Fearnside, P.M. 2015. Highway construction as a force in destruction of the Amazon forest. pp. 414-424 In: R. van der Ree, D.J. Smith & C. Grilo (eds.) *Handbook of Road Ecology*. John Wiley & Sons Publishers, Oxford, UK. 552 pp.

ISBN: 978-1-118-56818-7

Chapter 51

HIGHWAY CONSTRUCTION AS A FORCE IN THE DESTRUCTION OF THE AMAZON FOREST

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SUMMARY

Roads act as drivers of deforestation by drawing migrant workers and investment to previously inaccessible areas of forest. In Amazonia, deforestation is stimulated not only by roads that increase profitability of agriculture and ranching, but also by the effect of roads on land speculation and clearing for establishing and defending land tenure. Major highways are accompanied by networks of side roads built by loggers, miners and others. Deforestation spreads outwards from highways and their associated access roads. Highways also provide avenues for migration of landless farmers and others, thereby driving deforestation into adjacent areas.

51.1 Roads are important forces influencing the rate of deforestation in Amazonia.
51.2 Major roads stimulate deforestation by facilitating the construction of smaller side roads and human settlements in remote areas.
51.3 The alleged benefits of roads to the Amazon forest are illusory.
51.4 Roads must be included in deforestation models.
51.5 No amount of mitigation will prevent deforestation from occurring after a road is built.
51.6 Deforestation in Brazil is unregulated and future road projects will accelerate clearing.
51.7 'Governance scenarios' serve to justify approval of damaging roads.
51.8 Environmental safeguards are needed for approval of international financing of road development.

The consequences of the pattern of development associated with previously constructed Amazonian highways need to be recognised and lessons learned quickly, as plans for additional highways are rapidly moving forwards that would provide deforesters with access to much of the remaining area of Amazonian forest.

Handbook of Road Ecology, First Edition. Edited by Rodney van der Ree, Daniel J. Smith and Clara Grilo.

Companion website: www.wiley.com\go\vanderree\roadecology

INTRODUCTION

The Amazon forest is by far the largest area of tropical rainforest in the world. About two thirds of the forest is in Brazil, the remainder being divided between Bolivia, Peru, Ecuador and Colombia. The Brazilian portion of the forest originally covered an area roughly the size of Western Europe. By 1995, an area the size of France had been cleared, and by 2012, areas equivalent to Portugal, Belgium and the Netherlands had been added to this. Approximately 80% of Brazil's portion of the Amazon forest remains, although logging and fire have disturbed a significant part of this. The size of the remaining forest is misleading; its vastness creates the illusion that there are no limits. However, the process of deforestation is cumulative and can rapidly advance through immense areas. The remaining blocks of relatively undisturbed forest owe their current state of preservation mainly to lack of access, especially the lack of roads. The Amazon forest provides environmental services such as conserving biodiversity, water cycling that provides rainfall to central and southern Brazil and to neighbouring countries and maintaining carbon stocks in biomass and soil that avoid greenhouse gas emissions. These services are lost when forests are cleared. Decisions on road construction and improvement have consequences for deforestation that last for decades and extend far beyond the roads themselves. Understanding the consequences of these decisions and the process of deforestation is essential to better decision-making about roads in the Amazon Basin and in many other tropical forest areas.

LESSONS

51.1 Roads are important forces influencing the rate of deforestation in Amazonia

The presence and quality of roads have been shown to be major factors in predicting deforestation throughout the Amazon Basin, including Brazil (e.g. Nepstad et al. 2001; Laurance et al. 2002; Soares-Filho et al. 2006; Pfaff et al. 2007), Bolivia (Kaimowitz 1997), Peru (Imbernon 1999) and Ecuador (Southgate et al. 1991; Mena et al. 2006). Understanding why roads lead to more deforestation is essential information both for designing ways to control clearing and for better decision-making about road construction.

Roads play multiple roles in faci litating deforestation. Roads improve the profitability of ranching and agriculture, thereby attracting investment in clearing. Roads also improve access to timber, unleashing a chain of events that spreads deforestation by providing money for clearing and facilitating entry of migrant workers along logging tracks. These clandestine roads, built primarily for logging, amount to tens of thousands of kilometres. Roads in forest areas attract migrants, forming part of a positive feedback loop justifying still more roads (Fearnside 1987a). Roads also provoke population turnover, replacing small individual farms with more capitalised landholders who deforest more. Roads increase land values in the areas near them, which in turn increases speculation and deforestation in order to establish and maintain land tenure (Fearnside 1987a). These effects evolve over time, with the ultimate result of a largely deforested landscape, usually dominated by cattle pasture in medium- or larger-sized properties.

