
Tropical Rainforest Sustainability: An Assessment of Sri Lanka

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Figure 1. Sinhala rainforest, Sri Lanka (© P. Gibert)

I. Introduction

In a seminal report, Costanza *et al.* assessed the value of ecosystem services at \$33 trillion (1997). Eight years later, the Millennium Ecosystem Assessment's clear description of the relationship between ecosystem services and human well-being (Figure 2) provided a framework for the global conversation on conservation (2005). In the popular lexicon, Google Trends shows that searches for the term "ecosystem services" have increased more than fivefold from 2004 to 2019 (Google, 2019).

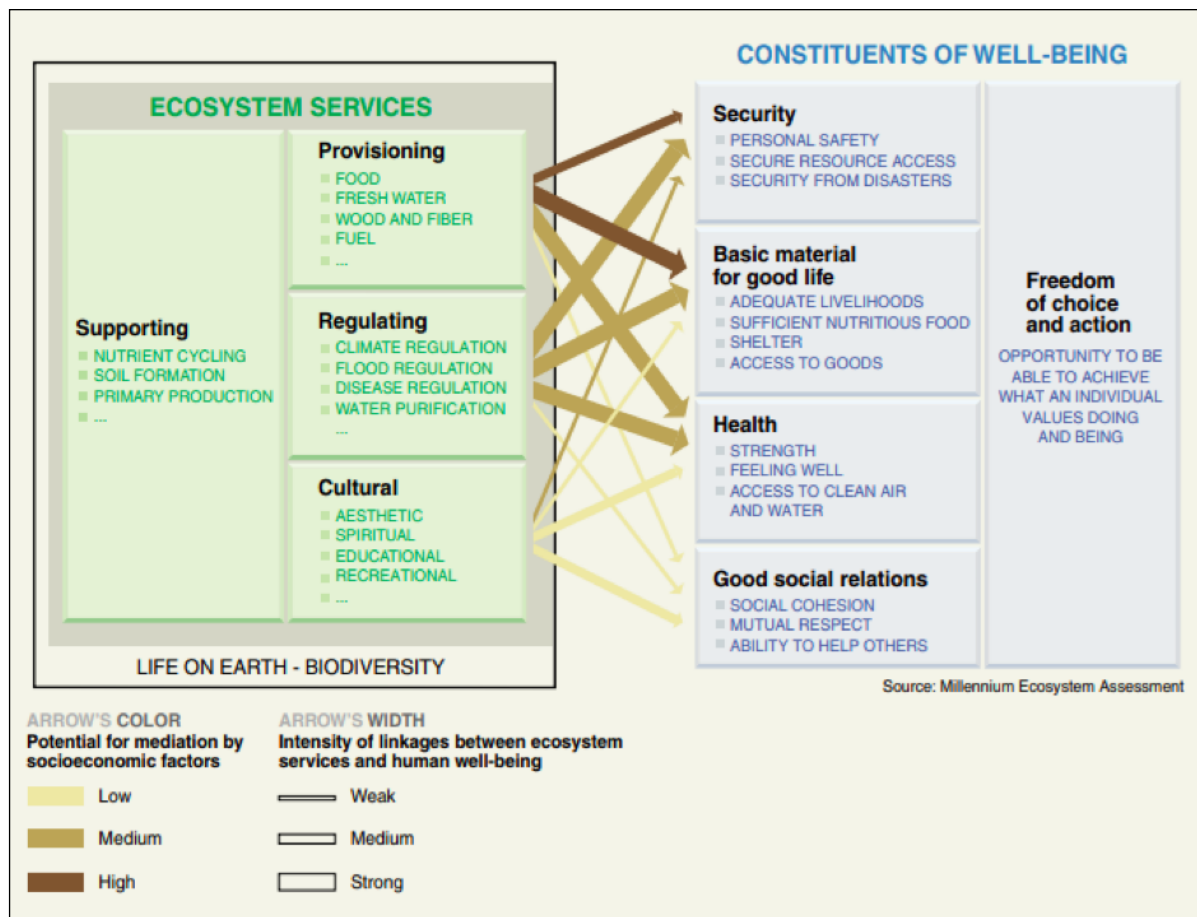


Figure 2 Ecosystem services and human well-being (Millennium Ecosystem Assessment, 2005)

Specifically, Costanza *et al.* estimated the annual value per hectare of rainforest as \$2,007 (not adjusted for inflation) (1997). This number quantifies all supporting, provisioning, regulating, and cultural services, such as timber, habitat, climate regulation, and recreation (Costanza *et al.*, 1997).

