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Doughnut Economics: A New Arena for Forest Accounting and Payments for Ecosystem Service

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Abstract

Forests today are expected to simultaneously deliver timber, carbon storage, biodiversity conservation, water regulation, and rural livelihoods. Yet forest management and accounting systems continue to prioritize timber yield and short-term financial returns, often overlooking social well-being and ecological limits. This article explores how Doughnut Economics, proposed by Kate Raworth, can be downscaled and applied to forest landscapes to address this imbalance. By framing sustainable forest management within a "safe and just space" between a social foundation and an ecological ceiling, the doughnut model offers a holistic lens for redesigning forest accounting and decision-making. The article further highlights the role of ecosystem services as the connecting bridge between human welfare and ecosystem integrity

1. Introduction

A timber company's balance sheet is simple: hectares managed, cubic meters harvested, revenue earned, profit reported. By these numbers, a forest is successful if it produces wood efficiently and continuously. Yet, step into that same forest and a different reality emerges. It filters drinking water for nearby towns, stores carbon, shelters wildlife, stabilizes soils, moderates local temperatures, and sustains the cultures and livelihoods of forest-dependent communities—values that rarely appear in accounting systems. For centuries, forest management has been guided by one central question: how much can we cut without running out? Today, a more urgent question confronts us: how much life can forest support without being pushed beyond their limits? Forests are now expected to do the impossible—to supply timber, store carbon, conserve biodiversity, regulate water, support rural livelihoods, and withstand climate change—yet our management models still define success largely in cubic meters of wood. This mismatch lies at the heart of a growing global crisis. Across the world, forests face a dual pressure of accelerating ecological degradation and persistent unmet social

needs among forest-dependent communities, challenges that traditional timber-centered management systems were never designed to address. In effect, forests continue to be managed as production units while being expected to function as life-support systems. Increasingly, economists and ecologists argue that resolving this contradiction requires more than better inventories or improved harvesting rules; it demands a fundamental shift in how we value forests. Integrating Doughnut Economics—with its emphasis on meeting human needs within ecological limits—with Payments for Ecosystem Services offers one such pathway, providing a framework to redesign forest accounting so that it captures not only what forests produce, but also what they protect, regulate, and sustain.

2. The Doughnut: a new compass for sustainability

Doughnut Economics, proposed by economist Kate Raworth (2017), reimagines development as a space between two boundaries:

- **The social foundation** – Minimum standards for human well-being (food, income, health, education, equity, energy, security).
- **The ecological ceiling** – Environmental limits that must not be exceeded (climate change, biodiversity loss, land-use change, freshwater depletion, nutrient pollution).

Between them lies the "doughnut": a **safe and just space for humanity**.
Visually:

- The **inner ring** represents *social shortfall* (where people lack basic needs).
- The **outer ring** represents *ecological overshoot* (where nature is pushed beyond safe limits).
- The **middle zone** is the *safe and just space* where human prosperity and ecological stability coexist.

Applied to forests, this framework becomes highly practical. The ecological ceiling corresponds to what forests regulate: carbon stocks, biodiversity, hydrology, soil stability, and climate buffering (IPBES, 2019). The social foundation reflects what forests provide to people: employment, food, fuelwood, clean water, disaster protection, and cultural continuity (FAO, 2022). The goal is

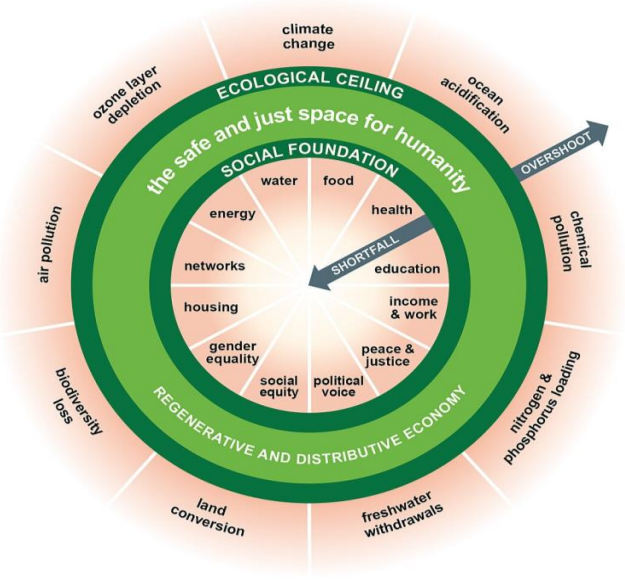

Figure 1. Conceptual framework of Doughnut Economics: social foundation, ecological ceiling, and the safe and just space

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no longer just sustainable timber yield, but sustainable life support.

3. Why downscaling matters for forests

Planetary boundaries are global, but forests are managed locally—by forest divisions, management units, community institutions, and landscape-level authorities. Decisions about harvesting, restoration, fire management, or conservation are taken at the scale of forest landscapes, not at the scale of the planet.

Downscaling Doughnut Economics allows:

- measurable local indicators,
- operational management targets, and
- integration into forest policy and accounting systems.

It transforms an abstract sustainability vision into a practical management tool.

4. Mapping the doughnut to sustainable forest management

Mapping the doughnut to sustainable forest management means translating the social foundation into indicators of forest-dependent human well-being and the ecological ceiling into measurable ecosystem limits. In practice, this approach evaluates whether forest landscapes simultaneously provide secure livelihoods, food, water, and equity while maintaining carbon stocks, biodiversity, soil health, and hydrological stability. Forest management decisions—such as harvesting intensity, restoration, or community forestry—are then guided by the goal of keeping the system within this safe and just operating space.

