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&

Environmental Impacts in the Amazon:

Focusing on

Transport Infrastructure

Honors Senior Capstone
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Abstract

Infrastructure investments are key igniters for development, in particular, in developing countries. The more globalized the world becomes the higher is the need to minimize production cost of goods in order to become more competitive in the international markets. On the environmental side of the globe, climate change and alerts of global warming have recently gained power and raised sustainability concerns. Both the promotion of development and environmental conservation are crucial to all countries worldwide. In the Brazilian Amazon, the first has historically affected the later, leading to environmental impacts that could affect the entire world. Within this context this capstone focuses on the interaction between infrastructure development (mainly transport infrastructure) and environmental impacts (particularly deforestation) in the Amazon. It qualitatively assesses the socioeconomic benefits of opening new roads as compared to the environmental costs such infrastructure developments in order to identify the main regional issues that must be resolved in order to achieve sustainability in the region. At the core of these issues, it is argued, are misguided governmental policies, which have continuously "fueled" the deforestation cycles in the area.

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1. Introduction

Development is desirable to every nation in the world. In developing countries, especially, infrastructure investments are key igniters for development. The more globalized the world becomes the higher is the need to minimize production cost of goods in order to become more competitive in the international markets. On the environmental side of the globe, climate change and alerts of global warming have gained power in the last few years. Nowadays, there is no doubt that the promotion of development and environmental preservation is a crucial need of all countries worldwide. What, then, is the relationship between infrastructure development and environmental preservation when the promotion of the first affects the preservation of the latter? Is it possible to promote infrastructure development in the Amazon without compromising the environment? If so, how should it be done? These are the key questions that this paper intends to address from analyzing the current debate on infrastructure development, reviewing the historical development initiatives in the Amazon, and discussing the current governmental plan to pave the missing half of highway BR-163/Cuiaba-Santarem.

High levels of deforestation in Brazil arose worldwide concern and scholarly debate about who should be responsible for the Amazon: Brazil and its neighbors or international organizations and NGOS led by the Greenpeace. While environmentalists defend that the Amazon must be watched by international players, Brazilian scholars and authorities mostly argue that since the Amazon within Brazil and its neighbors' territory, they have the right to protect and exploit it as a way of spreading development just like any other country has the right to exploit their oil.

Within this context, several infrastructure projects have been applied and are currently being discussed in the region. For that purpose, South American countries have created the

Initiative for the Integration of Regional Infrastructure in South America (IIRSA), a dialogue forum that "seeks to promote the development of transport, energy and telecommunications infrastructure from a regional viewpoint, aimed at the physical integration of the twelve South American countries and the achievement of an equitable and sustainable territorial development pattern."[1] IIRSA consequently serves as a connection between private and governmental investors and the financial institutions willing to support them, such as the Inter-American Development Bank (IDB).

While the debate on who should be responsible for the Amazon has been extensively explored, taking into account the Amazon's potential to generate environmental impacts in the entire world, a new and more specific issue needs to be discussed among international scholars. That is the link between infrastructure development and environmental impacts in the Amazon, a region that brings together natural resources, economic potential, as well as cultural and ethnic diversity. Very attractive at the first look, these characteristics may turn into a worldwide problem in the era of climate change and global warming. While economic potential and the local communities call for infrastructure development as a tool to economic development and higher living standards, the region's natural resources supplicate for help as it faces large-scale deforestation, expanded agricultural and urban frontiers in the tropical forest, among other environmental impacts related to the region's exploitation.

Given the increasing interaction between environment and development, it becomes crucial to further assess infrastructure projects in environmentally volatile areas long before they are applied. In other words, in order to understand how infrastructure development could be instigated without compromising the environment, the benefits and costs of these projects must be assed from the perspectives of the country's economy, local communities, and environment

altogether – and not separately. Even before that analysis, however, it is crucial to identify the root of the environmental issues in these fragile regions. For that matter, a historical perspective is of extreme relevance prior to entering the discussion about the current concerns in the region, namely the pavement of highway BR-163/Cuiaba-Santarem.

This project's proposal is to evaluate infrastructure development in the Amazonian region with particular attention being paid to transportation projects as they have a direct impact on the nation's economy, on the local communities, and on the environment at the same time. Easier access to ports in the region would make the country more economically competitive, improve living standards of some local communities – not necessarily all –, and trigger further opportunities to exploit the forest irresponsibly. In any case, can the forest be exploited responsibly? Should there be more investment on road projects in the region? If so, what should be done to assure that these projects are sustainable? What safeguard policies do they require? What is the core cause of deforestation and derived environmental issues in the Amazon? How can these issues be controlled, minimized or eliminated?

This study pursues the answer to these questions by subdividing the focus of the debate into three sections. First, the interaction between environment and development is put into the context of the impacts of infrastructure development and environmental issues. Attention is given to the most recent trends towards sustainable infrastructure development, in special those related to transport infrastructure. Then, the Amazonian history of development is presented with emphasis on the impact of government initiatives and their effects in the region over the years. In particular, the major highway openings and the agricultural colonization programs that accompanied them are highlighted. Lastly, a discussion is presented on the current project of the Brazilian government that intends to revive the plans of paving the missing half of highway BR-

163/Cuiaba-Santarem. The government's underlying motivations are to increase the country's competitiveness in the international markets by connecting the state of Mato Grosso – Brazil's key soybean and beef producer – to the port of Santarem, in the state of Para.

2. Environment and Development

Prior to entering the specific issues concerning infrastructure development and environmental impacts in the Brazilian Amazon, it is important to understand what they actually mean as well as why and how they relate to each other. Moreover, as sustainable development is the end goal of an optimal relationship between development strategies and the environment, it must also be well understood for the purposes of this discussion. In this section, these concepts are introduced along with key questions that should be kept in mind throughout the paper.

2.1 Sustainable Development

To avoid confusing interpretations, sustainable development is considered in as a long-term perspective involving two-way relationships between socio-economic and environmental variables that lead to the conclusion that limits should be imposed on the use of natural resources in production and consumption processes.[2] Within this context, two constituents make up the concept of social welfare (which is closely related to sustainable development) in this study[3] – both positively or negatively affected by infrastructure improvement in the region: 1) development achievement, and 2) environmental amenities. Analytical problems arise from the attempt to compare the very different dimensions of these two interrelated attributes. To what extent, for example, may a higher income level compensate for deteriorating deforestation rates? How much development can a new road represent as compared to the increase in deforestation rates that can result from easier access to unpopulated areas?

It can be said that sustainable development unequivocally occurs if both constituents improve simultaneously or if one of the two improves while the other remains unaffected. Could a decline in one argument be compensated by an improvement in the other? If so, how? Does social well-being exist if there is environmental conservation advancement along with an increase in poverty and inequality? Can there be any progress in poverty and inequality while the environment deteriorates? Nowadays, there seems to be a constant increase in worldwide concern about sacrificing environmental amenities to the advantage of consumption of goods – particularly related to climate change and global warming threats.

There are several other relevant discussions that can be taken into account when looking at the interactions between infrastructure development and the environment. One could focus in the differences between developed and developing countries, in the role of government interventions, or in the assessment of environmental impacts of specific development projects, for example. In any case, there cannot be sustainable development unless limits on the use of scarce resources or assets are enforced and followed by the present generation so that future generations are also enabled to achieve their welfare objectives.[4]

Another problem that relates to sustainable development has to do with how policy intervention promotes it. In this regard, it is crucial to consider whether or not – and, if so, to what extent – economic growth can be commensurate with, or is even required for sustainability. While some believe that the appetite for economic growth harms sustainable development prospects, others emphasize the need for adequate policy interventions and argue that economic development is actually a requirement of sustainability. As can be seen, any debate involving sustainable development necessarily entails a wide range of moral issues and indicates complex linkages between economy and ecology.[5] What should be the prioritized: helping the present

poor, safeguarding the (uncertain) prospects of future generations, or a balancing both? If both, where should the line be drawn?

