A Look Down the Road: The Future of Gold Mining and Deforestation Along Peru's Interoceanic Highway

Max Boath

University of Richmond
Environmental Senior Seminar

Dr. Mary Finley-Brook
June 2011

Table of Contents:

1.0 Introduction

The Amazon Rainforest supplies the world population with oxygen, medicinal assets, aestheticism, existence values, and other use- and non-use values (Liverman 2004, Fearnside 2007, Chavez and McDonnell 2010). A new road building initiative in Peru, Brazil, and Bolivia, called the Interoceanic (or Transoceanic) Highway, is under consideration, which could jeopardize these values. The highway is expected to cut through main forest, leaving a direct and indirect wake of deforestation that would diminish the aforementioned values, as well as impact global prices of tofu, beef, and cattle feed (Brandon et al. 2005, Kirby et al. 2006, Perz et al. 2008). Specifically, Peru could face harsh obstacles, as its public servers already struggle to control population problems, prostitution, drug trafficking, illegal mining and logging, child labor, land protests, and rampant alcoholism and drug use (Brandon et al. 2005, Chavez and McDonnell 2010). Nonetheless, the Interoceanic Highway need not persist as a malevolent undertaking, and in fact its main purpose is designated at bringing new market opportunities to Peru, Brazil, and Bolivia, while forwarding individual transportation, healthy migration, trans-regional communication, and employment opportunities. By addressing major social needs and preparing to combat the environmental hazards prior to the completion of the Interoceanic Highway, Peru holds the potential to unlock a new age of economic prosperity, resource conservation, and effective governance.

Through an analysis of the deduced social impacts likely to transpire as a result of the Interoceanic Highway—specifically in the gold mining and deforestation sectors—I will ascertain whether Peru is currently stable enough to absorb the highway's

negative consequences in stride, and then recommend strategies that Peru should invest in that will lead to the most promising future regarding these issues. The Interoceanic Highway may only exacerbate the complex environmental and social effects of gold mining and deforestation, and a proper management approach must consider all possible scenarios. I believe that by uncovering the causes of recurring cycles of deforestation and illegal mining, Peru will be in a better position to go about implementing socially- and environmentally-protective solutions to avoid consequences of the new highway.

The research conducted here has been obtained from a variety of second-hand sources and techniques, including scholarly articles (found mainly through Google Scholar and JSTOR), project summaries, and media content including magazines, newspapers, and radio reports. Through my research I hope to unearth the progress of the highway as well as current rates of deforestation and gold-mining; likely future scenarios if the highway is pushed ahead as scheduled; the best plan of attack that Peru should heed to based on a number of proposed ideas and how these solutions might most-effectively be implemented at various scales; and what further changes (good and bad) these preventive actions may bring about. I consider myself a valid applicant in this undertaking: I am currently earning my degree in an Environmental Studies discipline, which merges the natural sciences with geography and social sciences, among others, and have completed a minor in Anthropology. I recently spent the good part of a summer in and around Puerto Maldonado, Peru, where the Interoceanic Highway is projected to have a significant toll--many changes of which were presently evident through my personal observations and uncovered through casual talks with residents.

I will begin with an overview and background of the environmental and social

issues surrounding the highway project in Peru, as well as address previous literature and work that has documented highway construction in the Amazon. Following this will be a section each on the specific causes and effects of gold mining and deforestation through road building. The final body chapter will look at possible solutions Peru could take to minimize the highway's damage on its natural and cultural ecologies, through the framework of analyzing solutions at various levels of institution.

2.0 Background and Review of Literature

The Interoceanic Highway is a South America Regional Infrastructure (IIRSA) highway development project, funded primarily by the Brazilian and Peruvian governments as well as the Andean Promotion Corporation (CAF) (Mendoza et al. 2007, Bank Information Center 2005). The proposal was first conceived decades ago, but only recently has it become a potential reality (Chavez and McDonnell 2010, Conover 2003). The Interoceanic Highway will serve to facilitate the transfer of Brazilian goods (mainly soya products) to Asian markets, as well as Asian goods to Brazilian, US, and European markets. Peru's President, Alejandro Toledo, anticipates that Peru's gains will amount to a 1.5 percent annual increase in Gross Domestic Product (GDP) (Bank Information Center 2005).

The construction and renovation of 2,603 kilometers of roads from the Brazilian state of Acre to Peruvian ports Ilo, Matarani, and San Juan de Marcona includes twenty-two bridges, and is divided into five main sections. Brazilian sections of the highway have already been paved, connecting Porto Velho and Rio Branco to Iñapari on the Peru-Brazil border. For Peru, three of the five main sections of the Interoceanic Highway

remain undeveloped, dirt paths (Bank Information Center 2005). The completion of the highway is being forced ahead by Brazil's manifest destiny for Pacific access, spearheaded by the enormous Brazilian firm Odebrecht. "…If not a Brazilian flag, at least a Brazilian economy"; and "Brazil wants to build its empire and [Peru] is in the way" are remarks heard from politicians down to meager farmers (Garcia-Navarro 2009, interview with Bruce Babbitt and Huachaco, resp.). Peru sees the highway as a chance to grow its own presence too on the international stage; nonetheless, even with recent escalations in GDP the Peruvian Amazon seems to be paying the bill, for as the economy grows, social development lies dormant (Reaney 2011).

The tri-national region in which the highway is being constructed has been deemed the MAP region, based on the three cities along the route: **M**adre de Dios, Peru; **A**cre, Brazil; and **P**ando, Bolivia. The region encompasses approximately 300,000 km2 with a population of roughly 700,000 stakeholders, consisting of large-scale ranchers and farmers, miners, loggers, subsistence farmers, indigenous groups, and urban dwellers (Brandon et al. 2005, Perz et al. 2008). Indigenous groups make up forty percent of Peru's population, and an estimated sixty uncontacted groups still dwell in the bush; a portion of the nation's populace also works in the gold, timber, or oil extraction industries, where reducing transportation costs means establishing on-site quarters that further pollute and encroach on tribal lands (Reaney 2011).

The highway's negative outcomes are expected to be enormous, yet worst of all in Peru due to its inept frontier management (Bank Information Center 2005). To the surprise and enragement of many, the construction plans for the Interoceanic Highway were never subjected to an environmental impact assessment (EIA)--likely due to the

road having already been established as a dirt trail--which would have forced developers to review the environmental, social, and institutional risks associated with the highway, as well as consider alternative schemes that would minimize or eliminate these possible impacts (Maki et al. 2001, Bank Information Center 2005). Peru's jungles boast one of the highest concentrations of biodiversity in the world: its 25,000 species of plants make up ten percent of the world's catalogued flora; its nearly 3,000 bird, mammal, and herpetofauna species rank the country in the top five for animal abundance, with new species being discovered practically every day (Reaney 2011). Unfortunately, many of these novel findings come as a result of increased access to unexplored rainforest, as will similarly be provided by the Interoceanic Highway, and the influx of human presence will quickly deteriorate terrain (Perz et al. 2007, Reaney 2011). With sixteen percent of Peru's wildlife found only within its borders, new species may be discovered and just as quickly wiped out for eternity by the clearing of habitat for usable land. The scientific, pharmaceutical, and tourism industries would all suffer from a decline in Peru's realized—and undiscovered—endemic plants and animals. As a result of the neglect shown towards potential devastation, Peru's social and natural environments are more vulnerable to negative changes that perhaps could have been more thoroughly accounted for and avoided.

