

## Participatory Stakeholder Workshops to Mitigate Impacts of Road Paving in the Southwestern Amazon

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Elsa Mendoza, Stephen Perz, Marianne Schmink and Daniel Nepstad

**Abstract:** *Infrastructure projects are crucial for regional development, but they often lack participatory planning processes. As a result, they often generate negative socio-economic and biophysical impacts, threatening local livelihoods as well as environmental conservation. The Amazon is an instructive example, where new infrastructure projects may repeat the deforestation and social conflict seen around earlier road projects. This article considers the case of the Inter-Oceanic Highway, being paved through the tri-national frontier in the southwestern Amazon where Brazil, Bolivia and Peru meet. To raise local awareness and to facilitate public participation in planning to mitigate negative road impacts, we conducted multistakeholder workshops in eighteen municipalities along this road corridor. Participants identified and prioritised infrastructure, social, environmental, economic and political problems related to road paving. They also created their own land-use maps for*

**Elsa Mendoza**, Instituto de Pesquisa Ambiental na Amazônia IPAM, Avenida Nazaré 669, CEP 66035-170, Belém, Pará, Brazil.

**Stephen Perz**, Department of Sociology, 3219 Turlington Hall, University of Florida, PO Box 117330, Gainesville, FL 32611-7330, USA.

**Marianne Schmink**, Center for Latin American Studies, 319 Grinter Hall, University of Florida, PO Box 115530, Gainesville, FL 32611-5530, USA.

**Daniel Nepstad**, Woods Hole Research Center, 149 Woods Hole Road, Falmouth, MA 02540-1644, USA.

### Address for Correspondence

Stephen G. Perz, Department of Sociology, 3219 Turlington Hall, University of Florida, PO Box 117330, Gainesville, FL 32611-7330, USA.

**E-mail:** [sperz@soc.ufl.edu](mailto:sperz@soc.ufl.edu)

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*purposes of land-use planning. Such exercises can broaden public participation in planning to mitigate the negative impacts of infrastructure projects.*

**Keywords:** Amazon, roads, infrastructure, deforestation, land use, planning, Brazil, Bolivia, Peru

## INTRODUCTION

MANY DEVELOPING REGIONS, such as South America, are currently sites of numerous large-scale infrastructure projects (CEPEI 2002). Such endeavours are driven by the logic of regional economic integration, in order to facilitate national competitiveness in globalising markets. New roads and infrastructure upgrades are crucial for regional development, but they also bring negative social and ecological impacts (Trombulak & Frissell 2000; Forman et al. 2003). A key reason for this is that large-scale infrastructure projects are notorious for lacking a process that incorporates public participation, especially by communities in areas directly and indirectly affected by new construction. The result is that habitats and ecosystems are degraded because the communities that depend on them are marginalised.

This paper seeks to address this problem by reporting results from participatory workshops with municipalities along the Inter-Oceanic Highway in the southwestern Amazon. We employed methods developed by the non-governmental organisation (NGO) IPAM (the Institute for Amazon Environmental Research) to incorporate local stakeholders into planning processes in order to mitigate the negative social and environmental impacts of infrastructure projects (IPAM 2006a). A key innovation is that the workshops generated information that can be integrated with other data sources for the sake of scenario development and mapping (Alencar et al. 2004; Soares Filho et al. 2006). Visualisation of future changes, based on problems cited by stakeholders as well as other data sources such as satellite images coupled with dynamic modelling packages, provides concrete data products useful for planning to mitigate future road impacts and foster sustainable development. Such tools can help foster public participation in state policy formulation and to improve the transparency and accountability of state decisions that affect the governance of roads (Alencar et al. 2004; Perz et al. 2007).

Another innovation in these workshops is that they occurred in three different countries, for the Inter-Oceanic Highway passes through the tri-national 'MAP' frontier, where **M**adre de Dios (Peru), **A**cre (Brazil) and **P**ando (Bolivia) meet. This allows for comparisons in the perspectives among the three sides, as well as opportunities for stakeholders to learn from each other via cross-border exchanges of information. This is especially important, for the Inter-Oceanic Highway that has been paved in Brazil, allowing Peruvians and Bolivians to see what problems Brazilian face and how Brazilians understand their situation, so that similar problems might be mitigated following future road paving in Peru and Bolivia.

***Socio-economic and Biophysical Impacts of Past Infrastructure Projects in the Amazon***

The Amazon provides many telling case studies of the challenges to effective planning for the impacts of new or upgraded infrastructure. Highway projects beginning in the 1960s often led to widespread deforestation, land degradation, violent conflicts over natural resources, and limited rural livelihood options, which resulted in rural-urban migration and the reproduction of poverty in urban frontier areas (Goodland & Irwin 1975; Mahar 1989).

In Brazil, the Transamazon highway in the state of Pará opened a new swath of upland forest to colonisation in the 1970s (Smith 1982), but state abandonment in the 1980s hindered the ability of colonists to secure sustainable livelihoods (Nascimento & Drummond 2003). Landownership turnover and rising crop prices attracted new colonists in the 1980s, stimulating expanding deforestation (Nascimento & Drummond 2003). While some prospered for a time, price declines and pest attacks threatened colonist well being, prompting many to adopt cattle ranching, resulting in expanded deforestation (Veiga & Tourrand 2004). The Polonoroeste project, which featured paving of the BR-364 highway through the state of Rondonia with World Bank funds, led to an enormous influx of migrants from southern Brazil, which resulted in disorganised land settlement, widespread deforestation, invasion of indigenous lands, disordered small-scale mining that polluted rivers with mercury, and predatory timber extraction that degraded forests (Browder & Godfrey 1997). Again, many colonists found limited means for sustainable livelihoods despite the environmental exploitation underway, yielding landownership turnover, rural-urban migration and land concentration (Millikan 1988; Browder & Godfrey 1997). In the eastern Brazilian Amazon, the Grande Carajás project, which involved \$61 billion in investments for an 800 km railway from one of the world's largest iron mines to the port of São Luis, generated similar impacts (Almeida 1986). The mining operation was quickly surrounded by a rapidly changing landscape of conflicting land claims established by deforestation and violence (Hall 1989). Along the railway, chaotic land settlement proceeded, resulting in widespread forest clearing, invasions of indigenous lands and limited development opportunities for many local communities (Treece 1987; Wagner de Almeida 1995; Coelho & Cota 1997). Nearby, prospective paving of the state road PA-279 to the riverside town of São Felix do Xingú prompted debate among local residents over the likely impacts. While some were hopeful about future changes, others feared an intensification of land conflicts. The ensuing paving of PA-279 led to land conflicts so serious that federal government intervention became necessary (Schmink & Wood 1992). Since then São Felix became known as the 'violence capital' due to its unresolved land conflicts.

