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Terrazone™

Model for Planning Rural Regreening



Ecosystem Sustainability Must Go Beyond Carbon Projects

Half of the arable land on earth is already dedicated to agricultural purposes. Industrial monoculture has depleted 75% of soil putting pressure on expanding the agricultural land.

The world is not feeding itself sustainably.

In developing nations, demand for timber products, including wood and fuel, is another source of deforestation. Dozens of developing countries now have less than 10% of their land remaining forested.

Although slowing, deforestation continues.

Science agrees that reforestation of the planet is required to mitigate climate change and moderate local ecosystems. Therefore, habitat restoration must be integrated with agriculture and forestry. This results in distinctively structured projects that locally address the entire spectrum of rural needs.

“It is time to recognize that food security, agriculture and forestry can no longer be treated in isolation.”

A key message of “The State of the World’s Forests, 2018 FAO Report

Merely planting trees again does not end deforestation.

The competing demands for rural land resources has often pitted habitat, agricultural, and timber interests against each other. Spades developed a zoning approach for Integrated Landscape Restoration. This model can join rural land interests to guide planning efforts among stakeholders.

When balanced, diverse interests can enjoy the synergies of sustainable rural development.



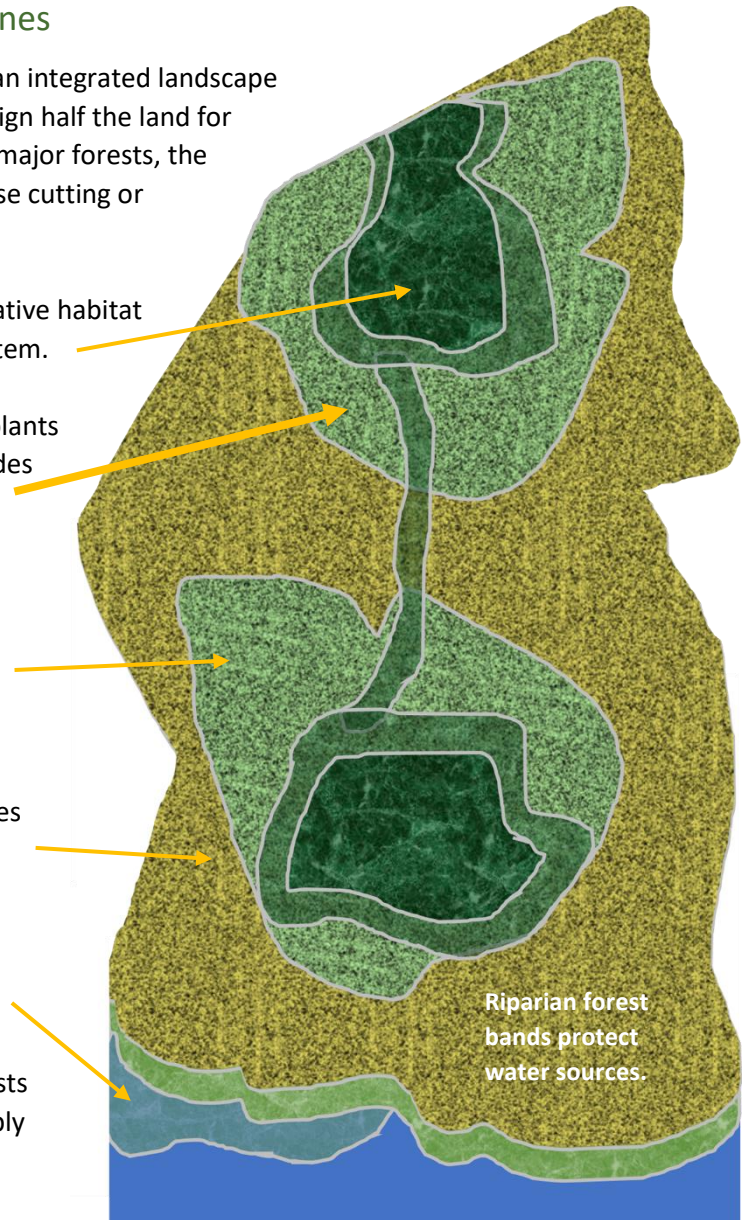
Deforestation can create deserts even in mountains next to rivers

Integrated Landscape Restoration Zones

The diagram depicts the five primary zones of an integrated landscape restoration. The areas are approximate but assign half the land for agriculture. It is understood that for sites with major forests, the layout would be different. This does not propose cutting or repurposing existing forests.

