8. PATTERNS OF ENVIRONMENTAL MIGRATION IN BRAZIL: THREE CASE STUDIES

Nathalia Capellini, Carolina M. Castro and Eva Gutjahr

INTRODUCTION

This chapter combines tree individual case studies of environmentally-linked internal displacement and migration in Brazil. This chapter is not meant to be comprehensive of all forms of environmental migration in Brazil, but a tripartite analysis allowing for a more nuanced understanding of a complex phenomenon. It covers both slow-onset migration and disaster-related displacement; both "natural" and "human" causes are explored. Moreover, these case studies take into account the unique context for migration in three distinct parts of the country: the legal Amazonian region, the Northeast Coast, and the Southeast near the metropolis of Rio de Janeiro. In doing so, they present a glimpse at the emerging issues and debate on environmental migration in South America's largest country.

The first case study, "Drought and Migration in Northeastern Brazil" details one of the most important mass migration waves in Brazilian history. From the 1960s to the 1990s, millions of Northeasterners were driven by recurring drought to migrate to other parts of the country, especially the wealthy, industrialized Southeast. However, this study does not take a deterministic view of these migration patterns, but rather examines ways in which drought and migration have shaped social adaptation systems. Likewise, the study is careful to avoid strictly natural explanations for drought, exploring how local economic powers and political leaders have contributed to a socially unjust "drought industry." Because of the migratory linkages between the Northeast and Southeast, this study is also linked with the Rio case study at the end of this chapter.

The second case study, "Environmental Migration in the Brazilian Amazon: what is the role of policy?" analyzes internal migration and displacement in Brazil's 'legal Amazon' region. First, it analyzes cycles of settlement, deforestation, resources exhaustion and further migration that characterize migration in the region, as well as the social, political, and economic consequences of these patterns. Second, it examines linkages between massive infrastructure projects (such as dams and mines) and mass population displacement in the region. The case also explores the political economy of these large-scale projects and questions their role in the region's social welfare, suggesting that a different development model may be needed to avoid recurring patterns of "boom-and-bust" on the Amazon frontier.

The third case study, "Environmental and Human Disaster in the Hilly Regions of the State of Rio de Janeiro" focus on an environmental disaster that took place in the Hilly

Figure 1. Brazil's Regions

8.1. CASE 1: DROUGHT AND MIGRATION IN NORTHEASTERN BRAZIL

Nathalia Capellini

"…his fate was to pace around the world, walking up and down, aimlessly wandering as an errant Jew. A tramp pushed by the drought." (Ramos, 1975)

"Ceará is always between one drought that's going and another that is coming down the road." (Theophilo, 1922)

1. BACKGROUND AND CONTEXT

1.1. The Northeast region by the numbers

The Northeast region of Brazil[37] has an area more than 1.5 million square kilometers. It covers 18% of the country's territory and contains 53 million people, 29% of the national population (IBGE, 2011). Economically, it produces 13.1% of Brazil's GDP, though the region's GDP per capita is 53% lower than the national average (IPEA, 2010). It has large concentrations of poor people and contains 69% of Brazil's urban population (IFAD, 2009).

Though geographically diverse, semi-arid climates cover more than half of the region's territory, and droughts are recurring. Indeed, part of the region has been labeled the "polígono das secas", or "polygon of drought", for its frequent droughts. Significant parts of the region's public policies are geared towards drought crisis prevention.

The social impacts of the region's frequent droughts are exacerbated by its high population density; indeed, the region is the most densely-populated semi-arid region in the world (Sales, 2003). Socially vulnerable populations, particularly the poor, have historically been heavily dependent on state "rescue policies" for drought relief, or migrated elsewhere in the country as a form of adaptation to the droughts.

Though drought is partially a function of the region's climate, it is also true that the region experiences extremely heavy rains between September and March. However, these heavy rains are offset by rapid evaporation during the dry season (Centro Feminista 8 de Março, 2006). In such conditions, modern irrigation and water storage are vital, but such development is hindered by large-scale poverty. Thus, social vulnerability and climatic conditions interact to create and aggravate the environmental crises in the region.

1.2. Drought in the history of the region

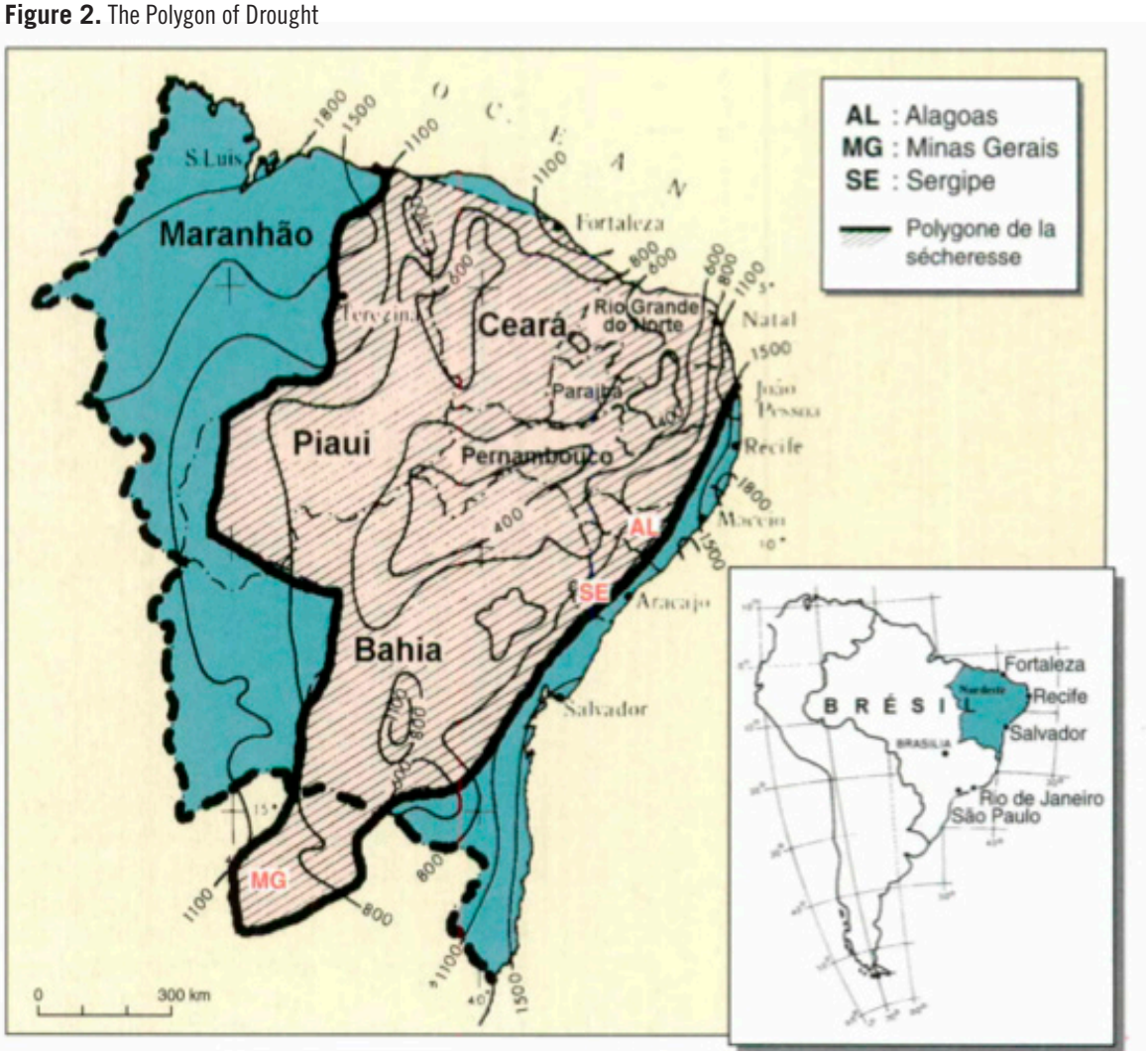
The region's first recorded drought occurred in 1499-1500; drought hit every 3-4 years throughout the sixteenth century. From 1877-1879, a particularly severe drought took 500,000 lives, 119,000 from the City of Fortaleza alone (Leprun et al., 1995).

Because of its susceptibility, drought has induced environmental migration in the region for centuries. For example, Campos and Studard (2001) found that indigenous populations often migrated as a result of climatic conditions; similar historical studies in post-colonial times have shown the same results. Thus, even in periods of low population density and small "human footprints", environmental migration has been a part of the region's social history.

In the late1950s, disparities between the rapidly industrializing Southeast and the poor and stagnant Northeast grew rapidly. The policy response from then-President Juscelino Kubitschek was to establish the Working Group for the Development of the Northeast, known as GTDN and headed by

37. Including the states of Bahia, Sergipe, Alagoas, Pernambuco, Paraíba, Rio Grande do Norte, Ceará, Piauí and Maranhão.

Figure 2. The Polygon of Drought



Source: Leprun et al., 1995.

the well-known economist, Celso Furtado. The group recommended stepping up investment in the region and stimulating food production (Melo et al, 2009). In 1959, this report was adopted as the main strategy of the Superintendency of Northeast Development, SUDENE, a new body created to bolster regional development and address the urban social tensions created by drought.

