Global forest restoration and the importance of prioritizing local communities

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Global Forest Restoration and the Importance of Prioritizing Local Communities

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Abstract: Forest restoration occupies center stage in global conversations about carbon removal and biodiversity conservation, but recent research rarely acknowledges social dimensions or environmental justice implications related to its implementation. We find that 294.5 million people live on tropical forest restoration opportunity land in the Global South, including 12% of the total population in low-income countries. Forest landscape restoration that prioritizes local communities by affording them rights to manage and restore forests provides a promising option to align global agendas for climate mitigation, conservation, environmental justice, and sustainable development.

Main

Forest restoration is considered a crucial strategy for conserving global biodiversity and mitigating climate change[1–3]. New research identifies the global extent of forest restoration opportunities, demonstrates the promise of forest restoration for mitigating climate change, and calls for more ambitious global forest restoration efforts[1–6]. There is some disagreement about the degree to which forest restoration can or should contribute to atmospheric carbon removal[7–9], as mitigating climate change depends on decarbonizing the economy while protecting intact forests and restoring degraded landscapes[10]. Yet prominent conservation initiatives such as "global no net loss" of natural ecosystems, "half for nature," and the Aichi Target 11 still combine conservation of intact natural habitat and restoring degraded forests to reach their ambitious targets[11–13].

To progress those goals, recent research on forest restoration advances conservation and climate mitigation agendas with knowledge about where trees can be grown and the global potential for restoration. It often fails, however, to address the social implications of global forest restoration. In this communication, we argue that the success of global forest restoration critically depends on prioritizing local communities[14].

To realize its full potential, forest restoration cannot avoid rural populations. Confining restoration efforts to sparsely inhabited forest landscapes removes the concern of displacing or marginalizing local populations, but it limits global restoration in three ways. First, remote restoration regions (1 person/km^2 or less within a 500 km radius) represent only 11% of global forest restoration opportunity areas[15]. Second, because remote forest restoration is only possible in areas far from human settlements, fewer people will enjoy any local benefits. Third, only pursuing remote forest restoration would not contribute as meaningfully to biodiversity conservation. The tropics are home to a disproportionate amount of the world's biodiversity but contain only 0.68% of all remote restoration opportunities. Remote forest restoration holds promise for carbon sequestration, but global agendas that seek to deliver the greatest number of benefits from forest restoration will need to focus on populated landscapes[5].

Forest restoration initiatives must, therefore, identify how best to work with local communities. Approaches that exclude indigenous people and local communities, including some protected areas, have been associated with environmental conflicts, poor conservation performance, and negative social outcomes[16–18]. Restoring forests without the consent of those who depend on the same land will likely lead to forced displacement (physical or economic), and/or costly monitoring and regulation to prohibit illegal (though often legitimate) activities.

Excluding indigenous people and local people from forest restoration also poses ethical problems. Such exclusion would force some of the most multidimensionally poor people—those who live in rural areas within low-income countries—to move or sacrifice their current livelihood for a global carbon and biodiversity debt to which they contributed little[19]. Just and equitable climate mitigation and biodiversity conservation from forest restoration requires the inclusion and participation of local communities[20,21].

As a mechanism of land and resource management, Forest Landscape Restoration (FLR) has considerable potential to include local populations and improve local livelihoods. FLR was initially conceived as a management approach to promote ecological restoration and human well-being in degraded landscapes by engaging local stakeholders[22]. By including local stakeholders from the public, private, and civil society sectors, proponents assert that FLR contributes to human well-being through the use and sale of forest products, increases in food as well as water security, and through diverse cultural values people hold for trees and forests[21–25]. However, competing definitions of FLR exist[26]. The Bonn Challenge to commence restoration of 350 million ha of forest landscapes by 2030 refers to FLR as large-scale forest restoration projects but does not emphasize the importance of engaging local stakeholders in planning and implementation processes[2,27,28]. Thus, many current debates about FLR reflect a lack of conceptual clarity and do not adequately address recent evidence as to how forest restoration can promote ecological as well as human well-being[24,29]. In this text, we define FLR as an approach to landscape planning and management that aims to restore ecological integrity and enhance human well-being on deforested and degraded lands through the inclusion and engagement of local stakeholders[22].

To unite global agendas for climate mitigation, conservation, and environmental justice, FLR must go beyond merely including local stakeholders and prioritize local communities. Given the uncertainty surrounding forest restoration and its impacts on human well-being[30–32], the tendency to implement restoration without consulting local stakeholders is untenable[33]. Consulting local stakeholders alone does not guarantee just and equitable forest restoration. However, there are numerous examples in the conservation sector where indigenous people and local communities have generated positive human and environmental outcomes when afforded rights to manage and use forests[16,34]. Technical training and equitable resource access reduces some risks associated with community resource management, including elite capture, overharvests, and exclusion[35]. In many contexts, empowering communities to manage forests for restoration provides a reasonable and just approach to address contextual uncertainty, incorporate traditional ecological knowledge, and assist forest proximate populations to receive the opportunities they desire from global restoration[28,36,37].

The potential synergies from prioritizing local communities through FLR emphasize the importance of determining where forest restoration, human populations, and development intersect. Our analysis examines the overlap between opportunities for tropical forest restoration, human populations, development, and national policies for community forest ownership to identify where focusing forest restoration efforts might best benefit both people and the planet. We focus on the tropics because of the synergies between carbon sequestration, biodiversity conservation, and human well-being benefits that FLR affords there[5]. We aggregate our data to present country-level estimates because nation-states remain primary actors in setting carbon removal and landscape restoration targets[2].

We find that 294.5 million people live in recently tree-covered areas representing tropical forest restoration opportunities in the Global South. Many more people live near these forest restoration opportunities. One third of the tropical population in our analysis (~1.01 billion people) live within eight kilometers of land predicted to enable forest restoration from 2020-2050, given a moderate carbon tax incentive ($\$20tCO_2^{-1}$). Table S1 provides additional information on population estimates across different forest restoration opportunities and methods.

Forest restoration opportunities, population, and development vary widely by country (Fig. 1). Brazil (BRA), the Democratic Republic of Congo (COD), India (IND), and Indonesia (IDN) have the greatest number of people living in or near (< 8 km) forest restoration opportunity areas with the greatest potential to remove carbon (Fig. 2a). Crafting global FLR strategies that seek to deliver sustainable development benefits to the most local people within the fewest countries would do well to focus on these nations. However, FLR may generate greater population-level benefits in nations where forest restoration opportunities, and the people who depend on them, comprise a significant proportion of their respective total population. Political, market, and civil society actors in these same countries are likely to enhance international activity and investment in FLR with national efforts, should restoration provide well-being benefits. Countries with a greater proportion of forest restoration opportunity area include the Democratic Republic of Congo (COD), Tanzania (TZA), the Central African Republic (CAF), and Mozambique (MOZ) (Fig. 2b).