Peru's social problems are numerous, and its government has been slow to take action towards widespread transgressions. Despite acknowledging illegal logging processes, drug trafficking, prostitution, gold mining, and other detrimental activities, the central government has fallen short of curtailing these activities due to the lawlessness and lax enforcement in frontier regions of the Amazon. Corruption and injustice are

present at both ends of the power ladder. Local, decentralized authorities allow illegal mining and logging ventures, and the transport of their ends, to continue unchecked due to personal compensation from large profits (Perz et al. 2007). Nationally-derived mandates are often disregarded in rural communities; Fox (1994) and Fearnside (2007) propose that this undermining mindset stems from the Latin American debt crisis of the 1980s, which caused national governments to abandon rural projects and leave frontier communities to self-governance. Consequently, state-based authority is met today by insubordination; this impels Peru's government to try to influence local communities more, which may be without local representatives committing to resolving specific social needs (Mendoza et al. 2007).

The Interoceanic Highway is by no means the first major highway undertaking in Amazonia. Brazil has been paving highways since the 1960s and 1970s for various reasons, including resettling dense populations and facilitating transport of factory goods (Smith 1977, Fearnside and Graça 2006). Indeed, Mendoza et al. (2007, p. 403) remark, "not all problems are resolved by road improvements, and in fact new social, environmental and economic problems (drugs, alcohol ism and violence; deforestation and water pollution and landownership turn over) can arise in the wake of road paving." The results of ecological changes from highways have been predicted and observed by many (i.e. Goosem 2007), and decades of Amazonian road infrastructure research have suggested a strong causation between government highway projects and social problems. Maki et al. (2001), Perz et al. (2007), and Fearnside (2007) have all recognized the serious association between new roads and the altering of livelihoods and forest connectivity. These authors and others (i.e. Arima et al. 2005, Perz et al. 2008,

Kirby et al. 2006) have thus come to agreement through various studies that official, paved roads often lead to the rapid expansion of unofficial, branching side roads, which do more environmental damage by expanding the effects of logging and deforestation. Because the official highways are solitary roads hundreds of kilometers apart from each other, their impact is relatively minimal (Perz et al. 2008). This contradicts Laurance et al.'s (2002) speculation that official highways tend to have considerably larger-scale impacts than unpaved roads and are the single most important predictors of deforestation. It is important to note, however, that because highways are the main contributors of new unpaved roads, neither official nor unofficial roads can be easily independently assessed. One article has been written in favor of paved highways as a way of slowing deforestation, and has been used to support evidence for infrastructure projects; however, the study only examines deforestation at the county level with high levels of population density and deforestation, and would not yield the same results in less populated frontier regions (Kirby et al. 2006).

Concern for falling trees has seemed to overshadow the issue of gold mining with regards to Amazonian research. While large-scale mining operations' environmental tolls and effects on indigenous communities have been investigated to some extent (i.e. Muradian et al. 2002, Bury 2003), the scholarly spectrum of resource-extraction research does not include the environmental toll of small-scale gold mining by local peoples. Still, previous research on gold mining activities can help us to understand some of the potential consequences. Globally, gold is by far the most extracted metal (Veiga et al. 2006), and the case is no different in Peru—a leading global supplier of the resource. Rising prices alone are driving up the artisanal (small-scale) gold miner

workforce (Veiga et al. 2006, Chavez and McDonnell 2010), but nearly everyone in this self-employed industry is unregulated by the government (Garcia-Navarro 2009). Because miners must use heavy metals, such as mercury, and incredible amounts of water to extract tiny gold particles, waterways are being altered and contaminated. Veiga et al. (2006) have revealed that despite there being plenty of mercury already available in the environment, developed countries are still producing mass amounts of virgin material; artisanal miners continue to buy the new mercury for cheap prices and deploy it into the environment instead of undergoing the process of extracting and recycling mercury already in the rivers. Veiga et al. (2006) suggest that better governmental regulation and tracking of mercury would help ensure it not be used illegally, but this proposal is a broad global vision and does not reflect upon Peru's poor control over its environmentally- and socially-degrading factors. Hilson (2002) offers several suggestions for Ghana's similar small-scale gold mining industry that could transfer to Peru's circumstance; for one, using disturbing mercury information to "educate miners and local chiefs, many of whom permit [artisanal miners] to mine illegally on their land" (p. 69). While Hilson's (2002) ideas are valuable, he does not detail how to effectually inform these people or install these strategies at any particular scale, which would need to be addressed if establishing these in Peru's remote frontier--where phone and Internet technologies are scarce.

In my attempt to dissect such extensive subjects, I will utilize an analytical framework of scale that will allow me to identify on what level the most positive changes can occur. How we view scale determines how we shape our perceptions of social life and the realm of space in which we live and interact (Herod and Wright, 2002), which

can help overcome obstacles associated with these, from land claims to social conflicts (Bardhan 2002). Using scale to analyze the tragedy of the commons, where many independent people take from a limited supply of a resource for their own benefit until depletion, can also be used to help resolve issues of environmental over-extraction through resource commodification (Giordano 2003, Liverman 2004). The issue of the commons, here pertaining to gold and timber as well as land, depends on the sociopolitical scale at which it is assessed, and so solutions should vary according to space and scale (Giordano 2003). Giordano (2003) addresses the tragedy of the commons from a conceptual approach, believing that "one of the conditions for the existence of commons problems is the lack of well-defined property rights" (p. 366), a characteristic of the region confirmed by Fearnside (2007).

Organizing land claims in the frontier might be an ambitious undertaking without better administrative direction on the local level. Centralized governance has failed on several accounts through history, deligitimizing its effectiveness and turning the reigns over to decentralized practices for benefits and solutions (Bardhan 2002). Yet a decentralization of governance is not solely about stealing power away from the central authority, nor is it about preferring local politicians to state authority; rather, it is essentially about improving a presiding administration's responsiveness to a larger majority of a population and their more individualized needs (Bardhan 2002). "Decentralization has been at the center stage of policy experiments in...a large number of developing and transition economies in Latin America" (Bardhan 2002, p. 185), not excluding Peru. Since the 1980s, Peru has been attempting to install decentralization operations in order to allow rural development projects to succeed (Fox

1994, Willis et al. 1999). Still, considering the incredible opportunity for improvement in regards to the lawlessness of resource management and frontier exploitation, more scalar analysis needs to be conducted, which several works speak to. Hiskey and Seligson (2003) acknowledge the positive potential of decentralization and its ability to improve individuals' support of the developing national leadership; on the contrary, if the elite are not controlled, corruption ensues, and the local institution falters, citizens will develop a renewed cynicism towards the national political system. Local authorities can be subdued into corruption by the local powerful elite or interest groups, who thus receive a disproportionate share of resources and public goods and pit the rich against the poor (Willis et al. 1999, Bardhan 2002, Hiskey and Seligson 2003).