Brazil is not alone among the countries sharing the Amazon with examples of socio-economic and biophysical problems following implementation of

new infrastructure. In the Bolivian lowlands, investments in the highway from the highlands to Santa Cruz stimulated rapid migration and urban growth (Stearman 1985). As Bolivia embarked on structural adjustment reforms in the 1980s and 1990s to improve international competitiveness, soybean and ranching operations proliferated in Santa Cruz (Pacheco 1998). Consequently, deforestation prevails along roads in Santa Cruz (Mertens et al. 2004). In Ecuador, investments in road infrastructure from the highlands to the eastern lowlands stimulated rapid migration into the Oriente (Rudel 1983; Uquillas 1984; Wunder 2000). As in other areas, new or improved roads generated new economic opportunities for many impoverished families in the densely settled highlands. However, colonists in the lowlands experienced varying degrees of success in farming, and the emergence of narcotrafficking in the Ecuadorian lowlands has greatly complicated the situation (Rossi 1996). New roads in the northern Peruvian Amazon have raised concerns about social and environmental impacts there as well (Mäki et al. 2001; Dourojeanni 2006).

Given this historical context, a new generation of infrastructure projects in the Amazon has become the subject of intense debate (Laurance et al. 2001). The *Avança Brasil* programme, an ambitious set of infrastructure projects in Brazil, was funded with little input from environmental groups, human rights organisations or the public. Consequently, paving of the BR-163 highway through the central Brazilian Amazon has become a controversial pillar of Brazil's current development planning, given the expansion of soybeans and cattle along that road (Nepstad et al. 2002).

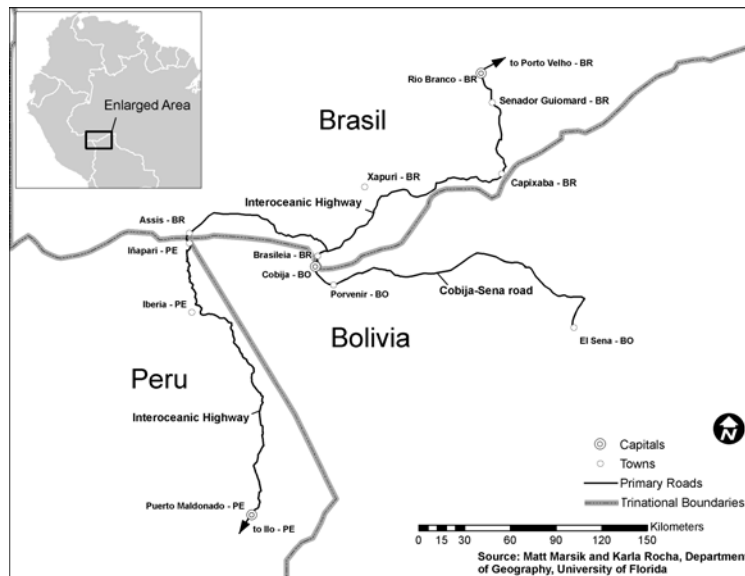
Many researchers argue that the principal problem with previous highways was the lack of a participatory planning process involving local people, and the failure to formulate mitigation plans to attenuate the indirect impacts up to 50 km to each side of the roads (Nepstad et al. 2002; Alencar et al. 2004; ISA 2005). Recent experiences suggest that participatory planning, supported by scientific data to generate possible scenario models, can improve the governance needed to negotiate priority policies to be implemented along new highways (Nepstad et al. 2002; Soares Filho et al. 2004, 2006; Dourojeanni 2006).

### ***The Inter-Oceanic Highway in the Southwestern Amazon***

Another strategic corridor currently receiving investments is the Inter-Oceanic Highway, which passes through southwestern Amazon (CEPEI 2002; Pro-Inversión 2005; Dourojeanni 2006). Paving of this road will facilitate links between the Atlantic ports in southern Brazil and the Pacific ports in Peru, opening the southwestern Amazon to global markets. The distance from Acre, Brazil to the nearest ocean port will be reduced from approximately 4000 km (to the Atlantic) to 1500 km (to the Pacific). On the Peruvian side, the road is now being paved starting from a newly built suspension bridge over the Acre River at the Brazilian frontier, to the Pacific ports of Ilo, Matarani and Callao (Figure 1).

Figure 1

*The Inter-Oceanic Highway in the MAP region (Madre de Dios, Peru; Acre, Brazil and Pando, Bolivia)*



Paving of the Inter-Oceanic Highway is being financed by the Andean Promotion Corporation (CAF) as well as the Brazilian and Peruvian governments, with a total budget of \$890 million, and construction is scheduled to be completed by 2008 (Pro-Inversión 2005; Dourojeanni 2006). Another corridor through Bolivia, to be paved in the future, will connect to the Inter-Oceanic Highway at Cobija, Pando and to Santa Cruz and from there to other Pacific ports. Both highways are part of the 'Brazil-Peru axis', one among roughly a dozen that constitute a continental integration plan for the next decade (CEPEI 2002; IIRSA 2005).

The Inter-Oceanic Highway represents a significant challenge to reconcile conservation and development goals. In Peru alone, the Inter-Oceanic Highway crosses ten natural life zones ranging from tropical rain forest to cloud forests (300–3800 m above sea level), which contain an enormous number of endemic and threatened species (Dourojeanni 2006). The southwestern Amazon is a biodiversity 'hotspot' and the Andes-Amazon interface has particularly high species diversity (Myers et al. 2000). Paving of this road will facilitate access to areas of incomparable beauty, stimulating tourism in a region very close to the archaeological site of Machu Picchu (OSITRAN 2005).

Approximately, thirty indigenous groups are located along the Inter-Oceanic Highway, as well as rubber tappers, *castaña* (Brazil nut) collectors, traditional riverside dwellers, and speakers of Spanish, Portuguese, Quechua and Aymara (Dourojeanni 2006). An official estimate suggests that six million people will be integrated by this highway on the Peruvian side, or 20 per cent of the national population (MTC 2005). Another estimate indicates thirty million people in the area of influence of the highway in Peru, Brazil and Bolivia (Brown et al. 2002).

### ***The MAP Region and the MAP Initiative***

The mix of positive and negative impacts of paving the Inter-Oceanic Highway is reminiscent of debates surrounding prospects for sustainable development around other infrastructure projects in the Amazon and elsewhere. But in the southwestern Amazon, the prospects for development and the threats to conservation are being debated in a tri-national frontier area where Brazil, Peru and Bolivia meet. This has stimulated cross-border discussions about impacts of paving the Inter-Oceanic Highway, for regional integration brings with it the likelihood that development as well as problems on one side of the frontier will affect the other sides (van Oosten 2004; Rioja 2005).

