

must be developed with local landowners emphasizing direct benefits, transparency, trust, patience, and indeed, some sacrifices. Our ability to conserve habitats and their biodiversity will be judged by what we have done in practice, rather than by what we have found theoretically possible. As the conservation of wildlife outside protected areas will ultimately depend on the goodwill extended to wildlife by private landowners, it is imperative that as information becomes available from research, it is evaluated and translated to guide future policies that are sensitive to the needs of people, wildlife, and the environment.

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Photos: Oscar Wambuguh

Reducing Negative Impacts of Road Paving in the Amazon

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Infrastructure projects are crucial for regional development, but they also bring negative social impacts such as land conflicts, as well as ecological impacts such as deforestation along with carbon emissions and loss of biodiversity. A reason for these negative impacts is that large-scale infrastructure projects lack a process to incorporate public participation. The result is marginalized communities, and consequent degradation of the ecosystems on which these communities depend.

To address this problem we organized participatory workshops with stakeholders in municipalities along the Inter-Oceanic Highway in the southwestern Amazon. This area is a biodiversity 'hotspot' and the Andes-Amazon interface has particularly high species diversity. Approximately 30 indigenous groups are located along the Inter-Oceanic Highway, as well as rubber tappers, *castaña* ('Brazil nut') collectors, and other groups who have long managed local natural resources.

The Inter-Oceanic Highway passes through the tri-national 'MAP' frontier, where Madre de Dios (Peru), Acre (Brazil) and Pando (Bolivia) meet. Concerns about cross-border impacts of the Inter-Oceanic Highway stimulated the emergence of the MAP

Initiative, a grassroots movement that integrates stakeholders on all three sides of the MAP region (www.map-amazonia.net). Since 2000, the MAP Initiative has organized tri-national meetings for dialogue and planning activities, which are open to the public. Imperative in this process is the need to work with local communities. Workshops provide a means for communities to receive information about potential changes as well as to articulate their preferences about possible futures. The Scenarios programme of the NGO, IPAM (the Institute for Amazon Environmental Research), features public workshops that incorporate the perceptions of local peoples into planning for road corridors receiving new infrastructure investments (www.ipam.org.br).

We adapted the IPAM Scenarios workshop process to the case of communities along the Inter-Oceanic Highway in the southwestern Amazon. This allows for comparisons of stakeholder perspectives among the three sides of the MAP frontier. This is especially important, for the Inter-Oceanic Highway has been paved in Brazil, allowing Peruvians and Bolivians to see what problems Brazilians face after road paving.

We conducted workshops

in 18 municipalities in the MAP region through which the Inter-Oceanic Highway passes. In each municipality, 25 to 30 local leaders participated, including municipal government representatives, local representatives of national environmental agencies, and diverse community leaders.

We asked participants to list concerns regarding infrastructure, social problems, environmental damage, economic difficulties, and local politics. Tabulations of concerns showed which problems were mentioned most often. We also asked participants to rank the problems they mentioned. Such rankings showed which problems were considered the most serious, and provided a means for prioritizing planning around specific concerns. In addition, the multi-stakeholder workshops included a participatory mapping exercise. This allowed participants to identify locations where they expected problems due to paving of the Inter-Oceanic Highway.

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 land-ownership turnover) can arise in the wake of road paving. In addition, participatory maps of municipalities revealed specific locations where participants felt problems would be most likely to arise.

Information from these workshops can be joined with information from other sources to support development of future scenarios in dynamic simulation models. These scenarios provide visual representations of possible future changes as mapped over a landscape. Because the models are based, in part, on local stakeholder input, they can inform local planning and improve local environmental governance, thereby avoiding negative outcomes of road paving.

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Photos: Stephen G. Perz

Ecological Services of Exotic and Native Tree Plantations in Northwest India

Kamaljit Kaur

Pre-1988 forest policies in India promoted wide-scale plantations of exotic *Eucalyptus tereticornis* mainly for the short-term visible gains from timber because of its straight bole, fast growth rate, high productivity per unit area, and minimal requirement for post-plantation care. However, the scientific community, private growers, and the public have been divided over the merits and demerits of *Eucalyptus* plantations in the past. One reason for this is that our current accounting system considers only the economic gains from wood and fails to consider the cost of lost ecological services when comparing exotic vs. native trees. Instead, we compared the total value of exotic *E. tereticornis* plantations in comparison with native *Dalbergia sissoo* plantations.

Total value included estimating economic (monetary) gains from wood (timber and fuel-wood), soil nutrients and their return through litter decomposition, and understory plant diversity. Two age groups of plantations, i.e., 6-8 y (young) and 19-21 y (old), were selected to compare net benefits as exotic *E. tereticornis* plantations deliver most of their benefits (especially wood) by 8 y of age, while native *D.*

sissoo plantations deliver benefits after 12-15 y of age. The diversity of plant species, nutrient content in soil, and nutrient return through litter were greater in *Dalbergia* than in *Eucalyptus* plantations. A comparison of plantations at 8 y suggested that the total monetary value of ecological services (tangible and non-tangible) was 1.6 times greater from *Eucalyptus* than from *Dalbergia* plantations, chiefly because of timber (Table). However, ecological benefits (intangible) were 1.8 times greater from *Dalbergia* than from *Eucalyptus* plantations. At 19-21 y of age, total benefits were 2.7 times greater from *Dalbergia* than from *Eucalyptus* (Table).

The study suggested that exotic plantations are more profitable than native tree plantations only over the short term and in terms of timber, which is at the cost of many ecological services. However, over the longer term the total benefits from native plantations are far greater where the value of intangible and tangible products and services increases over time, and adds to the continuum of services and sustainability of a system. The study suggests a need to consider both tangible and intangible

services over the long term and to carry out total value assessment of exotic and native tree plantations for sustainable gains and to design policy accordingly.

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