Through an analysis of the deduced social impacts likely to transpire as a result of the Transoceanic Highway—specifically in the gold mining and deforestation sectors—I will ascertain whether Peru is currently stable enough to absorb the negative consequences in stride, and then recommend strategies that Peru should invest in that will lead to the most promising future regarding these issues. Perz et al. (2007), in disagreement with Maki et al. (2001), believe that the best option for Peru is to focus on the infrastructure it already has in place, such as its existing roads that link local agriculture with markets, rather than promoting future road building to farther, less fertile places. Indeed, refocusing on established settlements with pressing needs may be smarter than investing in new communities that are too distant to credibly contribute to markets, but having no development may slow economic growth and lead to overcrowding. While few studies of the MAP tri-regional area have been undertaken, Mendoza et al.'s (2007) social impact study has found some interesting differences

between residents along paved and unpaved roads. Residents in Puerto Maldonado had complaints tied to the lack of a paved road that those along paved roads did not hold, such as weak community and inter-regional organization and a difficulty in transporting goods to markets. While these could be solved with the paving over of the road, the study also displayed that unique negative repercussions surfaced once paving had taken place, and other basic services and infrastructure dilemmas remained unimproved. Fearnside and Graça (2006, also Fearnside 2007) calculated what was likely to happen in Brazil in the aftermath of the BR-163 and BR-319 highways, and offered alternatives for more sustainable paths forward—yet stopped there without discussing potential repercussions of their remedies; the following analysis will aim to suggest steps forward with the best process to implement them, and warn of any foreseeable consequences. The Interoceanic Highway may only exacerbate the complex environmental and social effects of gold mining and deforestation, and a proper management approach must consider all possible scenarios.

3.0 Gold Mining

Gold mining is currently one of Peru's largest and unresolved problems. An important activity for many, small-scale, or "artisanal," mining provides an income in rural areas where financially viable alternatives, such as agriculture, are limited (Veiga et al. 2006). Gold is the main metal being extracted worldwide, with around 15 million people directly involved in artisanal mining, including 4.5 million women and 600,000 children (Veiga et al. 2006, p 437). "Gold is most commonly mined on a small scale because of its propensity to generate wealth quickly" (Hilson 2002, p 58). It is easy to

find buyers and unchallenging to transport across borders, and through its profitability has encouraged many to enter the illegal mining business, creating a great deal of environmental and social turmoil; land degradation and mercury pollution are by far the two most severe environmental crises in artisanal gold mining regions (Hilson 2002, Giordano 2003).

While not as extensively reported, some positives could transpire as a result of the highway, by bringing short-term improvements through economic gains. Paving the Interoceanic Highway would reduce transportation costs, increase fuel economy, and decrease delays caused by impassable, muddy roads. Goods, including gold, can reach more distant markets by paved highway faster than via unpaved routes, potentially allowing more fluent cash influx (Fearnside and Graça 2006, Perz et al. 2007, Mendoza et al. 2007). In areas of chronic idleness, highway construction (funded by nationwide taxpayers) can boost employment opportunities and local income, if only temporarily and confined spatially, and thus residents may rally for the highway to come through their area even despite foreseeable negative future consequences (Garcia-Navarro 2009). Citizen support may also come from middleclass residents anticipating vacation opportunities via the new highway (Fearnside & Graça 2006).

In reality, vacation plans may be more the farfetched dream than a reasonable prospect for many (Fearnside and Graça 2006), and hardly seems able to justify the negative effects of the construction. All-weather roads have the capacity to substantially worsen economic and social structures and can significantly influence surrounding ecosystems (Maki et al. 2002). Environmental degradation and social impacts brought on by gold mining, while currently considerable, have not yet achieved their maximum

potential for alteration. This can be attributed to unpaved roads being inaccessible some parts of the year, which keeps distant merchants from pragmatically competing in central markets. Paving sections of the highway would reduce transportation costs, increase product flows, and be beneficial for the economy, but would also allowing further rural environments to be explored, colonized, and exploited. Furthermore, the past several years have witnessed an influx of highland Peruvians coming down from "altiplano" regions to lowland rainforest in search of fortunes from artisanal gold mining (Garcia-Navarro 2009, interview with Pedro Sentero). Some predict the Interoceanic Highway might encourage and ease travel from Cusco and Maccu Picchu and thus boost eco-tourism in the area, but the facilitated commute for all means the highland peoples can also migrate to pristine rainforest habitat more fluidly. Instead of acting as an "escape valve" (p. 745) for reducing overcrowding and social tensions (Laurance et al. 2002), the Interoceanic Highway makes it easier for populations to encroach into capacity-sensitive areas with harmful practices.

3.1 Rising Numbers

Indeed, this has already happened in some areas, where shantytown communities have sprung up around artisanal gold mining. Dreadful conditions include streets lined with sewage that run unfiltered into silt-choked streams; young girls are trafficked in, summoned with lies, and forced to work at bars (Laurance et al. 2009, Garcia-Navarro 2009). Despite the unfavorable conditions and demanding work, people continue to flock to the mining towns near Madre de Dios; one in particular quadrupled in population in six months (Garcia-Navarro 2009). Most people are just barely able to subsist, and despite being one of the continent's most prosperous nations, forty percent of

Peruvians remain below the poverty line (Garcia-Navarro 2009, interview with Antonio Brack). The Interoceanic Highway is a factor in bringing more people to these quarters, yet Peru's gold rush is being further driven by record-high prices it has lately been able to fetch. From 2004 to 2009, the price of Peruvian gold more than doubled from (USD) $450 to $950 per ounce, and is expected to double again in the upcoming years (Garcia-Navarro 2009). Despite ninety-nine percent of mining around Madre de Dios being illegal, appealing profits tempt local law enforcers into corruption, and the central government continues to struggle to curtail its growth.

3.2 Land Change

The combination of improved rural-to-market transport with mounting global prices means small-scale gold mining will increasingly have large-scale environmental consequences. Most artisanal excavators mine for subsistence means, or to complement seasonal income (Garcia-Navarro 2009). Nevertheless, the term "small-scale" is misleading, for single operations can be two kilometers wide and involve multiple partakers. Miners do not evaluate the environmental impacts of their drilling, polluting, and overall extraction methods (Veiga et al. 2006). Miners must sift through thirty tons of sand and dirt only to collect enough particles of gold for a small wedding band (Garcia-Navarro 2009). The breadth of such quantities is of the magnitude to alter landscapes: murky rivers full of silt are the result of being altered or dredged, the water sometimes having been contaminated with acids and cyanide; vital minerals are removed from necessary biological cycles; entire tracks of forest are transformed into dirt craters, scraped clean of vegetation, that are too polluted for any future use besides mosquito breeding pools (Hilson 2002). Mining concessions have sprung up near popular eco-

tourist destinations, which deplete visitor experience through suspended sedimentation and color oxidation, lack of natural enjoyment (swimming, fishing), chainsaw and machine noises, and depletion of aesthetic values (pers. observation).

3.3 Mercury

On top of this, toxic mercury is used in the refining process to extract fine gold. Miners use mercury because it is cheap, widely available, and easy to use, but they have either not been informed of or choose to disregard the risks to their own health, public well-being, and the environment (Hilson, 2002, Veiga et al. 2006). Mercury has a brutal impact on natural systems: if ecologically-degraded streams did not hinder subsistence fishing efforts already, the compounding effect of mercury as it travels up the biological food chain makes fish incredibly dangerous to consume. Peru is among South America's leading mercury consumers, releasing between 10-30 tonnes of the contaminant byproduct every year (Veiga et al. 2006, p. 436). While enough mercury has already been deposited in Peru's water bodies to extract and recycle, miners are reluctant to do so due to the cheaper and more readily available alternative of buying imported virgin mercury. The element is not legally sold for mining (dental care is one of the few legal industries, though relatively little is distributed to this), but the product is not diligently tracked (Veiga et al. 2006). The Interoceanic Highway would increase the availability of mercury to farther reaches of the frontier, allowing it to be shipped faster and more reliably year-round.

