# Sustainability and Commercial Plantations

## Timberland Investment Group

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## Introduction

Sustainability is a fundamental component of successful timberland management, where the incentive to maximize the land's productivity and generate returns can simultaneously generate meaningful environmental and social impacts. The benefits of commercial timberland (including natural, semi-natural and commercial plantations) include large-scale carbon sequestration, the protection of natural forests and biodiversity, sustainably-sourced timber, and employment opportunities in rural communities.

This whitepaper explores the role of plantation-focused commercial timberland as a sustainable investment capable of generating significant environmental and social benefits, and also highlights real examples of these impacts in practice.

## Overview of Global Forest Types

Forests, which include both natural forests and planted forests, refer to land with a tree canopy cover of more than 10% and area of more than 0.5 hectares (one hectare "ha" is equal to ~2.47 acres), and are determined both by the presence of trees and the absence of other predominant land uses.[1,2] In aggregate, forests comprise 31% of the world's surface, covering over 4 billion ha.[2] Approximately 93% of global forest area is comprised of natural forests, which are generally defined as native tree species that have been established naturally, without active human intervention. Natural forests are generally classified according to three primary categories (Figures 1 & 2).[3]

- **Temperate:** Around 17% of the world's forests are classified as temperate forests, covering around 685 million ha.[2] Temperate forests are comprised of: 1) broadleaf and coniferous forests that can be found in the eastern United States, central Europe, and northeast Asia; 2) interior coniferous forests located in the U.S. (e.g., spruce-fir forests of the Rocky Mountains, Sierras, and Cascades), Canada, and Central Asia; 3) woodland and pineland forests found in the coastal Mediterranean region and in low elevation areas of Mexico, as well as the savannas of Southern Africa and Australia; and 4) temperate rainforests including the Pacific Northwest coast of the U.S. and Canada, the southwest coastal fringe of Chile and Tierra del Fuego, Argentina, New Zealand, and southeast Australia. Temperate forests contain about 14% of global forest carbon stock.[4]

- **Tropical:** Tropical forests exist between the Tropic of Cancer and the Tropic of Capricorn and comprise around 44% of the world's forest area.[2] Tropical forests are valued for their biodiversity (around 50% of the world's plant and 80% of the world's documented animal species inhabit tropical forests). Sub-types of tropical forests include rainforests, semi-evergreen forests, tropical savannahs, tropical dry forests, and tropical cloud forests, with the two largest tropical forests in the world being the Amazon and the Congo Basin forests. Tropical forests store over 50% of all global forest carbon stock.[4]

- **Boreal:** Boreal forests, which reside at higher latitudes where temperatures are at or below freezing for many months of the year, represent close to one-third of the world's forest area and store over 30% of global forest carbon stock.[2,4] Boreal forests have historically acted as significant carbon sinks as their cold and, in some cases, permanently frozen soils have accumulated large amounts of organic matter over time.

[1] Earth Policy Institute, 2012
[2] Food and Agriculture Organization ("FAO")
[3] FAO, Global Forest Resources Assessment 2015
[4] United Nations Forum on Forests; A Large and Persistent Carbon Sink in the World's Forests – Pan, et. al

The remaining 7% of the world's forest cover (approximately 290 million ha) is composed of commercial plantations (a.k.a. planted forests), which are defined as planted or semi-natural forests managed for the production of commercial-grade timber, and to a small degree, forests that are planted for ecosystem restoration or protection.[3]