Such conversations stimulated the emergence of the MAP Initiative, a grassroots social movement with a polycentric structure organised around various social actors on all three sides of the MAP region (Iniciativa MAP 2007). The MAP Initiative explicitly recognises the shared future of a regionally integrated frontier in the southwestern Amazon, and movement organisers have sought to broaden public participation in preparations for impacts of paving the Inter-Oceanic Highway. Since 2000, the MAP Initiative has organised tri-national meetings open to the public for presentations, dialogue and planning activities involving themes ranging from social equity to economic development, environmental conservation, and public policies (Iniciativa MAP 2007). Attendees include local, regional and national government representatives and politicians, as well as leaders of communities and various NGOs. Tri-national MAP meetings thus provide a forum for public exchanges about road impacts, where policy makers can be held accountable for their actions. Attendance at these tri-national meetings grew from 25 in 2000 to roughly 1200 in 2004. This growth proceeded alongside the emergence of numerous 'mini-MAP' working groups with specific foci such as roads, logging, agroforestry, ecotourism, botanical inventories, civil defence, environmental education and other topics.

Whereas, the planning and construction of the Inter-Oceanic Highway itself involved very little public participation, the MAP Initiative has sought to fill that gap through its organisational and planning efforts. These efforts have as their main objective the construction of greater regional capacity, on all sides of the tri-national frontier, to mitigate the negative impacts and capture the posi-

tive benefits of road paving (Brown et al. 2002). Imperative in this process is the need to work closely with local communities along or near the Inter-Oceanic Highway, in order that they receive information about the coming changes as well as articulate their own visions and preferences about possible futures. This paper reports one such effort to engage roadside communities via a series of multistakeholder workshops on all sides of the tri-national MAP frontier.

## METHODS

### *Road Impacts and Scenario Workshops in the Amazon*

Workshops are not new, but their application to participatory planning processes for infrastructure impacts in the Amazon is a recent innovation. The Scenarios Programme of IPAM is collaborating with other institutions to study these impacts and the perceptions of local populations along highways in different parts of Amazonia (IPAM 2006b). IPAM has convened workshops since 2000, primarily along the BR-163 corridor in the central Brazilian Amazon (Nepstad et al. 2002; Alencar et al. 2004). The goal of these workshops has been to engage communities in discussions and planning for possible future scenarios of change along road corridors receiving new infrastructure investments. This information is being used to construct qualitative and quantitative models of future scenarios, based on information about local perceptions of the costs and benefits of the impacts of road paving. The importance of these analyses is that they provide a means to facilitate the participation of civil society in regional planning while also supporting policy decisions about infrastructure with simulation models.

IPAM has employed several steps in the process of organising workshops for scenario development (IPAM 2006b). First, it is important to gather secondary data about the road corridor where workshops are to take place, in order to understand recent social and environmental changes in a broader historical context. The second step is to encourage participation by local actors by identifying key interest groups and mapping their concerns through group meetings, field visits and initial exchanges of information. The third step was to follow up with those social actors about development of possible future scenarios resulting from road paving. In particular, it is crucial to link workshop participation to the development of scenarios and to local planning to mitigate negative road impacts by making collective decisions. The fourth step is to mobilise local social actors to meet in workshops in order to develop probable future scenarios resulting from road paving. A priority in such workshops is for stakeholders to identify threats and opportunities in each scenario, in order to design action strategies for sustainable development given different possible outcomes of new infrastructure.

***Scenario Workshops along the Inter-Oceanic Highway in the MAP Frontier***

We adapted the IPAM scenario workshop process to the case of communities along the Inter-Oceanic Highway in the MAP frontier of the southwestern Amazon.<sup>1</sup> We first gathered available data about recent economic, social and environmental changes in Madre de Dios, Acre and Pando. We also collected information about paving of the Inter-Oceanic Highway (in Acre, Brazil) as well as plans for paving in Peru and Bolivia. We also gathered information concerning the legal frameworks and policies concerning resource use in the three states of the tri-national frontier. Finally, we employed maps of the administrative units of the MAP region in order to identify municipalities and their administrative seats. This way, we identified eighteen municipalities which the Inter-Oceanic Highway either passes through or are very close by in the MAP region: seven in Madre de Dios (Peru), six in Acre (Brazil) and five in Pando (Bolivia).

The second step was to identify key social actors in each of these eighteen municipalities for participation in scenario workshops. With support from IPAM, we contacted municipal governments, other government agencies, and NGOs working locally. We also worked through the MAP Initiative to identify and contact key social actors. These contacts required both use of communications infrastructure (phone calls, e-mail, etc.) as well as considerable travel around the MAP region. This resulted in lists of key social actors, many of whom we met in the process of establishing contacts.

As per the third step, we invited municipal government representatives (especially of health, education, planning and environment agencies), local representatives of national environmental agencies (INRENA in Peru, IBAMA in Brazil and SIF in Bolivia), and the most diverse possible array of community leaders (of churches, youth groups, women's groups, commercial organisations, workers unions, etc.). In each municipality, twenty five to thirty key social actors agreed to participate in a workshop. While this does not guarantee complete representativeness of all constituencies in a given municipality, it did ensure a diversity of perspectives. A process of coordination then transpired in order to set dates where the largest possible number of social actors could actually participate. This required coordination of dates for a series of eighteen workshops over a short time period. In total, nearly 500 stakeholders participated in these workshops.

In the fourth step, we moderated multistakeholder scenario workshops in each of the eighteen municipalities. Each workshop consisted of a 1 day meeting organised around two objectives: first, to define the principal economic, social, environmental, infrastructural and political problems, and second, to draw participatory maps of current land-use and land tenure and conflicts, economic activities, infrastructure, vegetation and natural resources.



### ***Defining and Ranking Priority Problems***

To address the first objective, participants engaged in a process of identifying concerns about the impacts of road paving, followed by an exercise in ranking the relative importance of those concerns.

First, all participants received note cards and were given 45 minutes to write down their five biggest concerns about road impacts. Participants then explained their reasons for choosing these problems, followed by brief discussion. During this discussion, we tabulated concerns by categorising them into five themes: (1) infrastructure (inadequate road maintenance; health-care facilities; schools; basic services such as water, electricity and sanitation); (2) social (limited access to credit and training programmes; land conflicts; rapid in-migration and urban population growth; lack of social organisation; drugs and alcoholism); (3) environmental (negative impacts on natural resources such as illegal logging, uncontrolled fires, deforestation and pollution); (4) economic (high production costs; market access and competitiveness; poverty) and (5) political (state centralisation and ineffective national policies; limited local government capacity; corruption; lack of civic participation and ineffective policies). Such tabulations showed which problems were mentioned most often, and provided a foundation for rankings as well as identification of probable future scenarios.

Once participants identified and discussed concerns, for each of these five categories, we then asked participants to rank order the most serious problems. This allowed for prioritisation of the problems considered most serious by the most participants for each thematic category. Such rankings showed which problems were considered the most serious most often, and provided a means for prioritising responses to future scenarios of change. The ranking process actually involved multiple steps in measurement. First, for each workshop, and within each theme, we tabulated the number of times a specific problem was mentioned. However, it was not ideal to calculate means for numbers of mentions because workshops had varying numbers of participants. We therefore employed a ranking procedure. Again, for each workshop and within each theme, we ranked problems on a scale from 1 to 10, with the most mentioned problem getting a value of 10, the next most common problem mentioned receiving a value of 9, and so on. Where the ranking was tied for two problems, we gave the same rank value to both problems. This scale ran down to a value of 10 minus the total number of problems cited within a given theme. This allowed for more direct comparisons of the relative importance of priority problems among municipalities where workshops were held. The ranking exercise allowed a more refined discussion of likely future changes along the Inter-Oceanic Highway, in that the most commonly mentioned problems can be interpreted as the more probable future changes, in the collective view of the workshop participants.