3.4 Highway Incentives

In other parts of Peru, multinational mining corporations have taken over regional functions. International chains of production that stem from mining for gold in Peru

cause powerful companies to externalize environmental and social costs on local, poor, powerless people, who can be cheaply compensated (Muradian et al. 2003). Indigenous peoples may sometimes also be mislead into signing away rights to extract from their lands (Fearnside 2007). While the area surrounding the Interoceanic Highway has yet to be taken over, the completion of the highway could prompt certain international mining conglomerates to branch into this gold-rich area that has yet to be tapped by corporations. The incentives of a paved road facilitating transportation, coupled with current lax enforcement, may prove enticing to large profit-seekers, which would spell disastrous changes in livelihoods and local customs. The environment is commonly viewed as a luxury (Muradian et al. 2003), which many poor, rural inhabitants would not be able to afford to save.

4.0 Deforestation Processes

Wide, paved roads have the ability to cause an array of ecological problems that thinner, unpaved roads may not as harshly register, for they open up the canopy and create edge effects (Goosem 2007). The inherent use of paved roads causes liquid, solid, and gaseous pollution, disturbances from noise, vibration, and headlights, and can turn up dust that may block sunlight and reduce photosynthesis and transpiration (Goosem 2007, Laurance et al. 2009). Vehicles transporting people or goods vast distances on highways also bring with them alien flora, fauna, and diseases, and at highway speeds animal mortality and human accidents are prone (Goosem 2007, Laurance et al. 2009). Fragmentation and thinned tree density have ecological consequences of increased tree mortality and reduced seedling succession; this results in a loss of

biodiversity, as well as biomass to combat global warming through carbon recycling (Perz et al. 2007, Laurance et al. 2002, Laurance et al. 2009). Advancing global warming also means an increase in drought-induced forest fires, further contributing to deforestation and risking lives (Fearnside 2007, Perz et al. 2007).

4.1 Unofficial Road Building

Although climate change has been assessed to impact forest dieback, a more pressing factor for deforestation is manmade, unofficial road building (Perz et al. 2008, Laurance et al. 2009). While Perz et al. (2008) claim that official roads have received the most attention, it is the unpaved roads that have the most social and environmental consequences by increasing rural access to markets and contributing to social change and local deforestation. Federal highways can be hundreds of kilometers apart, yet local actors build side roads that branch off from the main route. In some parts of the Amazon where official highways have been built, unofficial roads comprise eighty percent of all the roads in the area (Perz et al. 2007). Local individuals represent a much larger threat to the future of the Amazonian frontier than the central government (Arima et al. 2008).

4.2 Deforestation from Logging

More commonly than not, loggers are the first actors to arrive after a road has been paved, in search of exploiting and marketing untapped natural resources (Arima et al. 2008). Logging firms pay close attention to the latest market prices for particular timber species and will build roads through paths of least-resistance to high-density plots of profitable species (Arima et al. 2008, Perz et al. 2008). Fluctuating market prices cause new unofficial roads to be built to different timber stands (Perz et al. 2007). Often, directional decisions are made without knowing the location of other existing logging

sites; eventually, however, groups discover other exploitation operations in the area and create a linked network of roads, often only kilometers apart and intersecting to create ecological islands (Arima et al. 2008). This leads to a web of deforestation that extends far from the main highway. Overseeing all illegal frontier operations might seem too unrealistic an expectation, but even where enforcement can be practically established very few applications have succeeded in retarding the illegal trade and discouraging unofficial road building for logging. Checkpoints are a rare sight, and where they exist they are manned by corrupt inspectors or can be detoured around; illegal timber species can be disguised as legal species; fraudulent management projects and deforestation authorizations are unwisely passed; and indigenous tribe leaders may allow logging to occur on their lands (Bank Information Center 2005, Fearnside 2007). Representatives of Peru's industrial and civil sectors backing the construction of the Interoceanic Highway argue that, because most of the unpaved route has been in place for so long, the reconstruction and paving of it could not worsen environmental degradation beyond the current rate. However, while initial routes do lead to deforestation of juxtaposed forest, the improvement of a road—especially from paving—will accelerate deforestation by expanding access to natural resources (Fearnside and Graça 2006, Perz et al. 2007). In a study of deforestation rates near paved and unpaved roads, paved roads explained thirty-eight percent more variation in deforestation intensity than did unpaved roads (Kirby et al. 2006, p. 441).

4.3 Deforestation from Colonists

Private roads from loggers play a major role in frontier expansion; as loggers move on to new plots in search of more timber, abandoned lands are succeeded by people

rather than plants (Arima et al. 2008, Perz et al. 2008, Laurance et al. 2009). The first settlers to the area bear the brunt of the development hardships. These often poor colonists have continuously limited access to markets, credit, administrative centers, and other governmental services, and find difficulty reaching a higher standard of living due to low yields from nutrient poor soil (Maki et al. 2002). After an initial period of struggling, abandonment and farm turnover, new waves of settlers arrive and purchase established land at low cost (Maki et al. 2002). Land values increase due to the new higher standards of living from governmental services and access to the paved highway. Higher land prices provide incentive to develop further into the forest, breeding more deforestation. Increased access to major valuable resources allows colonists, loggers and miners to harvest the forest to sustain their own livelihoods, and profits encourage additional road building to more resource supplies. Thus, the short-term profitability of unofficial road building will continue, even though it is economically and ecologically unsustainable. Deforestation can also jump places, as new opportunities for movement open up (Fearnside 2007). Land prices escalate near paved roads, and the effects of this are already occurring in anticipation of the highway. If grileiros, or illegal land squatters, colonize an area of forest along an endogenous road (often with fraudulent documents) and maintain and work on the land (or, in other words, cut down the natural vegetation in order to grow inefficient crops), then they can claim title to that land (Fearnside and Graça 2006, Fearnside 2007). This rule allows peasants, as well as legal landowners with surrounding forested land, to expand into the wilderness without any incentive to preserve the forest and its biodiversity. The central government has considered opening up residential land away from the highway in order to discourage

settlers from deforesting road-side property; however, instead of moving to the new area outright, colonists will simply spread their families across both plots and do twice the damage (Fearnside 2007).

The pattern of pre- and post-paving in Brazilian Amazonia has been played out many times over, and it can logically be transposed to Peru's current and future situation (Reaney 2011). Among other drivers, urban areas are becoming overcrowded, so the central government seeks to build a highway from urban city 'A' to rural town 'B' in hope of displacing landless peasants. However, loggers end up carving up the space between the two endpoints, and grileiros, gold miners, and other colonists relocate to land and agricultural plots along the highway instead of at the end of it. Regardless of diverse cultural differences between the Peruvian and Brazilian populace, the economic status of rural colonists and non-state actors are similar, population densities are correspondingly becoming stressed, and illegal logging enforcement is as corrupt and/or not easily enforced due to falsified documents. The succession of Peru's forests along the proposed Interoceanic Highway will be remarkably, though perhaps not surprisingly, similar to that of Brazil's highway projects. While the Interoceanic Highway may not itself be the direct cause of potential mass deforestation, by indirectly influencing side roads and providing new access to trees, land, and gold, it is at fault.