The effect of roads is embedded in the social context of the country in which they are built. In the case of Brazilian Amazonia, they open frontiers to squatters (Fearnside 2001). The time when land tenure was established by squatting has faded from human memory in most areas of the world, but it is still common practice in Brazilian Amazonia (Fig. 51.1). In other tropical regions, such as Southeast Asia and Africa, this is an uncommon expectation. However, public land in Brazil is often illegally seized by individual squatters, organised groups of landless people and wealthy *grileiros* (landgrabbers who obtain land titles through various forms of fraud) (Fig. 51.2) (Fearnside 2008). A 2009 Brazilian law allowing illegal claims of up to 1500 ha to be legalised represents a setback in a transition to a land tenure system based on the expectation that illegal invasions will not be rewarded.

51.2 Major roads stimulate deforestation by facilitating the construction of smaller side roads and human settlements in remote areas

Major roads stimulate the construction of side roads that provide access to land far from the main highway route. An important example is the planned reconstruction of the BR-319 (Manaus–Porto Velho) Highway (Fig. 51.3; Textbox 51.1). Side roads would open the large block of intact forest in the western

Figure 51.1 Squatters near the BR-319 (Manaus–Porto Velho) Highway. Squatters, including organised landless farmers (*sem terras*), are one of several groups of actors that deforest when roads are built. Source: Photograph by P. Fearnside.

Figure 51.2 Cattle pasture in large and medium properties is the dominant land use in deforested areas. Here, *grileiros* (illegal landgrabbers) have established large ranches in the municipality of Lábrea (in the state of Amazonas) in an area with access by a privately constructed side road connected to the BR-364 Highway in Rondônia. Source: Photograph by P. Fearnside.

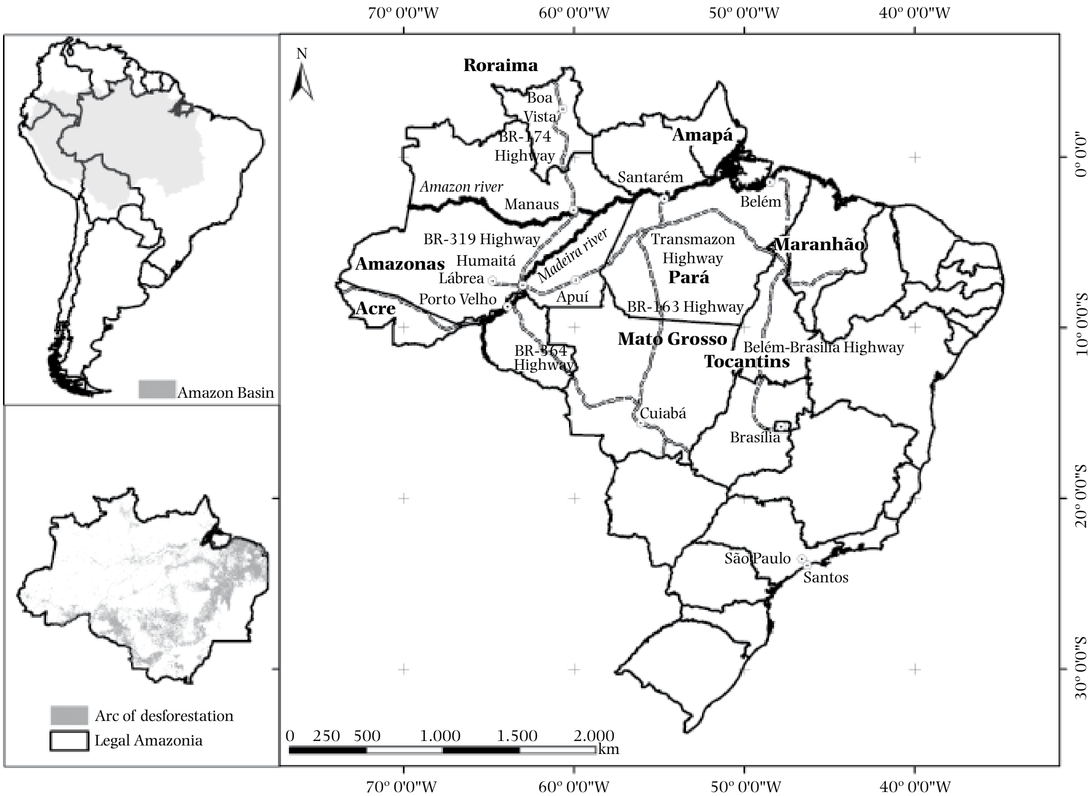

Figure 51.3 Map of Brazil showing major existing and planned highways in the nine states of the Legal Amazon region: Amazonas, Roraima, Pará, Amapá, Maranhão (western half), Tocantins, Mato Grosso, Rondônia and Acre. Source: Map by P. Fearnside.

part of the state of Amazonas that includes vast areas of public land – the category most vulnerable to invasion by *grileiros* and squatters (Fearnside & Graça 2006).