1.3. The "drought industry" and clientelism

Because of the primacy of food, water, and health needs in the region, the path to political control is through the meeting of these basic needs despite the droughts. Therefore, regional elites have often used drought as a pretext for donations and policies from the federal government that benefit them personally. Local colonels and latifundiarios (large property owners) play a central role in this "Drought Industry".[38] They are abetted by Brazil's concentration of land: 1% of property owners control 45% of the land, when small farms (less than 10 hectares) make up just 2.5% of rural land (Serra, 2003).

In response to drought, agricultural policy has prioritized damming. Though this creates water reservoirs, these storage mechanisms are vulnerable to evaporation. Furthermore, the reservoirs are often not accessible to the population, as they are generally built on private properties. Patronage—what Kenny (2002) defines as personal connections determining or facilitating resource access— inevitably follows.

Even for those who do have access to the

38. "Drought industry" is a concept very used in Brazil, both by the academic field and by the medias and the population. See for instance Goncalves, 2001; Fernandes, 2003; Marin, 2002.

Figure 3. Main migration flows by period

Source: own elaboration

reservoirs, the labor of traveling many miles to fetch water and returning with heavy kegs often represents a full quarter-day's work for farmers. This work is often done by women (Centro Feminista 8 de Março, 2006). The water obtained from these reservoirs is often full of mud and debris, and is therefore unfit for consumption (Reboucas, 1997).

2. A CHRONOLOGY OF MIGRATION AND PUBLIC POLICY IN THE NORTHEAST

2.1. 1950 to 1990

Mass migration within Brazil began in the 1950s, as intense urbanization and widening regional inequalities created economic incentives to move. Concentration of economic activities in cities and surplus labor in the countryside led to rural-to-urban migration, though urban areas in poorer regions were unable to absorb this population growth (Patarra, 2004). The rapidly developing Southeast, particularly around Sao Paulo and Rio de Janeiro, became a destination for Northeastern migrants; the new capital of Brasilia, coffee plantations in Parana, and rubber plantations of the Amazon were also popular destinations (with the state sponsoring migration to Amazon destinations).

These flows coincide with two periods of severe drought: from 1951 to 1953 and again in 1958. During the 1960s, migration in and out of the Northeast stabilized, as government efforts to reduce regional imbalances halted—and may have even reversed—flows from the region (Patarra, 2004).

In 1970, and from 1979 to 1983, a major drought hit the region once again, triggering a remarkable exodus from most states. However, the states of Bahia, Sergipe and Alagoas received significant investment in oil and petrochemicals during this period, which reduced outflows considerably (Patarra, 2004).

During this period, the State also institutionalized its response to drought in the Northeast (Melo et al, 2009). The Inspectorate for Works Against Drought was formalized into the Department of Works Against Drought: a key institution that critics claim is dominated by the regional elite (Ibid.).

Meanwhile, SUDENE's efforts did enhance development in the Northeast, but the region remains deeply dependent on more dynamic parts of the country for both capital and demand (Reboucas, 1997). At the same time, urban areas in the region were ill-prepared for the influx of labor migrants from rural areas, leading to infrastructure shortages and urban decay in the form of underserviced favelas, or slums (Melo et al, 2009).

From 1979 to 1983, drought affected 96.5% of the districts in this region: 1.2 million farmers had to cease productive activities during these droughts (Leprun et al. 1995). Many rural workers were forced to migrate to nearby cities, where they came to inhabit favelas in peri-urban areas. This process is evident in 1980-1990 Census figures, which show urbanization in the Northeast occurring much more rapidly than the national average.

The second half of the 20th century was also characterized by intensive state investment in major irrigation projects. As Campos and Studart (2001) show, these projects were meant to be cooperatives, but the concentrated land ownership by wealthy elites made such projects infeasible. Instead, large landowners invested in their own regional water provision schemes, often with public subsidies and limited benefits to local, small-scale farmers.

Figure 4. People of more than 5 years old, by destination and origin regions (1986-1991)

Origin	Destination					
	Total	North	Northeast	Southeast	South	Mid-west
North	277 319		79 483	73 275	29 182	95 379
Northeast	1 354 461	216 979		917 482	21 582	198 418
Southeast	786 816	78 945	334 434		170 418	203 019
South	470 640	41 421	16 630	282 118		130 471
Mid-west	336 734	71 177	47 381	154 068	64 108	
Total	3 225 970	408 522	477 928	1 426 943	285 290	627 287

Source: IBGE, Census of 1991.

Figure 5. People of more than 5 years old, by destination and origin regions (1995-2000)

Origin	Destination					
	Total	North	Northeast	Southeast	South	Mid-west
North	292 751		86 836	68 186	22 956	114 773
Northeast	1 411 420	182 709		969 435	31 029	228 247
Southeast	946 283	75 467	462 628		214 914	193 274
South	349 813	26 989	27 897	205 975		88 952
Mid-west	363 185	70 721	70 012	161 276	61 176	
Total	3 363 452	355 886	647 373	1 404 872	330 075	625 246

Source: IBGE, Census of 2001.

2.2. 1990 to present

From 1991 to 1996, 55% of all rural migrants in Brazil came from the Northeast, though the region represented less than 40% of the total rural population at the time (Patarra, 2004).

In 1998, a severe drought struck; the State responded, through SUDENE, with an emergency program aimed at providing temporary employment to 1.2 million workers put out of work by the drought. The program was a milestone in that it marked the first time that emergency relief extended beyond food and water to emergency employment (Duarte, 2001).

Official state figures[39] showed that the drought caused a 148% increase in local unemployment. The state data also show that 51% of families reported decreased income. Meanwhile, the emergency employment, which paid around 35 Euros per month, constituted 68% of families' incomes.

In 2001, under the government of Fernando Henrique Cardoso, SUDENE was dismantled. The main argument of the government was that the body was highly corrupt; government figures showed that nearly 900 million Euros had gone missing. In 2007, SUDENE was re-instated, with a new mission: "(to) promote inclusive and sustainable development of the Northeast and competitive integration of regional production in the national and international economy"[40].

As Northeast-Southeast migration flows have taken place for decades, a social network has emerged to facilitate the journey for new potential migrants (Fusco and Duarte, 2010). Migration is also an important part of households' adaptation strategy to drought, as it reduces household food needs.

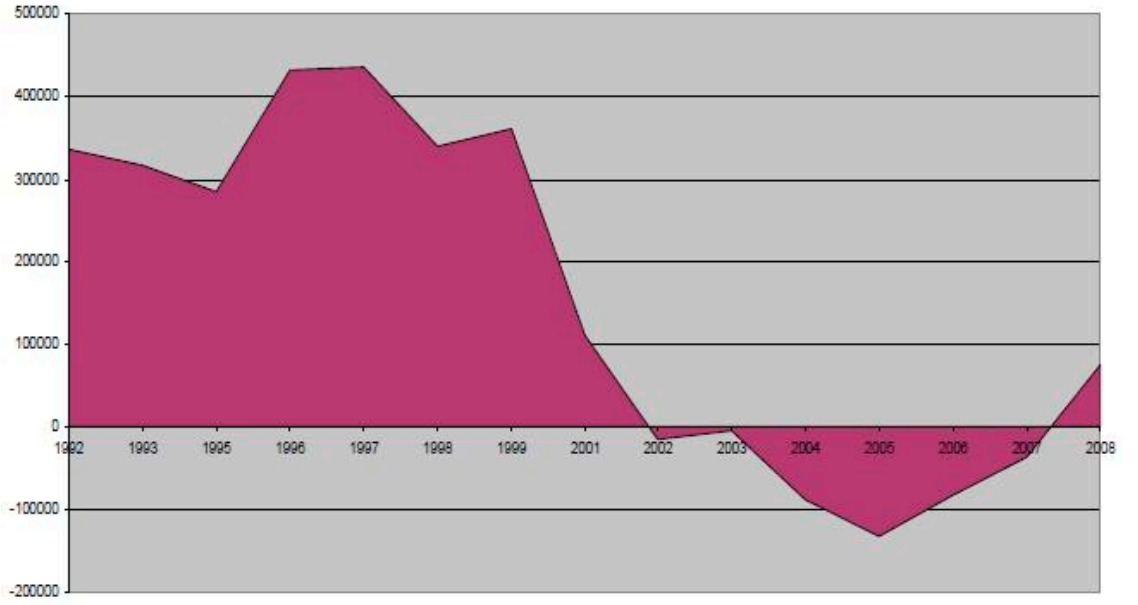
However, Figure 5 shows that these historic Northeast-to-Southeast patterns disappeared in the 2000s, and indeed were reversed. Baeninger (2008) asserts that economic changes, including a reconfiguration of national industry and economic stagnation in the Southeast, account for these changes. For example, survey data[41] show that Sao Paulo received 765,469 migrants from 2001 to 2006, compared with 1,223,809 migrants from 1995 to 2000. Migration to other parts of the country, including the Central-West (Brasilia) and within regions has also become more prevalent (Baeninger, 2008).

39. As Duarte (2001) shows in his article, a research was made with the people that participated on the program. This researched was ordered by the state, and was limited to a sample of 650 people.

40. See Sudene program website: http://www.sudene.gov.br/

41. The PNAD, National Survey by Household Sampling, is a survey conducted by the Brazilian Institute of Geography and Statistics (IBGE).

Figure 6. Net migration between the Northeast and the Southeast of Brazil



Source: IPEA (2010).

