

THE BUSINESS OF PLANTING TREES

A Growing Investment Opportunity



WORLD
RESOURCES
INSTITUTE

The Nature
Conservancy 

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FOREWORD

There has never been a better time to invest in land restoration. Governments have committed to restore 160 million hectares—an area larger than South Africa. These commitments are spurring increased demand for businesses that can deliver large projects cost-effectively.

Restoring degraded land has the potential to become big business. Established companies and entrepreneurs are finding new ways to make money from sustainably managed forests and farms. Some are responding to governmental incentives. Others are responding directly to the market, restoring land to generate new products and services, or to differentiate their offerings from the competition. Such enterprises are profiting very nicely by breathing new life into unproductive land.

Some entrepreneurs are betting that a huge new business opportunity for natural carbon capture and sequestration will emerge as more governments charge a fee for emissions that drive climate change. New research by The Nature Conservancy, World Resources Institute and other partners shows that restoration and other land management improvements could provide more than a third of the emissions reductions necessary to keep global warming under 2 degrees C.

Yet hurdles remain. And one of the biggest hurdles is funding.

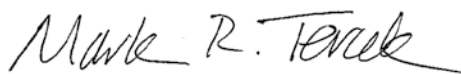
Many investors know little about restoration opportunities. This report can help. It includes case studies of 14 innovative enterprises across eight countries. They cover a fascinating range of activities, from drones that shoot seeds into hardened soils to genetic research on tree species threatened with extinction. Many of these businesses are expanding rapidly—one grew from 110 employees to 450 in just 18 months.

The restoration economy is at the take-off stage. New business models are emerging, technology is advancing and governments are showing political will. This is great news for investors looking for the next growth opportunity. And this is good news for the planet, since restoring land can provide clean water, improved livelihoods and enhanced biodiversity—all while pulling back to the earth the excess atmospheric carbon that would otherwise be heating the planet.

Opportunities have never been greater. The task has never been more urgent. An ancient Chinese proverb says: “The best time to plant a tree was 20 years ago. The next best time is now.” We hope that, after reading this report, investors and entrepreneurs will agree and be inspired to make money by taking up the business of growing trees.



Andrew Steer
President & CEO
World Resources Institute



Mark Tercek
President & CEO
The Nature Conservancy



EXECUTIVE SUMMARY

Across the world, companies with a wide range of business models are making money from planting trees. These restoration enterprises are proving that restoring degraded forests and agricultural lands is not only good for the planet, but a good business opportunity as well.

HIGHLIGHTS

- In recent years, hundreds of companies have entered the landscape restoration industry, forming an emerging “restoration economy.” They represent a wide range of business models that deliver financial returns for investors while restoring forests and agricultural lands.
- This report highlights four promising investment themes in land restoration: technology, consumer products, project management, and commercial forestry.
- We provide snapshots of 14 companies that restore land; the profiles are based on extensive research, field visits, and interviews with their senior management.
- Entrepreneurs continue to develop new opportunities that create value for investors as well as local communities and the planet.

Population growth and expanding consumer demand are placing immense pressure on the earth’s natural resources. The human population has more than doubled over the past 50 years and is projected to rise further, from 7.3 billion in 2015 to 9.8 billion by 2050 (UN 2017). Demand for food is likely to increase by 46 percent between 2017 and 2050 (Ranganathan et al. 2016), while global demand for industrial roundwood will rise by 49 percent from 2013 to 2020 (FIM 2015).

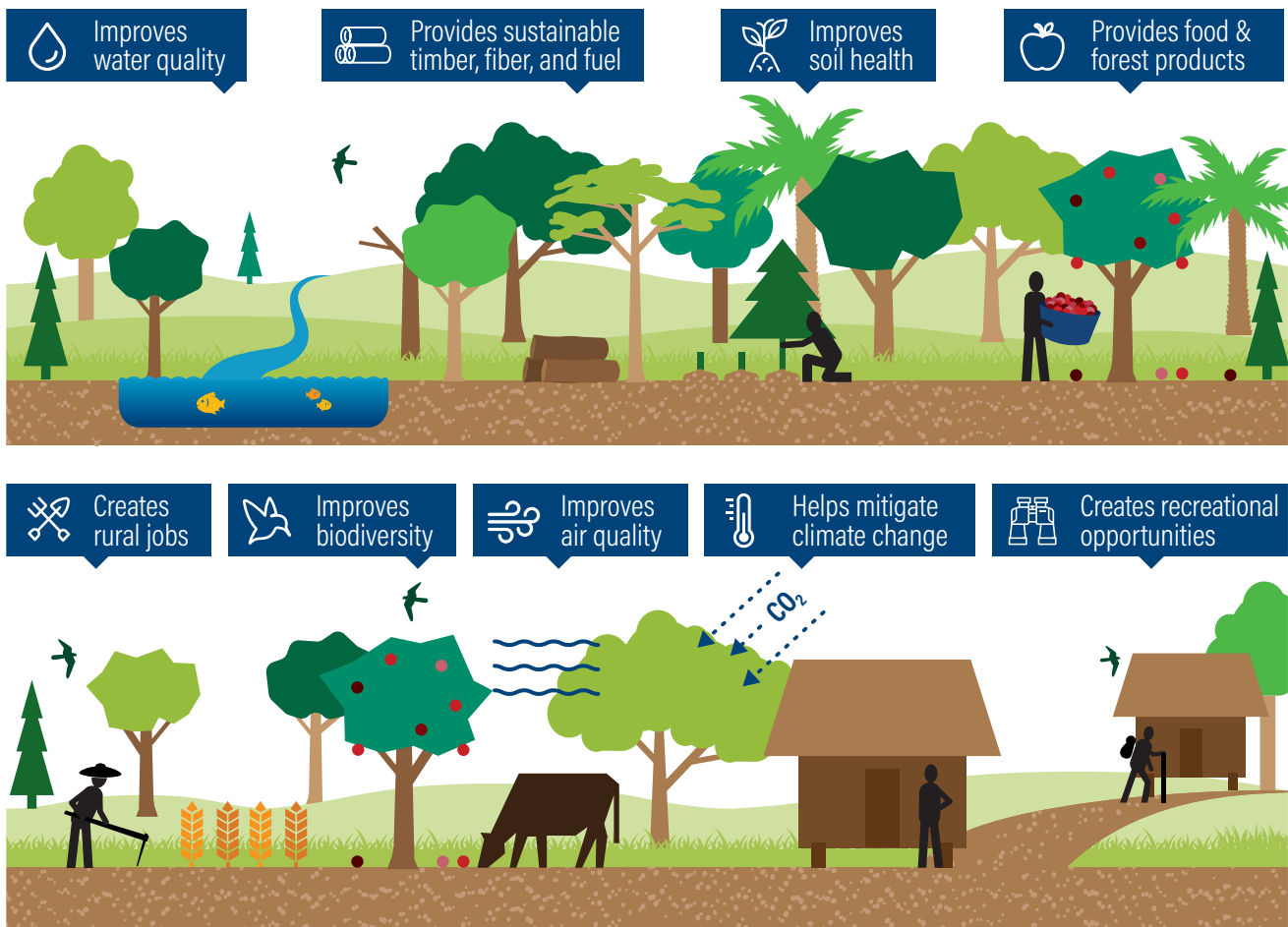
Signs of degradation can be found in almost every ecosystem in the world. One-third of agricultural landscapes were degraded in 2010, temporarily or permanently lowering the productive capacity of land (FAO 2011). Also, the world loses 7.6 million hectares (ha) (18.8 million acres) of forest every year—an area about the size of Panama. It also gains 4.3 million ha (10.6 million acres) of forest annually, as a result of planted or naturally regenerated forests, but there is a net loss of 3.3 million ha (8.1 million acres), or an area the size of Taiwan (FAO 2015). This loss has a direct impact on local communities that depend on the land, and it also exacerbates other environmental issues. For example, deforestation accelerates climate change as the carbon stored in soil and trees is released into the atmosphere. The dual issues of resource demand and environmental degradation—coupled with land’s inherently limited availability—make clear that the way we currently use land is unsustainable.

This challenge offers an opportunity for businesses and entrepreneurs. As we encounter constraints in the planet’s resources, pressure is growing to find new ways to enhance productivity and recover lost natural assets. Land restoration offers a path forward. Companies that develop profitable and scalable business models for restoration have the potential to grow substantially.

What Is Restoration?

In this report, we define *restoration* as an activity that improves the ecological function of a degraded landscape. We focus primarily on tree-based restoration, which can range from reforestation—completely replanting a deforested area with trees—to agroforestry—establishing

Figure ES-1 | Benefits of Tree-Based Restoration



Source: WRI.

agricultural systems that incorporate trees. Figure ES-1 shows the benefits of planting trees.

Restoration economy refers to the network of businesses, investors, and consumers that engage in economic activity related to restoring land. Given the wide array of benefits restoration can provide, end markets for restored forests and landscapes range from sustainable timber to consumer products to livestock feed.

There are no official measures of the size of the global restoration economy. This is not surprising because restoration spans a broad

range of industries, ecosystems, and regions. At the national level, data are similarly scarce in most countries. In the United States, a 2015 study estimated that the American restoration economy generated US\$9.5 billion in annual economic output and created an additional \$15 billion in indirect and induced output (BenDor et al. 2015). The study found that the ecological restoration industry employed 126,000 Americans in 2014, exceeding jobs in coal mining by 59 percent.

About This Report

Since early 2016, the World Resources Institute (WRI) and The Nature Conservancy (TNC) have been researching businesses that restore land (Box ES-1). This undertaking was motivated by the fact that some investors would like to invest in land restoration but are not sure how they will earn a financial return. Through Initiative 20x20 and the African Forest Landscape Restoration Initiative (AFR100), we have helped mobilize more than \$2 billion in commitments from investors in Latin America and Africa to allocate a part of their portfolios to restoration investments. This capital is ready to be deployed, but it requires investable deals.

BOX ES-1 | THE WORLD RESOURCES INSTITUTE AND THE NATURE CONSERVANCY'S APPROACH

The New Restoration Economy at WRI

Launched in early 2016, the New Restoration Economy (NRE) is part of the Global Restoration Initiative at WRI. NRE's mission is to foster enabling conditions for the growth of the restoration industry. We believe that businesses and markets have the potential to scale up restoration rapidly and deliver financial, environmental, and social benefits. We have engaged with numerous restoration businesses around the world, researching barriers to scale and identifying solutions. NRE has taken a similar approach with financiers, reaching out to a range of investors to understand their perspective on restoration.

Natural Climate Solutions at TNC

The Natural Climate Solutions initiative at TNC has demonstrated that natural climate solutions—ways of storing and reducing carbon emissions through better management of the world's forests, grasslands, and wetlands—can deliver at least one-third of the emission reductions needed by 2030 (Griscom et al. 2017). In addition, investing in nature brings numerous cobenefits such as clean water and air, sustainable food production, and wildlife habitat. TNC is working to deploy natural climate solutions at scale to promote sustainable development, economic growth, and a low-carbon future.

This report is primarily targeted toward long-term investors who make direct investments of, on average, between \$500,000 and \$10 million in private companies. This category includes venture capital, private equity, and impact investors; national and multilateral development banks; and grant-making organizations. All these categories of investors are represented among those who have financed the businesses discussed in this report.

This publication will also interest potential entrepreneurs who would like to reverse the cycle of land degradation. By presenting real-world examples of companies that generate revenues from restoration, entrepreneurs will gain insights into what business models exist. They can contact some of the highlighted enterprises to learn about their business model and operational setup. This may enable them to avoid early pitfalls and have a higher chance of success.

Commercial investment in restoration has been limited to date. There are several reasons for this. The proof of concept is often lacking because many of the business models are new. The small deal sizes involved have not been relevant to most institutional investors, and the long time horizon required—of five or more years—has further limited capital inflows. Nonetheless, our research indicates that business model development has advanced substantially, and rapid growth means investment sums are also rising.

Our Approach

We conducted a broad search for companies whose core value proposition is linked to restoring degraded land. We summarize the process briefly here and explain the methodology in more detail in the next section of the report. Based on a detailed analysis, we decided to focus on three countries: Brazil, Kenya, and the United States. The search gradually expanded as we discovered innovative enterprises in other nations. Eight countries are represented in this report.

In total, we analyzed around 140 businesses. The list is by no means comprehensive, and we assume it represents a small fraction of the corporate universe. Through online research, interviews with management, and field visits, we narrowed the list to 14 companies on the basis of the following five criteria that encompass the extent to which a company is:

- **Profitable:** Does the enterprise make money today (or will do so in the future)?
- **Scalable:** Does the company have the potential to become much bigger than it is today?
- **Replicable:** Can this concept be replicated in other regions by other businesses?
- **Environmentally beneficial:** Does the enterprise result in degraded lands being restored?
- **Socially beneficial:** Does the company have a positive impact on people?

Each company's core value proposition to customers centers on land restoration.

The businesses recognize that the status quo of continued environmental degradation is incompatible with growing demand for natural resources and that sustainable land management presents a significant commercial opportunity.

This is the only assessment to date that focuses exclusively on commercial businesses that restore land. Although there has been interest from governments and nonprofits in examining restoration projects broadly, we noticed an information gap in profit-oriented models suitable for private investment, which prompted our focus in this area.

Findings

Our research indicates that four themes are prominent in the emerging restoration economy. Companies are adopting a wide range of approaches to restore land, and these four themes appear to offer promising growth trajectories. Table ES-1 summarizes these themes and lists the businesses profiled in this report, while Figure ES-2 shows the companies on a map.

The variety of the business profiles demonstrates the breadth and depth of the restoration economy.

