RESEARCH PROGRAM ON

Water, Land and Ecosystems

CGIAR

LED BY:

IWMI

International Water
Management Institute

LEGACY BRIEF 1

Restoring degraded landscapes

A synthesis of evidence generated by the CGIAR Research Program on Water, Land and Ecosystems (WLE) to influence planning, investments, research, practice, capacity and policy

This synthesis brief draws on the experiences of the Restoring Degraded Landscapes sub-program, part of the CGIAR Research Program on Water, Land and Ecosystems (WLE). The brief captures learning from a decade (2011-2021) of research in development work with different stakeholders including farmers and governments across the world to reverse landscape degradation. It provides an overview of effective approaches, innovations and solutions that can be taken forward and scaled up to meet current and future challenges from land degradation – as well as the opportunities that may arise.

The program found that tackling landscape degradation requires:

■ Focusing on entire landscapes and providing solutions for different functions provided by the landscapes, rather than focusing on individual farm plots
■ Empowering women, youth and marginalized groups to take leading roles in restoration efforts and decision making
■ Establishing close three-way linkages between research, policy and development
■ Building political will, technical capacities and effective communications
■ Significantly scaling up successful approaches.

As WLE ends in 2021 after a 10-year journey, Restoring Degraded Landscapes innovations have now reached maturity and can feed into several global initiatives targeting landscape restoration. Over the course of these 10 years, WLE has generated strong evidence highlighting the potential of soil health restoration to become an important climate change mitigation and adaptation pathway.

Under a parallel global initiative, the Bonn Challenge, actors from 60 countries have already pledged to restore 210 million hectares of degraded and deforested lands, building on regional efforts such as Initiative 20x20 in Latin America and the AFR100 African Forest Landscape Restoration Initiative. The United Nations General Assembly has declared 2021-2030 the Decade on Ecosystem Restoration to mobilize resources for a massive scale-up of pilot initiatives with the potential to reverse the degradation of ecosystems, take gigatons of greenhouse gases out of the atmosphere, conserve biodiversity, and build human and landscape resilience against the impacts of climate change.
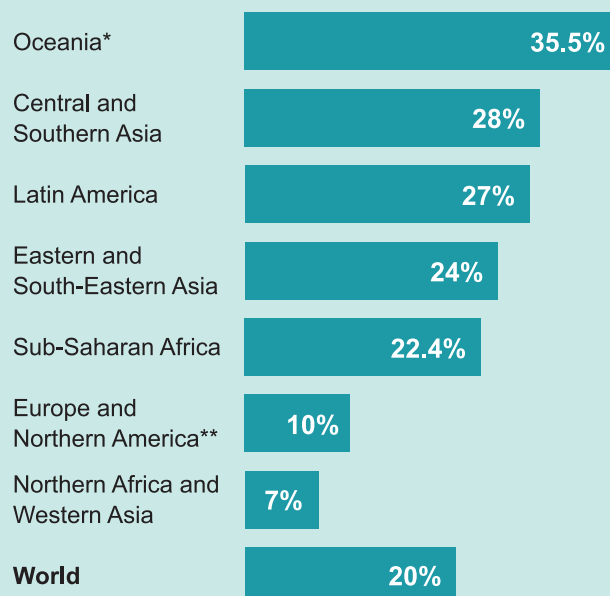

Aerial view of the Amazon Rainforest, near Manaus, the capital of the Brazilian state of Amazonas (*photo:* Neil Palmer / CIAT).

Landscape degradation: a 3.2-billion-person problem

Landscape degradation – the deterioration or loss of the productive capacity of soils – is progressing at an alarming pace (Figure 1). Globally, over a fifth of the total land area has already been degraded through deforestation, improper soil management, agricultural land expansion and desertification, causing substantial greenhouse gas emissions and leading to declines in the productivity of croplands and rangelands, food insecurity, higher food prices and the loss of biodiversity and ecosystem services. Among the 3.2 billion people affected, smallholder farmers and the very poor are being hit worst of all. Unless landscape degradation is effectively tackled, global crop yields are likely to decline even as the world's population continues to grow.