**Figure 1: Global Forest Types.** Source: Food and Agriculture Organization

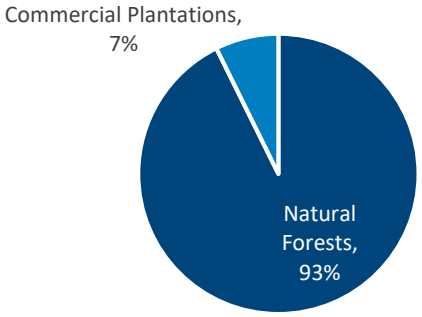
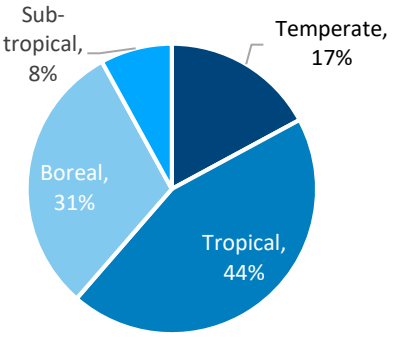



**Figure 2: Natural Forest Breakdown.** Source: Food and Agriculture Organization

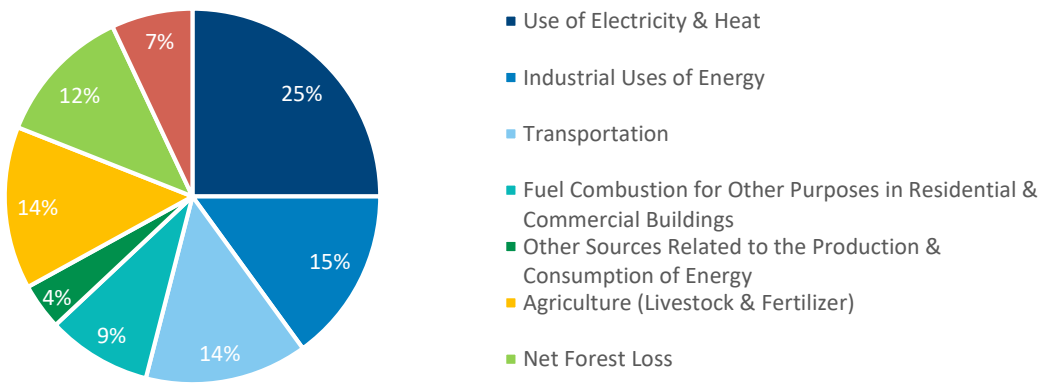



## Commercial Plantations as a Sustainable Investment

Commercial plantations often seek to employ sustainable silvicultural practices (such as harvesting, planting, thinning, prescribed burning, and site preparation) that endeavor to maximize forest productivity while simultaneously providing positive environmental and social impacts. Examples range from preserving and protecting high-conservation value areas (such as critical habitats, wetlands, and streamside forests), to providing jobs in rural communities, and minimizing the incidence of negative events (such as forest fires, disease, and pests).

One of the most significant benefits of commercial plantations is their ability to directly mitigate climate change. Greenhouse gas emissions, including carbon dioxide ("$CO_2$") and methane ("$CH_4$") from fossil fuel combustion, deforestation, and land-use change, are central causes of climate change. Specifically, deforestation and forest degradation, primarily due to expanded agricultural activity in tropical developing countries, is responsible for approximately 12% of global greenhouse gas emissions annually (Figure 3).

**Figure 3: Primary Causes of Greenhouse Gas Emissions.** Sources: U.S. Congressional Budget Office; TIG Analysis



A clear path to mitigating global climate change centers on reducing emissions and lowering the concentration of $CO_2$ in the atmosphere. Trees present a natural solution for offsetting $CO_2$ emissions – as trees photosynthesize, they capture $CO_2$ from the atmosphere and store it in their bark, stump, branches, leaves, roots, and other biomass (Figure 4). Generally referred to as "carbon sinks" for their absorption of $CO_2$, commercial plantations and natural forests alike play a crucial role in sequestering carbon.