Sri Lanka is widely recognized as a biodiversity hotspot (e.g., Gunatilleke *et al.*, 2008; FAO, 2012; Kottawa-Arachchi, and Wijeratne, 2017). Forest covers about 29.7 percent of Sri Lanka's terrestrial surface area, and tropical rainforests account for 1.9 percent of that area (FAO, 2010). Sri Lanka hosts

both lowland and montane rainforests, located in the southwestern to central parts of the island (Gunatilleke *et al.*, 2008).

This assessment focuses on the southwestern lowland forests, examining their value to Sri Lanka's population, drivers of deforestation, and methods for sustainable forestry management.

II. The role of tropical rainforests in Sri Lanka

Most of Sri Lanka's lowland rainforests are severely fragmented from substantial logging in the 1970s and encroachment by villages and agriculture (Gunatilleke, Gunatilleke, and Abeygunawardana, 1993; Rodgers and Abayawardana, 2007). Two of the most significant sites for understanding tropical rainforests in Sri Lanka are Kanneliya, Dediyaigala and Nakiyadeniya, hereafter "KDN Complex," and the Sinharaja Rainforest Reserve; these areas make up the majority of and the largest contiguous rainforests in Sri Lanka (Lindstrom, 2012). Sinharaja and the KDN Complex harbor the most endemic species in the lowland forests, including a large proportion of endangered and vulnerable species (Rodgers and Abayawardana, 2007). For its biodiversity richness, Sinharaja was declared a UNESCO Man and Biosphere Reserve in 1978 and Sri Lanka's first World Heritage Site in 1988 (Gunatilleke, 1998).

The relationship between Sri Lankans and the lowland rainforests has shifted in recent decades. A 1998 survey of households surrounding the Sinharaja Rainforest Reserve revealed that families earned an average of 23.9% of income from forest resources (Gunatilleke). More recently, FAO reported the Sri Lankan reliance on non-timber forest products (NTFPs) to be much lower than in other South Asian countries (2010); the Forest Department noted a decline in NTFP extraction (2009); and with increases in tea cultivation around Sinharaja and the KDN Complex, NTFP dependence has reportedly dropped (Rodgers and Abayawardana, 2007).

Despite these socio-economic shifts, the larger importance of forest-derived ecosystem services has become more prominent and recognized (see Table 1). Notably, the government banned logging in natural forests in 1990 (Forest Department of Sri Lanka, n.d.), and aims to increase forest cover to 30 percent by 2030 (Sathurusinghe, 2017). Research reveals the results of these actions and other integrated conservation approaches: the 1976-1985 rate of forest loss was 0.49 percent, which declined to 0.13 percent in 1985–1994, and in 2005–2014, to 0.01 percent (Sudhakar Reddy *et al.*, 2017).

Table 1: Tropical rainforests in Sri Lanka: Ecosystem services

ECOSYSTEM SERVICES	TYPE OF SERVICE	NATURAL RESOURCE	BENEFIT
	Provisioning	Timber	Income, fuelwood
		Non-timber forest products (NTFPs): Rubber, kitul sap, rattan, honey, vegetables, medicinal plants	Income, medicine, connection to indigenous knowledge, food
		Potable water	Drinking water
	Regulating	Water regulation and purification	Resilience to flooding and drought; agricultural support
		Pollination	Agricultural support
		Climate regulation	Reduction of climate change effects, including extreme weather
		Carbon sequestration	Climate change mitigation
		Soil formation and soil erosion prevention	Resilience to natural disasters and extreme weather (flooding, landslides)
	Supporting	Wildlife habitat	Large-scale ecosystem functioning; aesthetic value and benefit to nature-based tourism
Nutrient cycling		Large-scale ecosystem functioning; agricultural support	
Cultural	Nature-based tourism	Income and livelihoods ¹	
	Education and tradition	Connection to indigenous knowledge; educational curriculum that perpetuates the value of the environment	

Sources: Gunatilleke, Gunatilleke, and Abeygunawardena, 1993; Bandaratilake, 2001; Forest Department of Sri Lanka, 2009; Ranasinghe and Bambaradeniya, 2012; Kottawa-Arachchi and Wijeratne 2017

III. The impacts of unsustainable forest management

Like much of South Asia in the 20th century, Sri Lanka experienced rapid population growth coupled with high rates of land use change and deforestation (Figure 3) (IUCN, 2009; FAL, 2012; Sudhakar

¹ Tourism to all recreational forest areas yielded a revenue of 6.3 million Sri Lankan rupees in 2007 (Forest Department of Sri Lanka, 2009).