The notion that economic growth may result in environmental sustainability in the long run is based on the premise that as income levels rise, societies will want more environmental equality as a luxury good, generating an automatic demand for new, cleaner, and leaner technology. At the stage of development, it is argued, one would only need to worry about expanding the economy. The argument used in this case lies on the assumption that the relationship between environmental pressure and per capita income takes on an inverted U shape – referred to as the "Environmental Kuznets Curve." If this is the case, it is believed that the carbon emissions per million dollars of gross national product increase only up to a certain level along with the logarithm of GNP per capita. After that point is reached, the more GNP per capita there is, the less carbon emissions there should be.[6] This argument fails to define what level of environmental impact is needed until it would theoretically achieve its downward trend. In many causes, by the time the downward trend is reached, it may just have caused enough environmental and social impacts to make it irreversible.

Environmental problems are particular interconnected with socio-economic factors in rural areas, especially in developing and poor countries. Faced with poverty and inequality – or with higher profit opportunities –, people in such regions end up overexploiting land, aquatic systems, and forests as they pursue the essentials for their daily living. As a result of the high dependence of economic production on agriculture, fishery, and forestry, natural-resource depletion is inevitable. A vicious cycle is set in motion, in which unequal distribution of land (forcing the occupation of fragile lands mostly by the poor), absolute constraints on land development, and low productivity reinforce each other.[7] In the Brazilian Amazon, this type

cycle occurs between loggers, cattle ranchers, and soybean producers, who have negotiated occupied land with each other, pushing the "deforestation belt" further inside the forest.

Furthermore, government policies often contribute (even if unintentionally) to this type of ecologically harmful activities. This is the case, for example, when the government subsidizes agricultural inputs and/or energy, imposes negligible logging fees in natural forests, or provides access to fragile areas through the construction of roads and other infrastructure, among other cases. Moreover, the government frequently fails to provide precise information on the environment, in particular, to investors or national institutions when it is to provide the investment itself.[8] In the Brazilian Amazon, for instance, government interventions have played a crucial role in the massive deforestation levels. Great part of this disastrous development can be attributed to infrastructure, finance, and agriculture policies.[9]

In outlining the objectives of development, governments must take into account the complex relations between environment and welfare. While natural resources must not be disregarded as a source of development, they must also be seen as a constraint on it. It is fruitless to develop sustainability policies without proper consideration of the intractable linkages between poverty, inequality, and environment. Consequently, no matter what is the precise definition of sustainable development, the limited use of natural resources should serve as a guideline in policymaking.[10] Governments must be well aware of the carrying capacity of the ecosystems they are responsible for. In other words, they must be clear on how much pressure, shocks, and exploitation an ecosystem can endure before irreversible deterioration sets in.

2.2 Infrastructure Development

Infrastructure development is central to the socio-economic development of all countries and the well-being and prosperity of society. Infrastructure services are directly relevant to household, community, and economic activities as it can serve as a means to facilitate human development, economic growth, productivity in industry, and improve public services. With increased globalization comes the critical need for national economies to improve the level and quality of infrastructure development in order to remain competitive and innovative in the global market place. A variety of policies and strategic factors influence infrastructure development. In each country, economic, social, environmental, and political forces interact to determine the composition, priorities and timing of infrastructure programs. Therefore, infrastructure delivery fundamentally requires developing appropriate policy and strategic frameworks. Or else, there will be bottlenecks to economic growth and stifled human development.[11]

Among the several attempts to systematically define infrastructure, the most adequate description is said to be that of R. Jochimsen, who viewed it as "the sum of all basic materials structures, institutional conditions and human resources available to society, needed for the proper functioning of the economic sector. Jochimsen further distinguished between three components of infrastructure that are interrelated – institutional infrastructure [social or institutional capital], personal infrastructure [human capital], and physical infrastructure [physical capital]."[12] While it is crucial in policymaking to understand how these three components interact, for the purposes of this study, focus will be given to physical capital as it relates to all physical elements of transportation structures and networks.

Generally, there are five key stages to infrastructure development: 1) planning, 2) design, 3) construction, 4) operational, and 5) recycling and disposal. Traditionally, environmentalists

have been considered key participants only at the last two stages. However, there is an increased concern about including environmentalist perspectives at planning. A longer planning phase is usually required for large-scale infrastructure projects such as roads, railways, hydropower schemes, and airports, which particularly pose significant problems to site selection. In fact, the main cause of lower economic returns in infrastructure projects has been identified in the planning stage of infrastructure projects. Potentially irreversible damage and consequences can result from poorly defined and planned infrastructure projects, which often lack clear objectives and aims, creating short and long term difficulties.[13]

More recent studies highlight the importance of integrating environmental and social dimensions into project identification, preparation, appraisal, and supervision. Environmental and social analysis along with consultation with affected people and other stakeholders upstream the project cycle can provide crucial inputs into project design. It is more effective and sustainable to factor in environmental and social impacts through a holistic approach to cost-benefit analysis when selecting which investment to undertake, for example, than it is to try to address these concerns once the infrastructure has already been designed. Moreover, focus on environmental and social outcomes is also needed during implementation. Adverse environmental and social impacts often times arise from weak field-based supervision.[14]

In this respect, some types of infrastructure have particular externalities that must be considered. Some of the most relevant externalities are related to roads, railways, and airports as these can affect settlement/land use patterns, drainage, erosion, public safety, network effects, dust pollution, and – especially in the case of the Amazon – deforestation.[15] In fact, there are inherent difficulties in coordinating network infrastructures just as there is a strong argument for public sector intervention in planning them due to national security and development strategies.[16]

Increased budgetary constraints for investment and maintenance of infrastructure faced by governments worldwide have increased the need to diversify the types of investment, opening up infrastructure services (traditionally the responsibility of governments) to the private sector. In fact, it is expected the global demand for infrastructure services will continue to increase significantly across all sectors in order to facilitate economic growth and fulfill household needs. Approximately 1% of worldwide GDP (US$ 370 billion) is needed per year between 2005 and 2010 as new investment in roads, railroads, telecommunications, electricity, water and sanitation sectors only. Another 1.2% (US$470 billion) is needed for maintenance, not including expenditure on rehabilitation or upgrading of existing infrastructure in the selected sectors.[17]

As result, a major challenge brings up questions of how to increase infrastructure investment from the private sector while also keeping the appropriate level of government intervention. Within this context, public-private partnerships (PPP) have turned into a recent trend. Achieving improved performance and providing more efficient and valuable services through PPP initiatives are credited to innovation. PPP appeared as a viable means of providing hitherto unaffordable infrastructure and has considerably helped to raise public expectation of amenity and services derived from new and improved infrastructure. Furthermore, an approach to infrastructure development in conjunction with PPP forces public authorities to better define their requirements throughout and post the infrastructure development process in a way that improves procurement performance and project delivery.[18] However, it is important to note that the delivery of infrastructure services is not improved only with an appropriate project structure and secured investments. Many economists argue that it takes decades to transform master plans and projects into infrastructure capital even if a country has succeeded in raising investments.[19]

Additionally, political and professional planners, local communities, developers, and special interest groups often get into conflict. This is a result of the diverse interests of different stakeholders who, at times, are able to bring in notorious complexity to the planning process of infrastructure development. To make things worse, planning is essentially a political process and, as certain infrastructure projects tend to have a "high visibility impact," political assessments are frequently based on a desire to influence likely political voting or voting outcomes instead of on infrastructure gaps.[20]