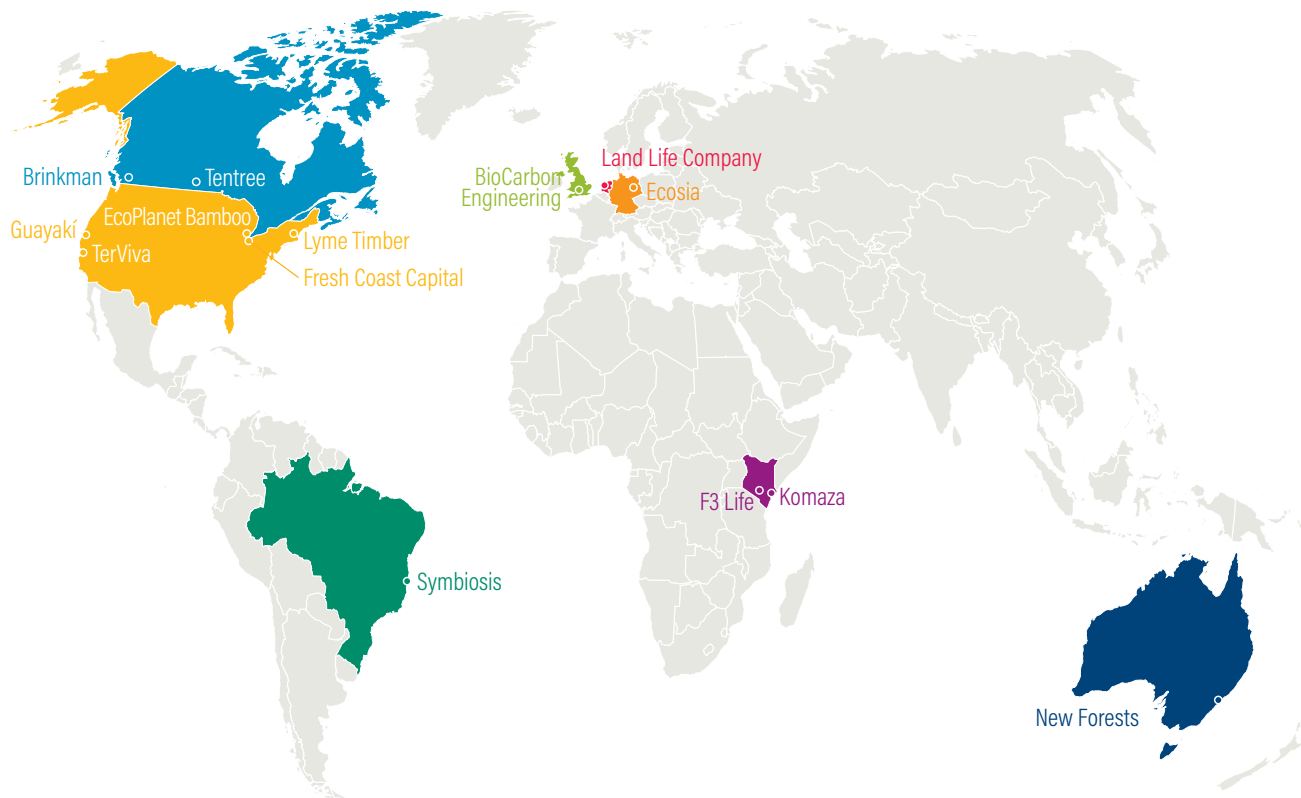
- They range from pre-revenue enterprises to businesses with more than \$50 million in sales.
- Some have been around since the 1970s; many started in the last few years.
- Company size ranges from fewer than 10 employees to more than 450 employees.
- Target markets range from middle-class consumers to large financial institutions.

Table ES-1 | Investment Themes and Businesses Profiled in This Report

THEME	DESCRIPTION	COMPANY	BUSINESS ACTIVITY
Technology	Companies that develop and deploy technology to facilitate restoration, often by improving efficiency and lowering costs.	BioCarbon Engineering	Uses specialized drone technology to reforest remote landscapes.
		Land Life Company	Patented a product that enables trees to grow in dry and degraded land.
		TerViva	Plants pongamia (<i>Millettia pinnata</i>) on distressed agricultural land.
		F3 Life	Enables access to credit for smallholder farmers in Kenya.
Consumer products	Companies that sell products to the end consumer, often using materials from their restoration activities or sponsoring restoration projects.	Guayakí	Sells beverages made from yerba mate grown in restored Atlantic rainforest.
		Tentree	Apparel company; plants 10 trees for every product sold.
		Ecosia	Online search engine; uses its profits to plant trees.
Project management	Companies that develop, implement, and manage restoration projects from start to finish on behalf of their clients. Often driven by government pledges or policies.	Brinkman and Associates	Manages large government projects in Canada and tropical plantations in Latin America.
		Fresh Coast Capital	Does large-scale urban revitalization in U.S. cities.
Commercial forestry	The management and harvesting of trees for timber and wood fibers. Only those plantations that plant trees on degraded land are considered restorative.	New Forests	Manages sustainable timber plantations and conservation investments.
		The Lyme Timber Company	Acquires and manages working lands under working forest easements.
Distributed plantations	Companies that aggregate supply through trees grown by smallholder farmers on the farmers' land.	Komaza	Works with smallholder farmers to plant and process trees for timber.
Bamboo plantations	Plantations that grow bamboo, a non-timber forest product comparable to trees in its potential uses that can be highly productive.	EcoPlanet Bamboo	Establishes bamboo plantations as alternative timber and fiber sources.
Mixed-species plantations	Plantations consisting of more than one species planted in the same area, improving biodiversity.	Symbiosis Investimentos	Manages and restores Atlantic rainforest with native species.

Source: WRI.

Figure ES-2 | Location of Headquarters of Companies Profiled in This Report



Conclusion

We hope the information presented in this report serves as a starting point for investors to understand the growth opportunity in the restoration economy. They may be interested in exploring certain categories further—for example, the intersection between technology and restoration—or they may want to learn more about specific companies. For those who want to join the wave of entrepreneurship, this report highlights bright spots of innovation.

This report is not an endorsement of any business. WRI and TNC’s focus has been on the restoration space overall, rather than on any one company within the industry. We did field visits with many of the enterprises, but we were unable to

visit all of them. Most of the quantitative and financial information presented is self-disclosed by the companies. We strongly recommend that investors perform their own due diligence.

New business models continue to emerge.

We expect the business landscape to look very different in the next few years. The companies presented in this report are a small sample of the broader industry. Entrepreneurs are vital to advance business model development and develop innovative market solutions, while investors can benefit from the growth trajectory by incorporating restoration in their portfolios. We are optimistic that the restoration economy will continue to expand, simultaneously creating financial, social, and environmental value..



THE BUSINESS OF PLANTING TREES

Across the world, businesses are making money from planting trees. These companies are sending the signal that the restoration economy is at a tipping point, poised for rapid growth. This report features 14 enterprises from eight countries. For investors and entrepreneurs looking for the next growth opportunity, we spotlight a little-known solution: trees.

Research Process

The New Restoration Economy (NRE) initiative at the World Resources Institute (WRI) began the search for restoration businesses in early 2016, in partnership with The Nature Conservancy (TNC). See Box 1 to learn about restoration.

We started in three countries: Brazil, Kenya, and the United States. The countries were selected on the basis of an analytical process that considered many factors, including the following:

- How business- and investment-friendly the country was.
- The need for large-scale land restoration and government commitment to move it forward.

- WRI and TNC organizational capabilities and networks in the country.

We also sought to highlight a range of countries that were at different levels of economic development and had different restoration needs; this would make our findings applicable to a broader range of economic contexts. We focused primarily on models based on tree-based restoration, although some other business models were explored as well.

Our search began with extensive online research and networking with organizational contacts on the ground. Also, we began to learn about innovative businesses doing restoration in other countries. This process resulted in a list of 140 companies. Using the methodology outlined in Box 2, we first narrowed the list of companies to 49.

BOX 1 | WHAT IS RESTORATION?

Landscape restoration is the process of “turning barren or degraded areas of land into healthy, fertile landscapes” (GPFLR 2013). This process can take a multitude of forms, depending on the intent and the ecosystem in question (Vaughn et al. 2010). Restoration may be active, such as planting trees or other vegetation to accelerate the rehabilitation process, or passive, such as allowing the land to regenerate with minimal intervention. Furthermore, restoration can take place in a variety of ecosystems, including forests, wetlands, and grasslands.

Restoring land is a means to an end; it is not an end in itself. Some restoration projects aim to improve ecosystem function as a whole, whereas others

have more specific goals, such as carbon sequestration or increased biodiversity. Sometimes, restoration is motivated by economic reasons, such as the need to increase agricultural productivity or reduce water treatment costs.

In this report, we refer to restoration broadly as an activity that improves the ecological function of a degraded landscape. We focus primarily on tree-based restoration, which can range from reforestation (completely replanting a deforested area with trees) to agroforestry (establishing agricultural systems that incorporate trees). We did not start out with the intention of emphasizing tree-based restoration, but that is where we found the most promising business

models. Furthermore, we include both exotic and native species in the definition of restoration. Although there are some instances in which exotic species can be invasive and harmful to the environment, if an exotic species is properly selected and managed, it can effectively improve a landscape’s ecological function. Evaluation is needed on a case-by-case basis.

Because no agreed-upon thresholds for measuring the impact of restoration exist, there is an element of subjectivity in determining what counts as restoration. It is important to note that the initial state of the ecosystem should be degraded; improving healthy landscapes is not considered restoration.

BOX 2 | METHODOLOGY FOR COMPANY SELECTION

Our five criteria for selecting companies are outlined below, along with examples of the types of questions we considered within each category. Although the profiles are written by WRI and TNC based on our assessment of the companies, most numbers are self-reported by the companies and have not been independently verified by the authors.

PROFITABLE: Does the enterprise currently earn more revenue than its cost of doing business, or is it on track to do so in the future? Long-term commercial viability is key for private investment, so this was the starting point of our analysis. For example:

- Is there a marketable product or service? What are the revenue streams? Is the operation profitable or expected to be profitable in the short to medium term?
- What is the target market, and how does the company plan to reach it? What are future avenues of growth?
- How does the company create value for customers, and how does it capture some of that value for shareholders?

SCALABLE: Does the business have the potential to become much bigger than it is today? Investors often seek to allocate sizable funds to the same investment, so we focus on companies that benefit from economies of scale and have significant

room to grow. For example:

- How much can operations grow from the existing level?
- What is the trend for marginal costs and customer acquisition costs? As these fall, revenue growth translates to higher profit margins.
- What is target size in terms of hectares/acres five years from now?

REPLICABLE: Can this concept be copied in other places by other people? This is important to ensure that our process prioritized ideas that can be replicated, rather than one-time projects. For example:

- What are the requirements for start-up capital, and what is the payback period? Models with low start-up costs and short payback periods are easier to replicate.
- How specialized or rare are the skills needed to operate such a business?
- What would it take to do something similar in a different location?

ENVIRONMENTALLY BENEFICIAL:

Does the enterprise result in degraded lands being restored in the long term?

For example:

- What is the impact on soil health? Carbon sequestration? Biodiversity?
- Does the business contribute to higher natural resource productivity?
- Is long-term sustainability incorporated into management plans and strategy?

SOCIALLY BENEFICIAL: Does this

company have a positive impact on people in the long term? Social impact can be quite difficult to measure and is often subjective and complex. For example:

- How many jobs have been created to date?
- What part of the workforce consists of women and youth?
- What is the effect of the business on local communities?

Within the short list of 49 companies, we conducted further analyses that often involved the following:

- Online research, including the company's website and any relevant blogs or articles.
- One or more interviews with senior management.
- Field visits with certain companies in our focus countries of Brazil, Kenya, and the United States.
- Research on the industry (in cases where multiple companies focused on the same area) and competitor analysis.

Based on detailed enterprise-level research, we narrowed the list further to 14 companies. Many businesses were promising but met only four of the five criteria in Box 2. For instance, some had great environmental impact but no clear revenue streams, while others had the opposite—a robust and profitable business but no demonstrable benefits for the environment. Some businesses met all of our criteria but were not willing to publicize detailed information.

Risk and Return Drivers

Each business is different, but some common trends emerged in our research on companies that restore land.

There are several advantages to investing in the restoration economy:

- **Market opportunity:** An area the size of Latin America—more than 2 billion hectares (ha) (4.9 billion acres) around the world—offers opportunities for forest and landscape restoration. Only a small fraction of this land has been restored, and the companies featured in this report are early movers in an industry that is building momentum. As such, they may benefit from first-mover advantage, having more time to develop their products and establish branding and distribution. Being a first-mover also comes with its set of risks—such as technological uncertainty or inefficient production processes—but the players that can scale have the chance to capture market share before the competitive landscape becomes more crowded.
- **Strong demand from governments:** Countries recognize the value of restoration and have made large, country-level commitments

through initiatives such as the Bonn Challenge, the New York Declaration on Forests, the African Forest Landscape Restoration Initiative (AFR100), and Initiative 20x20. They often seek to partner with the private sector to execute on their pledges, presenting a source of long-term, large-scale demand.

- **Diversification:** Most restoration businesses are working on degraded forests and agricultural lands. As natural resources, investments in forests and agriculture are not tied to the booms and busts of capital markets and are relatively independent of macroeconomic developments (Credit Suisse and McKinsey 2016). These real assets—which are physical and tangible assets—generally have low correlation to financial markets, making them attractive investments to diversify risks.
- **Inflation hedge:** All real assets, from land to commodities, tend to be a natural hedge against inflation due to their tangible nature, maintaining or increasing value even when a currency depreciates in value. This can be useful in countries where inflation is high or expected to rise; in these situations, investing in restoration, with its focus on land, can be an effective tool for preserving capital.



Investors should also be aware of the following risks:

- **High transaction costs:** Information on restoration businesses can be hard to find. Although visible avenues exist for technology or clean energy businesses to pitch ideas and raise capital, the same cannot be said for the restoration industry. Furthermore, restoration businesses are typically smaller and seek sums of capital under \$10 million. These characteristics can result in high transaction costs for investors.
- **Low liquidity:** To date, no publicly traded companies are focused on restoring degraded land. As with investing in any private company, liquidity—the degree to which an asset can be quickly bought or sold—is low.
- **Land tenure:** In many developing countries, land tenure—the legal regime in which individuals own land—is a problem. Insecure land tenure increases the probability that companies may not be able to capture the benefits of their efforts. Land tenure is not a risk in most developed countries.

- **Country risk:** This risk arises from the possibility of changes in a country’s political, economic, and regulatory regime. This may reduce incentives for companies to participate in the restoration economy. Country risk varies by nation and can be mitigated partly through insurance.

In upcoming sections, we examine four investment themes: technology, consumer products, project management, and commercial forestry. We provide a short overview that elaborates on each theme and why it is interesting from an investment perspective. Then, we share brief profiles of businesses that fall into that category. The information shared in the “at a glance” section is self-reported by the companies, as are most of the quantitative data in the company descriptions. The business profiles are relevant primarily to investors who make direct investments—equity or debt—in private companies, as well as to aspiring entrepreneurs.

We conclude the report with “The Path Forward,” which highlights key barriers in the restoration economy and their corresponding solutions. We also provide recommendations for investors and entrepreneurs.



THEME 1

TECHNOLOGY

Technology has dramatically changed our lives over the last century. Electricity, automobiles, computers, and the Internet are just a few examples of how technology has expanded the boundaries of what is possible. Technology has also had an impact on how trees are planted. Decades of research have been conducted on germination techniques, forestry management, and landscape monitoring. However, there continues to be significant room for innovations that can reduce costs.

The costs of restoration vary widely depending on the type of restoration. Natural regeneration—in which vegetation or tree cover on a landscape is reestablished by removing the source of degradation and allowing ecological recovery processes to take place naturally—is often the cheapest restoration approach. Natural regeneration can be passive, or it may be assisted or managed. However, it is not always an effective option in cases of extreme degradation (Prach and Pysek 2001), and it can take a long time to see results. Heavily degraded landscapes and areas where there are urgent reasons to restore—for example, to boost food and timber production—may be better suited to an active restoration approach.

Cost can sometimes be a big barrier to implementing active restoration, and a significant downward shift in the cost curve would make restoration more affordable for all stakeholders, including businesses, governments, landowners, and farmers. Lower costs would significantly improve any net present value calculations because the costs of

restoration are often incurred upfront (so they are not discounted in a financial valuation), while the cash flows materialize years later (and are subject to discounting). Technology can reduce costs in many ways—for example, by improving efficiency and reducing labor costs.

