. The index has been applied in a priority landscape in El Salvador (El Imposible-Barra de Santiago and Apaneca-Ilamatepec) (Figure 7); the results represent an opportunity for the strategic assessment of restoration actions and will assist in the landscape's adaptive management (Zamora Cristales *et al*., 2020).

7 Biophysical and social components of the Sustainability Index for Landscape Restoration, the El Imposible-Barra de Santiago and Apaneca-Ilamatepec landscape, El Salvador



Source: Zamora Cristales *et al*. (2020).

THE PROJECT SCALE

This year (2020) has ushered in a new wave of global commitments. Private-sector actors, governments, non-governmental organizations and individuals are establishing tree-planting programmes like never before with the aim of mitigating climate change and benefiting local communities. The Priceless Planet Coalition (led by Mastercard, with a goal of establishing 100 million trees) and the Trillion Trees initiative[8] are a few of those efforts.

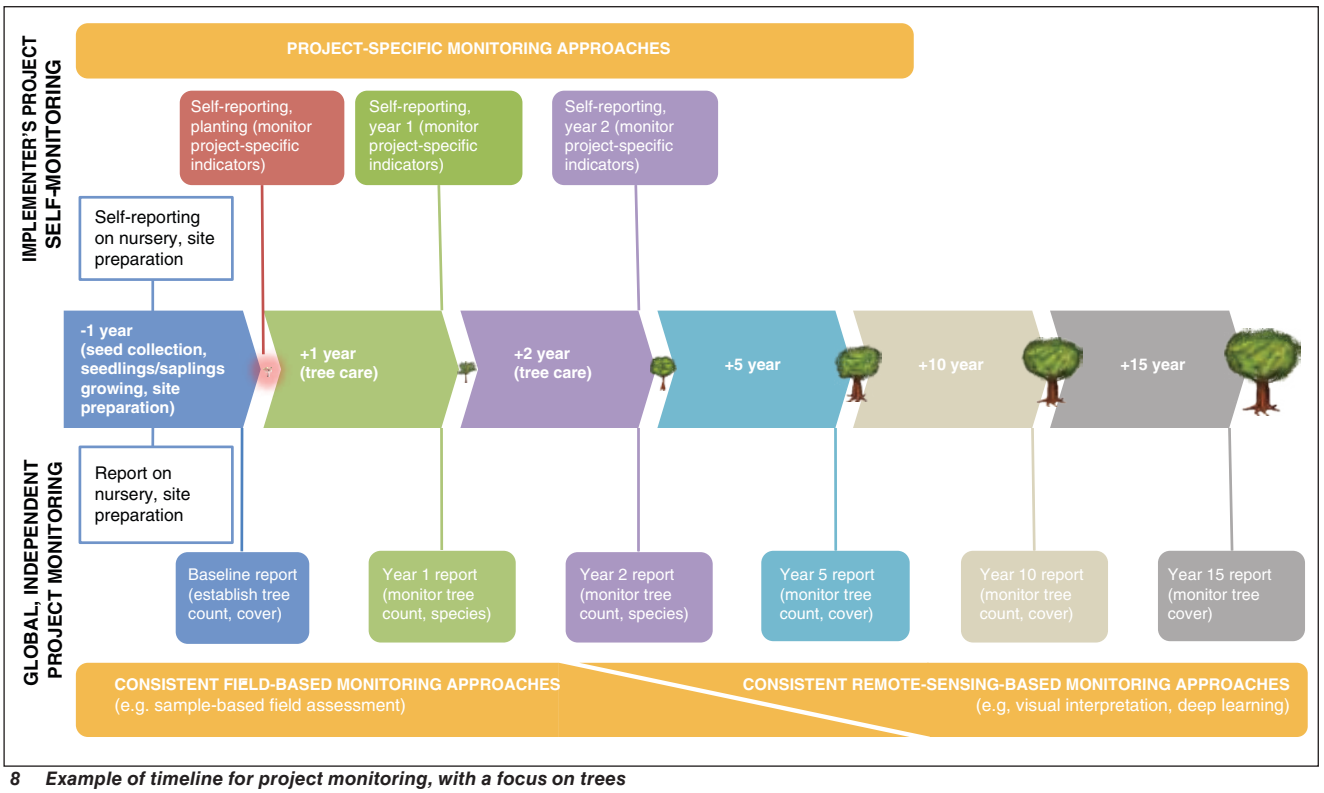
It is important that these and other restoration campaigns and projects are well planned and monitored. Not all newly established trees survive. Not all trees produce net social or environmental benefits. For example, the establishment of vast plantings of exotic species can negatively affect biodiversity and have other unforeseen ecosystem impacts, such as on water availability. Clear goals should be established at the project planning stage and an implementation strategy developed that is sensitive to the local environment and viewed through the lens of the overall landscape. It would be inadvisable, for example, to create ecologically inappropriate landscape change, such as by converting native grasslands to forest. Local community ownership and involvement is also important for ensuring sustainability beyond the project lifetime. Monitoring project-level restoration should focus on measuring progress relative to the goals outlined at the project planning stage, with the involvement of local communities.

Protocols are lacking

Project-level monitoring is complicated by a lack of simple, systematic, long-term protocols. Many projects are implemented without a monitoring strategy, with only ad hoc or anecdotal assessments of impacts. In other cases, monitoring protocols are developed for single projects, which limits the ability to compare progress across projects, regions and ecosystems. Carbon and forest sustainability certification schemes are among the best examples of independent, high-quality protocols for measuring progress against established baselines. These are robust and globally consistent across projects, but they are also time- and resource-intensive, focus mostly on deforestation, and are difficult to deploy at scale.

Obtaining positive impacts for people and the planet from FLR depends heavily on the types of trees deployed, where they are established, their survival, who owns the rights to use them, and the larger landscape and ecological context (Singh *et al*., 2020). The proliferation of restoration initiatives is an opportunity to invest in citizen-science monitoring approaches, such as by developing community cadres for monitoring using mobile assessment tools (e.g. open-data kits, LandPKS and Collect Mobile). Independent, systematic protocols will not only reduce the complexity of multiple self-reported projects that are difficult to compare over space and time but also ensure that projects are evaluated fairly and help assure project funders that

[8] 1T.org



8 Example of timeline for project monitoring, with a focus on trees

their investments are having positive social and environmental impacts.

Carbon markets are a key driver of FLR projects, but certification schemes linked to these focus on measuring tonnes of carbon removed at the project level, and their processes are project-specific, limited in their scalability, and time- and resource-intensive. New protocols for monitoring FLR are being developed and field-tested that are robust, independent and can be applied relatively easily on a large scale (i.e. across many projects) at a low cost. These protocols will measure plant survival rates via hybrid methods of high-resolution remote sensing images and fieldwork.

WRI is developing protocols to monitor project tree counts, tree cover and tree species over 15–20-year timeframes to help simplify, streamline and increase consistency in project-level monitoring (Figure 8).

CONCLUSION

The inclusion of FLR in international commitments and government and corporate agendas is a relatively new phenomenon; therefore, the need to monitor such commitments is still a developing field of study. Methodologies are being tested at the global, landscape and project scales. A question remains, however, about how and when these should appropriately be combined. There is a need to align multiple datasets that capitalize on their strengths and abilities to report progress on various aspects of restoration, combining the best of top-down and bottom-up approaches and uniting the latest technological advances with community engagement.

But no single monitoring tool or approach can capture all the nuances of FLR, and the path forward, therefore, will depend on combining data and tools to create a composite approach. Satellite imagery, data-collection software, machine learning for vegetation detection, guides to the development of monitoring frameworks, and citizen-science tools at the project level can be merged to form comprehensive systems.

At least three overarching challenges remain, however. First, there are inherent technical issues due to the temporal nature of FLR, resolution requirements, and the diversity of FLR interventions. Second, the alignment of the three scales – global, national/landscape, and project – will hinge on the uptake of standardized tools. And, third, there is a tendency for FLR monitoring to focus predominantly on vegetation growth. Although this is essential, more research and development is needed to find innovative approaches for monitoring economic and social data. Standardized tools will enable us to observe change and provide the evidence for effective action.

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Assisted natural regeneration: harnessing nature for restoration

K. Shono, R. Chazdon, B. Bodin, S. Wilson and P. Durst

Giving natural processes a boost can be a cost-effective means for restoring forests and drylands at scale in diverse contexts.

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Above: A naturally regenerated forest landscape in Bohol, the Philippines

Countries worldwide have committed to restoring millions of hectares (ha) of degraded land in the next decade. A myriad of national and local governments, non-profit organizations, actors from the private sector and local communities are ramping up efforts to plan, execute and monitor large-scale restoration. Given the scale of the challenge, it is essential that scarce resources are allocated efficiently. Certain sites where forest and shrubland restoration is desired will require active tree-planting strategies, with significant cost and infrastructure demands in terms of site preparation and seed and seedling supply-chain development.

Complementary, lower-cost options are needed if ecosystem restoration is to be achieved at the necessary scale. Natural regeneration is gaining recognition as a practical approach that allows the cost-efficient restoration of forests and drylands at a large scale. It is a biological process, and it can be assisted (hence "assisted natural regeneration", or ANR) by first understanding the obstacles to it and then overcoming them (FAO, 2019).

Over the past century, forests have been naturally regenerating in Europe and the United States of America at very large scales following the abandonment of agricultural lands (in some cases with active assistance), a trend that is now becoming evident around the world (Chazdon *et al*., 2020). In the tropics, where net forest loss is still occurring, large-scale natural regeneration following agricultural abandonment tends to be a more recent phenomenon (Song *et al*., 2018). In the tropical Andes, 500 000 ha of woody vegetation is estimated to have regrown over the period 2001–2014 (Aide *et al*., 2019). In Brazil, 2.7 million ha of the Atlantic forest regenerated naturally between 1996 and 2015 (Crouzeilles *et al*., 2020), a phenomenon attributed to agricultural intensification on the most suitable

agricultural lands and the abandonment of others (Chazdon *et al*., 2020).

ANR is a simple, relatively low-cost restoration method that can enhance the productivity and ecosystem functions of deforested or degraded lands. The method aims to accelerate, rather than replace, natural successional processes by removing or reducing barriers to natural regeneration such as soil degradation, competition with weedy species, and recurring disturbances such as fire, grazing and wood harvesting (Shono, Cadaweng and Durst, 2007). Properly applied, ANR can speed the recovery of native ecosystems and at least some of their original functions (Chazdon, 2017). It comprises one element of overall efforts to promote the recovery of ecological integrity.[1]

ANR encompasses a range of restoration interventions that can help achieve restoration goals and related policy objectives. It can also be used as a component of larger-scale forest and landscape restoration (IUCN and World Resources Institute, 2014) and in national action plans to support ecosystem restoration targets such as Aichi Biodiversity Target 15 (Chazdon and Guariguata, 2016), land degradation neutrality targets (Kust, Andreeva and Cowie, 2017) and commitments under the Bonn Challenge.

ANR is a relatively recent but growing field of restoration science, with examples of successful applications around the world multiplying in recent years (FAO, 2019; Chazdon *et al*., 2020). This article describes the many advantages of ANR as a restoration intervention and its limitations, and it stresses the importance of tailoring interventions to the local socio-environmental context. It explores the method's advantages and limitations in four case studies (in Australia, Burkina Faso, the Philippines and Indonesia) in different restoration contexts. Finally, it proposes a typology of ANR interventions and a decision-making process for deciding which approach is most relevant, alongside other types of restoration interventions, depending on the context and restoration objectives.

PRINCIPLES, ADVANTAGES AND LIMITATIONS

The approach for restoring a degraded area should be determined based on the objectives of restoration, the area's ecological and environmental conditions and socio-economic and cultural context, and the availability of funds. If, for example, the objectives prioritize quick results and predictable returns on investment through the output of fibre or timber, it may be most appropriate to invest in intensive tree plantations. But if there is a need to both restore ecological functioning (e.g. in terms of biodiversity, water and soils) and produce diverse end products, ANR may be an appropriate and cost-effective approach.

When practised effectively, ANR can accelerate the process of natural

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Forest restored through ANR

[1] Ecological integrity refers to the state or condition of an ecosystem that displays the biodiversity characteristics of the reference, such as species composition and community structure, and is fully capable of sustaining normal ecosystem functioning (McDonald *et al*., 2016; SER, 2004).

regeneration in deforested and otherwise degraded forest ecosystems and enhance native species diversity and conservation (Chazdon, 2013). In human-modified landscapes, ANR can be an important natural solution for mitigating and adapting to climate change and increasing the supply of other ecosystem services (Wilson *et al*., 2017) while also generating economic benefits for local farmers at multiple scales (Reij and Garrity, 2016; Smale, Tappan and Reij, 2018). ANR can protect and rehabilitate watersheds (Dugan *et al*., 2003; Paudyal *et al*., 2017; Yang *et al*., 2018) and increase carbon storage (Evans *et al*., 2015). Because of spatial variability in the ecological and social factors that influence natural regeneration outcomes, ANR is a highly flexible and adaptive approach to restoration that is context- and site-specific (FAO, 2019). The inherent flexibility of ANR places interventions on a spectrum between full tree-planting approaches and passive (spontaneous) natural regeneration processes.

In areas where grazing is a driver of land degradation, exclosures (i.e. areas in which large grazing animals are excluded by fencing) have proved effective for restoring ecosystems while providing economic benefits for local communities. There are many successful examples of this approach in the Sahel: in Burkina Faso, for example, small exclosures established as part of small-scale landscape restoration strategies have reduced food shortages by enabling smallholders to harvest diverse foods and non-edible forest products (including fodder for livestock, small wildlife, and crops of cereals and legumes) in and around the exclosures (Djenontin, Djoudi and Zida, 2015). In the Amhara region of northern Ethiopia, exclosures installed on communal grazing lands increased above-ground biomass, plant species diversity and fodder production and reduced soil erosion within seven years (Mekuria *et al*., 2015). In some cases, physical fencing may not be required if local people adhere to "social fencing" (in which community members agree among themselves to police their grazing regimes) as a way of reducing land-use pressure on degraded areas long enough to enable regeneration. Social fencing can succeed where there is strong community cohesion and a shared vision, and where access is rigorously restricted. China has a long history of "mountain closure", which employs social fencing to provide forests with sufficient time to regenerate naturally (Chokkalingam *et al*., 2018).

ANR can also be used as part of silvopastoral and agroforestry systems, as demonstrated in the wide adoption of farmer-managed natural regeneration (FMNR) in Africa. FMNR is a social-forestry approach in which farmers play a central role in promoting and managing natural regeneration. It can provide many benefits for farmers, including increasing crop and pastoral production, income from the managed harvesting of woodfuel and fodder, and the diversity of native trees in the landscape (Birch *et al*., 2016). As farmers in the Colombian Andes transitioned from pasture monocultures to silvopastoral systems, the exclusion of cattle by fencing led to the recovery of the structure and diversity of riparian forests within ten years (Calle and Holl, 2019).

In many regions, Indigenous Peoples and local communities have excellent knowledge of local successional and recovery processes. This knowledge can help in achieving successful ANR, thereby enhancing ecosystem recovery and capitalizing on local knowledge and cultures (Reyes-Garcia *et al*., 2019). For example, traditional shifting-cultivators have a vast knowledge of species characteristics in swidden fallows and can help identify native tree species with potential to promote natural regeneration and the recovery of biodiversity (Wangpakapattanawong *et al*., 2010; Douterlungne *et al*., 2010). Thus, ANR promotes cultural values, uses local knowledge, and helps keep traditional practices alive.

A key advantage of ANR is the low requirement for infrastructure and capital investment and the significantly lower costs of implementation and maintenance compared with full tree-planting. These qualities contribute to the effectiveness of ANR for household-, farm-, and community-based restoration activities that do not have access to or a need for external financing. In many areas, including parts of the Philippines, ANR is being implemented widely by local communities working in small watersheds. The average overall cost of site protection and weed control is in the range of USD 20 to USD 579 per ha for establishment, and it remains low for annual maintenance (Table 1). Enrichment

Table 1. Costs of establishing and maintaining assisted natural regeneration in the tropics based on data from the Americas, Africa and Asia

Cost category	Direct cost
Establishment cost per ha, year 1	Average = USD 257; range = USD 20–579
Annual maintenance and monitoring cost per ha per year, years 1–5	Average unavailable; range = USD 31–213
Annual maintenance and monitoring cost per ha per year, years 5–15	Average unavailable; range = USD 14–17

Note: The costs shown are averages for restoring tropical forest landscapes using ANR, including labour, inputs and equipment derived from a systematic review of literature and available field data comprising case studies, expert opinion, cost modelling and experimental trials in Australia, Brazil, Malaysia, the Niger, the Philippines and South Africa. Estimates are based on quantified total costs for establishing and maintaining ANR, including weeding and protection against fire, grazing and the unsustainable collection of woodfuel and other forest products.
Sources: Dugan (2011); Evans *et al*. (2015); Molin *et al*. (2018); Mugwedi *et al*. (2018); Ong (2011); Pavanelli and Voulvoulis (2019); Reij and Garrity (2016).

planting and fencing add to the cost but can also increase the financial and livelihood benefits (Maier *et al*., 2018). Enrichment planting is recommended in cases where natural regeneration is insufficient or the desired tree species are absent (FAO, 2019). The cost increases with additional interventions to attract seed dispersal.

Because of its lower cost and infrastructure requirements, ANR can be an appropriate approach for large-scale forest restoration, particularly following major disturbances such as fires and floods or on abandoned agricultural lands (Chazdon and Guariguata, 2016). Site-preparation measures alone, such as harrowing and initial herbicide application, have been shown to effectively stimulate natural tree regeneration in intensively used pastures in the southern Amazon, with no tree-planting required (Rezende and Vieira, 2019). In Brazil's Atlantic Forest region, it is estimated that 18.8 million ha could be restored using ANR, reducing implementation costs by USD 90.6 billion compared with the cost of full tree-planting (Crouzeilles *et al*., 2020). Estimation of the full spatial potential of ANR in other regions and countries is limited by a lack of assessments and maps of local site potential for natural regeneration.

ANR interventions can ameliorate site-specific obstacles to natural regeneration and support the livelihoods of local people. Interventions to suppress weeds and release the natural regeneration of desired species appear to be more effective at accelerating forest regeneration when used in combination (Shoo and Catterall, 2013). For example, restricting grazing alone may be insufficient because non-native species may proliferate and inhibit the establishment of native species. On the Pacific coast of Mexico, the recovery of tropical dry forest on former pasture was significantly accelerated by the removal of climbers and by soil ploughing (Méndez-Toribio *et al*., 2019). Where natural regeneration is limited by seed dispersal, the placement of artificial perches for seed-dispersing animals can enhance seed arrival and seedling establishment (Guidetti *et al*., 2016).

Several aspects of ANR limit its applicability in forest restoration efforts. Compared with conventional reforestation, tree growth and stand development are slower and commercial yields of timber and fibre are lower and less uniform than in intensively managed forest plantations. ANR is labour-intensive in its early stages, particularly where naturally regenerating trees face heavy competition from weeds and grasses, which therefore must be managed. ANR displaces grazing and woodfuel collection, so these needs must be satisfied elsewhere. Finally, ANR is poorly understood and rarely advocated by policymakers, who may be more familiar with active tree-planting approaches to the restoration of degraded sites.

Below, four case studies illustrate some of the points made above and demonstrate the advantages and limitations of ANR.

Case study 1. Assisted natural regeneration with fencing restores native woodlands and livelihoods

Context. Climate change and unsustainable agricultural and grazing practices have reduced tree cover in the Sahel, leading to desertification and a lack of woodland and water resources to support the lives of local people. The Switzerland-based non-governmental organization (NGO) newTree introduced ANR with fencing to central and northern areas of Burkina Faso in 2003 and, over a ten-year period, assessed the impact of this on income generation and vegetation regeneration.[2]

Interventions. Contracts were arranged between newTree and farmers. Farmers contributed labour to construct fences and newTree provided fence materials and technical support. Each fenced site was surrounded by a cultivated buffer area of agroforests. Vegetation in each fenced site was inventoried every five years. One hundred and ninety-eight sites were fenced between 2003 and 2012, and families and farmer groups protected 560 ha of fenced land.

[2] The information in this case study is based on Belem *et al*. (2017).

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Fodder production in fenced and agroforestry buffer areas as part of ANR helped increase income for local farmers in Burkina Faso

Outcomes. After eight years, tree abundance had increased five- to six-fold in fenced areas compared with areas outside the fences and species diversity had doubled. Trees grew faster and produced more fruit inside the fences. ANR contributed 21–23 percent of farmers' gross profit through the collection of non-wood forest products such as honey, fodder and seed oil. Tree regrowth enhanced biodiversity and reduced vulnerability to climate change. Farmers were actively engaged in the restoration process and protected the fenced areas from illegal wood cutting.

Case study 2. Farmer-managed natural regeneration in Timor-Leste

Context. Overgrazing and annual burning in the Aileu region of Timor-Leste led to declining soil fertility, decreased water-storage capacity, increased erosion and landslides. World Vision's Building Resilience to a Changing Climate and Environment project, implemented from 2011 to 2016, implemented FMNR to address these issues. Before the project, slash-and-burn agriculture was common in Aileu, but a growing population combined with reduced forest area made this practice unsustainable.[3]

Implementation. FMNR was implemented as a holistic land management strategy to improve farming and sustain livelihoods. Key implementation features were demonstration plots, community training, and the supplementation of natural regeneration with tree-planting to achieve specific outcomes (e.g. fruit, fodder and timber production). The strategy for promoting FMNR involved identifying the main environmental problems faced by communities and how changes in practice could solve them.

Outcomes. More than 50 ha of forests was restored in demonstration plots, with greater improvement achieved on private land. Forest cover, biodiversity and soil fertility had all increased after one year and soil erosion had declined. A decrease in vegetation burning and the adoption of slash-and-mulch practices created darker, richer soils and enabled trees of various native species to regenerate. After five years, FMNR had led to the better management of natural resources, increased forest cover and improved methods of conflict resolution. The rate of uptake by farmers was very high. More than 90 percent of farmers who were aware of the new land management technique adopted elements of FMNR, and they continued to implement these practices after the project ended. Farmers also reported increases in income because of higher vegetable, fruit and livestock production, and women reported an increase in shared decision-making. Across 51 ha in 46 community demonstration plots and an additional 50 ha of private land, 12 000 people benefited from the positive impacts of FMNR.

Forest restored through FMNR implemented by local farmers in Timor-Leste

Case study 3. Restoring the Danao watershed through assisted natural regeneration

Context. Increasing population pressure rendered traditional slash-and-burn agriculture unsustainable in the Danao watershed in Bohol, the Philippines, leading to deforestation and land degradation. The fire-prone grass *Imperata cylindrica* became dominant and inhibited natural forest recovery in the area. In 2006, FAO, the Department of Environment and Natural Resources of the Philippines, the Bagong Pagasa Foundation, local organizers and local governments initiated an ANR project in the Danao municipality with the aim of restoring a degraded and deforested watershed area and thereby demonstrating the potential of ANR as a forest restoration strategy. Initially, stakeholders were unaccustomed to using ANR, and government authorities at multiple levels were reluctant to change from conventional tree-planting. Considerable effort was required to encourage local stakeholders to participate, secure the support of local NGOs and educational institutions, and build local capacity.[4]

[3] The information in this case study was obtained from FMNR (undated); Rinaudo (2014); World Vision Timor Leste (2016); T. Rinaudo, personal communication, December 2019; G. Goncalves de Oliveira, personal communication, July 2020.

[4] The information in this case study is based on Castillo (2018); de la Torre (2009); Dugan *et al.* (in press); FAO (2011); FAO (2019).

Implementation. ANR was implemented on a 25-ha demonstration plot. Interventions included establishing firebreaks, employing community members to conduct fire patrols, staking and protecting naturally regenerated seedlings and saplings, reducing competition from grasses by weeding and pressing,[5] and controlling grazing and woodfuel-gathering. Farmers planted food crops in firebreaks to provide economic benefits during restoration. Over a three-year period, the implementation of ANR cost USD 579 per ha, compared with USD 1 048 per ha for a more conventional approach involving tree-planting.