5.0 Steps to Effective Governance

Based on the findings aforementioned in this analysis, I believe that the Interoceanic Highway will contribute to the rapid expansion of deforestation and environmental degradation by providing increased access to resources and facilitating

the ability to transport (illegally harvested) materials from remote areas to centers of commerce. Considering the current states of illicit mining, logging, land claiming, and the corruption that assists these practices, I believe that Peru is not yet ready to absorb the exacerbated environmental and social impacts likely to follow from the completion of the highway. In the best interest of environmental, social, and economic sustainability, planning and construction should be halted for a reevaluation of the issues at hand.

If the highway is to be built, however, it should be at least delayed until local and central government parties can come to terms with their corruption and unsustainable practices, and then develop new approaches that will lead to cooperation, communication, and better resource management. Potentially, a postponement could provide Peru the stability it needs in order to reach a point more suitable for managing its problems, which would allow it to move more reassuringly forward with the paving. Essentially, the government needs to do the following: First, conduct assessments on all potential foreseeable changes to the social and environmental landscape. Next, it needs to work with local peoples to establish a balance between central government supervision and local resource management. Lastly, a solution to the lack of frontier enforcement of environmental laws might attack many social problems at their roots. "Peru has some wonderful laws for protecting flora and fauna...the problem is they are not well-enforced" (Garcia-Navarro 2009, interview with Pedro Sentero, translated). While the Interoceanic Highway would likely cause lasting effects on Peru's social and environmental landscapes, it is not to say that the highway should never be constructed; if the state can begin to manage and collaborate with its people effectively, perhaps the highway will be able to realize its aspirations less controversially and more sustainably.

5.1 Assessing Impacts

To begin with, the government needs to conduct scientifically-based environmental impact assessments (EIA) and social impact assessments (SIA) of the Interoceanic Highway, in order to reevaluate the project's impacts as well as form a habit of making this mandatory all future government projects. Doing so will help organize and conceptualize the environmental and social impacts the Interoceanic Highway could have, as well as help avoid aftermath backtracking and development that is unsustainable. Because road paving leads to the rapid expansion of unofficial side roads, deforestation will steadily spread, land prices near the road will increase, and people will illegally settle lands and cultivate them to attain land title (Laurance et al. 2002. Fearnside 2007, Perz et al. 2007). These affairs are already occurring in anticipation of the Interoceanic Highway, and while this paper attempts to predict the advances of these, the Peruvian Government needs to properly quantify them. Doing so could provide incentive to not build the highway—perhaps in discovering that the last remaining habitat of a rare species of bird that attracts tourists and ornithologists would be bulldozed over, or assessing that it would be cheaper, faster, and more environmentally friendly for Brazil to continue to ship its goods to Asia by sea from the Atlantic rather than drive them to the Pacific. Lastly, part of the EIA and SIA plans should include actual, occurring changes on the ground level, for oftentimes governments will build highway infrastructure and promise local people that government aid and involvement will come afterward, then abandoning upon completion (Fearnside 2007). By helping people cope with the effects of the highway prior to construction, the government could dampen or avoid many environmental and social problems, and the actions could formulate a bond between local

and state actors.

5.2 Governance

New initiatives must be sponsored by the central government yet be in congruence with local identities, and need to address social and environmental sustainability caused by unofficial roads. Government highways encourage the unofficial roads that are tied to unsustainable community development through federal highways, and it is thus the responsibility of the government to see through with environmental protection in frontier regions; at the same time, strict unidirectional, top-down authority will be met with resistance because local people need to make a living, albeit through their unsustainable, unofficial roads (Perz et al. 2007). State-based governance includes things such as creating parks and reserves, giving tax breaks for sustainable resource use and extraction, establishing quota restrictions, and enforcing punishments (Perz et al. 2008). The problem with this form of control alone is that it is aimed to be implemented equally across a very diverse range of communities, and it has been less than successful in the enforcement of its regulation (Bardhan 2002). Community-based governance, on the other hand, involves communities devising their own resource-extraction rules, moreso based on indigenous and traditional land use (Perz et al. 2008). Problems here revolve around the tragedy of the commons, where the less-fortunate seek to advance their status via limited natural resources, by claiming land along highways, extracting timber, or mining for more gold, among other negative acts (Giordano 2003).

In order to balance these two structures of governance, a middle ground must be achieved that allows for constructive input and control from multiple levels (Bardhan 2002). Ideally, each community, or region of communities, would elect a representative

to fight for their needs from the government and to be in charge of local operations. The Peruvian Government would allocate resources to the communities based on their specific needs, and then oversee ventures. The central government could, hypothetically, pull funding if it saw that a community was not abiding by the parameters, possibly through corruption of unequal resource redistribution, blackmail, large fiscal imbalances, or incomplete monitoring, and one might predict the power scale to tip towards the state by being able to withhold resources, charge unfair prices for infrastructure, and act as an unregulated monopoly (Willis et al. 1999, Bardhan 2002). However, the clout of local representatives would help avert corruption of the state, with good behavior also leading to rewards; without federal supervision, local people could fall back on their prior unsteady ways, and this would not be wise for Peru's authorities or future economy. With both parties working together and keeping the other in check, enforcement of environmental standards could reach a balance with local enterprises.

A decentralized system of government could enable local participation and cater to the specific needs of individual communities. In slight contrast to the central government, which manages a large number of citizens with a few representatives, local governance involves one representative per locality, which allows that representative to be able to understand the pertinent issues and improve responsiveness; there is also the incentive for local officials to take action and hold more accountability than state politicians, as the former will be elected by local people based on their performance on local issues as opposed to regional or state representatives where local issues are diluted (Bardhan 2002, Mendoza et al. 2007). Lower levels of government can now handle tasks that only the state could previously handle, largely due to technological and

infrastructural improvements that help provide public services to smaller areas (Bardhan 2002). The Interoceanic Highway could act as a similar tool, allowing government resources to disperse to rural villages more rapidly and assuredly, and could also be used as an information highway, by letting communities monitor each other and gain inspiration for new community initiatives. Decentralization of governance, combined with the highway, could help diffuse conflicts by allowing diverse groups to collaborate on positive coalitions as well as help ensure local autonomy; in addition, "subnational governments also provide the opportunity for political parties that are competitors at the national level to learn how to work together in local coalitions" (Fox 1994, Bardhan 2002, p. 111).

Learning how to reduce problems of commons-sharing in groups of local populations from the vantage of state administration may be key in curtailing resource (i.e. timber, gold) exploitation. Maki et al. (2001) and Giordano (2003) assert that over-extraction can be avoided with proper demarcation and enforcement of property rights. In circumstances of group ownership over a communal resource, such as family members over a household, the group will create its own implicit rules regarding each person's rights, responsibilities and obligations towards managing the house, and there is little concern over degradation despite multiple-party ownership; an ocean's fish stocks, on the other hand, are "open-access" resources, and would be depleted rapidly without strict treaties, agreements, and enforcements that reroute the "open-access" approach towards that of the "household" (Giordano 2003). A similar system of management could be established in Peru's frontier, though would require compliance on multiple scalar levels. A treaty that successfully resolves open-access issues at the

international or national level would not necessarily fix the commons problems at the local scale (Giordano 2003), and allocations would need to be made at more localized contexts. Legislation could arrive from the national level in the form of seasonal limitations, daily quotas, equipment regulations, or boundaries, but would then need to be scaled down to the individual "household" level—most practically being a village or group of villages. This kind of governance operates on an open-access principle rather than a multiple-boundary one, which allows the forest to be considered as one fluid body of resources that caters to indigenous peoples' use-rights and avoids complications from individual overlapping and contested land claims.