With that said, commercial plantations can be more effective at carbon sequestration than older, unmanaged natural forests. This is because trees with faster growth rates can absorb more carbon from the atmosphere than older, slower-growing trees. In unmanaged natural forests, growth rates tend to be slower because trees are typically older, and they face a high degree of competition for nutrients and sunlight, hindering their ability to sequester carbon as efficiently as commercial plantations. In contrast, commercial plantations are often actively managed to promote the rapid growth of trees. As such, commercial plantations tend to be comprised of younger, healthier trees that are capable of sequestering more carbon than slower-growing natural forests. It is worth mentioning that even though unmanaged natural forests continue to sequester carbon for a longer period of time (as they are not harvested), shorter-rotation commercial plantations have the potential to sequester a greater amount of carbon overall as standing timber is converted to long-lived wood products, such as lumber for housing and furniture, which keeps carbon sequestered for long periods of time. Further, unmanaged forests, where trees are left to degrade and decompose, emit higher levels of $CH_4$, which is 25 times as damaging to the earth's atmosphere as $CO_2$ over a 100-year period.[5]

A key characteristic of commercial plantations is their ability to convert areas of land (such as cattle ranches or with soil not fit for agricultural purposes) into sustainably-managed plantations, creating new, long-term carbon sinks that had not existed previously. Carbon is sequestered as trees grow on the converted land, and sequestered carbon can remain in organic material long after harvest (Figure 5).

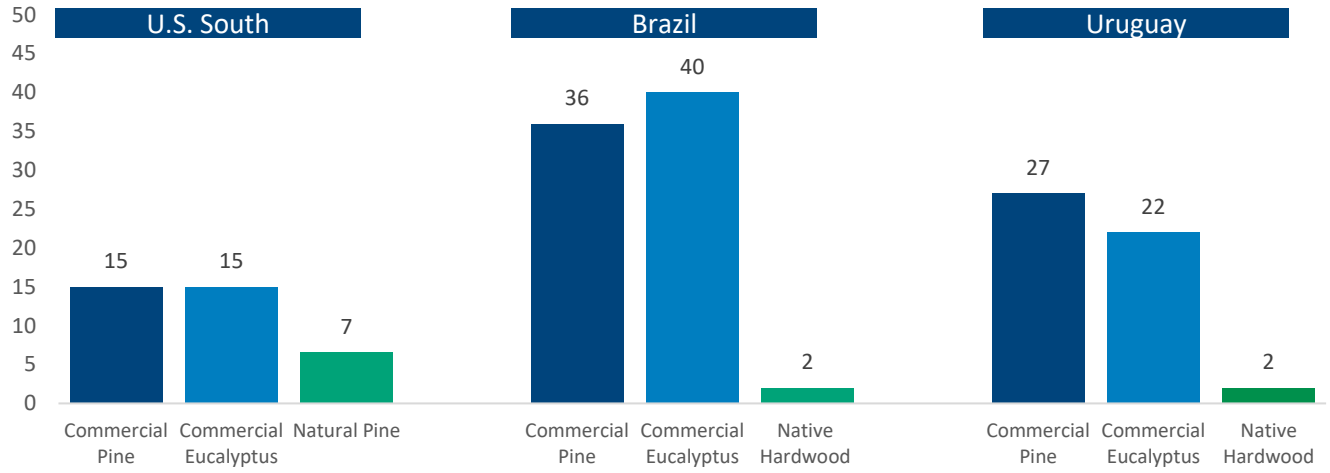
**Figure 4: Commercial Plantations Growing Alongside Natural Forests in Latin America.** Source: TIG

**Figure 5: The Forest Carbon Cycle.** Source: Washington Forest Protection Association


[5] U.S. Environmental Protection Agency

In most cases, active management and silvicultural practices focused on efficiency can result in significantly higher average growth rates for commercial plantations versus natural forests. In turn, these higher-growth commercial plantations have the potential to sequester more carbon on a per hectare basis than natural forests overall, despite emissions associated with plantation establishment (e.g., use of fertilization, equipment, etc.) (Figure 6).

**Figure 6: Select Growth Rates from Commercial Plantations and Natural Forests ($m^3$/hectare/year).** Source: TIG Analysis.