Outcomes. Observable changes in biodiversity were evident within 18 months, most notably in grassland areas. Several tree species naturally regenerated in these areas, enhancing natural forest recovery. Community members obtained socio-economic benefits. Cash crops planted in firebreaks (e.g. cassava, bananas, pineapples and peanuts) generated income, and local people were paid to patrol and protect the areas against illegal harvesting, grazing, and fire. ANR activities also improved prospects for expanding ecotourism. The Danao site became a showcase for ANR success and feasibility around the world. Based on its success, an increasing number of government agencies, NGOs and donors in the region now recognize and recommend the implementation of ANR.

5 Pressing is a technique whereby grasses are pressed down by stepping on wooden boards with a rope tied to each end of the board draped over the shoulders of the user.

Case study 4. Assisted natural regeneration stimulates native tree recruitment in a subtropical rainforest ecosystem

Context. Uebel, Wilson and Shoo (2017) report on a research project conducted from 2005 to 2015 to determine effective low-cost approaches to enhancing natural regeneration. The study was conducted in the Numinbah Conservation Area in southeast Queensland, Australia. This area was settled in the 1870s and used for timber harvesting, dairy and beef production, and banana plantations. Invasive shrubs are abundant and suppress the recruitment of native vegetation in the area.

Interventions. Baseline conditions were measured at all sites. Grazing was halted at some sites for ten years, with some of those also subject to 4–6 years of herbicide control of non-native plant species to encourage the regeneration of native species. Vegetation surveys were conducted for more than ten years to quantify canopy cover and the recruitment of native tree and shrub species.

Outcomes. The control of non-native plant species facilitated successful native tree and shrub recruitment, increased species richness and significantly accelerated forest recovery relative to grazed and ungrazed-only sites. Nevertheless, restricting grazing alone was insufficient to stimulate the regeneration of native species.

WHEN TO APPLY ASSISTED NATURAL REGENERATION

The key to unlocking the full potential of natural regeneration in forest and dryland restoration lies in identifying those areas where ANR is likely to succeed, from both social (encompassing policy, economics, demographics, tenure and regulations) and ecological perspectives (Crouzeilles *et al*., 2019). These considerations include ensuring:

- an adequate density of existing natural regeneration of tree seedlings;
- the availability of seed inputs from nearby remnant forest patches or the soil seed bank;
- the ability to prevent or at least minimize human-induced disturbances, such as fire, grazing and the unsustainable harvesting of forest products;
- the presence of social support, with incentives and long-term benefits for the participation of local communities in forest restoration activities;
- a shared vision among local stakeholders of the objectives of restoration and clear land and resource tenure;
- the ability to negotiate outcomes across sectors operating in the area;
- a favourable policy and regulatory

A family presses down* Imperata cylindrica *grass around regenerating trees, a technique to prevent and reduce competition and the severity of fires

© LUKE SHOO

*A site at which ANR was implemented to restore degraded subtropical rainforest in the Numinbah Conservation Area, Queensland, Australia. The cleared site had been in pasture for at least 30 years. Grazing was excluded in 2005 and assisted regeneration was initiated in 2010. Before treatment, the site was dominated by non-native species, predominantly lantana (*Lantana camara*) thickets and wild tobacco (*Solanum mauritianum*)*

environment for restoration, and political will; and
- capacity, technical knowledge and support among local governments and civil-society organizations.

Modalities of assisted natural regeneration

ANR is a flexible and adaptable approach that can be applied in a variety of socio-economic and ecological contexts. Some of these are described below.

To accelerate and enrich forest regeneration on heavily degraded shrub/grasslands. This approach typically includes grass pressing, the liberation of desired tree seedlings, working with local communities to control external disturbances, and enrichment planting with tree species of economic, social or environmental value, depending on the specific restoration objectives (FAO, 2019; Wangpakapattanawong *et al*., 2010; Shono, Cadaweng and Durst, 2007). This approach can be applied to transform abandoned agricultural lands into regenerating forests that provide landowners and local communities with multiple benefits (Chazdon *et al*., 2020).

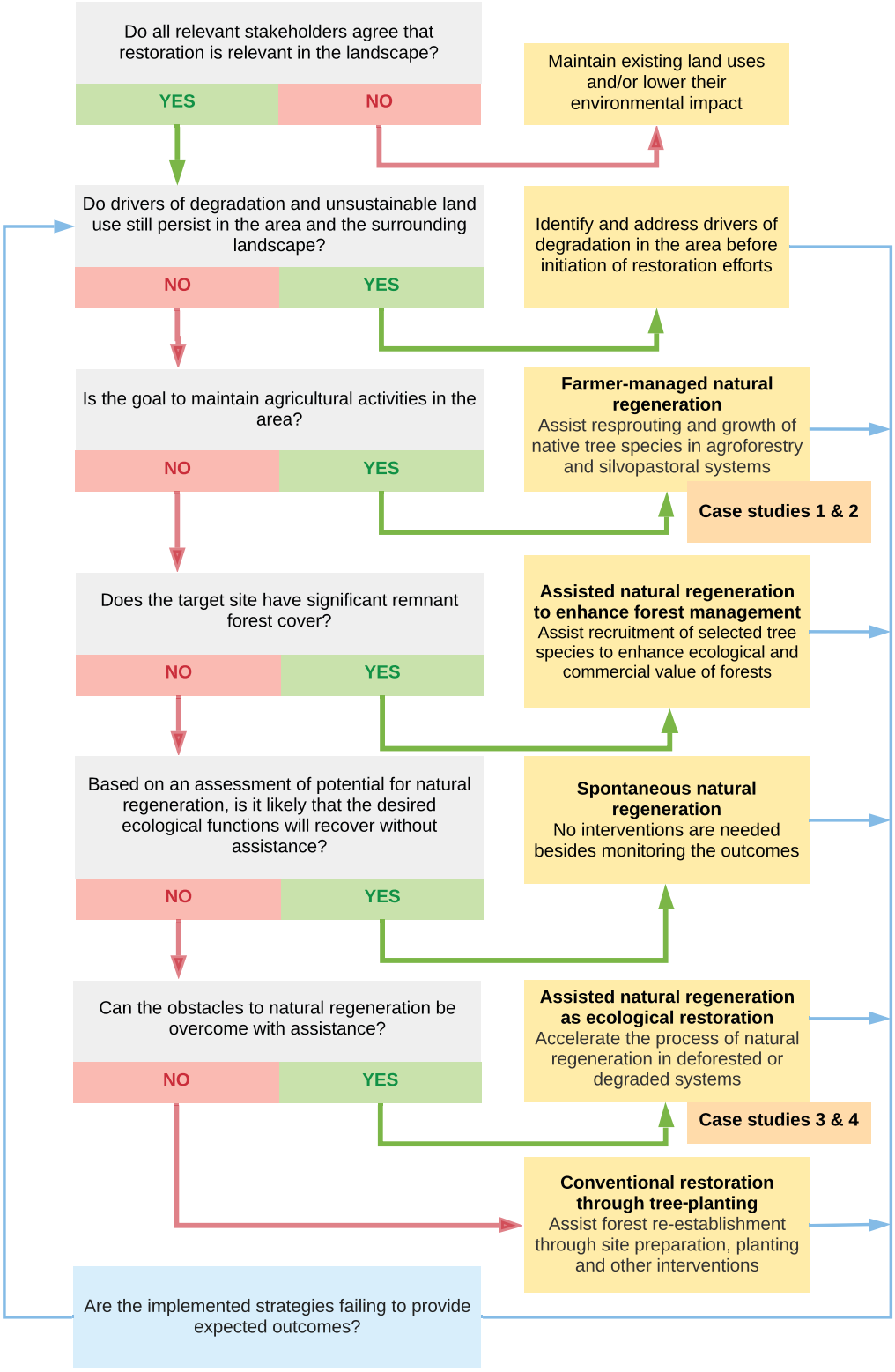
As a component of forest management. ANR can be part of forest management practices aimed at improving the environmental and commercial value of forest stands through thinning, the control of invasive species, enrichment planting, and the prevention of fires and other disturbances. This approach was used successfully to increase the growth of valuable timber species in degraded shrubby forests in Cambodia, where fire prevention, combined with the removal of competing vegetation such as vines and climbing bamboo, resulted in significant stand improvement (Chokkalingam *et al*., 2018). In the Philippines, a similar approach has been applied to remnant gallery forests to improve them and to gradually expand them into adjacent deforested areas. In China, the application of ANR in secondary forests resulted in significant increases in the supply of ecosystem services (Yang *et al*., 2018).

As a component of agriculture. ANR can be used to increase agricultural yields and as a component of agro-silvopastoral systems based on naturally regenerating trees and shrubs – also referred to as FMNR. Examples of successful FMNR in Africa (such as in case study 1) provide evidence of the increased production of staple crops, particularly in drought years, the alleviation of woodfuel shortages, and higher survival rates of livestock in dry years. Indigenous trees and shrubs that have regenerated provide habitat and food for wildlife, as well as greater access to wild foods and medicinal plants for local communities (United Nations, undated; Smale, Tappan and Reij, 2018; Reij and Garrity, 2016). In 2018, 34 years after FMNR was first introduced to the Miradi region of the Niger, it has been adopted on an estimated 7 million ha (Smale, Tappan and Reij, 2018). In Sumatra, Indonesia, ANR was applied on heavily degraded hillsides to establish agroforests, which provided communities with income from the sale of agroforestry products and carbon credits (Burgers and Farida, 2017).

Figure 1 illustrates a decision-making process that can be used to determine whether natural regeneration can be a viable restoration option for a given situation and, if so, whether it would need to be assisted and which modality of ANR would be applicable.

CONCLUSION

All successful forest restoration and forest management initiatives begin by developing a shared vision among key stakeholders and local people of the objectives of restoration and land-use management. If that vision includes a strong desire and appreciation for increasing the ecological functioning of forests and generating diverse socio-economic benefits, there will often be excellent prospects for integrating ANR into the management regime. ANR is particularly promising because of its relatively low cost, with ANR approaches



1 Decision tree to help determine when to use natural regeneration or assisted natural regeneration versus conventional restoration

typically requiring less than half the investment required for conventional reforestation.

ANR should be seen as one approach among many available to support forest and dryland restoration and management. Experience has demonstrated that ANR practices fit well with current principles underpinning landscape approaches to resource management. Various elements of ANR can be applied in different areas of typical landscape mosaics, such as to increase the regeneration of preferred species in degraded forests, improve agricultural yields through FMNR, and restore highly degraded sites at a relatively low cost.

Experiences in ANR around the world indicate that many of the requisites for successful ANR are identical to those needed for successful conventional reforestation and tree-planting, such as clear land tenure, supportive policies, benefits accruing to local stakeholders, and sound technical expertise. ANR may provide added benefits compared with conventional reforestation, however, by facilitating the development of more-species-diverse ecosystems (and consequently more diverse product lines) and regenerating sites with native species that are inherently well-adapted to local conditions at a considerably lower cost.

Efforts to scale up ANR globally to capture these advantages may require changes in mindsets, policies and practices (Chazdon *et al*. 2020). Greater awareness is needed among policymakers, extension workers, resource managers and the public of the potential of ANR – and that forests can be regenerated naturally without resorting to the planting of trees. In many instances, new policies will be needed to provide enabling conditions for the widespread application of ANR under various socio-economic (including cultural) and environmental conditions. To succeed, ANR also needs effective monitoring, and stakeholders need incentives to apply it that match those provided to catalyse conventional reforestation. Finally, given the necessity of engaging local stakeholders and winning their support for successful forest and dryland restoration and management, there is a critical need for creative field facilitators who are capable of working with multiple sectors and diverse political elements to motivate and support effective ANR across the full range of landscapes and contexts.

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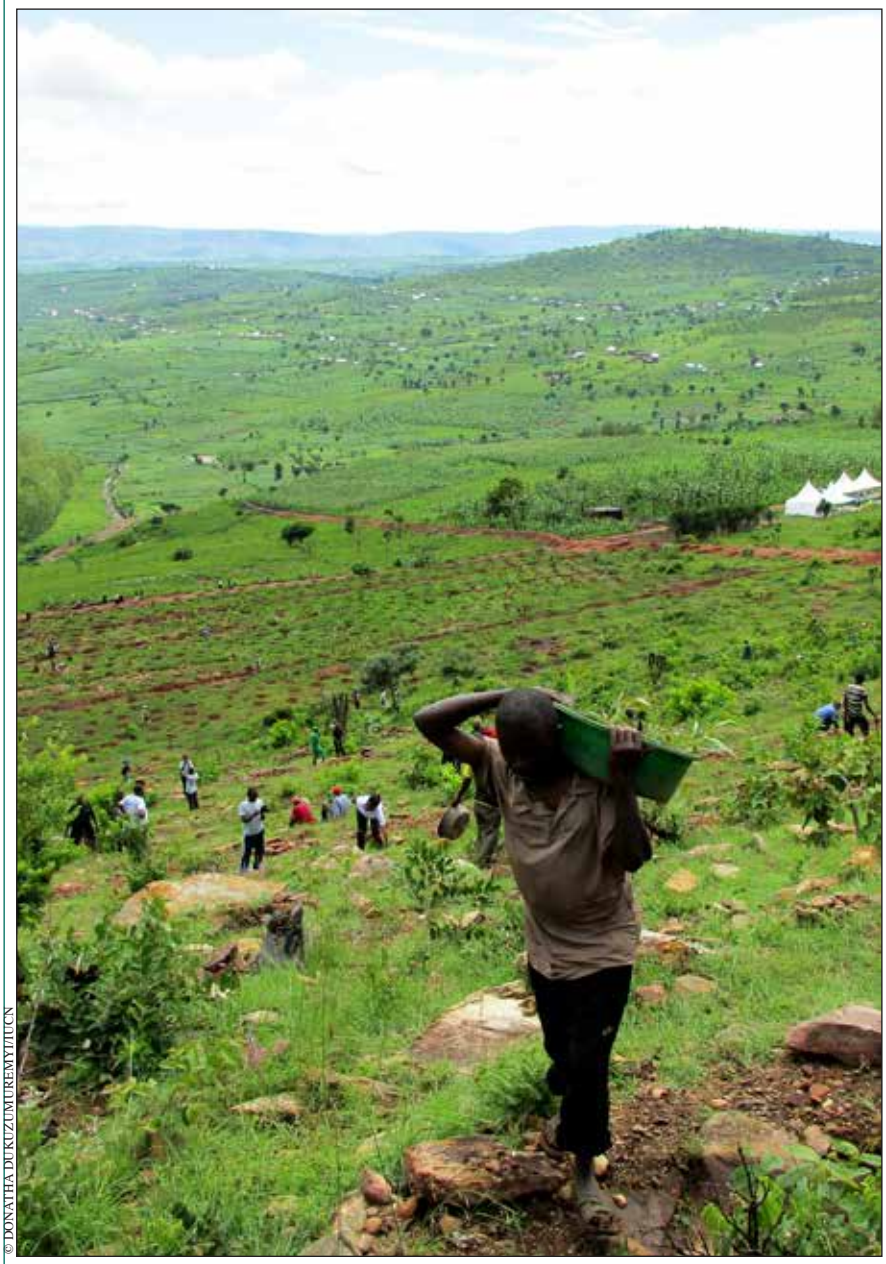
The Bonn Challenge: building momentum on restoration

C. Saint-Laurent, S. Begeladze, A. Vidal and S. Hingorani



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A large-scale tree-planting effort supported by the Government of Rwanda

Carole Saint-Laurent is Deputy Director, **Salome Begeladze** is Senior Programme Officer, **Adriana Vidal** is Senior Forest Policy Officer and **Swati Hingorani** is Project Knowledge and Impact Officer, all at the Forest Conservation Programme, International Union for Conservation of Nature, Gland, Switzerland.

This initiative to restore 350 million hectares is helping catalyse a global movement for repairing degraded landscapes.

The Bonn Challenge – the world's largest voluntary forest landscape restoration (FLR)[1] initiative – was launched in 2011. It built on a decade of work developing the FLR approach and milestones such as the launch of the Global Partnership on Forest Landscape Restoration in 2003 (GPFLR, 2003), the Petrópolis Challenge[2] in 2005 (IISD, 2005) and the London Challenge in 2009 (IUCN, 2016a). The Bonn Challenge is a global target to bring 150 million hectares (ha) of degraded and deforested lands into restoration by 2020 and 350 million ha by 2030 (IUCN, 2011).

The Bonn Challenge and its 2020 target were launched at a ministerial event hosted by the Government of Germany and the International Union for Conservation of Nature (IUCN), supported by the Global Partnership on Forest and Landscape Restoration. In 2014, the New York Declaration on Forests – which was signed

[1] Some organizations, including FAO, call this "forest and landscape restoration". The two terms have the same meaning and operate under the same principles.

[2] The first global Forest Landscape Restoration Implementation Workshop in April 2005 in Brazil, hosted by IUCN and the governments of Brazil and the United Kingdom of Great Britain and Northern Ireland, resulted in the Petrópolis Challenge, which is "to restore forest landscapes to benefit people and nature and contribute to reversing the trends of forest loss and degradation". In November 2009, the High-Level Roundtable on Forest Landscape Restoration, convened in London by IUCN and the Government of the United Kingdom of Great Britain and Northern Ireland, produced the London Challenge, raising political awareness about the role of restoration in addressing climate change (IISD, 2005; IUCN, 2016a).

by more than 100 governments, civil-society and indigenous organizations, and private enterprises – endorsed the Bonn Challenge target and triggered its extension to the 2030 target of 350 million ha.

The Bonn Challenge was designed as an implementation vehicle for addressing domestic priorities such as food security and rural development while simultaneously contributing to the achievement of international goals on climate change, biodiversity and land degradation neutrality. It is now also contributing to the Sustainable Development Goals, which were agreed in 2015.

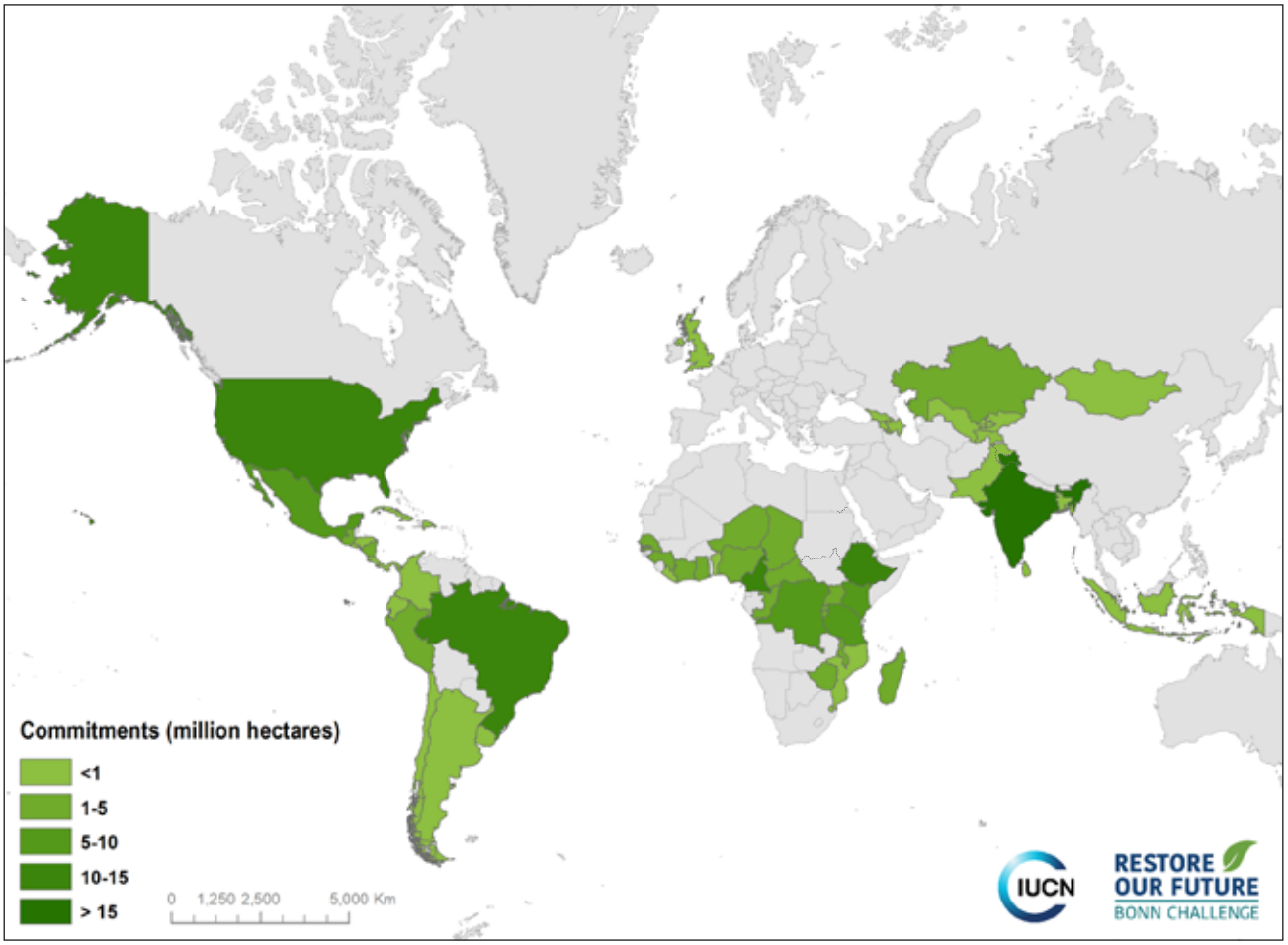
This article examines the way in which the Bonn Challenge has helped create global momentum for FLR and resulted in documented progress, assisted by the development of regional platforms. Reflections from active partners around the world point to success factors and future directions.

THE IMPETUS CREATED BY THE BONN CHALLENGE

The Bonn Challenge has spurred ambition and commitment. In its first two years, 18 million ha of pledges were announced by the Brazilian Mata Atlantica Restoration Pact, El Salvador, Rwanda and the United States of America, and the Convention on Biological Diversity's Hyderabad Call for a Concerted Effort on Ecosystem Restoration endorsed the Bonn Challenge's cause and goals. In 2013, the Restoration Opportunities Assessment Methodology (IUCN and World Resources Institute, 2014) was introduced to assist jurisdictions worldwide in defining and implementing restoration commitments. Building on the pioneering and unwavering support of the Government of Germany, the governments of Norway and the United Kingdom of Great Britain and Northern Ireland began investing in Bonn Challenge projects in 2014, followed in 2016 by the Global Environment Facility.

By the beginning of 2020, more than 170 million ha had been pledged by 63 countries, subnational governments and private organizations (Figure 1). At the third international Bonn Challenge high-level meeting in Brazil in 2018, Bonn

1 Commitments made by governments and other entities under the Bonn Challenge, as of May 2020



Source: adapted from Gozde Saral IUCN, 2020. Bonn Challenge – IUCN, ArcGIS HUB. Conforms to Map No. 4170 Rev. 19 UNITED NATIONS (October 2020)
Note: The map represents 63 pledges covering a total of 172.82 million ha.

Challenge country champion El Salvador sought the support of participating countries and organizations for the declaration of a United Nations Decade on Ecosystem Restoration in 2021–2030; the United Nations General Assembly adopted a resolution on this in March 2019 (Mollins, 2018; United Nations, 2019).[3]

Underlying the Bonn Challenge is the FLR approach, which is about "restoring forward" towards multifunctional landscapes in which trees and other woody plants contribute to meeting the needs of people and nature (rather than restoration that simply "looks back" to a historical state). IUCN and the Worldwide Fund for Nature coined the term FLR in 2000 (WWF and IUCN, 2000) in an effort to move people's thinking towards landscapes that can deliver multiple benefits simultaneously and to provide a basis for understanding and balancing trade-offs between land uses. FLR is directed at improving both ecological integrity and human well-being across landscapes. Seven FLR intervention types are counted under the Bonn Challenge (IUCN, undated). FLR results in a patchwork or mosaic of land uses including agriculture; agroforestry systems and improved fallow systems; ecological corridors; areas of forests and woodlands; and river or lakeside plantings to protect waterways.