Highways also impact the forest by promoting migration of people. The proposed reconstruction of the BR-319 Highway would link Rondônia with areas in central and northern Amazonia that already have road access from Manaus. Rondônia is in the 'arc of deforestation': the crescent-shaped strip along the southern and eastern edges of the Amazon forest where approximately 80% of past deforestation is concentrated. Migration of people to Roraima along the BR-319 and BR-174 Highways is expected to stimulate rapid deforestation of new areas to the north and recolonisation of the largely abandoned agriculture and ranching district of the Manaus Free Trade Zone in the state of Amazonas (Fig. 51.3).

51.3 The alleged benefits of roads to the Amazon forest are illusory

Roads allegedly have positive effects on Amazonian forests, although these have often been contested. One claim is that roads bring governance, providing access for inspection and management by environmental authorities which prevents illegal deforestation (e.g. Nepstad et al. 2002a, b; Câmara et al. 2005; but see: Laurance & Fearnside 2002; Laurance et al. 2005). A persistent idea is that economic development, to which roads contribute, leads to a forest transition where the area of forest increases after an initial phase of deforestation. Unfortunately, in parts of the world where this has occurred, it has been largely based on planting non-native tree farms (such as eucalypts), as opposed to maintaining original forest. This is part of the theory in which increased wealth eventually leads to an improved environment through a shift in the

Textbox 51.1 BR-319: Brazil's highway to destruction.

During Brazil's military dictatorship (1964–1985), decisions to build highways in Amazonia were made by a small group of generals who used the army to build roads. No economic viability study was necessary, much less an environmental impact assessment (EIA). The army built the BR-319 Highway in 1972–1973 linking Manaus with Porto Velho, in the state of Rondônia. The amount of traffic along the route was small, since freight could reach Manaus more cheaply by ship than by road. Because the expense of maintaining the road in a high-rainfall region was unjustified economically, the road deteriorated and was abandoned by the highway department in 1988. Since then, the bridges have been minimally maintained by the telecommunications department, but the road is impassable to normal vehicles and serves as an effective barrier preventing migration of people to the central Amazon (Fig. 51.4). This may soon change, as reconstructing the road continues to be featured in the Federal Government's development plans. Together with existing and planned roads connected to this highway, the BR-319 would provide deforesters with access to approximately half of what remains of Brazil's Amazon forest. The tremendous potential impacts of the road and the multiple deficiencies in the environmental licensing and decision-making process provide ample lessons for those who are willing to listen (Fearnside & Graça 2006).

Unlike other reconstruction projects, an economic viability study was not conducted for this reconstruction project. The rationale for this exception was that reopening the BR-319 was a matter of 'national security'. Yet a road far from any of Brazil's international borders is not among the items listed as priorities by Brazil's military. Were a viability study done, the result would be unfavourable because transporting freight to São Paulo from the Manaus Free Trade Zone would be significantly cheaper by ship (Teixeira 2007). The renewed interest in rebuilding the BR-319 appears to be primarily its value for electoral politics in Manaus.

The EIA for the project fails to compare the proposed road with the alternative options for transporting freight to São Paulo and confines itself to comparing transport modes between Manaus and Porto Velho (UFAM 2009). Porto Velho is not the destination of the freight, but rather a stopping place on the way to São Paulo. The EIA even admits that industry in Manaus does not consider the highway to be a priority. Furthermore, the EIA does not consider the highway's major impacts, namely, increased deforestation

Figure 51.4 The BR-319 (Manaus–Porto Velho) Highway was abandoned in 1988 and is a barrier to human migration. Its planned reconstruction would connect central and northern Amazonia with the 'arc of deforestation' where clearing has been concentrated along the southern and eastern edges of the Amazon forest (see Fig. 51.3). Source: Photograph by P. Fearnside.

and migration of people. Instead, it presents a scenario of 'strong environmental governance' and offers Yellowstone National Park, United States, as an example (Fig. 51.5). Yellowstone includes a network of roads yet no deforestation occurs. Unfortunately, the chaos of the Amazonian frontier is a completely different setting from Yellowstone National Park. It would be hard to exaggerate the unreality of the expectation that those who gain access to the forest by means of the new road would behave like visitors to Yellowstone.