FLR investments hold the promise to improve the livelihood and well-being of millions often underserved by standard investments in infrastructure and development. Within low-income countries, 12% of the population lives in forest restoration opportunity areas (Fig. 1c). Forest restoration opportunities exist outside areas of greatest human pressure, and populations in these areas often face greater infrastructural and developmental deprivation. Nighttime light radiance indicates the extent and magnitude of electrical infrastructure and usage, and it is strongly correlated with a host of development indicators[38–40]. Areas in low-income nations with the least nighttime light radiance and the greatest carbon removal potential indicate where FLR might best complement sustainable development agendas. There are many opportunities in central, eastern, and southern Africa to restore forests and provide socioeconomic and infrastructure benefits to local people facing many multidimensional deprivations (Fig. 2 and Supplementary Fig. 1). However, concurrently improving infrastructure and restoring forests does create additional risks, since forest cover loss and degradation often follow infrastructure development[41]. Providing indigenous people and local communities the ability to participate in managing forest landscapes via resource rights can moderate the relationship between improved infrastructure, forest cover loss, and human well-being[42].

Most forest restoration opportunity areas and their associated populations exist in countries with legal foundations for community forest ownership. Community forest ownership includes the following rights afforded in perpetuity: forest access, resource withdrawal, exclusion, as well as due process and compensation[43]. As such, ownership represents a stronger set of resource rights than community forest management or access alone. In this analysis, countries with pre-existing legal frameworks and evidence of community forest ownership (n=22) contain two-thirds of forest restoration opportunity areas (Fig. 2 and Supplementary Table 2). Further, countries that provide forest ownership rights to communities contain 70% of people living in or near forest restoration opportunity areas (Table S2), which represent a large proportion of their total tropical population (Fig. 2a-b). A legal framework for community forest rights and evidence of their recognition do not guarantee faithful implementation of community forest ownership, but their absence indicates forest proximate communities are excluded from making authorized decisions about the future of the forests on which they depend. This implies a greater likelihood of exclusion from forest areas, forest products, and related benefits. Continued efforts to expand community forest ownership are essential, and they are of pressing national importance in countries with a significant proportion of people living in forest restoration opportunity areas, such as the Central African Republic (CAF), the Democratic Republic of Congo (COD), Thailand (THA), and the Lao People's Democratic Republic (LAO) (Fig. 2b). To advance global restoration while prioritizing forest-proximate peoples through community forest rights, FLR must emphasize the importance of locally managed restoration.

FLR that prioritizes local communities represents a just mechanism for global forest restoration. Recent research highlights the importance of forest restoration to climate mitigation agendas, and it advances the ability to locate forest restoration opportunities. It remains essential to assess this information in relation to institutional, social, and political circumstances to determine how FLR can best contribute to equitable and sustainable climate solutions. Excluding local communities from global forest restoration limits our ability to mitigate climate change, and it risks resistance, conflict, and perpetuating environmental injustices. Empowering local communities to restore forests can provide human well-being benefits to millions of the most deprived and marginalized people as well as environmental benefits for all.

Methods

Forest restoration opportunity areas

We combine two datasets to identify areas that represent opportunities for forest restoration. Combining data that classifies forest restoration opportunities using demographic, geographic, and land-cover data with estimates from a land change model that predicts carbon removal from forest restoration provides more conservative estimates of where, and to what extent, forest restoration is likely to mitigate climate change.

We first define forest restoration opportunity areas as wide-scale and mosaic restoration areas in the tropics identified in the "Global map of forest landscape restoration opportunities"[15]. Wide-scale restoration areas have the potential to support closed forest canopy and contain population densities of less than 10 people/km^2. Mosaic restoration areas are similarly able to support closed forest canopy but contain population densities of between 10 and 100 people/km^2. Forest restoration areas from the "Global map" are identified by layering data. Through this method, deductively determined cut-off points and population densities applied to spatial biophysical and human pressure datasets identify locations most amenable to forest restoration. Other studies of global forest restoration opportunities and land-cover patterns employ this method of spatial identification[5,44]. Among the global set of forest restoration opportunities, we focus on opportunities in tropical countries because of the potential these areas have for removing atmospheric carbon, promoting biodiversity conservation, and contributing to the well-being of forest proximate people[3,5].

We further define forest restoration opportunities using estimates of where, and to what extent, atmospheric carbon removal from forest restoration would occur given a moderate economic incentive. Estimates of carbon removal come from a land-change model that calculates where a $\$20tCO_2^{-1}$ carbon tax is likely to incentivize forest restoration from 2020-2050, based on tree cover in 2000 and 2010, topographical variation, as well as agricultural opportunity-costs[4]. Though the model estimates forest restoration and carbon removal using a $\$20tCO_2^{-1}$ scenario, these data broadly represent where a moderate financial incentive equal to or greater than the value generated by a carbon tax is likely to promote forest restoration. Importantly, this approach improves upon many studies that identify forest restoration opportunities through layering because it explicitly models carbon removal from forest restoration as a function of opportunity costs based on prices of regional agricultural products.

The "Global map" and carbon removal spatial datasets differed in extent and resolution. We analyze forest restoration opportunities in the tropics from 23.4˚N to 15˚S because both datasets contain information across this spatial extent. Within this extent, the "Global map" data contains pixels measuring 30 arcseconds (~1 km pixels), while the carbon removal dataset contains pixels measuring and 3 arcminutes (~5.55 km pixels). To identify forest restoration opportunities as the union of these datasets, we calculated the percent of "Global map" opportunity areas within each pixel of carbon removal from forest restoration estimated by the land-change model. Country-level aggregates for carbon removal by population, as well as carbon removal by nighttime light radiance, vary in accordance with the "Global map" opportunity threshold (Supplementary Fig. 2-5). We present the 30% threshold findings in the main text to mirror the standard of using 30% canopy cover to categorize 30 m pixels as tree-covered[45]. However, the findings we report in the main text are largely robust to varying the threshold between 30% and 50% of "Global map" opportunity areas (Supplementary Fig. 2-5).

Using mutually informative datasets improves the identification of forest restoration areas and their potential carbon removal. By combining the "Global map" and carbon removal datasets, our findings draw from strengths of both datasets, and avoid (what some have considered) overestimation of forest restoration opportunities in high population density croplands (>100 people/km^2) and native grasslands[46,47]. We dropped all "Global map" opportunity areas with over 100 people/km^2, and our analysis does not include areas without at least 30% tree-cover in 2000 or 2010[4]. Thus, the forest restoration opportunity areas in this research represent estimates of where forest restoration is most likely to occur in regions that were tree-covered in the 21st century. Future research might apply the methods of this analysis to compare estimates across additional datasets that identify additional forest restoration opportunities and global tree carrying capacities[1,5].