Evidence of the value of the Bonn Challenge is seen in the accelerating pace of FLR implementation in developing and developed countries, the increasing diversity of partners supporting FLR, and the emergence of regional initiatives. As of early 2020, 50 national and subnational FLR opportunities assessments had been conducted or were under way across more than 1 billion ha of land – with the aim of ensuring that countries know where, how and with whom to restore, and what the expected economic and other benefits are (IUCN, undated).

[3] See article on page 119 of this edition for more information on the United Nations Decade on Ecosystem Restoration.

A national-level assessment of Guatemala's FLR opportunities, done as part of the country's plan to implement its Bonn Challenge pledge, formed the springboard for a national policy on FLR and a source for the design of projects for financing by the Green Climate Fund and the Global Environment Facility (Colomer *et al*., 2018). Moreover, FLR has been mainstreamed in the climate-change-related nationally determined contributions of many countries, including Benin, Brazil, Burundi, the Democratic Republic of the Congo, El Salvador, Guatemala, Honduras, India, the Lao People's Democratic Republic, Madagascar, Malawi, Panama and Sri Lanka.

Some Bonn Challenge partners have exceeded their commitments. For example, Pakistan's northern Khyber Pakhtunkhwa Province surpassed its pledge to plant 1 billion trees on 6 million ha under the Billion Tree Tsunami Project; its success has led to the creation of a nationwide "10 billion trees" programme.

The restoration barometer

The "Barometer" was launched in 2016 as the primary framework and tool for tracking progress on FLR pledges made under the Bonn Challenge (although its applicability to other ecosystems soon became apparent). The Barometer encompasses a comprehensive approach for building an accurate, credible and useful picture of progress by assessing two dimensions: "success factors" such as policies, institutional frameworks, financial flows and technical planning that create enabling conditions for FLR implementation; and "results and benefits", including the land area brought under restoration and the climate-change mitigation, biodiversity conservation and job-creation benefits associated with this.

The Barometer was subjected to in-depth piloting in 2018 involving intensive data gathering and consultations in five countries – Brazil, El Salvador, Mexico, Rwanda and the United States of America – complemented by the rapid application of a limited set of indicators in 13 other countries. In-depth application has now begun in Sri Lanka. According to the data gathered, the extent to which the pledged areas had been brought under restoration by the end of 2018 was 56 percent in the 13 rapid-application countries and 89 percent in the five pilot countries. For the latter group of countries, the predominant FLR strategies being applied to bring land under restoration are the improvement of degraded forest lands through silviculture and natural regeneration and the improvement of agricultural lands through agroforestry. Commercial plantations accounted for only 2.2 percent of FLR activities (Dave *et al*., 2019).

An additional 20 countries are being supported in 2020 to apply the Barometer to Bonn Challenge pledges, and the online platform will be available to all pledgers (IUCN, 2018a). The Barometer will increasingly incorporate data from other existing and emerging restoration monitoring tools, including those based on remote sensing, and it will report regularly on progress to 2030. The application of the Barometer in other ecosystems is being piloted in support of the United Nations Decade on Ecosystem Restoration. The next Barometer report will be published in 2021.

THE RISE OF REGIONAL PLATFORMS

Regional collaboration is playing an important role in advancing the Bonn Challenge. Although FLR implementation is a community-, government-, organization- or enterprise-led process, pledgers with similar or shared ecosystems and challenges can benefit significantly from belonging to a multistakeholder community of action in which they share experiences. Regional platforms provide spaces for participating countries and stakeholders to identify how FLR and the Bonn Challenge can be used to meet national and regional objectives, take stock of best practices and learning,

and generate networks and alliances of support.

Three regional collaborative platforms (hosted by intergovernmental or other international organizations) have been established in support of the Bonn Challenge: Initiative 20×20 in Latin America; the African Forest Landscape Restoration Initiative (AFR100); and ECCA30 for Europe, the Caucasus and Central Asia. The pledges made to, and progress achieved under, these regional platforms are counted in the Bonn Challenge (and vice versa).

In addition, regional series of high-level roundtables have been purpose-built to advance the Bonn Challenge in Africa; Latin America; Asia; and Europe, the Caucasus and Central Asia. Declarations emerging from these are evidence that political will is driving the restoration movement forward. Some existing regional processes have aligned their deliberations to support the Bonn Challenge, including in the Mediterranean and Asia-Pacific regions, as described below.

Regional platforms in Latin America and the Caribbean

Latin America and the Caribbean created the regional-platform model for FLR and the Bonn Challenge that has since been adapted for use in other regions. In 2015, El Salvador hosted the first high-level regional roundtable on the Bonn Challenge (CCAD and GIZ, 2015). Subsequent meetings were hosted by Panama (CCAD and GIZ, 2016), Honduras (CCAD and GIZ, 2017), Guatemala (CCAD and GIZ, 2018) and Cuba (International Climate Initiative, 2019). These created spaces for ministers and other high-level decision-makers to exchange views on issues of shared importance, including public incentives for implementing FLR at scale; forest governance; private investment; livelihood improvement through FLR; and, recently, a focus on adaptation and on projections for scaling up ecosystem restoration in the United Nations Decade on Ecosystem Restoration. Moreover, the Central American Integration System (SICA) has picked up on the region's interest in using FLR as a national development strategy through an initiative called Building Resilience in the SICA Region under a Synergistic Approach between Mitigation and Adaptation Focusing on the AFOLU [agriculture, forestry and other land use] Sector. This is a direct outcome of the action undertaken by regional stakeholders to raise the Bonn Challenge agenda regionally.

In addition to the high-level regional roundtables, Initiative 20×20 was launched at the twentieth Conference of

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Women prepare seedlings as part of a smallholder restoration effort in Guatemala

the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) in Lima, Peru, in 2014 with the aim of bringing 20 million ha of land into restoration by 2020 (World Resources Institute, 2020a) in support of the Bonn Challenge. The initiative has hosted annual meetings to connect governments, investors and technical partners to scale up FLR; financed technical studies; and supported the adoption of national restoration strategies, the organization of investment roundtables, and national interinstitutional groups working on restoration. Six ministers in Latin America and the Caribbean adopted the Declaration for Restoration at UNFCCC COP 25 in 2019, thereby committing to bringing 50 million ha under restoration by 2030 in support of the Bonn Challenge and the New York Declaration on Forests (World Resources Institute, 2020b). Seventeen countries in the region and three regional programmes have committed to begin restoring more than 50 million ha of degraded land by 2020 through Initiative 20×20. Initiative 20×20 is supported by 73 technical organizations and institutions and a coalition of 22 impact investors and private funds, which have already funded more than 100 projects on 20 million ha as contributions to the Bonn Challenge and Initiative 20×20.

Regional platforms in Africa

The first high-level African regional Bonn Challenge meeting in Rwanda in June 2016 brought together ministers from the East African Community. There, 14 countries endorsed the pan-African Kigali Declaration, the aim of which is to accelerate FLR interventions in support of the Bonn Challenge (IUCN, 2016b). In 2017, a high-level roundtable in Malawi triggered new pledges from Southern African Development Community countries and resulted in the Lilongwe Call for Action to reinforce ambitions in the Bonn Challenge (IUCN, 2017a). In 2017, at a roundtable in the Niger, the Niamey Call for Action endorsed both the Kigali Declaration and the Lilongwe Call for Action (IUCN, 2017a). In 2018, ministers at a roundtable of member countries of the Central African Forest Commission adopted the Common Strategy to Mobilize Funds to Implement the Bonn Challenge in Central Africa (COMIFAC, 2018). A ministerial roundtable of the Economic Community of West African States in October 2019 produced the Dakar Declaration on FLR, which calls for joint resource mobilization efforts and the adoption of the Barometer as a progress-tracking protocol (Anonymous, 2018). The momentum from these roundtables has helped countries mobilize funding – such as USD 30 million from the World Bank for implementation in Burundi and USD 25 million from the German International Climate Initiative to foster biodiversity conservation, climate-change resilience and better livelihoods through FLR in Cameroon, Kenya, Malawi and Rwanda.

In addition to the high-level regional roundtables, AFR100 was launched in 2015 as a region-wide effort to bring 100 million ha into restoration by 2030 (AFR100, undated). AFR100 contributes to the Bonn Challenge, the African Union Agenda 2063, the Sustainable Development Goals and other targets. It is Africa-owned and -led, with partner countries setting the agenda. To date, 30 African nations have committed to restoring 126 million ha of land with the support of 33 technical partners. Twelve financial partners have earmarked a total of USD 1.5 billion for FLR implementation in Africa. Since its launch, AFR100 has focused on securing political commitments and defining restoration strategies. It is now entering a second phase aimed at turning commitments and national strategies into action on the ground. This phase will be defined by the implementation of landscape-level FLR action plans, FLR monitoring systems, and mechanisms for unlocking private investment.

Regional platforms in Asia and the Pacific

The first Bonn Challenge high-level roundtable in Asia was held in Sumatra, Indonesia, in 2017, gathering together senior government representatives from 12 Asian countries as well as representatives of subnational jurisdictions, non-governmental organizations, donor

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The leader of a farmer-led tree-planting association in Thailand plants a seedling

agencies, international organizations and the private sector. The roundtable gave rise to 1.65 million ha of new pledges, making it a historic occasion at which total commitments to the Bonn Challenge surpassed the 150 million ha milestone. Participants addressed the need to draw in private-sector finance; the value of multistakeholder forums; and the need to better communicate the benefits of FLR for achieving rural-development, climate and biodiversity objectives. Governments called for increased regional cooperation, and this was further advanced at the South Asia subregional FLR technical workshop in India in 2018, at which participants focused on the need for national-level funding for FLR across ministries and for state-level FLR strategies to contribute to national restoration targets. In 2019, 12 countries gathered in Thailand for the second Asia high-level Bonn Challenge roundtable, which prioritized action on capacity development, the capturing of practical lessons through additional director-level dialogues, and embedding the Bonn Challenge in the mechanisms of the Association of South East Asian Nations. Additionally, the roundtable generated interest in adapting FLR to contexts such as urban landscapes, steppes and taiga (IUCN, 2017b; IUCN Asia, 2019).

In the Pacific, the 2015 Forest Ministerial Talanoa, facilitated by the Pacific Islands Development Forum, the Secretariat of the Pacific Community and IUCN, called for a regional framework to give effect to the goals of FLR and for a "Pacific pledge" on forest restoration aligned with the Bonn Challenge.

The 2017 session of the Asia-Pacific Forestry Commission (an FAO statutory body) in Colombo, Sri Lanka, produced the Regional Strategy and Action Plan for Forest and Landscape Restoration in Asia-Pacific, which was officially endorsed by all Commission representatives. The aim of the strategy is to guide collective actions to promote FLR in the region (FAO and AFPNet, 2018). In line with it, FAO and partners have been working to formulate projects, mobilize financing, develop capacity and raise awareness on FLR. The strategy is a key means for coordinating public, private and civil-society stakeholders in the Asia-Pacific region in setting FLR targets (where these do not yet exist, such as in the Pacific) and achieving them. Additional avenues exist for increasing regional cooperation on the Bonn Challenge in the Asia-Pacific region, such as the Asian Forest Cooperation Organization and the Asia-Pacific Network for Sustainable Forest Management and Rehabilitation.

Regional platforms in Europe, the Caucasus and Central Asia

The first ministerial roundtable on FLR and the Bonn Challenge in the Caucasus and Central Asia, held in Astana (now Nur-Sultan), Kazakhstan, in June 2018, was organized by the Kazakhstan Ministry of Agriculture, the United Nations Economic Commission for Europe (UNECE) and FAO in cooperation with IUCN. Six countries pledged to restore more than 2.5 million ha (IUCN, 2018b). Seven countries adopted the Astana Resolution, committing to the strengthening of partnerships and regional cooperation to accelerate the implementation of Bonn Challenge pledges and calling for policy dialogues, forest policy development and joint programming (UNECE, 2018). The Astana Resolution also requested countries to assess their efforts by aligning with the Barometer and voluntarily monitoring and reporting

The first ministerial roundtable on FLR and the Bonn Challenge in the Caucasus and Central Asia, Kazakhstan, 2018

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progress on FLR pledges. A ministerial regional roundtable is planned for East and Southeast Europe in 2021 to further raise ambition and increase FLR.

Also in support of the Bonn Challenge, ECCA30 – a country-led initiative to bring 30 million ha into restoration in Europe, Caucasus and Central Asia by 2030 – was launched by IUCN, UNECE, FAO, the World Bank and the World Resources Institute at the United Nations Secretary-General's Climate Action Summit in September 2019 (IUCN, 2019a). To date, eight countries have committed to restoring nearly 3 million ha under this initiative (IUCN, 2019b). ECCA30 was built on the Astana Resolution, committing the region to go beyond 3 million ha and to strengthen partnerships and regional cooperation across a broader region that includes Europe. The aim is to accelerate progress on national goals and international priorities (e.g. the Bonn Challenge, the Astana Resolution, the Paris Agreement on climate change, land degradation neutrality and the Sustainable Development Goals); catalyse domestic, regional and global funding; build a profile and show leadership at regional and global events; provide access to technical support and track progress on implementation using the Barometer; and facilitate the convening of regional and international learning exchanges.

The Agadir Commitment, which aims to restore at least 8 million ha by 2030, was endorsed by ten countries (Algeria, France, Iran (Islamic Republic of), Israel, Lebanon, Morocco, Portugal, Spain, Tunisia and Turkey) in March 2017 at Mediterranean Forest Week in Agadir, Morocco, under the umbrella of the Committee on Mediterranean Forestry Questions-Silva Mediterranea (an FAO statutory body) (FAO, 2017). The intent of the Agadir Commitment is to improve efforts on FLR, land degradation neutrality and biodiversity conservation in the Mediterranean region and to support the achievement of the Bonn Challenge and Sustainable Development Goal 15.

IMPACTS OF THE BONN CHALLENGE AND ITS REGIONAL PLATFORMS

The Bonn Challenge has catalysed and provided recognition to the commitment of people and institutions around the world on FLR (as summarized in Table 1), further raising their ambitions and scaling up their efforts. According to Bianca Jagger, IUCN's Bonn Challenge Ambassador, the Bonn Challenge is "a cohort of visionary governments and other entities who have recognized that restoring degraded and deforested landscapes is critical to improve people's lives by achieving poverty reduction and livelihoods generation while also generating benefits for biodiversity and combating climate change" (Scottish Government, 2018).

The success of the Bonn Challenge – as indicated by the status of pledges and rate of implementation and by the growing extent of national, regional and international deliberations on restoration – is a good measure of the political will and support for and engagement of diverse actors at all levels in restoring degraded and deforested lands.

Regional approaches encourage cooperation and partnerships where there is a bond based on physical proximity and ecosystem and economic interdependence and integration. The objectives and themes vary, reflecting diverse and changing contexts. Major themes around the implementation of Bonn Challenge pledges include climate resilience and food security in Africa, rural development and nationally determined contributions in Asia, and climate change, biodiversity and a low-carbon economy in Europe, the Caucasus and Central Asia. Regional multilateral dialogues on FLR – particularly within a global framework such as that provided by the Bonn Challenge – are a promising way to identify and implement solutions that can be replicated and implemented at scale to address crucial issues shared within regions.

Table 1. Bonn Challenge quick facts, May 2020

No. of pledgers to the Bonn Challenge	63
No. of hectares pledged to be brought under restoration	172.82 million
Regional initiatives in support of the Bonn Challenge	Initiative 20×20 in Latin America AFR100 in Africa ECCA30 in Europe, Caucasus and Central Asia
Regional series of high-level Bonn Challenge roundtables	Latin America (since 2015) Africa (East African Community, Southern African Development Community, Central African Forests Commission, Economic Community of West African States) (since 2016) Asia (since 2017) Europe, the Caucasus and Central Asia (since 2018)
Regional processes or events adopting plans or strategies supportive of the Bonn Challenge	Forest Ministerial Talanoa meeting (2015) Committee on Mediterranean Forestry Questions (2017) Asia-Pacific Forestry Commission (2017)
No. of restoration opportunities assessments made to support the definition and implementation of pledges	Completed – 27 (12 in Africa; nine in Latin America and the Caribbean; and six in Asia) Ongoing – 23 (12 in Africa; eight in Latin America and the Caribbean; and three in Asia) Upcoming – 10+ Applied over more than 0.5 billion ha
No. of countries applying the Barometer	19 countries (2018) 40 countries (2020–2021)

Regional platforms are influencing the generation and implementation of Bonn Challenge pledges. Through them, says Jesus Guerra in Cuba's Ministry of Science, Technology and Environment, "ministers have had the chance to share updates on the status of implementation of restoration action in their countries, delving into the challenges connected with enabling conditions from economic, policy, and social aspect" (J. Guerra, personal communication, May 2020). The World Bank's Paola Agostini says regional platforms also help to "direct the attention of policymakers to the cost of inaction related to land degradation; the value of landscape restoration activities for the economy; and the need to invest in landscape restoration" (P. Agostini, personal communication, May 2020). According to the Government of Uzbekistan's Abduvokhid Zakhadullaev, "the volume of work on FLR in Uzbekistan has increased almost ten times" since the ministerial roundtable on FLR and the Bonn Challenge in the Caucasus and Central Asia in June 2018. "Uzbekistan has restored more than 1 560 000 ha of forest landscapes, thus already fulfilling its Bonn Challenge pledge" (A. Zakhadullaev, personal communication, May 2020).

The voluntary regional platforms offered by the Bonn Challenge enable open discussions and exchanges and the building of networks of support; they are also sufficiently flexible and inviting for countries and stakeholders to participate in. The regional platforms serve as windows through which governments can see action taken elsewhere, increasing their own ambition to rise to the challenge and show regional leadership.

The participation of the Rio conventions in the meetings organized under the auspices of these voluntary regional platforms has reinforced the usefulness of Bonn Challenge pledges to global goals. The secretariats of the conventions responsible for the Aichi Biodiversity Targets, nationally determined contributions and land degradation neutrality targets are represented at Bonn Challenge roundtables to provide guidance on better integration and more comprehensive yet streamlined reporting (IUCN, 2018c; Gichuki *et al*., 2019; Beatty *et al*., 2020).

The Bonn Challenge is helping build bridges across constituencies and institutions in countries and regions. According to the United Nations Convention to Combat Desertification (UNCCD)'s Jamal Annagylyjova, processes originating from various international conventions and agreements are not always addressed coherently at the ministerial level, leading to the replication of strategies and poor joint planning. "LDN [land degradation neutrality] and the Bonn Challenge jointly could help to build a cross-sectoral dialogue and implement national ecosystem restoration commitments" (J. Annagylyjova, personal communication, May 2020).

Regional platforms can help unlock financial resources and international support. For example, ECCA30 is helping countries attract financial resources from multilateral banks and donors and facilitating coordination among development partners (P. Agostini, personal communication, May 2020). The regional platforms are expanding learning and global knowledge to new countries. According to Jesus Guerra, a key factor in the effectiveness of the regional initiatives is that they bring countries together that face similar challenges, and it is therefore "critical and strategic to be able to reflect on shared approaches to tackle them" (J. Guerra, personal communication, May 2020).

LESSONS LEARNED AND FUTURE DIRECTIONS

A success factor in the Bonn Challenge is the ability to shape annual regional and subregional meetings to address the most pressing issues arising as countries scale up actions to implement FLR. For example, the 2019 Bonn Challenge ministerial roundtable in Cuba "had significant participation, for the first time, of Caribbean countries, which tilted the dialogue to aspects of vulnerability and climate-change adaptation entrenched in landscape restoration responses" (J. Guerra, personal communication, May 2020).

Regional platforms are also more valuable when they make linkages across institutions, sectors and goals for greater impact. For example, national decision-makers, experts and practitioners could use data produced for UNCCD reporting and the Barometer to exchange geospatial data, information on financial flows and on-the-ground implementation success stories. Joining forces could help increase national capacity in the assessment and monitoring of land degradation (J. Annagylyjova, personal communication, May 2020).

As we head towards 2021 and the start of the United Nations Decade on Ecosystem Restoration, there is a great opportunity for the Bonn Challenge process and its contributing regional platforms to provide a model for aspiring actors to embrace or reinforce restoration efforts in other ecosystems, such as wetlands and coral reefs. According to Tangu Tumeo at Malawi's Department of Forestry, the Bonn Challenge and its platforms can "help in upscaling and movement building for greater impact" (T. Tumeo, personal communication, May 2020). Jesus Guerra says they could also help increase cross-sectoral responses to the climate, biodiversity and development agendas by creating space for guiding these processes and identifying new pathways in the means of implementation (J. Guerra, personal communication, May 2020).

In coming years, the Bonn Challenge and its regional platforms will promote the participation of all actors, across levels and ecosystem types, to steepen the curve of implementation. Alongside expanded monitoring and tracking, this will generate more visibility of the progress being made, which will, in turn, influence and motivate higher ambitions among governments and stakeholders.

The Bonn Challenge and its regional platforms have brought countries together to demonstrate political will, openly share data and restoration knowledge, and identify ways forward for joint programming and fundraising. Driving these global and

regional platforms is recognition that collaborative efforts are needed to support countries in delivering transformative change for people and the landscapes in which they live. When the Bonn Challenge 2030 target of 350 million ha is achieved, it will be due to massive collaborative efforts for transformational change – sustaining the future, conserving biodiversity, mitigating climate change and safeguarding ecosystems.

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Forest and landscape restoration: enhancing synergies between the Rio conventions

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The restoration of degraded landscapes contributes to many of the goals and targets of the three conventions.

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Note: This article reflects the opinions of the authors and not of their respective organizations.

The objectives of the three Rio conventions are to respond to the climate crisis (United Nations Framework Convention on Climate Change – UNFCCC); conserve, sustainably use and equitably share the benefits of biodiversity (Convention on Biological Diversity – CBD); and combat desertification, land degradation and drought (United Nations Convention to Combat Desertification – UNCCD). The three conventions are intrinsically linked (Millennium Ecosystem Assessment, 2005): many efforts have been made to improve alignment in the implementation of these international policy frameworks (UNEP, 2016), but there is an ongoing need to further identify and build on opportunities for collaboration, cooperation and coordination.

All three conventions acknowledge the contributions that the conservation, restoration and sustainable use of forests and other terrestrial ecosystems make to their objectives: such ecosystems act as carbon sinks, provide services to people and habitats for a wide range of species, and alleviate land degradation and desertification. Recently, ecosystem restoration has received renewed attention through the United Nations Decade on Ecosystem Restoration,[1] which has four objectives to

[1] Resolution adopted by the United Nations General Assembly at its seventy-third session on 1 March 2019, A/RES/73/284, available at https://undocs.org/pdf?symbol=en/A/RES/73/284. See article on page 119 of this edition for more information on the Decade.

Above: A worker tends a seedling in a forest nursery at the Centre National de Semences Forestières, Niamey, the Niger. The restoration of degraded forest landscapes can enhance synergies between the three Rio conventions

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Seedlings grown for use in restoration, Mata Atlantica, Brazil

support and scale up efforts to prevent, halt and reverse ecosystem degradation. The successful restoration of degraded ecosystems has the potential to contribute to the objectives of all three Rio conventions.

Forest and landscape restoration (FLR) (Box 1),[2] which was conceptualized in the early 2000s, has generated benefits in multiple geographies (WWF, 2018; Dave, 2019) and offers an opportunity to synergistically contribute to the objectives of the Rio conventions. This article summarizes relevant decisions under the three conventions on the topic of synergies, some of them specific to forest ecosystems. It describes how FLR supports this call for synergistic approaches as well as for specific ecosystem-based actions and approaches under each of the conventions. And it examines how FLR can provide a common entry point for the setting of coherent national targets under the Rio conventions, help unlock financing, and streamline the reporting of progress on the interrelated objectives of the conventions.

[2] This article uses the term "forest and landscape restoration" following Besseau, Graham and Christophersen (2018). Some organizations prefer "forest landscape restoration". The two terms have the same meaning.