Oceania*	35.5%
Central and Southern Asia	28%
Latin America	27%
Eastern and South-Eastern Asia	24%
Sub-Saharan Africa	22.4%
Europe and Northern America**	10%
Northern Africa and Western Asia	7%
World	20%

Figure 1. Percentage of total land area reported as degraded land, 2000-2015

Note: *Including Australia, New Zealand and Papua New Guinea but excluding the islands of Oceania.
**Excluding Switzerland and the United States.
Source: United Nations Statistics Division 2019.

Widening the focus from farms to landscapes

WLE's research has shown that successful efforts to reverse landscape degradation must take into account the interactions between individual farm plots and the wider landscapes that surround them.

Given that agricultural farms, pastures, wetlands and forests all form parts of an intricate web, WLE research on restoration of degraded landscapes has evolved from a narrow focus on individual farms to a more expansive focus that takes in entire landscapes. Just as agriculture can have positive or negative impacts on surrounding areas, adjacent ecosystems influence the quality and productivity of the soil, water and ecosystem services on which farmers' livelihoods depend. Understanding the drivers of landscape degradation – and the impacts of landscape restoration efforts – requires a holistic approach that takes into account both on-farm and off-farm dynamics.

A key lesson is that increasing food and energy production, maintaining sources of clean water, reducing emissions of greenhouse gases, conserving biodiversity and improving livelihoods requires a wider focus that takes into consideration the landscape as a whole. For example, a global study co authored by WLE staff has highlighted the potential for "major ecosystem reorganization in the coming decades" as drought-induced changes to forest cover affect local water cycles and overall ecosystem resilience, with possible knock-on effects for adjacent farms (Batllori et al. 2020).

Conversely, practices that improve soil health such as conservation agriculture, integrated soil fertility and agrobiodiversity management, and agroforestry not only boost crop production but also positively affect many other ecosystem services (Kihara et al. 2020) including biomass energy production, water filtration, nutrient cycling, carbon sequestration, biodiversity conservation and erosion control. Recent studies in the Amazon show that forest remains and agroforestry systems can significantly help to conserve soil environmental services, and that even moderate tree planting contributes to the restoration of severely degraded landscapes, reducing greenhouse emissions while boosting livestock productivity. However, such interventions must reflect a strong understanding of the complex interlinkages between food and land systems in order to succeed.

Supporting landscape restoration in Chad and Kenya

Mapping by WLE is currently guiding landscape restoration efforts in Chad and Kenya. Combining analysis of the soil itself with indicators like vegetation cover, biodiversity, historic land use and visible signs of degradation, the maps provide an overview of soil and ecosystem health at the landscape level. In Chad, sampling 800 km2 of on-farm and off-farm land revealed widespread risks of soil erosion and low soil organic carbon, providing a baseline to inform the government's ongoing efforts to restore the Sahelian belt's fragile soil. In Kenya, WLE mapping fed into a national resource hub containing data and maps for restoration use, which plugs directly into a decision dashboard that will help steer soil health measures on the ground. In the future, WLE's data may enable local farmers to generate income from global carbon offset funding.

Making community agrobiodiversity management initiatives sustainable

WLE's work has strengthened the ability of community agrobiodiversity management initiatives to improve food security and biodiversity. These initiatives collect, store, produce and distribute local varieties of seeds and cuttings that are optimally adapted to the local soil and climate. By running seed banks and mother orchards, farmers are able to support and promote on-farm biodiversity and conservation measures within their communities. WLE has published guidelines for supporting farmers to develop their agrobiodiversity initiatives into sustainable businesses. A WLE project in Niger demonstrated the potential of this approach to generate strong buy-in and uptake by local communities.

Involving farmers as partners in research in development

Letting local farmers take the lead in identifying challenges and opportunities is crucial for developing effective solutions that enjoy wide community uptake.

Building successful partnerships is key to reversing landscape degradation, WLE's experiences have shown. Worldwide, working directly with farmers to co-design land management approaches is essential to develop interventions that will be widely taken up by local communities and deliver both environmental and socio-economic benefits.