In addition to cost reduction, technology is becoming an important growth area in the restoration industry for the following reasons:

- It can enable access to areas that are remote or difficult to reach.
- It can connect a widely dispersed group of people—such as smallholder farmers—to each other and to other stakeholders, improving coordination and efficiency.
- It can reduce resource intensity in areas where inputs—such as water, topsoil, and fertilizers—are in short supply.
- It can enable scientific research, testing, and enhancements of plant species to determine environmental and economic performance and boost survival rates.

Technology has been playing an increasing role in the restoration space and is evolving rapidly. Several companies are developing and deploying technology to make it easier and more cost-effective to restore land. We present four examples.



BioCarbon Engineering

What makes BioCarbon Engineering ...

COMMERCIALY VIABLE: Drones operate 150 times faster than traditional hand-planting methods.

SCALABLE: Efficient manufacturing process enables low marginal costs.

REPLICABLE: Technology is applicable to a wide range of projects and countries.

ENVIRONMENTALLY BENEFICIAL: Drones enable restoration on land that is difficult to access.

SOCIALLY BENEFICIAL: Recent project in Myanmar involves the participation of local communities.

AT A GLANCE:

- **Revenues:** 2015: \$0, 2016: \$10k, 2017E: \$800k, 2018E: \$5m, 2019E: \$35m, 2020E: \$95m
- **Profits:** 2015: \$0, 2016: (\$200k), 2017E: (\$670k), 2018E: (\$2m), 2019E: \$5m, 2020E: \$30m
- **Funding to date:** \$2.4m in equity, \$500k in grants; principal investor: Parrot SA
- **Capital needs:** \$8m–\$10m in equity for fleet and manufacturing line expansion, in-field planting operations, and team buildout
- **Land to be restored in 2020:** 100,000 ha (247,000 acres)

YEAR FOUNDED:

2014

HEADQUARTERS:

Oxford, United Kingdom

PROJECT LOCATIONS:

United Kingdom, Myanmar,
Australia

FULL-TIME EMPLOYEES:

11

WEBSITE:

www.biocarbonengineering.com

EMAIL:

hello@biocarbonengineering.com

After a 20-year career at the National Aeronautics and Space Administration (NASA), Lauren Fletcher founded BioCarbon Engineering to address the urgent issue of land degradation. Globally, an estimated 15 billion trees are cut down each year (Crowther et al. 2015). The company seeks to reforest landscapes at a large scale by using drone technology that fires seed pods—biodegradable shells containing seeds, nutrients, and other components needed for germination and early growth—into the ground.

This approach is relevant in countries with high labor costs, such as most developed countries, where restoration can be cost-prohibitive, even when there are substantial benefits to gain. According to BioCarbon, labor can make up 70 percent of the cost of planting a tree in countries, including in the United States. Even in markets with relatively cheap labor, the technology remains a cost-effective method to restore certain areas, such as places with steep slopes or limited road infrastructure, that are difficult for humans to reach by land.

Over the past couple of years, the company has developed and patented the drone technology required for this approach, including the software and algorithms, seed pods, and the physical structure of the drones themselves. The drones are designed to plant seeds at a significantly higher rate than what is possible with human effort alone. Whereas a team of two people can plant up to 3,000 seeds a day, the same team operating 10 drones can plant up to 400,000 seeds a day. Laboratory and field testing of germination and early growth rates have produced success rates ranging from 20 percent in temperate regions to 70 percent in tropical climates; these rates are on a par with manual seed-planting in the natural environment, according to BioCarbon. The company is working on three key areas:

- Mapping software to create planting patterns that optimize plant germination and survival.
- Developing the planting drones, which fire seed pods along an outlined path.



BioCarbon Engineering's drone operators set up a tree-planting test run.

- Conducting research in plant science to determine species most suitable for planting. The technology can plant more than 30 species on one site to ensure healthy biodiversity.

BioCarbon has a varied customer base, from private landowners and corporations to nongovernmental organizations (NGOs) and governments. Demand is supported by regulatory requirements for mining companies in the United States, Canada, and Australia to restore land they have damaged, and by large national pledges countries have made to restoration initiatives like the Bonn Challenge. Projects currently being implemented include rewilding lands in the United Kingdom, mining land restoration in Australia, and mangrove restoration in Myanmar. To date, the company has largely relied on word-of-mouth and press coverage

to develop its business. As of October 2017, this strategy had resulted in a pipeline of 40 potential projects representing \$40 million in revenue, with several new leads per week.

In 2017, BioCarbon raised a second round of funding (of \$1.25 million) from Parrot SA, a wireless product and consumer drone manufacturer based in Paris. The initial business model is to offer restoration as a service, charging fees on a per-pod basis. As the technology advances, reducing the per-unit cost, the company expects markets with lower labor costs, such as Southeast Asia and sub-Saharan Africa, to become accessible.

Land Life Company

What makes Land Life Company...

COMMERCIALY VIABLE: Boosts tree survival rates while reducing costs and water needs.

SCALABLE: Higher volumes drive down implementation and unit production costs.

REPLICABLE: Global performance data and high-tech monitoring accelerate learning.

ENVIRONMENTALLY BENEFICIAL: Rehabilitates ecosystems, captures carbon, and combats desertification.

SOCIALLY BENEFICIAL: Enhances food security by aiding production of fruits, nuts, and fodder.

AT A GLANCE:

- **Revenues:** 2015: \$600k, 2016: \$1.2m, 2017E: \$2.2m, 2018E: \$7.0m, 2019E: \$20m, 2020E: \$36m
- **Profits:** Expected to become profitable after 2020
- **Funding to date:** \$5m in equity; investors include founders, Vectr Ventures, and DOEN Foundation
- **Capital needs:** Closing a Series A investment round of \$12 million to build a new factory, expand core markets, and invest in capabilities and partnerships across the value chain
- **Land to be restored in 2020:** 22,000 ha (55,000 acres)

YEAR FOUNDED:

2013

HEADQUARTERS:

Amsterdam, The Netherlands

PROJECT LOCATIONS:

Americas, Africa, China

FULL-TIME EMPLOYEES:

23

WEBSITE:

www.landlifecompany.com

EMAIL:

info@landlifecompany.com

Land Life Company started in 2013 with an idea: a patented technology that enables trees to grow in arid and degraded land. The company's Cocoon product is an industrialized version of an ancient Mesopotamian technique where farmers buried clay pots filled with water next to newly planted trees. Fast-forward to a new era: the Cocoon is made of recycled paper pulp and coated with an organic wax to keep it watertight. In the company's experience, the Cocoon boosts survival rates of young trees from 0–20 percent to 75–95 percent while reducing water usage and cost.

According to Land Life, the Cocoon requires 1–10 percent of the water used by traditional irrigation (25 liters of water during the tree's entire lifetime) and costs two to ten times less per survived tree than alternative methods such as manual watering or irrigation. In some countries such as the United States, the cost savings are driven by labor costs,

while in other regions, the higher survival rate drives down the cost per survived tree. This value proposition is attractive in dry landscapes and in large projects where cost is a major factor.

The company's vision is to provide a full solution for land restoration, from seedling propagation to implementation to performance and impact monitoring. This value proposition is relevant to governments that have made large commitments to restoration, as well as to corporations interested in carbon offsets and resource security for their supply chains. The approach is also applicable for land-scaping highways and urban parks, where labor, maintenance, and irrigation costs may otherwise be prohibitive. The company has planted more than 100 tree species, often starting with a demonstration pilot and then scaling to a larger project.



Workers prepare to plant a Land Life Cocoon at a restoration site in Zambia.

Land Life is advancing its planting methodology to improve performance, reduce costs, simplify logistics, and adapt to different climate conditions. The company operates a research facility in Amsterdam where it tests products and approaches. For example, Land Life has developed a tagging system that helps map outcomes in the field. Also, optimizing production and shipping efficiency has been key as operations scale globally. Land Life set up its second factory, in Mexico, in 2017 and plans to set up a modular factory in China in 2018, which will reduce transport cost and time.

Biodiversity is an important component of some projects. The company planted 10,000 trees to help restore the nesting habitat of the Monarch butterfly in Mexico and 6,000 trees for the endangered blue finch in the Canary Islands. These were degraded areas where climate change and deforestation destroyed critical wildlife habitat, and other reforestation efforts had failed. The use of the Cocoon technology increased oyamel tree survival rates for the Monarch butterfly from 5 to 10 percent to 93 percent and Canary Island pine tree survival rates from 20 percent to 80 percent.

TerViva, Inc.

What makes TerViva...

COMMERCIALLY VIABLE: Produces more oil and protein per acre than soy at a lower cost.

SCALABLE: Capital-light business model shares profits with farmers.

REPLICABLE: Extendable to degraded farmland in Africa, Asia, and South America.

ENVIRONMENTALLY BENEFICIAL: Improves soil health, reduces fertilizer use, and allows for intercropping.

SOCIALLY BENEFICIAL: Farmers receive income from sustainably grown food, feed, and energy.

AT A GLANCE:

- **Revenues:** 2015: \$95k, 2016: \$231k, 2017E: \$450k, 2018E: \$750k, 2019E: \$1.5m; 2020E: \$3.5m
- **Profits:** Expected to become profitable after 2020
- **Funding to date:** \$20m in equity, \$2m in grants; investors include Evans Properties and Jeremy Grantham
- **Capital needs:** Up to \$9m in equity to expand tree nursery production, develop livestock feed product for market, and plant 2,000 ha (5,000 acres) in Florida and Hawaii
- **Land to be restored in 2020:** 4,000 ha (10,000 acres)

YEAR FOUNDED:
2010

HEADQUARTERS:
Oakland, CA, United States

PROJECT LOCATIONS:
Florida and Hawaii, United States

FULL-TIME EMPLOYEES:
19

WEBSITE:
www.terviva.com

EMAIL:
info@terviva.com

TerViva aims to revitalize distressed farmland by growing a leguminous oilseed tree called pongamia (*Millettia pinnata*). The company's mission is to make better use of unproductive agricultural land by planting pongamia to produce food, livestock feed, and biofuels. The global biofuels market is expected to grow from \$168 billion in 2016 to \$247 billion by 2024 at a compound annual growth rate (CAGR) of 5%, while the livestock feed market is worth \$400 billion, with an expected growth rate of 4 percent per year from 2016 to 2021 (IFIF 2017; BI 2016; RM 2016).

A tree that is native to India, Australia, and Southeast Asia, pongamia has been found in the United States for more than a century. It produces a large number of oilseeds that are rich in vegetable oil and nitrogen/protein. Also, it is a nitrogen-fixing tree that is able to rehabilitate the soil and reduce the amount of fertilizer needed, even in highly degraded areas.

Pongamia has never been cultivated on a large scale for human consumption or livestock feed because the oilseeds are not naturally edible. Through feeding trials and lab research with Texas A&M University, TerViva has identified the genetic compounds that cause this inedibility. The company has developed methods using conventional oilseed and food processing equipment to remove these compounds, making edible vegetable oil and protein. TerViva is now working to commercialize pongamia protein for livestock and food applications.

Also, TerViva spent years developing improved genetic varieties of pongamia, first by identifying promising trees from around the world, then by propagating and planting these trees in different agro-climatic environments, and finally by incorporating the use of molecular markers to assist with breeding and selection—for which the company received a grant from the U.S. National Science Foundation. According to the company, TerViva's pongamia cultivars produce ten times more oil



TerViva plants pongamia trees on their plantation in Florida.

and three times more protein per acre compared to soybeans in the United States, while using only 20–50 percent of the water. Demand for soy is expanding faster than any other major crop due to its high protein content for livestock feed (Meyer et al. 2017), and pongamia offers a more efficient and sustainable alternative.

TerViva currently has 500 acres of pongamia planted with growers in Florida and Hawaii and is expanding its planting activities. Its business model involves working closely with farmers. TerViva and the farmer enter into a contract where TerViva sells its proprietary pongamia saplings (young trees) to the farmer, who takes care of planting, maintenance, and harvest. The farmer then delivers the harvested oilseeds to a TerViva processing facility, where vegetable oil and protein are produced and sold. TerViva and the farmer split the profit per acre, with the farmer netting \$2,500/ha (\$1,000/acre) per year and TerViva netting around \$700/ha (\$280/acre). The profit split starts in year 4 and reaches full level in year 8, then continues for

a 20-year period. On former citrus and sugarcane land in Florida and Hawaii, this represents a substantial increase from current profits for farmers.

TerViva oilseed processing facilities are being set up in the US, with financial support from the Florida-based Hardee County Industrial Development Authority and the Elemental Excelsior. The creditworthiness of these organizations provides stability to the farmers who are starting to grow pongamia.

In 2018, TerViva will process more than 200 tons of pongamia oilseeds in Florida for U.S. purchasers at quality specifications and prices that are better than what is currently available on the market. Starting in 2019, TerViva expects to sell its pongamia seed meal as protein livestock feed to ranchers locally in Florida and Hawaii. The company intends to serve the world's rapidly growing demand for protein and vegetable oil on far fewer acres than required by soybeans, while restoring the land.

F3 Life

What makes F3 Life...

COMMERCIALLY VIABLE: Licenses its system to agri-lenders to reduce their credit default risk.

SCALABLE: Platform creates value for both sides (agri-lenders and smallholders).

REPLICABLE: Relevant to the agricultural loan portfolios of many banks.

ENVIRONMENTALLY BENEFICIAL: Incentivizes farming practices that add trees and improve soil health.

SOCIALLY BENEFICIAL: Helps smallholder farmers to access credit.

AT A GLANCE:

- **Revenues:** 2015: \$0, 2016: \$0, 2017E: \$50k, 2018E: \$110k, 2019E: \$180k, 2020E: \$190k
- **Profits:** Expected to become profitable in 2020
- **Funding to date:** \$200k in grants from the Dutch Ministry of Foreign Affairs, Swiss Re Foundation, and Morgan Stanley Mitsubishi UFJ
- **Capital needs:** \$1m in equity and grants to upgrade monitoring system and build climate-smart credit product for commodities such as coffee and tea
- **Land to be restored in 2020:** 25,000 ha (60,000 acres)

YEAR FOUNDED:
2013

HEADQUARTERS:
Nairobi, Kenya

PROJECT LOCATIONS:
Kenya, Ghana, Rwanda

FULL-TIME EMPLOYEES:
2

WEBSITE:
www.f3-life.com

EMAIL:
info@f3-life.com

Climate change is a threat to smallholder farmers and the banks that lend to them. Unusual rainfall patterns affect crop yields, and the higher frequency of extreme weather events increases credit default risk. F3 Life has developed a climate-smart credit approach that addresses climate risks by increasing the climate resilience of farmers and de-risking agricultural loan portfolios. F3 is pursuing this approach with a group of partners—Financial Access, the Global Innovation Lab for Climate Finance, and the International Union for Conservation of Nature (IUCN)—that are pooling their networks and expertise to generate climate-smart lending dealflow.

