SUMMARY FOR POLICYMAKERS

The geography of forests in climate solutions

RESOURCES FOR THE FUTURE

Climate Advisers

Forest Carbon Index

Key Findings

- Tropical forests can provide up to 25 percent of needed climate solutions between now and 2020.
- The average price of forest carbon emissions reductions through 2020 will be slightly more than half of projected carbon prices in developed nations—saving at least $40 billion over this period.
- To unlock these climate solutions and cost savings, global payments for forest carbon will need to be $15 billion to $20 billion annually through 2020.
- In the near term, the focus should be primarily on Brazil, Amazon-Andes, and Malaysian Borneo. By 2020, the focus should expand to include Indonesia.
- Public-sector investments are needed to build capacity in poorly governed regions and to avoid shifting deforestation to areas of large intact forest.
- The sociopolitical consequences of forest carbon programs may be substantial as new funding streams could approach 1 percent of GDP in some nations.

www.forestcarbonindex.org

Introduction

Climate change is an urgent and growing threat that requires immediate action. Deforestation and forest degradation—mostly in the tropics—account for up to 17 percent of global greenhouse gas emissions, more than the entire global transport sector. Conserving and managing forests for their carbon represent affordable opportunities for near-term climate action, potentially reducing carbon prices in Europe, the United States, and other developed nations by as much as half through 2020, compared with purely domestic efforts. Forests also provide many other benefits: strengthening security by reducing instability, helping alleviate poverty, and protecting critical ecosystems and biodiversity. And unlike many other climate solutions, no new technologies are needed to grow and conserve trees.

Not surprisingly, emerging climate policy frameworks are starting to focus on tropical forests. Global payments for "forest carbon" could equal almost $20 billion annually over the next decade if leading policy approaches are adopted. As a result, policymakers and carbon market investors around the world are asking many questions: Where are the best places to conserve forests quickly and cheaply? What are the expected costs and mitigation potentials? What will be the scale of forest carbon revenues in particular countries, and how might these revenues impact society? What policy frameworks are needed to ensure that forest carbon investments produce desired results?

Project Goals

The Forest Carbon Index is designed to help policymakers and investors answer these questions. It analyzes the potential of every piece of land on Earth to combat climate change by storing carbon in forests, whether existing or newly planted. The Index illuminates the geography of potential forest carbon investments by compiling and mapping quantitative localized data relating to biological, economic, investment, and market readiness conditions. By matching this data against expected changes in forest cover, the Index also estimates likely forest carbon costs, quantities, and revenues for each country in the world.

Contributions

The Index may be the first attempt to organize such a wide range of technical information about local forest carbon conditions for policymakers and investors. The Index is unique because it does all of the following:

- provides insight at the global, national, and local levels for all countries with forest carbon potential;
- presents information relating to both conserving and growing forests;
- models forest carbon demand and supply using emerging U.S. and global climate policy frameworks;
- explicitly accounts for important risk factors such as country governance, ease of doing business, and forest carbon market readiness; and
- predicts the geography of future deforestation risks and forest carbon investments both nationally and locally.

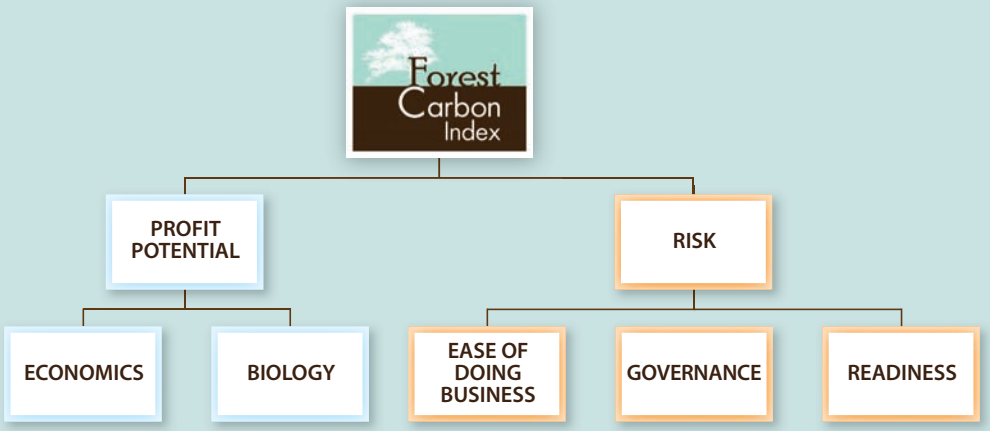
The Index employed 20 datasets at the national scale and 6 datasets at a gridded subnational scale, which were integrated and mapped across approximately one and a half million locations at a resolution of 85.5 square kilometers. The methodology is described in the full report available at www.forestcarbonindex.org.

Approach

The Forest Carbon Index is a geospatial analysis that estimates each nation's potential to attract forest carbon investment based on profit potential and country-specific risk factors.