It is important for the state to recognize that the domains, or extents, of scales vary over time and are not static (Giordano 2003). With a population influx facilitated by the highway, one would predict frontier villages to expand and new communities founded along the highway; as these villages sprawl out across previously untouched forest, they may become urbanized centers for exchange themselves. Thus through expanding their domain communities will require new levels of both governance from above and representation from below, and rule-making authorities will need to recognize and accept the fact that resource legislation most likely will need to change over time.

5.3 Education

Such a transition might not come overnight, but it can be made exponentially more feasible by first shifting local perspectives of resource extraction and land ownership and encouraging environmental conservation for future generations. Non-state actors need to be informed of why unofficial roads are detrimental to the environment, and how this practice will not sustain their resource-based lifestyles the

future. The state needs a way to make farmers and landowners believe that the value of their forested land is worth more than the value of their cleared land, despite strong export markets and rising gold and timber prices that continue to drive deforestation and mining pollution. Education can yield revolutionary results on the ground, which the government can support through improved programs, laws, and enforcement, using money from conservation to fund the efforts. Perhaps the most serious social problem in the MAP region currently is the lack of training and education in agriculture, forestry, health, tourism, business management, and other professions (Mendoza et al. 2007). Currently, there are no courses for innovative land-use alternatives, and the majority of the rural population lacks information about their own region and its problems (Mendoza et al. 2007). The Interoceanic Highway could permit rural people to travel more easily to cities for training, but realistically few will commute, and the central government needs to find ways to bring the information to the frontier—possibly through a program that regional representatives are required to conduct to qualify for federal funding.

Increasing available information to the public could also help remedy the ongoing environmental tolls from gold mining. Currently, the most reliable information on potentially productive gold-rich plots comes from local hearsay and speculation, which often results in unnecessary land degradation where gold is in fact scarce (Hilson 2002). Systematically spaced, government-sponsored, district information centers (elaborated on in the forthcoming section) could conduct organized scientific or geologic surveys and determine the most efficient plots. In small-scale gold mining, "environmental complications generally occur because of low safety

awareness and levels of training, poor exploitation of selective resources…an absence of environmental standards [enforcement], and utilization of highly inefficient equipment" (Hilson 2002, p 59). Local centers on the ground level could educate people about the harmful human and environmental effects of mercury, train them in sustainable practices and equipment use, ensure environmental compliance, and provide information on the most productive mining locations. Unfortunately, such a program might be difficult to implement initially due to a need to train the educators, and there might not be any observable evidence of changes for several years after the start of the program, making continued funding difficult without proving effectiveness. Eventually, the state may pull its funding here, but education should not simply be dropped from the agenda; non-governmental organizations (NGOs) may be the most promising actors to pick up the reigns and offer educative programs in sustainability.

5.4 Mining Solutions

With rising gold prices, facilitated highlander migration efforts, more expedient, reliable, and cheap transportation of goods, and stagnant government intervention, gold mining alone could contribute to significant degradation of the Peruvian Amazon and its inhabitants, independent and regardless of logging practices. A new control strategy must be applied, specifically one that fuses central and local governance systems in order to better manage the gold mining sector—an industry that must be addressed in anticipation of increased human access to healthy ecosystems. Although over ninety-nine percent of Peru's gold mining operations are illegal (Garcia Navarro 2009, interview with Antonio Brack), Peru can learn from the approved subdivision about how to effectively manage more operators. If large-scale mining concessions are

authorized in the north of the country, then small-scale, equally supervised, commercial businesses should be able to exist in the south along the highway. Creating a legitimate artisanal mining industry might help contain the spread of environmental damages and improve government agencies' control of individual operations. For the system to work effectively it is fundamentally important to have national recognition of small-scale industry, by legalizing it through central-government-issued permits and records, strong local enforcement, and strict punishments (Hilson 2002). The national government could more easily tax the sale of gold this way, as well as minimize unacceptable work practices.

In order to accomplish this, Peru's central administration would be wise to establish government-funded, district support centers situated centrally within mining communities and other rural villages along the highway where mining was in high volume. These district centers would provide local registration permits and fair gold-purchasing services, as well as offer environmental management services through (possibly mandatory) training or education. As mentioned earlier, this would require a balance between top-down support and bottom-up compliance, with each district center catering to the unique cultural requirements of local situations. Perhaps the largest problem might arise from the seemingly recurring theme of understaffing and the inability to figuratively crack the frontier's anarchic barrier (Gaventa and Valderrama 1999, Hilson 2002). There is a deficit in human capital available to operate the number of district centers that would realistically be needed to have a surefire outcome; staff would need to be trained on how to teach local people about environmental and human health, how to effectively record mining operations and issue permits, and how make sure

all the miners in the area are in compliance. District centers could not possibly reach out to all the miners; the miners, likewise, may not have access to transportation, and would thus opt to sell their product to illegal traffickers than commute short distances to district centers (Hilson 2002). While the perfect solution would be to employ agents to travel to isolated miners and purchase their gold for the government centers, again the obstacle is due to lack of manpower (Willis et al. 1999). Centers could be established fewer and farther between in order to help fill staff positions, but at broader scales the centers become even less effective at communicating with miners; these would likely be situated in more populated hubs, while illegal miners might operate far within the forest. Small-scale gold mining is an issue specific to the local and regional levels (Hilson 2002), for miners may often reside close together, and their pollution is most heavily concentrated within the local frame.

Of course, one might argue that establishing a domestic gold mining sector would legitimize all mining operations legal and illegal, and it would be practically impossible to tell the two kinds of gold apart. In theory, education, as well as the hybrid governance system could discourage this; the government could require some certification stamp on all trafficked gold, and hold local representatives, nearby district centers, and their communities responsible for illegally mined gold. The government should facilitate licensing procedures to encourage cooperation, and while people could still find ways around certification with fraudulent authentications, strong enforcement and harsh penalties might discourage some from entering on the side of illegal trade to begin with. The government could also significantly steepen the price of mercury by implementing a “mercury tax” or limiting the import of it into the country, and keep a

much closer watch on where and who its mercury is sold to by creating strictly monitored mercury vendors. Cost-cutting miners might find the incentive to use other techniques through improved equipment or by extracting the available mercury previously deposited in rivers, thus cleaning up waterways. New technologies can help reduce mercury emissions by ninety percent, and success stories have been reported from the Philippines, Zimbabwe, and neighboring Bolivia (Hilson 2002); unfortunately, this equipment can cost in the range of $200—roughly one-ninth of the annual Gross National Income per capita in Peru (Nationmaster.com). Government subsidization of this equipment—conceivably funded partially by mercury tax revenue—may be a crucial factor in helping limit mercury pollution, and could be discounted as a bonus for registering with the government's small-scale mining program.