The model works like this: credit access for smallholder farmers is contingent on them agreeing to agricultural practices that make the farms less vulnerable to climate change—for example, planting grass strips and trees. F3 Life systems are used to verify that required agricultural practices have

been adopted and score farmers according to their resilience to extreme weather events. This score can then be included in lenders' credit-scoring algorithm. Loan amounts and interest rates are variable, dependent on the lenders' needs.

In 2013, F3 Life started with a pilot of 75 farmers in the Aberdare mountains in Kenya to test how the system would work. The company saw high rates—above 90 percent—of environmental compliance and farm restoration because credit access was a strong incentive for farmers to improve land management. Moreover, farmers continued to plant trees even after the pilot ended because they witnessed a fall in soil erosion and an improvement in soil health. The program incentivized a long-term change in farmers' behavior.

The pilot helped F3 Life develop its technology to monitor farmers' implementation of climate-smart practices. The company's target clients consist of



Sugar snap pea farmers in the Aberdare mountains of Kenya participated in F3 Life's pilot.

local and regional banks that lend to smallholder farmers and would like to reduce portfolio default risk caused by unsustainable land management and climate change–related weather events. Lenders can use F3 Life's tools to ensure that farmers comply with the sustainable and climate-smart land management requirements of their loan agreements. Farmers, extension officers, or loan officers can use smartphones to take geotagged photos of the grass strips and trees they have planted, which F3 Life translates into a score for use by the lender. This is cheaper and more effective for banks than having a team of officers monitor whether restoration has taken place. F3 Life will charge an upfront fee of \$50,000 for each lender (to design its climate-smart credit products),

as well as a recurring per-user fee of \$1 per farmer per year.

F3 Life is currently developing lending projects with major lenders—including Deutsche Bank—in Ghana, Rwanda, and Kenya. This Phase 1 project targets 45,000 farmers by 2020 who are already receiving credit, albeit not on climate-smart terms. F3 Life has also recently launched a product targeted toward large nonprofits that grant funds to smallholder farmers, and IUCN and Pact are initial clients. Its technology has important implications for the risk management of agricultural loan portfolios, credit access for smallholder farmers, and the way farmers treat their land.

THEME 2

CONSUMER PRODUCTS

The consumer goods market in the United States—the largest in the world—was estimated at \$437.8 billion as of 2015 (ITA 2017). That same year, personal consumption expenditures in the United States amounted to more than 65 percent of gross domestic product (GDP).¹ The companies that make up the consumer goods industry are as diverse as the products they sell.

Most companies in the consumer space depend on natural resources to function and thrive. Globally, humans extract about 70 billion tons of raw materials per year to produce the goods and services people consume (Schandl et al. 2016). Given current population growth and a rising middle class in emerging markets, annual consumption may increase to 180 billion tons per year by 2050 (UNEP et al. 2016). Demand for goods will continue to rise as emerging countries become wealthier. In the future, consumption may become the primary driver of natural resource extraction (Putt del Pino et al. 2017).

Rising consumer demand places a major strain on the environment, especially on natural resources such as forests, soils, fisheries, and wildlife, which are now showing considerable signs of overuse and degradation. Concerns over the impact of consumption on the environment have influenced how and what people buy. This has allowed for organic, environment-friendly, and fair-trade products to grab a larger share of the market, gaining terrain in the global sales of consumer goods. For example, as of 2015, the global sales of organic food and drinks were nearly \$82 billion, up from \$33 billion in 2005 (FiBL 2017).

Some companies are starting to rethink how they generate value for their clients. Circular businesses are emerging, where companies proactively restore the land that provides them with the raw materials they need. Prosperity is shared through strong partnerships with local communities that support local employment and fair-trade practices. One of the businesses in this section, Guayakí, falls under this category.

Also, many businesses—including the world's largest consumer products companies—spend a small portion of their profits on corporate social responsibility (CSR). This consists of voluntary activities undertaken by a company to operate in a sustainable manner, which can include sponsoring restoration projects.

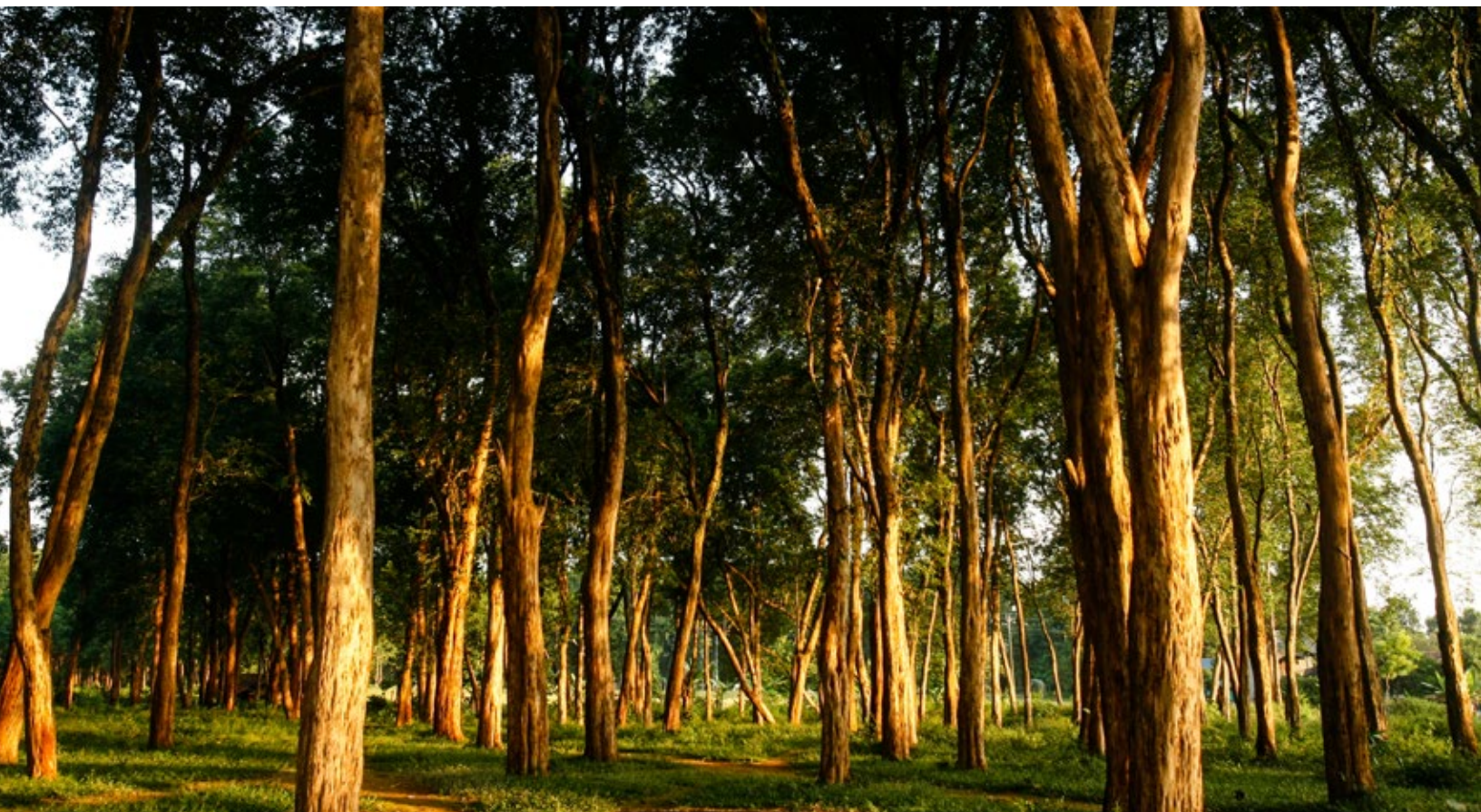
Then there are companies that make the sponsorship of social and environmental outcomes a core part of their business value proposition. These companies allocate profits from the sale of goods and services to fund a wide range of philanthropic activities and are occasionally termed *benefit corporations*. For instance, Newman's Own, Inc., a company that sells a wide range of food and drinks, dedicates all its earnings to support charity.² Since 1982, the U.S.-based company has donated 100 percent of its profits and royalties—more than \$495 million as of 2017—to diverse charitable purposes in more than 45 countries.

Similarly, some businesses direct their profits to restore land. They do this not as a CSR activity but as a core part of their value proposition to customers (their restoration work is a fundamental reason why customers purchase their goods or services). Businesses that sponsor restoration open an important new funding channel in a space that has traditionally depended on funding from governments and development banks.

Most organizations involved in sponsoring restoration don't carry out the projects themselves. Sponsor companies work in partnership with local organizations that implement projects on the ground for long-term success. Despite not being directly

involved in project execution, sponsors have been responsible for planting millions of trees around the planet. Moreover, companies try to connect consumers to the land—for example, by enabling them to track the number and location of trees planted as a result of purchase. This differentiates the product in the market and helps build a brand. We look at Tentree and Ecosia as examples of companies that sponsor restoration.

Although the three consumer-facing companies that are discussed in the following pages are very different from each other, all have restoration at the heart of their business models.



Guayakí

What makes Guayakí...

COMMERCIALLY VIABLE: Has built a market around yerba mate in the United States.

SCALABLE: The consumer lifestyle brand is backed by a growing distribution network.

REPLICABLE: Multiple companies, such as Pepsi, sell yerba mate products.

ENVIRONMENTALLY BENEFICIAL: Conserves and restores key biodiversity areas in the Atlantic Forest.

SOCIALLY BENEFICIAL: Products are fair-trade certified, guaranteeing worker and farmer rights.

AT A GLANCE:

- **Revenues:** 2015: \$38m, 2016: \$49m, 2017E: \$60m, 2018E: \$72m, 2019E: \$86m; 2020E: \$103m
- **Profits:** Already profitable, targeting 8 percent net margin by 2020
- **Funding to date:** \$8m in equity, \$5.6m in long-term debt; started with loans from the U.S. Small Business Administration; investors include White Road Investments
- **Capital needs:** Recently raised \$6m in equity to build a carbon-free distribution network in urban areas
- **Land to be restored in 2020:** Company declined to provide information

YEAR FOUNDED:

1996

HEADQUARTERS:

Sebastopol, CA, United States

PROJECT LOCATIONS:

Argentina, Brazil, Paraguay

FULL-TIME EMPLOYEES:

125

WEBSITE:

www.guayaki.com

EMAIL:

info@guayaki.com

Inspired by the link between yerba mate and the rainforest, Guayakí Sustainable Rainforest Products, Inc. has built a market in the United States around yerba mate (pronounced *yer-bah mah-tay*). Yerba mate (*Ilex paraguariensis*) is a species of the holly family and is often just called *mate*. The drink made from the namesake tree is Argentina's national beverage and is traditionally consumed in Paraguay, Uruguay, Chile, and southern Brazil. Guayakí has reinvented the traditional Argentinian drink to suit American tastes, while keeping the heritage intact.

The company targets the \$40 billion global tea market (Statista 2017). Within this market, the ready-to-drink (RTD) category is growing rapidly and makes up \$5.8 billion in the United States

alone (Tea USA 2017). Guayakí's canned energy RTD drinks have resonated with organic, health-conscious consumers, and the company has grown sales at a 24 percent compounded rate since 2004. Guayakí expects to exceed \$100 million in revenues by 2020.

Like high-quality coffee, yerba mate is best grown in the shade, delivering more flavor and nutrition than sun-farmed varieties. This makes it well suited for restoration in South America. In order to produce mate of the highest quality, Guayakí partners with 250 small farmers and indigenous communities in Brazil and Argentina to grow and harvest organic yerba mate under the Atlantic rainforest canopy. Typically, the company pays 1.25–2 times the market rate directly to the farmer.



Guayakí nursery in Andresito, Argentina.

Guayakí plants species of native hardwood trees around the yerba mate, helping restore biodiversity hotspots in the Atlantic Forest, of which only 8 percent remains (Torres 2016) due to landscape fragmentation and degradation. The company has planted 500,000 native hardwood trees to date and also provides technical support to farmers to set up nurseries for native species. Guayakí refers to this as “market-driven restoration,” where profits from forest products are reinvested into the ecosystem. Based in California, Guayakí imports and markets yerba mate products at grocery store chains in the United States, including Whole Foods, Kroger,

Safeway, and Sprouts. The company expects growth to continue as it expands distribution into U.S. convenience stores and additional mainstream grocers. Guayakí is also targeting college students as a prime health-conscious demographic that appreciates functional drinks.

The restored rainforest where the yerba mate is cultivated absorbs enough carbon dioxide (CO₂) to render the final product carbon negative. This means that purchasing one pound of loose-leaf Guayakí tea reduces atmospheric CO₂ by 573 grams, according to a third-party analysis. By 2020, Guayakí plans to steward or restore 80,000 ha (200,000 acres) in the Atlantic rainforest and create more than 1,000 jobs.

Tentree

What makes Tentree...

COMMERCIALLY VIABLE: Differentiated value proposition connects customers to impact.

SCALABLE: Has developed partnerships with multiple established international retailers.

REPLICABLE: Multiple other consumer products can be linked to restoration.

ENVIRONMENTALLY BENEFICIAL: Ecosystem services provided by 18 million trees.

SOCIALLY BENEFICIAL: Sponsored projects employ 500+ and provide income from fruit trees.

AT A GLANCE:

- **Revenues:** 2016: >\$10m; company declined to provide more information
- **Profits:** 5–10 percent net profit margins
- **Funding to date:** Line of credit and \$150k loan
- **Capital needs:** \$2–3m to develop physical locations; create community engagement program, and increase online and content marketing spending
- **Land to be restored in 2020:** Company declined to provide information

YEAR FOUNDED:
2011

HEADQUARTERS:
Regina, Canada

PROJECT LOCATIONS:
Madagascar, Nepal, and
9 other countries

FULL-TIME EMPLOYEES:
32

WEBSITE:
www.tentree.com

EMAIL:
support@tentree.com

Buy a product; plant 10 trees. This concept is the core of Tentree’s business model and is reflected in the company’s name and branding. By developing a value proposition that appeals to the young and environmentally conscious, the apparel company has supported reforestation by planting more than 18 million trees between 2012 and 2017.

Founded by two friends who are passionate about nature, the Canadian company was designed from the start with tree-planting in mind. Tentree offers a wide selection of apparel and accessories, from hoodies and tank tops to hats and bags, at a mid- to high price range. Tentree targets the 18–35 demographic in the global apparel industry and differentiates itself from the competition by planting 10 trees for every item of clothing sold.

Connecting customers to impact is an essential part of the business model. For every item, the buyer receives a virtual token to track via the “treemap” function on the company’s website where the trees

associated with that particular product are being planted. Significant time and resources are invested to develop compelling visuals and stories with each project, allowing customers to feel connected to the impact. Given that millennials constitute the core of its customer base, Tentree frequently uses social media to generate enthusiasm for the brand. In addition to online distribution, Tentree partners with several retailers with an outdoor or athletic focus—including REI, Lids, and Mountain Equipment Co-op—to establish a presence in brick-and-mortar stores. Retail stores that carry Tentree’s merchandise are primarily located in Canada and the United States.

