

SI Data and Methods

2.2 Restoration database, map with project locations, and comparative analysis

Table S1: Variables included in the database.

The complete database is available for download at *Harvard Dataverse* Online:

<https://doi.org/10.7910/DVN/B9OUOZ> and at the LUCID portal: <http://lucid.wur.nl/datasets/forest-and-landscape-restoration>

Category	Variable/ characteristic	Sub-variable/ characteristic	Answer options
1) General Information	a) Project ID		[1...154]
	b) Initiative		...
	c) Project title		...
	d) Information source		...
	e) Location	i) Country	...
		ii) Region/Province	...
		iii) Municipalities	...
	f) Biophysical characteristics	i) Project area (ha)	(1) <1000 ha
			(2) 1000 - 5000 ha
			(3) 5000 - 20000 ha
			(4) 20000 - 100000 ha
			(5) >100000 ha
		ii) Terrestrial ecosystems (WWF classification)	(1) Tropical and Subtropical Moist Broadleaf Forests
			(2) Tropical and Subtropical Dry Broadleaf Forests
			(3) Tropical and Subtropical Coniferous Forests
			(4) Temperate Broadleaf and Mixed Forests

			(5) Temperate Coniferous Forests
			(6) Boreal Forests/Taiga
			(7) Tropical and subtropical grasslands, savannas, and shrublands
			(8) Temperate Grasslands, Savannas, and Shrublands
			(9) Flooded Grasslands and Savannas
			(10) Montane Grasslands and Shrublands
			(11) Tundra
			(12) Mediterranean Forests, Woodlands, and Scrub
			(13) Deserts and Xeric Shrublands
			(14) Mangroves
			(15) Wetlands (Extra class)
	g) Social characteristics	i) Land tenure	(1) Private, smallholders
			(2) Private, large land owners
			(3) Private, company
			(4) Private, leased
			(5) Public
			(6) Community
		ii) Land use before implementation	(1) Mining
			(2) Agriculture
			(3) Grazing
			(4) Forestry
			(5) Agro-silvo-pastoral system
			(6) Secondary forest
			(7) Original ecosystem, selective extraction of timber / other non-timber products or fishing
			(8) Original ecosystem / felling

			(9) Abandoned / bare land
			(10) Original ecosystem not subject to extraction
			(11) Other_____
		iii) Community participation in the project	(1) Main responsible
			(2) Involved in implementation of restoration activities
			(3) Involved in project planning and discussion forums
			(4) Involved in monitoring of project goals
			(5) There are no communities in the vicinity of the project
		iv) Government participation in the project	(1) Convocants, contractors
			(2) They are not responsible for the project, but support with some resources
			(3) None
	h) Project management	i) Responsible implementing institution	(1) Public Institute
			(2) NGO
			(3) University
			(4) Company
			(5) Community
			(6) Other
		ii) Sources of project funding	(1) Public
			(2) National donors
			(3) International donors
			(4) Company, Owner)
			(5) Community
			(6) Investor

		iii) Estimated global project cost (not including monitoring). (USD)	(1) <500,000 USD
			(2) 500,000 - 1,000,000 USD
			(3) 1,000,000 - 2,000,000 USD
			(4) 2,000,000 - 5,000,000 USD
			(5) 5,000,000 - 10,000,000 USD
			(6) > 10,000,000 USD
		iv) State / current phase of the project	(1) Planning
			(2) In process, (field preparation, planting / implementation)
			(3) Actions finished
			(4) Further monitoring
			(5) Terminated without follow-up
2) Goals	a) Main objective of the project (may be more than one)		(1) Increase vegetation cover
			(2) Biodiversity recovery
			(3) Habitat recovery for endangered species (includes connectivity)
			(4) Promote ecological connectivity in fragmented habitats.
			(5) Recovery of ecological processes - restore the structure, function, and ecosystem services
			(6) Elimination of exotic / invasive or unwanted species
			(7) Erosion control
			(8) Reducing risks (eg, bioengineering in gullies or slopes, mitigation of coastal erosion, decontamination)

			(9) Reclamation, Repair of an ecosystem after extraction of minerals
			(10) Restoration of cultural and spiritual values
			(11) Generation of local employment and enhance livelihoods
			(12) Capture and storage of carbon
			(13) Promote silvo-pastoral productivity
			(14) Promote agro-forestry productivity
			(15) Recreation / eco-tourism
			(16) Comply with government mandate (decree, law)
	b) Type of land use / level of degradation to restore (drivers of land use change)	i) Loss of soil or substrate	(1) Opencast mining, or extraction of materials
			(2) Erosion / landslides, not associated with extraction
		ii) Contamination of the substrate or environment	Yes/No
		iii) Vegetation degradation	(1) Extensive and recurrent burning
			(2) Large-scale disturbance due to extreme events (burning, hurricanes, etc.)
			(3) Livestock (overgrazing)
			(4) Unsustainable agricultural practices
			(5) Recent logging for wood, grazing land or agriculture
			(6) Urban or sub-urban use