5.5 Deforestation Solutions

Governance has a long way to go before controlling the illegal logging trade in Peru's frontier (Fearnside and Graça 2006), but with the right steps forward it can be achieved. While illegal logging and land clearing endeavors may never entirely be stopped, effective frontier governance can at least slow the rate of deforestation (Fearnside 2007). First, a better cataloguing system is needed to identify legal landowners and ensure that grileiros and land-squatters do not confiscate large parcels unchecked. The system of being able to control unused land solely based on using it is an incredibly outdated routine, and with education and proper enforcement, this idea of self-acclimation can be eradicated (Fearnside and Graça 2006). In several regions of developing Amazonia, problems over land claims arise from disputes over overlapping boundaries (Mendoza et al. 2007), and these issues are likely to increase in number

as the Interoceanic Highway grants access to new lands for agriculture and resource harvesting. The government has not yet worked out zoning implications, and it would be unwise to proceed with highway construction until this is resolved. A federal highway might infer the presence of more qualified ground level forces to combat illegal logging efforts, but certainly not all can be done to foil the intentions of loggers set on intact rainforest. To fight the corruption of illegal logging efforts, enforcement officials and checkpoint guards should be paid a worth-while commission, related to how many operations (and of what magnitude) they seize, and using penalties forfeited by offenders to support wages. Salaries could also be subsidized by a "sustainability toll" (Fearnside 2007, p. 608) on all trucks carrying timber.

To help offset the negative ecological isolation effects caused by fragmentation from unofficial roads, efforts should be made to continue species migration abilities. From least to highest cost, these could include (but are not limited to): maintaining the canopy above unofficial roads; reducing traffic speed; writing legislation to reduce vehicle emissions; installing underpasses or canopy bridges; retrofitting small bridges for terrestrial species; building high bridges above the canopy; and reducing vehicle noise and headlight disturbance through new technologies (Goosem 2007). Installing or promising to maintain such corridors could limit settlers from colonizing areas when loggers evacuate if the state is able to act quickly and designate these areas as protected territories. Protecting lands can significantly diminish the chance of trees being removed, and occasionally even the mere rumor that a reserve will be created can deter deforestation (Fearnside and Graça 2006). Geographically, reserves should be projected to encompass the Interoceanic Highway on either side, to discourage

unofficial roads jettisoning directly from it. Peru has much to gain if it invests in the preservation of its economical carbon stocks and biodiversity, but the fifteen percent of Peru that is under protected status is currently well undermanned, and the government needs to create a legitimate policing force (Kirby et al. 2006, Reaney 2011).

These reserves, as well as the staffing for them and highway environmental enforcement, need to be implemented during the planning stages before highway construction gets underway. If the government waits too long to impose preventative measures, deforestation will have already begun along the route in anticipation of its improvement (Fearnside and Graça 2006, Fearnside 2007). The gap in time is crucial for allowing the outward spread of deforestation, as it has happened where local mitigation efforts were supposed to parallel government-funded projects, yet the project was pushed ahead to completion while the promised governance lagged behind (Fearnside 2007). Peru's two staple environmental laws (Ley No. 27037, Ley de promoción de la inversión en la Amazonía (1998), and Ley No. 27308, Ley forestal and de fauna silvestre (2000)) promote sustainable development both through private and public investments and conservation of biodiversity, as well as non-timber forest production and ecosystem services such as eco-tourism; despite good intentions, both have fallen short by merely promoting economic activities without following up on sustainability (Maki et al. 2001). The opportunity for resource conservation has been provided, but top-down implementation seeks economic advancement first and foremost; only by enabling local participation might sustainable forest management truly happen. If the Peruvian Government rushes forward with the construction of the Interoceanic Highway without first establishing and acting upon its social and environmental mitigation measures,

deforestation may be solidified and loggers, miners and colonists will be difficult to relocate.

6.0 Conclusion

Peru does not appear to be politically or socially stable enough at the current moment for the Interoceanic Highway to result in an economic and infrastructural success; the current level of enforcement over destructive artisanal gold mining, illegal logging, and self-proclaiming landowners is not at an appropriate level to combat the degradation that will stem from increased access to the more rainforest from the paved highway. I reason that all efforts should be made to not build the Interoceanic Highway, as this paper attempts to show how the paved highway would provide access to new areas for gold and timber resource extraction, producing unofficial side roads and clearings that would be resettled by colonists and forever changed into communities.

Ironically, while the government aims at using the Interoceanic Highway to open up trade opportunities and spark an increase in GDP, the highway also opens up previously inaccessible forest to people who comb out irreplaceable resources at unsustainable rates, in effect sponsoring a stagnant economy with little rainforest left to profit from in other ways. Authorities can only monitor so much of the approximately 2,600 km roadway and its surrounding landscape, and perhaps a more effective, promising, and long-lasting solution would be to educate rural locals about the importance of the preserving the environment and how to make more sustainable livings. The more people who can be taught to care for the future of the Amazon Rainforest, the less people perhaps will cut down trees on their own property, create paths

through habitats, steal ecologically important trees from the forest, become personally involved in the illegal and polluting gold mining industry, or stand by and watch as others do so.

Unfortunately, the strategies and alternatives expressed in this paper may be little more than idealistic proposals; effective governance in the Amazonian frontier is often not a practical goal in reality, and one would be naive to dream of such smooth solutions. The financial agendas of international corporations, Brazilian, Peruvian, and Asian central governments, hydroelectric and logging companies, artisanal miners, farmers and ranchers, and other national and multi-national stakeholders are not in sync with the land and resource needs of indigenous tribes, local residents, and rural villages. Different levels of scale contain competing stakeholders, and those near the top with the most money may be able to bend information to fit their schedules. While prospective formulas such as conducting impact assessments, educating local people about sustainable practices, and designating powerful local representatives to control illegal and detrimental practices might solve many foreseeable problems likely to come about from the completion of the highway, most of these solutions will likely not soon be effectively implemented, and even despite vast research, NGO work, and foreign aid for local peoples, it is unlikely there will be any sudden turns in highway plans.

Acknowledgements: I would like to thank Dr. Finley-Brook for her relentless valuable support and insightful feedback throughout the entire process of drafting and composing this paper. I would also like to thank Dr. Stevenson, Dr. Salisbury, my parents, and Curtis Thomas for their personalized assistance and guidance.

~~~~~~
~~~~~~

Bibliography

Arima, Eugenio Y., Robert T. Walker, Marcio Sales, Carlos Souza Jr., and Stephen G. Perz. "The Fragmentation of Space in the Amazon Basin: Emergent Road Network." *Photogrammetric Engineering & Remote Sensing* 74.6 (2008): 699-709. Michigan State University. Web. Jan.-Feb. 2011.

Bank Information Center. *The Brazil-Peru Trans-Oceanic Highway Project Summary*. Rep., 2005. Web. Jan. 2011. <http://www.bicusa.org/en/Article.10028.aspx>.

Bardhan, Pranab. "Decentralization of Governance and Development." *Journal of Economic Perspectives* 16.4 (2002): 185-205. *JSTOR*. Web. June 2011.

Brandon, Katrina, Gustavo A. B. Da Fonseca, Anthony B. Rylands, and Jose Maria Cardosa Da Silva. "Special Section: Brazilian Conservation: Challenges and Opportunities." *Conservation Biology* 19.3 (2005): 595-600. Wiley Online Library. 7 June 2005. Web. Jan. 2011.

Bury, Jeffrey. "Livelihoods in Transition: Transnational Gold Mining Operations and Local Change in Cajamarca, Per." *The Geographical Journal* 170.1 (2003): 78-91. USCS. Web. Mar. 2011.