There is a very complex linkage between infrastructure development and economic development. Several studies have pointed to a positive and significant relationship between infrastructure investment levels and economic growth. According to the economic theory, the productivity of both capital and labor is enhanced in the production process as infrastructure development increases. Thus, with the lower production costs comes increased profitability. However, there is still intense debate among economists regarding the causality running from infrastructure development to economic growth. Infrastructure investment by itself does no much good unless it is adequately used to increase international trade competition. Some developing countries, for example, have experienced a relative decline of exports due to high transportation costs and failure to maintain or improve ports and other transport infrastructure.[21]

Economists debate aside, it is important to highlight the fact that development is far more complex than economic growth, despite its key influence in infrastructure investment. By itself, economic growth is an inadequate criterion for project selection. Project evaluation must be conducted both in a macro and micro level, in a complementary way, when selecting which infrastructure projects to invest on. For macro purposes, focus should be given to the national overall goal of the project in terms of its broad policy impact or key contextual variables, such as

economic, socio-cultural, institutional, political, and environmental indicators. At the micro level, some of the key project-specific variables include choice, construction methods, size, and type of infrastructure development.[22]

In the socio-cultural sphere, some of the relevant considerations to bear in mind are particularly related to employment creation. While there is no question that infrastructure services contribute to poverty reduction through short- and long-term employment opportunities, the nature and type of infrastructure programs define the level of social impact and its sustainability. The level of employment intensiveness varies from one program to another especially during the construction and post-construction period. Regions without development potential do not experience employment creation in the post-construction phase unless other initiatives to enhance development potential are implemented alongside infrastructure programs.[23]

Political considerations are perhaps the most crucial factor in any type of infrastructure development. Investors have paid increased attention to governance, stability, and human rights issues. As a consequence, projects in situations of high risk and uncertainty can fail to succeed and reach farther implications if the political conditions are not sound. Needless to say, developing countries that lack a feasible democratic or governance structure or face human rights abuse civil wars have a significant negative impact on the interest of investors or donors in funding infrastructure projects.[24]

2.3 Towards Sustainable Infrastructure and Conservation

As has already been said, there is an essential relationship between economic growth and infrastructure development. Infrastructure affects urban, semi-urban, and rural environments and lies at the heart of sustainable development and conservation. As it plays a vital role in the well-

being and prosperity of society, understanding all aspects of the relationship between infrastructure to sustainability and conservation is key to this study. Nowadays, it has become generally accepted that most of the existing infrastructure worldwide is not sustainable in the long run and that there is an increasingly urgent need to address design choices, construction methods, and operation of infrastructure facilities in order to provide sustainable development for the built environment and satisfy governmental needs for human development along with economic growth. Sustainable infrastructure should create greater efficiencies and lead improved utilization of space taking into account reductions in waste, energy consumption, pollution, and deforestation as well as minimization of non-replaceable and replaceable natural resources. Solid guiding principles and approaches to sustainability and climate change started to become consensus among nations only in 1992, at the Rio Earth Summit. The Rio Summit reflected steady improvements in the weight of environmental evidence to support the case that unprecedented levels of economic growth and affluence are creating climate change, inequality, and human injustices since the summit on Environment and Development, in 1972. Further summits held in Japan and South Africa have subsequently confirmed and enhanced these principles.[25]

It is not possible to have a well-balanced and structured society that can enjoy high-quality townscape as well as open space and natural countryside without conservation of both urban and rural environments by means of sustainable development. The three dimensions of sustainable development – environmental, economic, and social – play a very complex role towards sustainability. While the environmental dimension imposes little difficulty of being understood, it is much more difficult to understand and quantify economic and social

dimensions. The demands from business and society have led to a perceived need to generate economic growth through increases infrastructure investment.[26]

This turns into a major problem, however, as it has caused major impacts on the environment by creating unsustainable use of non-replaceable resources, excessive waste and pollution, as well as deforestation – again, particularly in the Brazilian Amazon. There is general consensus nowadays that global warming and climate change are related to the release of greenhouse gases (GHGs) in the atmosphere. Technological advances have enabled high-quality assessments regarding deforestation, coastal erosion, pollution, and the presence of GHGs. In this scenario, it is now recognized that in order to decouple economic growth from wealth creation and well-being there must be a more responsible approach than simply economic growth by the introduction of emphasis on social and environmental integrity. For the purposes of reversing this trend, the design of sustainable infrastructure and conservation is central. Nonetheless, wherever the needs justify infrastructure actions, focus should be devoted to finding ways that mitigate adverse and social effects.[27]

Within the last thirty years, multilateral financial institutions, bilateral donors, and export credit agencies have developed environmental and social policies. This policy adaptation trend, in fact, started from widespread concern over the adverse impacts of international development projects, particularly large scale-infrastructure, water resources, and forestry worldwide. Policy progress in this direction was still relatively minor through the 1970s and 1980s, when lenders gave very little attention to environmental and social policies and most borrowers seemed unaware of them. As a result, the environmental and social impacts of these projects were not identified until the projects were already approved, during implementation. As a result of significant incidence of adverse impacts, institutions such as the World Bank suffered strong

reputational damages in a context of growing scrutiny by civil society. A positive legacy of the perceived and real mishandling of the environmental and social impacts especially of high-profile projects was the increasing demand for institutions' transparency and accountability, which gradually started to be established at several institutions that support infrastructure development projects worldwide.[28]

A relevant project that serves as an example of high environmental and social impacts and consequent damage to the World Bank's reputation is the Northwest Integrated Development Program (Polonoroeste), which is discussed in detail in the following section. In short, it was notorious for road pavement through the Amazon forest during the 1980s, mainly highway BR-364, which links Porto Velho, the capital of the state of Rondonia in northern Brazil, to the southern exporting cities. In the occasion, the World Bank supported its implementation with the purpose of providing an integrated approach to frontier development and avoiding further land conflicts and illegal logging. At the time, the road had already been carved out of the rainforest and social mitigation mechanisms had been designed. Nonetheless, BR-364 is nowadays associated with the rapid deforestation and social conflict that arose in the state. Massive opposition to this project including international campaigns organized by environmental civil society organizations (CSOs) eventually pressured the World Bank to establish its environmental and social safeguards, in 1997.[29]

Recently, the World Bank has shifted its focus towards a more balanced approach to infrastructure development. The World Bank affirms that the benefits of both people and nature have been considered in the projects supported by the institution. Moreover, the Bank now believes that it is even possible to turn people who have been adversely affected by programs and projects into supporters if they are given a stake in project benefits as well as an opportunity to

express their views and concerns at the design and implementation of projects. Civil society has gained importance on this new balanced approach not necessarily because of the fear of reputational damage, but rather because the positions must be evermore based on development impact and sustainability.[30]

Infrastructure networks designed to sustain cities and towns face a complex web of conflicting demands on resources at all levels of society. The continuing growth of commerce and trade manifests itself in transport networks, power generation and distribution networks, water treatment and distribution systems, sewage treatment, waste disposal, and communication systems. These complexities mean that the steady-state perfect built environment does not exist. Nevertheless, efforts to bring about improvement using a holistic and integrated approach must be constant just as it is vital. Some of the numerous factors that should be considered to achieve the sustainability and conservation objectives proposed include: climate change and global warming monitoring, low-carbon economy promotion, land zoning to improve the built environment, impact examination of key and large physical infrastructure networks such as transports (discussed separately in the following subsection), energy and water systems, reviewing waste management and disposal systems, and using assessment methodologies to determine the environmental performance by the use of key indictors.[31]