Profit Potential. Raw profit potential is calculated by subtracting the cost of taking forests out of alternative economic uses from expected forest carbon revenues. The Index measures profit potential by looking at biological and economic factors; estimates the physical and biological limits of storing forest carbon in any location based on existing forest carbon stocks and potential to grow new forests; and assesses the economic viability of forest carbon investments. Potential economic returns from timber,

Forest Carbon Index Framework



agriculture, and grazing are used to calculate the opportunity cost of protecting existing forests or converting nonforested land into forests.

Risk. The Index incorporates the technical readiness of each nation to conserve forests by examining forest-monitoring capabilities and environmental market experience. It also incorporates widely accepted data from the World Bank about governance conditions (including corruption) and the ease of doing business. Together, these factors create a risk score that is used to discount raw profit potential to more accurately reflect national and local conditions.

Policy Constraints

The Index models likely policy frameworks in the United States, Europe, and globally. The main constraints are the following:

Carbon Prices. Nations, companies, and investors are unlikely to pay more for forest carbon than other types of carbon investments. Expected carbon prices will be a function of the environmental

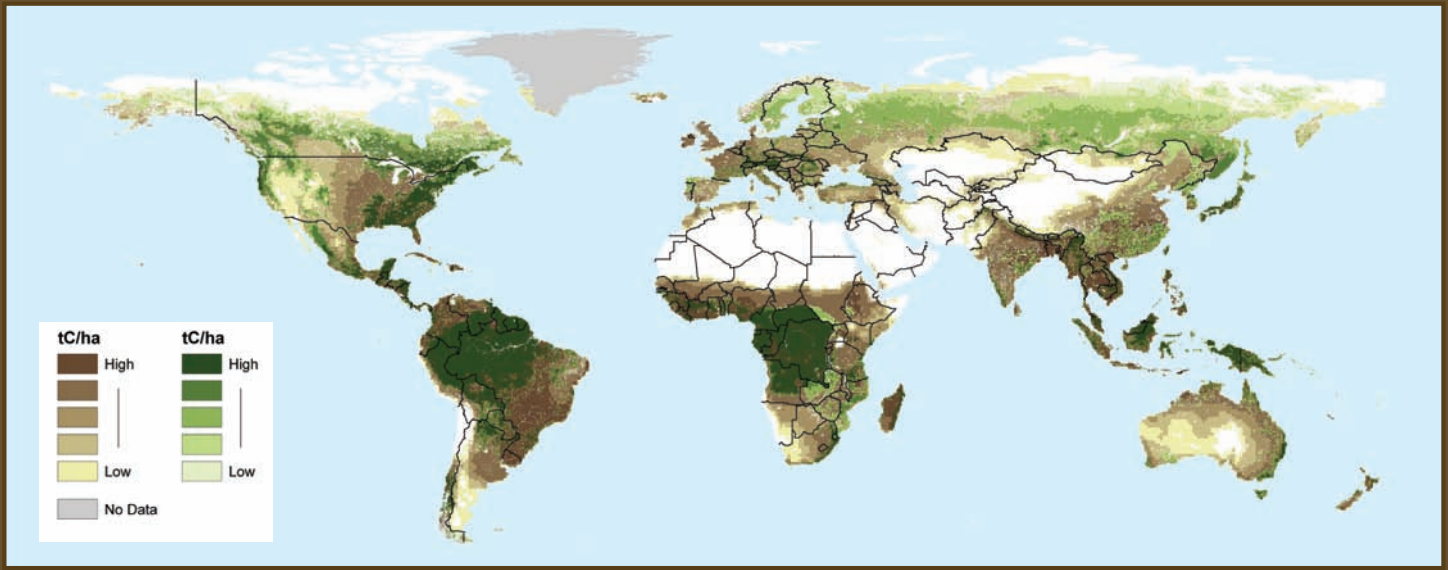
ambition or stringency of national, regional, and global climate change policy frameworks. The Index models a variety of price scenarios ranging from $1 to $100 per ton of carbon dioxide (CO_2), with a reference scenario of $20 a ton in 2020—an approximation of the likely cost of carbon in the United States and other major developed countries at that time.

Permanence Risks. Climate policies are likely to take into account risks that forests could be damaged by fires, storms, or other natural factors, as well as by climate change, human behavioral changes, and new government policies. Consistent with the approach taken in voluntary carbon markets, the Index sets aside a percentage of forest carbon as a buffer or reserve, 20 percent in 2020.

"Additionality" Requirements. Climate policy frameworks will reflect the strong desire by governments to incentivize actions that otherwise would not have occurred. Although some forests around the world are under threat, many are not. Nations are likely to direct most new resources for forest conservation to nations with high rates of deforestation. The Index limits the quantity of forest carbon each nation can supply based on its historical rate of deforestation. It also excludes the most inaccessible parts of forests in the world.