Estimating population, nighttime light radiance, and income categories in FLR areas

We combine forest restoration opportunities with spatial data on population and nighttime light radiance, as well as country-level data on income categories, to provide demographic, infrastructural, and economic insights concerning forest restoration opportunities. Population[48] and nighttime light radiance data[49] have the same spatial resolution as data from the "Global map." Thus, we aggregated these data to match our forest restoration opportunity area data. The number of people within restoration opportunity areas measuring 30 arcseconds differed from the number of people within areas measuring 3 arcminutes that provide any carbon removal additionality under a $20t$CO_2^{-1}$ carbon tax. We estimate approximately 294.5 million people live directly within forest restoration opportunity areas (30 arcseconds), over two thirds of the total tropical population (2.37 billion people) in this analysis live within eight kilometers of any predicted carbon removal from forest restoration between 2020-2050 given in a $20t$CO_2^{-1}$ incentive, and 1.01 billion people live in forest restoration opportunities identified in this study as a 3 arcminute area with any predicted carbon removed from forest restoration and covered by at least 30% of mosaic or wide-scale restoration opportunities identified by the "Global map" (Fig. 2). Supplementary Figure 6 visualizes country-level information for forest restoration opportunities defined as the union of the "Global map" and predicted carbon removal data, without imposing a minimum coverage threshold.

The income categories in this research follow the World Bank classification scheme, which categorizes low-income, lower-middle income, and upper-middle income countries by virtue of Gross National Income (GNI) per capita. Low-income countries have a GNI per capita of less than $1,025; lower-middle income countries, between $1,026 and $3,995; and upper-middle income countries, $3,996 and $12,375[50]. For pixel-level visualization, we overlaid country boundaries with high-value restoration areas to determine the related income category per pixel. To calculate the proportion of people per income category within forest restoration opportunity areas (Fig. 1c), we used the total number of people per country , including people who live in areas outside the extent of Fig. 1.

Community resource rights and tenure

This research considers community tenure to be a bundle of resource rights that enable communities to manage land areas for their own benefit[51,52]. Following the Rights and Resources Initiative, this research divides community forest tenure into two categories[43]. The first category is community ownership of forest areas. Community ownership of forest areas provides the rights to access forests, withdraw forest resources, manage forest resources, and exclude others from using resources. Community forest ownership is not limited by the need for renewal or oversight, and communities that own forests have the right to due process and compensation. The second category of community forest tenure refers to a bundle of rights that enable communities to manage forests in perpetuity. Community forest management rights include all the rights of community ownership, except for the right to due process and unlimited duration of rights. Community forest management rights often coincide with co-management governance strategies, where a governmental authority and a group of local people work together to manage forest areas. We further distinguish between countries that have a legal basis for community forest tenure (ownership or designation) and countries for which there is evidence of communities that legally hold tenure rights. We gather evidence from research conducted by the Rights and Resources Initiative[43,53].

Of the 106 low- and middle-income countries in the tropics within this dataset, 73 contained forest restoration opportunities as defined in this research. There are 42 countries that contain a legal basis for community forest tenure[43,53]. Of these 42 countries, 22 contain a legal basis for community forest ownership and provide some evidence of providing those rights. Table S2 highlights these 42 countries, ordered by evidence and legal basis for community forest ownership, evidence and legal basis for community forest designation, and the total amount of FLR opportunity area. All World Bank Country Codes for countries in this analysis are listed in Table S3.

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Author Contributions

J.T.E., J.A., J.A.O., and A.C. designed the analyses. J.T.E., J.A., and N.P. compiled the data and conducted the analyses. J.T.E., J.A.O., R.P., D.B., A.A., and A.C. wrote the paper.

Code Availability

Code for analysis is available at the Harvard Dataverse (https://doi.org/10.7910/DVN/YUUXKU). The folder contains information on setting up the Docker container to reproduce analysis as well as static versions of software dependencies that are not part of the default Docker image.

Data Availability

Data for and from this analysis are available at the Harvard Dataverse (https://doi.org/10.7910/DVN/YUUXKU). The folder contains instructions for obtaining all input and output data it does not contain due to size or sharing limitations.

Competing Interests

The authors declare no competing interests.

Figure Legends

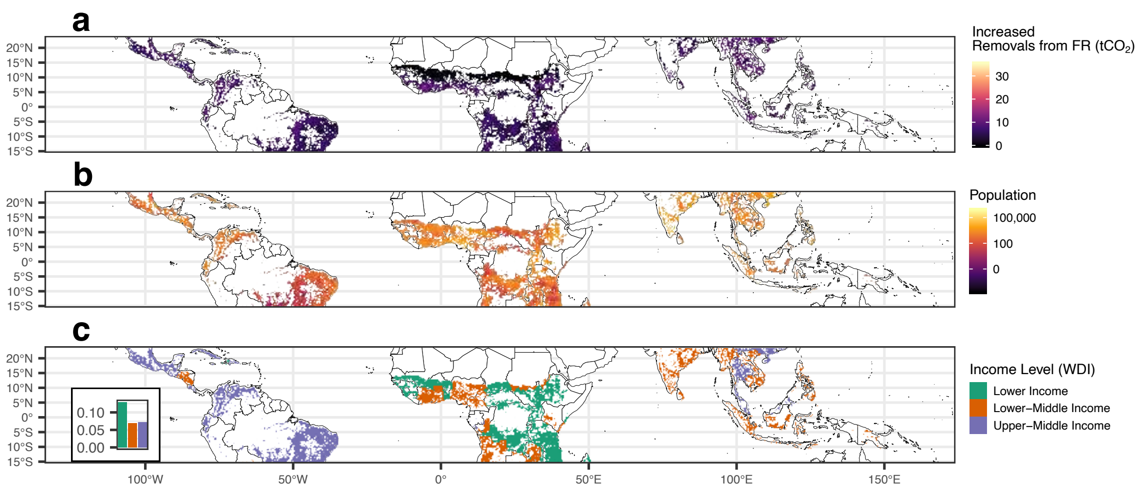


Fig. 1 | Forest restoration (FR) opportunity areas in the tropics. Forest restoration (FR) opportunity areas[15] by estimated carbon removal from 2020-2050 given a $20tCO$_2^{-1}$ scenario[4] (**a**), FR areas by population density (population/5.55 km^2)[48] (**b**), FR areas by country-level income categories[50] (**c**); and the proportion of people living in FR areas by income category (inset).