Public policies played a role in this new configuration. ASA Brazil[42] recently launched a program to build one million cisterns in the region; 255,000 of them (benefiting 4.4 million people) had been built by 2008 (CEDEPLAR/UFMG & FIOCRUZ, 20008). Meanwhile, in 2004, the Environment Ministry launched a Program for Fighting Desertification and Mitigating Drought Effects (PAN-Brazil). The program explores technology for small-scale, sustainable farming and energy use in the region, promoting resilience against the droughts. Lastly, the *Bolsa Familia* program (a nationwide conditional cash transfer program) and the food-security focused *Fome Zero* (Zero Hunger) program have also alleviated poverty and thus may have attenuated migratory flows out of the Northeast.

3. THE FUTURE: CLIMATE CHANGE AND DESERTIFICATION

3.1. Present and potential affected areas

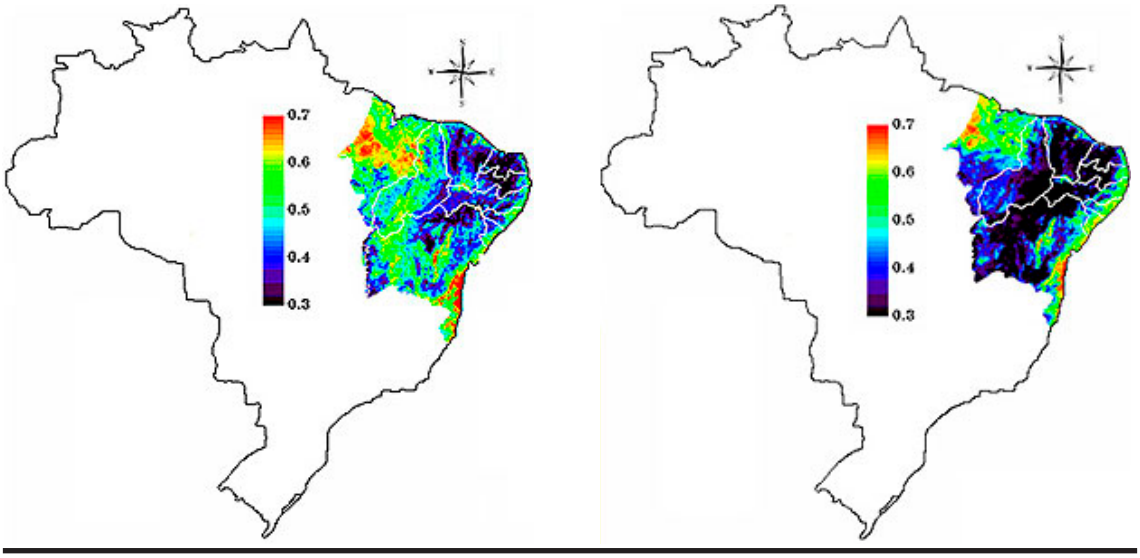
A recent report has analyzed potential climate impacts in Northeast Brazil (CEDEPLAR/UFMG & FIOCRUZ, 2008). It projects that 24% of the population of the region's poor cities will migrate as a result of climate change between 2030 and 2050. In spite of recent economic gains, climate scientists think that the most-affected areas will be those with both high population density and unstable environments, such as Northeast Brazil (Ojima and Nascimento, 2008). Indeed, parts of the Northeast may experience desertification, as increasing temperatures, decreasing rainfall, and inappropriate agricultural activities take their toll.43. According to the Ministry of Environment, 181,000 square kilometers of land in the region are vulnerable to desertification, which could cost $100 million annually (Sales, 2003).

The above image shows the areas of desertification in the Northeast in 1982 (first image) and in 2010 (second image). The darker areas are more desertified. Four are already called "centers of desertification": the cities of Gilbués (PI), Irauçuba (EC), Seridó (RN) and Cabrobó (PE) (Madeiros, 2010). In addition to climate change, natural climatic and soil conditions, as well as human practices (such as deforestation, forest fires, and overgrazing) are driving these processes. Irrigated areas may also be degraded by salinization from water reservoirs (Sales, 2003). All of these processes are likely to push poor populations off the land, decreasing quality of life for many

42. Network of NGOs, trade unions and civil society in the Region

43. Cf. Ecodebate, 2008 : "The increase in minimum temperatures on the planet, low levels of rainfall and inappropriate agricultural activities can lead to desertification in part of the Northeast, according to the Professor Augusto José Pereira Filho from the Astronomy, Geophysics and Atmospherical Sciences Center in the University of Sao Paulo".

Figure 7. Desertification in the Northeast region (1982 and 2010)



Source: Universidad federal de Alagoas - Image processing laboratory (2010).

households. Urban areas may see increased migration flows, with poor migrants likely to settle in *favelas* of peri-urban areas.

3.2. Public policies for the future

The risk of desertification and climate change will further increase threats to vulnerable populations. To combat these threats, the government must pursue a new development policy that weakens existing patterns of patronage in the region. Moreover, alternatives to the status quo, such as new methods for water storage and the organization of rural cooperatives, should be pursued, to increase water access sustainably.

Survey data shows that 51% of families in the region do not adequately prepare for droughts, instead waiting for government assistance (Duarte, 2001). Such attitudes imply a sense of helplessness that results from the rigid political context of the region. This political context may allow for infrastructure development, but these projects serve to consolidate and enhance existing inequalities.

For example, the federal government has recently undertaken a two billion-euro project to "integrate the Sao Francisco River watershed." In theory, the project will irrigate large parts of the region. However, critics argue that benefits will accrue to a tiny percentage of the semi-arid land in the region (0.3%), while triggering massive negative environmental changes in the riparian ecosystem (Centro Feminista 8 de Março, 2006). Others argue that large landowners will continue to benefit from the project, which they see as a continuation of the "Drought Industry" (Ab'saber, 2005).

Adapting to climate change, including the effects of drought and desertification, must take place in the context of a more democratic—and sustainable—process than has been the norm in the Northeast for the last half century. Small farms and cooperatives can be sustainable, but only if preceded by meaningful land reform. While such reforms have never been undertaken for reasons of political will, they are the best hope for an end to the cycles of chronic crisis and emergency relief that constitute the status quo.

Meanwhile, migration policy must take on two dimensions. First, receiving areas must have sufficient resources to welcome new arrivals. Second, action must be taken to address environmental push factors out of rural areas, so that migration becomes less desperate and more voluntary (Ojima & Nascimento, 2008). What's more, by strengthening local adaptive capacity in the rural Northeast, such policies can simultaneously reduce displacement and improve quality of life in the region.

Migration out of Northeastern rural areas will likely increase unless the State carries out major, structural reforms in the region. Northeasterners need access to water, for their subsistence and their livelihoods, as well as public health and education services. Though many actors can be part of the solution, only the State can guarantee rights of access to basic needs for all its citizens, most especially those living (precariously) with droughts.

8.2. CASE 2: ENVIRONMENTAL MIGRATION IN THE BRAZILIAN AMAZON: WHAT IS THE ROLE OF POLICY?

Carolina M. Castro

Migration in the Brazilian Amazon takes two main forms: 1) displacement based on the social, political, and economic consequences of deforestation, that results in land degradation and social conflicts and prevent people from keeping their livelihoods; and 2) displacement caused by major development projects (hydropower and mining) aimed at extracting the regions considerable natural resources.

While migration dynamics have been discussed in other works, few have examined the issue through the lens of environmental change. This angle is instructive, since humans not only contribute to environmental change, but also are affected by these changes, which can induce a disruption of livelihoods and social networks, as well as social unrest.

1. A HISTORY OF STATE INTERVENTION AND POLICY-INDUCED MIGRATION: IMPACTS ON THE ENVIRONMENT

The Brazilian Amazon is globally important due to its role in biodiversity, climate, and geo-chemical cycles. The region's biomass, hydropower, and natural gas resources have led to it being labeled "the world's last reserve of energy." Yet to date, the region has not been fully developed, economically.

In this context, the Amazonian development model of rapid forest clearing has been viewed through the paradigm of the "frontier economy", based on the continuous incorporation of land and natural resources. This paradigm associates the idea of "clearing the forest" with "progress" (Becker, 2005).

The region has experienced the rise and decline of economic cycles: economic expansion (and concomitant labor in-migration) has been closely tied to international market prices for raw materials; and has often been followed by long periods of stagnation and out-migration (Becker, 2001). The appropriation of forestry resources has led to unsustainable extensive practices and ebbs, as well as significant flows of migration.

1.1. Early economic immigration

One of the first important waves of in-migration occurred in the late nineteenth and early twentieth century. At the time, the region experienced the rubber boom, when thousands of Northern migrants (the seringueiros) first came to the Amazon to work on the extraction of latex. However, structured settlement patterns only emerged with the establishment of the modern Brazilian state, following World War II. In the 1950s, President Kubitschek constructed a number of major roads (such as the Belem-Brasília and Brasília-Acre highways). The Amazon region's population rapidly expanded through migration, increasing from one to five million during the decade (Becker, 2001).

In the 1960s, the military government established a new ideological paradigm. The Amazon region represented a "demographic vacuum" that should be occupied in order to secure sovereignty over the territory. With minimal consideration for local context, the federal government launched ambitious projects of colonization and development. These policies were mainly aimed at the expansion of the productive frontier, through road

construction, support to agriculture, ranching and logging, and public investment in large mining and hydroelectric projects. This model accelerated deforestation, migration, land conflicts and violence in the region (Hochstetler & Keck, 2007; Becker, 2001).[44]

Between 1970 and 1974, the National Institute of Colonization and Agrarian Reform (INCRA) sent more than 400,000 settlers to occupy lots along roads in the region (Ibase, 1985 apud Lui & Molina, 2009). In particular, many migrants were sent to take up residence near the 4,000 kilometer Transamazonica Road, inaugurated in 1972 in Para state (IPAM/FVPP, 2009).