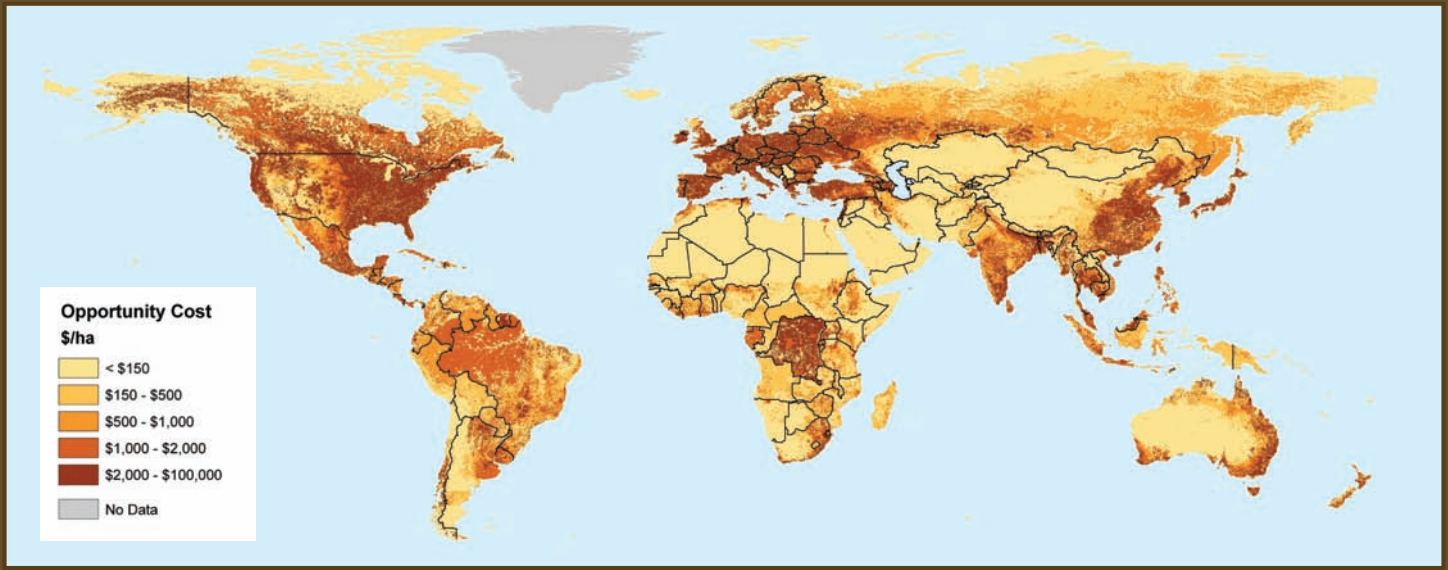
Quantity Limits. Developed-country governments are likely to cap demand for forest carbon by imposing quantitative limits on tons that qualify under various national, regional, and global climate policy frameworks. Legislative proposals in the U.S. Congress, for example, would limit the country's demand for tropical forest carbon to between 0.5 and 1.5 billion tons a year of carbon dioxide equivalents (CO_2eq). The Index limits global demand for forest carbon to twice that level.

Map 1: Aboveground Carbon Stocks Without Policy Constraints



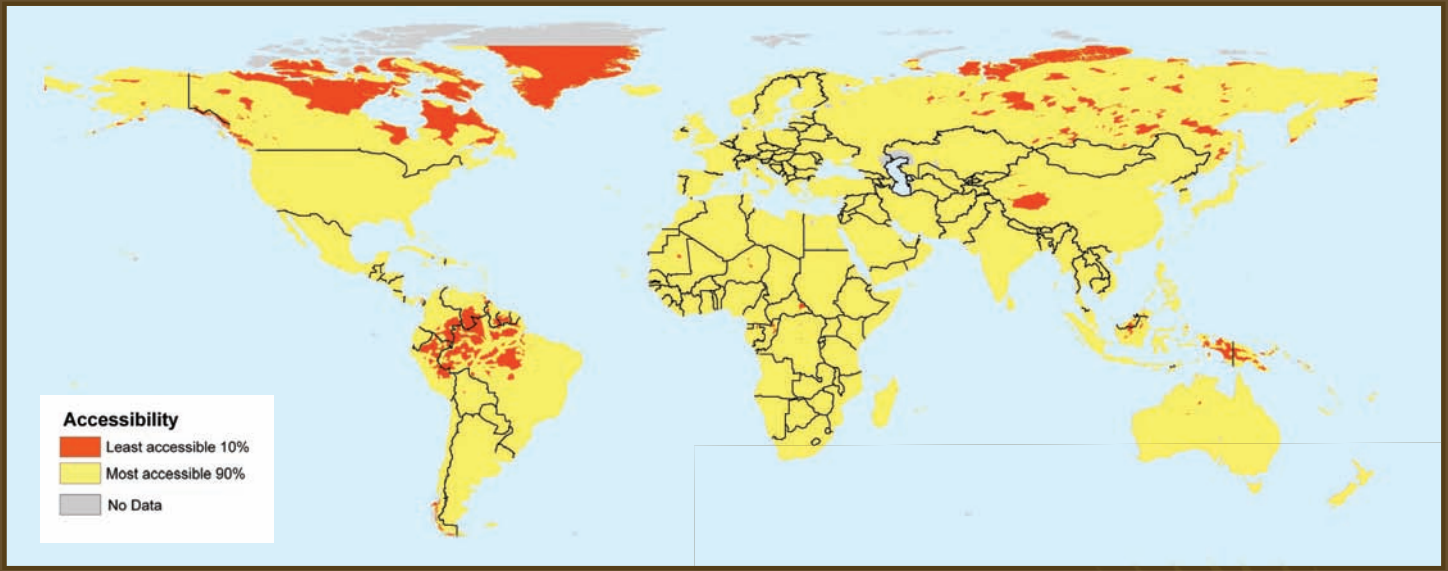
Of the Earth's entire land mass, 85 percent has the potential to be managed for forest carbon. Existing forests, shown in green, cover 37 percent of this land. Areas that are not currently forests but could be, shown in brown, make up the remaining 48 percent. The amount of aboveground carbon in existing forests is almost six times greater than annual global greenhouse gas emissions. The theoretical potential of land that could be turned into forests is almost five times larger than the existing forest carbon stock. Brazil, Russia, the United States, China, and Australia account for 34 percent of actual and potential forest carbon stocks. The Earth's soils hold great quantities of carbon, methane, and other greenhouse gases and may have the potential to store even more under the right management conditions. Significant uncertainties exist about current soil data.

