

SUSTAINABLE DEVELOPMENT

The promise and perils of roads

A global map of the potential economic benefits of roads together with the environmental damage they can inflict provides a planning tool for sustainable development.

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Roads are seen as necessary for economic development the world over. The process by which roads are planned and built, and their impacts on affected regions, are also similar regardless of where this happens. Governments routinely plan roads without adequate consultation with local people, and construction often goes ahead with insufficient attention to minimizing the environmental effects. A mix of unexpected and unhappy outcomes then ensues, and road-building advocates are criticized for making unrealistic promises about the economic benefits and for ignoring problems such as environmental damage. There remains a need to improve the planning of roads around the world. In a paper published on *Nature's* website today, Laurance *et al.*¹ take a major step towards addressing this need by presenting global maps of the potential economic and ecological consequences of future roads.

There are many scientific papers on the impacts of roads, and they draw very different conclusions. Economists have consistently documented the fact that new infrastructure fosters economic growth and reduction in poverty². By contrast, ecologists have compiled a long list of environmental problems ranging from habitat degradation to species extinction³. Social scientists have shown that roads often cause land-use conflicts and worsen social inequality. Nonetheless, governments focus on the economic importance of roads, and populations with poor infrastructure are demanding improved access to social services and urban markets. But the reality of road impacts is decidedly mixed⁴, and debate about building new infrastructure has intensified in recent years.

In this context, Laurance *et al.* provide important planning tools. The authors integrated global data sets to devise a map containing both an 'environmental-values' layer, measured in terms of the presence of protected areas, the value of various ecosystem services and biodiversity (especially of rare

animal species), and a 'road-benefits' layer that estimates the potential economic benefits of new or improved roads in terms of increasing agricultural productivity and sales volume.

A key contribution of these maps is the ability to overlay them in geographic information systems to create a global planning map that identifies regions of varying potential for economic benefits and ecological damage following road building (Fig. 1). For planning purposes, three main types of area of interest emerge from these overlays: those with potentially high economic benefits, those at risk of potentially high ecological damage and those with both. The policy prescriptions are straightforward for the first two: build roads where the potential economic benefits are high and avoid them where the potential ecological damage is substantial.

But the challenge resides in the 'conflict

zones' identified by Laurance and colleagues, where there is high potential for both economic benefit and ecological damage. As the authors note, these zones are key sites for the implementation of alternative policies — that is, something other than more road infrastructure is needed to solve the riddle of sustainable development in these areas. An array of policy alternatives already exists that may provide economic benefits without causing ecological damage, ranging from ecotourism to sustainable resource extraction to payments for ecosystem services.

Laurance and colleagues' map raises two main issues. First, it offers worldwide coverage, which means that it is based on a variety of data sources. Data quality is highly variable between countries, and this may have introduced biases in the findings. Their study is nonetheless helpful because it can serve as a point of departure for a broader effort to improve such maps for planning purposes. This amounts to a clarion call for the creation of an international scientific network focusing on roads, like the networks that already exist for land and climate science. If you think you can produce better maps of road impacts, step forward: Laurance *et al.* have placed their data products online (www.global-roadmap.org).

The second issue concerns policy initiatives to improve global road planning. Multilateral development banks fund roads to promote economic growth; in the same vein, governments build roads to support economic goals,



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Figure 1 | Economics versus environment. The Interoceanic Highway in Peru ascends from the Amazon lowlands to the Andean highlands, crossing several rivers and highly biodiverse ecosystems. The highway corridor, part of the Initiative for the Integration of Regional Infrastructure in South America, is intended to expand commerce, but is facilitating illegal gold-mining, timber extraction and drug trafficking. It is an example of the 'conflict regions' identified by Laurance *et al.*¹, where road building is associated with both high potential economic benefits and great potential for environmental damage.

although they also use roads for geopolitical purposes, such as securing national borders. Whether roads are built to expand commerce or improve security, a global plan for road building might be interpreted as an imposition on the priorities of sovereign countries. In particular, the conflict zones identified by Laurance *et al.* are mostly in poor countries — citing the road-planning map and telling those countries not to build roads is hardly going to be popular.

Thus, there is a need for clarity about the

purpose of such maps. A global road plan is not intended to 'keep developing countries poor', but rather to highlight the costs as well as the benefits of building roads, in order to motivate a discussion of policy alternatives for sustainable development. This carries implications for the funding priorities underlying bank loans and development assistance. In cases where roads will probably cause ecological damage, governments can cite global road-planning maps to argue for policies that invest in alternative strategies for development. ■

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2. Straub, S. Policy Research Working Paper No. 4460 (World Bank, 2008).
3. Forman, R. T. T. *et al.* *Road Ecology: Science and Solutions* (Island, 2002).
4. Perz, S. G. *et al.* *Reg. Environ. Change* **12**, 35–53 (2012).