WLE's work over the past decade has taken community ownership of landscape restoration efforts to new heights, with farmers themselves mapping local land use, leading research efforts and evaluating which interventions yield the greatest benefits. Farmers understand how their farm activities impact the wider environment and vice versa, and often know from personal experience how poverty can force people to over-exploit local resources. Leveraging this know-how, WLE has empowered farmers in Ghana, Tanzania and Malawi to become community advocates by filming, producing and directing films showcasing practical steps that their neighbors can take to use the land more sustainably.

Research has shown that forests being used and controlled by the communities that live there often fare better than those set apart by governments for conservation: in the Amazon, the oases of green are mostly where local communities manage the forest for their own uses. WLE built on this insight by working with a network of farmers in Colombia and Peru to co-design and jointly implement measures to restore deforested areas while boosting cattle rearing on deforested and degrading areas, co-investing to cover investment costs in the initial years.

Group of cattle ranchers asking about the benefits of intensive silvopastoral systems (*photo:* N. Castañeda / CIAT).

3

Farmers take the lead in mapping out feasible solutions

WLE's work on participatory mapping has demonstrated the benefits of drawing on farmers' extensive knowledge of local ecosystems and involving them in the design of landscape restoration approaches. For example, participatory mapping in Tanzania highlighted the impact of soil erosion on farm yields, and the differential impact of deforestation on farmers, with some now planting trees on their farms while others have to purchase timber and fuel wood with cash. In addition, the mapping revealed that the impacts of growing water scarcity could vary strongly from one village to the next. In general, communities use the entire surrounding landscape, with all land-cover types providing a variety of ecosystem services. Out of the 12 services identified, mapping participants identified nine that were in decline. By using participatory mapping to tap into local communities' vast network of knowledge, landscape restoration projects can better understand who has a stake in any changes in land management, identify areas where external investment is required, and determine which solutions are locally relevant and likely to be accepted by stakeholders. Working with farmers in this way is key to making agriculture more sustainable.

Farmer-led research maximizes learning, livelihoods and environmental benefits

In Ethiopia, Kenya, Mali and Niger, WLE placed farmers at the center of landscape restoration efforts by letting them lead the implementation of on-farm comparisons to test and innovate different land management practices to restore agricultural productivity and ecosystem health. More than 10,000 farmers were monitored over a period of three years to track and document the impact of landscape restoration options on socio-economic and environmental aspects as they experimented with a variety of soil and water conservation measures, tree management practices and composting systems. This approach – which differs radically from past development practice – embeds research into the development and scaling process, while empowering farmers to restore degraded lands. Comparisons of the performance of promising practices across differing contexts by farmers and local communities themselves ensures a process of co-learning by all stakeholders throughout the project cycle, enabling the design and precise targeting of landscape restoration strategies that maximize benefits both for farmer livelihoods and the wider ecosystem.

Social return on investment workshop in Othide village, western Kenya (*photo:* Neil Palmer / CIAT).

Achieving gender equality and women's empowerment

WLE's experience shows that collecting gender-disaggregated data and involving women in decision making is vital to ensure that landscape restoration interventions benefit and empower women as well as men.

Gender is a key factor affecting land management practices and the uptake and impact of measures to reverse landscape degradation. In many settings, men and women have access to different resources, engage in different on-farm and off-farm activities, have different preferences, and face different opportunities and constraints regarding the adoption of new approaches and technologies. Women and men may be responsible for growing different crops, farming in different zones, completing different phases of the cultivation cycle, or performing the same tasks using different tools.

A young girl carries forage for livestock, Xiang khouang Province, Laos (*photo:* Georgina Smith / CIAT).

Putting gender, youth and marginalized groups at the center of the agenda

WLE's work has firmly put gender at the center of the global landscape restoration agenda. WLE research on identifying the linkages between soil health and gender, taking advantage of gendered opportunities for restoring soil health, and integrating gender into mathematical modelling of agriculture and natural resource management, as well as country studies on the links between gender, poverty and soil fertility management, have had a strong impact on policy formulation and practice. WLE actively promoted the uptake of its research through academic publications, videos, webinars, workshops and presentations at numerous conferences and international forums.