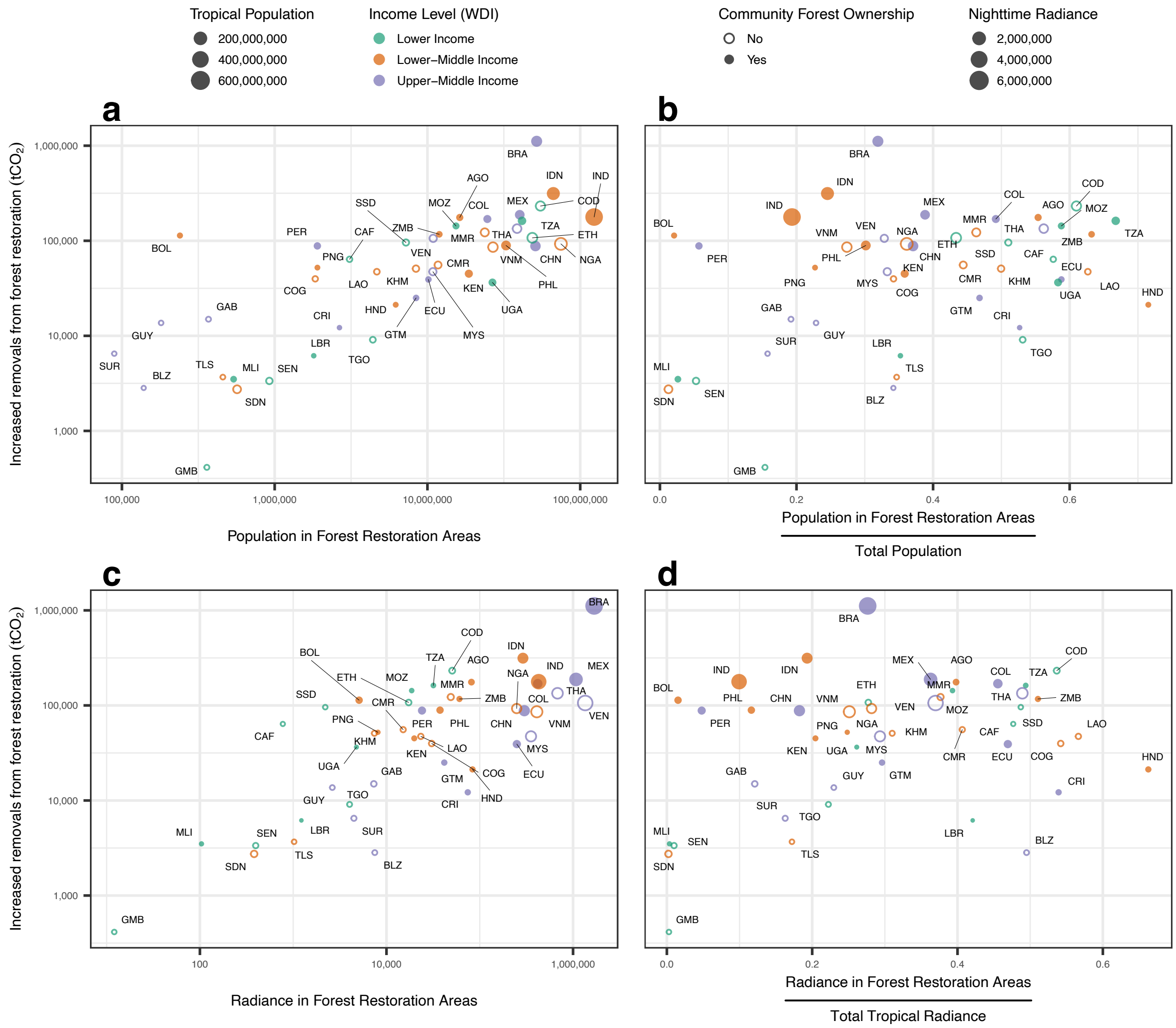


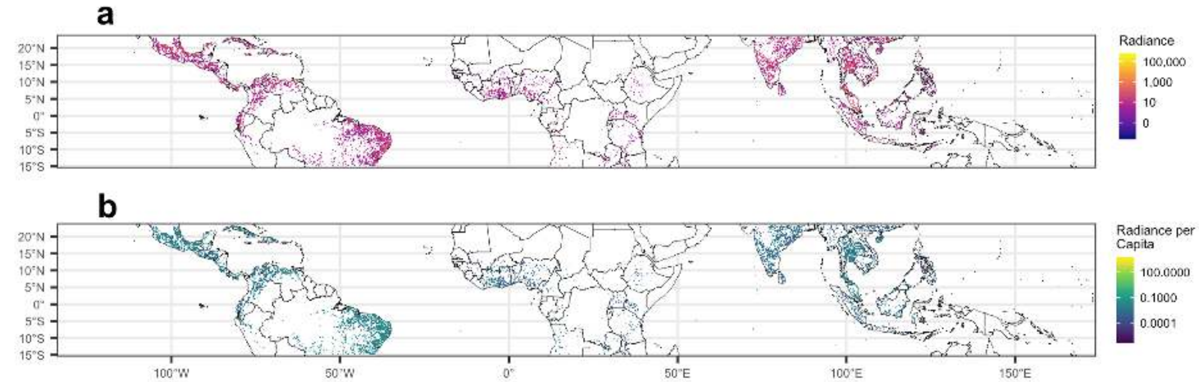
Fig. 2 | Country-level population[48] and nighttime light radiance[49] by increased removals from reforestation[4]. Countries are plotted in reference to population in forest restoration (FR) opportunity areas by increased removals from forest restoration in tCO_2 (**a**); the proportion of country population in FR areas by increased removals (**b**); total nighttime light radiance by increased removals (**c**); and the proportion of nighttime light radiance in FR areas by total tropical nighttime light radiance (**d**). Increased removals are predicted under a$20tCO$_2^{-1}$ scenario from 2020-2050. Nighttime light radiance is measured in (nanoWatts/cm^2/sr) x 10^9. All panels visualize 45 countries that represent 90% of the total FLR opportunity area in the tropics. Supplemental information contains plots with all countries (n=69).