Figure 51.5 The EIA for the BR-319 Highway presents this map of Yellowstone National Park illustrating the presence of roads without the threat of deforestation (UFAM 2009). The National Department of Transport Infrastructure (DNIT) logo in the corner of the map represents the road-building branch of Brazil's Ministry of Transportation. Unrealistic governance scenarios incite approval of highway projects despite major impacts in the real world. Source: UFAM 2009.

equilibrium between destruction and restoration (known as the environmental Kuznets curve). Despite being generally discredited, this theory is a major influence on Brazilian planning, especially with regard to Amazonia (Hecht 2011).

Another supposed benefit of roads is that they act as 'magnets' that attract deforestation out of the interior and focus it in areas along roads (Aguiar 2006; Câmara 2007; contested by Fearnside et al. 2009). Unfortunately, roads stimulate clearing at the roadside as well as further away. The claim that roads attract deforestation to the roadside and thereby protect more distant areas was based on a simulation for the BR-319 Highway (Aguiar 2006) where the size of the area to be deforested each year was fixed externally by the modeller, with only the location of clearings being subject to influence by the road (see Fearnside et al. 2009). In reality, deforestation would increase both near the road and in the other locations. A similar limitation prevents such demand-driven models from reflecting the effect that protected areas have on reducing the amount of deforestation.

51.4 Roads must be included in deforestation models

Models for predicting future deforestation are needed for various purposes, including decisions on the wisdom of constructing proposed roads. Another need for modelling deforestation is for use in Reducing Emissions from Deforestation and Forest Degradation (REDD) projects for mitigation of climate change through forest protection. In order to quantify the amount of deforestation avoided, for example, by creating a reserve, one must compare the deforestation that occurs after the reserve is created (i.e. what takes place in reality) with what would have happened if the reserve had not been created (i.e. a hypothetical baseline scenario). The effect of roads is critical in these models, and serious distortions can occur if the effect is not correctly represented, together with the related effect of deforestation being more likely adjacent to already-existing clearings.

The Juma Sustainable Development Reserve in the state of Amazonas is the first such project in Brazil and provides an example of how choices in modelling of road effects can cause greatly distorted deforestation predictions and calculated carbon benefits. Roads are a key factor in the baseline scenario, based on Soares-Filho et al. (2006), which indicates 80.7% of the reserve being deforested by 2050 in the absence of the project. The simulation calculated the total amount of deforestation each year for the subregion that includes the Juma Reserve by multiplying a proportion times the area of forest remaining in the subregion, which covers all of the state of Amazonas and parts of Mato Grosso and Pará. The calculated area to be cleared is therefore considerable even with a low proportion being cleared each year. The location where this clearing occurs is determined based on weights of evidence, which direct the clearing to the corner of the subregion where roads and previous clearings exist, namely, in the area that includes the Juma Reserve. When simulated using clearing rates based on local deforestation behaviour, clearing in the reserve by 2050 (18.9%) is over four times lower (Yanai et al. 2012). This shows that realistic modelling of deforestation requires that the calculation of the amount of deforestation (in which roads play a key role) and the location of deforestation (also closely tied to roads) must be referring to the same geographical location.

51.5 No amount of mitigation will prevent deforestation from occurring after a road is built

The decision to build a major road in Brazil is determined by the government, whereas much of what occurs after the road is built escapes government control as squatters and others move into the newly accessible areas. The key issue is the decision to build or not to build a road and determine its location – not the details of mitigation to help lower the road's impact. The initial decision on whether to build a road must be based on complete and unbiased information regarding both the impacts and benefits of the road and of other options for meeting transportation needs. Unfortunately, this is rarely the way these decisions are made in Brazil and in many other countries. Instead, the decision is made by a handful of people based on political considerations, and information on impacts is only sought later as a bureaucratic requirement of the licensing process. Comparison with other options is likewise an afterthought and can be done in such a way as to ignore the main options (see BR-319 example in Textbox 51.1). The decision-making process in Brazil (as in many other countries), including the EIA system, is in obvious need of reform (Fearnside 2012; Chapters 5 and 53).