In partnership with local NGOs, the company develops projects that have a sustained impact on local communities and the environment, whether it is agroforestry projects that improve soil fertility or mangrove restoration that restores fish habitat and local livelihoods. After considerable research, the company selects projects based on a range of



A worker prepares to plant seedlings to restore land in Madagascar, an operation sponsored by Tentree.

factors, including partner dependability, environmental impact, and narrative appeal.

For example, Tentree has partnered with Trees for the Future, a nonprofit organization focused on ending poverty in sub-Saharan Africa. Since 2014, Tentree has worked with Trees for the Future to develop agroforestry systems across Senegal, planting fruit trees in more than 50 villages and farms that provide farmers with an income stream while improving soil quality. According to the company's own estimates, this endeavor has benefited more than 200 farmers and planted 2.2 million trees.

Tentree seeks to minimize its environmental impact through the manufacturing process, working

only with certified, environmentally and socially responsible factories that source product locally. Its products are made with organic and recycled fibers. This is particularly relevant given the environmental impact of conventional cotton; globally, cotton is the crop with the single largest pesticide footprint, constituting 16 percent of all pesticide use (EJF 2007).

In the six years since the company's inception, annual sales have grown to more than \$10 million in an industry—North American apparel—that is mature and crowded. Tentree has been able to grow fast partly by differentiating itself on the basis of restoration.

Ecosia

What makes Ecosia...

COMMERCIALLY VIABLE: Seven million active users, with rapid growth.

SCALABLE: Low marginal cost allows platform to scale as the number of users grow.

REPLICABLE: Other consumer products can similarly be linked to restoration.

ENVIRONMENTALLY BENEFICIAL: Restored more than 20,000 ha (49,000 acres) of forest.

SOCIALLY BENEFICIAL: Projects create jobs for local communities in poor rural areas.

AT A GLANCE:

- **Revenues:** 2015: \$1.5m, 2016: \$2.1m, 2017E: \$8.8m, 2018–2020E: 10 percent revenue growth
- **Profits:** 2015: \$770k, 2016: \$1.2m, 2017E: \$5m; 2018–2020: target 50 percent net margin
- **Funding to date:** No external funding
- **Capital needs:** None at time of publication
- **Land to be restored in 2020:** 100,000 ha (247,000 acres)

YEAR FOUNDED:
2009

HEADQUARTERS:
Berlin, Germany

PROJECT LOCATIONS:
Tanzania, Peru, and 7 other countries

FULL-TIME EMPLOYEES:
22

WEBSITE:
www.ecosia.org

EMAIL:
info@ecosia.org

Ecosia is an online search engine that uses its profits to fund reforestation in high-biodiversity regions. Ecosia has an ad-based model, where it displays advertisements next to the search results and receives \$0.005 (or 0.5 cent) for every ad displayed. The company relies on the search engine Bing for its underlying algorithms, which means it does not need to invest much of its own capital to refine the formulas. Bing benefits because Ecosia increases the market for Bing advertisers.

Based in Germany, Ecosia had 7 million (and growing) active users as of 2016, mostly from Germany, the United Kingdom, the United States, and France. Ecosia's growth rate is accelerating as the platform gains traction and network effects take hold. Because search engines have a fixed cost structure—and low marginal costs as the consumer base expands—its profit margins are set to increase as the number of users grows.

Bing pays the company a monthly sum. Ecosia uses the revenues to cover its operating costs (which are around 50 percent of total revenue) and then distributes about 80 percent of the remaining surplus to on-the-ground restoration projects. It publishes monthly financial reports, available to the public, that detail its operating budget and capital allocation in that time period. Endemic biodiversity—the number of species that are unique to that area—is a significant factor in choosing the locations. Also, the company looks for projects that support poor agricultural communities. Current projects include deforested and degraded lands in Brazil, Burkina Faso, Indonesia, Madagascar, Morocco, Nicaragua, Peru, Tanzania, and Uganda.

The company is quick to acknowledge that impact is the primary reason consumers choose its product over Google. The search engine allows users to see how many trees have been planted as a result of their browsing, thus connecting them to change on



Woman watering an Ecosia nursery in Brazil.

the ground. The estimated cost per tree planted is between \$0.10 and \$2.00. Ecosia has planted close to 20 million native trees through local projects and invested more than \$5 million in restoration. Restoration methods include enrichment planting, direct seeding, and agroforestry, among others. Many projects create buffer zones and corridors for wildlife.

Ecosia was Germany's first B corporation—that is, a certified for-profit company that meets stringent social and environmental standards. In order to

be as climate-positive as possible, its servers run mostly on renewable energy. Management believes that in order for restoration to be sustainable in the long term, local communities need to benefit. The company's reforestation projects have created thousands of mainly seasonal jobs in poor rural areas, with more than 80 percent for women. Ecosia's business model enables it to grow rapidly while improving livelihoods and rehabilitating some of the most biodiverse ecosystems on the planet.

THEME 3

PROJECT MANAGEMENT

Restoration projects are often logistically complex. Suitable species for planting need to be identified for the landscape. The costs and benefits of the project need to be modeled and quantified. Local stakeholders must be consulted and engaged. And once the project has been developed and implemented, continued management and monitoring are required to ensure that vegetation is established and growing as planned. With all the moving parts, it often makes sense to hire a project manager.

As a “one-stop shop” for restoration, project management companies handle the process of restoration so their clients don’t have to. Such companies offer a variety of restoration services from beginning to end, including:

- Consulting services to analyze the scale and type of restoration needed.
- Design of restoration projects, including species identification, governance and financial structure, planting procedure, and material sourcing.
- Implementation of restoration projects, including hiring and managing a team.
- Monitoring and analysis of the restoration project’s progress.
- Auditing to evaluate the client’s environmental and social impact and ensure compliance with local and federal regulations.

Given the nature of restoration, there is no one-size-fits-all approach. Projects are tailored to the client’s need and the site’s ecological conditions. Depending on their geography and area of expertise, project managers may organize and work with a wide range of stakeholders, each with its own motivation:

- Governments may be interested in achieving sustainable development by fostering green markets and employment and generating cost savings through lower infrastructure maintenance costs.
- Businesses may be interested in securing their business supply chains by restoring degraded land and bolstering their environmental credentials by offsetting their carbon emissions.
- Nonprofits may be interested in supporting biodiversity and fostering community development.
- Individuals may be interested in achieving philanthropic goals and renewing the aesthetic appeal of natural landscapes.

Given the broad array of agendas and activities that need to come together, it may make sense to hire a project manager to deliver a restoration project. Project management companies are experienced in managing a range of activities, from scientific research to specialized recruitment to technical modeling. These enterprises are a vital part of the restoration industry because they promote and carry out restoration that involves complex logistics. Furthermore, the local, on-the-ground expertise that project managers provide is a core selling point for clients. Successful companies are able to scale up existing projects and expand their pipeline. With many countries around the world committing to large-scale restoration, we expect the project management industry to keep growing. Brinkman and Fresh Coast Capital are the two businesses highlighted in this section.

BOX 3 | COMPENSATORY MITIGATION

Compensatory mitigation has been a key enabler of landscape restoration in the United States. Over the last decade, 56 other countries have developed or are in the process of developing national mitigation policies (McKenney and Wilkinson 2015). The demand is primarily driven by policy frameworks that mandate the avoidance and minimization of impacts to regulated resources, followed by offsets (or compensatory mitigation) for remaining, unavoidable impacts.

The main regulatory drivers in the United States are the Clean Water Act §404 program, which regulates impacts to wetlands and streams, and the Endangered Species Act, which regulates impacts to listed species. The goal of mitigation policies is to foster sustainable industrial development with no net loss of ecosystem functionality. Compensatory mitigation obligations can be met through three mechanisms:

- **Permittee-responsible mitigation:** The permittee identifies and carries out the compensatory mitigation project and is responsible for the project's success.

- **Mitigation banks:** These are often created by private companies that undertake a compensatory mitigation project to restore and protect aquatic resources such as wetlands and streams. "Credits" are assigned to the compensatory mitigation project by the appropriate regulatory agency, such as the U.S. Army Corps of Engineers. These credits can then be sold to offset the impacts to similar aquatic resources ("debits") that result from permitted impacts.

- **In-lieu fee programs:** Sponsored by nonprofits or government agencies, these programs are approved by the appropriate regulatory agency and allow permittees to make a payment to the program in lieu of carrying out compensatory mitigation activities themselves (EPA 2017).

Various methods can be used to generate compensatory mitigation credits, including restoration. These activities can occur both on-site where the industrial activity is proposed, or off-site, thus necessitating transferrable credits.

In the United States, mitigation banking was first endorsed by the U.S. Fish and Wildlife Service in 1981 through its

Mitigation Policy, which was followed by guidance specifically on mitigation banking in 1983. Currently, these types of regulatory, compliance-driven, compensatory markets are active in the United States and a small number of other industrialized nations (Ecosystem Marketplace 2017). It is important to note the importance of regulatory stability for this market.

Although it would be better environmentally not to damage the ecosystem in the first place, mitigation policies offer an opportunity to maintain some level of ecological functionality while allowing for increased levels of development. In the United States, it is estimated that \$3.8 billion a year is generated from restoration and conservation activities that stem from mitigation requirements (BenDor et al. 2015).

With the goal of profiling a mitigation bank in this report, we contacted multiple players in the United States. However, companies were unwilling to share the detailed financial and operational information we asked for.

Brinkman & Associates Reforestation Ltd.

What makes Brinkman...

COMMERCIALY VIABLE: Reforestation required under Canada's forest laws.

SCALABLE: Large corporate & government contracts of 100,000 to 5 million seedlings.

REPLICABLE: Business model being replicated in other countries.

ENVIRONMENTALLY BENEFICIAL: Have planted 1.4 billion trees; plantations managed to high standards.

SOCIALLY BENEFICIAL: Partners with indigenous communities to foster sustainable development.

AT A GLANCE:

- **Revenues:** 2015: \$39m, 2016: \$40m, 2017E: \$41m, 2018E: \$41m, 2019E: \$43m, 2020E: \$44m
- **Profits:** 2015: \$2.7m, 2016: \$1.8m, 2017E: \$1.6m, 2018E: \$1.9m, 2019E: \$2.1m, 2020E: \$2.7m
- **Funding to date:** Equity from founders and management team; no debt
- **Capital needs:** \$5m–\$10m in equity to augment existing revenue streams with advanced technologies and expand multicountry operations
- **Land to be restored in 2020:** 43,000 ha (106,000 acres)

YEAR FOUNDED:
1970

HEADQUARTERS:
New Westminster, Canada

INVESTMENT LOCATIONS:
Canada, Central America

FULL-TIME EMPLOYEES:
150

WEBSITE:
www.brinkman.ca

EMAIL:
info@brinkman.ca

Canada has 347 million ha (857 million acres) of forest, representing nearly 9 percent of the planet's total forest cover (NRCAN 2017). Brinkman and Associates Reforestation Ltd. is a Canadian company that executes reforestation projects on behalf of forest companies and land managers, as required under Canada's forest laws. Under these regulations, which Brinkman designed and lobbied for in British Columbia and other Canadian provinces in the 1980s and 1990s, areas harvested for timber extraction must be reforested with an ecologically appropriate mix of species so they are "free to grow" to maturity.

Over the course of 47 years, Brinkman crews have planted 1.4 billion trees on more than 1 million ha (2.5 million acres) of land. Much of this tree-planting has occurred as a result of direct contract awards from Canada's forest companies, resource developers, and government agencies, with projects ranging from 100,000 to 5 million seedlings. Depending on location, topography, and other considerations, Brinkman crew members are paid \$0.07–\$0.60 per tree, primarily planting 500–5,000 trees per day by hand, to create free-growing

stands of new forests covering more than 97 percent of the restored area. Crews of 10–30 planters may use long-line helicopters and barges to access steep slopes in coastal British Columbia during the early season. Larger crews of up to 100 planters, who live together in remote wilderness camps, work to reforest vast areas of Canada's boreal forests. At peak season from May to July, around 1,000 seasonal tree-planters work for Brinkman across Canada, representing roughly 10 percent of the total Canadian tree-planting workforce. The company prides itself on an employee culture of friendly peer competition and has several dozen veteran crew members who have each planted more than 1 million trees and are known as the "millionaires."

In 1994, Brinkman expanded its reforestation work into Central America by incorporating Brinkman y Asociados Reforestadores de Centro America S.A. (BARCA). BARCA has operations in Costa Rica, Panama, Colombia, and Nicaragua, where it establishes and manages more than 3,000 ha (7,400 acres) of Forest Stewardship Council (FSC) Certified plantations of teak and other high-value tropical hardwood species on lands previously



Brinkman tree-planters hike over difficult terrain to reach a planting site.

degraded by “slash-and-burn” agricultural practices. BARCA’s strategy is to work with local communities, including indigenous tribes, to develop “full-rotation” forestry programs from selecting and buying properties, through planting and managing stands, to harvest and market. The company is actively developing plans to scale its demonstrated full-rotation forest restoration pilot projects in the region.

Brinkman also provides a suite of related ecosystem services that make up about 10 percent of its annual revenues. Treatments include removing invasive plants that compete with species from local ecosystems, and planting, protecting, tending, and watering local species. During the last 20 years, Brinkman has increased the tree canopy in Toronto and other cities across Canada to reduce ground temperatures, purify the air, and slow the flow of stormwater.

In 2013, Brinkman formalized its decades of climate work into a new division, Brinkman Climate, which provides emissions offset services to support climate change action by governments, including Canada’s commitment to the Paris Agreement and the emerging carbon markets in Ontario, Quebec, and British Columbia. Brinkman Climate has already generated more than 180,000 tons of verified carbon offsets valued at more than \$2.4 million through the British Columbia Pacific Carbon Standard for improved forest management practices in the Cheakamus Community Forest in Whistler, British Columbia. In addition, Brinkman developed the first comprehensive soil methodology for the Verified Carbon Standard in collaboration with U.S.-based The Earth Partners LP. This methodology will allow governments and markets to monetize the ecological value soil provides by capturing carbon that otherwise would be released into the atmosphere as a greenhouse gas.

Fresh Coast Capital

What makes Fresh Coast Capital...

COMMERCIALY VIABLE: Cost efficiency and high demand from cities offer market opportunity.

SCALABLE: Target large plots of vacant public land with low marginal costs.

REPLICABLE: Concept can be replicated in vacant and underused urban land.

ENVIRONMENTALLY BENEFICIAL: Projects help cities manage storm water and reduce soil contamination.

SOCIALLY BENEFICIAL: Provides low-income urban communities with green space and jobs.