1. **Core zone:** rewilding and conserving native habitat on the path to a self-organizing ecosystem.
2. **Buffer zone:** available for local use of plants (without cutting or digging), also provides wildlife habitat.
3. **Plantation development zone:** multispecies plantation forestry and permaculture with attention to native species and habitat space.
4. **Regenerative agriculture zone:** sustainable agriculture that incorporates agroforestry practices and avoids monoculture.
5. **Blue carbon zone:** mangrove trees protecting coastlines and fisheries.

The Terrazone model integrates all local interests so that long-term sustainability can more reliably be achieved.



Core Zones

Forests are the dominant land ecosystems holding 80% of all plant mass and providing refuge for most of the world's animal species.¹ These areas create rivers, provide ground water, and affect nearby climate conditions. When large enough, they can even create weather systems.

Forestry core zones are best as self-organizing ecosystems, that is, sustaining without human intervention. Unfortunately, regreening such systems often requires human assistance because of depleted or compacted soils, invasive or exotic species, grazing animals, human activities, etc.

Addressing these challenges is benefitted by starting with intact core zones. Worldwide, there are 202,467 conservation areas protected by law, covering almost 20 million square kilometers or 14.7% of the world's land (excluding Antarctica.)²

There are numerous benefits if core zones can be expanded from such existing protected habitats³:

Protected areas are being locally recognized, even if the legal protection provided is not yet fully respected.

Integrating with core zones increases the total area and project advantages, benefitting all stakeholders, including financially.

Millions of plant and animal species are protected from extinction. Thousands of these species will be the source of future medicines, food sources, and genetic diversity.



Habitat tree density primes the biotic pump for surface and underground water systems, helping areas around it to thrive.

The project can directly integrate and balance protected areas with other land-uses, like agriculture and timber.

Long-term protection allows for expansion and Buffer zones to be established with pioneer species. This opens up **genetic diversity** to naturally follow as needed conditions are established.

Habitats sequester more carbon per area than most other zones.

Trees are unable to migrate as fast as climate change is moving. When species are selected to regreen these areas, consideration needs to be made for adapting to current and future climate conditions. **Core zones are truly central to the sustainability of regreening projects. Making sure they are sustainable is a win for all.**



¹ Pan, Y. D. et al. 2013. *The structure, distribution, and biomass of the world's forests*. – Annu. Rev. Ecol. Evol. Syst. 44: 593–622.

² According to scientists at IUCN and UN Environment's World Conservation Monitoring Centre

³ Regenerate natural forests to store carbon <https://media.nature.com/original/magazine-assets/d41586-019-01026-8/d41586-019-01026-8.pdf>

Buffer Zones

Buffer zones surround and are ecologically nearly identical to core zones. Plants, people, and animals may occasionally meet in a nondestructive way. Buffer zones allow local people to forage for native plants and trees used for food or medicine. Harvesting of leaves, fruit, or fallen branches is allowed but no cutting or digging is permitted. Global experience shows that outright separation from traditional plant sources may not be accepted, leading to lack of acceptance of the protected core zone. **Buffer zones allow all stakeholders to receive increased benefits.**