### ***Participatory Land-Use Mapping***

Infrastructure impacts are often spatially variable, usually being greater near new or newly paved roads, where land-use and land cover changes are most evident. When used for planning purposes, land-use maps usually are based on satellite images or governmental data to implement zoning proposals or land tenure regulations, leaving aside local people's knowledge of existing land-use patterns. Therefore, in addition to the problem prioritisation exercise, the multistakeholder workshops included a participatory mapping exercise. Working with maps allowed for a more spatially explicit discussion of the situation of a given municipality, the prospective impacts of paving the Inter-Oceanic Highway, and the problems cited and ranked in the first exercise. We first presented cartographically accurate maps of the municipality where a given workshop was held. The maps showed the municipal boundaries, the administrative seat and other communities, the Inter-Oceanic Highway and other roads, rivers, and officially designated lands (parks, reserves, etc.). The participants then identified their places of residence in their municipality.

Participants then engaged in creation of their own maps of their municipality. This allowed them to cartographically express their own understandings of their municipality based on lived experience, and to identify areas they expected to experience changes due to paving of the Inter-Oceanic Highway. For participatory mapping, workshop participants broke up into (on average) four groups of six or seven persons each. Each group included participants from different backgrounds, which provided an opportunity for closer interaction among community members. We required the groups to include specific themes in their maps: infrastructure, population centres, economically productive forests (timber and non-timber forest products), land tenure (reserves, private lands, etc.), rivers and land cover [forest (riparian and upland types), deforestation (especially along rivers), pasture, secondary vegetation and areas affected by fires]. The groups spent roughly 3 hours in designing their maps, and the local mayor and/or secretary of planning circulated among groups to provide assistance in mapping these themes as necessary.

On completion of the participant group maps, the workshop participants reconvened as one group to compare the maps via discussion. This discussion focused not only on differences in the landscapes represented by different group maps, but also on expected changes in those landscapes in the future. Here, the priority problems from the first exercise were combined with the group maps to identify likely future scenarios of change after paving of the Inter-Oceanic Highway, in a spatially explicit format. This provided the foundation for discussion of planning for steps to mitigate paving impacts arising from the scenarios discussed. This is a major initiative in the IPAM Scenarios Programme (IPAM 2006b), and will only be touched upon here, as it is beyond the scope of the present paper and is the focus of detailed discussions elsewhere (Soares Filho et al. 2002, 2004, 2006). The basic logic, however, is

to develop spatially explicit simulation models that show changes in forest cover and other outcomes over time under specific assumptions. Visualisation allows both stakeholders and policy makers to evaluate the probable results of specific courses of action, which can then inform planning to avoid unwanted negative outcomes.

### *Comparative Analysis*

Because these multistakeholder workshops occurred in municipalities on all sides of the tri-national MAP frontier, it is possible to compare stakeholder perspectives across national borders. Given that the focus of these workshops was to identify likely scenarios of future changes resulting from paving the Inter-Oceanic Highway, this is especially useful, for to date the highway has not yet been paved on all three sides of the tri-national frontier. Paving was completed in Acre, on the Brazilian side, in 2002; the highway was being prepared for paving in Madre de Dios, on the Peruvian side; and at the time of the workshops, there were not yet investments scheduled for paving roads in Pando on the Bolivian side. However, the Bolivian government in 2006 announced plans for paving roads from La Paz to Cobija, Pando.

This makes a comparison of perspectives among workshop participants from municipalities on one side of the frontier potentially very informative to participants on the other sides. In particular, it is likely that the perspectives of the Brazilians who have already experienced the benefits and problems of road paving will differ from those of Peruvians and Bolivians who are yet to witness impacts of paving of the Inter-Oceanic Highway. Further, the lived experiences of Brazilians in the context of road paving can be potentially instructive to Peruvians and Bolivians, who may not yet be aware of certain benefits or problems that come with road paving. Returning findings to participants in the workshops in the three countries may provide helpful insights. These insights have the potential to serve as a basis for improved mitigation planning and exchanges among representatives of different municipalities.

## **RESULTS**

### *Ranking of Principal Problems*

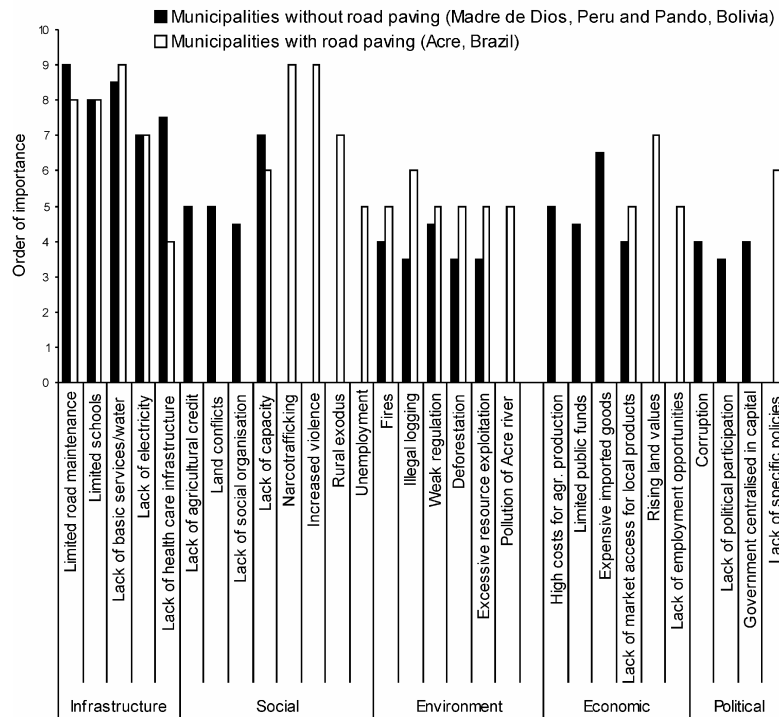
In each municipal workshop, participants provided a total of roughly eighty mentions of problems on average, though many mentions referred to the same problem. We constructed a matrix of problems mentioned by each municipal workshop, and organised them by the five themes. In turn, we broke the five themes into twenty nine principal problems: infrastructure (five), social (eight), environmental (six), economic (six) and political (four).