Map 2: Opportunity Costs at the Local Level



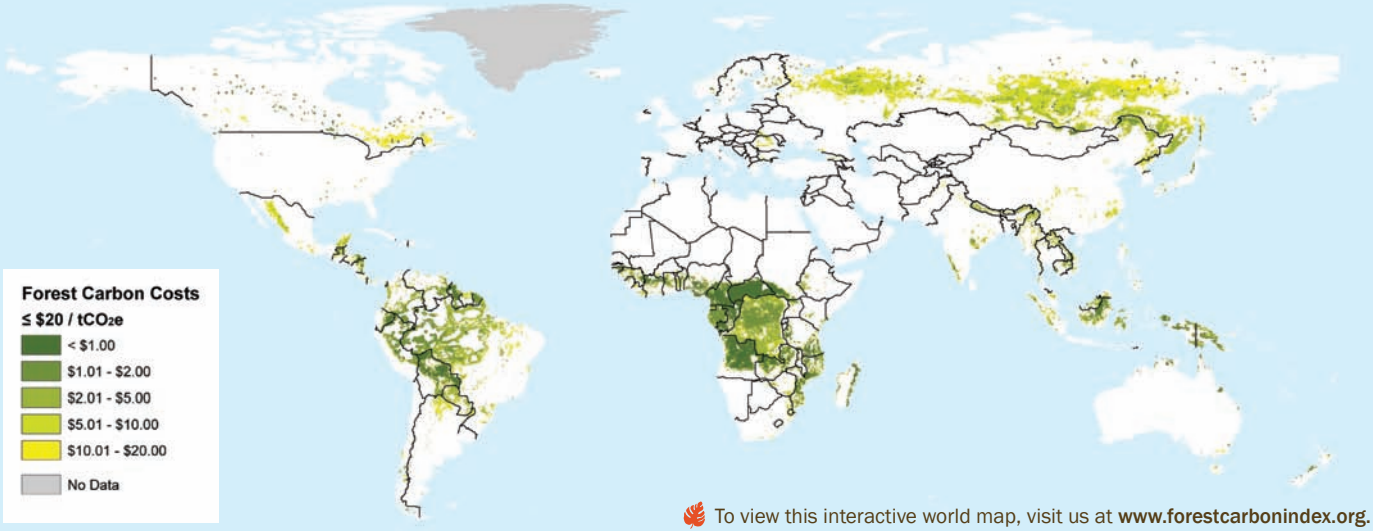
Map 2 shows the opportunity cost of land around the world—the amount that would be required to move land into carbon management instead of competing uses, leaving aside transaction costs. The opportunity costs for growing forest are based on the present value of forgone profits from agriculture, whereas those for conserving existing forests are calculated by adding the present value of timber extraction plus profits from subsequent agricultural use. Among carbon-rich tropical forest nations, countries in the Congo Basin, Amazon-Andes, and Southeast Asia have relatively low opportunity costs. (High costs shown in the Democratic Republic of the Congo reflect timber values and may reveal potential inaccuracies in global data.)