Supplementary Information for

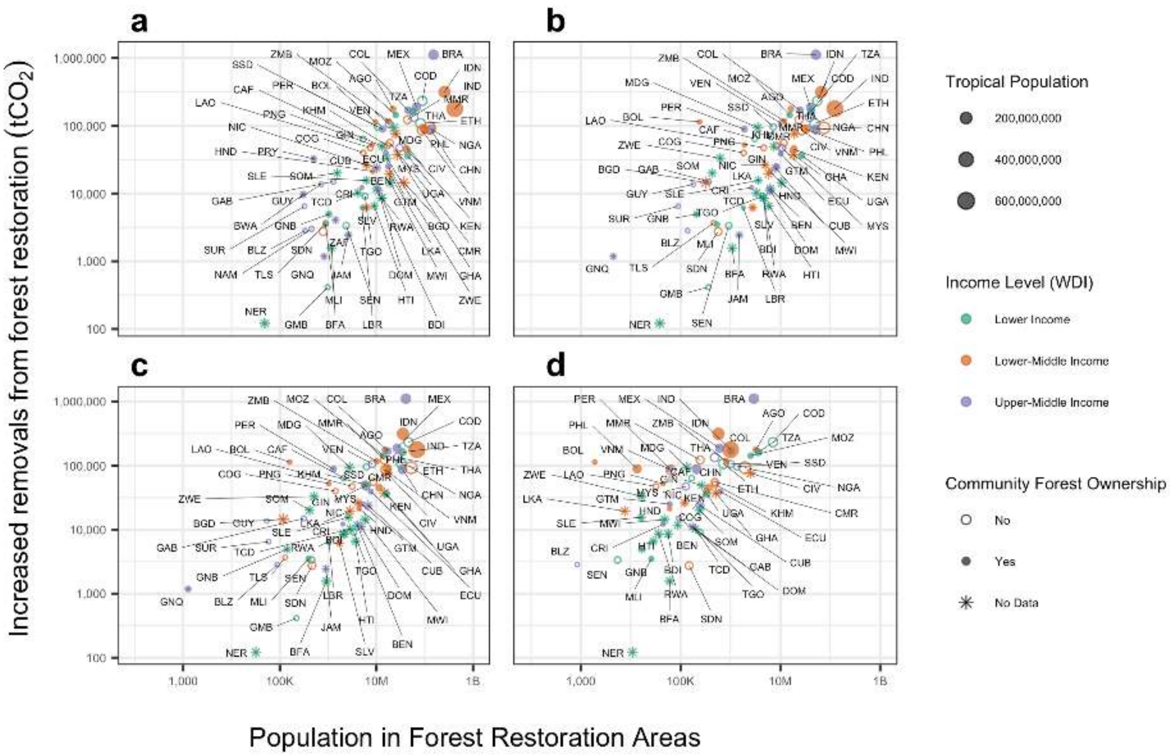
Global forest restoration and the importance of prioritizing local communities

This file includes:

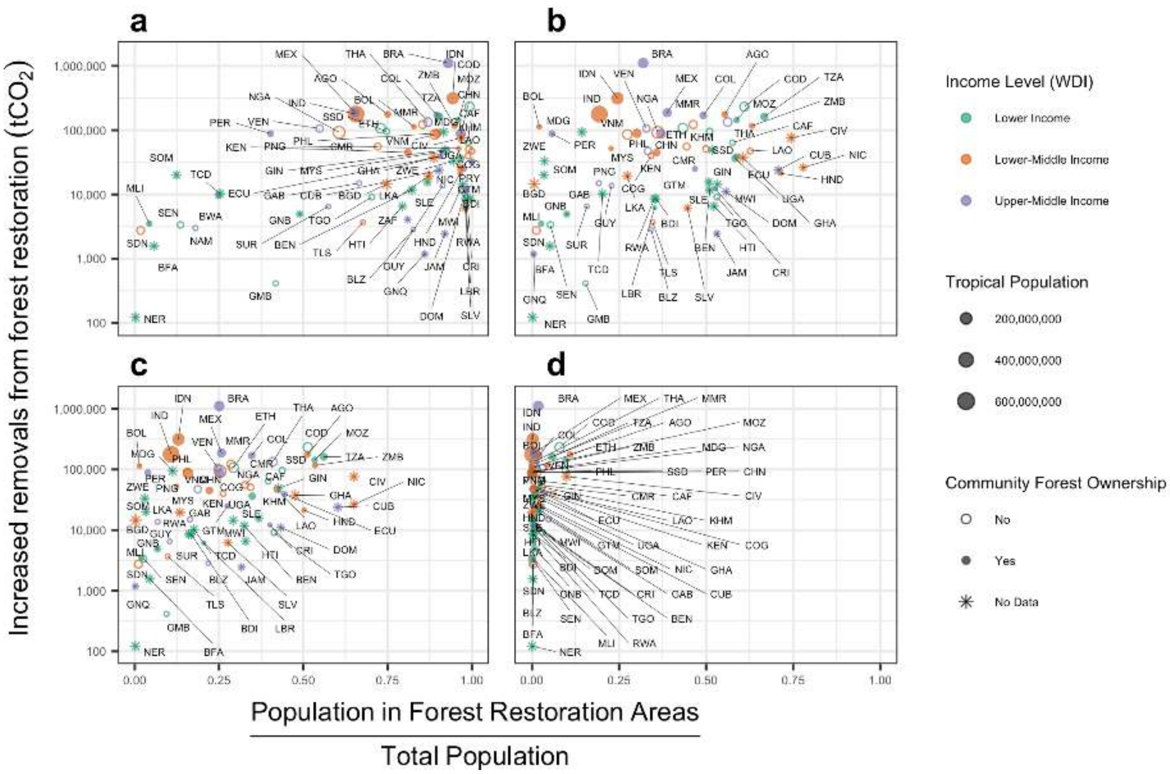
Supplementary Figures 1-6
Supplementary Tables 1-3



Supplementary Figure 1
Forest restoration opportunities[15] by nighttime light radiance[49] (nanoWatts/cm^2/sr)x1.44[11]. Forest restoration opportunity areas are visualized by total pixel-level radiance (a) and by total pixel-level radiance per capita (people/5.5 km^2) (b).