Government policy also shaped migration and development patterns indirectly. For example, land titles were given in proportion to the amount of land cleared. Because livestock-raising had low start-up costs (and was government-subsidized), settlers started building ranches as a cheap way of acquiring land. However, these policies backfired: overgrazing and decreasing economic returns created a massive ecological disaster. From 1970 to 1980, more than half of primary forest that was converted to pasture became so degraded that it had to be abandoned; much of the remainder was highly unprofitable (Buschbacher et al 1988 apud Hurtienne, 2004).

The ecological failure of the 1970s did not lead to a roll-back of frontier settlement. Conversely, settlers migrated deeper into unoccupied forest: by 1975, 40% of families had abandoned their government-issued plots (Oliveira, 1991 apud Henchen, 2002). The legacy of government colonization in the region has thus been an "arc of deforestation", which is still expanding to this day.

In addition to cattle farming, mining was a main economic activity in the Amazon, and attracted large numbers of migrants (Santos, 2002). Mining was lucrative but highly unsustainable and weakly integrated with the rest of the regional economy, so that its social benefits were scarce (Carvalho, et al., 2005).

Mining generally requires very large capital investments[45] and nearly all capital control takes place outside the region (Monteiro, 2005). Except for substances used in the construction industry, almost all mining products are exported, creating very little added value for the local economy (DNPM, 2008). Moreover, steel and other metals require energy-intensive processing (Monteiro, 2005), consuming about half of the region's hydroelectric power capacity.[46]

1.2. Development-induced displacement

Large hydroelectric projects in Amazon have also faced recurring criticisms on the basis of social and environmental concerns. In the 1980s, such projects (including Tucuruiin Para and Balbina in Amazonas) displaced communities, flooded huge tracts of land and destroyed local fauna and flora. The construction of Balbina hydroelectric usine has meant the flooding of Waimiri-Atroari reserve, fish mortality, food shortages and hunger. 30,000 hectares of indigenous land were flooded and one third of that population was displaced. The river Uatumã was then considered biologically dead according to the National Institute of Amazonian Research (INPA). And because of the construction of Tucuruí, almost 10,000 families had to leave their land. Many migrated to other regions in the same state. Besides, the environmental change caused an intense proliferation of mosquitoes, bringing a qualitative change in people's lives (Silva, 2009).

There are no systematic data on the number of people affected by hydropower projects in Brazil, but according to the Brazilian Movement of People Affected by Dams (MAB), nearly one million Brazilians have suffered the ill effects of dams (the government and the dam industry contend that the figure is much lower, around 300,000; Carneiro Filho, et al., 2009). Population flows that have ensued from dam's construction and mining activities follow two movements in the Amazon: the territorialization of groups in search of labor, and the de-territorialization of population displaced from the areas of the plant. In this context, plans to build the Belo Monte dam in the Xingu River Basin (projected to provide up to 11,000 MW) have been facing controversies for the last 20 years. Social movements and indigenous leaders believe that the socio-environmental impacts are not adequately sized and after Belo Monte, five other dams will be built, changing completely the local life (Fearnside, 2005).

Roads influence migration and development patterns, as well. By lowering transportation costs, they reduce barriers to in-migration. At the same time, they increase incentives for individual farmers to participate in extractive activities. Once the land is exhausted, the farmers simply sell it (if he or she has property rights) and relocate deeper into the frontier, expanding the "arc of deforestation"

44. Ironically, Amazonian settlement was also perceived as a response to social tensions arising from the expulsion of small farmers in the Southern region, due to the modernization of agriculture.

45. Over U.S. $ 1 billion in many cases (Monteiro, 2005)

46. Notably, approximately 20% of the electricity produced in the country is consumed for exports goods production, especially aluminum.

and replicating the pattern of boom-and-bust (Celentano, et al., 2007).

1.3. The boom-and-bust pattern of recent population mobility

Boom-and-bust economics often generates population movements. In the early years of economic development and clearing of the territory, a rapid but short-lived increase in income and employment occurred, attracting migrant labor. This period was followed by social, economic, and environmental collapse, leading to out-migration (Celentano, et al., 2007). In the Amazon, logging set off economic booms and immigration, followed by cattle ranching. This ultimately led to ecological collapse, inducing an economic bust and mass emigration (a pattern that Rodrigues et al [2008] demonstrated through an assessment of 286 frontier municipalities.) Our own statistical analysis shows that people do indeed migrate to an area where deforestation is underway, only to vacate the area again once resources are depleted.[47]

We can assert that people migrate to municipalities in which economic activity associated with deforestation is high, but tend to emigrate after the depletion of natural resources and the disruption of local economy. After deforestation, migration rates decrease, meaning that people stop immigrating.

In summary, development projects and deforestation affect human migration patterns in Brazilian Amazon. Those projects attract labor migrants, while also displacing many indigenous people due to their environmental impacts. Additionally, the deforestation process caused by logging, cattle, agriculture, etc., make Amazonian lands unproductive, disrupting local economies and livelihoods. This is followed by subsequent migration flows heading either to regional cities or to new frontiers of deforestation.

Indeed, as the International Organization for Migration notes, environmentally-induced migration increases pressures in urban areas, exerting additional pressures on already fragile urban infrastructures and services, what has happened in the Amazon context (IOM, 2008). 70% of population growth in the region occurs in cities, in the form of migrants returning from the frontier (Moura & Moreira 2001).[48] Most immigrants going to the inner frontiers are coming from nearby consolidated frontiers, showing how the frontier perpetuates itself.

47. Analysis based on 2000 Census data.

48. However, these author judiciously stress the caution we should have in adopting the concept of "urbanization" to perform analysis on macro areas of the Amazon region. They prefer the term "new rurality" for most of frontier agglomerates, since most of them do not even count on basic urban services.

The boom-and-bust pattern

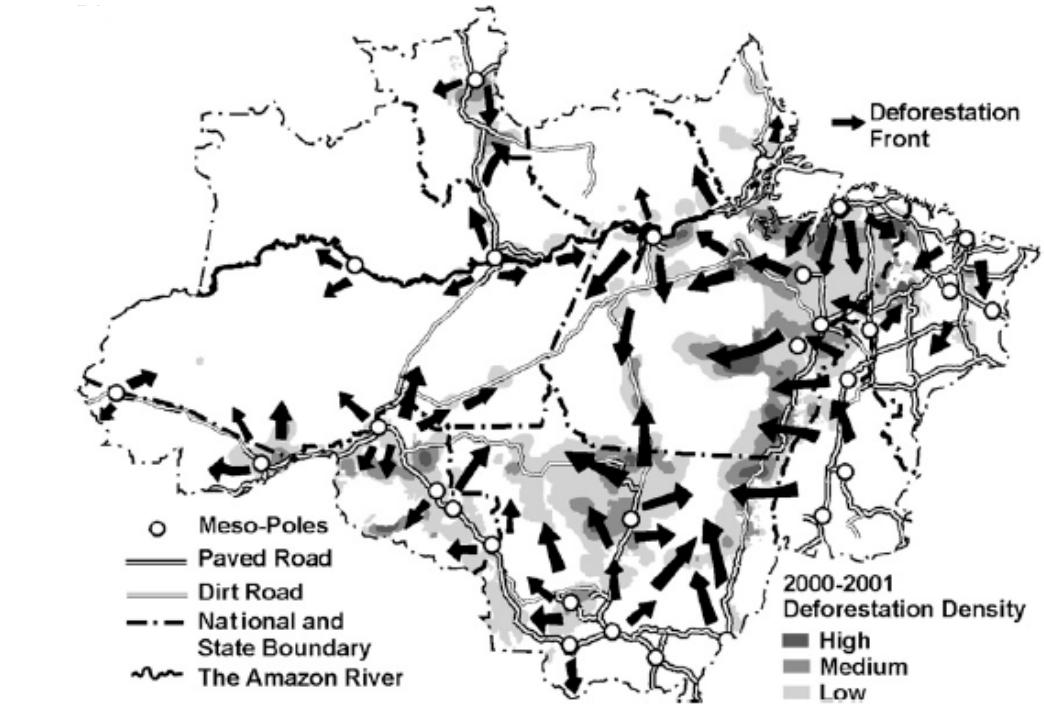
This pattern is grounded in the deforestation process. That is, in the early years of economic development and clearing of the territory, there was a rapid and transient increase in income and employment (boom), followed by a social, economic and environmental collapse (bust) (Celentano, et al., 2007).

In the short term, there is a growth of economic indicators, and HDI is favored by income growth and immigrant's arrival. But when there are no more trees standing, loggers give way to cattle ranching and look for another area nearby. The income falls with the livestock industry and the deforested areas show lower socio-economic indicators than those of regions where deforestation is taking place (Celentano, et al., 2007).

Based on this model, we intend to show the relationship between environmental degradation and migration patterns in the region. Migration rates from the 2000 IBGE Census of all Amazonian municipalities are grouped into seven classes (A to G) describing their position relative to deforestation frontier in 2000. Both deforestation activity (rate) and deforestation extent are considered.

The classes ranged from pre-frontier municipalities, with essentially intact forest (A), to progressively deforested regions with high (B to D) and low (D to F) deforestation activity, and to heavily deforested post-frontier municipalities with almost all their natural resources depleted (G). The results show a slight but significant difference between migration rates of each group of municipalities.

