Geographer’s Contribution to Research on Tropical Deforestation

Land Minds: 100 Geographic Solutions to Saving Planet Earth
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As the global crisis deepens, deforestation...cries out for the geographer's attention...Human manipulation of the plant cover, especially through agricultural clearing...is the most evident of all human relationships with the physical earth and is thus central to cultural geography (Parsons 1994).

Introduction

The long history of deforestation represents the most expansive footprint of human habitation of the earth’s surface. The planet’s intact forests have dwindled to approximately one-fifth of the their original cover (See figure 1. World Resources Institute, 2002). During recent decades deforestation has accelerated and is now almost totally concentrated in the tropics. While not one developed nation had a positive rate of deforestation during the 1990s, only India and Vietnam (with a reforestation rate of 0.1% and 0.5% respectively), experienced net forested area growth among tropical nations with substantial humid forests (FAO 2001). If tropical deforestation rates continue as during the last decade, most biologically rich forests on the planet will be erased within fifty years.

Estimates of land-use change over the last few millennia are crude, but research suggests that approximately 50% of the area of tropical forests has been removed by human influence in Africa and 40% in Latin America and Asia (CSAEHT 1993). Lower estimates of world tropical deforestation are in the 20-30% range. As forests have dwindled worldwide, deforestation rates have accelerated (approximately 40% from the mid-1980s to the mid-1990s). A slightly greater percentage of forests were cleared in Asia and Africa (34-38%) than in Latin America (approximately 28%) during the last century, though a far greater absolute amount was cleared in Latin America due to the vastness of the Amazon basin. The lion’s share of this deforestation has occurred during the century's last four decades.

Understanding human-environment dynamics has increasingly been recognized as a priority of global environmental change research (Turner II and Meyer 1994; Geist and Lambdin 2001). How have geographers furthered our understanding of the spatial and temporal dimensions of the complex suite of factors underlying tropical deforestation?

Information presented in this chapter comes from research by geographers on tropical deforestation conducted since 1990. Hundreds of geographers deserve mention for their research on this topic, but page and bibliographic constraints disallow but a brief overview of major trends in (mainly anglophone) geographical work on the topic.

Frameworks

The great diversity of human systems of forest change inscribe widely varied patterns across regions and nations. Our understanding has moved beyond simple Malthusian assumptions to dynamic and complex multi-scaled causal mechanisms.
Recent frameworks consider a host of proximate and underlying causes to land use and land cover change (e.g. Turner II, Moss et al. 1993; Geist and Lambdin 2001). From the research on tropical deforestation explicitly categorizing proximate causes, three essential types of land use emerge: agricultural expansion, timber extraction, and infrastructure development. Literature on the underlying causes of deforestation typically identifies the following broad types of factors: demographic, socio-economic, technological, political-economic, and environmental factors.

**Impacts of deforestation**

Deforestation may be largely confined to the tropics but its impacts are global. Tropical forest conversion influences global biogeochemical cycles, hydrological flows, and soil degradation. Tropical forest conversion also threatens to exacerbate climate change at local and global scales. The geographic literature has highlighted the spatial variation in the environmental impacts of each of these processes. Geographers have helped us understand that forest clearing is likely to warm the surface climate predominantly in the tropics and subtropics. Geographers have also been significant contributors to the notion that not just the total amount but patterns of forest clearing distinctly impact physical landscapes. For example, geographical research has noted how forest fragmentation can inhibit forest re-growth, decrease biodiversity, and threaten the integrity of ecological systems. Temporal scales are also important. Geographers have shown, for example, how inter-annual land-cover changes can be considerably more notable than long-term change in some regions.

Geographers have also investigated how forest conversion threatens the rich biological integrity of tropical ecosystems. In recent years, virtually all species extinctions have occurred in this biome covering only 7% of the earth's terrestrial surface. Species elimination irreparably damages the planet's biological gene pool, invaluable for the advancements of science, medicine, and food production.

A disproportionate number of global species extinctions are concentrated in those places set up to protect them, such as national parks and ecological reserves. As governments expand the area of wildlands under protection, and as little unclaimed forest remains outside of these areas, protected areas represent an increasingly large proportion of unoccupied land available to migrant farm households.