RESTORATION AS A MEANS TO ENHANCE SYNERGIES AMONG THE RIO CONVENTIONS

Held in 1992, the Rio Summit saw the birth of three "Rio" conventions addressing the interrelated issues of climate change, biodiversity and desertification (Box 2). Synergies in their work, including actions to be implemented in forests and other terrestrial ecosystems, have been promoted through various decisions made by conferences of the parties (COPs) to these conventions. The most recent of these decisions (for each convention) are as follows:

- In 2018, recognizing the importance of collaboration and cooperation among conventions, the CBD COP welcomed previous work on synergies and requested the consideration of actions to enhance these, including actions among biodiversity-related conventions based on the roadmap proposed by the CBD Executive Secretary. The COP noted that the congruence among forest-related multilateral commitments and the Aichi Biodiversity Targets offered opportunities for further action to achieve the targets in a mutually supportive manner, including with regard to forest restoration (CBD, 2018).
- The UNFCCC COP urged relevant international organizations, non-governmental organizations and stakeholders to integrate and coordinate their efforts on REDD+ activities[3] to avoid duplication and to enhance synergies in regard to these activities (UNFCCC, 2009, 2010).
- The UNCCD COP invited Parties that have committed to voluntary land degradation neutrality (LDN) targets to implement measures to accelerate their achievement, as appropriate, by fostering synergies among the Rio

[3] REDD+ refers to reducing emissions from deforestation and forest degradation, the conservation of forest carbon stocks, the sustainable management of forests and the enhancement of forest carbon stocks (UNFCCC, 2010).

Box 1
What is forest and landscape restoration?

FLR is a process that aims to regain ecological functionality and enhance human well-being in deforested or degraded landscapes (Besseau, Graham and Christophersen, 2018). FLR is not an end in itself but, rather, a means of regaining, improving and maintaining vital ecological and social functions, in the long term leading to more resilient and sustainable landscapes (IUCN and World Resources Institute, 2014). Forest landscapes include a variety of ecosystems in which trees play a role, including natural ecosystems such as forests and mangroves as well as managed ecosystems. FLR is underpinned by six principles: 1) focus on landscapes; 2) maintain and enhance natural ecosystems within landscapes; 3) engage stakeholders and support participatory governance; 4) tailor to the local context using a variety of approaches; 5) restore multiple functions for multiple benefits; and 6) manage adaptively for long-term resilience (Besseau, Graham and Christophersen, 2018). FLR is implemented through restoration interventions that effectively address the drivers of deforestation and land degradation, meet present and future needs, and offer multiple benefits and land uses over time (IUCN, 2017a). Such interventions include natural regeneration, silviculture, planted forests and agroforestry and other actions that respond to the specific characteristics of a landscape (IUCN and World Resources Institute, 2014).

conventions and other multilateral environmental agreements, including the consideration of joint programming activities at the national and subnational levels (UNCCD, 2019).

FLR has the potential to contribute to the mandates of the Rio conventions and capitalize on synergistic approaches pertaining to forests and other terrestrial ecosystems. Below, we present evidence of existing entry points for FLR for advancing the goals of the Rio conventions.

Potential of restoration to contribute to the Convention on Biological Diversity

The concept of ecosystem restoration is embedded in the text of the CBD as well as in multiple decisions and in its work. Article 8(f) of the CBD calls on Parties to "rehabilitate and restore degraded ecosystems and promote the recovery of threatened species". In 2012, a decision of the CBD COP emphasized the importance of ecosystem restoration and called for scaled-up action (CBD, 2012). In 2016, the CBD COP adopted the Short-Term Action Plan for Ecosystem Restoration (STAPER) (CBD, 2016a) as a contribution to (among other things) reversing the loss of biodiversity, improving ecosystem resilience, and achieving the objectives of other conventions. The STAPER encourages ecosystem restoration across all types of habitat, biomes and ecosystems, on a range of scales, within a mosaic of land uses, for a range of purposes, and with different actors.

FLR interventions seek to balance outcomes for both people and nature where the improvement of conditions that support biodiversity is a natural outcome of achieving a given FLR objective (Beatty, Cox and Kuzee, 2018). FLR is implemented predominantly in managed ecosystems that are often geographically near to areas considered high priority for conservation purposes. In that context, FLR presents an opportunity to address degradation and deforestation challenges, improve ecological productivity, reduce pressure on natural ecosystems, and find landscape-level solutions to enhance biodiversity (Beatty, Cox and Kuzee, 2018). Thus, FLR is aligned broadly with the objectives of ecosystem restoration. FLR principles have various possible points of connection with the principles set out in the STAPER. For example, the STAPER outlines that restoration is a complement to conservation activities; priority should be given to conserving biodiversity and preventing the degradation of natural habitats and ecosystems by reducing pressures and maintaining ecological integrity and the provision of ecosystem services; and restoration activities should be consistent with the provisions of the convention (CBD, 2016a). In its STAPER decision, the CBD COP provided guidance for biodiversity considerations in ecosystem restoration (e.g. avoid the afforestation of grasslands and ecosystems with low tree cover), and, in a later decision, it invited Parties to consider the relevance of these in the design and implementation of FLR programmes (CBD, 2018).

Box 2
The Rio conventions

The CBD has three objectives: the conservation of biodiversity; the sustainable use of its components; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. The United Nations General Assembly endorsed the Strategic Plan for Biodiversity 2011–2020 and its 20 Aichi Biodiversity Targets as a universally agreed framework for action on biodiversity and a foundation for sustainable development for all stakeholders. Accordingly, Parties set targets in their national biodiversity strategies and action plans. The post-2020 Global Biodiversity Framework (Box 3) is under development; once adopted, Parties will be invited to revise or develop their national plans in that light.

The goal of the UNFCCC is to address climate change by stabilizing greenhouse-gas concentrations to prevent dangerous anthropogenic interference with the climate system. The Paris Agreement on climate change, which builds on the UNFCCC (UNFCCC, 2015), holds the ambition of further enhancing global actions to address the threat of climate change by keeping the global average temperature rise below 2 °C above pre-industrial levels and limiting the temperature increase even further to 1.5 °C. The Paris Agreement emphasizes the importance of cooperation among countries in both their mitigation and adaptation actions and activities in order to reach the agreed goal. It also calls on Parties to communicate their NDCs, which contain the climate goals and activities of countries and are to be updated every five years to demonstrate increased ambition.

The UNCCD is the sole legally binding international agreement on land issues explicitly linking environment and development to sustainable land management. The UNCCD aims to improve the living conditions of people in drylands, maintain and restore land and soil productivity, and mitigate the effects of drought. The 2018–2030 Strategic Framework, adopted at UNCCD COP 13 (UNCCD, 2017), sets a global commitment to achieve LDN.

Potential of restoration to contribute to the climate-change convention

The UNFCCC recognizes the role of the agriculture, forestry and other land-use (AFOLU) sector in the mitigation of, and adaptation to, climate change.[4] One of the most important frameworks recognizing the role of the AFOLU sector agreed under the convention is that pertaining to REDD+, in which the COP encourages developing countries to undertake mitigation actions in the forest sector on a voluntary basis by reducing emissions from deforestation; reducing emissions from forest degradation; conserving forest carbon stocks; enhancing forest carbon stocks; and sustainably managing forests.

FLR interventions such as assisted or natural regeneration and reforestation are likely to contribute most directly to REDD+. FLR interventions such as restoring the productivity of degraded agricultural land while avoiding the further conversion or degradation of forests have the potential to contribute to all other REDD+ activities. The Warsaw Framework for REDD+ calls for the following principles or "safeguards" to be "addressed and respected" through REDD+ activities: the conservation of natural forests and biological diversity; the protection and conservation of natural forests and their ecosystem services; and the enhancement of other social and environmental benefits. REDD+ safeguards encourage countries to identify appropriate synergies with their actions mandated under the other Rio conventions.

[4] As recognized in the preambular text of the UNFCCC and the Paris Agreement, specifically in Article 4, paragraph 1(d) of the UNFCCC and Article 5 of the Paris Agreement.

Box 3
The Convention on Biological Diversity and the post-2020 Global Biodiversity Framework

The CBD COP will adopt, at its 15th meeting, the post-2020 Global Biodiversity Framework towards achieving the 2050 vision of "living in harmony with nature". This framework is being developed under a fully participatory approach, including a global consultation workshop on ecosystem restoration (CBD, 2019, 2020a). The consultation workshop proposed elements to consider in the development of potential goals, targets and indicators and related monitoring and reporting. Ecosystem restoration is expected to play a key role in the post-2020 Global Biodiversity Framework. Draft targets include the following: "retain and restore freshwater, marine and terrestrial ecosystems, increasing by at least [50%] the land and sea area under comprehensive spatial planning addressing land/sea-use change, achieving by 2030 a net increase in area, connectivity and integrity and retaining existing intact areas and wilderness" (CBD, 2020b).

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Mangrove restoration, Thailand

Beyond REDD+, carbon removals and emission reductions from restored forest landscapes could be among the mitigation actions of other interventions in the AFOLU sector. For example, FLR can be used to promote agroecological practices involving trees (such as agroforestry) that generate carbon removals (UNFCCC, 2016). Restoring landscapes through FLR also generates crucial benefits for adaptation, such as by reducing the vulnerability of ecosystems and forest-dependent communities to the impacts of climate change via climate-smart restoration and management approaches such as restoration using climate-change-resilient species (Rizvi *et al*., 2015).

Potential of restoration to help combat desertification

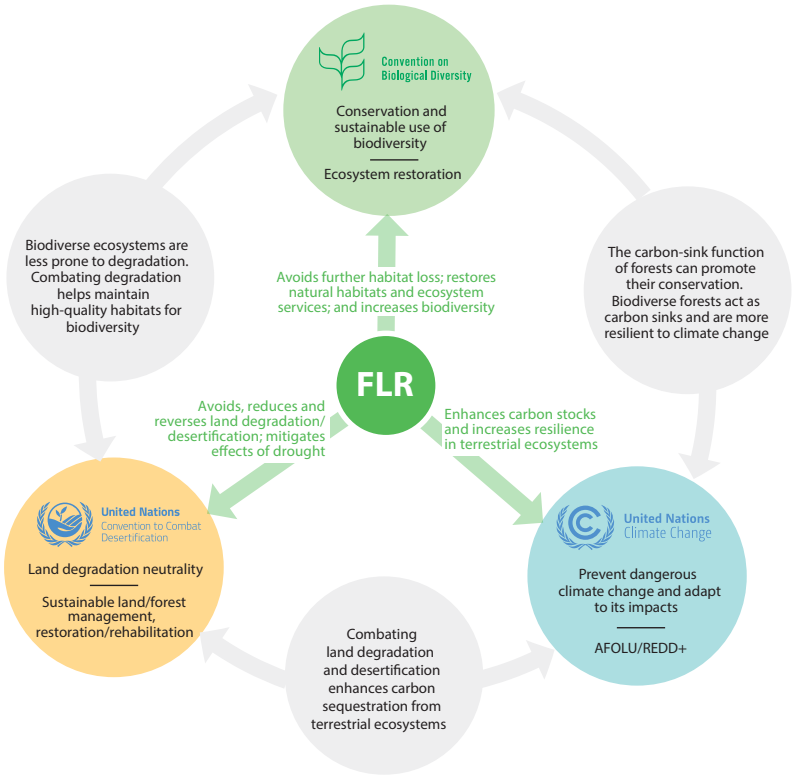
Under the UNCCD, achieving LDN requires keeping the land in balance by avoiding, reducing and reversing land degradation, as per the LDN approach and response hierarchy (Orr *et al*., 2017). In the LDN framework, complementary actions should be applied to avoid or reduce land degradation (through sustainable land management – SLM – and sustainable forest management – SFM) and to reverse land degradation (through restoration and rehabilitation) (Box 4). Most FLR interventions contribute to the implementation of SLM and SFM approaches at a large scale and help maintain ecosystem services (Orr *et al*., 2017).

Figure 1 summarizes the synergies between the land-use-related targets and mechanisms of the Rio conventions and how FLR can contribute to these.

PATHWAYS FOR SYNERGIES BETWEEN THE RIO CONVENTIONS THROUGH RESTORATION

FLR's capacity to deliver multiple benefits and tackle the challenges addressed by the Rio conventions can be translated into specific pathways of action, from three

1 Synergies between the objectives of the Rio conventions and potential contributions of forest and landscape restoration under each



Note: FLR = forest and landscape restoration; AFOLU = agriculture, forestry and other land use; REDD+ = reducing emissions from deforestation and forest degradation, the conservation of forest carbon stocks, the sustainable management of forests and the enhancement of forest carbon stocks.

Box 4
Implementing land degradation neutrality

The Global Mechanism of the UNCCD and its international partners developed the Land Degradation Neutrality Target Setting Programme (LDN-TSP) to support countries in establishing national voluntary targets for LDN. To date, 123 countries have participated in the LDN-TSP and more than 80 have established voluntary LDN targets. The LDN approach encourages countries to pursue an optimal mix of measures designed to avoid, reduce and reverse land degradation to achieve a state of no net loss of healthy and productive land across sectors and relevant policies, including biodiversity conservation (Global Mechanism of the UNCCD and CBD, 2019), climate change (Global Mechanism of the UNCCD and UNFCCC, in prep.[a]), and land-use planning (Global Mechanism of the UNCCD and UNFCCC, in prep.[b]). Moving forward towards the implementation of the LDN targets, the Global Mechanism has started assisting countries to develop gender-responsive transformative projects and programmes, including FLR interventions, by providing tailored support in the early stages of project preparation.

perspectives: 1) the setting of coherent national targets; 2) the unlocking of finance for national implementation; and 3) the streamlining of reporting on progress towards interrelated objectives.

Restoration as an entry point for integrated national targets

Ecosystem-based targets and actions are an important part of national contributions to achieving the objectives of the Rio conventions. For example, links between land and climate are reflected clearly in the nationally determined contributions (NDCs) of countries, with more than 192 countries indicating specific land-based activities for climate-change mitigation and adaptation (Global Mechanism of the UNCCD, 2019). Seventy-four percent of NDCs contain forest-related targets, including FLR activities, although 65 percent of those include the condition of international support (Seddon *et al*., 2019). Similarly, 97 percent of LDN country commitments are related to reforestation and forest restoration and 86 percent to afforestation as integrated response options to land degradation and climate change (Global Mechanism of the UNCCD and UNFCCC, in prep. [a]). Finally, a 2016 analysis of national biodiversity strategies and action plans (NBSAPs) and national reports under the CBD showed that most Parties had adopted national targets on ecosystem restoration linked to Aichi Biodiversity Target 15. Few such targets, however, had specific, quantitative elements such as the area or type of ecosystem to be restored (CBD, 2016b).

Ecosystem-based targets and actions related to FLR are not necessarily aligned across the national commitments and contributions put forward by Parties to the Rio conventions in their ambition, scope or level of detail. Moreover, such targets seldom align with ambitious area-based FLR pledges by countries in voluntary platforms like the Bonn Challenge[5] – which was conceived as a platform to support the achievement of the objectives of the Rio conventions, especially Aichi Biodiversity Target 15. The further improvement of synergies within targets needs to be coupled with the synergistic implementation of the conventions in forests and landscapes and a better alignment and integration of relevant measures in national instruments.

Target-setting and implementation planning at the national level offer opportunities to establish synergies, articulated policy instruments and cost-effective implementation. For example, assessments have been made through the LDN target-setting process of how LDN targets can be linked with biodiversity targets and climate-change mitigation and adaptation response options. Guidance and decisions under the CBD have also encouraged Parties to take the targets of other conventions into account when establishing or reviewing and implementing their national targets (e.g. CBD, 2016a; CBD, 2018).

More could be done, however, to better integrate the national action programmes under the UNCCD, the CBD's NBSAPs and the UNFCCC's national adaptation programmes of action, NDCs, long-term low-greenhouse-gas-emissions development strategies and REDD+ national strategies and actions plans. FLR pledges under the Bonn Challenge could also be better accommodated. Such pledges, often expressed in terms of hectares (ha) to be brought under restoration by 2030, are relevant to the achievement of Aichi Biodiversity Target 15 and other targets under the CBD but are rarely aligned with related national plans and reports to support their practical implementation (CBD, 2016b). Congruence is higher between Bonn Challenge pledges and NDCs, with 31 percent of Bonn Challenge countries included their voluntary pledges in their NDCs (IUCN, 2017b). Nevertheless, discrepancies exist in the target area to be restored, and the relationship between quantitative targets expressed in different metrics is not always explained (e.g. between an area-based FLR pledge and an AFOLU-related NDC expressed in tonnes of carbon dioxide) (CBD, 2016b). In only a few cases (e.g. Cameroon and Malawi), Bonn Challenge pledges have been integrated into national LDN targets; there is ample opportunity for other countries to integrate Bonn Challenge voluntary pledges into LDN targets, which in several cases are less ambitious than the voluntary pledges (Gichuki *et al*., 2019).

The example of Uganda

Uganda provides an example of the successful integration of objectives of the Rio conventions in the design of restoration-related national targets and commitments. In 2014, Uganda committed 2.5 million ha to the Bonn Challenge and started the process of assessing restoration opportunities in its national territory (IUCN, 2016). In 2015, the Government of Uganda issued its initial NDC with a strong focus on emission reductions from the AFOLU sector and through REDD+ (Ministry of Water and the Environment of Uganda, 2016). In 2016, the country adopted its NBSAP (National Environmental Management Authority of Uganda, 2016), which has specific, quantified targets for forests and wetlands in line with the NDC. In 2018, the government adopted a voluntary LDN target that crossed-referenced its initial NDC and also focused on forests and wetlands associated with specific targets on land productivity and soil organic carbon (Government of Uganda, 2018). This coherence also rests on the adoption of the country's National Vision to 2040, which lays a strong policy foundation on which to develop international commitments. With a unified national policy and targets on restoration, Uganda is better placed to achieve the objectives of the Rio conventions in a synergistic manner and to access international financing for restoration through integrated restoration programmes. Table 1 puts side-by-side the respective national commitments of Uganda under the Bonn Challenge and the three Rio conventions.

Like Uganda, at least 50 jurisdictions

[5] See article on page 82 of this edition.

have undertaken or are undertaking (27 completed, 23 ongoing) national and subnational assessments of restoration opportunities using the ROAM methodology[6] (IUCN and World Resources Institute, 2014) across more than 0.5 billion ha, identifying in excess of 180 million ha with restoration potential. These assessments offer technical evidence of the economic, social, environmental, policy and physical feasibility of implementing and scaling up FLR with information on specific optimal interventions and techniques. Although several countries have used these assessments to support decision-making processes related to the implementation of new policies, strategies, incentives and programmes for restoration, there is still significant untapped opportunity to integrate the results of these assessments with planning and target-setting efforts undertaken in the context of the Rio conventions.

[6] The Restoration Opportunities Assessment Methodology (ROAM), produced by IUCN and the World Resources Institute, provides a flexible and affordable framework for countries to rapidly identify and analyse areas that are primed for FLR and to identify specific priority areas at a national or subnational level. More information is available at www.iucn.org/theme/forests/our-work/forest-landscape-restoration/restoration-opportunities-assessment-methodology-roam

Restoration as a common entry point for unlocking financing

Bringing FLR interventions to scale will require significantly higher levels of investment. Estimates suggest that more than USD 837 billion will be needed to restore 350 million ha by 2030 (FAO and Global Mechanism of the UNCCD, 2015). Financial mechanisms are in place to support the implementation of the Rio conventions but require the submission of solid proposals. Proposals for integrated approaches such as FLR that support the implementation of all three conventions are ideal candidates for funding.

The Global Environment Facility (GEF) serves as the financial mechanism of the three Rio conventions and several programmes relevant to restoration, including the GEF-7 Sustainable Forest Management Impact Programme on Dryland Sustainable Landscapes (FAO, 2018). The GEF-7 Impact Programme on Food Systems, Land Use and Restoration was designed for integrated approaches that sustainably meet demand for crop and livestock production while preventing the further loss of ecosystems and reversing land degradation. This impact programme brings attention to the existing political drive to implement large-scale restoration demonstrated by the pledges made to the Bonn Challenge (GEF, 2018).

The Green Climate Fund (GCF)[7] assists developing countries in climate-change mitigation and adaptation activities and supports projects relevant to the restoration of forests and other ecosystems. The GCF aims for a 50:50 balance between mitigation and adaptation over time (GCF, 2018). Project proposals have been submitted and approved by the GCF to implement FLR-related activities in both the mitigation and adaptation windows, responding to priorities such as livelihoods and resilience to climate change. Countries are accessing the simplified approval process under the GCF to seek funding for their actions and activities related to forest restoration, the enhancement of forest carbon stocks and ecosystem resilience (GCF, 2019). Therefore, countries that frame their efforts to achieve the objectives of the Rio conventions through FLR could potentially gain access to GCF finance more easily.

At the national level, some countries have developed integrated financing strategies and mechanisms blending various capital

[7] Article 9 of the Paris Agreement and Article 11 of the UNFCCC.

Table 1. The national restoration targets of Uganda under the Bonn Challenge and the three Rio conventions

Bonn Challenge (2014)	Initial NDC (2015)	NBSAP (2016)	LDN target (2018)
A total of 8 079 622.1 ha was identified as available for restoration using various options. Of this, 31% (2 500 000 ha) was translated into the Uganda pledge towards the Bonn Challenge	Increase wetland coverage to 12% by 2030, from approximately 10.9% in 2014, through the demarcation, gazettement and restoration of degraded wetland Reverse the deforestation trend to increase forest cover to 21% in 2030, from approximately 14% in 2013, through forest protection, afforestation and sustainable biomass production measures	By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15% of degraded ecosystems Plant at least 200 000 ha trees annually to contribute to the national target in Vision 2040 Restore at least 11 250 ha of wetlands annually to contribute to the achievement of the national target in Vision 2040	LDN in Uganda in 2030 compared with 2015 baseline; i.e. LDN achieved by 2030 compared with 2015 (no net loss) 21% tree or forest cover by 2030 (in line with Vision 2040 and the NDC) 12% wetland cover by 2030 (in line with Vision 2040 and the NDC) Areas of declining or stressed land productivity reduced by 50% by 2030 Level of soil organic content at the country level maintained or improved by 2030 compared with 2015 baseline

Note: Quantified and coherent targets specific to forest and wetland ecosystems are highlighted in green and yellow, respectively, based in part on the assessment of restoration opportunities conducted for the government's pledge to the Bonn Challenge. NDC = nationally determined contribution; NBSAP = national biodiversity strategy and action plan; LDN = land degradation neutrality.

Sources: Ministry of Water and the Environment of Uganda (2016); IUCN (undated).

sources (national, international, public and private) to invest in FLR in both the readiness and implementation phases. National forest and environment funds are appropriate for addressing the multiple objectives of FLR, as shown by examples in Costa Rica and Rwanda.

Restoration as a common entry point for reporting

Actions undertaken to implement FLR are relevant to the objectives of all three Rio conventions and should therefore be reported under all three. Although the impacts of FLR may vary, the interventions are the same and present a common basis for reporting.

Contributions to biodiversity conservation and restoration achieved through FLR should be indicated in national reports to the CBD. Parties can make use of guidance available to enhance synergies between the conventions for undertaking ecosystem restoration and to invest FLR plans with a biodiversity focus (Beatty, Cox and Kuzee, 2018). Many countries that have pledged to the Bonn Challenge have conducted restoration opportunities assessments, which often consider how FLR interventions will benefit biodiversity and certain Aichi Biodiversity Targets (Beatty, Cox and Kuzee, 2018; Beatty *et al*., 2020). These assessments are also highly relevant to the activities listed in the STAPER under the CBD and should be reported as such.