AT A GLANCE:

- **Revenues:** 2015: \$0, 2016: \$0, 2017E: \$762k, 2018E: \$4.8m, 2019E: \$6m, 2020E: \$6m
- **Profits:** Expected to become profitable after 2020
- **Funding to date:** \$150k in equity, \$1.6m in grants, \$1.5m in convertible notes; grantors include the U.S. Department of Agriculture's Natural Resources Conservation Service Conservation Innovation Grant and The Kresge Foundation
- **Capital needs:** \$750k convertible debt to grow the pipeline and build out the team, \$2.75m debt for green infrastructure plan development for two cities, and \$1.5m debt bridge financing for utility rebates
- **Land to be restored in 2020:** 25 ha (62 acres) of stormwater forests

YEAR FOUNDED:
2014

HEADQUARTERS:
Chicago, IL,
United States

PROJECT LOCATIONS:
Illinois, Michigan,
Indiana, Ohio, and
Missouri, United States

FULL-TIME EMPLOYEES:
7

WEBSITE:
freshcoastcapital.com

EMAIL:
laura@freshcoastcapital.com

April Mendez, co-founder of Fresh Coast Capital (FCC), says, “Where other people see blighted, overgrown, and contaminated land, we see the opportunity to create something beautiful and productive to uplift a community.” Through public-private partnerships, Fresh Coast Capital works with local governments to design, install, finance, and maintain restoration projects in low-income urban communities. In bidding for government contracts, the company promotes large-scale restoration projects as a form of green infrastructure—stormwater management that utilizes natural vegetation and soils instead of built infrastructure made of concrete and metal.

Urban areas contain many impermeable surfaces, including roads, parking lots, and driveways, that cause high amounts of stormwater runoff (water that flows over the ground during rains). Left unmanaged, this runoff can flood and erode streams, rivers, and lakes, while contaminating them with pollutants like oil, trash, and heavy metals. In many cities, stormwater treatment systems exist but are overwhelmed by continued development and are frequently over capacity. Whereas conventional solutions to this problem involve adding an expensive system of pipes and treatment plants, green infrastructure offers the potential to complement existing infrastructure, achieving the same results through cost-effective means.

In an analysis of 479 case studies across the United States and Canada, green infrastructure was found to reduce costs 44 percent of the time, while increasing costs only 25 percent of the time (Odefey et al. 2012). For example, a cost-benefit analysis of a green infrastructure investment in Portland, Maine, found that the green infrastructure was \$10 million, or 10 percent, cheaper than that of conventional infrastructure (Ozment et al. 2016). In addition to managing stormwater runoff, green infrastructure provides a host of benefits attractive to municipalities, such as improved water and soil quality, as well as green spaces for communities to gather and foster social connections (EPA 2013). Studies show that these benefits affect housing markets, leading to rising property values (Madison and Kovari 2013).

FCC’s business model is targeted toward cities with aging infrastructure, which is extremely common across the United States (ASCE 2016). Typically, the city contributes vacant land in the form of an easement or lease, while FCC owns and manages the restoration operations carried out on the land. In collaboration with national restoration and environmental engineering firms, the company implements a wide variety of green infrastructure practices, from street trees and bioswales (drainage systems that incorporate vegetation) on city rights-



The groundbreaking ceremony for Fresh Coast Capital's restoration site in Peoria, Illinois.

of-way, to rain gardens and stormwater forests (large canopy trees that capture stormwater).

Thanks to efficient design, the company implements projects that manage large amounts of stormwater on relatively small plots of land. When the trees are fully established from year seven onward, a 0.4-ha (1-acre) stormwater forest plot can manage 1.7 million gallons of precipitation and redirected runoff per year. Furthermore, the company often plants poplar trees, which are exceptional at phytoremediation, helping remove organic contaminants from the soil. To date, the company is implementing and managing projects in seven cities across the U.S. Midwest; 25 ha (62 acres) of stormwater forests and green infrastructure projects have been planted to date, with an additional 4 ha (10 acres) to be restored in 2018.

The United States' Clean Water Act creates a market opportunity for FCC by permitting green infrastructure as a compliance solution. FCC is now exploring ways to participate in incentive programs that restore private property as a project aggregator. Given that the majority of urban land is privately owned, this approach has the potential to expand the market substantially (Sinha et al. 2017).

Fresh Coast was recently awarded a \$500,000 grant from The Kresge Foundation to pilot this work.

In 2016, FCC received a \$1 million Conservation Innovation Grant from the U.S. Department of Agriculture to pilot a \$2 million green infrastructure program in Illinois. To scale up its operations, FCC is raising \$750k in convertible debt. This will be invested in executing current projects, increasing the project pipeline, and developing the program management “toolkits for scale” to ensure streamlined and efficient customer experience and project delivery.

Of the \$105 billion in additional funding needed to modernize American water infrastructure by 2025, FCC estimates that green infrastructure could represent one-third, or \$35 billion, of the solution (ASCE 2016). Given the model's replicability to other U.S. cities struggling with stormwater runoff—an estimated 10 trillion gallons of untreated stormwater, equivalent to more than twice the volume of Utah's Great Salt Lake, enters U.S. waterways each year (Chen et al. 2013)—FCC expects to grow by completing dozens of new projects in at least four cities by 2020.

THEME 4

COMMERCIAL FORESTRY

The commercial forestry sector contributes more than \$600 billion to the global economy each year (World Bank Group 2016). With 1.2 billion hectares (2.9 billion acres) of timber plantations globally (FAO 2016), the industry has a vital role to play in land management and restoration. This is especially true as demand for wood products continues to grow. For example, pulp and paper consumption is projected to increase by more than 100 percent between 2010 and 2060 (Elias and Boucher 2014). The forecast is shown in Figure 1.

The main drivers of demand are economic growth and technological advancement. It is now possible to use wood fibers for a range of new applications that were not previously possible. In particular, demand is rising strongly from fast-growing nations such as China, where consumption of industrial roundwood, used in construction, grew 72 percent between 2005 and 2013 (FIM 2015). Industrial roundwood includes all industrial wood in the rough (sawlogs, veneer logs, pulpwood, and other industrial roundwood) as well as chips, particles, and wood residues. Policy incentives and technology advancement may boost wood demand further—for instance, through the development of new wood-based materials and substitution in construction and other sectors.

It is important to note that only those commercial forestry players that plant trees on degraded land are considered restoration businesses. Many plantations clear natural forest to make room for their operations. Such clear-cutting has a destructive impact because it eliminates wildlife habitat and releases carbon into the atmosphere. It also hurts local communities: 1.2 billion people—90 percent of whom live in poverty—depend on forests for direct support in the form of food, jobs, wood fuel, timber, construction materials, medicines, and forage (WRI 2014). We focus on the subset of plantations within the commercial forestry sector that plant on degraded land.

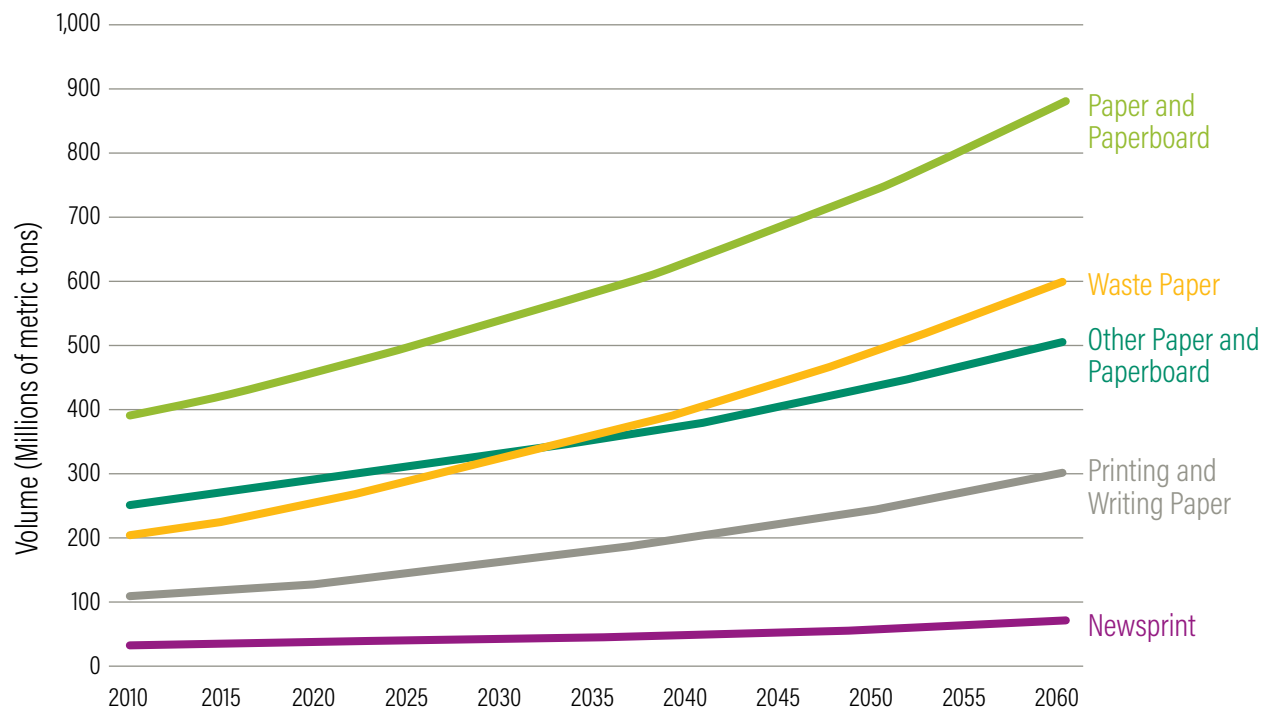
More than half of the global roundwood market consists of softwood species such as pine, spruce, and fir, with the remainder made up of hardwoods such as oak, maple, and eucalyptus. Seventy-nine percent of softwoods are supplied by North America, Europe, and Russia, while 57 percent of hardwood volume is sourced from managed forests and plantations in Asia and South America. In 2012, plantations and managed forests—forests in which usually at least one tree is planted for every tree cut—supplied almost half of total global roundwood production from all types of forests (FAO 2012; FAO 2014).

Improved Forest Management (IFM) can create more productive and healthy plantations. This increases the quality and quantity of wood produced, reducing pressure to expand to new areas. Practices include the following:

- Selectively removing trees to improve the growth rate or health of the remaining ones, a practice known as thinning.
- Extending rotation ages and harvest schedules to provide sufficient growth periods for the target production volumes.
- Implementing reduced impact logging (RIL) to limit the damage to surrounding trees during selective harvests.
- Adopting land “sparing” or mosaic design practices to couple intensive timber plantations with protection of high-conservation-value forests and critical habitats.

IFM can restore land by helping to protect biodiversity, improve hydrology, increase carbon storage, and reduce emissions from forest loss. Improved land tenure and certification standards, such as the FSC, also drive continuous improvement of management practices and community benefits

Figure 1 | Wood Pulp–Based Products Consumption through 2060



Source: Elias and Boucher 2014.

and welfare. These sustainable practices have also been shown to improve investment returns; in a study analyzing the financial performance of 55 real assets impact investing funds between 1997 and 2014, timber sector impact funds overperformed relative to their benchmarks, producing internal rates of return (IRRs) of 5.9 percent compared to 3.3 percent for conventional timber funds (Cambridge Associates LLC 2017).

Opportunities exist to expand global plantations on marginal ranching and agricultural lands that may otherwise be converted permanently to nonforest uses. Not only is this a viable growth approach for existing plantations, but it is also promising for new businesses. Strategies to improve the biodiversity and ecosystem service value of plantations are emerging—such as mixed-species plantations—and are discussed later in this section. Other practices include combining agricultural and timber production in agroforestry systems, or using commercial species to establish a forest and then promoting the regeneration of a mix of native species to facilitate forest recovery.

Although commercial forestry takes many forms, our research identified three categories that were particularly relevant to restoration, elaborated in each of the subthemes below:

- **Bamboo plantations:** Bamboo offers a sustainable, highly renewable source of fiber and building material.
- **Distributed plantations:** In this “sharing economy” model, tree supply is aggregated across a large number of smallholder farmers.
- **Mixed-species plantations:** Here, multiple species are cultivated on a single plantation.

Effective management and execution is essential. If managed poorly, new plantations can lead to forest loss, damage to habitats, and high carbon emissions. Environmental and social safeguards are critical to ensuring that commercial forestry delivers positive restoration and conservation benefits and avoids unintended consequences, such as the introduction of invasive species or the reduction of local biodiversity.

New Forests Pty Ltd

What makes New Forests...

COMMERCIALLY VIABLE: \$3 billion in timberland assets under management.

SCALABLE: Provides large institutional investments with sustainable land use solutions.

REPLICABLE: Sustainable forestry model has been replicated in Asia-Pacific countries.

ENVIRONMENTALLY BENEFICIAL: 110 million tons of carbon stored in its plantations.

SOCIALLY BENEFICIAL: Created 3,600 jobs, mainly in Asia; partnered with 5 Native American tribes.

AT A GLANCE:

- **Revenues:** Company declined to provide information
- **Profits:** Company declined to provide information
- **Funding to date:** \$3 billion in capital commitments primarily from institutional investors, including pension funds and sovereign wealth funds
- **Capital needs:** Company declined to provide information
- **Land to be restored in 2020:** Company declined to provide information

YEAR FOUNDED:
2005

HEADQUARTERS:
Sydney, Australia

PROJECT LOCATIONS:
Australia,
New Zealand, Asia,
United States

FULL-TIME EMPLOYEES:
51

WEBSITE:
www.newforests.com.au

EMAIL:
info@newforests.com.au

New Forests manages sustainable timber plantations, rural land, and conservation investments related to ecosystem restoration and protection. Founded in Sydney in 2005, the company works with institutional investors to place capital in the forestry asset class in Australia, New Zealand, Southeast Asia, and the United States. New Forests manages nearly AUD\$4 billion (US\$3 billion) in assets covering more than 780,000 ha (1.9 million acres).

As of 2016, New Forests reports that 213,000 ha (526,000 acres) of their lands were managed for ecological restoration (primarily for carbon sequestration benefit), with a total of 330,000 ha (815,500 acres) of protected land for conservation—representing 39 percent of their entire land estate. The remaining area is managed for sustainable timber production. The company works on previously degraded natural areas, including native forest, other native vegetation, and wetlands.

The company's investment approach focuses on six areas: productivity, ecosystem services, land use planning, shared prosperity, risk management, and governance. New Forests is developing a set of metrics to report on progress under this framework.

More than 96 percent of the 6.3 million tons of timber produced by New Forests in 2016 was certified to FSC and/or Program for the Endorsement of Forest Certification (PEFC) compliance schemes. The three primary investment strategies are climate-smart forestry and ecosystem restoration in the United States, sustainable forestry in Australia and New Zealand, and sustainable forestry in the emerging markets of Southeast Asia.

New Forests manages the first institutional timberland fund dedicated to Southeast Asia, the Tropical Asia Forest Fund (TAFF), which was established in 2012, and has invested \$105 million in the following three assets across Malaysia, Indonesia, and Laos:

- **Hijauan Group and Acacia Forest Industries (AFI):** TAFF's first investment was a majority interest in the Hijauan Group, which in turn holds a 50 percent interest in AFI, a hardwood plantation in northern Sabah, Malaysia. The net planted area is around 11,000 ha (27,000 acres), and TAFF's investment strategy has focused on increasing biological asset value through a shift in species and silviculture.