Reddy *et al.*, 2017). From 1990 to 1992, the population density grew from 54 people/sq. km. to 269, while natural forest cover declined from 70 to 24 percent (IUCN, 2009).

It is relevant to address the environmental implications of the Sri Lankan Civil War. From 1983 to the 2002 ceasefire, Sri Lanka experienced a violent civil war between the independence-seeking Tamil population and the Government of Sri Lanka (Deane, 2016; Grimaa and Singh, 2019). After the ceasefire, outbreaks of conflict continued through 2009 when the government declared victory (Deane, 2016). Though deforestation rates were actually lower during the conflict (Grimaa and Singh, 2019), the instability that pervaded the country affected the government’s capacity and funds for forest management—the accumulated war cost up to 1996 is estimated at 1,135 billion Sri Lankan rupees (in 1996 prices) (Arunatilake, Jayasuriya, and Kelegama, 2001). Resettlement activity in the post-conflict era also correlated to unplanned infrastructure development and corresponding land-use changes (Fernand *et al.*, 2015).

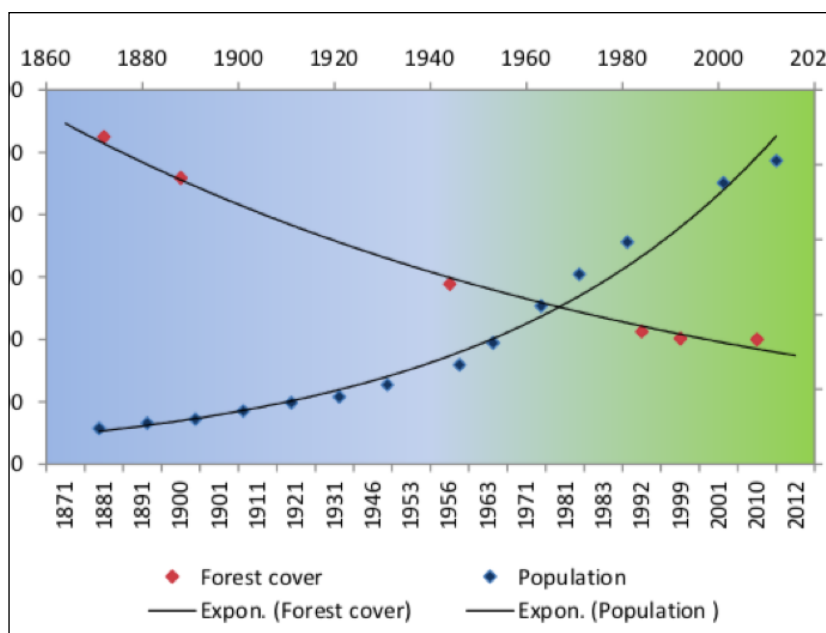


Figure 3 Forest cover and population change in Sri Lanka (Fernand *et al.*, 2015)

In addition to the war that affected the country across social, political and economic realms, a number of issues have driven deforestation and degradation in the lowland rainforests, with subsequent consequences for the ecosystem services that support people—particularly rural communities. See Table 2 for an overview of deforestation drivers and the impacts on the rainforest ecosystems and human population.

The breadth of impacts illustrates how deforestation cross-cuts issues of health, food and water security, and protection from natural disasters. Tropical deforestation is also a primary source of anthropogenic carbon dioxide emissions (Baccini, *et al.*, 2012), a threat to Sri Lanka and the global population. The assessment of Sri Lanka’s tropical rainforests also highlights the importance of healthy forests for agricultural production. Research from the Center for International Forestry Research emphasizes the critical role of forest services for agriculture, through support of watersheds, soil

Table 2: Drivers and impacts of tropical deforestation and degradation in Sri Lanka