Another crucial need for sustainable infrastructure to occur relates to the lack of general awareness regarding the adverse implications on future generations of today's consumption of their heritage through irresponsible and uninformed use and wastage of resources that cannot be replaced. This is the case for social and cultural change. It is the responsibility of governments worldwide to educate their citizens in order to bring about a greater sense of social responsibility for the Earth's habitat and population's well-being, both now and in the future. It is worth

reminding that changes in social attitudes and cultures normally take a long time and that there must be a dedicated approach designed to change not only social attitudes but also social responsibilities.[32]

2.4 Transport Infrastructure Impacts

Transportation issues are not only a concern of poor and developing countries. Old and deteriorating roads, railways, and waterways in advanced industrialized countries are also failing to meet the ever-increasing demands imposed on them. As a result, the busiest roads become congested and there is a poor level of service on the railways, creating delays and wasted time. Moreover, the internal combustion engine and the dependence on fossil fuels cause pollution and also turn into a major source of concern. In developing countries, economic growth is restricted by the lack of transport infrastructure, which prevents easy access to markets for trading goods and services. It can be said, in fact, that the main problem for poorer developing countries has more to do with the growing gap in prosperity with industrialized countries than with pollution and sustainability itself. An attempt proposed by the Kyoto Protocol, in 1997, to benefit developing countries is the system of carbon credits, in which they can trade these credits with industrial producers who cannot meet their GHG targets.[33]

The argument that more roads simply encourage greater road use and result in further increases in congestion, pollution, and deforestation is of great relevance to the Brazilian Amazon. To avoid such issues while also meeting the increased levels of demand, the aim should be to reduce the frequency of journeys by efficient and effective land use together with developments in communication and information technology. In addition, it is necessary to implement holistic strategies geared towards the integration of different transport systems to provide ease of access along with regular and reliable services using public transport. This

approach is intended to move away from the roads vehicle use of personal needs, supply and distribution of goods, and business requirements, substituting them by public transport such as trains, trams, and buses.[34]

Yet, this approach may fail to address the occupation of new fragile land in the Brazilian Amazon, which can be an inevitable result of easier access to areas that are currently inaccessible given the precarious or non-existing roads. Another means of transport relevant to the case of the Brazilian Amazon that could be improved are the waterways, which have fallen out of use worldwide, except for those that lead to coastal ports where goods are imported or exported and water-borne is provided inland by barges. In all cases, technological design and development of all forms of transport should be given special attention in the pursuit for more reliable, fuel-efficient, increased levels of passenger comfort and safety, as well as environmentally sound safeguards peculiar to each region where better access to transportation is needed.[35]

3. The Region: Historical Development[a] Perspective

The Rubber Cycle

At the early colonization times of the Americas, the Amazon did not sound economically attractive compared to the other regions in which gold and silver were abundant. For centuries, the "green hell" was set aside from the development initiatives. Only after 1720, while the mining cycle was still the main economic activity in the center-south areas of Brazil, the Amazon began to be seen as economically interesting as rubber became profitable. The first wave immigrants to the Amazon would only start after the severe droughts that hit the Northeast between 1877 and 1900. Some 160,000 emigrants, mostly rubber-seeker northeasterners from

[a] The term "development" used particularly in this section refers to the perspective of the Brazilian government and people at time these initiatives were implemented. It does not necessarily refer to the notion of development of the author.

the state of Ceara, were responsible for the "rubber boom" that would follow in the state of Acre[36]. They were attracted by the abundance of rubber trees, native to the Amazon[b]. Between 1905 and 1910, the rubber cycle achieved its peak, as rubber was the second product in Brazilian exports, right after coffee. In 1910, it contributed to 40% of the national exports value. Brazil dominated the international markets for elastic rubber up until then, when Asia suddenly arose as a strong competitor and consequently led to an economic debacle in Brazil, and especially in the Amazon.[37]

In a private initiative, around 1927, Henry Ford was one of the first people to bring the notion of economic development to the Amazon. Ford invested heavily in the cities of Fordlandia (named after Ford himself) and Belterra, in the state of Para. Ford intended to cultivate his own rubber plantations in order to avoid the natural rubber price impositions by the Asians. His investments turned into a major failure when pests heavily hit rubber plantations, around 1939. As a result, Ford passed on his properties to the Brazilian government at very cheap prices soon after the end of World War II. As the Brazilian government relied on its navy forces as the main means of transportation in the Amazon, during the war, the Amazon was particularly abandoned as the coastal Merchant Marine was paralyzed, completely cutting off the Amazon from the rest of the country for two whole years.[38]

Marching to the West: Assessing the Amazonian Opportunities and Risks

Henry Ford's initiative also served to alarm the Brazilian government of the risks of foreign incursion in the still vastly empty west and north regions of the country. Colonization, thus, would gradually surge as a solution to protect the region from the foreign interests while also benefiting the settlers and numerous peasants instead of only a few landholders. Getulio

[b] The rubber tree was described and classified by Fusee Aublet around 1972. Aublet denominated it as Hevea Brasiliensis. Decades later, it would be transplanted to the Asian British colonies located in equatorial areas. There, the rubber tree investors had financing means and cultivating methods not available in the Amazon (Rebelo, 1973).

Vargas, the first Brazilian president to visit the Amazon, reinforced the idea of a nationalistic people's movement in the Amazon in 1940, when he delivered his notable "March to the West" speech[39]:

> Nothing will stop us in this movement which is, in the 20th Century, the highest task of civilizing man: to conquer and dominate the valleys of the great equatorial torrents transforming their blind force and their extraordinary fertility into disciplined energy. The Amazon, under the impact of our will and our labor, shall cease to be a simple chapter in the history of the world and, made equivalent to other great rivers, shall become a chapter in the history of civilization.[40]

Upon his return from the trip to the Amazon, Vargas announced the approval of a plan for the colonization of the still distant states of Goias, in the center-west region of Brazil. Settlers would be provided with a free house and fifty acres of public land to migrate to Goias.[41] While the war times prevented him from going much further than his speech and initiative in the center-west region, the notion of occupying the Amazonian areas would not be forgotten.

In the decades to follow, the focus on development in the Amazon would focus mainly in three different areas: industrialized exploitation of natural resources, large-scale cattle ranching, and small-farm colonization. Brazil has traditionally expanded its agricultural frontier in order to keep up with growth in demand for agricultural products. Despite the several claims of social integration, the primary reasons to develop the Amazon are economic and geopolitical, namely: the discovery of spectacular mineral wealth by sideway-looking radars; the existence of reasonably good agricultural lands in certain areas; the high potential for lumber extraction of some forested areas; and the geopolitical fear of foreign interventions. Altogether, these facts would lead to the government initiatives of development in the Amazon with road construction being crucial for their achievement.[42]

Governmental Initiatives in the Amazon

The First Wave of Governmental Initiatives

The wave of major Brazilian government development initiatives in the Amazon can be said to have officially started with the establishment of the Amazonian Economic Development Superintendency (SPVEA), in 1953. The SPVEA was to design to apply 3% from the total Brazilian tax revenues to the Amazon. At the initial phase, however, environmental destruction did not spread because the investment was still relatively little and it was mostly concentrated in agricultural activities near Belem, capital of Para. By 1967, per-capita income in the Amazon was no more than US$171 and population density remained under one inhabitant per squared kilometer. Concerned with the low progress, the Brazilian government revitalized SPVEA in 1966 and turned it into the Superintendency for the Development of Amazonia (SUDAM). At the time, SUDAM conferred "free port" status to about 10,000 squared kilometers, including Manaus.[43] In fact, SUDAM would be extinct in 2001 after several corruption denunciations, giving place to the Amazon Development Agency (ADA). In 2007, the Lula government incorporated ADA's structure to the "new SUDAM."[44]

Another major governmental initiative that affected the development approach in the Amazon was the inauguration of Brasilia as the new capital of Brazil, in 1960. The government of Juscelino Kubitschek based its decision in the 1891 constitution, which indicated the Central Plateau as the strategic location for the ideal Brazilian capital. The idea was to integrate "all the Brazilian Federal Units in one singular group, in which none of them was put into a position either inferior or privileged compared to the rest of the country and to populate the interior of Brazil, considering it as a crucial need to the existence of the Nation."[45] Thus, Brasilia was meant to be the political, cultural, and economic pole of the country, around which the entire

national development process should circulate. Moreover, it served is a base point to "conquer" the forgotten Amazon.