			(7) Fuel wood collection / charcoal production
		iv) Duration of the intervention	(1) Less than 1 year
			(2) 1 - 5 years
			(3) 5 – 10 years
			(4) 10 - 50 years
		v) Duration of monitoring	(1) Less than 1 year
			(2) 1 - 5 years
			(3) 5 – 10 years
			(4) 10 - 50 years
3) Planning	a) Was the main cause for degradation determined?		Yes/No
	b) Did the work plan include actions necessary to stop the cause of degradation?		Yes/No
	c) Was the degree of degradation determined, to identify the most appropriate intervention(s)?		Yes/No
4) Execution: technical aspects	a) What types of interventions were needed?	i) Civil works	(1) Stabilization of the land, restoration of soil profiles
			(2) Erosion control
		ii) Control of regeneration barriers	(1) Exclusion of grazing/adapting grazing pressure

			(2) Restoration of fire regime. Control of fires or controlled burning
			(3) Herbicide application or grazing
			(4) Fertilization
			(5) Bioremediation to remove toxicity from soil or water
			(6) Contaminant control
		iii) Restoration of vegetation in aquatic systems	(1) Natural succession
			(2) Sowing of plant species
			(3) Transfer of sludge
		iv) Restoration of vegetation in terrestrial systems	(1) Natural Regeneration
			(2) Assisted regeneration
			(3) Regeneration (unspecified)
			(4) Monoculture plantation
			(5) Mixed plantation with only trees
			(6) Mixture of trees, shrubs, grasses
			(7) plantation (unspecified)
		vi) Restoration of fauna	(1) Establishment of structures to facilitate colonization
			(2) Translocation of individuals from other places
	b) Origin of biological material	i) What type of species were used?	(1) Exotic species
			(2) Native species
5) Monitoring	a) Was a monitoring plan developed to quantify the		Yes/No

	effects of the intervention?		
	b) Was a baseline for specific variables established so as to quantify the effects of the intervention?		Yes/No
	c) Is there a clear relationship between the variables to be monitored and the project objectives?		Yes/No
	d) Who participates in the monitoring?		(1) Public Institute
			(2) NGO
			(3) University
			(4) Company
			(5) Community
			(6) Other
6) Results	a) Economic	i) Which socio-economic incentives (Payment for Environmental Services or other voluntary market mechanisms) were applied?	(1) Payment for Environmental Services
			(2) Carbon capture
			(3) Timber products
			(4) Non-timber products
			(5) Other

7) Potential project impact	a) Environmental impact	i) Does the project intend to protect and improve biodiversity?	Yes/No
		ii) Does the project intend to manage water availability and regulate hydraulic processes	Yes/No
		iii) Does the project intend to address climate change and increase C stocks in soils and/or biomass?	Yes/No
	b) Social impact	i) Does the project intend to ensure food security	Yes/No
		ii) Does the project intend to strengthen (technical) capacities of communities	Yes/No
		iii) Does the project intend to reduce poverty and improve livelihoods of communities	Yes/No

2.3. Assessment of project carbon stocks and associated mitigation potentials

Input data that were used to derive the potential additional forest AGB that currently deforested and partially deforested/degraded areas can potentially store when they are restored to their potential forested condition are described in Table S2.

Table S2. Input data for analysis of potential additional forest AGB

Theme	Source/Reference	Metadata
WRI, Atlas of Forest Restoration:	Potapov et al., 2011.	<ul style="list-style-type: none"> • Global dataset • Raster data, Cell size: 1km
1. Forest conditions (<i>Intact, Fragmented/managed, Degraded, Deforested</i>) and 2. Current and Potential forest coverage (<i>Closed forests, Open forests, Woodlands</i>)	Online available at: http://www.wri.org/applications/maps/flr-atlas/#	<ul style="list-style-type: none"> • Variables: Forest condition and Current and Potential forest coverage
FAO, Global Ecological Zones (second edition, 2010)	FAO, 2012. Online available at: http://www.fao.org/geonetwork/srv/en/main.home	<ul style="list-style-type: none"> • Global dataset • Vector data (polygons) • Variable: Global Ecological Zone
GEOCARBON global forest biomass	Avitabile, V., et al., 2016; Avitabile, V., et al., 2014; Santoro, M., et al., 2015. Online available at: http://lucid.wur.nl/datasets/high-carbon-ecosystems	<ul style="list-style-type: none"> • Global dataset • Raster data, Cell size: 0.01 decimal degree • Variable: Aboveground biomass density of vegetation in units of Mg/ha

WRI's Atlas of Forest Restoration (Potapov et al., 2011) is a global dataset with information on current and potential forest coverage and the condition of the forest. Forest condition clarifies if the forest is intact (large blocks of virgin forest, >50,000 hectares), fragmented/managed (natural forests and woodlands that are fragmented by roads and/or managed for timber production), deforested (formerly forested areas) or partially deforested/degraded (forests with reduced density). Forest coverage defines the forest as closed forest (canopy cover > 45%), open forest (canopy cover 25-45%), woodlands (canopy cover 10-25%) or non-forest. The areas that currently have a deforested or partially deforested/degraded condition offer opportunities to be restored to their potential coverage.