Map 3: Accessibility to Human Encroachment



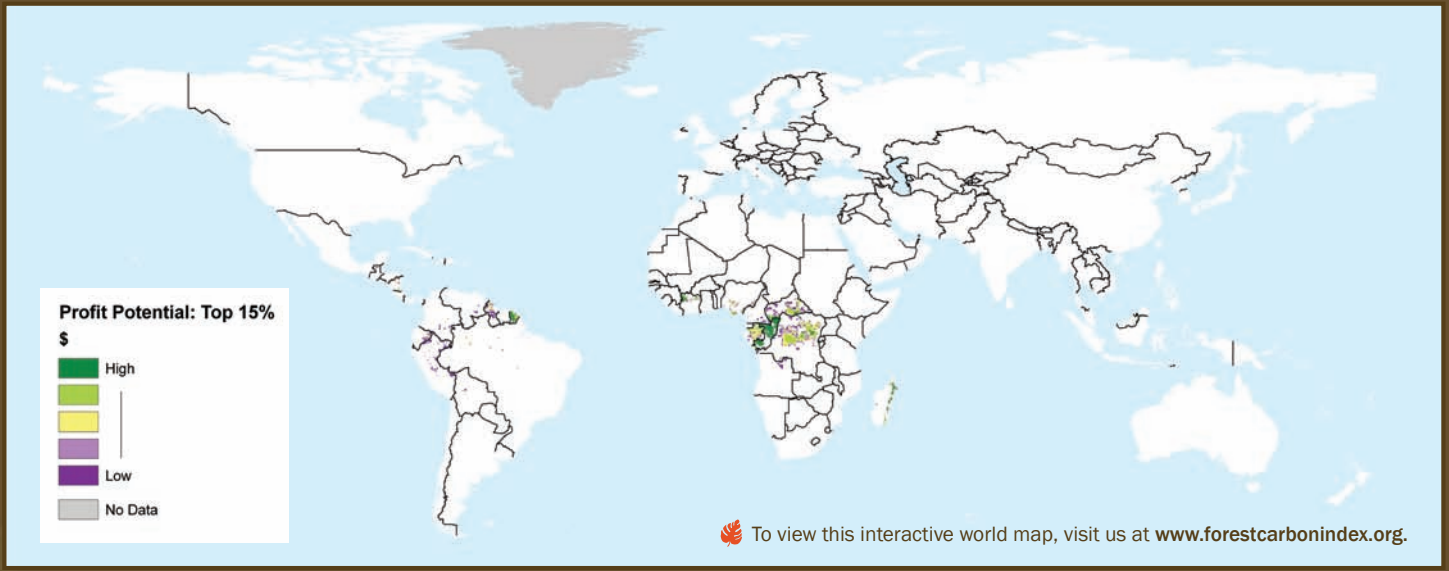
Parts of the world's forests are so inaccessible that they are not under immediate threat from human encroachment. These forests are therefore excluded from the Index. Forests account for 38 percent of the world's least accessible places, based on topography, ecosystem type, distance from transportation corridors, and other relevant factors. The least accessible carbon-rich tropical forests are in the Brazilian Amazon.

Map 4: Forest Carbon Costs at the Local Level



Many areas of the world seem ideal places to manage forests for their emissions mitigation benefits, with many opportunities at $20 or less per ton of CO_2eq. More than a third of these potentially cost-effective places are in Brazil and the Democratic Republic of the Congo, and 23 percent are in the Congo Basin. In fact, the Congo Basin accounts for 43 percent of the very cheapest places, defined as potential prices no more than $3 per ton of CO_2eq.

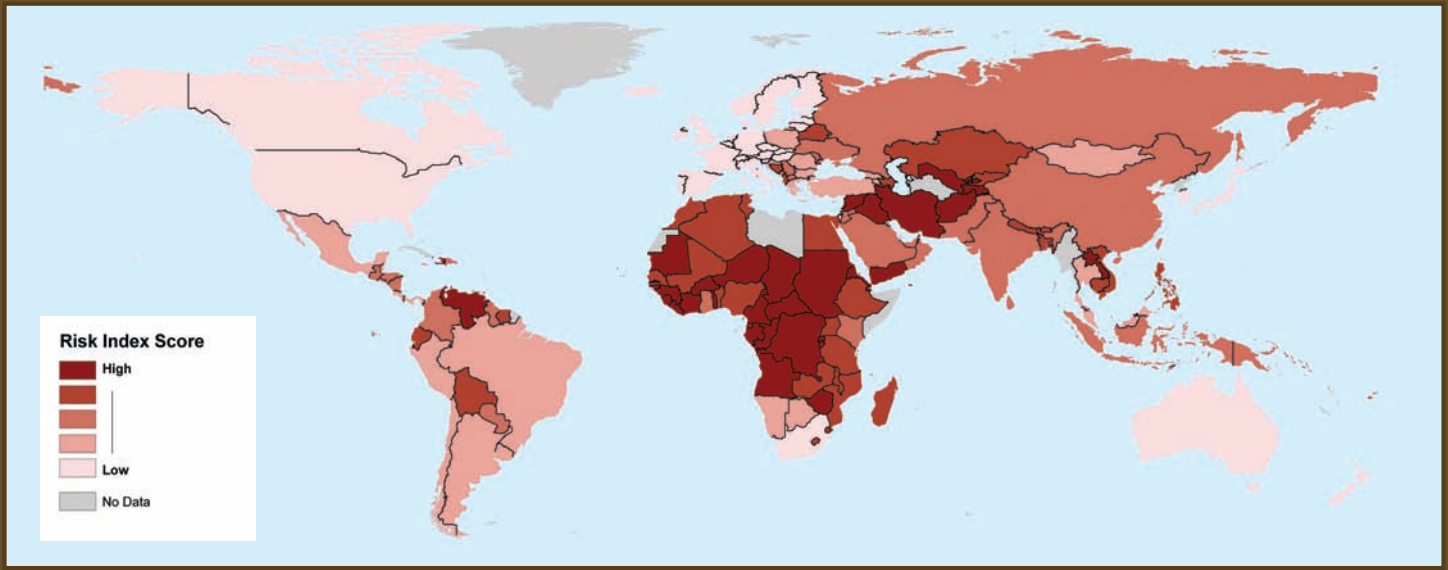
Map 5: Top 15 Percent of Profit Potential Locations



Investments will flow to places where the costs of mitigation are lowest and the opportunities for mitigation are plentiful, leaving aside questions of risk. *Map 5* shows the theoretical profit potential of some of the most promising places in the world (top 15 percent) where one could manage forests to mitigate climate change. The Congo Basin—with its inexpensive, carbon-rich lands—contains 75 percent of these theoretically high-profit places.