Commercial plantations can also generate important social benefits and community development, as they are a strong source of rural employment (bringing investment capital, jobs, and income, often in underserved areas) and, in some cases, can help fund social programs for the benefit of local communities. For example, in the state of Georgia alone, the forest industry contributes ~US$ 36 billion to the state economy while creating over 145,000 direct and indirect jobs, while in North Carolina the forest industry contributes ~US$ 33 billion to the state economy and creates ~150,000 jobs.[6,7] In Brazil, where most commercial plantations are situated in rural areas, the forest products industry comprises a full 6.2% of GDP.[8]

## Sustainable Development Goals ("SDGs")

Commercial plantations' benefits to rural communities and local ecosystems, and ability to help mitigate climate change also directly align with several key United Nations Sustainable Development Goals (Figure 7).

[6] Georgia Forestry Association
[7] NC State University
[8] Ibá 2017 Annual Report

**Figure 7: UN Sustainable Development Goals.** Source: United Nations

| Sustainable Development Goal | Timberland's Contribution & Exposure |
|---|---|
| SDG 6: Clean Water and Sanitation | Watershed restoration, protection and restoration of riparian zones |
| SDG 8: Decent Work and Economic Growth | Job creation in rural, often overlooked zones, plus ability to promote safe working conditions |
| SDG 9: Industry, Innovation and Infrastructure | Sustainably produced timber contributes materially to sustainable industrialization |
| SDG 12: Responsible Consumption and Production Patterns | Timber is a recyclable and reusable material as well as a renewable resource |
| SDG 13: Climate Action | Timber sequesters carbon on a large-scale basis; Conversion of "other" land to timberland creates new carbon sinks |
| SDG 15: Life on Land | Restoration of riparian zones and afforestation efforts, habitat protection for threatened or endangered species, long-term landscape conservation |

## Avoiding Deforestation and Conserving Biodiversity

Approximately 3-4 million ha of natural forests are lost every year due to deforestation, primarily as populations increase and forested land is converted for cattle grazing, agriculture and other land uses.[3] Though a large majority of this deforestation is not focused on timber extraction, commercial plantations have the potential to disincentivize deforestation for timber by legally providing a higher-quality alternative to timber that is often unsustainably extracted from natural forests. Active management of commercial plantations can produce trees that are uniform in size and species, which results in more streamlined harvesting and processing as compared to the multi-species, multi-age structure typical of natural forests. Due to this dynamic, combined with natural market forces and regulation, extractions from natural forests for commercial use has declined in recent decades in geographies such as Latin America. For example, in the Brazilian portion of the Amazon, and in spite of illegal logging being a persistent problem, the increasing availability of commercial plantations has helped to meet rising timber demand and significantly reduced the need for trees to be harvested from natural forests for this purpose (please refer to the "Providing Sustainable Alternative to Natural Forest Harvesting in Brazil" and "Buffer Zones in Brazil" case studies below for examples of this trend).

## Wood Products & Sustainability

Both renewable and recyclable wood-based products (products derived from trees such as lumber, paper, cardboard, and tissue) can be an appealing substitute for nonrenewable materials such as steel, concrete, and even plastics, which are broadly derived from petrochemicals.[9] Advances in construction and architectural techniques have begun to embrace "cradle to cradle" design, an approach that eliminates the concept of waste in favor of renewable, reusable materials. New approaches to wood-based based construction, such as Mass Timber, are beginning to displace energy-intensive alternatives such as cement and steel. Mass Timber allows for larger buildings (such as offices or multi-family housing) to be constructed with commercial plantation species, primarily

[9] Bain & Company

in urban spaces.[10] Grown independently of fossil fuel resources, wood-based products can disrupt the usage of environmentally harmful materials and, as a result, help to reduce global emissions (Figure 8).