Figure 9. Major deforestation fronts, derived from the integrated analysis of the Amazon urban network, population movements and socioeconomic index, laid over 2000-2001 deforestation hotspots



Source: Alencar et al, 2004

2. ADVERSE CONSEQUENCES OF ENVIRONMENTAL MIGRATION

The Amazonian case draws on a context of human mobility widely associated with the use of natural resources and subsequent environmental changes. Nevertheless, it is worth noting that if on the one hand the pressure on the environment results from socio-economic patterns, on the other hand, these changes also induce disruption of local economies and change in social and cultural life, making the issue a multidimensional process.

For example, the impacts of environmental change on traditional floodplain agriculture, inland fisheries, and forest productivity have provoked serious disruption, affecting populations such as indigenous and riparian populations who have practiced varzea (floodplains) agriculture for many years. Fishing is another important economic activity that has been disrupted by environmental change. Rivers have become polluted from mining activities and social tensions have been registered between traditional fishermen and commercial fishermen in places such as Southern Para (Lopez, 2001).

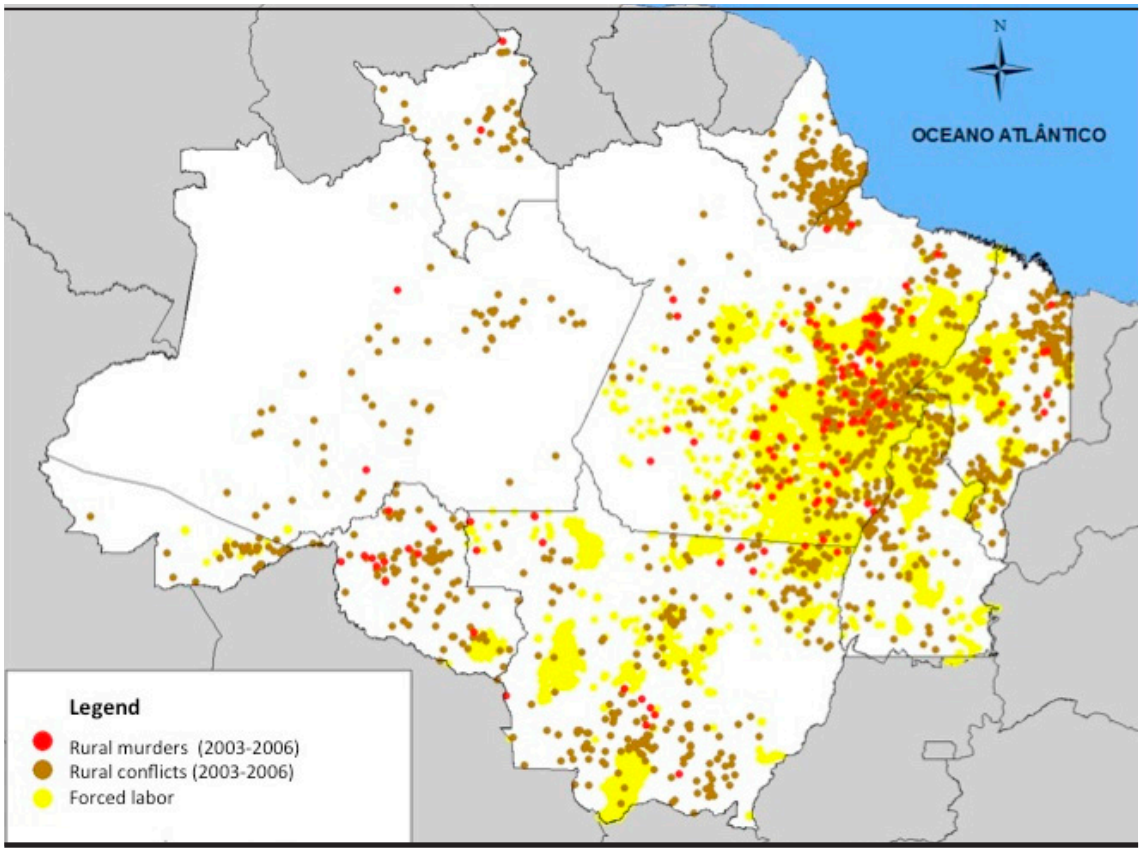
All these aspects led to constraints on income and labor of the riparian populations. Environmental change, in large scale, is responsible for prior social, political, and economic variables that contribute to so-called "side effects", or secondary impacts, that can precipitate disputes.

Recent narratives about climate change have maintained that environmental change itself leads to social conflict. However, Lopéz (2001) posits that migration flows and economic disruptions—rather than environmental change itself—drives social conflict. Drawing from the case of the Amazon, the general web linking environmental change to social conflicts follow three different phases: (I) environmental change; (II) side effects, such as economic disruption and population displacement; and (III) conflict-issues, such as land and mineral conflicts.

Society in the Amazon region is composed of a fragile constellation of social actors, including landless people, posseiros (settlers without legal title), grilleiros (land grabbers), large landowners, and indigenous people. Environmental change, and associated population movements, alters the social order in ways that places two or more of these groups in conflict with one another, increasing the risk of violence.

Clearly, social tensions run higher in the case of the Amazon deforestation zone. Indeed, 43% of rural murders in the Amazon region between 2003 and 2006 occurred in the zone of deforestation, and the area had a much larger homicide rate than the regional and nationwide rates. Land conflict

Figure 10. Rural violence in the Amazon Region, 2003-2006



Source: Verissimo apud CPT 2004, 2005, 2006 e 2007.

and slave labor rates were also higher in the deforested area, leading to high rates of violent crimes (Celentano, et al., 2007). Such social unrest often reflects the land tenure issues that were brought upon by deforestation.

In a nutshell, environmental change in the Amazon region has provoked large population displacements and livelihoods disruption, with a clear influence in the dynamics of manifest disputes.

3. CLIMATE CHANGE, ECOSYSTEM DEGRADATION AND VULNERABILITY: THE ROLE OF POLICYMAKING

The Amazonian case should also be discussed in the light of adaptation strategies to climate change. Recent studies indicate that the region faces alarming risks. For example, climate models show that the region will experience considerable warming and drying in the coming decades. General Circulation Models project a regional increase of 2-3°C by the year 2050 and a decrease in precipitation in the Amazon during dry months, leading to widespread drying (WWF, 2010). Land use and climatic changes may turn the Amazon from net sink of atmospheric CO_2 into a source of emissions. Such changes would not only be globally devastating, but would have serious local impacts, including soil erosion, ecological degradation, loss of biodiversity, decreased agriculture yields, and increases in infectious diseases. At the biome level, it is projected that evergreen forests could be succeeded by mixed forests, savannah and grassland in Eastern and in parts of Western Amazonia (Cramer et al., 2001; Cramer et al. 2004 quoted WWF 2010). According to the INPE (Brazil's National Space Research Institute), between 30% and 60% of the Amazon rainforest could become a dry savannah.

The forest can also be threatened by secondary effects of climate change, such as a potential increase in the frequency and intensity of fires (Nepstad et al., 2001; Laurance and Williamson, 2001; Laurance et al., 2001; Cochrane and Laurance, 2002 all in WWF 2010). A decrease in rainfall during critical dry months may also lead to increased evapotranspiration and pest infestation, which will undoubtedly negatively impact agricultural yields (IPCC 2001). The result would be that more land would need to be cultivated to meet population food needs.

A key concept in mitigating forced migration caused by environmental change should be the reduction of vulnerability and adaptation policies. The Amazon region must undergo a total shift in its socioeconomic model, which even under current conditions leads to displacement, land concentration, environmental degradation, and social conflict. State policy should aim to improve people's ability to cope with environmental change rather than simply encourage deeper expansion into the frontier. However, current State capacity in the Brazilian Amazon is weak. Many regions on the frontier lack even the most basic public services. In many regions, especially those inner to the forest (far from infrastructure access), people must travel days by small boat to access hospitals or other public facilities. For most, the Army is the only form of contact residents have with public officials of any sort. In such a context, institutional capacity for planning or law enforcement is very low. The State must act to establish its writ and to develop comprehensive systems of public administration, including banking, education, health, housing, sanitation, and land ownership. At the same time, it should not ignore existing local and regional civil society organizations, which have played key roles in the region's recent history.

Programs that comprise economic and social changes should be implemented if the Brazilian State wants to reduce the already existing social instability in the Amazon region and its high vulnerability in a context of climate change. This requires for instance more interaction between Environment and other ministries such as Energy and Agriculture, eschewing conflict of agendas such as those that were exemplified in Belo Monte dam project. Institutional capacity is a structural problem and depends in a large sense on the presence of public sector in remote areas.

In the most stressed communities, it is a challenge to reconcile forest conservation with immediate employment needs and income generation. Forest management systems need to be strengthened, combined with mechanisms for the payment of environmental services. In forested areas, it is necessary to halt the advancing frontier of deforestation with the creation of protected areas. The Amazon Protected Areas Programme (ARPA) is one of the largest forest conservation programs in the world and represents an important step in this direction.

In the long term, the economic model of the region must shift from the supremacy of primary activities with low value-added to an economic model in which forest products and services are valued and the income generated contribute to improving community's quality of life. To do so, it is necessary to expand investment in science and technology in the region. Though NGOs and private actors have been working in these areas, the idea of a "forest economy" is still largely missing from the Brazilian Amazon.