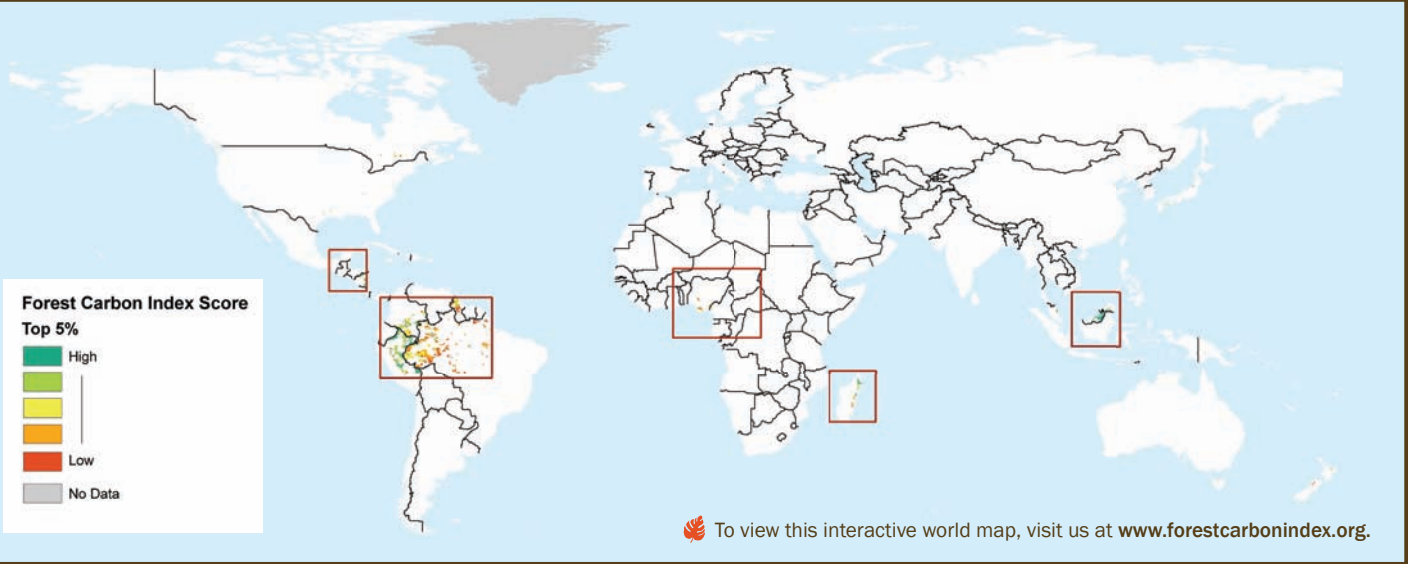
The greater Amazon region captures 13 percent, with Southeast Asia and Central America a distant third and fourth best. After taking into consideration where deforestation is actually occurring today (which *Map 5* does not show), Brazil accounts for 38 percent of the total global profit potential, with Indonesia coming in second, at 17 percent.