Under the UNFCCC, emission reductions achieved through FLR may be included in the reporting of emissions and removals in the AFOLU sector, such as within national greenhouse-gas inventories or in national reports such as national communications, biennial reports, biennial update reports and reports on REDD+ forest reference emissions levels. Where FLR activities are implemented in areas under country-led emission reduction programmes, there is an opportunity to build on information about mitigation outcomes arising from FLR. Countries, organizations and stakeholders are encouraged to share knowledge, experiences and lessons learned from REDD+ implementation – which could include how FLR interventions are contributing to such implementation – through the REDD+ web platform.[8]

Under the UNCCD, the Performance Review and Assessment of Implementation System lists a number of LDN indicators (land cover, land primary productivity and soil organic carbon) that should be reported against. These indicators are well adapted to reporting on the implementation of FLR interventions, and they also complement reporting on certain Sustainable Development Goals (Global Mechanism of the UNCCD, 2019).

Countries that have made pledges to the Bonn Challenge can make use of the Bonn Challenge's Barometer to report on those dimensions that are compatible with the reporting requirements of the Rio conventions. These include estimates of emission reductions from FLR activities aligned with the Intergovernmental Panel on Climate Change's accounting principles; FLR in, or in proximity to, key biodiversity areas; finance flows; and policy and institutional enabling conditions (Dave *et al*., 2019).

CONCLUSION

All three Rio conventions – through the Aichi Biodiversity Targets (soon to be replaced by the post-2020 Global Biodiversity Framework), the Warsaw Framework for REDD+ and actions in the AFOLU sector, and LDN – encourage the restoration of forests and other ecosystems. As a concept that relates to the objectives of all three conventions, FLR has the potential to contribute to all existing targets and mechanisms and to increase ambition under the post-2020 Global Biodiversity Framework, the Paris Agreement on climate change and the UNCCD 2018–2030 Strategic Framework. The development of FLR pledges, plans and programmes is an opportunity to consider the choice and location of restoration interventions to ensure that they contribute to the achievement of all three Rio conventions in a balanced and integrated manner, thereby promoting synergies in the implementation of associated interventions. Voluntary pledges on FLR such as the Bonn Challenge can also be capitalized on and integrated as potential contributions to national targets under the Rio conventions. These contributions could also be duly reported so that the identification of remaining gaps in national actions to reach global goals are as accurate as possible.

[8] The platform is available at https://redd.unfccc.int

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When institutions work together on restoration

J.N. Rakotoarisoa, A. Vidal, M. Pagliani, O. Keo, A. Schiavone, C. Ann and S. Sar

Case studies in Brazil, Cambodia, Madagascar and Sao Tome and Principe illustrate the range of options for – and importance of – institutional coordination mechanisms in forest and landscape restoration.

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Forest and landscape restoration (FLR) seeks a balance between regaining the ecological functionality of degraded forests and landscapes and enhancing the well-being of humans who depend on them (IUCN and World Resources Institute, 2014). FLR is a particularly relevant approach in "mosaic" landscapes characterized by a variety of land uses and a multiplicity of views among stakeholders. To reach an agreed optimal balance of economic, social and environmental benefits, common ground must be found in the midst of the diversity – and divergence – of standpoints. FLR involves stakeholders in all affected land-use sectors (Sabogal, Besacier and McGuire, 2015), whose isolation from one another has often resulted in a "silo syndrome" whereby sectors are in competition and conflict with each other (FAO, 2014). Collaboration among sectors and stakeholders is imperative (Reinecke, Blum and Geck, 2018) at the national and landscape scales to better manage the multiple needs, expectations and behaviours of diverse stakeholders and to negotiate trade-offs. A common vision shared among all stakeholders needs to be developed that will help in defining responsibilities and reducing overlaps and will lead to coordinated planning, thereby reducing competition between land users.

Effective coordination across sectors, stakeholders and scales requires well-designed policy and legal frameworks. It might also occur through cost-effective coordination mechanisms, which can take several forms, ranging from simple communication systems enabling effective

Above: A meeting of the Technical Working Group on Forestry Reform in Cambodia – a national government–donor coordination mechanism to ensure coherence and harmonization in the implementation of forest and landscape restoration projects and programmes

information-sharing to more complex platforms aimed at fostering collaborative work. Identifying the forms of these coordination mechanisms and implementing them is a challenge common to many countries. They need to be tailored to circumstances – for example, they may make use of relevant pre-existing instruments to avoid the duplication of effort – and the geographical scope of the foreseen FLR interventions. Strong ownership by government institutions of the coordination process and expected outcomes is crucial for successful and effective coordination at both the national and landscape scales. The four case studies presented in this article – in Madagascar, Cambodia, Brazil and Sao Tome and Principe – highlight the diversity of contexts in which coordination mechanisms are needed for scaling up the implementation of FLR and how they can be adapted locally to suit the circumstances.

MADAGASCAR'S NATIONAL COMMITTEE ON FOREST AND LANDSCAPE RESTORATION

Issue

The Restoration Opportunities Assessment Methodology process undertaken in 2016 in Madagascar revealed governance issues related to a lack of intersectoral approaches across institutions (Lacroix *et al.*, 2016). Subsequently, the government proposed setting up a multistakeholder mechanism to solve these institutional challenges by breaking down the land-use-sector "silos" and enhancing cross-sectoral coordination.

Coordination mechanism

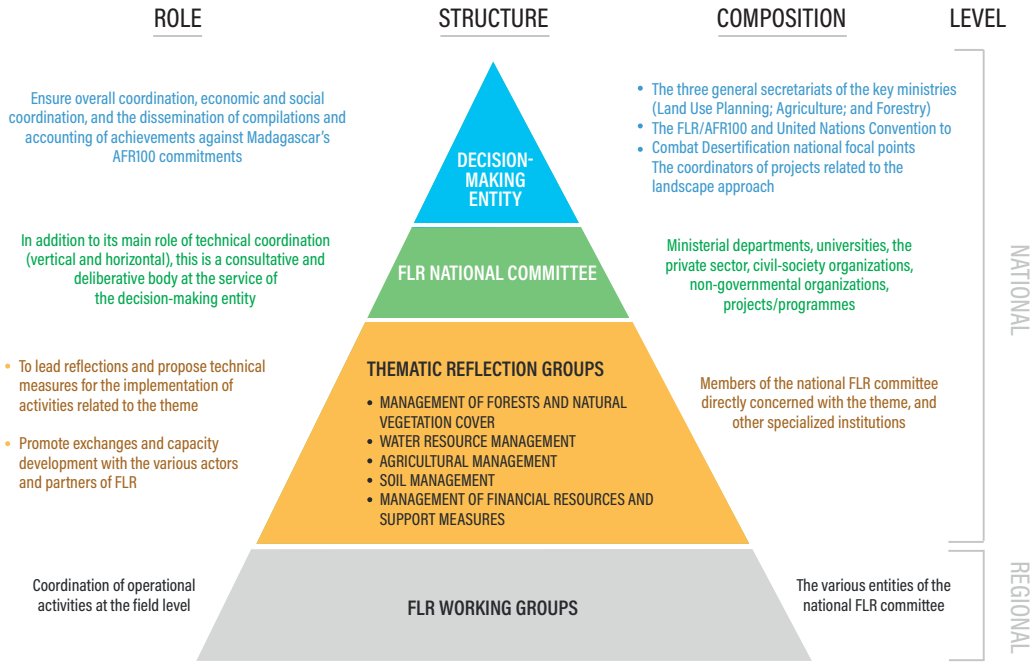
Soon after its commitment (made in 2015) to restore 4 million hectares (ha) of degraded forests and lands by 2030, the Government of Madagascar created an intersectoral coordination mechanism including stakeholders from relevant sectors called the National Committee for Forest and Landscape Restoration (Comité National pour la Restauration des Paysages et des Forêts – CNRPF) (Figure 1). Relevant line ministries in Madagascar are the Ministry of Forests; Ministry of Agriculture, Livestock and Fisheries; Ministry in Charge of Water; and Ministry in Charge of Land-use Planning and Tenure. At the national level, the CNRPF enables stakeholders to interface with policymakers and law enforcement officials; both are crucial for building a conducive environment for FLR.

At the decentralized level, technical working groups on FLR were created to ensure the participation of stakeholders at the landscape level and the coordination of activities at the sites to be restored. These working groups include local non-governmental organizations (crucial for knowledge dissemination and innovation), private-sector representatives (key for facilitating the development of green value chains) and local communities (essential for the management of restoration interventions).

Modalities of operation

The functions of the CNRPF have evolved over time to meet the changing needs

1
Structure of Madagascar's National Committee for Forest and Landscape Restoration



Note: AFR100 = African Forest Landscape Restoration Initiative.

of the FLR process and as progress has been made towards Madagascar's FLR commitments.

In the early stages of the process, the CNRPF and its constituency guaranteed the full involvement of all stakeholder groups (e.g. government, local communities, the private sector, civil society, non-governmental organizations and research) in the drafting of national framework documents. These included the national FLR strategy and spatial guidelines for identifying priority landscapes for the restoration of ecosystem functions to support sustainable land use and green infrastructure.

The country started implementing its FLR plans in 2018, with two main overall objectives: to mobilize resources for FLR operations; and to design FLR models according to landscape type and implementation options. Effective funding mechanisms are still needed to upscale successful restoration models, and the financial instruments and flows need coordination. Accordingly, the terms of reference of the CNRPF have evolved, and they now cover the following aspects:

- coordination of interventions related to landscape approaches – studies, planning, resource mobilizations, operational actions, and monitoring and evaluation;
- mobilizing the various sectors for improved synergies across interventions;
- knowledge-gathering and the promotion of knowledge exchanges for capacity development; and
- the intensification of cross-sectoral dialogue to foster the adoption of a landscape approach.

Impact

The CNRPF has enabled the involvement of the various sectors (agriculture, land-use planning and forestry) and stakeholders in all aspects of the FLR process, from the design of methods and approaches to their final joint validation. Consensus was reached on seeking to optimize landscape functionality for human well-being.

The Ministry in Charge of Land-use Planning and Tenure has increased the knowledge and skills of its staff in FLR. This is proving useful in developing and updating national and subnational land-use schemes, such as the national scheme for land-use planning; regional schemes for land-use planning; and municipal land-use schemes. More recently, FAO supported the Government of Madagascar in operationalizing its national forest fund. In this, the CNRPF provided the umbrella for brainstorming on the interface with sectoral funds such as the Agricultural Development Fund and the Livestock Fund.

Central-level institutional coordination across sectors, and local-level coordination, are both essential for guaranteeing the success of Madagascar's long-term countrywide process. The coordination mechanisms at these levels are playing crucial roles in restoration interventions, from planning, to implementation, to monitoring and evaluation. Coordination between the central and local mechanisms to ensure feedback loops between the two is yet to be tackled.

THE STATE HYDROLOGIC COMMITTEE, ESPÍRITO SANTO, BRAZIL

Issue

Espírito Santo is a Brazilian state in the country's southeast.[1] It is part of the Atlantic rainforest biome, which, although one of the world's biodiversity hotspots, has lost 87 percent of its original forest cover. The state's main environmental challenges have been brought about by changes in land use and massive forest loss, especially adjacent to water bodies and in areas of water recharge. Water quality and quantity are serious concerns. The decrease or complete loss of soil permeability, and an increase in soil erosion, have meant the release of large volumes of sediments into rivers (IUCN Brazil, 2016). Espírito Santo experienced its worst drought in 80 years in 2014, with 20 municipalities facing critical water shortages.

In addition to affecting water supply for daily use, the availability of water for agricultural purposes was seriously diminished, forcing producers in some regions to slow down production and eventually to close export companies and warehouses (IUCN, 2017). In response, state authorities adopted a series of water-saving measures, such as rationing and rotation schemes.[2]

Coordination mechanism

In the midst of this water crisis, the state governor mandated the creation of the State Hydrologic Committee (SHC), which was formed in January 2015 by the State Agency of Water Resources (AGERH) (without a formal creation process involving an administrative resolution or order). The SHC initially comprised representatives of state government bodies, including the Secretariat of Government; the Secretariat of Agriculture; the Environment Secretariat; the Secretariat of Social Communication; the Secretariat of Urban Development; the Secretariat of Security; the Agency of Basic Sanitation and Infrastructure; and the Sanitation Company of Espírito Santo. Later, representatives of other state and federal bodies, as well as academia, were invited to address specific issues on the SHC agenda when raised by members in response to the evolving crisis. Meetings of the committee were convened at the request of members – often with the participation and leadership of the state governor – to coordinate action. The SHC operated on the basis of staff time provided by the agency representatives on the committee. It constituted a strategic space for interinstitutional dialogue and coordination in seeking

[1] This section is adapted and updated from Imbach and Vidal (2019).

[2] See, for example, www.ana.gov.br/todos-os-documentos-do-portal/documentos-sre/alocacao-de-agua/oficina-escassez-hidrica/legislacao-sobre-escassez-hidrica/espirito-santo/resolucao-no-02-2015-alerta-escassez

short- and mid-term collaborative solutions to the water shortage. The execution and implementation of agreed measures was left to the agencies and bodies that formed the SHC according to their competencies, although the SHC also coordinated actions requiring multiagency participation as well as community-level actions. The SHC provided guidance through resolutions of the AGERH for addressing the water crisis (AGERH, 2016).

Modalities of operation

The SHC focused on three lines of action: 1) water supply for urban and rural populations; 2) water supply for agricultural uses; and 3) the design and implementation of policies for forest restoration in water recharge areas. The SHC mobilized the community – targeting crucial districts for massive public campaigns – to support the implementation of measures such as community-level cooperation agreements on water-saving actions and the controlled usage of water resources in certain water basins. The SHC also coordinated the design of state-level planning instruments and programmes such as the Water Resources Plan and the Water and Landscapes Programme. Under the SHC, state agencies designed medium-term solutions to ensure water security, which were then included in the state's strategic planning for 2015–2018 for the agriculture and environment sectors; these prioritized investment in green and grey infrastructure, such as in the construction of several new dams and the restoration of forest cover on 80 000 ha of strategic water recharge areas. For the latter, the SHC invested the state programme, Reflorestar, with greater strength (Box 1).

Impact

During its most active time (between 2015 and 2018), the SHC was an effective dialogue space for government institutions and other key actors dealing with the water crisis, where they were able to coordinate strategic actions for the integrated management of water resources in the short, medium and long terms. The SHC enabled state authorities to implement measures effectively, follow up as needed to mitigate the immediate effects of the water shortage, and design effective awareness and engagement strategies aimed at changing the unsustainable water-related practices of private landowners and the public. Key measures implemented under the SHC's coordination included the creation of new reservoirs, the formulation of community cooperation agreements with management plans for prioritized watersheds, and social communication campaigns on the sustainable use of water resources (Folha Vitória, 2016). Moreover, the SHC gave an important boost to the Reflorestar programme, enabling it to obtain access to new financial resources, create new incentives for rural producers, and establish a partnership with a private bank for the financial management of the payment scheme for ecosystem services, which ensured its success.

Coordination under the SHC also enabled the execution of mid- and long-term processes to improve the state's resilience to climate change. Measures established as a response to the water crisis were integrated in the state's strategic planning for 2019–2022 (Government of Espírito Santo, undated).

The SHC is not operating today, with the positive results obtained through better water management, coupled with the arrival of wetter seasons, reducing the urgency for coordinated action and therefore the role of the SHC. Nevertheless, the committee provided considerable long-term value in the actions it took and the water-management governance structures it established.

CAMBODIA'S TECHNICAL WORKING GROUP ON FORESTRY REFORM

Issue

In the past decade, Cambodia's international forest-related commitments have only rarely translated into management plans and actions. Implementation is hindered by a lack of clarity on, for

Box 1
Reflorestar, a state programme for restoration

Espírito Santo's Reflorestar is a flagship programme aimed at promoting the conservation and restoration of forest cover to protect the hydrologic cycle and generate livelihood opportunities for smallholders through the adoption of sustainable practices. The programme's annual restoration goal was 80 000 ha by 2018, which would count towards the state's pledges to the Bonn Challenge and Initiative 20×20.

Reflorestar is coordinated by the State Secretariat for the Environment and Water Resources with the support of the Development Bank of Espírito Santo. Established in 2008, Reflorestar was the first state-based payment scheme for ecosystem services in Brazil, and it was funded by the first specific water fund (Fundágua). After receiving increased attention as a pillar for addressing the water crisis, Reflorestar's strategy was updated to include four components aimed at stimulating rural landowners to implement active and passive restorative activities: 1) payments for ecosystem services in recognition of the benefits for water production and conservation; 2) technical assistance; 3) the promotion of income-generating activities such as agroforestry, silvopastoral management, and forest management; and 4) linkages with value chains associated with forest restoration products (SEAMA, undated). Reflorestar also supports the implementation of the Water and Landscape Programme, focusing on restoring water basins, reducing erosion, and controlling sedimentation (Government of Espírito Santo, 2018).

example, land tenure and the demarcation of production forests, protected areas and biodiversity conservation corridors. Sectoral strategies often overlap, if not conflict. There is a lack of incentives for local and national financing and inadequate technical support for the conservation and management of native forests and endangered plant species. Cambodia needs to coordinate effectively across sectors to support the mainstreaming of FLR in relevant land-based interventions.

Coordination mechanism

Established in 2004, the Technical Working Group on Forestry Reform (TWG-FR) is the national government–donor coordination mechanism to ensure coherence and harmonization in the implementation of forestry projects and programmes in Cambodia. Given its mandate, this body was identified as an appropriate mechanism to lead on FLR coordination at the institutional level.

The TWG-FR is composed of 12 government institutions, ten development partners engaged in the forest sector, eight international or national non-governmental organizations, and two private-sector representatives. Several important government actors are also TWG-FR members: the Ministry of Land Management, Urban Planning and Construction, which leads on and manages land, urbanization, construction and cadastral work; the Ministry of Economy and Finance, which is in charge of financial planning; the Council for the Development of Cambodia, which provides guidance, monitoring and planning; and the Ministry of Commerce, which plays a key role in the trade of wood and wood products.

The TWG-FR is chaired by the Director General of the Forestry Administration in the Ministry of Agriculture, Forestry and Fisheries and co-chaired by the Head of Operations of FAO Representation in Cambodia. FAO is the lead facilitator among development partners; before each TGW-FR meeting, it convenes a meeting of development partners, the eight international and national non-governmental organizations, and the two representatives of the private sector. These meetings are designed to coordinate the views of development partners and help drive strategic discussions in the TWG-FR.

The TWG-FR was dormant between 2016 and mid-2019 following reforms to the forestry jurisdiction in 2016, leaving the sector poorly coordinated. It has taken some time to revitalize discussions.

Modalities of operation

Based on "joint monitoring indicators" for the period 2019–2023, the TWG-FR focuses on three thematic areas: 1) sustainable production and community forest management (including forest restoration and community livelihoods); 2) forest biodiversity and wildlife protection and conservation; and 3) forest law enforcement, governance and trade. Sustainable financing is also an important aspect for enabling the implementation of the sustainable forestry programme. TWG-FR meetings are now being convened about four times a year to discuss sectoral planning and other issues, share information and build collaboration and partnerships.

Impact

The TWG-FR plays a key role as the unique coordination platform addressing forest-sector issues. It facilitates dialogue among institutions and is the only intersectoral committee or group able to promote integrated landscape management. Thanks to the TWG-FR, FLR is now reflected in various strategies, action plans and programmes, and pilot investments are being made at the field level. Nevertheless, huge challenges remain in many existing policies and the platform itself, and field activities are still operating on only a small scale. Key barriers to scaling up FLR include a lack of active engagement of stakeholders across sectors and domains (including state, non-state and private actors); the absence of efficient financial instruments; and a lack of capacity, approaches and standardized tools for FLR opportunity assessment, planning, implementation and monitoring among relevant institutions at the national and subnational levels. In addressing these barriers, the TWG-FR should help achieve a national consensus on future FLR targets and plans, building on the momentum that will be generated by the upcoming United Nations Decade on Ecosystem Restoration.

PLATFORM FOR FOREST AND LANDSCAPE RESTORATION IN SAO TOME AND PRINCIPE

Issue

A multistakeholder consultation process in Sao Tome and Principe in 2017, conducted during the design of a national project, The Restoration Initiative (TRI) (funded by the Global Environment Facility), highlighted a widespread lack of knowledge and technical capacity on FLR and related issues, such as payment schemes for ecosystem services. It also showed that coordination was weak among the various branches and layers of the public administration, and there was a need to mainstream FLR and sustainable forest management in key sectoral policies, including land use and planning, energy, and agriculture.

Coordination mechanism

In late 2018, the project created the national Platform for Forest and Landscape Restoration (PFLR) to spearhead future FLR work in Sao Tome and Principe; the aim was to help create a conducive environment for FLR and provide a vehicle for increasing FLR capacity and knowledge. Over the TRI timeframe (to 2023), the PFLR is set to perform a steering function in support of FLR interventions comprising fieldwork, communication and education, policy, and socio-economic development.

Following a scoping phase led by the TRI project team, a validation workshop was held in May 2019 to confirm the membership of the PFLR and agree on a road map and workplan for the first year of operation. A wide range of institutions is represented by individuals in the PFLR, including

various arms of the national administration (forests, agriculture, protected areas, rural development, energy, tourism, fisheries, finance, armed forces and national police); research institutes; district administrations; agriculture cooperatives; the private sector (mainly companies involved in agroforestry); and civil-society organizations.

In total, the PFLR has 33 individuals as members, of whom 21 percent are women (over the project lifetime, efforts will be made to improve the gender balance of the PFLR). In addition, the project team offered informal membership to representatives of other forest-related projects under implementation in the country, including the European Union, the United Nations Development Programme, the African Union, the World Bank, the International Fund for Agricultural Development and private foundations. Such informal members are welcome to join the PFLR at their own expense.

The PFLR was established officially by government order in 2019.

Modalities of operation

The PFLR has four thematic subgroups: 1) Legislation and Supervision; 2) Mapping and Restoration; 3) Information and Communication; and 4) Finance and Economic Development. Each is coordinated by a member of the Directorate of Forests and Biodiversity (DFB, the official governmental counterpart of the TRI project) and one member of the TRI Project Implementation Unit, and each has its own calendar of meetings and works based on the needs of the project.

Impact

A workplan to develop the capacity of the PFLR has been agreed, including workshops, training and field events. A first workshop on the principles and practices of FLR was conducted on November 2019, attended by 44 PFLR members and DFB staff. The three-day programme consisted of plenary sessions, group work and a study visit to the country's north. A second workshop is planned for late 2020 under the lead of the DFB.

Meanwhile, the PFLR subgroups are involved in specific actions under the TRI project workplan. One of these is to support the national consultants developing two key studies that will pave the way for project action – the policy influence plan, and the capacity development assessment. The Mapping and Restoration Subgroup is contributing to work coordinated by the DFB to set the ground for FLR fieldwork, including a nationwide assessment of the state of forests, a landscape mapping exercise, and the design of participatory FLR plans in the target landscapes.

CONCLUSION

The four case studies presented here show the diversity of mechanisms that can be put in place to improve coordination across sectors, stakeholder categories and scale to implement FLR. Although coordination can be sought through policy and legal frameworks, having such mechanisms in place seems indispensable for ensuring coordination on the ground and thereby the effectiveness and sustainability of FLR interventions. Coordination mechanisms can play a crucial role in building capacities in a continuous and adaptive fashion. Facilitating experience-sharing across countries – for example in the context of regional initiatives – can help disseminate lessons learned and to fast-track the design of effective coordination mechanisms.

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Upscaling restoration: how to unlock finance

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Providing evidence-based estimates of the costs, benefits and risks is key to increasing investment in the restoration of degraded landscapes.

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According to the Global Partnership on Forest and Landscape Restoration, more than 2 billion hectares (ha) of the world's deforested and degraded landscapes have potential for forest and landscape restoration (FLR) (Minnemeyer *et al*., 2011). FLR, and ecosystem restoration in general, has the capacity to generate essential economic, social and environmental goods and services, thereby helping fight climate change, enhance food security, improve water supply and quality, and protect biodiversity. The yearly budget needed to meet internationally agreed restoration targets has been estimated at USD 36 billion–49 billion (FAO and Global Mechanism of the UNCCD, 2015). Upscaling restoration, therefore, will require the mobilization of many public and private investors (FAO, 2018).