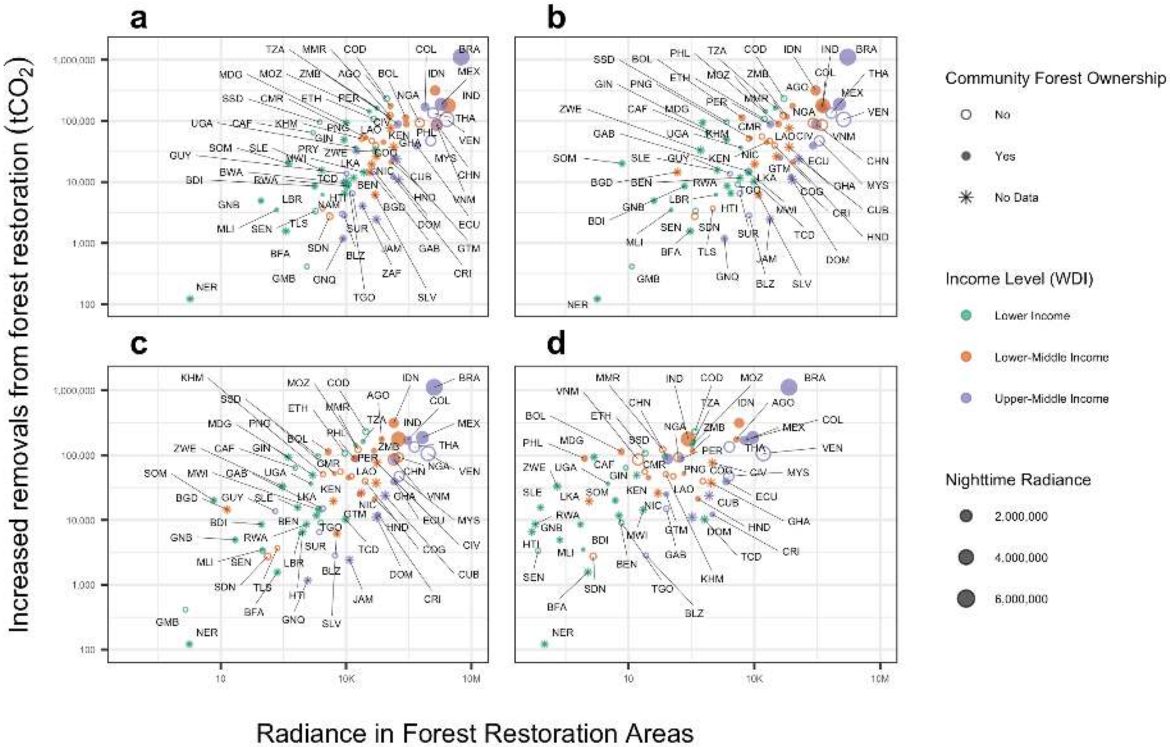


Supplementary Figure 2
Tropical population[48] by increased carbon removal from reforestation (tCO_2) in a $\$20tCO_2^{-1}$ tax scenario from 2020-2050[4]. Panels are faceted by the percent of FLR opportunity area[15] within a 3 arcminute pixel used to estimate carbon removal. Panel (a) includes all pixels, (b) includes pixels with 30% coverage or more, (c) includes pixels with 50% coverage or more, and (d) includes pixels with 100% coverage.



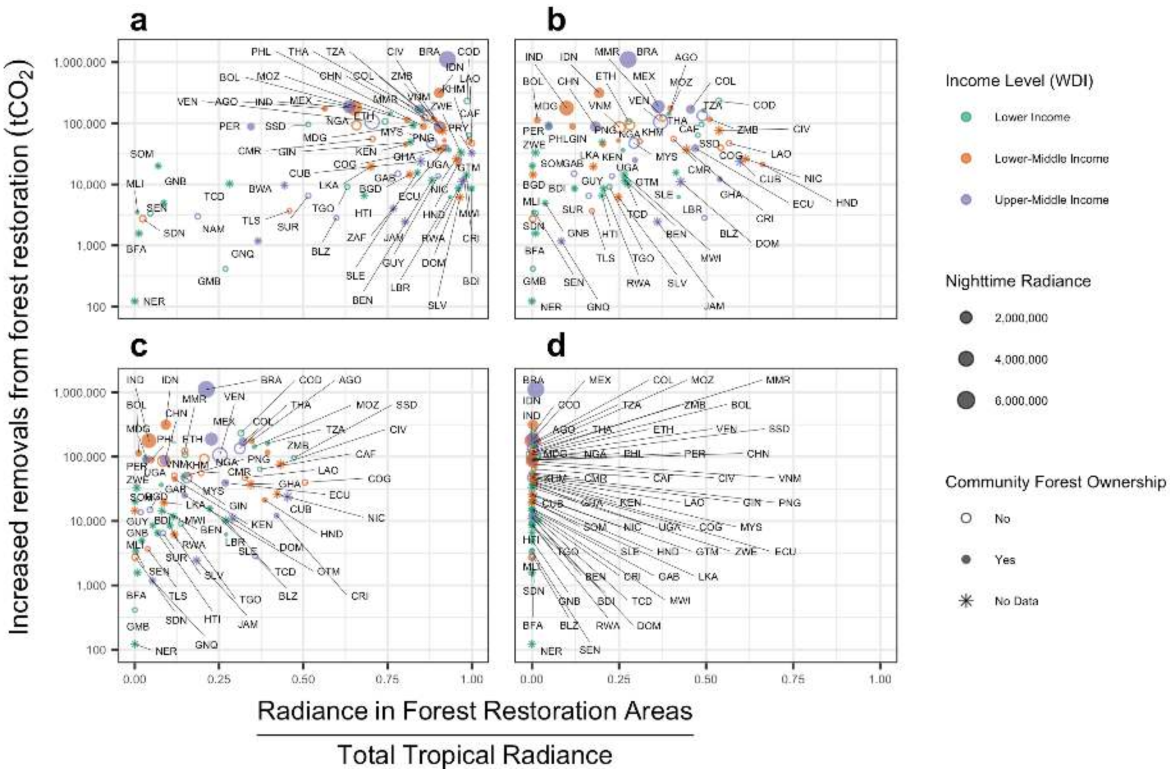
Supplementary Figure 3

The proportion of tropical population[48] by increased carbon removal from reforestation (tCO_2) in a \$20tCO_2^{-1} tax scenario from 2020-2050[4]. Panels are faceted by the percent of FLR opportunity area[15] within a 3 arcminute pixel used to estimate carbon removal. Panel (a) includes all pixels, (b) includes pixels with 30% coverage or more, (c) includes pixels with 50% coverage or more, and (d) includes pixels with 100% coverage.