Map 6: FCI Composite Risk Index



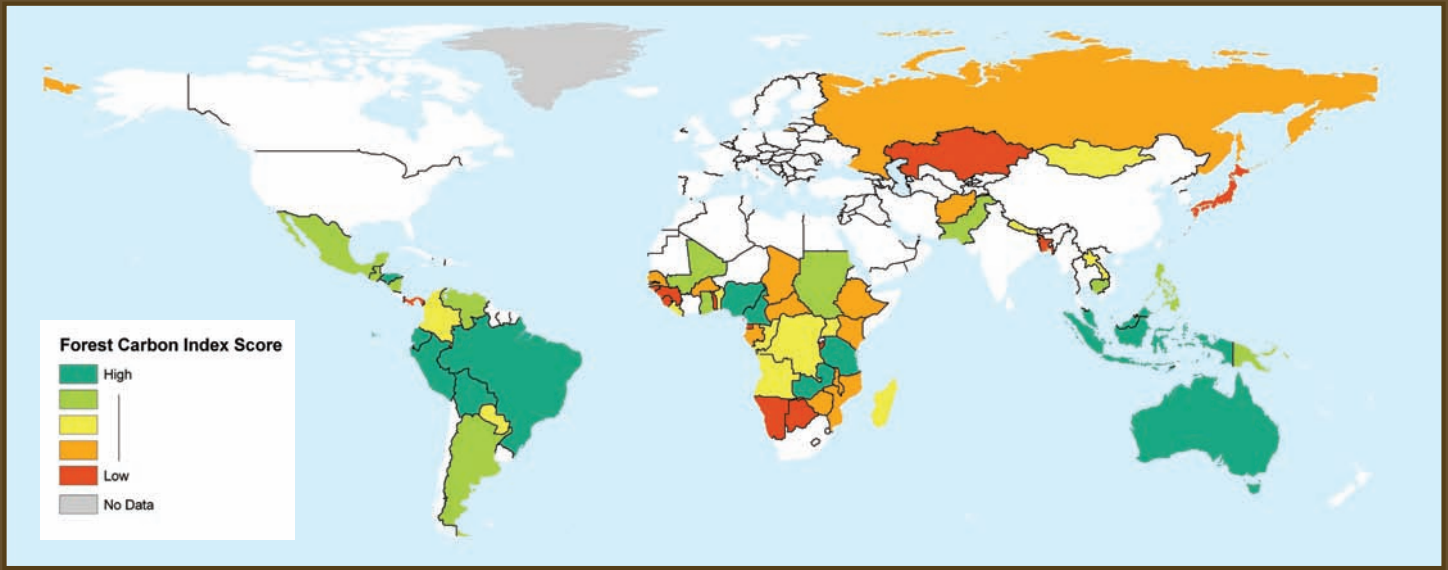
The ability of a country or place to conserve forests verifiably will depend greatly on a wide variety of political and social risks. *Map 6* categorizes countries based on three types of risk. The first risk factor is national governance conditions, which include control of corruption, rule of law, political stability, and government effectiveness, among other factors. The second is the ease of doing business in a country, as measured by a wide variety of regulatory, tax, and employment conditions. The third is a country's readiness to participate in forest carbon markets and incentive programs specifically, which is measured by its capacity to measure, report, and verify changes in forest carbon and its experience with global carbon markets.

Map 7: Best Places for Early Investments at the Local Level



The Forest Carbon Index predicts how much a country or place will contribute to the global effort to conserve and manage forests to mitigate climate change by discounting theoretical profit potential by risk. Using this approach, *Map 7* highlights the five best places in the world for early forest carbon returns. Of the best places, 85 percent lie in the greater Amazon, with 45 percent in Brazil and 23 percent in Peru. Poor governance, ease of doing business, and readiness scores dramatically reduce expected outcomes in Africa, and in Southeast Asia these factors allow Malaysia to outperform Indonesia. Each of these countries and regions is experiencing enough deforestation to capitalize on its superior conditions to attract early investment and produce rapid results.

Map 8: FCI Country Scores Based on Flows



As noted previously, the *Best Places* map highlights where early investments should flow. Because climate policies are likely to channel investments to nations with high deforestation rates, some of these early movers will soon exhaust their potential, as their deforestation rates are low. *Map 8* takes into account existing deforestation rates to better predict the geography of forest carbon investment in the medium term. Once again, Brazil emerges as the best place for forest carbon investments, and Amazon-Andes countries stand out as well. But Indonesia, as a result of rapid deforestation, moves to second place behind Brazil. Australia has many opportunities to offset its industrial emissions by conserving and growing domestic forests. Countries in West and East Africa with high deforestation rates, from Nigeria and Cameroon to Tanzania and Zambia, also come to the fore.

Policy Recommendations

These results lead to important insights about how nations should include forests in their climate policies:

1. *Forests, particularly in the tropics, must be a central focus of climate policy.* Tropical forests can provide up to 25 percent of needed climate solutions between now and 2020. They could reduce carbon prices in developed nations by as much as half through 2020—saving roughly $40 billion over this period. To unlock these cost savings, global payments for forest carbon to developing nations could equal almost $20 billion annually through 2020, thereby creating substantial development opportunities for these nations.

2. *Four needs must be met through public and private funding.* Climate policy frameworks must generate resources for 1) planning and capacity building; 2) policy reforms and program implementations; 3) avoiding future risks of deforestation, particularly in nations with low rates; and 4) reducing deforestation, particularly in nations with high rates. As a practical matter, public funding will be required for the first three needs, whereas private-sector carbon markets are likely to do much to satisfy the fourth.

3. *For near-term tons, the focus should be primarily on Brazil, Amazon-Andes, and Southeast Asia.* In the first years of new forest carbon programs, nations with relatively good governance, inexpensive land, and significant deforestation provide the greatest opportunities for early returns on investment. To meet near-term emissions reduction targets, developed nations should establish active forest carbon partnerships with these countries and regions.

4. *Over the medium term, the focus should be on Brazil and Indonesia.* For the world to achieve the significant emissions reductions required by 2020, policy frameworks also will need to engage nations with the highest deforestation rates. This means forming active partnerships with Brazil and Indonesia that together account for 50 percent of global deforestation and are expected to provide more than 60 percent of the forest carbon supply in 2020.