**Figure 8: Environmental Impact of Select Building Materials.** Sources: TIG Analysis, BBC Science & Environment, Pictet Asset Management

| Material | Commercial Plantations | Cement & Concrete | Steel |
|---|---|---|---|
| **Emissions** | Net positive when well-managed and properly sited | 8% of global $CO_2$ emissions[11] in addition to Nitrogen Oxides ("NOx"), and Sulfur Dioxide ("$SO_2$") | 5% of global $CO_2$ emissions[12] |
| **Opportunities for Recycling** | 100% recyclable; (Cradle to cradle design) | None | 86% of steel is recycled[13] |
| **Energy Efficiency** | Leading insulation efficiency | 15x less efficient thermal insulation than wood[14] | 400x less efficient thermal insulation than wood[14] |

## Additional Benefits of Commercial Plantations

In addition to carbon sequestration, disincentivizing deforestation, and providing an alternative to unsustainable materials, commercial plantations can also produce local, tangible benefits. Commercial plantations offer a variety of environmental benefits, such as soil and watershed health at little-to-no additional cost – and the benefits come from the same forces that drive investment returns.

### Water

Commercial plantations are capable of regulating water supply and reducing erosion by sheltering soil from heavy rainfall. Trees absorb rainfall, releasing it slowly into streams and rivers, while helping to increase soil porosity, filtration, and groundwater recharge. In some cases, trees can absorb nutrients from agricultural runoff and filter sediments and other pollutants (e.g., certain heavy metals) from the water, thereby reducing flows into water supply systems. This often lowers treatment costs and minimizes expenditures on man-made filtration systems.[15]

Meanwhile, the presence of timberland in general can benefit riparian zones (transitional areas between land and water) by helping to develop strong root systems that fortify streambanks, helping to control erosion.[16] In addition, by fostering riparian habitats, commercial plantations can encourage the development of areas that tend to be higher in productivity and biodiversity, provide shade that reduces water temperature thereby increasing dissolved oxygen content and improving aquatic productivity, and provide a haven for threatened and endangered aquatic species.

[10] Wisconsin Department of Natural Resources
[11] Chatham House – The Royal Institute of International Affairs
[12] Columbia Climate Center, Earth Institute Columbia University
[13] Steel Recycling Institute
[14] Pictet Asset Management
[15] World Resources Institute
[16] U.S. Department of Agriculture National Resources Conservation Service

### Air Quality

Commercial plantations can help improve air quality by reducing smog and airborne pollutants. Trees have the ability to lower temperatures through a combination of providing shade and moisture, decreasing the likelihood of smog. Trees also absorb airborne pollutants such as $SO_2$, produced from burning coal or refining petroleum products, and remove them from the air. Ozone ("O3"), NOx, and $SO_2$ are also among some of the toxins that trees can remove from the atmosphere.[17]

### Fire

Commercial plantations are often far less susceptible to forest fires, as flammable debris is constantly monitored and managed by thinning (the process of removing smaller trees from an existing stand while retaining larger, healthier trees, thereby increasing the amount of space between trees and their crowns). Slash (debris left after logging, thinning, or brush cutting) is removed to reduce potential flame lengths and make fires easier to control. Commercial plantations also use roads to improve forest access and contain potential fires, serving as breaks (natural or constructed barriers) and as a secure location for firefighting in the event of a fire.

To ensure thorough fire prevention, best practices for commercial plantation management include training in fire control and ground patrols that monitor properties to detect any risks of potential fires, all of which protect the interests of asset owners and can help to prevent sequestered carbon from being released into the atmosphere.

### Recreation

Timberland management plans, primarily in the U.S., often include permits for hunting or state programs, which provide tax abatements for improving wildlife habitat or water quality.[18] The sale of hunting leases to interested local parties can serve as an additional source of revenue and also create incentives for local communities and owners of commercial plantations to work together to monitor the assets.

