



Review and synthesis

Forest Resources Assessment of 2015 shows positive global trends but forest loss and degradation persist in poor tropical countries [☆]Sean Sloan ^{*}, Jeffrey A. Sayer

Centre for Tropical Environmental and Sustainability Science, College of Marine and Environmental Science, James Cook University, P.O. Box 6811, Cairns, Qld 4870, Australia

ARTICLE INFO

Article history:

Received 16 March 2015

Received in revised form 7 June 2015

Accepted 8 June 2015

Available online 7 September 2015

Keywords:

Global forest trends

Forest transitions

Sustainable forest management

Plantation forests

Planted forests

Forest pests and diseases

Canopy cover reduction

ABSTRACT

The Global Forest Resources Assessment 2015 shows that deforestation has slowed and afforestation has increased globally during 1990–2015. Planted forests have increasingly provided goods and services hitherto derived from natural forests, and mosaic forests in agricultural landscapes are increasing. Forest gain is occurring at higher latitudes and in richer countries whilst forest loss continues in poor countries in the tropics. Some middle income tropical countries are now also transitioning to forest gain. These transition countries are characterised by reforms to forest management and improvements in agricultural practices but also by significant expansions of planted forest, which account for ~25–100% of gains. Forest-area estimates of the FRA align with satellite-derived estimates, with deviations of $\leq \pm 7\%$ globally and $\leq \pm 17\%$ for the tropics. Mosaics comprised of trees outside forests, remnant forest patches, and young regenerating forests constitute a modest proportion of the tropical forest estate and are seemingly well inventoried by the FRA. Extensive areas of forest experienced partial canopy cover reduction since 2000, particularly in the tropics where their area is ~6.5 times that deforested since 1990. The likelihood of the eventual loss of these forests and a decline in their capacity to provide goods and services is a matter of concern. Demand for industrial wood and fuelwood increased 35% in the tropics since 1990, principally in poorer countries, and growth in demand will accelerate into the future, particularly in the Asia-Pacific region. Notwithstanding significant increases in forests within protected areas since 1990 to 517 Mha (16.3%) globally and 379 Mha (26.6%) in the tropics, increasing demands for ecological services, forest products, and climate change mitigation is likely to be met from an expanding area of planted forests more than from the declining area of natural forests, particularly in Africa. The global rate of planted-forest expansion since 1990 is close to a target rate of 2.4% per annum necessary to replace wood supplied from natural forests in the medium term, though the expansion rate has declined to 1.5% since 2005. Multiple-use forests permitting both production and conservation account for 26% of the global forest area and 17% of the tropical forest area, and have increased by 81.8 Mha or 8.5% globally since 1990, with most gains in the tropics. Sustainable forest management in low-income and tropical countries remains modest, with only 37% low-income country forests covered by forest inventories. International support has proven effective at increasing this coverage since 2010.

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[☆] This article is part of a special issue entitled “Changes in Global Forest Resources from 1990 to 2015”.

^{*} Corresponding author.

E-mail address: sean.sloan@jcu.edu.au (S. Sloan).

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1. Introduction

The Global Forest Resources Assessment (FRA) of the Food and Agricultural Organization of the United Nations (FAO) has undertaken global assessments of forest area, characteristics, and production every 5–10 years since 1948 (MacDicken, 2015). More so than previous FRAs, the FRA of 2015 paints a broadly positive picture of the state of the world's forests. Whilst there are many reasons to be optimistic about the future of forests, there remain major areas of concern as stark regional variations belie the apparent progress at the global scale.

The global rate of forest loss has decreased since 2010 to 3.3 million hectares (Mha) or 0.08% annually, being half the rate in the 1990s. Forests are stable or expanding in temperate and boreal regions, and the rate of deforestation in the tropics is slowing (Keenan et al., 2015). Similarly, rates of afforestation are steady or rising not just in temperate countries, where planted forests have long been integral elements of the forest estate, but also in the tropics where the extent of planted forests has nearly doubled since 1990 (Payn et al., 2015). Forest inventories and management plans now exist in more countries than ever and local stakeholders are increasingly engaged in managing and owning forests (MacDicken et al., 2015). International processes that seek to build a global consensus regarding multi-functional forest management are moving slowly towards agreement, as reflected in steady progress in national planning and commitments (MacDicken et al., 2015). The importance of maintaining forest area as part of the portfolio of measures to address climate change is also increasingly recognised (Federici et al., 2015), and we are inching towards commitments to fund measures to reduce deforestation and forest degradation (REDD+), with the United Nations REDD program now supporting forest monitoring initiatives in 58 countries.