Promising to deliver "fifty years [of development] in five", Kubitschek was elected to bring rapid economic progress to Brazil. With this purpose, it was under his government that the first and link between the Amazon basin and the rest of Brazil started to be constructed; the 2,100-kilometer highway became known as Belem-Brasilia. From that point on, millions of people who lacked other opportunities in their areas, particularly in the Northeast, began to be pushed through dense tropical forest. About two million people soon crowded the trucks and buses that traveled with goods between Belem and Brasilia. The Amazon was now officially connected with the rest of the nation and so was the new trend of massive road-building programs and agricultural colonization (discussed in the following subsection) under the catchy premise of "Integrar para não Entregar" – integrate (the region) in order to not hand it over (to the foreigners).[46]

The Second Wave of Governmental Initiatives

The military regimes, starting with Castelo Branco, furthered the incentives to develop the Amazon. In fact, the abolition of the SPVEA – under charges of technical incompetence and misuse of funds – was part of Castelo Branco's government plan called "Operation Amazonia." Basically, Operation Amazonia involved a series of legislative acts and decrees enacted in 1966 and 1967 that intended to attract private enterprises to the region through a compilation of governmental incentives summarized as increased public infrastructure (roads, airports, and telecommunications, for example) along with special fiscal incentives and credit lines for private investors willing to operate in the Amazon.[47]

From that point on, the new development agency, SUDAM, became part of the Ministry of Interior. Moreover, the reorganized Amazonian Bank (BASA) replaced the old Credit Bank of the Amazon to serve as the financial arm of SUDAM. The first phase of the development plan promoted by SUDAM, between 1967 and 1971, encouraged private investment in industrial, agricultural, livestock, and forestry resource. Between 1972 and 1974, the development plan was concentrated in the National Integration Plan (PIN) of President Emilio Medici, which prioritized road building and small farmer colonization. Nonetheless, the areas in which SUDAM and BASA were involved continued to focus mainly in region-wide investment in ranches and industries. Large-scale enterprises became the focus of regional development policies again between 1975 and 1979, the third plan. As of 1976, for example, only22 investment projects were approved for services and infrastructure compared to 335 in the agricultural sector (mostly in cattle ranches) and 171 in the industrial sector.[48]

The geopolitical concerns were particularly related to Peru and Venezuela, who had already initiated programs of occupation and development in their respective Amazon region. Consequently, the military leaders in Brazil were eager to establish self-sustaining settlements in the area in order to ensure national sovereignty. The militaries failed, however, to consider the unique physical and human environments of the Amazon in their economic development strategies.[49]

SUDAM's development plans have been strongly criticized over the years. Most criticism points to its tendency to foster projects only in or near the two major urban centers of the region, Manaus and Belem; to the fact that it failed to affect a larger population in the region through its mostly capital intensive projects; and to its focus on producing mainly export products for the industrial south. In addition, most of the cattle projects that were implemented

between northern Mato Grosso and sourthern Para – today's critical "deforestation belt" – were approved by SUDAM. In average, the size of each project was of 23,465 hectares of cheap land value to be used for extensive ranching. For each 1,000 hectares, only 2,3 jobs were created.[50]

The creation the Superindency of the Duty-Free Zone of Manaus (SUFRAMA) was also part of Operation Amazonia. One of the most important aspects of the federal legislation incentives in the Amazon, SUFRAMA's main incentive was the reduction of the high import tariffs in effect elsewhere in Brazil through the creation of a free trade zone. Through SUFRAMA, fiscal incentives were given out to promote private investment for the formation of an industrial, commercial, and agricultural center in the region's interior. While it led to rapid in crease in the population of Manaus and improved local employment, it has been argued that few of SUFRAMA's have extended beyond the city's limits. As such, it might have succeeded as an urban development policy, but failed to deliver the regional changes it was supposed to.[51]

In short, the developmental approaches promoted in the Amazon were not much different from a colonial use of resources. Actions were taken primarily around the two main cities, Belem and Manaus, and the projects involved extensive landholdings, low labor requirements, and the production of a limited number of export products. In fact, these strategies may have further depopulated the interior of the Amazon towards Belem and Manaus, failing to encourage significant in-migration.[52]

The Root Causes of Deforestation

The list of deforestation impacts has extended from local to worldwide issues over the years. In the case of the Amazon, in particular, the list of environmental impacts derived from deforestation is so extensive that it could take a whole study simply on this matter. For the

purposes of this study, the main focus will be on identifying the root causes of deforestation as an attempt to address the issue at its core.

In general, the causes of deforestation vary significantly among regions worldwide and even within countries. There is an overall consensus among experts, however, that the spread of small-scale agriculture is one of the most important causes. In the Amazon, small-scale agriculture accounted for an average of 150,000 square kilometers every year by 1989. Other proximate causes involve commercial logging, fuelwood gathering, cattle ranching, mining, urban growth, hydroelectric development, and road building. These factors are indeed very relevant and must be taken into account, despite the fact that one cannot determine with much precision the relative contribution of each of these activities. Nonetheless, there are underlying causes of forest destruction that must be addressed in order for the proximate ones to be controlled.[53]

It does not help to "blame the victims" and hold only the small farmers as responsible for tropical depletion. While further research is still needed in order to better understand the underlying causes, some crucial factors are already known. Poverty, unequal land distribution, as well as rapid population growth combined with low agricultural productivity certainly figure as some of the root causes of deforestation. More importantly, though, is the causes that can affect all of the above, and those revolve around misguided public policies that can purposely or inadvertently provide the "fuel" to rapid forest destruction. In fact, unless economic incentives encourage people to do the opposite, attempts to stop or reduce deforestation only through land-use zoning, legislative national park creation or prohibition of certain types of economic activity, among other fiat measures are unlikely to succeed.[54]

By 1989, nearly one-fourth of the forest had already been cleared around the major overland routes in the states of Rondonia and Mato Grosso, opened under the military governmental development plans. In comparison, by that time, over 90% of the forest remained intact in the state of Amapa, which was unaffected by the governmental policies.[55] Another relevant example of how government polices lay at the core of the deforestation causes are the consequences of the tax credit mechanism implemented to attract private investors to the Amazonian regions. Despite the fact that it had been officially prohibited since 1979, by 1985, out of the 950 projects approved by SUDAM, 631 were in the livestock sector[c] – which also serves as an example of the difficulty to enforce the laws in the region. By 1989, SUDAM had approved livestock projects throughout the entire Amazon, but three-fourths of them were located in what has been denominated the "deforestation belt" (southern Para and northern Mato Grosso). It has been argued that these projects – more precisely, the governmental policies promoting these projects – "have probably been the single most important cause of deforestation in these two subregions."[56]

This is not to say that the openings of these new roads were necessarily the root causes of deforestation in these regions, but rather a case in which unplanned government policies in fragile areas turned into massive environmental impacts. It is as naïve to affirm that forest regions should remain untouched as it is to affirm that countries should no longer exploit their oil resources. In an ideal world, no doubt, there would be economic exploitation neither on environmental fragile regions nor of perishable natural resources, such as fossil fuels. The real

[c] Studies have convincingly argued that cattle ranching is *intrinsically* uneconomic in the Amazon. Some of the reasons against livestock raising in the Amazon include negative employment effects and the fact that the environmental damage associated with cattle ranching can be of up to two-thirds of the deforestation in the region (Mahar, 1989, 15-19).

world, however, that is no the case. Thus, governments should be held accountable for their policies.