Large-scale infrastructure projects should also be revisited in terms of their social and environmental impacts. Small hydroelectric stations are more appropriate to a region with such fragile and rich ecosystems and with turbulent social dynamics. Mining projects, which consume more than half of power produced in the region, should also be re-evaluated, with greater consideration for environmental impacts and local economic benefits.

4. MOVING FORWARD

The linkages between environmental change, migration, human security and social conflict in the Brazilian Amazon are multiple and complex. Environmental change results in resource scarcities that alter social dynamics and contribute to social tension, instability, and violence.

Even though social groups strongly depend on the natural environment, manifest violence could arise not only because of scarcity of resources, but because of incompatibility of different social structures materialized in different patterns of resource use. Ecological scarcities contribute to other political, social, and economic conditions that more directly precipitate violence. These shift in conditions occur due to continuous flows of environmental migration, which are mostly intra-regional.

Frontier expansion, having been initiated by the State, now reproduces itself, through boom-and-bust cycles that attract migrants and then drive them deeper into the forest, in search of resources. Ironically, the State, having initiated this pattern, now finds itself unable to control the process. Therefore, the route to a solution begins with the State asserting itself in the Brazilian Amazon. But recent suggestions and initiatives based on the role of civil society and private sector are also promising in shifting Amazonian economic and social model. It is necessary in order to reduce current insecurities, and long-term vulnerabilities caused by climate change.

8.3. CASE 3: ENVIRONMENTAL AND HUMAN DISASTER IN THE HILLY REGIONS OF THE STATE OF RIO DE JANEIRO (JANUARY 2011)

Eva Gutjahr

This case focuses on an environmental and human disaster that took place in the Hilly Region (Região Serrana) of the State of Rio de Janeiro in Brazil in January 2011. With this event as a backdrop, it also explores larger issues of environmental disaster, social vulnerability and internal migration in Brazil, including the current debate over settlement and risk in environmentally-protected areas. Finally, this case covers issues of disaster prevention in the short- and long-term, as well as linkages between exposure to environmental risk and internal migration patterns in Brazil.

This case is particularly of interest because it is a rapid-onset disaster and displacement event with linkages to slow-onset migration from other parts of the country. This context links the case with the previous two cases, on the Northeast Semi-Arid Region and the Amazon Frontier. Furthermore, though this case studies the floods and landslides of 2011, these sorts of phenomena are common in the Brazilian Southeast, and are likely to be repeated in coming years.

1. CONTEXT AND VULNERABILITIES

1.1. The January 2011 floods and landslides

On January 11-12, 2011, the area known as Hilly Region (Região Serrana) of the State of Rio de Janeiro in Brazil, comprising the municipalities of São José do Vale do Rio Preto, Nova Friburgo, Teresópolis, Petrópolis, Bom Jardim, Sumidouro and Areal, was the scene of a major catastrophe: storms leading to landslides and floods caused the death of 910 people (Shäffer et al. 2011).

The disaster began with heavy rains in the final days of December 2010, which saturated the soil. Then, on January 10-11, it rained for 32 consecutive hours, as cold fronts from the south collided with warm, humid air from the Amazon. Meteorologists note that the rainfall overnight on January 11-12 matched expected totals for the entire month of January in the region (Vieira, 2011).

The'Hilly Region of the State of Rio de Janeiro comprises four 'micro-regions': the 'hilly micro-region' or microrregião serrana (composed of the municipalities of Petrópolis, São José do Vale do Rio Preto and Teresópolis), and the micro-regions 'Nova Friburgo', 'Santa Maria Madalena' and Cantagalo.

The population of the Hilly Region[49] amounted to 713,652 inhabitants (approximately 5% of the total population of the State of Rio de Janeiro), according to the Brazilian Institute of Geography and Statistics (IBGE) 2010 Census. The region is characterized by steep hills and valleys, and very little topsoil, so heavy rain frequently causes mudslides. Moreover, as river valleys and floodplains become developed and covered with infrastructure or asphalt, they reduce water absorption and increase runoff, increasing the likelihood of rapid flooding.

Region-wide, it was estimated that 12,768 people were made homeless by the disaster. Another 23,315 were temporarily dislodged (forced to abandon their homes because of the risk). One month after the disaster, there were still 662 people registered as 'missing' (Shäffer et al. 2011).

49. According to the Brazilian Institute of Geography and Statistics, "IBGE" 2010 census, the total population (urban and rural alike) of each of the Municipalities where the disaster took place are: Petropolis: 295,917 inhabitants; Teresopolis: 163,746 inhab.; São José do Vale do Rio Preto: 20,251 inhab.; Areal: 11,423 inhab.; Sumidouro: 14,900 inhab.; Nova Friburgo: 182,082 inhab.; Bom Jardim: 25,333 inhab.

Episodes of intense rain leading to environmental and human disasters are not rare in the State of Rio de Janeiro or in Brazil, especially in its highly urbanized Southeast region. In 1966, 1967, 1988, 2006 and 2010 (to cite only the most dramatic examples), tragedies of this kind have marked the summer rainy season (December to March) in the region. Nationwide, 71,380 people were estimated to have been dislodged or made homeless by rains in January 2011 (Mota, 2011). Moreover, 51% of human deaths due to natural disaster in Brazil are associated with flooding; another 15% are due to landslides (Globo Rural On line, 2011).

1.2. Lack of prevention and preparedness

Since November 2008, public authorities in the State of Rio had information regarding the vulnerabilities of the region to flooding and landslides. The State Government of Rio had commissioned a team of researchers from the Federal University of Rio de Janeiro, under the coordination of geographer Ana Luiza Coelho Netto, which produced a map of vulnerable areas of the state, especially those that had suffered from natural disasters between the years 2000 and 2007 (Coelho Netto, 2008). Their analysis pointed out huge vulnerabilities caused by irregular patterns of urbanization and settlement.

For example, the Netto study showed that most of the population in the municipality of Nova Friburgo lived in "areas of risk", while Petrópolis and Teresópolis presented "several different risk factors", because their communities were located on mountainsides and along river valleys considered to be most vulnerable to landslides and flooding. In spite of this study, the government responded with no preventive measures.

Strikingly, the Government of the State of Rio spent 10 times more on rescue measures (36 million Euros) than on disaster prevention (3.6 million Euros) in 2010. Similarly, in 2010, the Brazilian Federal Government spent 14 times more on reconstruction than on prevention, having 'invested' 350 million Euros in emergency measures for people and areas that had been victims to flooding and landslides, and to the reconstruction of transportation routes (Spinelli, 2011).

1.3. Deficient alert systems

On January 11, the National Institute of Metereology (Inmet) and the Centre for Weather Forecast and Climate Studies (CPTEC/INPE) released an alert bulletin informing the National Civil Defense of "meteorological conditions favorable to the occurrence of moderate to heavy rain" in the Hilly Region[50]. The National Civil Defense transmitted this information to the Civil Defense of the State of Rio de Janeiro. However, this last body did not warn the population, as it followed the recommendation of another institute, the Meteorological Service of the State of Rio (Simerj). The decision not to warn the population was mainly due to the fact that Simerj used a different weather forecasting model, which predicted only "moderate rain."

On January 12, the National Institute of Meteorology (Inmet) released another alert bulletin again warning of "meteorological conditions favorable to the occurrence of moderate to heavy rain". The National Civil Defense transmitted this information to the Fire Brigades in the City of Rio de Janeiro and to the State Office of 'Public Order', who passed on the message (through e-mail) to all the municipalities in the State of Rio. Nonetheless, the population was once again not warned. The exception was the municipality of Areal, where the mayor, worried about the intensity of the storm, took the initiative, recording a message of "high alert" via a car driven through the town's streets, equipped with a loudspeaker. 800 people were preventatively resettled, and Areal was the sole municipality registering no deaths in the disaster (Oliveira, 2011).

It should also be noted that none of the smaller municipalities in Rio state possess public alert systems. Only the City of Rio has a system for detecting extreme weather events; it then distributes information to community leaders in highly vulnerable areas, such as favelas, via mobile phone (Agencia O Globo, 2011).

In July 2011, six months after the disaster, municipalities of the Hilly Region considered implementing alert-systems similar to those in the City of Rio, including warning sirens when rain levels exceed 40 millimeters per hour. If bad conditions persist, inhabitants are urged to leave areas of risk, such as floodplains. These systems should be integrated with existing river level monitoring systems, installed in Nova Friburgo the month after the disaster. Critically, these systems can function even in the event of a power outage, whereas traditional media (TV and radio) are power-dependent and thus failed in the January 2011 disaster. Moreover, as the storms also knocked out phone service, affected municipalities have wisely invested in amateur radios, which can play an important role not only in early warning, but also in rescue activities in isolated areas (Carlyle, 2011a).

50. Jornal Nacional, TV Globo. 13/01/2011.

1.4. Protected areas and social vulnerability

The Rio flooding and landslide disaster was due not only to climatic factors, but also to the patterns of settlement in risk areas. Many people living in the most vulnerable areas are low-income, including many migrants and their families (including, as was detailed in the first case, a large number of migrants from the Northeast of the country seeking a better life in the wealthy and industrialized south) (Hogan, 2005).