Notwithstanding this progress, forest conversion for agriculture, especially for estate crops, remain significant in many, mainly poorer, tropical regions. Partial canopy cover reduction is extensive in many tropical countries and may lead to eventual forest loss (Van Lierop and Lindquist, 2015). Whilst forest diseases and pests are reported at significant scales only in richer high latitude countries (Van Lierop and Lindquist, 2015: Table 6), they are likely also a growing and under-appreciated threat to forests in poorer tropical countries. Even where forest areas are stable, as in Central Africa, forest wildlife is being lost at historically high rates (Butchart et al., 2010). In South America forest conversion is slowing, land use change is increasingly regulated, and protected-areas systems are expanding. Notwithstanding this, South America continues to experience the greatest losses of forest by far (Keenan et al., 2015). In many African countries forest management institutions remain weak (Romijn et al., 2015), leaving forests highly vulnerable to clearance and degradation (Keenan et al., 2015). In the Congo Basin low levels of forest conversion largely reflect ongoing conflict and a related lack of investment and infrastructure, rather than good management (de Wasseige et al., 2010). In South Asia stronger forest institutions are conserving the modest remaining areas of forest and encouraging the expansion of plantations, but total forest area is now critically low in many countries (Pandit et al., 2007; Sloan et al., 2014). In South East Asia forest conversion remains high as forest departments and corporate investors alike respond to global demand for estate crops such as oil palm, sugar, and wood fibre. Disparities in power over land resources is an issue

in all regions as increasing influence is concentrated in the hands of the rich (Piketty and Goldhammer, 2014) and the interests of hopefully more conservation-minded local communities are marginalised.

Massive infrastructure investments are planned for many tropical regions and will soon open most of the world's remaining remote and pristine forests to commercial interests seeking land for estate crops, including industrial forest plantations (Weng et al., 2013; Edwards et al., 2014; Laurance et al., 2014a). The effects of such investment on forests are difficult to anticipate and have arguably not been fully accounted for in national economic and forest management strategies (Edwards et al., 2014). Agricultural expansion along new and improved roadways may concentrate populations and enable agricultural transformation and intensification; where this occurs in agriculturally favourable areas a depopulation of hinterlands may reduce pressures on forests (Angelsen and Rudel, 2013; Masters et al., 2013; Rudel, 2013). In countries with weak governance, new infrastructure may pave the way for opportunistic land development, with negative consequences for forests and the people dependent on them (Laurance et al., 2014b). Whereas infrastructure development would ideally be directed towards regions with high agricultural potential and little forest cover, the contrary is often the case when infrastructure expansion targets mineral resources or estate crops and, to a lesser degree, industrial timber plantations (Gutiérrez-Vélez et al., 2011; Durán et al., 2013; Weng et al., 2013; Gaveau et al., 2014). New mineral infrastructure poses significant threats to the major tropical forests in the Amazon and Congo Basins as well as the islands of Borneo and New Guinea – collectively accounting for most of the world's intact tropical forests. For the first time, the 2015 FRA gathered data on forest areas earmarked for conversion and official targets for total forest area by 2020 and 2030. Most of the countries surveyed and all climatic domains (tropical, subtropical, temperate, boreal, polar) anticipate *greater* forest areas¹ by 2030 than today. Such increases in forest area will have to be achieved in a world in which agriculture will pose a significant competing demand for land (Sayer and Cassman, 2013; Laurance et al., 2014b).

The dynamics of forest change have shifted over the 25-year period surveyed by the 2015 FRA and will continue shifting in the near term. In the tropics, where most forest change has occurred, deforestation due to smallholder agricultural expansion has given way to large-scale, enterprise-driven forest conversion (Hecht, 2005; Rudel, 2007; Asner et al., 2013). Rates of forest loss have declined, but the increasingly globalised pressures on forest lands pose significant new challenges to maintaining these declines (Lambin and Meyfroidt, 2011). In this context we integrate the analyses presented in this special issue of *Forest Ecology and Management* to assess the significance of the major trends in forest change reported by the 2015 FRA for 1990–2015. Special attention is given to the tropics, where the environmental stakes are highest and forests are still declining rapidly.

This article is structured as follows. The following section considers the FRA forest estimates in light of newly available satellite estimates and an increasing extent of dispersed mosaic forests. Section 3 summarises global patterns of forest loss and gain and

¹ 'Forest area' here adheres to the FRA definition encompassing both natural and planted forests.

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