Deforestation

One of the most notable processes by which humankind has affected the Earth's surface is via the conversion of forested land for agriculture, logging, and urbanization, that is, deforestation. Up through the latter decades of the 20th century, deforestation had accelerated and come to be almost totally concentrated in the tropics, almost wholly within developing countries. In the 1990s, the extent of old-growth forests was approximately one fifth of their original cover.

Estimates of land use change over the 20th century (the lion's share of which was concentrated in its last four decades) are crude, but research suggests that though Asia and Africa had a slightly greater percentage of their forests cleared (34% to 38%) compared with Latin America (approximately 28%), a far greater absolute amount was cleared in Latin America due to the vastness of the Amazon basin. A continuation of those rates would mean the end of tropical forests within 50 years and therefore the elimination of an area prized as a repository of biodiversity.

More recent estimates of global deforestation rates reveal that while the conversion of forest to agricultural land continues at the alarming rate of roughly 13 million ha/yr. (hectares per year), countervailing forces of afforestation (the conversion of open land into forest) via planting and natural expansion have significantly reduced the net loss of forested area. From 2000 to 2005, there was an estimated net decrease of 7.3 million ha/yr., a rate substantially lower than the average 8.9 million ha decrease per year between 1990 and 2000. During the 2000 to 2005 period, while the largest net forest losses occurred in Africa and South America, net forest loss also took place in Oceania and North and Central America. During the same period, Asia reported a net gain, primarily because of reported afforestation in China, despite the fact that Indonesia had one of the world's highest forest-clearing rates, though exact rates are contentious. Of all forested areas, primary forest constitutes 36%. Each year 6 million ha of primary forest are lost or modified, continuing trends reported in the 1990s. Although the trend in primary forest was toward a net loss, a few European countries and Japan reported gains in primary forest.

Forest-clearing "hotspots" in the humid tropical forest biome are revealed by the fact that 55% of the clearing occurs in 6% of the biome's total area and is largely confined to the current agro-industrial clearing centers of South America and insular southeast Asia. The next level of intensity of clearing, constituting 40% of the clearing within the biome, is dispersed over 44% of the land area. The remaining 5% of clearing takes place within the predominately intact forest, which makes up 35% of the biome area, and within the 15% of the biome area that had already been substantially deforested prior to 2000. In this period, Brazil and Indonesia stand out as centers of humid tropical forest loss, with Brazil constituting 47.8% of all clearing and Indonesia another 12.8%. Other Latin America hotspots include Northern Guatemala, Eastern Bolivia, and Eastern Paraguay, with the Asian countries of Malaysia and Cambodia, particularly along the Thai border, having exceptional clearing rates. Africa's humid tropical forest loss is primarily through low-intensity selective logging, without the agro-industrial-scale clearing seen elsewhere. The loss of humid tropical forest in Africa, therefore, constitutes a much less substantial portion of the loss of this biome, at 5.4% of the worldwide loss within this biome between 2000 and 2005.

Explanatory Frameworks

Attempts to explicate deforestation outcomes have moved beyond simple Malthusian assumptions in an attempt to capture the dynamic and complex multiscaled causal mechanisms, often framing causation in a host of proximate and underlying causes to land use and land cover change. The tropical deforestation literature seeking to categorize proximate causes has highlighted three essential types: agricultural expansion, timber extraction, and infrastructure development. The underlying causes have more often identified demographic, socioeconomic, technological, political-economic, and environmental factors.

Within geography, deforestation has been examined from a variety of perspectives, from a more purely land cover standpoint seeking improved methods of measuring its extent and rates of change across different locations to human-environment research seeking to characterize the drivers of deforestation. One of the challenges of addressing deforestation is having accurate measures of the extent, intensity, and pattern of the deforestation. Thus, many of the tools that fall within the domain of geography, such as remote sensing and geographic information science, seek improved methods for characterizing the changes in this land cover in space and time.
Logging and slash-and-burn agriculture have led to extensive deforestation in Eastern Chiapas, Mexico, which is home to the Lacandon Maya.

Source: Jami Dwyer.

A recent academic framework attempting to incorporate both agency and structure for explicating land change, often via the case study, is land change science (LCS), which serves as a foundational element in the study of global environmental change and sustainability science. The focus on the individual or the “agent” of change arises from the cultural ecology and risk hazards traditions, which have focused on the behavior of local agents. Structural explanations arise from the political ecology and vulnerability traditions. While in the past each perspective has often been employed at the exclusion of the others, more recent approaches have sought to incorporate both perspectives.

**Causes**

The most common proximate cause of forest clearing on the planet is the expansion of small farms along forest frontiers, followed in importance by in situ agriculture and livestock expansion, timber harvesting for fuel and construction, and the expansion of infrastructure. Road building for the last two activities often precedes expansion into the external frontier, while the in situ agriculture and pasture expansion often follows it. These proximate, immediate causes most often have at their root demographic, political, economic, and environmental processes.