**Principal Problems Mentioned by Stakeholders**

For the initial step in the analysis, we summed mentions for each problem across workshops in places where the Inter-Oceanic Highway had already been paved (six municipalities in Acre, Brazil) and where it had not yet been paved (seven municipalities in Madre de Dios, Peru and five municipalities in Pando, Bolivia). We then ranked problems (based on the number of times mentioned) across all themes for these two groups of municipalities. This allows for a general overview of the problems cited in municipalities with and without road paving, as well as a comparison of the relative importance of problems both between and within themes. Subsequent steps in this analysis will employ rankings within themes when we focus on the relative importance of specific problems within a given theme.

Figure 2 shows the principal problems identified, comparing municipalities with road paving (in Acre, shown in black) to those without (in Madre de

**Figure 2**  
**Problems mentioned in stakeholder workshops (N=18) in municipalities with and without paved highways in the MAP region**



Dios and Pando, shown in grey). Of the twenty nine specific problem types mentioned, twelve were mentioned in both groups of municipalities, whereas nine were only mentioned in Acre (with paving) and eight were only mentioned in Madre de Dios and/or Pando (without paving). This indicates a number of shared concerns, but also a wide range of distinct problems depending on whether the Inter-Oceanic Highway had been paved.

Of the twelve problems common to all municipalities, five of the six most highly ranked concerned infrastructure (inadequate roads, schools, basic utility services, energy and health-care facilities). This result is surprising given the difference one would presume that paving the Inter-Oceanic Highway would make in terms of transport costs and access to urban services. Nonetheless, this finding indicates that road paving by itself does not resolve infrastructural problems. Also common among the problems cited by participants in municipalities with and without paved roads were environmental issues (uncontrolled fires, illegal logging, lack of law enforcement, deforestation and natural resource exploitation). This finding reflects the importance of natural resource use for local economies on all sides of the MAP frontier, along with limited state capacity for regulating resource use. There was also one shared social problem, lack of training and a related economic problem in common, namely a lack of markets for agricultural products. These findings seem to indicate a shared concern about limited local business capacity and market opportunities.

Similarities aside, nine problems were only cited by participants in workshops in Madre de Dios and Pando. These included three social problems (limited agricultural credit, land conflicts and weak social organisation), three economic problems (poor agricultural production, restricted local government budgets and costly products), and three political problems (corruption, government centralisation and lack of community integration). Many of these problems arise not from a lack of highway paving, however (e.g. limited agricultural credit, restricted local government budgets and government centralisation), but rather are due to country-specific government policies and institutional structures, which we will explore in later steps of this analysis. That said, some problems mentioned only in Madre de Dios and/or Pando would seem to reflect transportation difficulties stemming from a lack of highway paving (e.g. weak social organisation, poor agricultural production, costly products and lack of community integration).

In addition, eight problems were cited only in the municipalities along the paved portion of the Inter-Oceanic Highway in Acre. Frequently among these were social problems (drugs, violence, expulsion of population from rural areas and unemployment), along with one environmental problem (pollution of the Acre river), two economic problems (rising land prices and lack of jobs) and one political problem (lack of coherent public policies). Many of these problems have been seen in other parts of the Amazon experiencing road infrastructure upgrades, as many reflect structural changes in land ownership re-

sulting in rural out-migration, urbanisation and urban social problems. The pollution of the Acre river, which flows from Madre de Dios along the border with Pando and then into Acre, reflects shared environmental problems on all three sides of the tri-national MAP frontier (e.g. deforestation) as well as problems specific to Acre (e.g., rural expulsion and urban population growth). Given the rapid changes that often follow road paving in the Amazon, it is notable that people in Acre complained about the lack of defined and coherent policies for forest, agricultural and cattle sectors, which indicates a persistent governance problem.

**Infrastructure Problems**

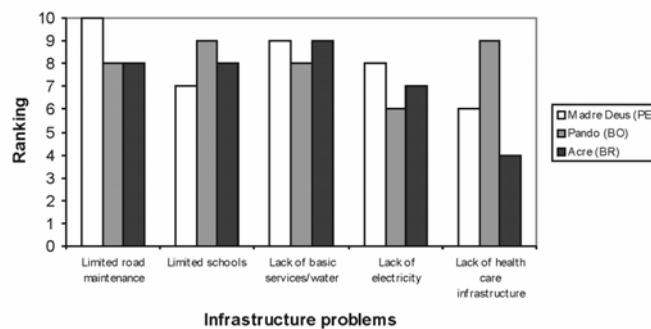
The second step of the analysis focuses on a more detailed discussion of problems within each of the five themes. Here we begin by discussing infrastructural problems. Figure 3 presents relative rankings of infrastructure problems cited by participants in workshops on all three sides of the tri-national MAP frontier. For this and all subsequent figures, this may change the rankings presented somewhat from those shown in Figure 2.

Figure 3 shows that infrastructure problems are concerns shared on all three sides of the tri-national MAP frontier. For residents of Madre de Dios, the principal problem was the need to pave the Inter-Oceanic Highway, which people hoped would resolve all the other problems they faced. In Pando, people also hoped for improvements to the main roads and the secondary roads that provided access to the communities in the winter (rainy) season. Even in Acre, where the Inter-Oceanic Highway was already paved, the problem of secondary road access persisted.

With regards to education and health services, workshop participants mentioned the lack of physical space, materials, and qualified and specialised personnel as the main problems in all three countries, as well as the lack of basic

**Figure 3**

*Infrastructure problems mentioned in stakeholder workshops (N=18) in the MAP region*



services such as treated water, sanitation, city planning, and electricity. Some municipalities in Madre de Dios and Pando had electricity for less than 4 hours per day, making it impossible to operate hospitals, health posts, schools, communications systems, water treatment plants or processing facilities for timber, Brazil nuts and fruits produced in the region. On the Brazilian side most municipalities had electricity, but the diesel generators used, when available, were costly. In sum, while stakeholders in Pando and especially Madre de Dios perceived road improvement to be the solution to most of their problems, the experience in Acre shows that, even after paving, difficulties with infrastructure and basic services remained.

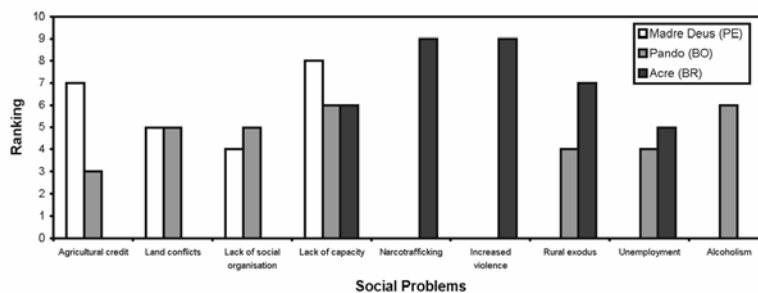
### *Social Problems*

Figure 4 presents relative ranks for social problems for stakeholders in Madre de Dios, Acre and Pando. If the main infrastructural problems were similar across national boundaries, the social dimension was very different. Only one problem was identified by stakeholders on all three sides of the MAP frontier—the need for training, including primary and secondary education, as well as specialised training in agriculture, forestry, health, business management, data processing, tourism and other professions. Workshop participants often cited the lack of courses and new technologies needed to improve productivity and product quality. People also mentioned the lack of access to information about their region and its problems, as well as limited opportunities to learn about innovative land-use alternatives.