Plantation Development Zones

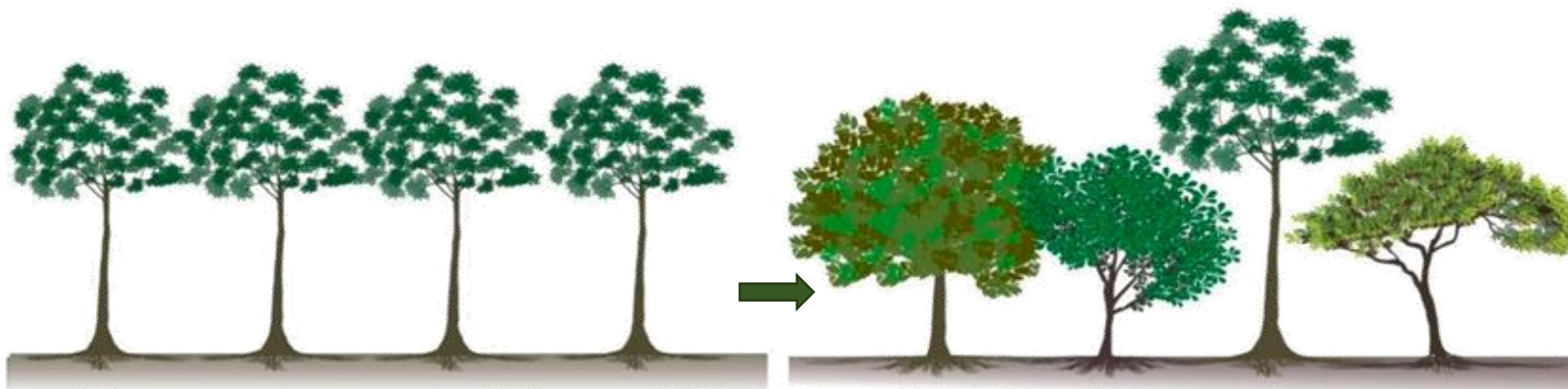
These are zones where many of the human-oriented benefits of trees can be leveraged for focused outcomes. This includes fruits, nuts, wood, paper, renewable energy, spices, herbs, etc. For sustainability and greatest impact, related value-chain partnerships should be established.

Timber forests should be multispecies plantations that incorporated trees that prefer the spectrum from full shade to full sun. Former timber plantations have often been monocultures introducing exotic species, especially pine and eucalyptus. This ignores the local high-value species and those that grow in shaded conditions. With small changes, these zones can be made habitat-friendly to local animals and plants. When positioned near core and buffer zones, these development zones can provide a further habitat transition to the core zone.

Fruit and nut plantations should avoid monoculture for sustainability. They are best when incorporating local species. They may part of an agroforestry model. Timber, fruit, and nut plantations provide:

- Timber and fuel, reducing pressure on deforestation
- Perennial food, helping provide food security and agricultural economics
- Green canopy, stabilizing climate, protecting soil, and managing water
- Area for livestock to browse, consuming unused fruit and nuts and providing fertilizer
- Local employment and income
- Opportunities to intercrop with annual plants

Plantations expand opportunity, engage people in tree husbandry, and instill tree appreciation.



Regenerative Agricultural Zones

Regenerative agriculture is the practice of sustainable food production that minimizes or eliminates the use of chemicals. It is often organic production but incorporates additional practices like *climate smart farming* that increases resilience and sustainability.

Benefits:

- Increase food security
- Resolve soil depletion
- Sequester carbon in the soil and trees
- Farm and ecosystem resilience including rainfall, surface water, and ground water

Practices:

- Manage for maximum profit rather than maximum yield
- More agroforestry and less monoculture
- Less dependent upon imports, including seed and chemical suppliers

Anyone entering a forest on a hot day notices lower temperatures and higher humidity. This buffering effect is known as *forest microclimate buffering*, *microrefugia*, *refugia*, or *canopy buffering effects*. Trees help regulate the climate around them, moderating temperature and humidity. **Trees create climate refuges.**

Science has measured this tree regulating capacity. With 50% canopy coverage, the impact is an average 5.3°C cooler and lowers vapor pressure deficit (“VPD”) 1.1 kPa.⁴ VPD is a measure of relative humidity. Hot temperatures dry out plants and soil because VPD goes up. Deserts can be as high as 8 kPa but most plants like conditions that are under 1 kPa. With climate change, temperatures and VPD are rising everywhere – on a continental scale⁵ – putting agriculture at risk and creating deserts. Reducing VPD means farms need less water. *Resilient agriculture*, also known as *climate smart farming*, requires aggressively incorporating trees in the agricultural landscape. **A 50% canopy in agricultural zones improves resilience to climate extremes and should be a baseline target for greening efforts.**



Given a little time trees regreen the world around them. They create healthy soils and manage water. Known as agroforestry, trees’ offer many ways to achieve regenerative agriculture objectives. For example, leguminous trees can be intercropped with maize, increasing yields 4x, while providing soil mulches, fuel, and animal fodder. There are numerous such practices, which are summarized below. Each of these practices are well documented and practiced widely. They are often combined and blended for greater effect. **Agriculture is most resilient and profitable when it incorporates trees.**

⁴ K. T. Davis et al, *Microclimatic buffering in forests of the future: the role of local water balance*, Ecography 42: 1-11, 2019