**Causes**

A burgeoning literature has identified a host of causes thought to be driving tropical deforestation. As mentioned above, it is increasingly evident that a concatenation of variables interact across spatial and temporal scales. Small farmer agricultural expansion along forest frontiers is probably the primary proximate cause of forest clearing on the planet—followed by in situ agriculture and pasture expansion, timber felling for fuel and construction, and infrastructure expansion. The latter two processes often antecede frontier expansion; the former two often follow it. Underlying these proximate causes are demographic, political, economic, and environmental processes.

Some geographers have estimated that population explains half or more of the variation in worldwide deforestation patterns and that the great majority of cases involve demographic dynamics at some level. However, population is never the sole cause but
interacts with other proximate and underlying factors. Socio-economic, technological, and ecological conditions all play key roles. It has been observed, for example, that forest impacts are low in the early phase of development, accelerate during development, and again are reduced at later development stages when primary resource extraction is moved to a new developing region. Politically, the wealthiest and most democratic countries usually enjoy stable or expanding forests, while poor and despotic countries tend to experience rapid forest loss.

Much of the research on tropical deforestation by geographers has been conducted in Latin America. The region harbors the greatest area of closed tropical forests in the world and over half of all fresh water on the Earth. Small farmer agricultural expansion along forest frontiers has been the primary proximate cause forest clearing in Latin America. Examples of rapid forest conversion following colonization are abundant in the literature and satellite imagery has illustrated particularly high rates of clearing adjacent to roads. In these environments of abundant (but often insecure) resource access and scarce labor, most forms of agricultural intensification represent an unnecessary labor burden, are uneconomical, inefficient, or too risky for small, semi-subsistence producers, leading to an extensive swidden land use pattern. Soil nutrients are depleted in oxidized tropical soils in a matter of two to four years, encouraging farm abandonment once the swidden cycle is complete. Over time farms are consolidated in the hands of rural elites, who take advantage of the cleared soil degraded abandoned farms for raising cattle, spurring exodus among the poor, often to a subsequent forest frontier where the deforestation cycle begin anew. An important point that is relatively neglected in the literature, is that demographic, ecological, and political-economic pressures elsewhere foments migration to the frontier, and this migration process is a necessary antecedent to frontier forest clearing. Another prerequisite to frontier deforestation is road building resulting from corporate and state policies favoring certain regions for economic or geopolitical reasons.

Contrary to Latin America, in Africa, a greater proportion of deforestation has come from the expansion of sedentary, intensive (non-frontier) agricultural expansion and timber harvesting. International trade has brought indebtedness, maintaining pressures to produce for export, and promoted increased agricultural expansion and timber extraction. High rural population densities depending on scarce woodland for fuel has also been a major driver. In Asia, despite a rapid fertility transition in many Asian countries, notable deforestation continued through the 1990s due to increasing demands on the regions' tropical timber resources and the continued migration of peasants into formerly remote areas on logging roads by swidden rice farmers. Today, in some of the smaller southeast Asian nations, such as Malaysia, deforestation has claimed virtually all but a handful of forest reserves.

Conclusion

Geographers have contributed a formidable corpus of research on tropical deforestation. But given the enormity of the phenomenon to human and environmental systems, geographers can do much more. Research from practitioners in our field represents only about a fifth of all research on the topic. Yet geographers are strategically positioned to lead the way in future research endeavors. Our understanding of the processes of deforestation are still inchoate; indeed even estimates of current
tropical forest cover remain notoriously unreliable. Geographers are exceptionally equipped to advance both of these important research frontiers. The multidisciplinary strengths of geographers are featured in the widely diverse research methods on the topic, including remote sensing, GIS, ecosystem processes modeling, surveys and interviews, participant observation, and stakeholder analyses. Tropical deforestation is quintessentially geographical. Forest clearing represents the most salient mark of the human ecological footprint on the earth’s surface and is inherently linked to place and space. When it comes to research on the causes and consequences of tropical deforestation—to echo UN Secretary General, Kofi Annan—“the great adventure of geographic exploration is far from over (Annan, 2001).”

Figure 1.

![Frontier Forests](image)