Some common social problems emerged in Madre de Dios and Pando: limited agricultural credit, land conflicts and weak social organisation. Credit became an issue as landholders sought to invest in products for markets that would become accessible with the paved highway. Land tenure was especially problematic in Pando (and elsewhere in Bolivia) due to the lack of secure titles and disputes between private logging concessions, peasants and indige-

**Figure 4**

*Social problems mentioned in municipal stakeholder workshops (N=18) in the MAP region*



nous communities. While loggers and traditional *castaña* ('Brazil nut') concessionaires were seen by many participants as having special privileges, entrepreneurs were hesitant to plan or invest due to tenure insecurity. In Peru, the problem was not lack of titles but rather overlapping land uses such as timber and *castaña* concessions, agriculture and mining. Government zoning efforts there were still incipient and ineffective.

The results in Acre differed. There, people complained very frequently of new social problems—drug trafficking and violence—that increased after the road was paved. Brazilians also complained much more about rural-to-urban migration due to the sale of land along the road to outsiders. Migrants moved to the capital city, to small towns, or further along the road to still-forested areas, a pattern seen in other frontier road corridors in the Amazon. In addition, workshop participants in Acre also frequently mentioned their impression that the rural land sales and rural out-migration were leading to greater unemployment in urban areas.

Conversely, in Pando, workshop participants believed that rural underemployment was the cause of seasonal rural-urban migration when *castaña* collection and agricultural activities were not competing for workers in rural areas. Stakeholders in Pando also associated seasonal unemployment with alcoholism, family problems, moral breakdown, violence and poverty. The multiple social problems linked to rural change, migration, and the shared lack of educational opportunities, indicate the social difficulties faced by communities when dealing with the impacts of road paving.

### ***Environmental Problems***

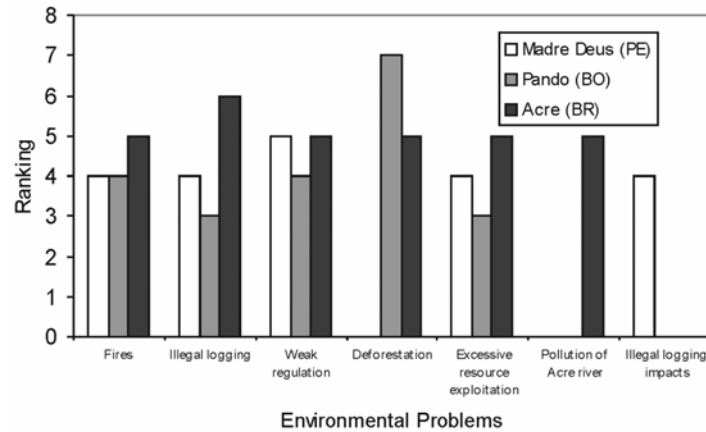
Madre de Dios, Acre, and Pando share a similar biophysical environment with relatively undisturbed tropical forest with roughly only 4 per cent deforestation in the total area of 220,000 km<sup>2</sup> (e.g. Brown et al. 2002). Figure 5 shows shared as well as distinct environmental problems across the MAP region. Common environmental problems included burning, illegal logging and lack of enforcement by responsible agencies. The first two are facilitated by road paving and the third reflects limited state capacity to deal with rapid changes resulting from paving.

Figure 5 also shows important differences. In Pando, stakeholders mentioned deforestation very often. From 1999 to 2005 the cattle sector grew by a factor of 14, reaching 70,000 head of cattle (SENASAG 2005). This rapid growth reflects rapid deforestation along roads in Pando, particularly near the Brazilian border. Workshop participants in Pando commented that Brazilians owned practically all the large cattle ranches in Pando. In Acre, deforestation increased after road paving, also for cattle ranches purchased by outsiders. In 2004, there were two million cattle in Acre (IBGE 2004). In Peru, where the intention of authorities and small producers was to genetically improve the current cattle herds, deforestation did not emerge as a priority problem.



Figure 5

Problems mentioned in municipal stakeholder workshops (N=18) in the MAP region



In Acre and Pando, over-exploitation of natural resources emerged as a priority problem. The rise in *castaña* prices in 2005 led companies and buyers to indiscriminately increase their harvesting in the MAP region, which led to land tenure conflicts in Pando. In Acre, workshop participants pointed to pollution of the Acre River and the drying up of streams, due to deforestation facilitated by road paving, and resulting in erosion, siltation and water shortages. By contrast, in Madre de Dios, the focus was specifically on logging, especially high-value species such as mahogany (*Swietenia macrophila* sp.), *cedro* (also referred to as Spanish cedar, *Cedrela odorata*) and *cumuru* (*Dipterix intermedia* Ducke). The new system of forest concessions in Peru experienced implementation problems, resulting in considerable illegal logging in Madre de Dios.

In brief, stakeholder comments indicate that while the MAP region still has abundant natural resources, road paving and a lack of state regulatory capacity are facilitating several interwoven environmental changes, particularly those stemming from deforestation and resource overexploitation, resulting in land conflicts, water scarcity and forest impoverishment.

### ***Economic Problems***

Figure 6 presents the principal economic problems mentioned by workshop participants. Most are specific to one side of the tri-national MAP frontier or another, a reflection of peculiarities of the respective national economic systems in Bolivia, Brazil and Peru. The one problem identified by stakeholders on all three sides of the frontier was a combination of difficult access to na-

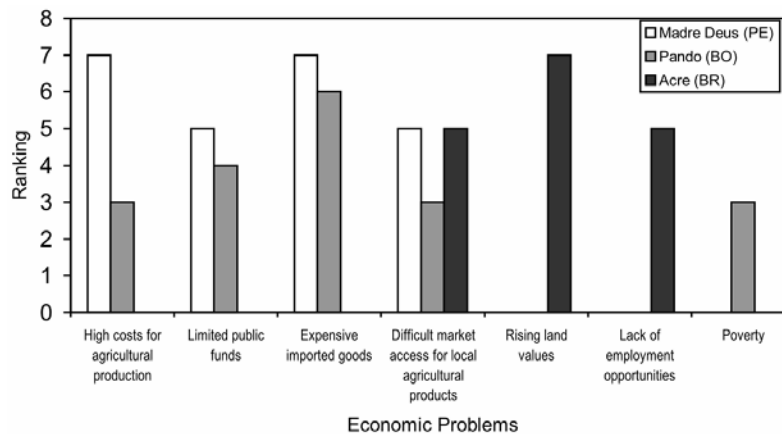
tional markets, paired with concerns about an inflow of cheaper products produced elsewhere. Stakeholders noted that the remote location Madre de Dios, Acre and Pando relative to their respective national capitals makes product marketing a difficult proposition.