⁵ Ficklin et al, *Historic and projected changes in vapor pressure deficit suggest a continental-scale drying of the United States atmosphere*, JGR Atmospheres, Volume122, Issue4, 27 February 2017, pp 2061-2079

Agroforestry Methods



Permaculture

Fruits, nuts and other tree products grown for economic or local uses, generating high value in 4 to 7 years



Shelterbelts

North-south rows of trees with a companion crop grown in the alleyways between the rows increases fertility

A barrier against erosion, wind, storm, and animals; close plantings of 500–1000/ha can include coppicing supply



Riparian forest bands

Adding trees and avoiding monoculture and chemicals increases crop yields even 4x while replenishing soils

Natural vegetation at water edges buffers pollutants, controls erosion, and provides habitat



Silvopasture

Pasturing animals among trees, benefits the animals, the trees, and supply of forage

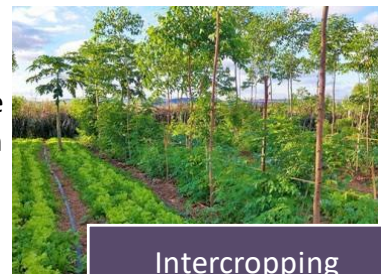


Forest farming

High-value crops under the protection of a managed tree canopy serve shade loving plants



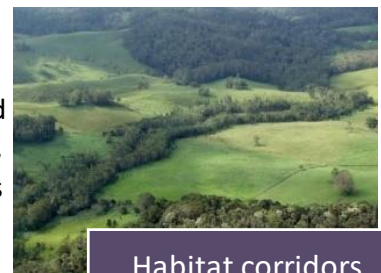
Alley cropping



Intercropping



Coppicing

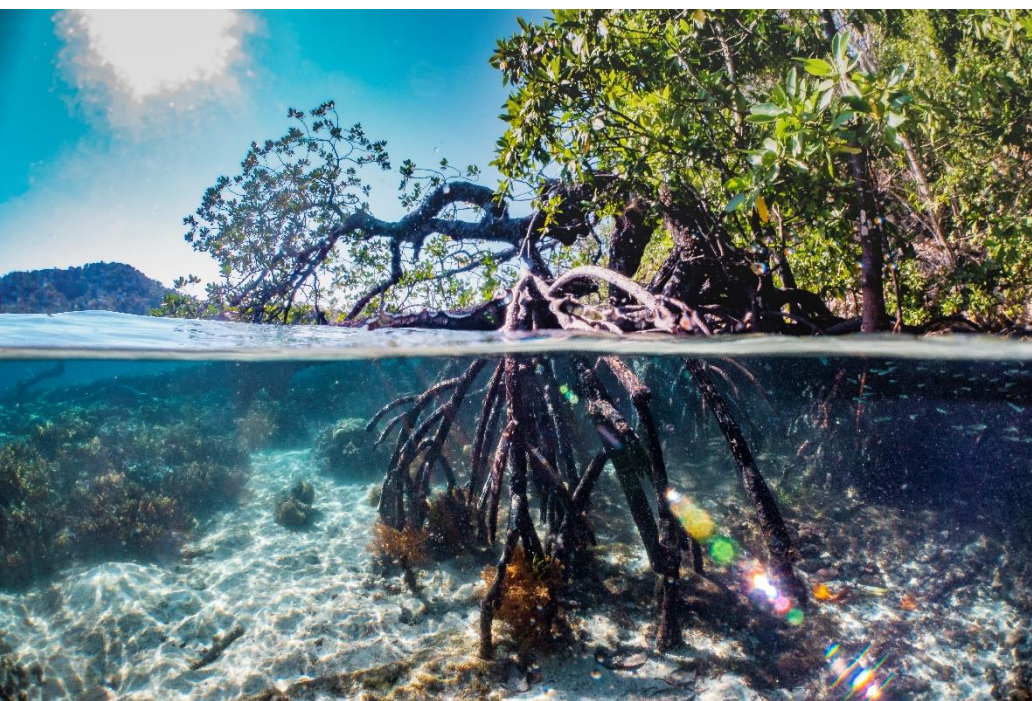
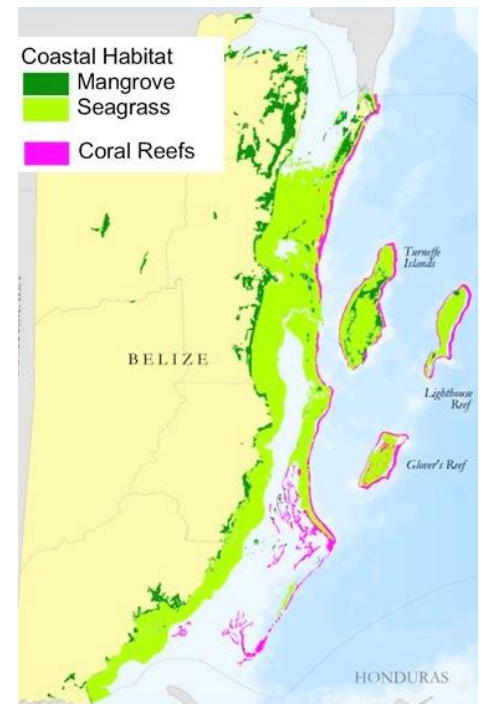