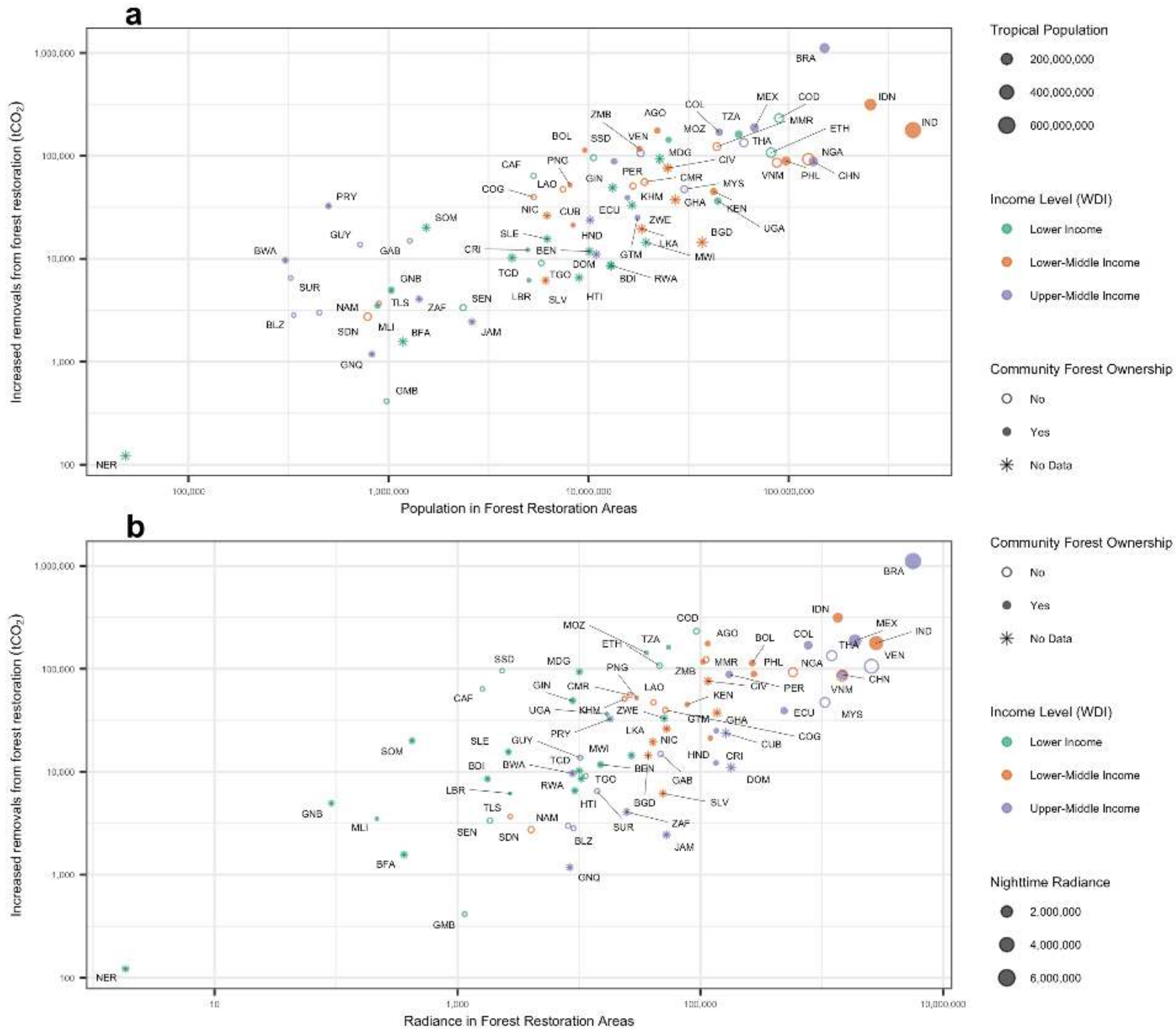


Supplementary Figure 4

Nighttime light radiance[49] measured in (nanoWatts/cm^2/sr)x10^9 by increased carbon removal from reforestation (tCO_2) in a \$20tCO_2^{-1} tax scenario from 2020-2050[4]. Panels are faceted by the percent of FLR opportunity area[15] within a 3 arcminute pixel used to estimate carbon removal. Panel (a) includes all pixels, (b) includes pixels with 30% coverage or more, (c) includes pixels with 50% coverage or more, and (d) includes pixels with 100% coverage.



Supplementary Figure 5
The proportion of nighttime light radiance[49] measured in (nanoWatts/cm^2/sr)x10^9 by increased carbon removal from reforestation (tCO_2) in a \$20tCO_2^{-1} tax scenario from 2020-2050[4]. Panels are faceted by the percent of FLR opportunity area[15] within a 3 arcminute pixel used to estimate carbon removal. Panel (a) includes all pixels, (b) includes pixels with 30% coverage or more, (c) includes pixels with 50% coverage or more, and (d) includes pixels with 100% coverage.



Supplementary Figure 6

Total population[48] (a) and nighttime light radiance[49] (b) within 7.1 km of increased carbon removal from forest restoration (tCO_2) between 2020 and 2050 in a \$20tCO_2^{-1} tax scenario[4]. Nighttime night radiance is measured in (nanoWatts/cm^2/sr)x10^9. Panels (a) and (b) replicate Supplementary Figure 1 (a) and Supplementary Figure 3 (a), respectively.

Method of estimation	Datasets	Resolution	Population estimate
Population summed between 23.4 degrees north and 15 degrees south	CIESIN 2019[48]	30 arcseconds (~1 km pixels)	3,003,677,668
Summed population within "Global map" wide-scale and mosaic forest restoration opportunities between 23.4 degrees north and 15 degrees south	CIESIN 2019[48], Potapov *et al.* 2011[15]	30 arcseconds (~1 km pixels)	830,424,187
Summed population within "Global map" restoration opportunities with at least 30% tree-cover in 2000 between 23.4 degrees north and 15 degrees south	Hansen *et al.* 2013[45], CIESIN 2019[48], Potapov *et al.* 2011[15]	30 arcseconds (~1 km pixels)	294,521,349
Summed population within "Global map" restoration opportunities with at least 50% tree-cover in 2000 between 23.4 degrees north and 15 degrees south	Hansen *et al.* 2013[45], CIESIN 2019[48], Potapov *et al.* 2011[15],	30 arcseconds (~1 km pixels)	140,412,143
Summed population within pixels that estimate any carbon removal from forest restoration given a $\$20tCO_2^{-1}$ incentive between 23.4 degrees north and 15 degrees south	Busch *et al.* 2019[4], CIESIN 2019[48],	3 arcminutes (~5.5 km pixels)	2,372,546,672
Summed population within pixels that estimate any carbon removal from forest restoration given a $\$20tCO_2^{-1}$ incentive, with at least 30% pixel area covered by mosaic or wide-scale forest restoration opportunities from the "Global map," and between 23.4 degrees north and 15 degrees south.	Busch *et al.* 2019[4], CIESIN 2019[48], Potapov *et al.* 2011[15]	3 arcminutes (~5.5 km pixels)	1,012,654,847
Summed population within pixels that estimate any carbon removal from forest restoration given a $\$20tCO_2^{-1}$ incentive, with at least 50% pixel area covered by mosaic or wide-scale forest restoration opportunities from the "Global map," and between 23.4 degrees north and 15 degrees south.	Busch *et al.* 2019[4], CIESIN 2019[48], Potapov *et al.* 2011[15]	3 arcminutes (~5.5 km pixels)	690,389,729
Summed population within pixels that estimate any carbon removal from forest restoration given a $\$20tCO_2^{-1}$ incentive, with at least 100% pixel area covered by mosaic or wide-scale forest restoration opportunities from the "Global map," and between 23.4 degrees north and 15 degrees south.	Busch *et al.* 2019[4], CIESIN 2019[48], Potapov *et al.* 2011[15]	3 arcminutes (~5.5 km pixels)	38,256,811

Supplementary Table 1.