Looking at the different classes in the Atlas of Forest Restoration, the following forest restoration opportunities appear (see Table S3):

Table S3. Possible forest restoration opportunities (forest transition), based on different classes in WRI's Atlas of Forest Restoration.

Current condition	Current coverage	Potential coverage
Deforested	Non-Forest	Woodlands Open Forest Closed Forest
Partially deforested/ Degraded	Woodland	Open Forest, Closed Forest
Partially deforested/ Degraded	Open Forest	Closed Forest

We associated each forest transition (see Table S3) with the potential to store additional forest AGB. As different ecoregions can store a different amount of biomass (e.g. a tropical moist forest contains more biomass than a temperate mountain system), we first created a new GIS shapefile by combining the data from the Atlas of Forest Restoration and FAO's Global Ecological Zones. This resulted in 132 polygons consisting of all possible combinations of current and potential forest coverage that occur within each ecological zone in Latin America and the Caribbean. We calculated the current mean forest AGB for each of these polygons, by overlaying them on the GEOCARBON global forest AGB dataset. Then we determined the potential mean forest AGB for all deforested and partially deforested/degraded areas, by taking the mean forest AGB values from areas that currently already have the "potential forest coverage" within the same ecozone and which have the forest condition "fragmented/managed". Hereby we assume that the transition to 'intact' forests is not a realistic option for mid-term restoration goals. Thereafter, we calculated the *potential additional* forest AGB (Mg/ha) for all polygons with current condition "deforested" or "partially deforested/degraded" by subtracting the *current* forest AGB value from the *potential* forest AGB value. In Table S4 a calculation example is given how to derive the potential additional forest AGB for Ecozone "Tropical moist forest" where "Non-forest" land can potentially be "Woodlands" (FID 104).

First we assessed the current mean forest AGB in "non-forest" land within this ecological zone by taking the mean value of the forest biomass map using "Zonal statistics" in ArcGIS.

This is: 19.62 Mg/ha. Then, we assessed the current mean forest AGB for the current “Woodlands” which are in a fragmented/managed state (FID 110) within this ecological zone. This is 30.76 Mg/ha. As the non-forest area can potentially become a Woodland, and fragmented/managed is the end stage, the current mean AGB value belonging to “Woodlands” will be the potential forest biomass value for this area. We then calculate the potential additional forest AGB (Mg/ha) for all polygons under this transition, by subtracting the current mean forest AGB value from the potential mean forest AGB value. For FID 104 this is 11.13 Mg/ha.

Table S4: Example calculation

FID	FAO Global Ecological Zone	WRI Code	WRI Potential Forest Coverage	WRI Current Forest Coverage	WRI Forest Condition	Current Mean Forest AGB (Mg/ha)	Potential mean Forest AGB (Mg/ha)	Potential additional Forest AGB (Mg/ha)
101	Tropical moist forest	1	woodlands	woodlands	intact	76.25		
102	Tropical moist forest	2	open forests	open forests	intact	117.74		
103	Tropical moist forest	3	closed forests	closed forests	intact	240.31		
104	Tropical moist forest	4	woodlands	nonforest	deforested	19.62	30.76	11.13
105	Tropical moist forest	5	open forests	nonforest	deforested	17.02	66.04	49.02
106	Tropical moist forest	6	closed forests	nonforest	deforested	28.21	144.64	116.43

107	Tropical moist forest	7	open forests	woodlands	partially deforested	35.65	66.04	30.39
108	Tropical moist forest	8	closed forests	woodlands	partially deforested	57.54	144.64	87.10
109	Tropical moist forest	9	closed forests	open forests	partially deforested	93.14	144.64	51.50
110	Tropical moist forest	12	woodlands	woodlands	fragmented /managed	30.76		
111	Tropical moist forest	13	open forests	open forests	fragmented /managed	66.04		
112	Tropical moist forest	14	closed forests	closed forests	fragmented /managed	144.64		

With the derived **Potential additional Forest AGB (Mg/ha)** values for every possible forest transition in each Global Ecological Zone, a map was generated for whole Latin America and the Caribbean. Areas that have no potential to become forested, such as agricultural areas, urban areas, water and other lands, were excluded from the map and further analysis. These areas were eliminated by overlaying the ESA LC-CCI map from 2015 ([ESA, 2017](#)) on the potential additional forest AGB map. This resulted in the exclusion of the following land cover classes for Latin America and the Caribbean: Cropland, rainfed; Herbaceous cover; Cropland, irrigated or post-flooding; Sparse vegetation (tree, shrub, herbaceous cover) (<15%); Sparse herbaceous cover (<15%); Urban areas; Bare areas; Water bodies and Permanent snow and ice.

Reference

Romijn, J. E. and Coppus, R., 2019. Replication Data for: Restoration Database for Latin America and the Caribbean. Comparative Research Project on Landscape Restoration for Emissions Reductions, CIAT/WUR project for USAID *Harvard Dataverse* Online: <https://doi.org/10.7910/DVN/B9OUOZ>