DEFORESTATION AND DEGRADATION	INDIRECT DRIVERS	DIRECT DRIVER(S)
	<ul style="list-style-type: none"> Income disparity and poverty 	<ul style="list-style-type: none"> Unsustainable use and illegal extraction of forest resources (including timber and NTFPs)
	<ul style="list-style-type: none"> Population growth 	<ul style="list-style-type: none"> Increased resource demand Agricultural expansion, e.g., tea cultivation Community and infrastructure encroachment²
	<ul style="list-style-type: none"> Governance failings, particularly lack of community rights and decision-making 	<ul style="list-style-type: none"> Illegal felling and extraction Community and infrastructure encroachment
	<ul style="list-style-type: none"> Climate change 	<ul style="list-style-type: none"> Temperature increases Extreme weather Invasive species
IMPACTS ON THE ENVIRONMENT		IMPACTS ON PEOPLE
Provisioning		
<ul style="list-style-type: none"> Reduction of endemic species and medicinal plants Reduced habitat for pollinators and other wildlife 	<ul style="list-style-type: none"> Decreases and depletions of NTFPs and traditional medicines Reduction in crop yields and food security Unreliable water supplies 	
Supporting		
<ul style="list-style-type: none"> Decreased soil fertility Habitat fragmentation 	<ul style="list-style-type: none"> Decrease in agricultural productivity and loss of large-scale ecosystem support 	
Regulating		
<ul style="list-style-type: none"> Loss of climate regulation Loss of stored carbon and increased emissions from deforestation Loss of climate regulation Soil erosion Declines in flood control 	<ul style="list-style-type: none"> Decreased climate change mitigation Increased flooding and/or droughts Landslides Decrease in agricultural productivity Increased human-wildlife conflict Siltation and water pollution Fire hazards 	
Cultural		
<ul style="list-style-type: none"> Reduced habitat for pollinators and other wildlife 	<ul style="list-style-type: none"> Ecotourism declines Aesthetic degradation Loss of Buddhist forest hermitages 	

Sources: Bandarattillake, 2001; Bandarattillake, 2003; De Zoysa and Inoue, 2008; Global Environment Facility, 2014; Fernando *et al.*, 2015; World Bank Group, 2016; Kottawa-Arachchi and Wijeratne, 2017; Camisani, 2018

fertility, nutrient cycling, pollination, seed dispersal, and natural pest control (Sunderland *et al.*, 2013). The further reduction of Sri Lanka’s lowland rainforests would threaten agricultural productivity and

² Since 1948, researchers estimate that 809,000 ha of natural forests have been converted for agriculture or residence (Bandarattillake, 2001).

job and food security, particularly for the 48% of rural populations that work in agriculture (World Bank Group, 2010).

Though Sri Lanka's natural forests are protected from logging, other encroachments continue. Assessments of Sri Lankan socio-environmental conflicts detail multiple incidents in the southwestern lowlands, including the contested conversion of forested land into a golf resort (Camisani, 2018; Government of Sri Lanka, 2018). With increased expenditures in infrastructure and tourism (Camisani, 2018), these land conversions hold the potential for future deforestation and the resulting ecosystem service losses.

IV. Future sustainability

The widely accepted pillars of sustainability are economic prosperity, environmental quality, and social equity (see Purvis, Mao, and Robinson, 2018, for discussion). Within this framework, Sri Lankan forestry authority has failed to balance poverty alleviation and economic opportunity with natural resource protection. Poverty is a common driver of deforestation through illegal harvesting (Bandaratillake, 2001; Lindström, Mattsson, and Nissanka, 2012), and as World Bank Group data indicate, some of the largest groups of Sri Lankans living below the poverty line reside in southwestern rural areas, near tropical rainforests (Figure 4) (2017).

Sri Lanka is also the only South Asian country in which the percentage of population in urban areas has not increased since 1990 (FAO, 2012). It is therefore essential that forest policy continues to prioritize rural populations' needs and that the government works collaboratively with communities in forest management.