Highway Openings and Agricultural Colonization Programs

In 1960, the Amazon was only accessible from the rest of Brazil by air and long sea routes and intraregional traveling was quite difficult. Out of the mere 6,000 kilometers of roads available in the classic Amazon that year, only 300 were paved. For more than four centuries, the region had been isolated from the more dynamic south, which for serves both the argument of those who claim that the region's economic development was retarded as well as of those who see it from the environmental perspective, arguing that isolation in fact protected the rain forest.[57]

Highway Belem-Brasilia

As has been said, the isolation times came to an end with the military government regimes, starting in 1964, when the highway Belem-Brasilia, initiated by Juscelino Kubitschek, was completed. The completion of the highway technically means that it was now prepared to support transit of goods and people all year long, regardless of the whether conditions. Although the official estimates were probably exaggerated, they can provide a numerical notion of the impact of the Belem-Brasilia highway. According to the official sources, the total human population along the zone of influence of the highway jumped from 100,000 in 1960 to about 2 million after ten years. Moreover, the same source affirms that the cattle population reached approximately 5 million in 1970, rising from practically nothing ten years before. Whether or not these are the precise numbers, the fact is that the improperly planned construction of the highway – along with the development programs carried out the years that followed its opening – contributed heavily to widespread deforestation in the region. Additionally, with the increase in

population also increased the demand for secondary and feeder roads, which created a cycle attracting more population and spreading to adjacent areas to the Belem-Brasilia highway.[58]

The Transamazonica Highway/BR-230: "Land without Men for Men without Land"

The announcement made by President Medici that his government was planning to construct the Transamazon Highway came just a few days after his visit to the Northeast region, in 1970. In the spring of that year, the region had been devastated by a severe drought. In fact, the precarious conditions in the Northeast are considered to have been the precipitative event for the Medici's famous Plan for National Integration (PIN). The Transamazon highway was the top priority of Medici's program. According to the president, it would resolve agrarian problems of the region by attracting the landless population of the region to the unpopulated lands of the Amazon.[59]

President Medici planned to build 15,000 kilometers of national integration highways in the region. The Transamazon would serve as the east-west axis and backbone for all the new roads that would be opened. Consequently, the National Department of Highway Roads (DNER) contracted six private Brazilian firms to open the 3,300 kilometers of the Transamazon. In 1972, the first stretch of the Transamazon was completed, connecting the cities of Estreito and Itaituba (1,266 km). Two years later, the portion between Itaituba and Humaita (1,056 km) was finished.[60] Conversely, the planners relied more on their utopian vision of the "Brazil of the future" rather than on the soils, swamps, or the hills over which the highway would be laid. Consequently, the road presented several stretches highly vulnerable to the rainy seasons. At places, the highway would be completed washed away due to the lack of drainage. In addition, the heavy government equipment was very hard to move during the rainy season.[61]

Emphasizing the social aspects of the program, the government provided several titles of land titles with rapidly increasing value to thousands who would have never had that opportunity without the government's assistance. Moreover, although the quality of the service was still rather low, families had access to free medical care and their children could study in schools for the first time. As such, the Transamazon plan had some success initially, but soon proved to become a failure as the program started to be tested by the lack of adaptation of the newcomers. Disappointing agricultural yields, a confusing credit system, administrative shortcomings, as well as diseases led to a rapid turnover of lots, indicating that the Transamazon project had failed to turn the landless peasants into successful small-scale farmers.[62]

Agricultural Colonization Programs

On theory, it was quite an impressive plan. It promised to arrange a 100-kilometer stretch of land on each side of the new highway to be distributed and financed to the northeasterner settlers together with several other benefits. Rather than an agrarian reform, however, the idea of the agricultural colonization programs was to combine the national interests of economic development in the region with the need to address the issues of the numerous poor from the dry Northeast on the basis of a colonization scheme geared to small agricultural land plots along the new highways. It is important to note that only 6,000 families were settled within the first four years of Medici's settlement plan compared to the forecast of 100,000 families made in 1971. These facts suggest, again, that instead of focusing on creating a sustained-yeld system, the Brazilian government continued to emphasize on the production of goods for other regions.[63]

The small farm colonization structure was centered in three traditional river towns along the Transamazon highway: Maraba, on the Tocantins river, Altamira, on the Xingu, and Itaituba,

on the Tapajos. In each town, the occupation of the land was regularized by the agencies of the National Institute of Colonization and Agrarian Reform (INCRA). These agencies were in charge of selecting, transporting, processing the arrival of, assigning lots and house sites to, and guaranteeing land rights to the newcomers. Moreover, farmers were offered an attractive package of benefits, which entailed one hundred hectares of virgin land along a federal highway along with boundaries and titles provided by INCRA. These generous benefit packages were needed to motivate the families to "brave the last great frontier on earth" instead of migrating to the Center-West, where land was also still available.[64]

More precisely, INCRA provided the new immigrants with: a modest house with 5 acres of cleared land; a provisional land title which made peasant owners eligible to participate in the financing fund established by the Bank of Brazil and the Bank of the Northeast; at least six months of minimum wage; and guaranteed prices for the agricultural production.[65] With such benefits, the push factor to migrate increased significantly as compared to the pull factor of regions where poverty and unequal land distribution prevailed.

The Polamazonia Program

In 1974, as General Ernesto Geisel became the Brazilian president, he was faced with two crucial development policies to pursue regarding the agricultural occupation and settlement of the Amazon. The first policy would be to continue the agricultural colonization program implemented by president Medici along the Transamazon Highway. The other choice involved fiscal and tax incentives from the regional states as a way of attracting large cattle ranchers to the region. While the first option, despite its drawbacks, reflected a more social approach, the second was geared to boost the national income by increasing the production of beef in the world markets. Not much later it became clear that the large-scale cattle ranching projects that had

already been established in central Brazil would serve as a model for the new development initiative in the Amazon. The Polamazonia Program was then announced as an initiative to stimulate a series of new cattle raising, as well as timber and mining ventures around the fifteen "poles of development" to be designated by the government. In practice, the Polamazonia Program represented a "second-stage proposal" of the Plan for National Integration (PIN) previous president Medici.[66]

4. The Present Case of BR-163/Cuiaba-Santarem

In 1973, when it was opened, BR-163 represented an opportunity for economic development and national integration in Brazil, along with the Transamazon and the Belem-Brasilia. Originally built to integrate the Amazon into the national economy as part of the military government initiatives in the 1970's, after over thirty years, less than half of the highway has been paved, and the precarious road conditions in the unpaved portions make it unable to be used as a significant export route.[67] The advanced frontier of Northern state of Mato Grosso demarks the "arc of deforestation" boundaries with the south of the state of Para. The city of Guaranta do Norte, in Northern Mato Grosso, is the last city along the BR-163 corridor with paved access. Nowadays, Northern Mato Grosso is 72% urbanized, and has the second highest population along the highway. Moreover, 84% of the land in the region is in properties of 200 hectares or greater, and a large proportion of it has been deforested at high deforestation rates.[68]

Road pavement can indeed be a positive form of infrastructure development, but deforestation issues are at stake when the road to be paved "splits the heart of the Amazon along 1,100 miles (1,770 kilometers) from Southern Mato Grosso north to Santarem in Para,"[69] as is the case of BR-163/Cuiaba-Santarem. BR-163 connects the states of Mato Grosso, a crucial

soybean and beef producer for the national economy, to the state of Para, which would provide Mato Grosso with a much more efficient and cheaper access to the Atlantic in the north. The highway crosses one of the richest regions in natural resources, economic potential, cultural and ethnic diversity. As has been the case with the other highways that cross the Amazon, Brazilian forests have been deforested on a large-scale throughout the process of opening and paving BR-163, particularly in northern Mato Grosso and southern Para.[70]

Considering the fact that road pavement is a positive type of infrastructure development, and that deforestation is a negative indicator of environment preservation, it becomes interesting to analyze a case in which these two factors are opposed to each other. With easier transportation came better living conditions and national economic benefits, but also loss of biodiversity, contributions to global warming, and reduced water (and rainfall) cycling.[71] In short, road development in forestry regions ultimately leads to deforestation and its consequences.