5. *For long-term success, the focus should be on the Congo Basin.* Climate policy frameworks must reward not only nations that reduce deforestation, but also tropical forest nations that have very low rates now. Absent the latter, deforestation may merely shift from one country to the next, and climate policies will create perverse incentives that accelerate deforestation now in order to qualify for financial payments later. Relatively modest payments in the Congo Basin could protect huge, carbon-rich forests that are not currently under threat but soon could be if these nations are not included in new forest conservation frameworks.

6. *Policy frameworks must promote public participation and transparency.* New forest conservation programs will mobilize substantial funding for developing countries. In many forest-rich developing nations, new funding streams may approach 1 percent of gross domestic product, or anywhere from 10 to more than 100 percent of current government expenditures as in the cases of Brazil and Cambodia, respectively. These new resources have the potential to create positive economic opportunities for the 1.6 billion forest-dependent people in developing nations. Poorly designed or managed programs could also threaten vulnerable populations, increase corruption, alter access to land, and result in forced migrations. Strong public participation and transparency will be essential to ensure that new forest conservation programs promote local sustainable development objectives and good governance without harmful societal impacts, particularly on indigenous communities and the poor.

7. *Developed governments should consider creating financial intermediaries.* Compared with the private sector, developed governments are in a stronger position to engage developing nations on the social impacts of forest conservation and negotiate forest sector–wide incentive programs that compensate developing nations for emissions reductions. Few private firms in the developed world have the expertise or financial incentive to help developing nations ensure that emissions reduction projects and programs advance local sustainable development objectives, strengthen governance, and contribute to social justice and stability. By creating a financial intermediary between their companies and developing-country actors, developed countries can help both promote these objectives and verify that emissions reductions are genuine. Absent a financial intermediary, forest carbon prices will be relatively high compared with the cost of reducing deforestation in some countries. Higher-than-necessary forest carbon prices hurt the global economy and reduce emissions mitigation for each dollar invested. A developed-country, government-managed financial intermediary would be able to use its bulk purchasing power to lower costs and increase emissions mitigation, while also improving environmental quality and social outcomes.

8. *Governments should design policies to channel resources to high-priority areas.* Forests have many values beyond carbon. Some contain high biodiversity; others hold cultural significance, enhance security, reduce climate vulnerability, or make special contributions to poverty alleviation and local livelihoods. Climate policy frameworks should give priority to the most important forests, taking into account the full range of societal objectives. More analysis is needed to understand where these high-value forests are and design investment frameworks that protect them.

9. *Policy frameworks should promote a transition to comprehensive land management and terrestrial greenhouse gas accounting.* Food, biofuel, and fiber production compete with forests for a finite land area in developing nations. Changes in tropical forests are driven by that competition as forests are turned into farmlands and rangelands or harvested for timber. To achieve global food security and climate goals, nations must find a way to meet the expected doubling of global food demand by 2050 and also stop deforestation well before then. Safeguards are needed to help ensure that climate policies—whether through incentives for expanding biofuel production or payments for forest conservation—do not produce unintended societal, security, or climate consequences. Toward this end, nations should develop comprehensive approaches to managing land use and greenhouse gas emissions across various land types, not just forests.

Conclusion

Conserving and managing forests for their carbon represent affordable opportunities for near-term climate action. The Forest Carbon Index can help policymakers and investors understand the expected costs and mitigation potentials of different areas of the world, as well as provide insights on the appropriate design of climate policy. As experts might expect, Brazil is the very best place in the world to achieve large-scale, affordable emissions reductions in the near and medium term. Many other nations in South America, Southeast Asia, and Africa also are well positioned to reduce emissions.

An improved understanding of the geography of forest carbon provides important insights into the ideal design of climate policies. Not only must forest conservation become a central pillar of climate action, but also success depends on tailoring these efforts to local needs and conditions in order to maximize benefits and manage risks.

The maps in the Forest Carbon Index are created for informational purposes based on the best available global datasets. The Index is intended to be used by investors as a starting point to identify potential areas which merit further due diligence. The maps and market analyses are illustrative outputs that offer policymakers and decisionmakers insights into the potential volume and geography of supply of forest carbon assets and impacts of policy decisions. There are unique factors affecting forest carbon potential in any site that could not be captured by a global index, and the Forest Carbon Index will inevitably differ from the geography and quantity of actual forest carbon assets that are developed.

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UNITED NATIONS FOUNDATION

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This summary for policymakers and investors was authored by Nigel Purvis and Adrian Deveny.

The Forest Carbon Index project was directed by Nigel Purvis. Adrian Deveny was the lead author and principal researcher of the full report. Janet Nackoney conducted the spatial modeling and analyses and created the cartographic results. (Map 3 was created by Michael Jennings of The Nature Conservancy.) Mykola Gusti, Georg Kindermann, Raymond Kopp, Molly Macauley, Erin Myers Madeira, Michael Obersteiner, and Andrew Stevenson were coauthors. Views expressed are those of the authors.

Visit **www.forestcarbonindex.org**
to download the full Forest Carbon Index report and use interactive maps.

Contact info@climateadvisers.com to learn more about how the data in the Forest Carbon Index can be analyzed to aid decisionmaking.

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