Workshop participants in Madre de Dios and Pando noted similar economic problems. In both, stakeholders emphasised the high cost of agricultural production and non-timber forest produce (NTFP) extraction and processing. Agricultural products are highly seasonal and carry very high transport costs to reach outside markets via unpaved roads, and forest products are expensive to extract from primary forest and process without credit. Stakeholders in Madre de Dios and Pando also both emphasised the problem of excessive government centralisation in the Peruvian and Bolivian national capitals, with limited state funds passed to the local level. By contrast, the state government in Acre had almost complete autonomy in managing economic and political decisions.

The three other economic problems cited were all unique to one side of the MAP frontier. In Acre, workshop participants frequently complained about rapidly increasing land prices. With land values increasing roughly seven-fold since paving of the Inter-Oceanic Highway, local residents in municipalities in Acre said they were unable to acquire additional land. In Madre de Dios, the cost of imported food and fuel from the national capital, Lima, was prohibitively high due to unpaved roads, especially during the rainy season. And in Pando, some stakeholders emphasised poverty as a key economic problem, a reflection of relatively lower per capita incomes in Bolivia than in Peru and Brazil.

Figure 6

*Economic problems mentioned in municipal stakeholder workshops (N=18) in the MAP region*



Given the weak economy of the MAP region, many workshop participants expressed hope that paving of the Inter-Oceanic Highway would open up market opportunities for expanded trade among the three sides of the frontier. Stakeholders also recognised, however, that financial support for agricultural production and forest product processing was still needed. Moreover, the experience in Acre showed that rising land values after road paving tended to favour wealthy outsiders over local producers.

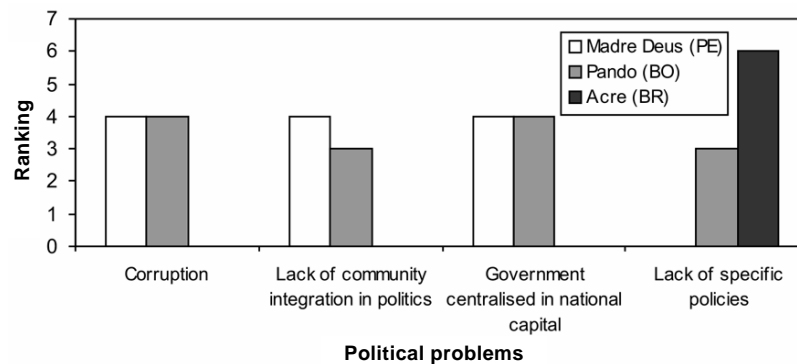
**Political Problems**

Figure 7 shows similarities in the political problems mentioned by workshop participants in Madre de Dios and Pando: corruption, lack of integration of politicians with the community and overly centralised government. Many people commented that the lack of local government independence created greater incentives for corruption. In Peru in particular, a highly centralised government and political influence from outside Madre de Dios were viewed as problematic. They also complained about the indifference and lack of commitment of local leaders to the resolution of problems, making empty campaign promises and not being held accountable thereafter. In Bolivia and Brazil, people also complained about the lack of effective policies.

These results showed that the municipalities lacked some key elements for effective governance of the impacts of road improvement: decentralised administration, participation by local populations in a dialogue with policy makers, and well-defined policies related to paving the Inter-Oceanic Highway and its consequences.

**Figure 7**

*Political problems mentioned in municipal stakeholder workshops (N=18) in the MAP region*



**Participatory Maps and Future Scenarios**

Stakeholders in the eighteen municipal workshops created a total of seventy two participatory maps, which allow for spatially explicit discussions of the problems identified in the ranking exercise. Infrastructural problems were clearly located, as were land conflicts, deforestation and other environmental impacts, as well as economic activities, marketing locations and natural resources. Figures 8 and 9 shows examples of the municipal maps produced in the workshops held in the MAP region.

In the process, the participatory maps revealed the detailed knowledge of local people, as linked to the problems discussed in the workshops. The scale on which stakeholders were aware of problems was smaller than that reflected in government maps. But based on lived experience, workshop participants were able to more clearly and directly relate various problems if they coincided spatially. Further, stakeholders located emergent problems such as where soil erosion and land conflicts were appearing, and even where there had been otherwise undetected fires. The maps also allowed discussion of economic issues such as market distances and transport routes for different local communities. As such, the participatory mapping exercise provided a forum for many local stakeholders to discuss issues related to concerns with paving the Inter-Oceanic Highway. This in turn served as a platform for stakeholder input about problems that could then more feasibly be addressed collectively via local planning initiatives involving shared governance.

**Figure 8**

*Participatory map of land tenure and forest use (Las Piedras, Madre de Dios and Peru)*

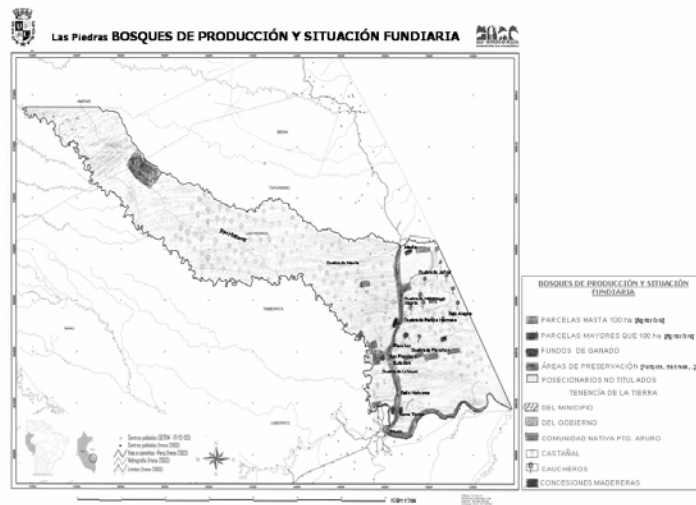
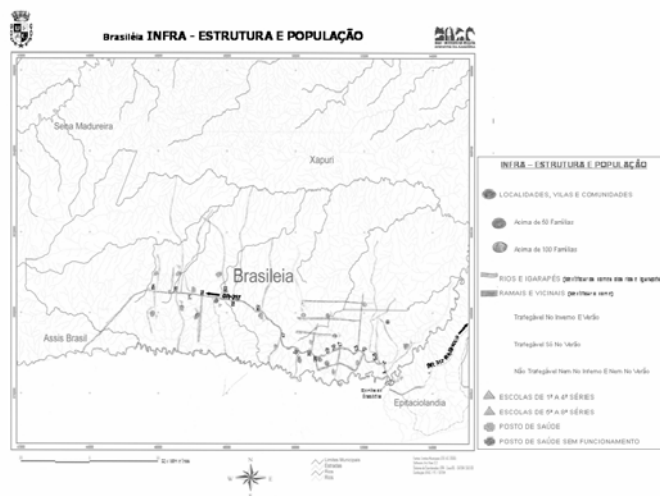


Figure 9

Participatory map of infrastructure and population (Brasileia, Acre and Brazil)