While population and demographic dynamics are invoked in the great majority of deforestation case studies, they are never the only causes but instead correspond to other proximate and underlying drivers, such as socioeconomic, technological, and ecological conditions. In the early stages of development, for example, impacts on the forest are low and then accelerate during development, followed again by lower forest impacts. From a political perspective, wealthier and more democratic countries are more likely to have stable or expanding forests when compared with poor and despotic countries, which tend to experience rapid forest loss.

Much research on tropical deforestation has focused on Latin America, which is home to the greatest area of closed tropical forests in the world. In this context, small-farmer agricultural expansion along forest frontiers is the primary proximate cause of forest clearing, and examples of rapid forest conversion following colonization are abundant in
the literature. Satellite imagery has illustrated particularly high rates of clearing adjacent to new roads. Road building, therefore, is a prerequisite to frontier deforestation, pointing toward corporate and state policies, which promote access to certain regions for economic or geopolitical motives. These rural frontier environments are characterized by their remoteness, abundant but often insecure resource access, and scarcity of labor. This farming technique often leads to the depletion of soil nutrients from the thin, oxidized tropical soils in 2 to 4 years’ time, leading to farm abandonment on completion of a swidden farming cycle, followed by the consolidation of lands in the hand of rural elites, who often convert the land to cattle pasture. The poor then often leave to go to the next forest frontier, beginning this deforestation cycle anew. An often overlooked point in the literature is that demographic, ecological, and political-economic drivers elsewhere spur migration to the frontier and thus serve as a necessary underlying cause of frontier agricultural expansion.

While much frontier deforestation has, at least as the proximate cause, been at the hands of small subsistence farmers, a recent trend in the expansion of large-scale mechanized agriculture into frontier-forested areas has introduced an alternate pathway to deforestation. Frontier areas of the Amazon, for example, have seen a rapid rise in the establishment of industrial-scale plantings of crops such as soybeans, though these plantings are still dwarfed in areal extent by more traditional frontier uses of small-scale agriculture and pasture. The Brazilian state of Mato Grosso, for example, saw a trend in the rise of large-scale deforestation events for the establishment of industrialized soybean farms from 2001 to 2004, often in direct relation to the price of soy in global markets. Given the current trends of soy farmers in the developed world converting to cropping maize to meet the production demands for biofuels, the forest frontiers of the developing world are increasingly vulnerable to this industrial cropping.

Unlike in Latin America, a greater proportion of deforestation in Africa derives not from colonization along the agricultural frontier but from the expansion of sedentary intensive agriculture and fuelwood harvesting. Wood fuel demands have a great impact on deforestation in Africa, perhaps more than farm expansion, though this is not always the case in countries with significant remaining tracts of forest. In the humid forests of Central Africa, logging concessions have become the most extensive form of land use in the area, making up 30% of the area, and, even though selective, alter the ecosystem and increase depredation in affected areas.

In Asia, the principle factors in deforestation have been commercial logging and the continued migration of peasants into formerly remote areas on roads established by loggers. As in all world regions, scale-dependent relationships representing social, biophysical, and geographical factors interact dynamically. Results from a case study in Thailand indicate the importance of population factors at finer scales and biophysical factors at coarser scales for explaining the variation in plant biomass levels.

Impacts

Even though deforestation is largely limited to within the tropics, its impacts are global, affecting global biogeochemical cycles and hydrological flows and threatening to aggravate climate change at both the local and global levels. The geographic literature has placed an emphasis on highlighting the spatial variation of the environmental impacts of each of these processes, such as the disproportionate warming of the tropical and subtropical climates from forest clearing. Similarly, geographic research has shown not just the total forest area lost but also that the patterning of deforestation has profound implications for the physical landscape, with forest fragmentation leading to the inhibition of forest regrowth and biodiversity loss and compromising the integrity of ecosystems.

Geographers also play a lead role in the understanding of how deforestation affects the biological integrity of tropical ecosystems. Despite the fact that this biome covers only 7% of Earth's terrestrial surface, virtually all the recent species extinctions occurring in recent years have taken place in it, causing damage to Earth's biological gene pool, a potential treasure trove for science, medicine, and food advancements.

A disproportionate number of global species extinctions are concentrated in those places set up to protect them, such as national parks and ecological reserves. The amount of land under legal protection has increased at an exponential rate, and by 2005, 17.1 million square kilometers of total land across more than 100,000 protected areas had been established, constituting 11.5% of the planet's terrestrial surface. As governments expand the area of wild lands under protection and as little unclaimed forest remains outside these areas, protected areas represent an increasingly large proportion of unoccupied land available to migrant farm households.

Conclusion

The study of deforestation is quintessential geography. Given the enormity of the process to humans and the environment, geographers stand to make an ever-greater contribution, being strategically positioned to pioneer future research endeavors by pressing the discipline's comparative advantage of linking human-environment interactions at diverse spatial scales. Future efforts within geography include increasing the efficiency and accuracy of monitoring via remote sensing. And given the emphasis on the case study within land change science, developing further methods of comparability between case examples will likely increase in importance.
Further Readings


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