Rodgers and Abayawardana's analysis of an internationally-funded conservation program in Sinharaja and the KDN Complex showed success in re-establishing protected area boundaries with community input, demarcating these boundaries, and developing community conservation groups (2007). Other reviews have remarked on the value of decentralizing Sri Lankan forest management to local collaborative forest governance (e.g., Yamamoto, 2000; De Zoysa and Inoue, 2008; Lindström, Mattsson, and Nissanka, 2012; Global Environment Facility, 2014). Based on these studies and

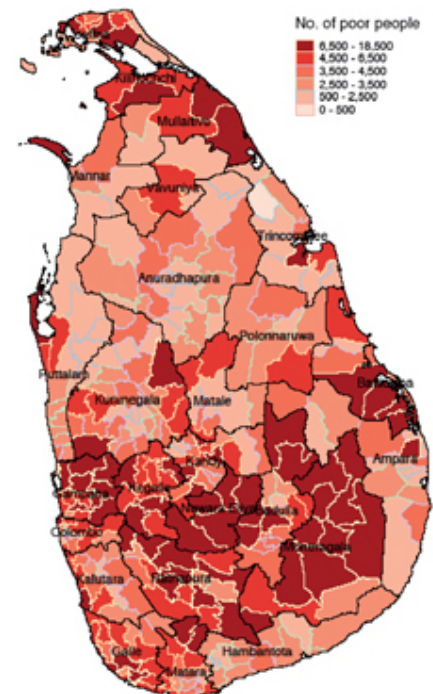


Figure 4 Poverty in Sri Lanka (World Bank, 2017)

others, Table 3 outlines the most viable options for balanced sustainable development in Sri Lanka.

Table 3: Sustainable management options for tropical rainforests in Sri Lanka

SUSTAINABLE MANAGEMENT	APPROACH	EXAMPLE ACTIVITIES	POTENTIAL OUTCOME(S)
	Buffer zone community development focusing on conservation and livelihood issues	<ul style="list-style-type: none"> • Access to loans to build alternative livelihoods, e.g., ecotourism, forest management, small businesses • Trainings in alternative skills • Conservation awareness and education programs 	<ul style="list-style-type: none"> • Greater range of income sources and community understanding of rainforest benefits
	Systems for integrating community involvement in decision-making	<ul style="list-style-type: none"> • Village conservation societies 	<ul style="list-style-type: none"> • Community invests in and takes ownership of surrounding rainforests
	Sustainable use of NTFPs	<ul style="list-style-type: none"> • Legal recognition of indigenous/cultural rights to limited extraction • Training in sustainable extraction 	<ul style="list-style-type: none"> • Limited and sustainable extraction
	Improved protection illicit felling and extraction	<ul style="list-style-type: none"> • Investment in other sustainable activities to shift focus from necessary forest <i>protection</i> to better forest <i>management</i> 	<ul style="list-style-type: none"> • With alternative livelihoods, secure land tenure, etc., communities will be disincentivized to illegally extract from rainforests
	Improved agroforestry	<ul style="list-style-type: none"> • Trainings and investments in improved agroforestry techniques for both large-scale agriculture and home gardens³ 	<ul style="list-style-type: none"> • Reduced pressure on rainforests as agricultural income increases and home gardens provide “substitute” forest products
Reforestation	<ul style="list-style-type: none"> • In selected areas, institute assisted natural regeneration, seeding, and planting 	<ul style="list-style-type: none"> • Reduced affects of deforestation • Improvements to agricultural activity • Protection from natural hazards 	

Sources: Bandarattillake, 2003; Yamamoto, 2000; Rodgers and Abayawardana, 2007; De Zoysa and Inoue, 2008; IUCN, 2009; Fernando *et al.*, 2015

V. Discussion

After three decades of civil conflict and the devastating 2004 tsunami, Sri Lanka has made remarkable achievements in economic growth and poverty alleviation: The national poverty headcount dropped

³ Home gardens are increasing in Sri Lanka, in both number and total area, and account for almost half of wood production (FAO, 2012).

from 15.3 percent near the end of the civil war to 4.1 percent in 2016, and economic growth averaged 5.8 percent from 2010 to 2017 (World Bank Group, 2019).

However, this economic growth has not yet translated into positive outcomes across the country. Income disparity has increased since 2009 so the majority rural population is facing even larger development distances from the urban middle classes (World Bank Group, 2016). Simultaneously, climate change is increasing the frequency and severity of natural disasters, costing Sri Lanka about \$380 million annually and disproportionately affecting the poorer rural populations (World Bank Group, 2016).

Across its forested ecosystems, from the lowland rainforests to the coastal mangroves and the dry evergreen forests, Sri Lanka has the opportunity to mitigate climate change, secure income opportunities for rural communities, and protect the country from future natural hazards. Sustainable forestry management holds the opportunity achieve many widespread goals and to advance Sri Lanka into a new era of peaceful and equitable development.

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