51.6 Deforestation in Brazil is unregulated and future road projects will accelerate clearing

One of the barriers to instilling greater caution in road-building decisions is the belief that deforestation is under control and a thing of the past. This has become commonplace as a result of misinterpretation of the declining rate of deforestation in Brazil over 2004–2012 (e.g. Fearnside 2009), although planning officials made such claims before any decline in deforestation occurred (e.g. Silveira 2001; contested by Laurance et al. 2001). The belief that deforestation is under control is pervasive throughout Brazilian planning circles and affects the current Plan for the Acceleration of Growth (PAC-2). However, from 2004 to 2008, when most of the decline in the rate of deforestation took place, the main explanations were decreases in international prices of soy and beef and a worsening exchange rate between the Brazilian Real and other currencies for exporters (Assunção et al. 2012). Only from 2009 onwards did deforestation actually follow a trend that would best be explained by governance, not economic instability. Whether increases in governance mean that Amazonia can be criss-crossed by new highways without increasing deforestation is open to question.

51.7 'Governance scenarios' serve to justify approval of damaging roads

Planning of new highways is often done on the strength of 'governance scenarios' that portray a future with highways that bring benefits but minimal impacts. For example, the effect of the proposed reconstruction of the BR-163 (Cuiabá–Santarém) Highway was simulated, with a governance scenario indicating much less deforestation than a 'business-as-usual' scenario (Soares-Filho et al. 2004). The decision-maker is presented with choices as if he or she were in an all-you-can-eat buffet restaurant where one is free to choose anything with essentially no consequences. Any planner will choose the governance scenario over one indicating environmental destruction. However, the governance scenario implies tremendous change in government action and in individual behaviour, which is unrealistic. Consider the BR-163, a road intended to transport soybeans from Mato Grosso to a port on the Amazon River, in which the crash in global soy prices from 2003 led to successive postponements of the project (but the road is now expected to be completed in 2015) (Fig. 51.6). Even without the reconstructed highway, deforestation in the area has exceeded even that projected in the business-as-usual scenario, and much of the

Figure 51.6 The BR-163 (Santarém–Cuiabá) Highway was built in 1973 and is now planned for reconstruction – essentially the building of a new highway on the route of the old one. In its present condition, it is inadequate for transporting soybeans from Mato Grosso to an Amazon River port in Santarém. Source: Photograph by and reproduced with permission from M. Torres.

forest expected to be saved in the governance scenario is already gone (Fearnside 2007). The BR-319 Highway offers another example of a completely unrealistic governance scenario being used to justify approval of the project, in this case using Yellowstone National Park in the United States as a representation of the government control proposed for the area (Textbox 51.1).

51.8 Environmental safeguards are needed for approval of international financing of road development

Road development in Amazonia has often been funded and influenced by international entities. Funding from multilateral development banks for reconstruction of the BR-364 Highway that opened up Rondônia and Acre to migration and deforestation is the classic example (Fearnside 1986, 1987b). The creation of the World Bank's Environment Department in March 1987, together with a system of EIA within the Bank, was a direct reaction to the dramatic surge of rainforest destruction in Rondônia as a result of the highway. The announcement of the Environment Department occurred less than 48 hours after an exposé of the highway project aired on the 60 Minutes television programme in the United States.

Brazil is a major source of financing and construction resources for road projects in Peru, Bolivia, Ecuador and Guyana, including the Transoceanic Highway in Peru and the Highway to the Pacific in Brazil. The primary purpose of this road is to transport commodities from Brazilian Amazonia to Pacific ports in Peru. It is being built by Brazilian construction firms with funding from Brazil's National Bank for Economic and Social Development (BNDES). The road, although officially completed in 2010 but still undergoing upgrading (as at early 2015), is already causing an upsurge in deforestation in the biodiversity hotspot in the Madre de Dios region at the base of the Andes in the Amazonian portion of Peru. The highway is part of the Initiative for the Integration of the Regional Infrastructure of South America (better known as 'IIRSA'), a massive programme to integrate transportation infrastructure in South America (Killeen 2007). Despite the deficiencies of Brazil's environmental review and licensing system, the neighbouring countries in Amazonia have even less protections against road impacts. Therefore, Brazil's road-building activities are a major force in Amazonian deforestation.

CONCLUSIONS

Roads built in Amazonia expose areas of rainforest that previously remained intact largely due to inaccessibility to deforesters. Decisions to build new highways and upgrade or reopen marginal or abandoned highways have consequences for forest loss that are far-reaching, both in space and time. Rational decisions require realistic modelling of future deforestation, including the critical effect of roads. Unfortunately, the widespread belief that deforestation in Amazonia is under control and that highways can therefore be built at will without increasing deforestation is erroneous.

ACKNOWLEDGEMENTS

The author's research is supported exclusively by academic sources: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq: Proc. 305880/2007-1; 304020/2010-9; 573810/2008-7; 575853/2008-5) and Instituto Nacional de Pesquisas da Amazônia (INPA: PRJ15.125).

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