Both gender roles and power relationships can shift when new livelihood strategies or farming techniques are adopted. Collecting gender-disaggregated data and involving women in decision making is vital to ensure that their needs and interests are met, and that land management interventions benefit and empower women rather than inadvertently marginalizing them even further, as happened in Gambia when women's gardens were taken over by men in the course of an agroforestry project.

Highlighting the importance of women's crops for nutrition security

The Barotse Floodplain of Zambia is an area with high biodiversity conservation value where multiple agricultural development interventions are seeking to improve nutrition and food security among residents, who every year suffer through a long and intense hungry season. Native vegetation cover in the region is in steep decline due to large-scale road construction, expansion of agricultural lands and climate change, threatening the maintenance of biodiversity and ecosystem services in the country's second-largest wetland. Looking beyond 'agriculture' and 'conservation' as two separate challenges, researchers conducted a gender-sensitive ecosystems services assessment in three communities to discover new options for sustainable agricultural development that would benefit women as well as men. Using coded cards, they collected gender-disaggregated data on how women and men access 17 different ecosystems services to identify differences in each cohort's constraints and opportunities.

The data showed that in some locations, women tended to work fields located in different eco-types, and cultivated more crop types than men did, enriching family diets. Also, while women and men both went fishing, women brought home smaller fish. By highlighting the importance of women's crops for nutrition security, such gender-sensitive assessments can avoid repeating the mistakes of the past, when programs exclusively focusing on cash crops often exacerbated intra-household power dynamics and heightened food insecurity. A gender focus enables planners to take into account the unique challenges that female farmers can face in adopting some practices and crops, and to develop interventions that deliver benefits for everyone in the community.

Influencing policy and practice at all levels

WLE's pioneering work on restoring degraded landscapes has significantly shaped efforts to move agriculture onto a more sustainable trajectory as researchers, policy makers and individual farmers have adopted approaches that deliver benefits both to people and to the landscapes that they inhabit.

WLE's research and experiences have highlighted the importance of widening the focus from farms to entire landscapes, involving farmers as partners in research and implementation, and gearing landscape restoration initiatives toward empowering women and sustainably using natural resources, including agrobiodiversity. They have also demonstrated the value of analyzing the impacts of existing policies and incentives on land management, and the need for new policies to overcome barriers to enhancing agrobiodiversity. WLE's research questions were oriented toward informing future research and policy formulation.

Approaches pioneered and developed by WLE have significantly shaped international, national and local agendas for reversing landscape degradation. For example, donor agencies as well as governments are increasingly considering the interconnectedness of soil, water, food and energy systems, and the possible synergies and trade-offs between them, in their development strategies. Armed with better and more policy-relevant information, decision makers are now rolling out and scaling up innovative approaches that simultaneously conserve water, enhance soil quality and boost smallholder livelihoods, and launching initiatives that enable livestock owners and crop growers to increase their incomes while preserving surrounding rain forests.

Supporting government action through better data

In Kenya, WLE supported the development of an online resource hub for Makueni County, where a high level of landscape degradation acutely threatens smallholders' ability to feed their families and provide a basic income. Using the SHARED approach, WLE partners brought together a wide range of diverse stakeholders around a 'data wall' of existing datasets and maps to discuss the challenge and develop solutions. The local government recommended the development of a database of existing activities within Makueni to identify gaps and needs, mobilize partners and make tools accessible for prioritizing and implementing future investments. In a workshop, participants defined their information needs and co-designed the resource hub. Designed by users for users, the resulting decision dashboard brings together maps and data in a way that supports evidence-based and effective local government action. Going forward, the Makueni County government will use the resource hub to better integrate its various ongoing initiatives targeted at landscape restoration and improving market access, agricultural productivity and nutrition. Worldwide, six local governments are using similar WLE-supported data hubs to inform their efforts to reverse landscape degradation.

Annual Meeting of the Initiative 20x20, at the International Center for Tropical Agriculture (CIAT) headquarters in Colombia (*photo:* Neil Palmer / CIAT).