Chavez, Michael Robinson, and Patrick J. McDonnell. "Transoceanic Highway a Gain - but at What Cost?" Philadelphia Inquirer [Philadelphia] 12 Dec. 2010, International sec. <http://www.philly.com/philly/news/nation_world/20101212_Transoceanic_Highway_a_gain_-_but_at_what_cost_.html>

Conover, Ted. "Peru's Long Haul: Highway to Riches, or Ruin?" *National Geographic* June 2003. *NationalGeographic.com*. Web. <http://ngm.nationalgeographic.com/ngm/0306/feature5/>.

Fearnside, Philip M, and Paulo Mauricio Lima de Alencastro Graça. "BR-319: Brazil'sManaus-Porto Velho Highway and the Potential Impact of Linking the Arc of Deforestation to Central Amazonia." *Environmental Management* 38.5 (2006): 705-16. *SpringerLink*. Web. Jan. 2011.

Fearnside, Philip M. "Brazil's Cuiabá- Santarém (BR-163) Highway: the Environmental Cost of Paving a Soybean Corridor through the Amazon." *Environmental Management* 39.5 (2007): 601-14. *SpringerLink*. Web. Jan. 2011.

Fox, Jonathan A. "Latin America's Emerging Local Politics." *Journal of Democracy* 5.2 (1994): 105-16. *Center for Global, International, and Regional Studies*. UCSC, 1 Apr. 1994. Web. June 2011.

Gaventa, John, and Camilo Valderrama. "Participation, Citizenship and Local Governance." *Institute of Development Studies* (1999): 1-15. *Universitat De Valencia*. 21 June 1999. Web. June 2011.

Garcia-Navarro, Lourdes. "Traveling Down the Amazon Road." The Amazon Road: Paving Paradise for Progress? NPR, 14 Sept. 2009. National Public Radio. 14 Sept. 2009. Web. Mar. 2011. <http://www.npr.org/templates/story/story.php?storyId=112489035>.

Giordano, Mark. "The Geography of the Commons: The Role of Scale and Space." *Annals of the Association of American Geographers* 93.2 (2003): 365-75. JSTOR. Web.

"Gold Price Today in Peru in Peruvian Nuevo Sol." *XE*. Web. 30 May 2011. <http://www.goldpricerate.com/english/gold-price-in-peru.php>.

Goosem, Miriam. "Fragmentation Impacts Caused by Roads through Rainforest." *Current Science* 90.11 (2007): 1587-595. *Indian Academy of the Sciences*. Web. Feb. 2011.

"Gross National Income (per Capita) Statistics - Countries Compared - Nation Master." NationMaster - World Statistics, Country Comparisons. Web. June 2011. <http://www.nationmaster.com/graph/eco_gro_nat_inc_percap-gross-national-income-per-capita>.

Helmsing, A.H.J. "Partnerships, Meso-institutions and Learning; New Local and Regional Economic Development Initiatives in Latin America." *Institute of Social Studies* (2001): 1-16. *UCL*. June 2001. Web. June 2011.

Herod, Andrew, and Melissa W. Wright. "Placing Scale: An Introduction." Introduction. *Geographies of Power: Placing Scale*. Oxford [u.a.: Blackwell, 2002. 1-14. University of Georgia Dept. of Geography. Web.

Hilson, Gavin. "The Environmental Impact of Small-scale Gold Mining in Ghana: Identifying Problems and Possible Solutions." *The Geographical Journal* 168.1 (2002): 57-72. JSTOR. Web. May 2011.

Hiskey, Jonathan T., and Mitchell A. Seligson. "Pitfalls of Power to the People: Decentralization, Local Government Performance, and System Support in Bolivia." *Studies in Comparative International Development* 37.4 (2003): 64-88. *La Sociedad Civil*. Web. June 2011.
“Inclusion, Socioeconomica, y Ambiental en la Region MAP.” *Amazonlink.org*, 2009.

Kirby, K., W. Laurance, A. Albernaz, G. Schroth, P. Fearnside, S. Bergen, E. Venticinque, and C. Dacosta. "The Future of Deforestation in the Brazilian Amazon." *Futures* 38.4 (2006): 432-53. *ScienceDirect*. Web. Jan.-Feb. 2011.

Laurance, William F., Ana KM Albernaz, Gotz Schroth, Philip M. Fearnside, Scott Bergen, Eduardo M. Venticinque, and Carlos Da Costa. "Predictors of Deforestation in the Amazon." *Journal of Biogeography* 29 (2002): 737-48. Blackwell. Web. Jan. 2011.

Laurance, William F., Miriam Goosem, and Susan G.W. Laurance. "Impacts of Roads and Linear Clearings on Tropical Forests." *Trends in Ecology and Evolution* 24.12 (2009): 659-69. Trends in Ecology and Evolution. Cell, 11 Sept. 2009. Web. May 2011.

Liverman, Diana. "Who Governs, at What Scale and at What Price? Geography, Environmental Governance, and the Commodification of Nature." *Annals of the Association of American Geographers* 94.4 (2004): 734-38. *AIMES*. Web. May 2011.

Maki, Sanna, Risto Kalliota, and Kai Vuorinen. "Road Construction in the Peruvian Amazon: Process, Causes and Consequences." *Environmental Management* 28 (2001): 199-214.*Cambridge University*. May 2002. Web. Feb.-Mar. 2011.

Marston, Sallie A. "The Social Construction of Scale." *Progress in Human Geography* 24.2 (2000): 219-42. Florida State University. Web. May 2011.

Mendoza, Elsa, Stephen Perz, Marianne Schmink, and Daniel Nepstad. "Participatory Stakeholder Workshops to Mitigate Impacts of Road Paving in the Southwestern Amazon."*Conservation and Society* 5.3 (2007): 382-407. *Conservation and Society*. Web. Mar. 2011.

Muradian, Roldan, Joan Martinez-Alier, and Humberto Correa. "International Capital Versus Local Population: The Environmental Con£ict of TheTambogrande Mining Project, Peru." *Society and Natural Resources* 16 (2003): 775-92. *Uky.edu*. University of Kentucky. Web. Feb. 2011.

Perz, Stephen G., Marcellus M. Caldas, Eugenio Arima, and Robert J. Walker. "Unofficial Road Building in the Amazon: Socioeconomic and Biophysical Explanations." *Development and Change* 38.3 (2007): 529-51. Michigan State University. Web. Jan. 2011.

Perz, Stephen, Silvia Brilhante, Foster Brown, Marcellus Caldas, Santos Ikeda, Elsa Mendoza, Christine Overdevest, Vera Reis, Juan Fernando Reyes, Daniel Rojas, Marianne Schmink, Carlos Souza, and Robert Walker. "Review. Road Building, Land Use and Climate Change: Prospects for Environmental Governance in the Amazon." *Philosophical Transactions of the Royal Society B: Biological Sciences* 363.1498 (2008): 1889-895. Print.

Reaney, Michael. "Peru's Less-Than-Benign Environmental Policy." *Council on Hemispheric Affairs*. COHA, 8 Apr. 2011. Web. Apr. 2011. <http://www.coha.org/perus-less-than-benign-environmental-policy/>.

Veiga, M., P. Maxson, and L. Hylander. "Origin and Consumption of Mercury in Small-scale Gold Mining." *Journal of Cleaner Production* 14.3-4 (2006): 436-47. *Global Mercury Project*. Web. Mar. 2011.

Willis, Eliza, Christopher Da C.B. Garman, and Stephan Haggard. "The Politics of Decentralization in Latin America." *Latin American Research Review* 34.1 (1999): 7-56. *JSTOR*. Web. June 2011.