Some of these vulnerable settlements lie in protected areas, including public "Conservation Units" and "Areas of Permanent Protection".[51] According to specific environmental legislation, human settlement is illegal in these areas. Moreover, illegal settlements contribute to deforestation of hills and occupation of valleys, thus increasing the risk of erosion, flooding, and landslides. Many communities damaged in the Rio floods were illegally located in protected areas. For example, in Nova Friburgo, 50,000 of the town's 83,000 homes were in such areas (Agencia O Globo, 2005).

For many poor families, the only housing options lie in these protected areas. Because of their risk, lack of infrastructure, and irregular legal status, real estate values are lower, bolstering accessibility for the poor.

Previous case studies of flooding disaster in Brazil have shown a similar relationship between environmentally protected areas, social vulnerability and environmental risk: for example, the 1983 floods in the State of Santa Catarina (South of Brazil) studied by Hermann[52] (Hermann, 2006). Hermann found linkages between natural protected areas, unsafe settlement, and socioeconomic vulnerability. Such problems were exacerbated by a lack of infrastructure, including poor waste management and sanitation. Besides, the migrant (or descendent of a migrant) status is also directly related to social vulnerability (Hogan, 2005). In short, vulnerability is self-replicating, as vulnerable people were forced to inhabit environmentally risky areas that exacerbated their vulnerability to disasters (Fonseca Alves, A. P. & Gama Torres, 2006).

1.5. Natural and socio-economic characteristics

80% of the population from the Hilly Region live in the Municipalities of Petrópolis (39%), Nova Friburgo (23%) and Teresópolis (18%)[53]. The concentration of population in these cities is due to the historic settlement pattern of the area and their proximity with the city of Rio de Janeiro, the State's most important economic centre.

These three cities also have the highest Gross Domestic Product and are the largest suppliers of services in the Hilly Region. Although some of the rural activities that characterized the region in the past persist, the Hilly Region's economy has diversified to include industry, commerce and services, information technology, and rural tourism. "Rural Tourism" and "Green Tourism" are among the most important economic activities in the region, known for its hilly landscape and temperate climate. Other important economic activities are the beverage industry, the wooden furniture industry and activities in the mechanical and textile sectors. The textile sector has been particularly fast-growing in the municipalities around Nova Friburgo, and textiles have come to characterize the economy of the region, according to a study by the Rio branch of the Brazilian Support Service to the Micro and Small Enterprise - "SEBRAERJ." (SEBRAERJ, 2010). The sector accounts for 25% of the national textile sector, providing 20,000 jobs in the region, and produces more than 125 million articles of clothing per year (Mariano, 2011).

2. IMPACTS OF FLOODINGS AND LANDSLIDSES

2.1. Damages and migration

Most of the population of the Hilly Region displaced by the floods and landslides went to

51. 'APP' following to the Brazilian 'Forest Code' articles 2 and 3, and Federal Laws nº 4771/1965, 7803/1989 and 7875/1989. The Brazilian Forest Code determines that all river sources, river borders, top of hills and mountains, as well as areas presenting a declivity superior to 45 degrees are 'Permanent Protected Areas' (APP), and as such they should not be occupied by any type of settlement or neither be submitted to deforestation. These areas are subject to regulations no matter if they are localized in urban or rural areas. Legislation also establishes that deforestation is forbidden in APP areas of declivity between 25 and 45 degrees. This last case is related to protection from erosion, areas of declivity being the most erosion-prone. Areas that are now being appointed as lacking legal protection are those localized at the bottom of high declivity mountains and hills, which are the most vulnerable to landslides and are not under specific protection legislation.

52. Herrmann, M. L. P. (Org.) Atlas de desastres naturais do Estado de Santa Catarina. Florianópolis: IOESC, 2006. Cited in: Schäffer et all.; 2011

53. Petrópolis and Teresópolis have also become known as 'imperial cities', having hosted the Portuguese royal family during the 18th and 19th centuries. Petrópolis was the official capital of the State between 1894 and 1903.

public shelters offered at the municipal level (in schools, churches and sports stadiums), or were hosted by family or friends living in the same city. Though official figures show 12,768 people were made homeless and 23,315 dislodged (Shäffer et al. 2011), it is still difficult to find data showing displacement and migration patterns in and out of the affected area.

In the aftermath of the landslides, a lack of workers was one of the main reported problems, particularly in the textile sector, even one month after the disaster (Gandra, 2011). On January 19, the Federation of Industries of the State of Rio the Janeiro (FIRJAN) reported that, of 278 companies consulted, 62.2% suffered some kind of impact, and that economic losses were estimated at 67.2 million Euros, mostly related to loss of production time, raw materials and stock. Of the 117 affected companies affected, 92.3% registered absences among blue-collar workers and 41.9% reported absences of administrators, implying that poorer, less-educated workers were most severely affected by the disaster.

Nova Friburgo, where 79.8% of companies suffered some impact, was the most economically damaged. Second came Teresopolis (68.8%) and third Petropolis (30.7%). Among all companies in the region, 67.6% reported missing workers, while 83.3% reported power outages, and telephone lines were down in 73.4% of businesses. Meanwhile, 38.2% of companies were affected by flooding in their vicinity and 21.4% suffered flooding within their industrial plants. The return to normal activities was postponed by internal and external infrastructure problems, as 62.4% had difficulties shipping their wares, and 59.5% encountered trouble bringing in raw materials due to transportation outages. [54]

After the incident, industries pledged not to dismiss personnel, so people who left their jobs probably did so voluntarily (Gandra, 2011). According to the president of the Council for the Development of the Textile Sector of Nova Friburgo and the Region", Nelci Layola, most of the workers who left had migrated elsewhere within the state, in search of work (ibid.). However, such assertions are hard to verify in the absence of precise labor migration data. It is also possible that some left the state altogether, fearing economic stagnation brought about by the difficult economic conditions following the floods (ibid). In addition, for those employed in farming rather than factory work, the disaster had more serious ramifications on communities, and may have forced families to migrate elsewhere in search of new livelihoods (Carlyle, 2011b).

2.2. Health and sanitation impacts

Within a month of the disaster, there were 28 registered cases of leptospirosis in the Region, 26 in Nova Friburgo and 2 in Teresópolis.[55] Leptospirosis is a potentially deadly disease transmitted by a bacteria found in rat urine. Proliferation risks tend to increase during episodes of flooding and its aftermath, with the accumulation of mud and debris and increased human contact with contaminated water. In the following days after the episode, the State Undersecretary of Health distributed 200 textbooks about the disease and visited 150 shelters to raise awareness about the risks of the disease among displaced people.[56] Other diseases related to the disaster were hepatitis, diarrhea, tetanus and infections. One week after the incident there were 200 registered cases of diarrhea; meanwhile, 13,000 affected people had been vaccinated against tetanus (Caruso, 2011).

Six months after the incident, the Ministry of Health reported an investment of 1.26 million Euros in the construction of basic health units in 7 cities of the Hilly Region (Carlyle, 2011c).

2.3. Migration for reconstruction purposes

Despite the difficult conditions, the public and private sectors have launched initiatives to attract or retain workers in the Hilly Region, especially for reconstruction purposes (Portal Brazil, 2011). These initiatives can be seen as state-support efforts to encourage return migration in the wake of the disaster. As part of these efforts, the Ministry of Employment and State Secretary of Employment are promoting continuing education classes in civil engineering for 1,000 workers in the 6 most-affected municipalities. The idea is to contribute to reconstruction of the region, bolster the regional economy, and employ people living in shelters (ibid.). However, investment in reconstruction will also likely draw migrants from

54. From the 278 companies consulted 129 are located in Nova Friburgo, 88 in Petrópolis, 48 in Teresópolis, 7 in Areal, 5 in Sumidouro and one in São José do Vale do Rio Preto. 272 companies are in the transformation sector and 6 in civil construction. Micro-entreprises are the most representative group, accounting for 65,8% of the total. Source: Sistema FIRJAN. 62% das empresas da Região Serrana foram afetadas pelas chuvas. 18.01.2011.

55. Notícias R7." Sobe para 28 o número de casos confirmados leptospirose na região serrana". 02/02/2011.

56. Id.

other parts of Brazil, who may come in search of new work opportunities. Such patterns echo other internal population movements in Brazil (described in cases 1 and 2), as people move from region to region in search of a better life.

However, historically, as all three cases have demonstrated, internal migrants in Brazil have found insufficient public services and basic infrastructure in their new homes. These shortages often force migrants to occupy environmentally vulnerable land. It remains to be seen if these potential "reconstruction migrants" to the Hilly Region suffer the same fate.

3. POLICY RESPONSES

3.1. Mitigation and Reconstruction

Three months after the flooding and landslides, 60 families in Nova Friburgo were still living in shelters and receiving food offered by the municipality and donors. Though donations had begun to dwindle, many families were still stuck, with no place to go. As the weeks went by, many chose to return home, despite the risks, rather than to remain in the shelters indefinitely.

The main public and private measures directed to the victims of the disaster in the Hilly Regions of Rio were:

1. The 'Bolsa-família' allowance given to 31,000 people.
2. A credit line provided to the commercial sector, by the Ministry of Social Integration.
3. The plan for the construction of 6,000 'social' houses to the victims whose houses have been either destroyed or expropriated for reasons of risk, and the construction of another 2,000 houses by a pool of construction companies on land donated by the State Government.
4. A 'lottery' game by the National Lottery had been created, with proceeds reverted to the disaster victims.
5. The option to access 2,421 Euros of the FGTS (Retirement Fund) for workers in the region.
6. An extension of two months on the payment of home and vehicle taxes.
7. The implementation of a 'Reconstruction Program for the State of Rio de Janeiro', by the National Bank for Social Development (BNDES), with a total funding of 179 million Euros to finance, under special conditions, companies and entrepreneurs in the affected municipalities.
8. An emergency credit line implemented by the National Program for the Strengthening of Family Agriculture, with a funding of 5,8 million Euros, directed to the reconstruction of productive infrastructure, irrigation systems, and agricultural inputs.
9. 'Social security' allowance of 225 Euros to cover rent expenses for dislodged families.