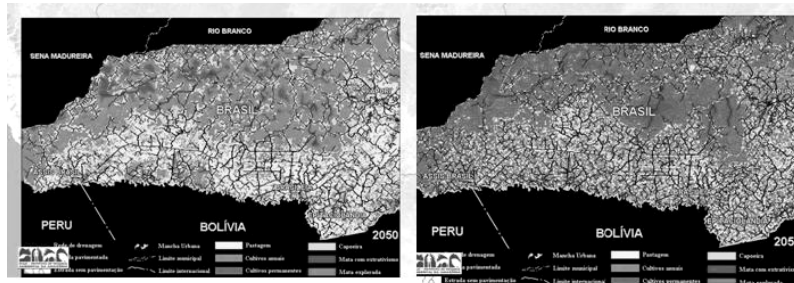


In addition, the participatory maps produced by the workshops constitute one source of data for input in constructing alternative future scenarios of change along the highway corridor. The IPAM Scenarios Programme has integrated participatory maps and other secondary data in geographic information systems, and used the simulation programme *Dinâmica* to generate scenarios of change with different sets of assumptions (Soares Filho et al. 2002, 2004). We digitised participatory maps for the eighteen municipalities along the Inter-Oceanic Highway in the MAP region, and superimposed the maps on Landsat satellite images in order to compare with remotely sensed land cover patterns. IPAM also included satellite data on past land cover in order to observe recent changes. This, along with spatial data about the route of the Inter-Oceanic Highway and the principal problems cited by stakeholders, constituted parameters for dynamic models as a means of developing scenarios of possible future changes in the MAP region. IPAM has developed land cover change scenarios based on expected socio-economic changes as a result of new infrastructure (Soares Filho et al. 2002, 2004, 2006).

Specifically, IPAM works with two broad types of scenarios: 'business-as-usual' (a continuation of current trends) and 'governance' (i.e. enforcement of existing land-use laws). Figure 9 presents an example for one of the municipalities in the MAP region. In the business-as-usual scenario, the areas of deforestation increased by approximately 45 per cent over the 15 years, but in the governance scenario, there was 15 per cent less deforestation compared to the first scenario. Along with rankings of principal problems and participatory

Figure 10

Alternative scenarios of change along the Inter-Oceanic Highway: 'Business-as-Usual' (left) and 'Governance' (right) (Brasília, Acre and Brazil)



maps, visualisation of alternative future scenarios provides a concrete tool for local planning to mitigate the negative impacts of paving road corridors. And as a result of stakeholder workshops, scenario maps reflect a process that broadens local stakeholder participation to realise shared governance in the context of infrastructure change (Figure 10).

## CONCLUSIONS

Debate over infrastructure impacts often amounts to different voices selectively emphasising only the positive or negative consequences. Positive impacts from improved highways typically include improved access to services and markets, and greater integration between countries, states and municipalities, initiating new economic dynamics in these corridors. These primarily economic factors typically dominate policy decisions, with (often negative) social and environmental factors that are considered separately or secondarily (CEPEI 2002; Pro-Inversión 2005). Relatively few mechanisms exist for analysing the interactions among different dimensions of impact, and their relative importance to local people.

Discussions of infrastructure impacts, moreover, largely occur in policy-making circles with little input from the public, something this project sought to reverse. The Inter-Oceanic Highway is one of the latest Amazonian roads to be paved without adequate consideration for indirect social and environmental impacts, repeating errors from roads paved previously. Large-scale infrastructure projects are undertaken without consideration for the fragility of remote regions and their inability to address the social, environmental, economic and political impacts that arise during and after road improvements. To avoid or mitigate these negative impacts, effective governance requires local citizen participation along with decentralised government action. This is be-

cause purely state- and community-based models of road governance have both proven inadequate to the task of governance, necessitating a 'hybrid' approach that combines the strengths of both while seeking to avoid their liabilities (Perz et al. 2007). Given its great biological and cultural diversity, sustainable and long-lasting development in the MAP region will therefore depend on the involvement of local and regional populations as well as buy-in by government representatives. The IPAM workshops included participation by government representatives, and resulted in signed declarations in which the government and stakeholders agreed to collaborate for improved road governance (Alencar et al. 2004). Similarly, the MAP Initiative has sought and received recognition by ministries of foreign relations in both Brazil and Peru (Iniciativa MAP 2007).

The results presented in this paper demonstrate that it is possible, and relatively straightforward, to involve a large number of local people in the diagnosis of problems that have or are likely to arise from infrastructure upgrades, providing crucial information for defining local planning priorities. Comparison of results from eighteen municipalities in three countries showed both common problems and significant local differences. Data from workshops in Brazil demonstrated that not all problems are resolved by road improvements, and in fact new social, environmental and economic problems (drugs, alcoholism and violence; deforestation and water pollution and landownership turnover) can arise in the wake of road paving. Further, participatory maps of municipalities along the road corridor can be used as planning tools for municipal and state zoning of land-use. This is especially the case when participatory maps serve as inputs to dynamic simulation models that can spatially visualise future scenarios of change, which can reveal future problems and their locations (Soares Filho et al. 2002, 2004, 2006).

Following the eighteen workshops described, we and other researchers visited many of the same municipalities again, as a means of returning the findings from the workshops. A full description of that endeavour is provided elsewhere (Mendoza et al. *forthcoming*). For purposes here, it is worth noting that the presentation of findings from workshops held on all three sides of the tri-national frontier exposed stakeholders to the perspectives of participants from many other portions of the Inter-Oceanic Highway corridor. In particular, such presentations allowed stakeholders to compare the problems in municipalities with and without road paving, in order to make their own evaluation of the impacts of infrastructure upgrades. This facilitated further exchanges of knowledge among stakeholders, and brought more stakeholders into discussions of local as well as tri-national problems, and into the process of planning to mitigate negative impacts (Mendoza et al. *forthcoming*).

Information generated in the future scenario models described in this paper can provide important inputs for social and political decision making regarding the mitigation of possible impacts of road paving. Improved governance in the context of road paving in the tri-national MAP frontier will require re-

gional, shared planning and administration, involving active participation of local stakeholders. The process and products of this study, and subsequent workshops to return results and discuss their implications with local communities and researchers, constitute strategies to build the social capital and local political pressure for improved governance to mitigate the impacts of road improvements. In the MAP region, we arguably find a necessary combination of factors to realise participatory governance for sustainable development along highway corridors. The multistakeholder workshops discussed here, which provide inputs into data products and spatial simulation models with scenarios of future change, along with tri-national forums that facilitate exchanges between stakeholders and government representatives, together provide a basis for inclusive discussions of the linkages between current policies and future changes in ways that foster public input into planning and hold policy makers accountable for their actions.

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#### Notes

1. This article was written collaboratively by the authors, who are referred to collectively as 'we'. For disclosure, it was the first author who organised the workshops and conducted the analysis reported here. The text refers to 'we' throughout for consistency.

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