Population estimates within forest restoration opportunity areas by method, data, and spatial resolution. Estimates of additional carbon removal from forest restoration under a $\$20tCO_2^{-1}$ tax are only within areas that were tree-covered in 2000 or 2010[45].

Country	Code	Community Forest Ownership		Community Forest Designation		FRO Area (Mha)	FRO Proximate People (1E6)
		Evidence	Legal Basis	Evidence	Legal Basis		
Brazil	BRA	1	1	1	1	220.11	51.86
Tanzania	TZA	1	1	1	1	69.06	41.59
Indonesia	IDN	1	1	1	1	53.17	66.68
Zambia	ZMB	1	1	1	1	29.99	11.95
Mozambique	MOZ	1	1	1	1	25.10	15.38
Philippines	PHL	1	1	1	1	16.93	32.68
Kenya	KEN	1	1	1	1	10.50	18.66
Ecuador	ECU	1	1	1	1	9.63	10.15
Honduras	HND	1	1	1	1	6.65	6.20
Guatemala	GTM	1	1	1	1	6.43	8.43
Peru	PER	1	1	1	1	5.35	1.90
Bolivia	BOL	1	1	1	1	0.24	0.00
Uganda	UGA	1	1	0	1	13.33	26.64
Mali	MLI	1	1	0	1	2.30	0.54
Liberia	LBR	1	1	0	1	1.68	1.80
Angola	AGO	1	1	0	0	53.41	16.27
Mexico	MEX	1	1	0	0	51.25	40.19
India	IND	1	1	0	0	49.76	123.31
Colombia	COL	1	1	0	0	36.52	24.67
China	CHN	1	1	0	0	21.75	50.93
Papua New Guinea	PNG	1	1	0	0	5.41	1.90
Costa Rica	CRI	1	1	0	0	3.28	2.65
Cambodia	KHM	0	1	1	1	10.55	8.41
South Sudan	SSD	0	1	0	0	25.93	7.23
Togo	TGO	0	1	0	0	3.63	4.39
Belize	BLZ	0	1	0	0	0.78	0.14
Dem. Rep. of the Congo	COD	0	0	1	1	103.94	54.91
Thailand	THA	0	0	1	1	34.95	38.59
Ethiopia	ETH	0	0	1	1	34.67	48.59
Myanmar	MMR	0	0	1	1	25.28	23.73
Venezuela	VEN	0	0	1	1	24.39	10.90
Cameroon	CMR	0	0	1	1	16.62	11.73
Vietnam	VNM	0	0	1	1	16.53	26.84
Laos	LAO	0	0	1	1	8.37	4.66
Gabon	GAB	0	0	1	1	3.12	0.37
Sudan	SDN	0	0	1	1	2.05	0.57
Guyana	GUY	0	0	1	1	0.36	0.18
Gambia	GMB	0	0	1	1	0.28	0.36
Nigeria	NGA	0	0	0	1	34.00	74.75
Central African Rep.	CAF	0	0	0	1	21.14	3.09
Rep. of Congo	COG	0	0	0	1	13.10	1.84
Malaysia	MYS	0	0	0	0	10.28	10.85
Senegal	SEN	0	0	0	0	1.46	0.92
East Timor	TLS	0	0	0	0	0.74	0.46
Suriname	SUR	0	0	0	0	0.11	0.09

Supplementary Table 2.
Country-level information and opportunities for community-based FLR. Countries are listed in descending order based on evidence and legal basis for community forest ownership, evidence and legal basis for community forest designation, and forest reforestation opportunity (FRO) areas[4,15,43,48,53]. FRO areas (3 arcminute pixels) are between 23.4˚N and 15˚S with any modeled carbon removal from restoration under a $\$20tCO_2^{-1}$ tax scenario[4] and at least 30% coverage of wide-scale or mosaic forest restoration opportunities identified in the "Global map of forest landscape restoration"[15]. Population is estimated within FRO areas[48].

Country	Code
Algeria	DZA
Angola	AGO
Argentina	ARG
Aruba	ABW
Australia	AUS
Bahamas	BHS
Bangladesh	BGD
Belize	BLZ
Benin	BEN
Bolivia	BOL
Botswana	BWA
Brazil	BRA
British Virgin Islands	VGB
Brunei	BRN
Burkina Faso	BFA
Burundi	BDI
Cambodia	KHM
Cameroon	CMR
Cayman Islands	CYM
Central African Republic	CAF
Chad	TCD
Chile	CHL
China	CHN
Colombia	COL
Comoros	COM
Costa Rica	CRI
Côte d'Ivoire	CIV
Cuba	CUB
Curaçao	CUW
Democratic Republic of the Congo	COD
Djibouti	DJI
Dominican Republic	DOM
East Timor	TLS
Ecuador	ECU
Egypt	EGY
El Salvador	SLV
Equatorial Guinea	GNQ
Eritrea	ERI
Ethiopia	ETH
Gabon	GAB
Gambia	GMB
Ghana	GHA
Grenada	GRD
Guatemala	GTM
Guinea	GIN
Guinea-Bissau	GNB
Guyana	GUY
Haiti	HTI
Honduras	HND

Country	Code
Hong Kong	HKG
India	IND
Indonesia	IDN
Jamaica	JAM
Kenya	KEN
Laos	LAO
Liberia	LBR
Libya	LBY
Macao	MAC
Madagascar	MDG
Malawi	MWI
Malaysia	MYS
Maldives	MDV
Mali	MLI
Mauritania	MRT
Mexico	MEX
Mozambique	MOZ
Myanmar	MMR
Namibia	NAM
Nicaragua	NIC
Niger	NER
Nigeria	NGA
Palau	PLW
Panama	PAN
Papua New Guinea	PNG
Paraguay	PRY
Peru	PER
Philippines	PHL
Puerto Rico	PRI
Republic of Congo	COG
Rwanda	RWA
Sao Tome & Principe	STP
Saudi Arabia	SAU
Senegal	SEN
Seychelles	SYC
Sierra Leone	SLE
Singapore	SGP
Sint Maarten	SXM
Solomon Islands	SLB
Somalia	SOM
South Africa	ZAF
South Sudan	SSD
Sri Lanka	LKA
Sudan	SDN
Suriname	SUR
Taiwan	TWN
Tanzania	TZA
Thailand	THA
Togo	TGO

Country	Code
Trinidad & Tobago	TTO
Uganda	UGA
Venezuela	VEN
Vietnam	VNM
Virgin Islands, U.S.	VIR
Yemen	YEM
Zambia	ZMB
Zimbabwe	ZWE

Supplementary Table 3.
A list of all countries that appear in the analysis (including SI) with country name and World Bank country code.