### Rural Employment

Aside from the environmental benefits associated with commercial plantations, there are also social benefits that accrue to local communities including jobs and income. In addition to its environmental benefits, commercial timberland can broadly provide employment for local communities. For example, commercial timberland in the U.S. alone supports 2.5 million jobs, US$ 109 billion in payroll, producing US$ 288 billion in sales and manufacturing.[19]

## Industry Standards and Accountability

### Third Party Certification and Best Management Practices

Third party certification for environmental sustainability, social responsibility, and governance is recognized by private companies and governments alike. These certifications, such as Forest Stewardship Council ("FSC"), Programme for the Endorsement of Forest Certification ("PEFC"), and American Tree Farm System ("ATFS") attempt to ensure forest and community health by establishing standards across a variety of activities and guide

[17] The Nature Conservancy – Planting Healthy Air 2016
[18] The New York Times
[19] National Alliance of Forestry Owners ("NAFO")

operations in and around commercial plantations. For example, FSC monitors commercial plantation management in expanding protections of water quality and preventing the harvesting of natural forests and use of hazardous herbicides and pesticides.[20] FSC certification also requires asset owners to protect the rights of indigenous people and encourages transparency by requiring that certification audits be made public. These certifications can be used as a means for companies and government agencies to identify sustainably-sourced materials and encourage timberland asset owners to adhere to each certification's guidelines. For example, green building standards, including Leadership in Energy and Environmental Design ("LEED") certification's Certified Wood Credit in the U.S., incentivizes the use of FSC-certified materials. In addition, governments across the U.S., Europe, and Asia are implementing requirements for FSC-certified products.[20]

## Case Studies in Commercial Plantations

The following are case studies demonstrating a variety of positive impacts from commercial plantations..

### Cattle Farm Conversions to Commercial Plantations in Brazil

The conversion of cattle farms to commercial plantations in Brazil can create new carbon sinks, which have the potential to exist for long periods of time. Marginally productive cattle land, typically with sandy soils, lacks the nutrients required for intensive agricultural production yet can be ideal for eucalyptus plantations. As this land is converted to commercial plantations, trees absorb $CO_2$ on a sustained basis and help avoid emissions which could have occurred if the prior land use had continued (Figures 9, 10, 11 & 12).

**Figure 9: Marginally Productive Cattle Land.** Source: TIG

**Figure 10: Prior to Conversion Process.** Source: TIG


[20] Forest Stewardship Council

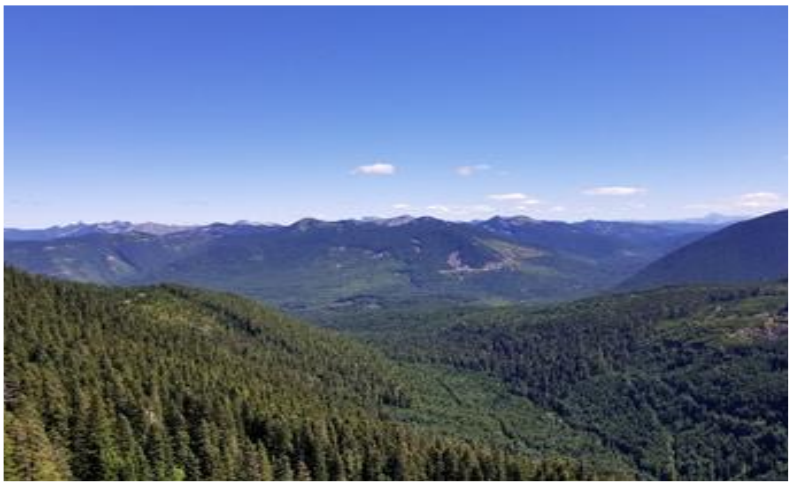
**Figure 11: Commercial Plantation at 2 months.** Source: TIG

**Figure 12: Same Commercial Plantation at 60 months.** Source: TIG

## Watershed Filtration in Tacoma, WA

The Green River Municipal Watershed in Tacoma, WA has supplied the county's water since 1913 (Figure 13). The watershed, which services more than 300,000 people, is surrounded by almost 60,000 ha of public and privately held commercial plantations, all of which filter precipitation before it reaches the creeks and tributaries that feed it. All commercial plantations along the watershed are subject to the Tacoma Water Habitat Conservation Plan – a 50-year plan to regulate forest management, protect wildlife habitat, and preserve water quality.[21] The active management practiced on these commercial plantations prevents erosion, improves and maintains water quality, and helps to protect wildlife.