Using evidence to shape policy – and vice versa

Across the parched and degraded landscapes of Ethiopia, the scale of environmental deterioration is clearly visible. The cost of soil degradation alone drains the Ethiopian economy of $4.3 billion every year, but WLE research has demonstrated that effective soil and water management measures can reduce soil erosion by up to 75%, reduce water scarcity and strengthen food security. However, the impacts of different interventions can vary widely, making it vital to systematically review and analyze the effects of past policies and projects on ecosystems and livelihoods in different regions of the country (Abera et al. 2019).

Over the past decade, WLE's work has informed and significantly strengthened the Ethiopian government's efforts to provide context-specific solutions to landscape degradation and low agricultural productivity. With the support of WLE, Ethiopian policy makers enacted a new national data sharing policy that allows researchers to merge soil datasets that were previously fragmented across multiple institutions. By improving data availability, the policy supported the collective development of national fertilizer recommendations and the targeting of site-specific recommendations. WLE has also brought the evidence of carbon sequestration in soils to the global agenda, which has resulted in UNCCD recommendations to monitor soil organic carbon in areas under restoration (Hunt 2019).

In Peru, WLE's research examined the institutional, legal and financial bottlenecks preventing rewards for ecosystem services schemes – potential mechanisms to incentivize conservation and restoration. The results of this study were used to help Peru's Ministry of Environment and Congress design a law to promote the application of these schemes.

Transforming entire landscapes – and millions of lives

WLE's pioneering work has given decision makers the approaches and tools needed to reverse degraded landscapes on a global scale.

The insights and solutions generated by WLE's Restoring Degraded Landscapes initiative have proven the feasibility of reversing landscape degradation on a large scale while improving the livelihoods of smallholders. Adopting a multifunctional landscape approach, closely involving both male and female farmers in research and implementation, and using policy to enrich research (and vice versa) has the potential to transform millions of lives and entire landscapes.

Safeguarding and improving rural livelihoods in the face of growing populations, increasing resource pressures and the rapidly accelerating impacts of climate change is the defining challenge of the 21st century.

Armed with the approaches, tools and technologies developed by WLE over the past decade, national governments, One CGIAR, the UN Decade on Ecosystem Restoration, the UN Convention to Combat Desertification, the Bonn Challenge, Initiative 20x20 and the AFR100 African Forest Landscape Restoration Initiative are now able to design and scale up programs that will reverse degraded landscapes on a global scale.

Transforming Ethiopia's degraded landscapes

Federal, state and local agencies in Ethiopia are now using WLE's framework for landscape-level interventions to achieve their target of restoring 15 million hectares by 2025. Meanwhile, decision makers across the country are considering emulating a vast WLE-supported watershed initiative in a highland region where communities have worked together to capture rainfall, revitalize soil, bring in new livestock breeds and improve market access.

Selected resources

Abera, W.; Tamene, L.; Tibebe, D.; Adimassu, Z.; Kassa, H.; Hailu, H.; Mekonnen, K.; Desta, G.; Sommer, R.; Verchot, L. 2019. Characterizing and evaluating the impacts of national land restoration initiatives on ecosystem services in Ethiopia. *Land Degradation & Development* 31(1): 37-52. Available at: https://doi.org/10.1002/ldr.3424 (research paper, 2019).

Batllori, E.; Lloret, F.; Aakala, T; Anderegg, W.R.L.; Aynekulu, E.; Bendixsen, D.P. et al. 2020. Forest and woodland replacement patterns following drought-related mortality. *Proceedings of the National Academy of Sciences* 117(47): 29720-29729. Available at: https://doi.org/10.1073/pnas.2002314117.

Elias, M.; Joshi, D.; Meinzen-Dick, R. 2021. Restoration for whom, by whom? A feminist political ecology of restoration. *Ecological Restoration* 39(1-2): 3-15. Available at: https://doi.org/10.3368/er.39.1-2.3.