The United Nations Decade on Ecosystem Restoration (United Nations, 2019) and its draft strategy (United Nations, 2020) recognize the need to unlock finance for restoration. This paper examines opportunities for obtaining new sources of funding for investment in restoration – focusing on what is needed to mobilize such sources and emphasizing the importance of accurate information on the costs, benefits and risks.

Above: Women prepare* Gnetum *(okok) seedlings in a nursery in the village of Minwoho, Lekié, Cameroon

OLLIVIER GIRARD/CIFOR

An FLR site in Tigray, Ethiopia

COSTS, BENEFITS AND RISKS IN INVESTING IN RESTORATION

Restoration is often depicted globally as a highly rational activity, with the overall benefits outweighing the costs (e.g. Ding *et al*., 2018; Bullock *et al*., 2011; United Nations, 2020). On this basis, restoration should be a logical primary focus of local, national and international finance and investment. One reason why this is not the case is to be found in the economics of restoration.

The magnitude of restoration commitments worldwide, as expressed in (for example) the Bonn Challenge, the national determined contributions (NDCs) of countries towards the mitigation of climate change, and Aichi Target 15, greatly exceeds national and international public funding capacity. There is a need, therefore, for greater involvement by the private sector (FAO and Global Mechanism of the UNCCD, 2015), in which national and international public sources either target specific public projects or facilitate and supplement private investment, including within the same projects (e.g. through blended finance, subsidies and incentives) (OECD, 2018).

Motivations vary widely for investing in restoration. Because of their emphasis on public goods, public actors are most likely to focus on social and environmental returns, such as the protection and provision of public goods, demonstration, and the correction of policy and market failures. Private-sector investors vary in their objectives and constraints, expected levels of return and risk appetite, depending in large part on their relationship with and dependence on the land to be restored. Farmers may use their own financial resources and conduct restoration to increase land productivity and resilience. Investing in land is part of the core business of landowners, long-term resource users and downstream enterprises to ensure the sustainable supply of raw materials and returns that secure a given enterprise's future. Some enterprises may also be motivated by corporate social responsibility, compliance with environmental legislation, and impact marketing. Financial entities may be interested in land to diversify their assets, particularly because this is generally not correlated with other asset classes like stocks. Timber has been shown to be a low-risk investment with low volatility and high returns in the long term (FAO and Global Mechanism of the UNCCD, 2015). But there are also risks in ecosystem restoration (e.g. fire and political instability) that are not well known by investors and may limit their appetite for such activities. Private banks and institutional investors such as pension funds and sustainable finance funds may see advantages in investments with lower financial risk (not correlated with stock markets) and with positive social and environmental impacts (GSIA, 2019).

Across the range of landscape actors and investors, restoration projects and programmes incur different costs and obtain different benefits over time. Costs include those related to the initial establishment of the restoration venture (e.g. establishing plantations or installing exclosures for protection against grazing animals); maintenance costs; and income foregone during the restoration period and due to changes in land use. Restoration projects also incur indirect costs, such as the establishment of infrastructure, community outreach, and project management. The benefits of restoration can be categorized as:

- marketable benefits – private goods such as wood products, crops, livestock, non-wood forest products, and other income;
- public goods – such as improvements in soils (e.g. increased fertility, and erosion control), water (e.g. water quality, water provision and flood regulation), biodiversity conservation, and carbon storage; and
- social benefits – such as job creation, farm income, health impacts, migration reduction, and food and nutrition security.

In some cases and for some actors, the marketable benefits (e.g. the production of wood and non-wood products) may outweigh the costs but are realized with a substantial time lag compared with upfront investments. In other cases, the costs may outweigh the marketable benefits, even over longer timeframes. In this scenario, restoration is not economically rational – even though it may be seen as "valuable" when non-financial social and environmental benefits are accounted for (IPBES, 2018). To increase investment in restoration, therefore, there is a need to attract investors interested in these social and environmental benefits to cover part of the cost.

Sensitivity to the costs and benefits, including those not valued by markets, varies between investors. Nevertheless, all investors share two types of information need: on the costs and benefits of a project, with particular attention to monetized and other benefits; and on the level of investment risk, including the risk of losing capital and of not achieving expected outcomes.

To attract more money for restoration, therefore, the design of financing instruments such as direct investment, equities and bonds needs to consider (and leverage) the multiple objectives and perspectives of various public and private actors in any long-term restoration intervention.

KNOWLEDGE TO ENGAGE ACTORS AND MOBILIZE RESOURCES

Independent of the objectives and perspectives of the actors involved, sufficient knowledge of the underlying "market fundamentals" of land restoration is a prerequisite for devising appropriate financial instruments for restoration and to mobilize additional public and private investment. These include the costs, benefits and rates of return according to the nature of the intervention and its specific context in different regions and biomes. Existing knowledge of these market fundamentals is insufficient. More inclusive, standardized analyses of the short-, medium- and long-term costs and benefits of restoration are needed to support decision-making by stakeholders, communities, governments and private investors (IPBES, 2018) as well as the planning stage of restoration projects (Box 1).

Various studies have quantified the economic value, costs and returns of investments in sustainable land management and ecological restoration, including the Millennium Ecosystem Assessment (MEA, 2005), The Economics of Ecosystem and Biodiversity (TEEB, 2010) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services's assessment report on land degradation and restoration (IPBES, 2018). The yearly budget required to meet internationally agreed restoration targets may range from USD 36 billion to USD 49 billion (FAO and Global Mechanism of the UNCCD, 2015), and the benefits of such restoration have been estimated at USD 170 billion per year from watershed protection, improved crop yields and forest products. The restoration would also sequester an estimated 1–3 gigatonnes of carbon-dioxide equivalent per year, depending on the areas restored (Global Commission on the Economy and Climate, 2014).

Aggregated estimates of costs and benefits at the global level are important for advocacy and political momentum and commitments. They are insufficient, however, to enable investors to make decisions to support specific projects. Attempts have been made to estimate the costs of restoration interventions and to assess the benefits they generate at different scales (e.g. at the intervention, site and project levels) using various methodologies (e.g. Ding *et al*., 2018; ELD Initiative, 2015; Thomas and Quillérou, 2012). No common tool or standardized framework to collect and report on such information has been developed to date, however. The Economics of Ecosystem Restoration initiative aims to address this shortcoming globally (Box 2), with a view to facilitating the investment of funds to upscale restoration.

Louman *et al*. (2020) looked at the barriers to finance for local stakeholders in agricultural and forest landscapes. From their work, we can derive the following seven criteria that need to be met (in addition to improving knowledge on costs and benefits) for scaling up FLR. FLR interventions need to 1) attract large-scale investments to support long-term projects; 2) bridge the time lag between investment and revenue; 3) address the potentially wide range of operational risks of restoration activities (e.g. fire, wind, grazing damage, and insects and pests); 4) address uncertainty and unknowns around key parameters of interventions and the surrounding physical and policy environment; 5) ensure the permanence of restoration actions over time; 6) fairly and equitably remunerate all actors (e.g. landowners, farmers, foresters and external investors, both public and private); and 7) address gaps for affected actors when marketed returns do not outweigh the costs, regardless of positive social and environmental returns.

Linking REDD+ and restoration

The United Nations Framework Convention on Climate Change (UNFCCC) recognizes and promotes activities that contribute to climate-change mitigation in the forest sector in developing countries through REDD+.[1] Such activities include:

- reducing greenhouse-gas (GHG) emissions from deforestation;

[1] REDD+ refers to reducing emissions from deforestation and forest degradation, the conservation of forest carbon stocks, the sustainable management of forests and the enhancement of forest carbon stocks (UNFCCC, 2010).

Box 1
Assessing the costs and benefits of restoration in the Al-Shouf Cedar Nature Reserve, Lebanon

by Lina Sarkis, Al-Shouf Cedar Reserve

The Shouf Biosphere Reserve (SBR) developed its first FLR plan in 2014 for the ecological corridor connecting the Beqaa Valley and the Ammiq wetland. The plan included a cost–benefit analysis to better target efforts and justify returns on investment. Rigorous protocols for high-quality plants were prepared and more than 50 ha of land was restored using a mixture of innovative techniques.

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Landscape view of the Shouf Biosphere Reserve

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Replanting in the Shouf Biosphere Reserve

From the beginning, the development of the FLR plan involved all the main stakeholder groups, including municipalities, communities, farmers, small and medium-sized businesses in the agriculture and forest sectors, and other concerned stakeholders. The FLR interventions were monitored and evaluated, with excellent results, including a remarkable seedling survival rate of 75–95 percent at most sites after three years. For an average plantation density of 700 seedlings per ha, the cost was estimated at USD 1 750–2 100 per ha, depending on the features of each site (e.g. slope steepness and soil rockiness) (Hani *et al*., 2017). The cost per planted seedling was reduced from USD 10 to USD 2.5–3.0 through the use of plant production protocols that avoided the unnecessary consumption of water and other inputs; improvements in the equipment used for soil preparation; the empowerment and professionalization of staff; and reduced watering at restored sites. In the short to medium term, further improvements are expected to reduce the cost to USD 1.5–2.0 per seeding.

The project encouraged beneficiaries at the community level to create small businesses related to non-wood forest products, handicrafts, tourism and biomass-energy production. It created a small-credit scheme to launch new enterprises linked to the sector, and it also raised awareness, improved communication and produced technical guidelines to upscale and disseminate results.[2] The SBR widened the scope of its restoration programme to include other important habitats in the SBR and its buffer zone. The project has placed special emphasis on the empowerment of the weakest segments of rural society, specifically women and unemployed youth. It has also applied lessons learned in the restoration of extensive agroforestry systems; promoted value chains for high-quality products (e.g. oregano, sumac, pomegranate and pine nuts); conserved and monitored the rich biodiversity associated with restored habitats; and introduced tourism measures to increase the monetized value of the natural and cultural heritage.

[2] For example, the project published guidelines on FLR in the SBR in 2019.

Box 2
The Economics of Ecosystem Restoration

by Valentina Garavaglia, FAO

FAO launched The Economics of Ecosystem Restoration (TEER) initiative in 2019 in collaboration with the Secretariat of the Convention on Biological Diversity's Forest Ecosystem Restoration Initiative, Bioversity International, the Center for International Forestry Research, the International Union for Conservation of Nature, Tropenbos International, WeForest, and the World Resources Institute. The aim of TEER is to offer a reference point for the evaluation of the costs and benefits of future FLR projects based on data from comparable past projects collected through a standardized framework.

The first output of TEER is a database of the costs and benefits of ecosystem restoration. The framework is being developed and tested in 2020 and will then be expanded. The data are being collected directly from experts involved in projects, increasing ownership of the initiative at the field level. The main target users for TEER's products are donors, investors, governments and organizations that are implementing ecosystem restoration projects.

- reducing GHG emissions from forest degradation;
- the conservation of forest carbon stocks;
- the sustainable management of forests; and
- the enhancement of forest stocks.

Initiatives that aim to restore degraded forests and landscapes share many goals with REDD+, but their scope and perspectives differ. REDD+ was conceived originally for countrywide implementation, but most restoration projects are narrower in scope. Few restoration projects track their impacts on forest carbon because pledges (and therefore objectives) are based mainly on the area to be restored; nor do many restoration projects include the establishment of reference levels or carbon monitoring (Verchot *et al*., 2018). Integrating restoration projects as part of REDD+ implementation – including monitoring the effects of restoration projects on carbon stocks to ensure compliance with carbon measurement rules – would provide additional financing opportunities.

Many countries have integrated their NDC commitments related to forest management and more broadly to land use (FAO, 2016b). The implementation of NDCs, therefore, offers opportunities for financing restoration projects as well as carbon-monitoring mechanisms, thus helping create enabling conditions for individual carbon projects. Such synergies, however, require closer collaboration among national agencies and project proponents than is usually the case.

Carbon markets

In carbon markets, units of GHG emission reductions generated through certain activities can be sold to buyers, who can use these to offset their own emissions. Such markets exist in cap-and-trade mechanisms, in which emission limits are set for a geographical area or sector and penalties imposed when these limits are not respected through emission reductions or offsets. In addition to the European Union's emissions trading system, national or subnational trading systems are operating or under development in Canada, China, Japan, New Zealand, the Republic of Korea, Switzerland and the United States of America (European Commission, undated), with ongoing collaboration among these to facilitate mutual recognition (not all these markets recognize carbon credits from forestry, however). The State of California recently approved its California Tropical Forest Standard Criteria for Assessing Jurisdiction-Scale Programs that Reduce Emissions from Tropical Deforestation (California Air Resources Board, 2019). The International Civil Aviation Organization agreed in 2016 to set up a new offsetting mechanism – the Carbon Offsetting and Reduction Scheme for International Aviation – to compensate for the growth in aviation emissions beyond 2020, with airlines purchasing offsets from international schemes.

Unlike in cap-and-trade systems, sellers and buyers in the voluntary carbon market operate under their own rules. This market is driven by the private sector (with the related offsets often part of corporate social and environmental responsibility programmes) and consumer interest. The voluntary carbon market supports activities in the forest sector, including the protection of forests, improving forest management, planting trees on non-forest land, and the rehabilitation of degraded forests and forest areas (Vickers, Trines and Pohman, 2012). A shift towards nature-based climate solutions is taking place in this market, with credits for forestry and land use surpassing those for renewable energy for the first time at the end of 2018 (Forest Trends, 2019). Such schemes that quantify environmental benefits and give them a market value can help in attracting private investors.

Funds providing grants and loans for climate-related projects

Climate financing instruments are complex and evolving, and monitoring the flow of climate finance is difficult because there are no consistent accounting rules or agreed definitions. Nevertheless, efforts to increase coordination are increasing. A range of funds are financing climate-related and (more broadly) environment-related projects. This section gives a broad overview of the main available funds and provides information on what can be mobilized to help finance restoration. The mechanisms described here can provide initial funding to create an enabling environment

Box 3
Two projects funded by the Green Climate Fund in Latin America

by Hivy Ortiz and Jessica Casaza, FAO

The aim of the GCF-funded project, "Poverty, Reforestation, Energy and Climate Change" (PROEZA) (2020–2025), in Paraguay, is to support a transition to sustainable forest management to reduce the country's loss of forest cover and improve the quality of life of about 17 000 vulnerable families, many in indigenous communities. Beneficiaries will receive technical assistance and incentives to establish sustainable agroforestry practices on 13 940 ha of land, strengthen land tenure, and increase the efficiency of household biomass use. Technical advice will also be provided on how to better use funds to invest in land-tenure recognition and bioenergy programmes. Beneficiaries will gain access to credits for forest plantations for energy production (24 000 ha of new-generation forest plantations) as well as for soil protection, the protection of natural areas, biodiversity conservation and forest restoration in watersheds (4 800 ha). PROEZA will assist local communities to develop their financial literacy and thereby increase returns on small investments and facilitate the scaling up of restoration activities into larger investable initiatives. The overall package is expected to avoid 7.9 million tonnes of carbon-dioxide-equivalent GHG emissions.

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An agrosylvopastoral system in Latin America

The aim of the GCF-funded project, "Scaling up Climate Resilience Measures in Agroecosystems in the El Salvador Dry Corridor (RECLIMA)" (2019–2024), is to increase the climate resilience of farming systems in El Salvador, thereby benefiting about 225 000 people, and to restore and reforest degraded ecosystems to protect water resources and stimulate aquifer recharge. RECLIMA will be implemented in close collaboration with the Ministry of Agriculture, the Ministry of Environment, local authorities, municipalities, local communities and non-governmental organizations. It will directly benefit 50 000 family farms, increase the resilience of 56 600 ha of agricultural land and restore more than 17 000 ha of degraded ecosystems, thereby avoiding emissions of up to 4.2 million tonnes of carbon-dioxide-equivalent GHG emissions. It will involve the private sector and attract investors by sharing results, best practices and knowledge.

and support the preparation of bankable projects for the private sector.

Green Climate Fund. The Green Climate Fund (GCF), which was set up under the UNFCCC in 2010, is the largest international climate fund designed to help developing countries reduce their GHG emissions and increase their capacity to respond to climate change. The aim of the GCF is to allocate funds equally for climate-change mitigation and adaptation. Two results areas are particularly relevant for forests: forest and land use (under mitigation); and ecosystems (under adaptation). The GCF aims to address these simultaneously under cross-cutting mitigation and adaptation projects (Box 3).

Adaptation Fund. This fund was established to finance climate-change adaptation projects and programmes in developing countries. Since 2010, it has committed USD 720 million to support 100 adaptation projects with about 8.7 million direct beneficiaries involving the restoration or conservation of 271 680 ha of natural habitat and the protection of

121 025 km of coastline (Adaptation Fund, undated).

Forest Investment Programme. The Forest Investment Programme (FIP) is one of the most significant sources of finance for forests. It provides bridging finance between early-policy and capacity-development support and the demonstration of verified GHG emission reductions on the ground. As with many other multilateral agencies, the FIP has, above all, been investing in enabling environments for bankable projects and in providing alternative livelihoods and income-generating activities (Macqueen, 2018) by addressing policies and assisting vulnerable families. The risk of such investments is, however, that there will be a lack of support for small and medium-sized enterprises, which require technical assistance and incubation support to scale up or transform their operations. Thus, such programmes may miss out on involving a large group of local actors that could help make investments more sustainable.

National and regional funds. An example of this kind of fund is the Amazon Fund, the largest source of public finance for forest conservation programmes in the Amazon biome. Bilateral funds contribute significantly to climate finance for avoided deforestation and FLR; these include the German International Climate Initiative (IKI) (Box 4), the International Climate Fund of the United Kingdom of Great Britain and Northern Ireland, and the Norwegian International Forest Climate Initiative.

INSTRUMENTS AND ENABLING ENVIRONMENT TO MOBILIZE LARGE PRIVATE-SECTOR INVESTMENTS

The availability of public funds is insufficient to meet the targets set in international restoration commitments (Sethi *et al.*, 2017). Private-sector investors, therefore, are the key to long-term FLR finance (FAO and Global Mechanism of the UNCCD, 2015). This section explores how the enabling environment can be shaped to mobilize large private-sector investments.

Existing instruments and opportunities to finance restoration

There is a wide range of existing instruments to orient and support private-sector investment in restoration. One group of these is linked to concessions regimes on public land. An option would be to orient new concessions for agriculture and forestry towards degraded lands, with the restoration of productive capacity a necessary first step. Such an approach could include conditions related to the restoration of part of the land given in concession. Land concessions that involve degrading activities could also include clauses related to restoration, such as a condition to restore the land, provide funds to do so, or restore an area of land equivalent to or larger than the land to be degraded during the concession. Such systems exist in Europe and the United States of America (e.g. for mining concessions). In Brazil, landowners must conserve or restore a minimum percentage of their land as forest or pay compensation (FAO and Global Mechanism of the UNCCD, 2015).

A second group of instruments comprises various public incentives, such as subsidies for restoration activities and reduced taxation for long-term sustainable land management. Most schemes involving payments for ecosystem services (PES) financed by public funding can be placed in this category. In Costa Rica, for example, the National Forest Financing Fund provides credits and incentives for small and medium-sized landowners to conserve and restore forests through afforestation projects and a national PES scheme to enable the production of multiple benefits (e.g. water security, carbon sequestration, biodiversity and landscape values).

A third group of instruments is constituted by actions to reduce risks. For example, the World Bank Group's

Box 4
The Paris Agreement in action

by Valentina Garavaglia

The main objective of the project, "The Paris Agreement in Action: Upscaling Forest and Landscape Restoration to achieve Nationally Determined Contributions", funded by IKI and implemented by the FAO Forest and Landscape Restoration Mechanism, is to enhance national and regional capacities to plan, implement and monitor large-scale programmes to mainstream FLR as a key option for achieving NDCs. The project promotes activities in three regions (Africa, Asia and the Pacific, and the Mediterranean) and six countries (Ethiopia, Fiji, Lebanon, Morocco, the Niger and the Philippines). Its Technical Assistance Facility offers specialized technical assistance for integrating FLR and land use, land-use change and forestry in the investment frameworks of NDCs. The project also builds capacity for preparing project proposals for submission to dedicated land-degradation and climate financing instruments. The Technical Assistance Facility is funding studies to identify the potential of FLR to contribute to current NDCs and potential donors; studies for the revision of NDCs to better integrate FLR options; the preparation of FLR investment frameworks for national GCF investment frameworks; capacity-development workshops on climate financing instruments; and the preparation of submissions to the GCF and the Land Degradation Neutrality Fund for readiness support and project concept notes.

Box 5
Trees for Global Benefit: incentivizing smallholder-led investment in landscape restoration in Uganda

by Pauline Nantongo Kalunda, Ecotrust, Uganda

TGB is a cooperative carbon-offsetting scheme that links smallholder farmers in Uganda to the voluntary PES market. The project combines carbon sequestration with rural livelihood improvements through small-scale, farmer-led forestry and agroforestry projects while also reducing pressure on national parks and forest reserves. TGB is based on an innovative financing model that uses public financing from multilateral and bilateral donors to create diversified income streams, which kick in at different stages of smallholder-led reforestation projects. TGB works with thousands of smallholders (with each household treated as an economic unit) to develop land-use/business plans that include forestry as a livelihood strategy. TGB works with established community structures to mobilize farmers and monitor the implementation of land-use plans. Participating farmers receive training and attend workshops to identify forestry activities suited to their needs. Farmers are registered and enter into sale agreements, which specify the ecosystem services they will sell and the conditions for remuneration.

The programme is working with nearly 10 000 smallholders in five landscapes in western and eastern Uganda, mobilizing more than USD 1 million annually as foreign direct investment in smallholder-led agroforestry. The project uses the Plan Vivo certification system, which is a set of guidelines, procedures and standards for generating carbon offsets while promoting sustainable land use and improving livelihoods. PES payments create a credit history for each household, enabling it to access loan financing. In addition, PES agreements can be used as collateral for loans. The combination of PES payments and loan financing enables smallholders to consider longer-term investment horizons and to use their land to develop assets that provide both short-term cash and long-term benefits.

Multilateral Investment Guarantee Agency can insure investors against losses related to expropriation, breach of contract, war, terrorism and civil disturbance. Some bilateral agencies, such as the United States Agency for International Development, also provide first-loss guarantees for investments in innovative assets for which part of the risk is a lack of sufficient documented experiences on how the investments may perform over time.

A fourth group comprises financial instruments, products and institutional arrangements that enable the better sharing of investment risks and benefits and encourage longer investment periods. Green, carbon and impact bonds that relate investments to results-based payments are beginning to have promising outcomes, but such bonds have been little applied in restoration initiatives to date. Partnerships, including public–private partnerships, can be developed on the basis of multiple benefits becoming available at different times, some of which are marketable and some of which are not. If well designed, such partnerships can attract several types of investor, thus aggregating financial resources. Trees for Global Benefit (TGB) (Box 5), for example, shows how an implementing agency has been able to aggregate beneficiaries with differing needs and objectives, each contributing in different ways to forest restoration and conservation. TGB set up the scheme to help ensure the permanence of restoration actions and to enable the fair and equitable remuneration of all actors.

Enabling conditions for financing restoration

To attract both public and private investors to restoration projects, it is crucial to have a precise definition of the costs and benefits, including non-tradable benefits, and to measure and report on these. TEER has an important role to play here, along with the framework being designed to track progress in the United Nations Decade on Ecosystem Restoration. Public funds can be used to support early-stage activities to make projects more attractive to private investors.

Many restoration projects will provide both marketable and non-marketable benefits, and there is a need, therefore, to either attract investors interested in non-marketable benefits or make these marketable (in the same way that carbon credits are designed to monetize climate-change mitigation benefits). There is also a need to combine various types of investment with differing time horizons and objectives using appropriate financial and institutional mechanisms, including public–private partnerships.