**Figure 13: Washington State.** Source: TIG

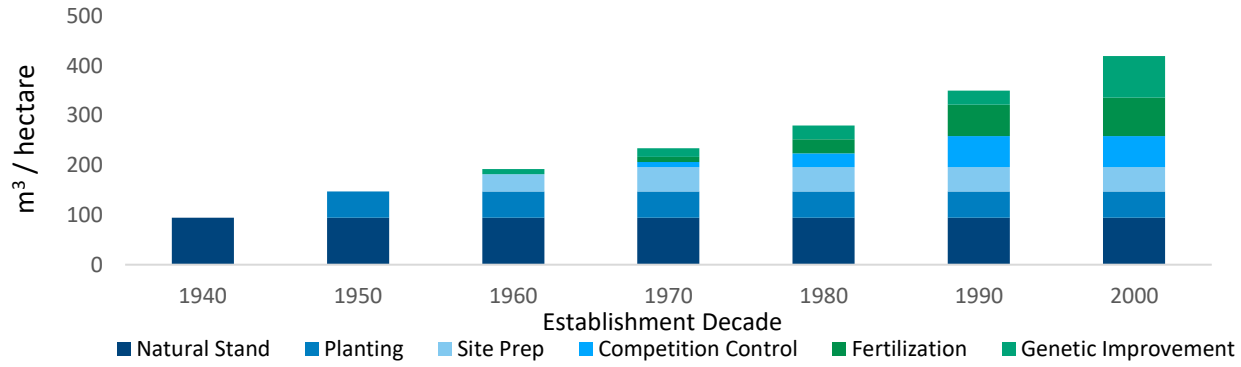


## Increased Carbon Stock in the U.S. South

Commercial plantations are often intensively and actively managed to maximize yield on every hectare, and as yields have increased through innovation and silvicultural practices, so has the ability of commercial plantations to sequester carbon (Figure 14). One example of this innovation is the increase in productivity in pine plantations in the U.S. South. Beginning in the 1940s, timberland owners in the region operated on natural stands and were constrained by each species' natural growth rate. Over the subsequent decades, improvements such as increased site preparation prior to planting, intensive property management, and genetic enhancements in seedlings have significantly increased yields per hectare. In return, these gains in efficiency have increased how much carbon commercial plantations can sequester as stands grow more quickly.