Ever since the 1970s, when a wave of highway openings hit the region, deforestation rates have increased for various reasons, but only recently have Brazilian scholars begun to pay attention to BR-163 in particular. Although several articles have been written about the pavement project of BR-163, including a couple in The Economist[72], to date, there are still very little scholarly debates specifically addressing the issues at stake on BR-163. Among these debates, two result from Brazilian group projects of a complex simulation of land-cover changes to road paving analyzes,[73] and of a faulty literature review with still unclear arguments.[74] Both groups offer a rather historic assessment of BR-163 and do not clearly express their views on the future of the road.

Among the few scholars who have researched the subject, Philip Fearnside is one of the most prominent in discussing the pavement plans of BR-163. Nonetheless, Fearnside is still very

skeptical about the project and does not seem to be 100% sure on where he stands.[75] Clearly, Fearnside believes that the environment should gain more weight in the infrastructure projects. His concerns are actually regarding whether or not the Brazilian government is able to assure the implementation of the sustainability plan it has prepared for BR-163. Fearnside's shaken argument is seen, for example, when he says, "even with substantial monetary benefits for BR-163, the various forms of impact from the project must be quantified and compared to the benefits before a decision is made.[76] In other words, Fearnside calls for a careful cost-benefit analysis prior to the government's decision to pave the road, but he does not provide that analysis himself. The lack of relevant scholarly debate suggests that the Brazilian government could be committing now the same mistake as before, when it promoted several initiatives in the Amazon without due knowledge of the area.

Fearnside's concern is also shared with Hermann Hrdlicka et al (2006). There is a "strong correlation between opening and paving of highways and deforestation." [77] Furthermore, they believe that the paving of BR-163 will accelerate the trends for large-scale farming enterprises and for cattle and pasture expansion (one of the main contributors to deforestation). The concern with environmental impacts does not make development undesirable and unnecessary in the region, though. Hrdlicka et al report that there are several regional groups supporting the most recent pavement project proposal, Brazil's Multi-Year Plan for 2004-2007, put forward by the Lula administration – though very little action has actually been see this far. According to the government, the plan is not restricted to facilitating the market of goods, and "it also offers the prospect of raising living standards in rural populations (among the poorest in the country) and improving vital services related to health and education."[78]

The peculiarity of paving the other half of highway BR-163 lies on the fact that it represents a major infrastructure project, which is expected to bring economic development not only to the peoples of the region, but also to the national economy, but at the same time it can empower deforestation actors specially in the already critical Northern Mato Grosso and Southern Para. Years after the government promoted occupation programs, a new deforestation cycle began. Unsettled government lands and the history of weak law enforcement in the region have attracted loggers, who have set in motion a series of events more destructive than logging itself. These events are in great part related to the fact that, more recently, cattle ranchers have followed the loggers in their occupation of forested areas, while soybean farmers are coming after the cattle ranchers.[79] As a result, these main economic regional players have run the Northern Mato Grosso economic community and generated a new vicious cycle of deforestation patterns with high probability to grow at uncontrollable rates if the highway to the port of Santarem is paved without careful preventive and sustainable considerations by the Brazilian government.

At the turn of the 21st century, the Brazilian government included the pavement of the rest of BR-163 in its $40 billion Amazon development program "Avanca Brasil" (Forward Brazil). The government's hopes are that asphalting the highway will bring development to the region as it will connect the agricultural zone of central Brazil with the port of Santarem—diminishing the cost and time of the transportation of goods. On the other hand, the still pristine Southern Para region, just a few miles north of Guaranta, is likely to suffer the largest impact. Unless the government enforces strict environmental laws in the region along with reliable sustainable plans prior to paving the rest of BR-163, significant deforestation of the "Lungs of the World" will inevitably continue. "The expansion of agricultural and urban frontiers in

tropical forest regions releases approximately one-fourth of the word's global human-induced carbon emissions to the atmosphere:"[80]

> This phenomenon accounts for the high influx of people towards the South of Para, most of them coming from the neighboring region of Northern Mato Grosso, where towns, like Guaranta do Norte, have become the base from which entrepreneurs access the coveted lands of the South of Para.[81]

This process of coveted land appropriation has been informally named *grilagem* in Brazil. Grilagem marks the first step towards deforestation nowadays, and most of the times the *grileiros*—those who practice *grilagem*—are illegal loggers. Expectations of the BR-163 project are already impacting the region. That is because the current "arc of deforestation" will expand along with other issues such as "unplanned migration, the increasing exploitation of natural resources, the illegal occupation of public and protected lands, the concentration of land ownership in the hands of a few large holders, increasing crime… and the uncontrolled spread of diseases,"[82] which are all factors that derive from pavement and development expectations. Basically, the future of the Amazonian arc of deforestation rests on the behavior of the local communities upon the pavement of BR-163; the future of the Amazon forest is directly related to the contention of the arc of deforestation; and the healthy future of the world environment is directly related to the Amazon.

Thus, coming to a consensus about whether or not the government should continue with its plan to pave BR-163 is of worldwide concern, since uncontrolled destruction of the Amazon will certainly have a significant effect on global warming and other climate issues. These concerns lead us back to the famous debates on the importance of, and responsibility for, the Amazon. Those who favor economic development through infrastructure projects in the region support the counter-argument against the environmentalists this time. Considering that this new, more specific, and heated debate can be triggered by the social patterns of the Northern Mato

Grosso community, it must be in the interest of the global community to study those social patterns of the locals in Northern Mato Grosso. There have been many projects related to the pavement of BR-163 throughout these years, but there has not been a focus on the recent social patterns of deforestation.[83]

In addition, Philip Fearnside argues that "the benefits of export infrastructure are meager, especially from the point of view of generating employment," and that "the environmental and social costs of forest loss are high; among them is loss of opportunities for sustainable use of the forest, including loss of environmental services such as biodiversity maintenance, water cycling, and carbon storage."[84] Fearnside recognizes that the transportation cost savings after the pavement of BR-163 are substantial, especially in soybean production. Nevertheless, He believes that "the various forms of impact from the project must be quantified and compared to the benefits before a decision is made."[85]

Considering the importance of the social patterns in Northern Mato Grosso regarding the expansion of the Amazonian arc of deforestation, there is a relevant need to further research the case of BR-163. Experts on the issue must be able to reach a common agreement or ground for discussion based on actual studies of the local community rather than to simply "*think* that the ranchers and soybean farmers can't be stopped [emphasis added]."[86] The key uncertainty on the issue is tied to the vicious deforestation process involving loggers, cattle ranchers, soybean farmers, and in many cases even regional politicians. To affirm that these regional actors cannot be stopped without deeper exploration of their social patterns is to ignore the reality of those whose lives are economically dependent on the region. At the same time, this uncertainty should serve to caution the government about taking further initiatives in the region without the necessary sustainability debate.