CONCLUSION

It is widely acknowledged that FLR provides numerous benefits, including marketable and non-marketable products and ecosystem services, making it desirable for the global community – as expressed by numerous commitments by governments to increase the area of degraded land under restoration. But the magnitude of investment needed for restoration will require the unprecedented mobilization of public and private financial resources. These diverse investors have differing objectives, interests and constraints. Private actors that depend for their livelihoods on the land in which they are investing need to obtain profit in the short term. Public actors are generally more motivated by long-term social and environmental benefits. Some private institutional investors have long-term financial objectives. Sustainable finance generally combines lower expectations for financial returns with sustainability criteria. There are opportunities, therefore, to combine different sources of investment, to which are linked different types of expected benefits

and differing lengths of return on investment in restoration.

Climate finance offers new opportunities for financing restoration because dedicated funds are increasingly integrating co-benefits into their decision-making criteria. But such finance will be insufficient to meet the restoration goals of international agreements, and private resources, including among landowners and land users, need to be attracted. Public funding schemes can be used to facilitate the preparation of bankable projects, bridge the time lag between investments and revenues, reduce risks and ensure the provision of adequate remuneration and benefits to all categories of investor. All investors, regardless of their specific objectives, share the same need for precise, evidence-based estimates of the costs and benefits of restoration and of the risks associated with investment.

The COVID-19 pandemic is likely to have a deep impact on investment choices among both public and private actors. Governments face considerable increases in financial outlays to deal with immediate needs related to, for example, health, livelihoods and the economy. To a certain extent, these will compete with longer-term investments. At the same time, however, there is growing willingness among governments to direct financial support in ways that will "build back better", with an emphasis on addressing social and environmental issues. This can create opportunities for restoration projects, even in the short term, particularly where these can provide employment. Many private-sector actors will experience reductions in income, which will limit investment in the short term. But publicly funded incentives can be used to encourage investment as part of efforts to restore economies and employment. Moreover, the impacts of the crisis on stock markets and commercial and residential real estate may convince some institutional investors to diversify their assets, including towards land restoration projects, in ways that are less sensitive to financial ups and downs. Paradoxically, therefore, the COVID-19 pandemic may create opportunities to mobilize funding for restoration as part of a broad willingness to build back better – provided there is convincing evidence of the costs, benefits and risks of bankable projects.

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The United Nations Decade on Ecosystem Restoration: catalysing a global movement

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Providing evidence-based estimates of the costs, benefits and risks is key to increasing investment in the restoration of degraded landscapes.

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On 1 March 2019, under resolution 73/284, the United Nations (UN) General Assembly proclaimed 2021–2030 as the UN Decade on Ecosystem Restoration (hereafter "the Decade"), with the primary aim to "prevent, halt and reverse the degradation of ecosystems worldwide". The resolution recognizes that the numerous benefits accruing from ecosystem restoration can play a major role in achieving the Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development – including to end poverty, conserve biodiversity, combat climate change and improve livelihoods for everyone, everywhere.

For the purposes of the Decade, ecosystem restoration refers to a wide continuum of practices (Gann *et al*., 2019) that help conserve and repair damaged ecosystems, including the replenishment of organic carbon in agricultural soils and the restoration of biodiversity to states similar to those that existed before degradation. Many land managers have implemented various ecosystem restoration practices

Above: Thicket restoration in the Eastern Cape, South Africa; the thicket on the right is being restored and the remainder is degraded. The UN Decade on Ecosystem Restoration must lead to the scaling up of efforts to restore millions of hectares of degraded land worldwide

OLLIVIER GIRARD/CIFOR

over the past few decades, but the scaling up of these to millions of hectares has only recently gained momentum through initiatives such as the Bonn Challenge.[2] The Decade will build on these practices and initiatives as well as on other global, regional and national restoration commitments. This article explores the challenges in scaling up restoration, the vision for the Decade, the strategy for realizing this vision, and the approaches needed to implement the strategy.

THE ECONOMIC AND FINANCIAL CHALLENGE

An implicit challenge for foresters posed by the Decade is to develop new protocols for restoring degraded forests that maximize the contributions of restoration to the SDGs and assist societies to recover economically from the COVID-19 pandemic. Such protocols would optimize the economic, social and environmental benefits of restoration and focus on the extent to which investments in restoration can generate jobs and enhance rural economies (BenDor *et al*., 2015). A multidisciplinary assessment of the wide range of benefits arising from restoration would need to underpin the protocols. These benefits, which would vary considerably according to the type of restoration undertaken, may include increasing: water supply and quality; pollination services for the agriculture sector; soil stability and quality; carbon sequestration; biodiversity conservation; the resilience of ecosystems to climate change; and jobs and incomes. The selection of a given restoration protocol should draw on modelling of the ways in which different types and diversities of tree species will affect such benefits over time. Without modelling, decision-making may fail to take into account trade-offs between restoration approaches. Foresters will need to play a central role in highlighting the wide range of benefits of forest and landscape restoration (FLR), as well as the trade-offs, to prevent a focus on single (and possibly economically suboptimal) benefits such as carbon sequestration or income generation.

A further challenge for FLR advocates is to find innovative ways to finance the scaling up of restoration over hundreds of millions of hectares. An upscaling of this magnitude is unprecedented – yet necessary if FLR is to make a meaningful contribution to achieving the SDGs. For example, the restoration of large swathes of degraded tropical forest landscapes is needed urgently to achieve globally significant carbon sequestration (Lewis *et al*., 2019). Foresters will need to work with multidisciplinary teams of stakeholders to develop business models for catalysing large-scale restoration. Each landscape will need to be assessed on its merits and according to its socio-economic and biophysical context. Interventions in degraded landscapes could include natural regeneration, the planting of indigenous tree species, agroforestry, and timber plantations. In many landscapes, a mix of these and other interventions is likely to provide an optimal route forward (Ghazoul, Bugalho and Keenan, 2019; Guariguata *et al*., 2019). Agroforestry and timber plantations, for example, can ease the pressure on natural forests by providing woodfuel, timber, fodder and income. Local land-use planning will, however, also need to feed into the bigger picture – that is, at the global scale – if the SDGs (particularly related to climate-change mitigation) are to be achieved. Importantly, this integration of planning scales will require innovation by a wide range of local, national and international stakeholders. For example, restoration initiatives are known to receive greater support from local stakeholders if they are part of a global programme that has endorsed and recognized the importance of the work (C. Milne, personal communication, October 2019; this is also the experience of the authors). Through the Decade, such endorsement and recognition could become a standard part of high-quality restoration initiatives. Part of this connection between the local and global scales could include providing feedback to local initiatives on how their activities are contributing to global objectives and where adjustments could be made to further align local activities with global needs.

[2] See article on page 82.

This degraded area in the Chop Tasok Community Protected Area, Phnom Kulen National Park, Siem Reap Province, Cambodia, will be planted with indigenous trees as part of forest restoration efforts in communal areas

THE VISION OF IMPROVED HEALTH AND WELL-BEING

The overarching vision of the Decade is a world where – for the health and well-being of all life on Earth and those of future generations – the relationship between humans and nature has been restored by increasing the area of healthy ecosystems and putting a stop to their degradation and loss. Underpinning this vision are two main goals: enhancing global, regional, national and local commitments and actions to prevent, halt and reverse the degradation of ecosystems; and increasing and applying our understanding of successful ecosystem restoration in our education systems and in all public- and private-sector decision-making. An underlying premise of the Decade's strategy (see below) is that numerous sectors will take action to upscale ecosystem restoration when societies across the world are convinced that this will have major positive impacts on the well-being of current and future generations. Sufficient public and private finance will be made available, enabling policies and legislation will be implemented, and appropriate technical skills will be developed.

THE STRATEGY FOR UPSCALING RESTORATION GLOBALLY

Three pathways have been laid out for achieving the Decade's goals (see the theory of change in Figure 1):

I. Building a global movement
II. Generating political support
III. Building technical capacity.

Building a global movement

Pathway I, which will include many linked local networks, will focus on increasing the intent of societies worldwide to restore degraded landscapes on a large scale. Such restoration could be achieved through single investments in large areas (hundreds of thousands of hectares) or through many smaller initiatives that, in total, coalesce to result in a considerable increase in the supply of ecosystem goods and services in a particular location. A digital hub will be established in Pathway I that provides targeted calls to action for shifting societal norms and behaviours related to ecosystem restoration; two-way flows of information between the Decade's stakeholders; peer-to-peer learning; a platform for restoration practitioners to connect with investors and funders; compendiums of best practices

Workers harvest cuttings of the plant **Portulacaria afra** *for the restoration of thicket in the Eastern Cape, South Africa*

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in different ecosystems; and the tracking of current and past ecosystem restoration initiatives worldwide.

Work will be carried out with the finance sector to catalyse investments in ecosystem restoration by developing financing mechanisms such as global and local impact funds, microfinance, credit lines in banks, payment incentive schemes, public–private partnerships, state budget lines (national and subnational) and official development assistance projects. Calls to action for divestment from projects that degrade ecosystems will be detailed and disseminated via the digital hub. Bankable business plans and value chains that facilitate ecosystem restoration will also be developed and supported.

Generating political support

Pathway II will focus on assisting heads of state, ministers of finance, ministers of other relevant departments, business leaders and others to champion restoration in their respective countries. The aim will be to change legislative, regulatory and policy frameworks in ways that reduce the degradation of ecosystems and catalyse their restoration. Pathway I links with pathway II because increased political support will also be encouraged by greater public commitment to the upscaling of ecosystem restoration. Pathway II will facilitate dialogues within countries on ecosystem restoration – across sectors, within and between governments and within the private sector – on the interventions needed to embark on restoration. Such dialogues will address, among other things:

- redirecting fossil-fuel, agricultural and fishing subsidies to conservation and ecosystem restoration;
- supporting micro, small and medium-sized enterprises within value chains that promote ecosystem restoration;
- developing land-tenure and fisheries-management systems that incentivize individuals and local communities to make long-term investments in ecosystem protection and restoration;
- investing in research and development to maximize returns from the restoration of specific local ecosystems;
- introducing legislation, policies and regulations that incentivize the private sector to invest in ecosystem restoration;
- ensuring that ecosystem restoration is central to all resource-use planning processes; and
- incorporating data on ecosystem restoration into routine national accounting.

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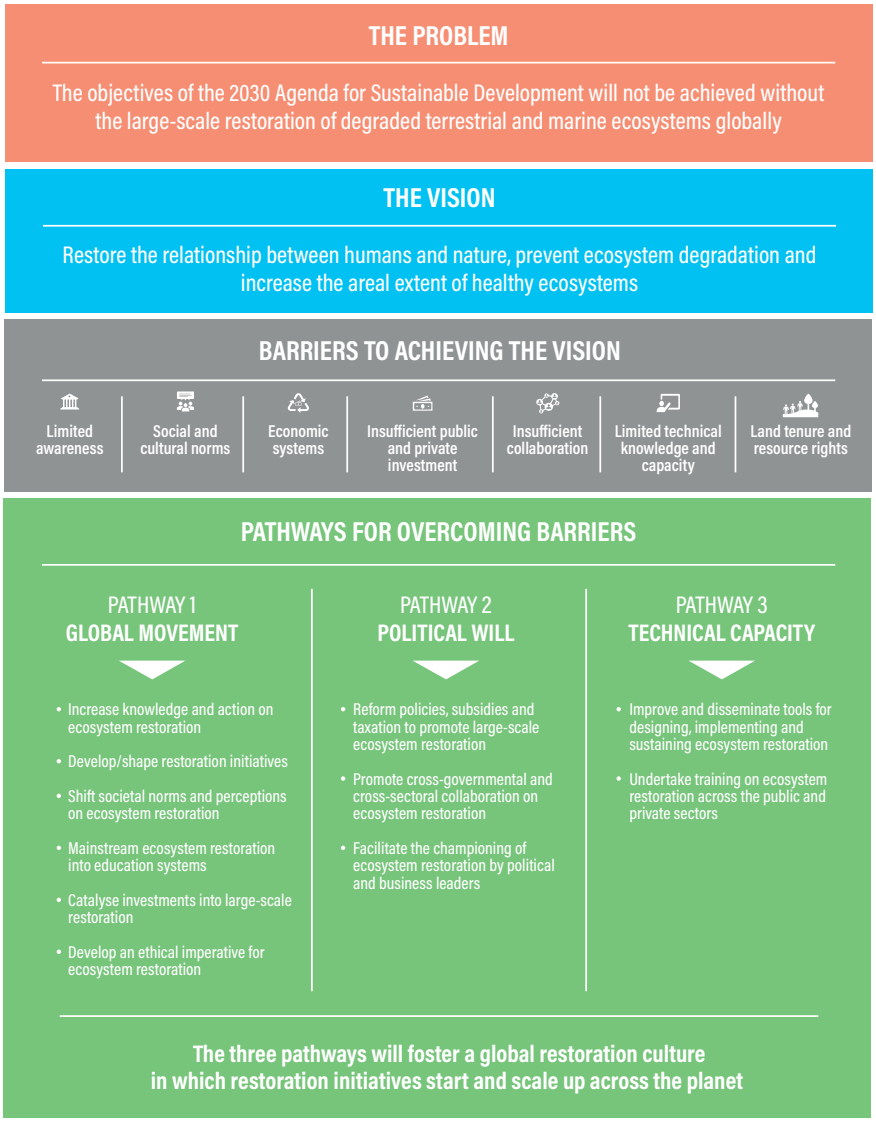
Seedlings of an indigenous species for planting out in the Chiork Boengprey Community Protected Area, Boeng Peae Wildlife Sanctuary, Kampong Thom Province, Cambodia. Scaling up restoration efforts includes the production of very large numbers of seeds and seedlings

Building technical capacity

Pathway III will focus on providing the best available methods for designing, implementing and sustaining ecosystem restoration initiatives for use by institutions involved in ecosystem restoration as well as by individual restoration practitioners globally. The aim will be to increase the role of science, indigenous knowledge and traditional practices in upscaling ecosystem restoration. Tools for monitoring and evaluation, conducting baseline studies, undertaking primary research, and developing site-specific ecosystem restoration protocols will be disseminated via the Decade's digital hub. Training courses on upscaling ecosystem restoration will also be developed and conducted for a wide range of stakeholders, including restoration practitioners, politicians, schoolteachers, academics, scientists, Indigenous Peoples, local community trainers, government technicians and youth.

IMPLEMENTATION

Recognizing the abundance and diversity of restoration efforts taking place globally, the Decade will rally support from a wide range of stakeholders – governments (at the national, subnational and local levels), non-governmental organizations, private-sector entities, academic institutions, civil society, women's groups, faith groups, Indigenous Peoples' groups and youth organizations – to continue their efforts and to start new initiatives that protect, sustainably manage and restore ecosystems. The Decade will also engage with individuals willing to volunteer their expertise and time to catalyse and implement the hundreds of thousands of initiatives that will help restore the relationship between humans and nature as well as create jobs in the aftermath of the COVID-19 pandemic. The



1 The theory of change for the UN Decade on Ecosystem Restoration, highlighting the problem, vision and barriers, and the three pathways for overcoming the barriers

UN Environment Programme (UNEP) and FAO, as the Decade's lead implementing UN agencies, will facilitate collaboration among governments and all other stakeholders (including organizations and individuals) wherever feasible.

Many of the activities to be carried out during the Decade will build on previous and existing initiatives. An important role of the Decade will be to assist stakeholders in identifying such initiatives and supporting their expansion in ways that optimize resource use and prevent unnecessary duplication. The Decade will also build on other ongoing initiatives, such as UN-REDD, and other decades, such as the UN Decade on Family Farming (2019–2028) and the UN Decade of Ocean Science for Sustainable Development (2021–2030). All initiatives seeking to contribute to the Decade's vision will be welcomed as partners.

Governance

As the Decade's two lead UN agencies, the main roles of FAO and UNEP will be to empower others to plan, implement and monitor ecosystem restoration; coordinate and promote the Decade; share knowledge, tools and lessons learned; and report on the success of the Decade to the UN General Assembly and donors. UNEP and FAO will also implement on-the-ground ecosystem restoration activities, drawing on the work they have done under other projects and programmes. The two agencies will be joined in their ecosystem restoration efforts by many other organizations working in countries and regions. The scale of the global challenge is such that all existing, and many new, actors will need to work together. Subject to the availability of resources, FAO and UNEP will establish a small joint core team to coordinate the Decade's activities and manage communications.

Facilitating collaboration

The institutions charged with leading the implementation of the Decade will use, among other tools, its digital hub and social media to coalesce the global movement of organizations and individuals involved in ecosystem restoration. Among its unifying actions, the Decade will serve to generate and share information, raise funding, develop calls to action, host dialogues and inspire people across all economic sectors to advocate for widespread ecosystem restoration. Media platforms such as Facebook, Instagram and Twitter will facilitate the rapid dissemination of information derived from a wide range of sources, including academics, ecosystem restoration practitioners and the public. Webinars will build capacity on specific technical topics, such as restoration protocols for different ecosystems, and the digital hub will provide a repository of easily searched and categorized information on the design, implementation and maintenance of ecosystem restoration. The digital hub will enable the showcasing and recognition of local ecosystem restoration initiatives on the international stage. Thus, the Decade will assist in elevating the prominence of such initiatives among decision-makers and communities by

showing how their local activities are contributing to the SDGs. The digital hub will also be used to coordinate activities that have regional or global application.

It is envisaged that the Decade's calls to action will result in the informal, spontaneous emergence of local activities coordinated by volunteers (individuals and organizations), including through peer-to-peer learning. Youth organizations will be particularly important for galvanizing the global movement given their presence at a local level and strong role in social media trends and activities.

Working with educators

Ensuring that ecosystem restoration features prominently in decision-making globally in the decades ahead will require educating children on the benefits to be derived from ecosystem restoration, conservation and sustainable use – and this, therefore, will be a focus in 2021–2030. Given the considerable influence of the UN and its member states on the content of school curricula, and the immense power of social media, the Decade provides the world with an opportunity to ensure that an entire generation of school children – who are society's future decision-makers – fully understand the benefits derived from ecosystems and the need for their restoration. The UN Educational, Scientific and Cultural Organization, and other Decade partners working globally in the primary, secondary and tertiary education sectors, will be invited to embed ecosystem restoration into education by adjusting curricula and introducing extracurricular activities. An immediate focus on school curricula and extra-curricular activities at the start of the Decade will enable children aged 6–8 years in 2021 to receive at least ten years of education on ecosystem restoration by decade-end. The careful design of lessons on ecosystem restoration for different age groups will ensure that each year of education adds new layers to a child's understanding. By the time the child leaves school, they will be in a position to form sophisticated views on the importance of ecosystem restoration and the ways in which society should be allocating its resources for it.[3] Greenpop, a local non-governmental organization in Cape Town, South Africa, is pioneering such work by designing lessons for maths, science, geography and English primary-school teachers that can be held outdoors in restoration gardens planted by pupils.[4]

Showcasing flagship initiatives

Existing ecosystem restoration initiatives worldwide will be an important source of information for the Decade's stakeholders. FAO and UNEP will facilitate the systematic analysis and sharing of barriers encountered and successes achieved in such initiatives, enabling new initiatives to optimize their approaches based on worldwide experiences. Flagship initiatives that are leading the way in terms of exemplary practices will also be identified. These will be selected using criteria such as government endorsement; activities that fall within the continuum of ecosystem restoration practices developed by the Society for Ecological Restoration (Gann *et al*., 2019); frequent cross-sectoral dialogues among stakeholders; and the potential for replication and further upscaling.

Engaging heads of state and ministers

The Decade's promotors will encourage and support heads of state, ministers of finance, ministers from other government departments, and business leaders to champion ecosystem restoration through, for example, changes to national accounting systems, fiscal policies, land-tenure systems and fisheries management systems. Many initiatives are well positioned to provide such support. The UN System of Environmental-Economic Accounting (SEEA), for example, advises governments on how to include data on agriculture, forestry, fisheries, air-pollutant emissions, energy, ecosystem health, material flows and water in their national accounting systems and on how to use these data for holistic decision-making. It is anticipated, therefore, that SEEA will assist in elevating the profile of ecosystem restoration in societal decision-making and in tracking progress on ecosystem restoration initiatives, both nationally and globally.

Unlocking finance

The cost of restoring 350 million hectares of degraded forest landscapes is likely to be in the order of USD 1 trillion (NYDF Assessment Partners, 2019). By comparison, the global cost of fossil-fuel and agricultural subsidies currently exceeds several trillions of United States dollars annually (Coady *et al*., 2015; OECD, 2019).[5] Given the scale of forest degradation and the potential benefits of restoration, investing USD 1 trillion over a decade would be prudent and realistic (Barbier and Hochard, 2014; De Groot *et al*., 2011; IPBES, 2018). Indeed, it is a relatively modest starting point (about 0.1 percent of expected global gross domestic product over the course of the Decade)[6] for the Decade as a whole, with larger allocations expected to be made when communities start experiencing the returns on initial investments in ecosystem restoration (FAO and Global Mechanism of the UNCCD, 2015).[7] Benefit:cost ratios of 10–37 can be expected for forest restoration, based on analyses of existing

[3] The social media hashtag for encouraging school children to join the Decade's global movement on ecosystem restoration is likely to be #restorationgeneration.

[4] More information on Greenpop's work is available at https://greenpop.org/fynbos-for-the-future.

[5] The total cost of fossil-fuel subsidies globally, when taking externalities into account, is estimated at USD 5.3 trillion per year (Coady *et al*., 2015). The total support to agriculture (including support to farmers, general services to the sector, and consumer subsidies) across a sample of 53 countries covered by the latest Organisation for Economic Co-operation and Development Agricultural Policy Monitoring and Evaluation report was estimated at USD 705 billion per year in 2016–2018 (OECD, 2019).

[6] Based on a global gross domestic product of USD 86 trillion in 2019, with 2 percent annual growth.

ecosystem restoration initiatives across a wide range of ecosystems (TEEB 2009; De Groot *et al*., 2013; Verdone and Seidl, 2017). These ratios are, however, likely to be conservative because few in-depth economic analyses of restoration efforts have been conducted. To address this knowledge gap, a coalition of partners launched an initiative called "The Economics of Ecosystem Restoration" in 2019.[8]

Numerous existing coalitions and forums are well positioned to help governments make "fast and fair" changes to subsidy and taxation regimes and the regulatory environment to make more finance available for ecosystem restoration. The changes would be fair because they would reduce unintended negative consequences of subsidies, taxes and regulations (e.g. biodiversity loss, land degradation and climate change) and strengthen intended consequences (e.g. in terms of social cohesion, food security, resilience and natural capital). Such changes would redirect subsidies to catalyse ecosystem restoration on a vast scale (i.e. hundreds of millions of hectares). Other avenues for policymakers to support resource mobilization for restoration include mainstreaming restoration into national budgets, establishing appropriate funding mechanisms, engaging with the private sector, and attracting investors (FAO and Global Mechanism of the UNCCD, 2015). The Decade will provide a conducive environment in which governments can pursue these routes.

Large corporations, small businesses and individual entrepreneurs can play crucial roles in the Decade by developing bankable business plans for restoration initiatives that take into account the full suite of benefits expected over the long term. In some landscapes, bankable plans will only be achieved by blending the returns from public benefits (e.g. increased supplies of clean water, improved public health, and carbon sequestration) with private goods (e.g. increased revenues from tourism and agricultural operations). In such cases, public–private partnerships will need to be developed through intensive collaboration between ministries of finance and the private sector.

Deploying science and technology in ecosystem restoration

The Decade's stakeholders will be encouraged to support ecosystem restoration initiatives globally by providing scientific guidance, undertaking research, deploying technology where feasible, guiding policymakers on best practices, and taking indigenous knowledge and traditional practices into account when designing restoration interventions. Several initiatives are already under way to synthesize and disseminate lessons learned from existing experiences in ecosystem restoration, such as the Restoration Resource Center Project Database (a compilation of ecosystem restoration projects worldwide managed by the Society for Ecological Restoration); the EcoHealth Network (which increases awareness of the benefits of ecological restoration among policymakers and the public, particularly in the field of public health); the Global Land Outlook (a communication platform of the UNCCD Secretariat); the UNCCD's Knowledge Hub (which collates the best available scientific and technical knowledge on reversing land degradation); FAO's Forest and Landscape Restoration Mechanism knowledge platform; and the Convention on Biological Diversity's Forest and Landscape Restoration Initiative database. These and other initiatives are well positioned to provide both information and inspiration to ecosystem restoration practitioners wanting to embark on ecosystem restoration projects for the first time or to upscale existing initiatives.