Habitat corridors

Blue Carbon Zones

Blue carbon refers to carbon captured by the oceans and coastal ecosystems. Mangrove trees have adapted to grow in tropical, shallow, saline water. Although not as large as many trees, mangroves densely pack up to 4 times as much carbon in their wood. A study of mangroves in Brazil shows that its mangroves sequester twice as much carbon per hectare than the Amazon jungle.⁶ Mangroves grow quickly and are relatively inexpensive to plant. That makes them very investable, from a carbon credit perspective.

Environmentally, mangroves are amazing. They sequester the bulk of their carbon in root systems anchoring them deep into ocean coasts, securing the land against storms. They can reduce hurricane storm surges 90%. Their roots are nurseries for fish, hinting at the complex web they have with ocean ecosystems. In Belize, World Wildlife Fund has been mapping the links from mangroves to reefs (see map). People sometimes remove



mangroves for the ocean view, but that can simultaneously destroy their fisheries and reef tourism, while putting their land at risk to the next storm.

Mangroves account for only 1% of carbon sequestration by the world's forests, but as coastal habitats they account for 14% by the global ocean.⁷ These 'walking trees' provide crucial benefits to both people and the environment, tying together land and ocean ecosystems.

Mangroves are a critical component to any project having tropical coastlines.

⁶ J. Boone Kauffman, Angelo F. Bernardino, Tiago O. Ferreira, Leila R. Giovannoni, Luiz Eduardo de O. Gomes, Danilo Jefferson Romero, Laís Coutinho Zayas Jimenez, Francisco Ruiz. Carbon stocks of mangroves and salt marshes of the Amazon region, Brazil. *Biology Letters*, 2018; 14 (9): 20180208 DOI: 10.1098/rsbl.2018.0208

⁷ Daniel M Alongi (2012) Carbon sequestration in mangrove forests, *Carbon Management*, 3:3, 313-322, DOI: 10.4155/cmt.12.20



Implementation with Spades

The Terrazone model maps the synergies between rural interests, including the people that live there, governments, environmentalists, businesses, agriculture, and foresters. These interests are all rooted in the same ecosystem. Unity is found in the urgency of climate change, locally apparent damage, good business and jobs, and climate resilience. Spades' integrator approach enables this effort with a suite of services that unlock opportunities:

- **Diversity of partnership capacities** serve the interests of stakeholders and ecosystems for long-term economic, environmental, and social sustainability, not just a planting phase.
- **Integrator support** from planning to implementation to permanent presence. Includes plan review, monitoring, reporting, verification, sustainability, and fundraising.
- **Unique laboratory testing** that determines and improves the viability of any given tree species to survive in the current and future conditions.
- **Blended capital** that incorporates investment banks, institutional banks, development funding, and donors while advancing the objectives of all. Considers project design, financial structuring, fundraising, risk mitigation, fund management, etc.
- **Technical tracking solutions** that provide intimate details on the life of the trees from planning through 50 years of growth.

Spades' suite of services is unequalled. This is a position of necessity driven by the needs of sustainability for integrated landscape restoration. Our team of global professionals has experience across the breadth of landscape zones.



Much more than a carbon project developer, Spades is a rural development integrator.

Spades solves the problems that plague regreening to unlock better deals with scale.