A New Forests rubber reforestation investment in West Kalimantan, Indonesia.

- **PT Hutan Ketapang Industri (HKI):** TAFF acquired a 35 percent shareholding in this large-scale rubber plantation estate in Indonesia, working together with majority partner Sampoerna Agro to expand the estate to a target of 32,500 ha (80,000 acres) of rubber. The plantation is anticipated to be one of the largest rubber plantations globally and will meet emerging demand for “deforestation-free” and sustainable natural rubber.
- **Mekong Timber Plantations Ltd (MTP):** TAFF acquired an 85 percent share in a Lao-tian plantation forest consisting of eucalyptus and acacia. MTP operates around 15,000 ha (37,000 acres) of planted area on a gross lease area of 22,000 ha (54,000 acres). New Forests has hired qualified external managers for key roles and implemented better business systems.

New Forests is the largest timberland investment manager in Australia and has operated in New Zealand since 2005. In these countries, markets are mature with well-established forestry management systems and new opportunities for increasing Asian demand for wood products. New Forests sees tropical Southeast Asia as an emerging opportunity for institutional investors to invest in the transition of Asia’s forest sector to a more sustainable and certified plantation timber supply. In the United States, New Forests expects to boost total returns by 2–4 percent, driven by the valuation of ecosystem services in growing environmental markets, such as conservation finance and forest carbon.

The Lyme Timber Company LP

What makes The Lyme Timber Company...

COMMERCIALLY VIABLE: Differentiates itself by managing land with unique conservation values.

SCALABLE: Current and historical portfolio of more than 525,000 ha (1.3 million acres) of land.

REPLICABLE: Can replicate the concept in developed countries.

ENVIRONMENTALLY BENEFICIAL: Has permanently conserved more than 323,000 ha (800,000 acres).

SOCIALLY BENEFICIAL: Supports rural economies by conserving working forests.

AT A GLANCE:

- **Revenues:** Company declined to provide information
- **Profits:** Company declined to provide information
- **Funding to date:** More than \$650m in capital contributions and commitments from a blend of investors (insurance companies, high-net-worth individuals and family offices, impact investors, foundations and endowments, fund of funds, pension funds)
- **Capital needs:** Company declined to provide information
- **Land to be restored in 2020:** Company declined to provide information

YEAR FOUNDED:

1976

HEADQUARTERS:

Hanover, NH, United States

PROJECT LOCATIONS:

United States and Canada

FULL-TIME EMPLOYEES:

12

WEBSITE:

www.lymetimber.com

EMAIL:

info@lymetimber.com

The Lyme Timber Company is a private timberland investment management organization (TIMO) based in New Hampshire. Founded in 1976, Lyme focuses on the acquisition and sustainable management of working timberlands and other rural real estate with unique conservation values—landscapes that provide ecosystem services such as habitat and food supply to wildlife (Capmourteres and Anand 2016). The company has permanently conserved more than 323,000 ha (800,000 acres) in the United States and Canada through the sale of working forest conservation easements (see Box 4) and fee-simple sales (sale in full of the property) to local, state, and federal agencies and conservation NGOs.

Lyme raises capital in pooled private equity funds in which it co-invests and serves as the general partner. In its first three funds, Lyme secured more than \$400 million in capital commitments and invested in 24 properties totaling 373,000 ha (923,000 acres). In its latest fund, Lyme secured \$250 million in capital commitments and, as of October 2017, has made six investments totaling approximately 69,000 ha (170,000 acres).

Lyme targets large working timberlands that present opportunities for attractive yield and total return. Working closely with conservation organizations such as TNC and The Conservation Fund, Lyme identifies lands that will ultimately attract funding from public conservation agencies and philanthropy. The company creates value through the financing and operational restructuring of existing commercial activities associated with the working lands that are purchased. Investment returns come from a combination of sustainable timber harvesting, recreational leasing, ecosystem services such as mitigation banking, and capital events, including the sale of conservation interests and the final sale of the property. Lyme's timberland properties are certified by the FSC and/or the Sustainable Forestry Initiative to ensure that forest management systems and operations are in compliance with standards for long-term forest health and productivity.

From an ecological perspective, large, connected assemblages of protected lands are more valuable than small, isolated blocks. This means that Lyme's investments can fill holes in important conservation landscapes. For example, through a series of transactions started in 2011, Lyme acquired



Lyme Redwood Forest in Mendocino County, California.

more than 32,000 ha (80,000 acres) of land in Wisconsin. The Wisconsin Department of Natural Resources purchased conservation easements over approximately 30,000 ha (75,000 acres) of Lyme's Wisconsin holdings, the largest conservation effort in the state's history. These lands are part of a much larger, multistate block of conserved lands that encompass more than 1.2 million ha (2.9 million acres). In September 2017, Lyme sold all of its Wisconsin holdings to another timberland investment manager. The conservation easements on these properties ensure that the land will be available for timber production and remain open to the public for recreation in perpetuity (TLTC 2016).

Although Lyme's investment mandate includes only the United States and Canada, it is possible for other players to expand the model to other countries with stable governance and legal frameworks that allow for conservation instruments such as easements.

BOX 4 | CONSERVATION EASEMENTS

In a conservation easement, a landowner voluntarily agrees to sell or donate certain rights associated with his or her property—often the right to subdivide or develop—and a private organization or public agency agrees to hold the right to enforce the landowner's promise not to exercise those rights. In essence, the rights to develop the property are forfeited and no longer exist. An easement selectively targets only those rights necessary to protect specific conservation values, such as water quality or migration routes, and is individually tailored to meet a landowner's needs. Because the land remains in private ownership with the remainder of the rights intact, an easement property continues to provide economic benefits for the area in the form of jobs, economic activity, and property taxes (TNC 2017).

SUBTHEME 4.1

DISTRIBUTED PLANTATIONS

Traditional plantations consist of a large plot of land planted with a single species, such as eucalyptus or pine. However, this is starting to change, for several reasons. With a rising human population paired with a decline in fertile land, large plots of land for conventional plantations are becoming more scarce and expensive. Furthermore, conventional large plantations, although attractive in their size and efficiency, are particularly susceptible to pests and fires, creating outsized risks of catastrophic loss. In some countries, these large-scale plantations also face political risks as local communities may view them as exploitative land grabs.

These realities are giving rise to a new type of plantation within the commercial forestry sector: distributed plantations, where trees are grown on different small plots of farmland. The farmers manage the trees during the growth period, but the supply of timber is aggregated by the company, which manages everything from seedling production to harvest to processing. The company has exclusive harvest rights, and farmers are compensated upon harvest.

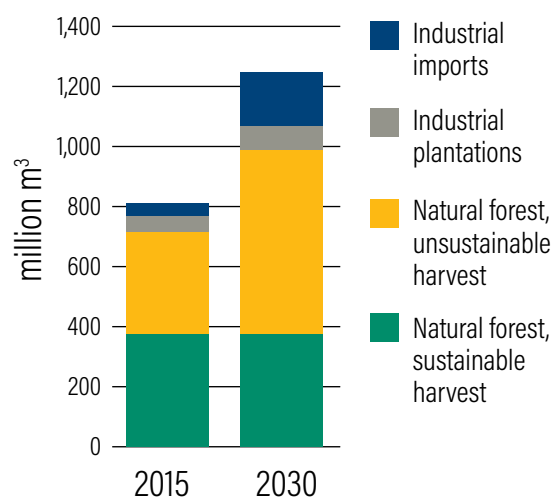
Distributed plantations can be likened to the broader pattern of the sharing economy, where supply is generated by small producers (along the same model as Uber drivers or Airbnb hosts), and then is aggregated by a central platform. Given the large number of smallholder farmers looking for additional income streams, it is straightforward to bring more farmers into the production network. This model creates shared value for the business, the local farmers, and the timber buyers. Also, the environment benefits because the planted trees reduce soil erosion, encourage a return of biodiversity, and improve the water cycle.

The distributed plantation model is particularly promising in Africa, where the demand for wood, both fuelwood and timber, far exceeds the legal supply (see Figure 2) (GEF 2013). This market gap is filled by destruction of natural forests for

fuelwood and grazing land, which causes significant environmental degradation. By working with smaller farmers, the distributed plantation model alleviates this damage by providing high-quality, legal supplies of timber.

It is important to note that fair commercial agreements between the outgrowers and companies, backed by contracts, are important to ensure fairness. Otherwise, there are risks of companies exploiting low-wage labor and perpetuating inequality (FAO 2002). Independent certification standards such as the FSC can play an important role in reinforcing ethical business agreements. There are several reasons why we expect the distributed plantation model to be more suitable in Africa than conventional plantations and to increase in prevalence over time. Distributed plantations face a lower hurdle in finding the land required, and there are incentives for smallholder farmers to join, such as gaining access to international timber markets (Smalley 2013). Also, distributed plantations face lower risks of pest or disease because the trees are spread over much larger areas.

Figure 2 | Wood Supply in Africa



Source: GEF 2013. Adapted by WRI.

Komaza

What makes Komaza...

COMMERCIALLY VIABLE: Eucalyptus and mukua have robust demand and limited supply in Kenya.

SCALABLE: Farmers provide the labor and the land to grow trees.

REPLICABLE: Large number of smallholder farmers with low opportunity cost.

ENVIRONMENTALLY BENEFICIAL: Sustainable timber supply reduces deforestation of natural forests.

SOCIALLY BENEFICIAL: Company provides more than 9,000 farmers with a source of income.

AT A GLANCE:

- **Revenues:** 2015: \$0, 2016: \$12k, 2017E: \$32k, 2018E: \$200k, 2019E: \$600k, 2020E: \$1.5m
- **Profits:** Expected to be profitable after 2020
- **Funding to date:** \$10m equity, \$1m debt, \$3m grants; investors include Novastar Ventures, Mulago Foundation, and the Dutch Development Finance Bank (FMO)
- **Capital needs:** \$10m in equity in 2018 to plant 1,500 ha (3,700 acres), establish wood processing operations, and develop mobile applications to manage a growing farmer base. Continued grant support for high-impact projects
- **Land to be restored in 2020:** 5,000 ha (12,400 acres)

YEAR FOUNDED:
2006

HEADQUARTERS:
Kilifi, Kenya

PROJECT LOCATIONS:
Kenya

FULL-TIME EMPLOYEES:
450

WEBSITE:
www.komaza.com

EMAIL:
engage@komaza.org

Africa's wood markets are expected to exceed \$100 billion by 2030 (GEF 2013), half of which will consist of high-value industrial wood products for construction, furniture, and infrastructure. More than 93 percent of the present wood supply in Africa comes from natural forests (GEF 2013), causing rampant deforestation and accelerating loss of biodiversity. Komaza seeks to provide an alternative source of timber, creating a domestic supply of sustainable wood while augmenting farmers' incomes and generating environmental benefits in a biodiversity hotspot.

The company takes a distributed plantation approach, working with smallholder farmers to plant eucalyptus and mukau (*Melia volkensii*) trees on the farmers' land. To date, Komaza has planted over 2 million trees with more than 9,000 farmers, providing direct support via a network of 350 rural field staff who assist farmers through the forestry life cycle. The company provides seedlings, tools, and training in the form of monthly farm visits in

the first year, while farmers provide the labor and the land. When the timber is ready for harvest, Komaza buys the trees from the farmers at a fair farm gate price, determined every year based on an algorithm that starts with the retail price of raw wood and subtracts all costs to infer the price received by the producer.

According to Komaza, the final harvest of a single woodlot is expected to return two to seven years' worth of a local family's baseline annual cash income. This is meaningful in a rural area with a 50 percent poverty rate and where children often suffer from chronic malnutrition. After purchase, Komaza processes raw wood into higher-value products, such as building poles and fence posts, and sells those to the broader market. Mukau can be exported globally, while eucalyptus is used locally as raw material for construction.

Komaza's approach has some advantages over conventional large-scale timber plantations:



A farmer holds eucalyptus seedlings, ready for planting, at Komaza's nursery in Kilifi, Kenya.

- **Low costs:** A large supply of land from small-holder farmers is available with no rental costs. Also, Komaza's labor costs are minimal because farmers plant on their own land. Farmer opportunity cost is low because the level of degradation reduces the planting options, and the trees are intercropped with maize and beans.
- **Market access:** The proximity of farmers to the port city of Mombasa means lower transport costs, a big factor in a country with poor infrastructure.
- **Lower risk:** Widespread distribution of plantations reduces risk of pests, diseases, and fire.

There are some challenges with the model. Given the distributed network of farmers, managing the operation is fairly complex. Also, the markets for small-diameter trees in the early years are distinct from the markets for large-diameter trees later in the business cycle, requiring development of multiple products and market strategies over time.

The company raised \$10 million in its Series A financing round in 2017. This capital will be used to plant 1,200 ha (3,000 acres) in April 2018; expand south into Kwale County; scale up harvest, processing, and sales; and fill key senior roles on the management team.

SUBTHEME 4.2

BAMBOO PLANTATIONS

Bamboo is a non-timber forest product (NTFP) that belongs to the grass family. Although bamboo is not a tree, it is comparable to perennial trees in its appearance and potential uses. More than 1,200 species of bamboo can be found in tropical and subtropical regions around the world. Common in Africa, Asia, and Central and South America, bamboo varies in size, shape, and color. In contrast to most traditional forest plantations, bamboo's fast growth rate and shorter rotation cycles make it a high producer of wood biomass per acre. It is one of the fastest-growing plants in the world—some species grow nearly 3 feet a day—and has been cultivated commercially in Asia for thousands of years, used for everything from musical instruments to building material for homes (Shi 2017).

Most of the research, knowledge, and genetic material related to bamboo has been concentrated in Asia, which has led to limited investment in bamboo cultivation elsewhere. This is starting to change as bamboo has received increasing attention over the last decade for its economic and environmental value. As a subcategory of commercial forestry, bamboo plantations offer a potential model for restoration and sustainable development.

Bamboo has a wide range of end markets, from timber and textiles to pulp and paper and bioenergy. Its versatility and rapid development have led to the emergence of a number of companies, such as Eco-Planet Bamboo, that focus exclusively on bamboo. Importantly, these companies are outside Asia; this may result in new bamboo-based markets forming around the world, presenting a growth opportunity for investors.

Environmentally, bamboo is advantageous because it can grow on marginal land, stores more

carbon than similar-sized tree species, and can be harvested repeatedly for up to 40 years (Bamboo Habitat 2017). Bamboo's underground rhizomes, or horizontal stems, control soil erosion, helping restore degraded land. Also, its shallow roots sometimes allow the species to have lower water requirements.