Table 1. Social dimensions of sustainable forest management under the Doughnut Economics framework

Doughnut dimension	Forest context
Income & work	Timber jobs, non-timber forest products (NTFPs), ecotourism
Food security	Wild foods, agroforestry
Health	Clean air, medicinal plants
Water	Watershed protection
Energy	Fuelwood and biomass
Equity	Community forest rights
Education	Indigenous knowledge, capacity building

Table 2. Ecological ceiling of sustainable forest management under the Doughnut Economics framework

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Planetary boundary	Forest indicator
Climate change	Carbon stocks, emissions
Biodiversity loss	Species richness, habitat integrity
Land-use change	Forest cover and fragmentation
Freshwater use	Streamflow and groundwater recharge
Nitrogen & phosphorus	Soil nutrient loading
Chemical pollution	Pesticide residues
Invasive species	Spread index

5. A practical downscaled doughnut model for forest landscapes

A practical downscaled doughnut model for forest landscapes operationalizes the social foundation and ecological ceiling using locally measurable indicators and thresholds. Social variables such as household income, fuelwood access, and water quality are assessed alongside ecological indicators including canopy cover, biomass, and species diversity. Management actions—ranging from harvesting regulation and restoration to community forestry and payments for ecosystem services—are then adjusted to keep the forest system within a safe and just operating space. A forest-level doughnut can be operationalized in three steps:

Step 1: Identify indicators

Social: Household income, fuelwood access, water quality, employment stability

Ecological: Canopy cover, biomass, species diversity, soil carbon

Step 2: Set thresholds

- minimum acceptable social standards
- maximum ecological pressure limits

Step 3: Guide management decisions

- adjust harvesting intensity
- prioritize restoration
- expand community forestry

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- assisted natural regeneration
- implement Payments for Ecosystem Services (PES)

This structure aligns closely with ecosystem accounting approaches such as the UN's **SEEA-EA framework** (United Nations, 2021).

6. PES: financing the doughnut

Payments for Ecosystem Services (PES) compensate land managers for maintaining ecosystem functions (Wunder, 2015).

In the doughnut framework:

For the ecological ceiling

- carbon credits (climate regulation)
- watershed protection fees
- biodiversity conservation payments

For the social foundation

- indigenous territorial stewardship payments
- community forestry revenue sharing
- agroforestry incentives

PES reverses the traditional logic: forests generate income by *standing*, not by being cleared.

7. What it looks like in the real world

7.1 Costa Rica: forests as national infrastructure

Costa Rica's PES program, launched in 1997, pays landowners for conservation, reforestation, and sustainable forest management. Funded by fuel taxes and international climate finance, it has contributed to doubling forest cover while supporting rural incomes (Pagiola, 2008).

Forests are treated as water utilities, climate regulators, and tourism assets—not just timber sources.

7.2 Nepal: community forests and social returns

Nepal's community forestry system transfers forest rights to local user groups. Income from timber, non-timber products, and carbon projects is reinvested in schools, health services, and infrastructure (Acharya et al., 2009).

Forest cover has increased while rural poverty declined—a textbook example of thickening both sides of the doughnut.

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7.3 A caution on carbon-only thinking

Carbon-focused PES schemes have sometimes promoted monoculture plantations that store carbon but undermine biodiversity and local livelihoods (Ferreira et al., 2018). The doughnut's value lies in integration: forests must satisfy **multiple ecological thresholds and social needs simultaneously**.

8. Why this shift matters now

Climate change, biodiversity loss, and water scarcity are converging crises. Forests sit at the center of all three.

A doughnut-based forest accounting system:

- improves climate finance targeting
- strengthens REDD+ credibility
- enhances forest certification standards
- guides landscape-scale restoration
- supports SDG monitoring
- justifies long-term conservation investment

Most importantly, it aligns economics with ecological reality

Policy and management relevance

A downscaled doughnut framework strengthens:

- National Forest Policy implementation
- REDD+ design and monitoring
- FSC and other certification systems
- landscape-level planning
- Sustainable Development Goals tracking
- climate adaptation strategies

The forest of the future

The future of forestry will not be judged by timber volumes alone.

It will be measured by:

- stable carbon stocks
- resilient watersheds

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- living biodiversity
- secure rural livelihoods
- cultural continuity
- and landscapes that absorb shocks rather than amplify them

One can imagine forest managers monitoring dashboards not of profits alone, but of living indicators—carbon, species, water, income—displayed as a dynamic doughnut.

That would be true wealth accounting.

9. Conclusion

Forests should no longer be managed to maximize extraction, but to remain within a safe and just ecological space where both people and nature can thrive. In an era defined by climate change, biodiversity loss, and persistent social inequalities, measuring success solely in terms of timber volumes and short-term revenue is no longer sufficient.Doughnut Economics provides the conceptual compass to navigate this transition by clearly defining the social foundations that must be met and the ecological ceilings that must not be crossed. Ecosystem services translate these boundaries into measurable benefits and limits, revealing the true, multi-dimensional value of forest landscapes. Payments for Ecosystem Services then deliver the economic incentives needed to align day-to-day management decisions with long-term sustainability goals. Together, these approaches offer a credible pathway from narrow timber accounting to forest life accounting—a system that recognizes forests not merely as sources of wood, but as vital infrastructures for climate stability, biodiversity conservation, water security, and human well-being. Such a shift is essential if forests are to remain resilient, productive, and equitable in the decades to come.

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