Gauchan, D.; Tiwari, S.B.; Acharya, A.K.; Pandey, K.R.; Joshi, B.K. 2017. National and international policies and incentives for agrobiodiversity conservation and use in Nepal. *Proceedings of the 2nd National Workshop: Conservation and utilization of agricultural plant genetic resources in Nepal. Kathmandu, Nepal, May 22-23, 2017*. Kathmandu, Nepal: NAGRC/FDD/DoA/MoAD. Pp. 176-183. Available at: https://hdl.handle.net/10568/92022.

Hadgu, K.; Bishaw, B.; Iiyama, M.; Birhane, E.; Negussie, A.; Davis, C.; Bernart, B. 2019. *Climate-smart agriculture: Enhancing resilient agricultural systems, landscapes and livelihoods in Ethiopia and beyond*. Nairobi, Kenya: World Agroforestry (ICRAF). Available at: www.researchgate.net/publication/334599900_Climate-Smart_Agriculture-_Enhancing_Resilient_Agricultural_Systems_Landscapes_and_Livelihoods_in_Ethiopia_and_Beyond.

Hunt, A. 2019. UNCCD moves to increase soil carbon sequestration, accepts report recommendations. *WLE News*. Available at: https://wle.cgiar.org/news/unccd-moves-increase-soil-carbon-sequestration-accepts-report-recommendations.

Kihara, J.; Bolo, P.; Kinyua, M.; Nyawira, S.S.; Sommer, R. 2020. Soil health and ecosystem services: Lessons from sub-Sahara Africa (SSA). *Geoderma* 370: 114342. Available at: https://doi.org/10.1016/j.geoderma.2020.114342.

Nkonya, E.; Kato, E. 2020. Rethinking agro-food sector to combat land degradation and desertification. In: *Encyclopedia of the UN Sustainable Development Goals: Life on Land*, (eds.), Filho, W.L.; Azul, A.; Brandli, L.; Salvia, A.L.; Wall, T. Cham, Switzerland: Springer. Available at: https://doi.org/10.1007/978-3-319-71065-5_132-1.

Zhang, W.; Walker, D.; Hernandez, C.C.; Elias, M.; Meinzen-Dick, R.; Nkonya, E.M. 2019. *Gendered opportunities for improving soil health: A conceptual framework to help set the research agenda*. IFPRI Discussion Paper 1822. Washington, DC, USA: International Food Policy Research Institute. Available at: https://doi.org/10.2499/p15738coll2.133203.

Zomer, R.J.; Bossio, D.A.; Sommer, R.; Verchot, L.V. 2017. Global sequestration potential of increased organic carbon in cropland soils. *Scientific Reports* 7: 15554. Available at: https://doi.org/10.1038/s41598-017-15794-8.

Acknowledgments

Contacts

Marcela Quintero, Alliance of Bioversity International and International Center for Tropical Agriculture (CIAT) (m.quintero@cgiar.org)
Leigh Ann Winowiecki, World Agroforestry Center (ICRAF) (l.a.winowiecki@cgiar.org)

Suggested citation

RESEARCH PROGRAM ON
Water, Land and Ecosystems
CGIAR

LED BY:
IWMI
International Water Management Institute

CGIAR Research Program on Water, Land and Ecosystems

The CGIAR Research Program on Water, Land and Ecosystems (WLE) is a global research-for-development program connecting partners to deliver sustainable agriculture solutions that enhance our natural resources – and the lives of people that rely on them. WLE brings together 11 CGIAR centers, the Food and Agriculture Organization of the United Nations (FAO), the RUAF Global Partnership, and national, regional and international partners to deliver solutions that change agriculture from a driver of environmental degradation to part of the solution. WLE is led by the International Water Management Institute (IWMI) and partners as part of CGIAR, a global research partnership for a food-secure future.

International Water Management Institute (IWMI)
127 Sunil Mawatha, Pelawatta
Battaramulla, Sri Lanka
Email: wle@cgiar.org
Website: wle.cgiar.org
Thrive blog: https://wle.cgiar.org/thrive

IN PARTNERSHIP WITH:

Bioversity International · CIAT · FAO · ICARDA · ICRISAT · IFPRI · RUAF · World Agroforestry · CIFOR · CIP · ILRI · WorldFish