Two task forces focused on monitoring and best practices, comprising individuals from key partner organizations in ecosystem restoration, have been set up under FAO's leadership to prepare the ground for, and provide services over, the Decade. The task force on best practices is supporting knowledge management and dissemination efforts aimed at making a wide range of relevant, high-quality resources (e.g. manuals, guidelines, websites, training materials and expertise) available. The task force on monitoring is developing a framework for operational monitoring and reporting; serving as a focal point for technical guidance on restoration monitoring over the Decade; and identifying initiatives (covering a wide range of ecosystems) that are monitoring and reporting on restoration efforts.

CONCLUSION

The UN Decade on Ecosystem Restoration provides the global forest sector with an enormous opportunity to make a major contribution to the achievement of the SDGs by 2030. To realize it, forest managers and policymakers will need to develop ambitious visions of how to upscale forest restoration across hundreds of millions of hectares. Multidisciplinary teams will need to develop comprehensive business cases for governments and private-sector investors that provide details on the multiple benefits of forest restoration. New policies and legislation will need to be developed and enforced to support investments in restoration in the order of USD 1 trillion. Foresters and other land-management professionals – in consultation with all stakeholders – will need to design protocols for restoration that are tailored for specific landscapes and take into account trade-offs between sectors as well as local and global needs. Technical capacity to implement these protocols will need to be built in the public and private sectors. Lastly, societies worldwide will need to be convinced of the global restoration imperative by rational economic argument, compassion for current and future generations, and an emotional connection to nature.

There is insufficient time to achieve the

[7] It has been estimated that USD 4.8 trillion would be required to restore 2 billion hectares of land and in so doing achieve SDG Target 15.3 relating to land degradation neutrality (FAO and Global Mechanism of the UNCCD, 2015).

[8] See article on page 109 of this edition for more information on this initiative.

SDGs by 2030 if large-scale restoration projects stall while awaiting research results to fully de-risk the massive investments needed. The multiple crises of climate change, biodiversity loss and economic damage as a result of the COVID-19 pandemic make ecosystem restoration even more urgent, and global taxpayers will need to accept the risks associated with implementing an unprecedently large programme of restoration projects. Such risks will inevitably decline over time as lessons are learned. The UN Decade on Ecosystem Restoration offers the promise of mobilizing the support of taxpayers, and consequently political and business leaders, to not only accept the risks but to eagerly implement FLR at the scale required for the health and well-being of present and future generations.

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World Forestry Congress in 2021

The XV World Forestry Congress will be held on 24–28 May 2021 at the COEX Convention and Exhibition Center, Seoul, Republic of Korea, hosted by the Government of the Republic of Korea. The congress will bring together global forest stakeholders to review and analyse the key challenges facing the forest sector and ways to address these. Participation will be diverse, with representation from all regions and sectors and including the public and private sectors, non-governmental and civil-society organizations, scientific and professional bodies, students, and forestry societies, as well as non-specialists who simply care about forests and the environment.

WFC 2021 will provide a unique opportunity for the global forestry community to consider the state and future of world forestry, particularly in the context of recovery from the COVID-19 pandemic, while striving to achieve the Sustainable Development Goals. The theme of the congress is *Building a green, healthy and resilient future with forests* and there are six subthemes:

1. Turning the tide: reversing deforestation and forest degradation
2. Nature-based solutions for climate-change adaptation and mitigation and biodiversity conservation
3. The green pathway to growth and sustainability
4. Forests and human health: revisiting the connections
5. Managing and communicating forest information and knowledge
6. Forests without boundaries: enhancing management and cooperation.

More information: https://wfc2021korea.org/sub02/theme.html; info@wfc2021korea.org

Building back better: COVID-19 pandemic recovery contributions from the forest sector

The COVID-19 Forestry Webinar Week was convened on 22–25 June 2020 to explore the impacts of the pandemic on the forest sector globally and the sector's potential contributions to recovery. The week featured several virtual sessions per day, with each session attracting 250–350 participants. Panellists from six governments, four United Nations agencies, two intergovernmental organizations, 15 non-governmental organizations and four private-sector institutions provided insights. The week was organized and opened by FAO and the Collaborative Partnership on Forests.

As COVID-19 has spread around the world, multiple impacts have become visible, and forests and forestry have been affected in many ways. Businesses have been disrupted along almost all value chains, and people are losing jobs and income, with some migrating from

urban to rural areas in search of subsistence. There is a heightened risk of deforestation and forest degradation, with potentially long-term negative consequences for societies and forest producers.

Forests act as safety nets for many vulnerable people, providing food, subsistence and income in times of scarcity and thereby increasing their resilience to shocks. Forestry and the forest-based sectors, therefore, have key roles to play in the recovery from the COVID-19 pandemic.

Given the link between climate change and emerging diseases, it is imperative to strictly control legal and illegal deforestation and forest degradation and to improve forest governance through people-centred policies. Education and investment in human capital focusing on equity – especially gender equity – is essential for building a net-zero-carbon future. People living at the margins of societies need to be at the centre of recovery plans. A comprehensive approach across value chains is required, focusing on the most vulnerable groups. Close collaboration with the health sector will help ensure a safe return to work in the forest industry that does not jeopardize rural communities.

The webinar week addressed the central role of functioning forest ecosystems for human health, with zoonotic disease outbreaks often associated with forest destruction and degradation. Addressing the global health crisis requires repairing the relationship between societies and nature – participants strongly called for a change in the ways that societies interact with nature to avoid future pandemics.

The priority for building back better should be to rebalance the demands placed on nature by societies based on evidence and through joint action. A sustainable forest sector should be a core element of national COVID-19 recovery plans – planting the seeds for a circular economy and a green future.

More information: www.fao.org/about/meetings/cofo/covid-19-forestry-webinar-week

Remembering Jim Ball and El Hadji Sène

It is with great sadness that FAO Forestry announces the passing away of two former staff members, Jim Ball and El Hadji Mbara Sène.

Jim Ball had a long and distinguished forestry career, equally at home in the field planting trees in muddy boots and on a podium orchestrating large international meetings. Jim worked for FAO from 1974 to 2001 as a technical officer and project manager in field projects in Nigeria and the Sudan and at FAO headquarters in Rome. At the time of his retirement, he was Chief of FAO's Forestry Information and Liaison Unit, in which capacity he served as secretary of the Committee on Forestry and Chair of the Unasylva Editorial Advisory Board. He remained a member of the latter board until his death in April 2020.

El Hadji Sène was Director of Water and Forests in Senegal before joining FAO as a staff member in 1986. At FAO he was successively Arid Zone Forestry Officer, head of the Forest and Arid Lands Conservation Service and Director of the Forest Resources Division, and he was awarded the French Order of Agricultural Merit. After retirement from FAO, El Hadji served as Mayor of Sokone, Senegal, for five years. El Hadji Sène was a talented poet, and former colleagues remember him as an excellent professional, deeply cultured and humble, and a "wise man among the wise".

Both Jim and El Hadji were great mentors, role models and friends to dozens of colleagues at FAO and respected partners to many forestry professionals throughout the world. The world's forests and forest-dependent people have lost two lifelong champions.

Mount Ararat, Armenia

International Mountain Day 2020

International Mountain Day is held each year on 11 December to recognize the role mountains play in sustaining human communities and the planet. The 2020 edition will draw attention to mountain biodiversity.

Mountains loom large in some of the world's most spectacular landscapes. Their unique topography, compressed climatic zones and isolation have created the conditions for a wide spectrum of life forms. Biodiversity encompasses the variety of ecosystems, species and genetic resources, and mountains have many endemic varieties. The differentiated topography in terms of altitude, slope and exposure in mountains offers opportunities to grow many high-value agricultural, horticultural, livestock and forest species. Moreover, the diversity within this assortment of species and ecosystems serves a valuable purpose. For example, certain mountain livestock herds have been bred for disease resilience. Mountains perform many other functions, such as providing clean water for half the world's population and a home for 15 percent of humanity.

As temperatures rise due to climate change, the struggle for survival will become even harder among impoverished people who rely on precious mountain resources. International Mountain Day 2020 will help inform a wide audience – especially youth – about the challenges faced by mountain biodiversity and how we can all help spread awareness and make a difference to a global problem on a communal scale.

More information: www.fao.org/international-mountain-day and www.un.org/en/observances/mountain-day

World conservation congress

The International Union for Conservation of Nature (IUCN) World Conservation Congress, originally scheduled for 2020 and now likely to be held in 2021 (dates to be announced in light of COVID-19), represents an opportunity to set priorities and drive conservation and sustainable development action. IUCN's more than 1 400 members, comprising governments, government agencies, and civil-society and indigenous peoples' organizations, will vote on action to guide humanity's relationship with the planet in the decades ahead. IUCN's unique and inclusive membership – not solely government or non-government, but both together – will give the congress a powerful mandate.

The congress will also serve as a marketplace for conservation and sustainable development science, practice and policy. Scientists, policy experts, business leaders and professionals from around the world will share their experiences, innovations and latest research. The congress, which will feature 1 300 interactive sessions, is expected to attract more than 10 000 participants from 160 countries.

More information: www.iucncongress2020.org

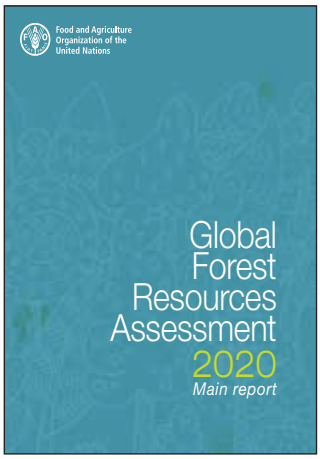
World conference on ecological restoration

The Ninth World Conference on Ecological Restoration will be held in Quebec City, Canada, on 19–24 June 2021 (postponed from 2020). It will bring together experts in the scientific, technical, socio-economic and policy dimensions of restoring degraded ecosystems across all biomes and continents. Conference participants will discuss and debate big-picture issues and broad trends as well as tools, techniques, research and policies. The conference is expected to draw more than 1 000 delegates from around the world.

Jointly convened by the Society for Ecological Restoration, the Canadian Land Reclamation Association and Université Laval, the conference's theme will be "reclaim, restore, rewild". Conference attendees will participate in symposia, workshops, trainings and field trips to examine diverse approaches to terrestrial and aquatic restoration along the restorative continuum, as well as how communities engage with restoration. The plenary sessions will feature speakers from across the world, and a high-level panel will explore the role of wetland restoration as a tool for improving biodiversity and mitigating climate change – both pressing topics at the launch of the United Nations Decade on Ecosystem Restoration. The conference will provide a dynamic platform for discussing the many ways of reversing ecosystem degradation at the regional, national and international levels.

More information: www.ser2021.org

BOOKS



Monitoring the world's forests

Global Forest Resources Assessment 2020 – Main report. FAO. 2020. Rome. https://doi.org/10.4060/ca9825en. ISBN 978-92-5-132974-0.

Forests have immense potential to support sustainable development pathways, and the key to realizing this is reliable evidence. Accurate information on forest resources is also needed to monitor progress towards the nationally determined contributions of countries under the Paris Agreement on climate change; the Global Forest Goals and Targets of the United Nations Strategic Plan for Forests 2017–2030; and the forthcoming post-2020 global biodiversity framework and United Nations Decade on Ecosystem Restoration.

FAO completed its first assessment of the world's forest resources in 1948. Since then, the Global Forest Resources Assessment (FRA) has evolved into a comprehensive evaluation of forest resources and their condition, management and uses, covering all the thematic elements of sustainable forest management.

The Global Forest Resources Assessment 2020 (FRA 2020), the latest of these assessments, examines the status of, and trends in, more than 60 forest-related variables in 236 countries and territories in the period 1990–2020. This main report of FRA 2020 presents a comprehensive view of the world's forests and the ways in which the resource is changing.

According to the report, for example, the world has a total forest area of 4.06 billion hectares (ha), which is 31 percent of the total land area and equivalent to 0.52 ha per person. The tropical domain has the largest proportion of the world's forests (45 percent), followed by the boreal, temperate and subtropical domains. The report finds that the world has lost 178 million ha of forest since 1990.

The wide-ranging data reported in FRA 2020 will support the development of sound policies, practices and investments affecting forests and forestry.

Available online: www.fao.org/3/ca9825en/CA9825EN.pdf

The state of forest biodiversity

The State of the World's Forests 2020 – Forests, biodiversity and people. FAO & United Nations Environment Programme. 2020. Rome. https://doi.org/10.4060/ca8642en. ISBN 978-92-5-132419-6.

As the United Nations Decade on Biodiversity 2011–2020 comes to a close and countries prepare to adopt a post-2020 global biodiversity framework, this edition of *The State of the World's Forests* examines the contributions of forests – and of the people who use and manage them – to the conservation and sustainable use of biodiversity.

Forests cover just over 30 percent of the global land area, yet they provide habitat for the vast majority of the terrestrial plant and animal species known to science. But forests and the biodiversity they contain are under threat from unsustainable exploitation – much of it illegal – and conversion to agriculture.

The State of the World's Forests 2020 assesses progress towards global targets and goals related to forest biodiversity and examines the effectiveness of policies, actions and approaches in terms of both conservation and sustainable development outcomes. Case studies provide examples of innovative practices that combine the conservation and sustainable use of forest biodiversity to create balanced solutions for people and the planet.

Available online: www.fao.org/3/ca8642en/CA8642EN.pdf

Promoting the pollinators

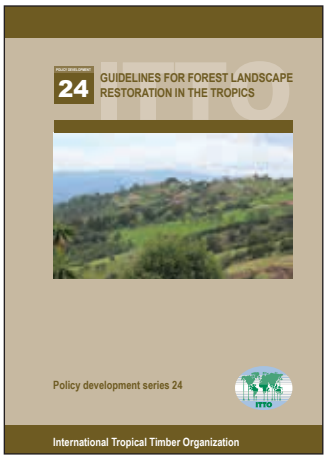
The pollination services of forests – A review of forest and landscape interventions to enhance their cross-sectoral benefits. Forestry Working Paper No. 15. Krishnan, S., Wiederkehr Guerra, G., Bertrand, D., Wertz-Kanounnikoff, S. & Kettle, C.J. 2020. Rome, FAO and Bioversity International. https://doi.org/10.4060/ca9433en

ISBN 978-92-5-132813-2.

Pollination is the process of transferring pollen from a male part of a flower (anther) to the female part (stigma) to enable fertilization and the production of seeds. Most flowering plants, including wild species and many food crops, are pollinated by animals, which are vital, therefore, for biological production and the maintenance of biodiversity. Pollinators benefit from diverse natural habitats for forage and nesting, especially when these are limited in plant production systems. Landscape and forest management practices can help ensure the continued availability of pollinators and thereby increase resilience and the productivity of forestry and agriculture.

This working paper, which is aimed at forest practitioners, landscape planners and land-use decision-makers, reviews published literature on the impacts of forest and landscape management practices on pollinators. It also addresses the implications of climate change, collates 36 case studies, and makes recommendations on measures for maintaining pollinator diversity and abundance in forests and landscapes. At the landscape scale, such measures may include landscape-scale planning to maintain key landscape components on which pollinators depend; ensuring habitat connectivity, including through agroforestry; creating biological corridors or stepping stones; and retaining native vegetation. At the forest management scale, potential measures include establishing baselines of pollinator diversity and abundance and monitoring these over time; where fire is used as a management tool, maintaining a mosaic of burned and unburned pollinator habitat; and drawing on and learning from indigenous and local knowledge about pollinators and phenologies.

Available online: www.fao.org/3/ca9433en/CA9433EN.pdf



Restoring tropical forests

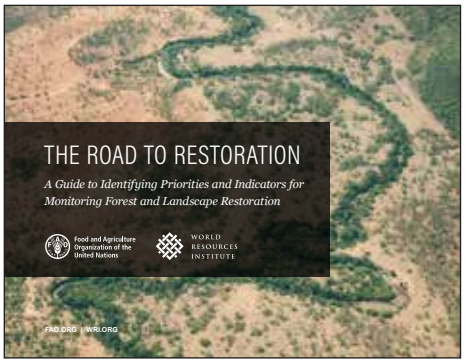
Guidelines for forest landscape restoration in the tropics. ITTO Policy Development Series No. 24. International Tropical Timber Organization (ITTO). 2020. Yokohama, Japan.

Enormous changes have occurred in tropical forest landscapes in recent decades, and large areas—nearly a billion hectares—have become degraded and require restoration. Considerable knowledge and experience exists on how to restore degraded forest landscapes, and there are many inspiring examples of success in the tropics.

These guidelines on forest landscape restoration (FLR) in the tropics have been compiled by two world-renowned experts based on vast recent experience in implementing FLR in the field and the invaluable inputs of forest landscape specialists and institutions from around the globe. The guidelines are presented in a comprehensive and easy-to-use form for policymakers, practitioners and other stakeholders; they provide guidance at the policy and operational levels for restoring degraded tropical landscapes for the benefit of local people and wider communities.

The guidelines, which include 18 case studies from the three tropical regions, are designed to provide a basis for policy decisions and a technical guide that can be used or adapted to the needs and capacities of users. They constitute an international reference document for the development and improvement of national and subnational guidelines on FLR in the tropics.

Available online: www.itto.int/policy_papers



Monitoring restoration

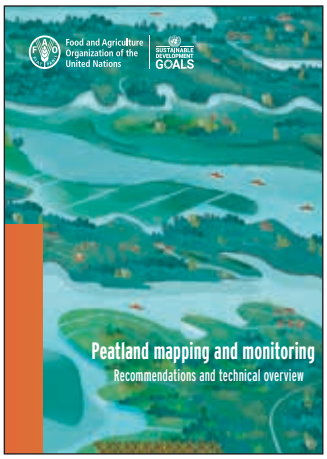
The road to restoration – A guide to identifying priorities and indicators for monitoring forest and landscape restoration. FAO & WRI. 2019. Rome and Washington, DC.

The aim of this guide is to help stakeholders develop monitoring systems tailored to their needs by identifying indicators and metrics for monitoring progress towards set goals. It emphasizes the need to make choices and understand potential trade-offs and synergies when designing restoration projects.

The guide walks users through seven questions related to goals and targets for restoration, land-use interventions, and barriers to sustainability. Through examples, the guide identifies considerations regarding constraints and priorities, data access and availability. It also discusses suitable indicators and shows how to create an index from those indicators.

The guide is not intended to be prescriptive. It is a supportive starting point designed to help stakeholders focus on specific landscape contexts. It provides entry points for considering goals and targets such as biophysical and social factors, ecosystem goods and services, and goals under United Nations initiatives to enable flexible approaches.

Available online: www.fao.org/3/ca6927en/CA6927EN.pdf



Putting peatlands on the map

Peatlands mapping and monitoring – Recommendations and technical overview. FAO. 2020. Rome. https: //doi.org/10.4060/ca8200en. ISBN 978-92-5-132295-6.

Peatlands have a naturally accumulated peat layer at their surface. In their natural state, peatlands store large amounts of carbon, which is released into the atmosphere if they dry out. This report gives an overview of key elements for developing peatland maps and integrating them into national land-use monitoring systems and reporting processes, describes the advantages and limitations of different choices, and offers practical guidance to facilitate decision-making. Mapping and monitoring methods are explored to ensure that carbon emissions and emission reductions are measurable, reportable and verifiable. Information is given on other benefits from peatland conservation, restoration, rehabilitation and sustainable management. Country case studies present current achievements. Finally, recommendations are made for the development of robust peatland mapping and monitoring.

Available online: www.fao.org/3/CA8200EN/CA8200EN.pdf

Restoration lessons

Forest landscape restoration implementation – Lessons learned from selected landscapes in Africa, Asia and Latin America. Occasional Paper No. 33. Stanturf, J.A., Mansourian, S., Darabant, A., Kleine, M., Kant, P., Burns, J., *et al*. 2020. Vienna, International Union of Forest Research Organizations (IUFRO). 63 p. ISBN 978-3-903345-03-4

Considerable effort has been devoted globally to promote forest and landscape restoration (FLR) and its potential to provide benefits for nature, climate and society; to date, however, there is limited evidence that progress has been made on the ground in restoring specific local landscapes. The aim of the analysis of FLR implementation in Africa, Asia and Latin America presented in this publication is to enhance understanding of the ecological, social and economic dimensions of FLR and the underlying challenges involved.

Seventeen landscapes in nine countries with Bonn Challenge commitments (Bangladesh, Brazil, Ethiopia, Ghana, Guatemala, India, Madagascar, Mongolia and Peru) were analysed as "snapshots" of FLR implementation. Local teams of scientists in cooperation with a global IUFRO team of FLR specialists collected data and interviewed people on-site. The analysis revealed 60 specific lessons learned, which were distilled into ten overarching lessons presented in this publication.

The publication attempts to link lessons learned from the analysis to progress made in achieving the Bonn Challenge goals. It suggests possible ways forward for global processes addressing the problems of deforestation and land degradation and concludes with a view on the outlook and implications for global FLR-related processes such as the Bonn Challenge.

Available online: www.iufro.org/publications/series/occasional-papers/article/2020/02/14/occasional-paper-no-33-forest-landscape-restoration-implementation-lessons-learned-from-selected

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Forests and alleviating poverty

Forests, trees and the eradication of poverty – Potential and limitations. A global assessment report. IUFRO World Series 39. Miller, D.C., Mansourian, S. & Wildburger, C., eds. 2020. Vienna, International Union of Forest Research Organizations. ISBN 978-3-903345-06-5.

According to the World Bank, more than 700 million people live below the international poverty line of USD 1.90 a day, a number expected to worsen due to the unpredictable consequences of the COVID-19 pandemic. It is timely, therefore, that the Global Forest Expert Panel on Forests and Poverty has released this global assessment report on how forests can contribute to poverty alleviation around the globe. An expert panel of more than 20 renowned scientists reviewed current research on key concepts for understanding forest–poverty dynamics, specific socio-economic and biophysical conditions influencing these, and possible levers for alleviating poverty in forests and tree-based landscapes. They investigated the implications of major global trends – such as climate change, the spread of infectious diseases and technological innovations – on poverty and sustaining forests. The report is a joint initiative of the Collaborative Partnership on Forests.

Available online: www.iufro.org/science/gfep/gfep-initiative/panel-on-forests-and-poverty

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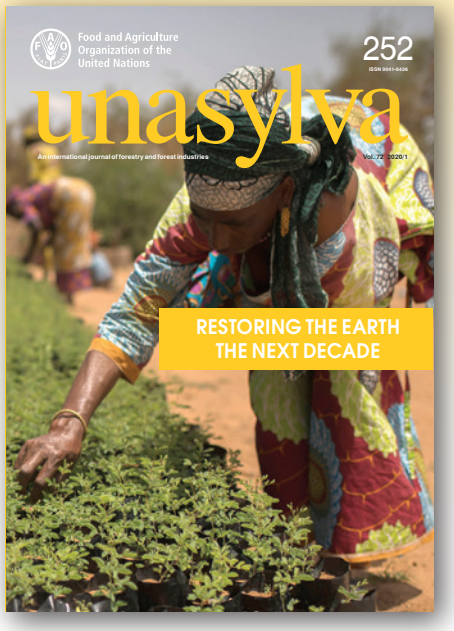

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Forest and Landscape Restoration Mechanism

FAO's Forest and Landscape Restoration Mechanism (FLRM), created in 2014, is a programme to help countries meet their ambitious pledges on the restoration of degraded forests and lands. In collaboration with its partners, the FLRM provides direct support to countries with a focus on:

- Developing the enabling conditions needed to take forest and landscape restoration (FLR) to scale.
- Providing technical assistance and capacity development for the implementation of FLR.
- Mobilizing resources and innovative financing instruments.
- Supporting the monitoring, reporting and assessment of FLR interventions.

More information: www.fao.org/in-action/forest-landscape-restoration-mechanism

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