[21] Tacoma Public Utilities

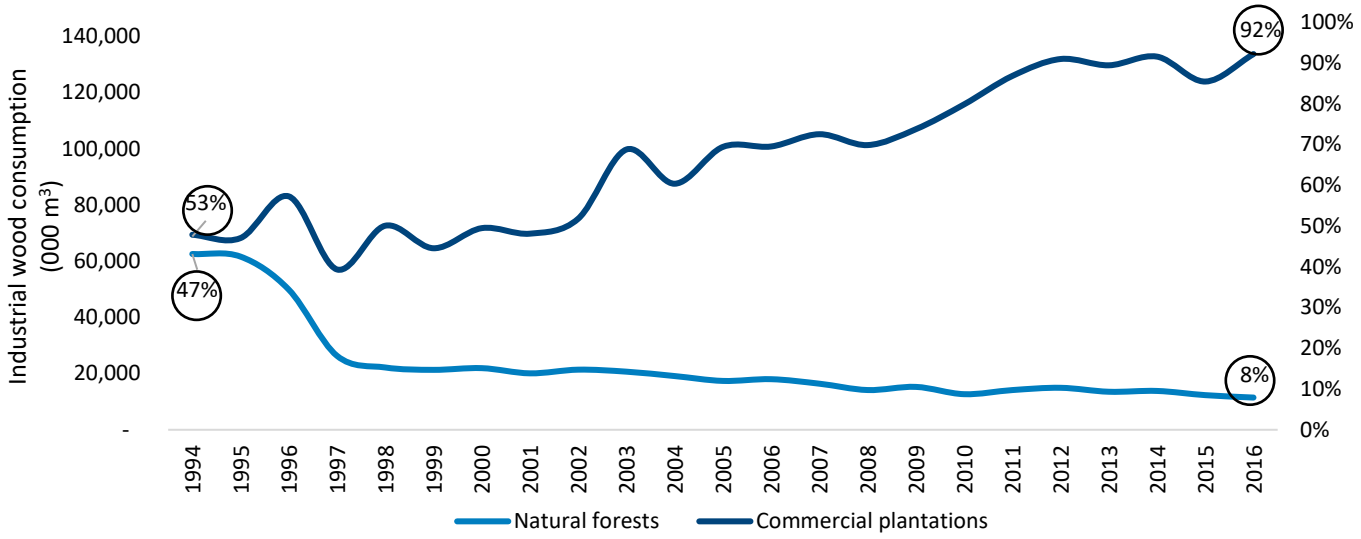
**Figure 14: Productivity of U.S. South Pine Plantations over Time.** Sources: Journal of Forestry; TIG Analysis




## Providing Sustainable Alternative to Natural Forest Harvesting in Brazil

While the illegal logging of natural forests for conversion to agriculture remains a challenge globally, the growth of commercial plantations has helped to meet rising timber demand via sustainable practices. For example, in the Brazilian portion of the Amazon, illegal logging has been a persistent problem, but increasingly available commercial plantations have helped to meet rising timber demand and likewise reduce the need for trees to be harvested from natural forests for this purpose. With the significant increase in commercial plantation area in Brazil over the last several decades, natural forests have seen a corresponding decline in extraction and production (Figure 15). Commercial plantations continue to provide a sustainable alternative for meeting demand for forest products in the region.

**Figure 15: Growth of Industrial Wood Consumption in Brazil from Commercial Plantations Has Notably Increased.**
Sources: Serviço Florestal Brasileiro; TIG Analysis




## Buffer Zones in Brazil

In Brazil, government policies dictate and restrict the types of human activities that can occur within buffer zones, or are areas with high biodiversity or that contain important water resources These policies, when combined with topographical restraints, have resulted in more than 5.6 million ha being permanently preserved alongside over 7 million ha of commercial plantations (Figure 16).[8]

**Figure 16: Buffer Zone in Brazil.** Source: TIG

### Net Carbon Sink in Uruguay

The development of commercial plantations in Uruguay began in 1987 when the government adopted a law intended to incentivize large scale commercial plantation areas for industrial purposes ("Forestry Priority Areas"). The law sought to encourage commercial plantation development through a VAT refund and tax incentives on income, net worth, and rural real estate, all of which eventually motivated multinational forest products companies to begin investing in Uruguayan commercial plantations and industry Over the last 30 years Uruguay's commercial plantation area has grown from 46,000 ha to over 1 million ha in 2018, employing over 12,000 people, while native forest area has increased from 667,000 ha in 1990 to 850,000 ha in 2018.[22]

## Conclusion

Sustainability is a fundamental component of a successful commercial plantation operation, where the owner's incentive to maximize productivity is in balance with the needs of the surrounding environment and communities. The alignment of these interests means that commercial plantations can serve two valuable purposes simultaneously – providing raw material for a wide array of essential end products (such as construction material, paper, cardboard, and furniture) and generating significant environmental and social benefits. Examples of the benefits commercial plantations can generate range from mitigating climate change and combatting deforestation to creating jobs in rural communities, and ultimately helping to foster a cleaner, healthier planet.

[22] 2019 National Risk Assessment for Uruguay

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