However, given the smaller market for bamboo (GMA News Online 2012) compared to tree-based forest products (Mendell 2017), relatively little research has been done on the vast range of bamboo species and their suitability for large-scale planting. To realize the environmental benefits, it is important that the species selected for cultivation is suited to the climate and terrain. When planted outside its native ecosystem, bamboo can be invasive, spreading outside its native environment and causing environmental harm, so it is essential to select the species very carefully. Also, it is important to ensure operations are sustainable because some by-products of traditional bamboo processing plants contain high levels of toxic heavy metals in soluble form, posing a major environmental concern (Sahariah et al. 2014).

Global statistics on bamboo production and trade are scarce. A joint report by the Food and Agriculture Organization (FAO) and the International Network for Bamboo and Rattan found that naturally occurring species of bamboo are located around the world (Lobovikov et al. 2007). It is estimated that the total domestic markets for China and India—the world's two biggest bamboo producers—are worth at least \$40 billion (Friederich 2014). In China, the bamboo industry is expected to employ 10 million people by 2020 (Musau 2016). Few official numbers exist because so much consumption and production of bamboo takes place in the informal economy.

EcoPlanet Bamboo

What makes EcoPlanet Bamboo...

COMMERCIALY VIABLE: Plantations mature in five to seven years; production under way in earlier plantations.

SCALABLE: Current operations expected to produce 280,000 tons of bamboo per year.

REPLICABLE: Concept can be replicated in deforested and underproductive lands.

ENVIRONMENTALLY BENEFICIAL: Alleviates demand for wood and fiber, reducing pressure on natural forests.

SOCIALLY BENEFICIAL: Creates 500+ local jobs, from fieldwork to manufacturing.

AT A GLANCE:

- **Revenues:** Company declined to provide information
- **Profits:** Company declined to provide information
- **Funding to date:** \$31m in equity from founders, managers, and investors; \$17m in debt
- **Capital needs:** \$25m in equity to build a biorefinery, expand existing harvest and manufacturing operations in Nicaragua & South Africa; \$20m to complete planting operations in Ghana
- **Land to be restored in 2020:** 5,000 ha (12,400 acres)

YEAR FOUNDED:
2010

HEADQUARTERS:
Barrington, IL
United States

PROJECT LOCATIONS:
Nicaragua,
South Africa, Ghana

FULL-TIME EMPLOYEES:
200

WEBSITE:
www.ecoplanetbamboo.com

EMAIL:
info@ecoplanetbamboo.com

As an integrated forestry company, EcoPlanet Bamboo (EPB) aims to alleviate the pressure on natural forests by developing sustainable bamboo as an alternative timber and fiber source for major industrial markets. The company's fully planted Nicaragua and South Africa operations total 3,500 hectares (8,645 acres) with an additional 10,000 ha (25,000 acres) in Ghana under development. EPB's existing plantations are expected to produce an annual yield of 280,000 tons upon maturity in 2024.

To ensure sustainability, EPB has invested in research and development across the bamboo supply chain. The company's research on plant science has allowed it to identify select species that are optimized for large-scale production, choosing native and naturalized species that are noninvasive for each country of operation. Investment in manufacturing processes has led to the development of bamboo-specific manufacturing technologies, including specialized silvicultural management practices for bamboo plantations, which have active or pending patents. EPB is targeting a range of end markets, including:

- **Pulp and fiber:** With its zero-waste, closed-loop biorefinery in Nicaragua, EPB is developing bamboo pulp packaging materials for the food and beverage industry, promoting them as a substitute for single-use plastics, Styrofoam, and aluminum.
- **Sanitary products:** The bamboo pulp will also be used to produce toilet and tissue paper in partnership with a global manufacturing entity. First production is set for January 2020.
- **Construction material:** In Nicaragua, the company is creating bamboo alternatives to hardwood and other construction and housing materials, with the intention to meet timber demand with locally available materials. EPB is exploring this with the Nicaraguan government.
- **High-end charcoal:** In South Africa, EPB is producing high-value charcoal for specialty applications, such as air and water purification systems.



EcoPlanet Bamboo's restored and commercially productive ecosystem in Nicaragua: native bamboo interplanted with native trees and remnant forest patches.

To guarantee demand, EPB is engaging in discussions with local and international purchasers. For example, in June 2017, the company signed a Memorandum of Understanding with the Mantis Collection, a company running more than 80 luxury properties around the world. This agreement seeks to reduce Mantis's environmental footprint by installing bamboo charcoal air purifiers and water filters; replacing packaging for food, drinks, and cosmetics with a compostable bamboo alternative; and using toilet paper and textiles made of bamboo fiber.

In addition to its commercial activities, EPB has a subsidiary—EcoPlanet Restoration—that focuses on developing green charcoal with smallholder farmers in sub-Saharan Africa to combat deforestation. Although not profitable, this subsidiary seeks to leverage public and philanthropic capital to produce a sustainable energy source from bamboo that is cost-competitive with alternatives in the market.

By establishing bamboo on severely deforested areas, EPB is able to utilize otherwise unproductive lands while allowing the bamboo to restore the landscape by conserving water and organic matter

(Friederich 2017). Unlike most plantations, EPB does not cut any of the existing trees on the land and works around them, which results in integrated, biodiverse ecosystems.

EPB has restored 5,400 ha (13,300 acres) in the last three years and is targeting an additional 1,200 ha (3,000 acres) in 2018. EPB's Nicaragua and South Africa plantations have FSC certification. Based on a carbon assessment of its restoration activities (separate from its manufacturing operations), which was audited by the Rainforest Alliance and verified under the Verified Carbon Standard, EPB's plantations in Nicaragua will remove more than 1.5 million tons of carbon from the atmosphere upon full maturity.

The company emphasizes community impact, seeking to provide job opportunities for local communities and employing and training several hundred workers. In addition to standard technical training to assist with bamboo production, EPB has hosted site-specific training tailored personal development, including language and software courses. All employees have access to clean water and health care.

SUBTHEME 4.3

MIXED-SPECIES PLANTATIONS

Mixed-species plantations consist of multiple tree species planted in the same area. Monoculture plantations—settings where only one species is grown—are still the norm but can negatively impact wood production. On average, a 10 percent loss in tree diversity in natural forests leads to a 3 percent loss in wood production (Liang et al. 2016). This relationship exists because different species are less likely to compete with each other for light and nutrients. The “diversity dividend” is worth between \$166 and \$490 billion a year for natural forests globally—ranging from unmanaged to extensively managed—that produce timber for construction and other uses (Liang et al. 2016).

In countries where there are many species of native trees—such as Brazil, where there are more than 8,000 native tree species—the mixed-species plantation has the potential to restore degraded land in a way that is more productive and supports biodiversity (Rio de Janeiro Botanical Garden 2017). There are many ways to select tree species to enhance timber yields and improve revenue streams. In addition to producing wood, these plantations can generate commercial products such as fruits, seeds, essential oils, and medicinal ingredients. For example, alpha-Bisabolol is produced from the stem of the candeia tree (*Eremanthus erythropappus*), a species found in the Brazilian Atlantic Forest. Alpha-Bisabolol is an effective anti-irritant used in products such as deodorants, wet wipes, and sun protection products.

An additional benefit to mixed-species plantations is that it is possible to develop ecosystems that are close to what is found in nature. This is important because natural systems have their own defenses

and coexistence mechanisms developed over millions of years through evolution. Given the diversification of trees and their genetic traits, mixed-species plantations have higher scenic value, greater integration with local fauna, and higher resistance to pests and diseases (in contrast to monoculture plantations, where a single pest or disease can destroy the entire plantation). Mixed-species tree plantations can also be integrated with agricultural crops, resulting in agroforestry systems.

Mixed-species plantations are more complex to manage than monocultures because it is necessary to consider interactions between species. Each species has specific ecological behavior—for example, some require light while others seek shade. This increases the complexity of forest management, especially because factors such as light will change dynamically as the trees grow. Therefore, species spacing, canopy-level shading in different years, pruning, and thinning must be carefully planned from the start.

The complexity of working with multiple species has been a barrier to widespread adoption of mixed plantations. Furthermore, the diverse growth rates of trees can be inconvenient during harvest. In contrast, monocultures allow the entire plantation to be harvested at the same time. Also, when planting mixed-species plantations, the species need to be chosen carefully so they are complementary. This foresight is not necessary with single-species plantations.

In this section, we take a look at a forestry company that benefits from the diversity dividend.

Symbiosis Investimentos e Participações S.A.

What makes Symbiosis...

COMMERCIALLY VIABLE: Plants 22 high-value timber species that are mostly commercially extinct.

SCALABLE: Selective breeding provides higher yields and better climate resilience.

REPLICABLE: There are many valuable timber species with low supply.

ENVIRONMENTALLY BENEFICIAL: For every 3 ha (7 acres) planted, 2 ha (4 acres) restored and conserved.

SOCIALLY BENEFICIAL: \$1.5 generated in local economy for every \$1 invested.

AT A GLANCE:

- **Revenues:** No revenues expected before 2020
- **Profits:** Expected to be profitable after 2025
- **Funding to date:** \$19m in equity
- **Capital needs:** \$50m in equity to expand forestry operations from 1,500 ha (3,700 acres) to 3,500 ha (8,600 acres) and continue the genetic improvement program
- **Land to be restored in 2020:** 1,120 ha (2,800 acres)

YEAR FOUNDED:
2008

HEADQUARTERS:
Rio de Janeiro, Brazil

PROJECT LOCATIONS:
Bahia, Brazil

FULL-TIME EMPLOYEES:
12

WEBSITE:
www.symbiosisinvestimentos.com

EMAIL:
brunomariani@symbiosisinvestimentos.com

Symbiosis Investimentos is a forestry company focused on planting high-value tropical timber species and restoring permanent protection areas and legal reserves in Brazil's Atlantic Forest. Symbiosis was founded by Bruno Mariani, who previously served as the chairman of the Brazilian Biodiversity Fund's board and worked in the Brazil investment banking sector for 20 years. The company operates at all stage of wood production—from selecting tree species and mother trees to collecting seeds and producing seedlings to planting, managing, harvesting, processing, and selling the wood products.

Symbiosis has a multispecies approach, whereby native “end” species are planted alongside “accessory” native and exotic species. The end species—which include Ipê, Jacarandá da Bahia, and Peroba—are some of the most valuable in the timber market, and their price per cubic meter (m³) of lumber can reach \$1,500. However, the initial growth rate is slower and rotation cycles are longer, and the end species need partial shade provided by accessory species. Planting native and exotic

accessory species next to the end species—which have faster initial growth rates (requiring rotation cycles of 21 years or less)—not only provides the shade necessary for end species to flourish but also generates early sources of revenue. In 2018, Symbiosis will do its first thinning, which is the selective removal of trees, primarily undertaken to improve the growth rate and health of the remaining trees.

The company manages 22 different native tree species on its plantations, which total 560 ha (1,400 acres), while restoring sections of its land with 160 native species (300 ha/740 acres) for conservation. This land was originally degraded by cattle ranching and coconut plantations. The company plans to purchase an additional 3,500 ha (8,600 acres) in the next 5 years. Symbiosis has already started to expand the nursery, where it produces its own seedlings of the most sought-after tree species in the timber market. It is not an easy task to establish the initial seed bank. Symbiosis collected seeds from 4,000 mother trees from remnants of the Atlantic Forest across three states in Brazil.



An aerial view of Symbiosis Investimentos' nursery and research center.

Symbiosis has the first commercial genetic improvement program for native species in Brazil. After collecting seeds from the mother trees, the company established a population base. This base was tested to ensure genetic variety and to select the best trees to be cloned and planted for commercial purposes. While exotic species such as eucalyptus have received more investment in genetic research, the same cannot be said for native species. For example, outside Australia, eucalyptus is an exotic species. Its yields were 12 m³/ha/year (171 feet³/acre/year) in the 1960s and have since expanded 3.5 times to 40 m³/ha/year (572 feet³/acre/year) due to research and development (Ibá 2014). Yields and price are the most important sources of returns for forestry assets. Research is needed to determine which native species have the potential for a significant rise in timber yield per hectare, but investment in such research is very low, making Symbiosis's approach unique.

Native tropical tree species face uncertainty on the demand side due to illegal logging. It is estimated that 50 percent of tropical timber traded globally has an illegal origin, and this is as high as 70 percent in the Brazilian Amazon (BVRio 2016). This suppresses the value of timber by creating a glut of supply, reducing the incentive for ethical businesses to enter the market. Indeed, legal timber production in the Brazilian Amazon has fallen by 40 percent over the last decade (BVRio 2016). Because high-value species have been heavily depleted, however, they can no longer be sourced at scale from the wild. This presents an opportunity for Symbiosis to ensure the survival of the species while fetching an attractive price in the market.

THE PATH FORWARD

In this report, we have explored how restoration enterprises can create value through a range of business models. Each featured theme—technology, consumer products, project management, and commercial forestry—offers opportunities for businesses and investors to make money. Furthermore, the companies highlighted in this report are a small sample of the restoration economy. Additional research is needed to understand the full potential of this emerging space.

It is important to note that several systemic barriers exist, slowing the growth of the restoration economy. These include the following:

- Many environmental and social benefits generated by restoration—such as biodiversity, carbon sequestration, and air and water quality—are not fully valued by the market.
- Incentives to degrade land—for example, through entrenched government subsidies for conventional agriculture—often outweigh incentives to conserve or restore land.
- Some business models require a long investment time horizon of 10–20 years.

Although these factors have limited capital flows to restoration, solutions can and do exist. These policy solutions to the financial barriers are discussed in further detail in a WRI report published in December 2017, “Roots of Prosperity: The Economics and Finance of Restoring Land” (Ding et al. 2017).

What is needed to accelerate the growth of the restoration economy? We provide the following recommendations for investors and businesses:

Investors: The themes outlined in this report provide a good starting point for investors who are considering if and how restoration fits into their strategy. Given the broad range of countries and industries encompassed in the restoration economy, it is possible to include restoration in many investor portfolios. We recommend that investors do their own due diligence on any companies in the space. A number of resources exist to facilitate private investment in restoration; we encourage investors to reach out to the authors of this report as a first step.

Entrepreneurs and businesses: Entrepreneurs play a critical role in implementing restoration on the ground and testing the business models that can scale. For entrepreneurs looking to create new companies, this report provides some insight on how existing businesses create and capture value. The WRI publication “Attracting Private Investment to Landscape Restoration: A Roadmap” lays out a framework for businesses that seek to raise private capital and can help entrepreneurs construct a targeted investment pitch (Faruqi and Landsberg 2017).

The restoration economy has the potential to benefit many stakeholders. Investors can participate in the growth trajectory, businesses can enter new markets, local communities can gain employment, and the environment can thrive as forests and agricultural lands are restored. By highlighting a range of investment themes and businesses in this report, we hope to unlock some of this potential.

ENDNOTES

1. See Federal Reserve Bank of St. Louis Economic Research (FRED). 2017. (Database.) "Personal Consumption Expenditures/Gross Domestic Product." <https://fred.stlouisfed.org/graph/?g=hh3>. Accessed November 15.
2. See Newman's Own, Inc., at <http://www.newmansown.com>.

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Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

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We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

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We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

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We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.

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