But such benefits were only available to those who had sufficient identification. However, many families had lost their documents in the disaster, and requests for new documents flooded issuing agencies. And the fund of 225 Euros allowance to cover monthly rent expenses failed to account for a lack of available housing options in the region (Castro, 2011).

International financial support included:

1. A credit of 341 million Euros by the World Bank for the reconstruction of houses, expropriation of land, resettlement and demolitions.
2. A credit of 448 million Euros by the Inter-American Development Bank for the rebuilding of roads in the State of Rio de Janeiro.

3.2. Long-term initiatives

National long-term initiatives included:

1. The Federal Program PAC 2 (Growth Acceleration Program) planned an investment of 5 billion Euros for construction of drainage systems in all vulnerable regions in Brazil.
2. The Federal Program, 'My House My Life' (*Minha Casa, Minha Vida*) planned to invest 76 million Euros for relocating families living in vulnerable and disaster prone areas.
3. The BNDES (National Bank for Social Development) will financially support a study to identify areas of risk in the whole country to support national risk management plans.
4. The Federal Government also announced its willingness to invest in continuing education and equipment to municipal Civil Defense Forces, the institution responsible for the reduction of disasters including prevention, preparation for emergencies, responses to events and reconstruction.
5. In March 2011 the government launched the 'National Monitoring and Alert of Natural Disasters System' (Sistema Nacional de Monitoramento e Alerta de Desastres Naturais).
6. The creation of a "Civil Defense Payment Card" from May 2011 onwards. The objective of the card is to improve transparency and efficiency in the transfer of funds for rescue, assistance and rehabilitation in events of disaster. It is also supposed to serve as a tool to accountability, monitoring the use of resources.

Table 1. Sequence of events in the 15 affected Municipalities of the "Hilly Region" of Rio de Janeiro

Date	Events	Consequences
Last days of December 2010	8 to 10 days of intense rain	soil overly wet
10th and 11th January 2011	32 hours of uninterrupted rain	soil overly wet
11th to 12th January 2011	4,5 hours of very intense rain	landslides and floods
12th January 2011	Intense rain, landslides and floods	12,768 homeless 23,315 dislodged 662 'missing persons' **910 deaths**

Source: Own elaboration.

CONSIDERATIONS AND RECOMMENDATIONS

Few public official documents have been prepared related to the January 2011 disaster. Nonetheless, starting in November 2008, Rio State authorities had information on vulnerabilities to flooding in their state (Coelho Netto, 2008).

Two public official documents were prepared in the aftermath of the event. The first is an inspection report produced by the Brazilian Ministry of Environment and the Rio State Office of Biodiversity and Forests, "Areas of permanent protection, conservation units & areas of risk, How are they related?" (February, 2011) (Shäffer et al. 2011). It is noteworthy that this report relates only to the environmental and legal—but not social—context. It notes the occupation and settlement of natural protected areas, but fails to refer to the social vulnerability of the populations in such settlements. It emphasizes the need for enforcement and improved monitoring and control of irregular occupation in such protected areas, but makes no recommendations regarding social policy. The team did not include a social scientist or urban planner and thus, it did not develop an integrated approach in its analysis, with no discussion of the human, sociological, or historical context. The team also failed to explore ways that the environmental sector could engage with other public sectors on these issues.

The second official document is the report "Diagnosis of the mega-disaster in the Hilly Region" prepared by the Geological Service of the State of Rio de Janeiro (2011). This report was produced one month following the disaster and consists mainly of an analysis of the geology of the area. It relates to the Civil Defense's rescue response but says nothing regarding disaster risk reduction efforts.

The Hilly Region floods have also triggered an interesting public debate about questions of responsibility for the disaster. Many victims were perceived as having occupied the area voluntarily, and thus chose to place themselves at higher risk. Alternatively, the media has run stories of a wealthy family who lost its home in the disaster, obscuring the fact that the disaster hit hardest among the poor.[57] Others point out that public authorities are responsible for preparedness, and thus should be blamed for what happened, rather than blaming "nature" or the victims themselves.

The overlap of environmental and social factors makes this issue a challenge for public authorities, as inter-sectoral cooperation is essential. Moreover, the disaster is a challenge for academic and analysts, as one must include environmental, geographic, sociological, economic and historical information, rather than adhering to traditional disciplines. Lastly, such analysis requires sophisticated technology and highly trained operators—neither of which may be ubiquitous, even in a large country such as Brazil.

Regarding public sector capacity, a few suggestions emerge from this case. First, early warning systems clearly failed, as a result of miscommunications between various meteorological and civil defense agencies. These communication breakdowns and the resulting confusion likely cost lives. Second, it is essential that various public sectors be more harmonized, particularly at the local level. Third, adaptation, mitigation, and rescue practices are all essential, but disaster prevention is both vastly important and vastly overlooked. The state must consider investment in significant infrastructure to prevent future extreme weather events from turning into deadly disasters.

Lastly, this case study has shown the links between internal migration and residence in environmentally-sensitive areas. In Rio, as in many other parts of the country, massive infrastructure projects have attracted migrant labor to cities unprepared to deal with the new arrivals.[58] The result

57. The Conolly family, including, Erick Conolly, CEO of the 'Icatu holding' and his daughter Daniela Conolly, a famous Brazilian stylist. Seven members of this family died in the disaster, as they were hosted in the farm-house of the even more wealthy 'Gouvêa Vieira' family, one of its owner being a deputy of the State of Rio. In: Lage (2011).

58. Articles report to 7,030 civil construction workers only for the hydro-elecritc of Santo Antônio, 84% originary

has been unplanned urbanization, often in areas of environmental risk. Thus, it would be wise for future large-scale projects in Brazil to include not only the classic Environmental Impact Assessments, but also "Social Impact Assessments", which would establish if the community in question is – or should be - equipped to deal with the inflow of labor associated with the project. As this case shows, such analysis would be a critical part of any disaster prevention system, by preventing the establishment of irregular settlements in environmentally-sensitive areas that can so easily turn into disaster areas.

BRAZIL'S CASE STUDIES: GENERAL CONCLUSION

The three cases we have presented here illustrate different aspects of Brazilian environmental migration. From historical and current examples of slow onset migration to a very recent event of disaster-related displacement, we intended to analyze a diverse range of causes of this process, which may affect and create social instabilities at the local and regional levels.

Although we have studied regions with different social and ecological conditions, and our data vary in sources and scope, all three cases yield similar considerations. First, both long-lasting migration and short-term displacements were clearly (and generally, negatively) correlated with environmental changes. Indeed, the environment was relevant in the three examples, but the impacts were not solely the result of nature. Negative outcomes, such as economic disruption and population displacement, are highly dependent on the social and political contexts. In each case, a lack of urban and regional planning and the dominance of extractive and patronage-based development models increased social vulnerability to these negative outcomes of environmental change.

Vulnerability is a key concept in these cases and is the consequence of structural problems which can only be tackled through public policies and transformation of current socioeconomic systems.

from the State of Rondônia, and 16%, 1,124 workers originary from other States. Strikes and uprisings have taken place over the year 2010 because of critic working conditions. "Superexploração dos trabalhadores na usina hidrelétrica do Rio Madeira", PSB Nacional, 5/07/2010.

The historical drought process in the Northeast has negative impacts on people's lives, but these effects become deeper and more insidious when associated with the region's patronage system, which creates vicious cycles and halts development. Thus, drought (and its negative impacts) has more or less become "institutionalized".

The Amazonian case is the result of decades of destructive economic and demographic policies, founded on the idea that the forest should be cleared in order to assure national security and progress. To date, the region's development has been based on low value-added resource exploitation, a process that has led to ecological catastrophe and a cycle of voracious expansion into frontier zones. Combined with a total lack of state services and authority, this development pattern has resulted in high rates of violence, continuous environmental degradation, and economic disruption, as well as large-scale voluntary and involuntary migration.

Structural problems are also present in the Hilly Region of Rio de Janeiro, where migration flows, the occupation of risky areas, deforestation, and absence of flood prevention measures produce glaring vulnerabilities each rainy season. The disaster displaced thousands of families, and reconstruction itself may bring new migrants to the area.

Climate change is expected to exacerbate severe droughts, desertification, and flooding: the three environmental changes covered in these cases. Brazil's ability to adapt to climate change will be hindered by these socially-rooted structural factors in each of the regions in this chapter. Moreover, having made massive infrastructure investments in the three areas, it will be difficult for Brazil to change course quickly in the face of global environmental change.

Public policy is the only comprehensive way to tackle these challenges. Each case in this chapter has set forth policy recommendations. More broadly, urban and regional planning, deploying basic services and functions of the state, and formulating infrastructure projects consistent with on-the-ground realities are all crucial strategies for dealing with migration and instability in the face of environmental change. Moreover, while the State must have a central role, it must also work alongside private and civil society actors. Building capacity to deal with environmental change is not a peripheral concern, but is central to Brazilians' quality of life and human security.

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