Contrary to most other authors and researchers of the issue, a group of five worldwide economists affirm in the book "The Dynamics of Deforestation and Economic Growth in the Brazilian Amazon," that the development program might actually slow the deforestation process. To assess the relative importance of the many causes of deforestation, the economists used satellite imagery and Brazilian agricultural census data, which documents livestock and crops as well as farmers. They suggest that "paving the roads in parts of the Amazon that are already thickly settled… will strengthen local economies and reduce the pressures that send farmers into virgin forest in search of land to clear."[87]

As has been said, towns like Guaranta do Norte serve as the base for those who are related to the core cause the expansion of the deforestation frontier. Although more than 70% of the local community currently lives in the city, the local and even state economy would tip down in the absence of the loggers, cattle ranchers, and soybean farmers. Fearnside is definitely correct when he affirms that "understanding who is to blame for deforestation is vital for any program that attempts to reduce it."[88] As in the past, the underlying cause of deforestation is intrinsically related to the government policies regarding the issue in the region. If before these policies were misguided, they seem to have been absent for some years in terms of lack of institutional capacity to implement and regulate the related legislation in the region. This implies that the deforestation frontier, or "arc of deforestation," must be stabilized before the highway project continues, or it will be too late. In fact, efficient governance can "potentially entail up to 60% reduction in the expected deforestation due to the pavement."[89]

5. Conclusion:

Rarely have the governmental policies towards the Amazon considered their environmental consequences properly. Aside from (perhaps) some short-term benefits, the deforestation that resulted from these policies has benefited neither the regional population nor the Brazilian people as a whole. The governmental decisions to provide overland access to the Amazon – especially between the mid-1960s and late 1970s – were made without enough knowledge of regional natural resources and sustainable development techniques. Thus, the misguided public polices are most likely the root to many of today's problems that derive from the Amazonian deforestation. Poverty and unequal land distribution in the regions of origin, in this case, served rather as a push-factor while the Amazonian settlers were in fact responding to governmental incentives provided in the forms of various public services, access to roads, public land titles, as well as subsistence allowances in the case of the Transamazon scheme.[90]

Unless policies are carefully reconsidered in the region, particularly taking into account the sustainable development approaches backed by strong and efficient safeguard policies, deforestation rates will remain uncontrolled. For areas in which the environment has already been degraded and the lands abandoned, government policies should strongly promote and support their recuperation in order to restore the forest's biological diversity. For the rainforest areas that are still inaccessible overland, governmental policies should ever more pursue a new policy focus that differs considerably from the past policies implemented during the military regime.[91]

Under this alternative development approach, all levels of the government (federal, state and local) should emphasize the region's forest-based economic activities that offer a competitive advantage. The following is a suggested list of recommendations that should be

kept open for further innovations and creative solutions: no new roads or infrastructure services should be provided without careful research and extensive knowledge about the impacts of these projects in the region; alternative means of transportation – such as improved water transport facilities and railroads used solely for commercial purposes in areas where general public access are not sustainable – should be powerfully considered as substitution to road openings; fiscal incentives for livestock projects in the Amazon should be literally (enforcedly) eliminated while all other projects should be strictly regulated; and a well thought tax reform should consider a progressive rural land tax that penalizes those who engage in environmentally unsound activities.[92]

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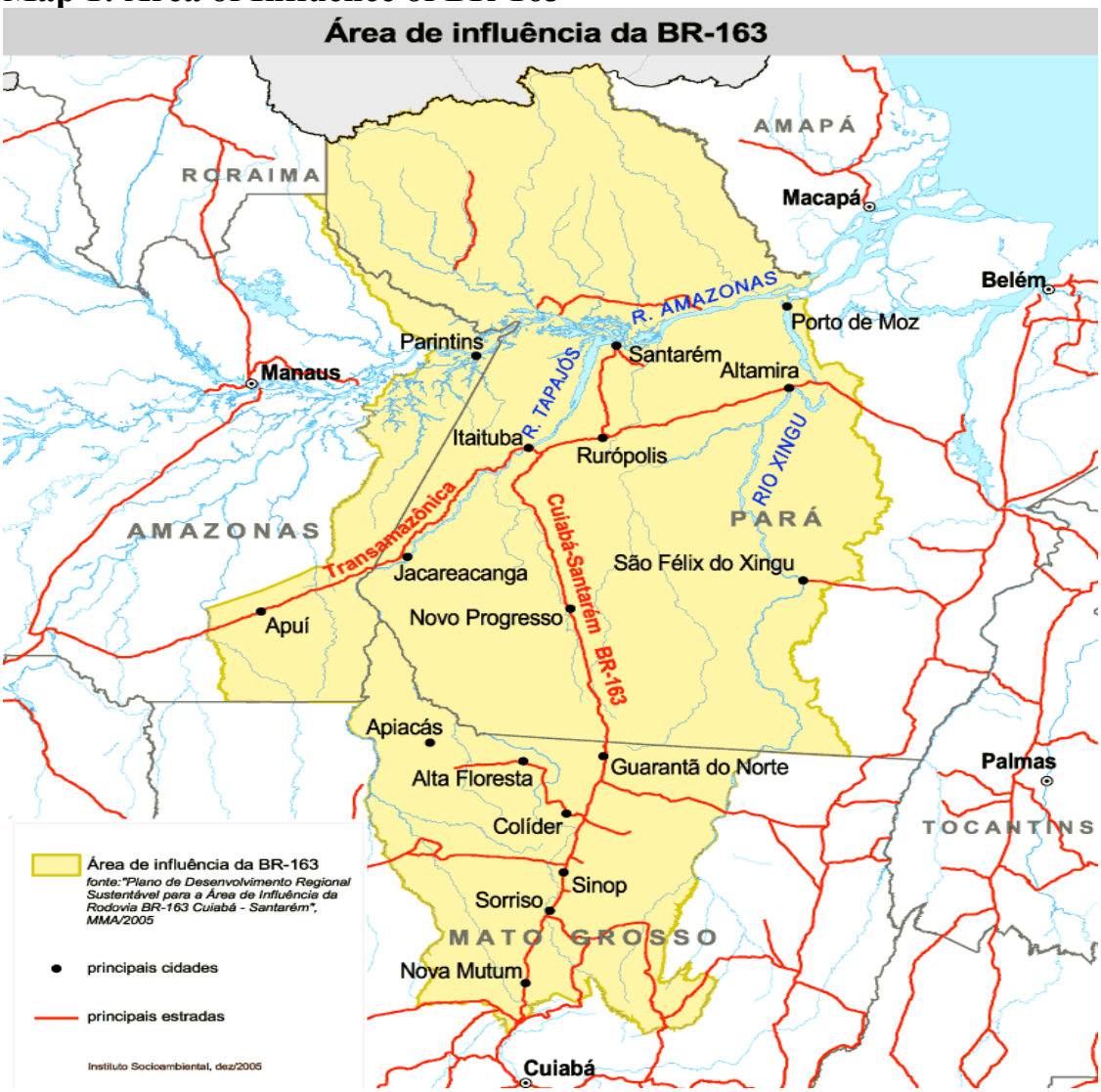
Appendix: Maps and Pictures

Map 1: Area of Influence of BR-163



Source: Instituto Socioambiental, Dec/2005

Map 2) Focus Area and Conditional area of Deforestation by 2020 with and without Intervention

Relevant Pictures of the Region: