

Science & Society

Conservation and the
Global Infrastructure
Tsunami: Disclose,
Debate, Delay!William F. Laurance^{1,*}

Efforts to protect nature are facing a growing crisis, one that often revolves around the burgeoning impacts of roads and other infrastructure on biodiversity and ecosystems. Potential solutions are possible but they will involve serious trade-offs and the confrontation of deep misconceptions. Here, I identify some time-critical tactics to aid scientists in informing and influencing the global infrastructure debate.

A Crisis in the Making

On many levels, efforts to promote nature conservation are failing. The number and extent of protected areas has increased markedly in recent decades [1], but many other indicators reveal that nature is in broad retreat. For example, the total area of wilderness is declining rapidly worldwide [2], 70% of the world's forests are less than 1 kilometer from a forest edge [3], the rate of tropical forest fragmentation is accelerating sharply [4], and half of the world's biodiversity hotspots retain <10% of their original intact habitat [5]. As the human footprint expands, many wildlife populations are collapsing, especially in the tropics [6], while protected areas are becoming increasingly isolated and assailed by illegal encroachers and poachers [1,3].

A key driver of the contemporary demise of nature is the explosive proliferation of roads and other infrastructure and the diverse human pressures they catalyze [7–10]. From 2010 to 2050, the total

length of paved roads is projected to increase by 25 million kilometers globally, enough to encircle the Earth more than 600 times [7]. Such changes are arising from massive infrastructure-expansion schemes—such as China's Belt and Road Initiative, African 'development corridors' (Figure 1), and the Initiative for Integration of Regional Infrastructure in South America—as well as widespread illegal road building [9–12]. Around nine-tenths of all infrastructure is slated for developing nations [7], which include most of the world's tropical and subtropical ecosystems that sustain unparalleled biodiversity and environmental services.

Tactics to Motivate Change

Scientists are in a uniquely pivotal position. Evidence needs to be disseminated urgently to inform and temper the global infrastructure tsunami. Many of these points are not intuitively obvious and need to be conveyed in a credible and convincing manner—hence the crucial role for scientists. The first three points concern tactics.

Tactic 1: Focus on specific projects or initiatives. Generic arguments are useful but the greatest urgency is to focus on actual projects [13], despite the often messy and contentious circumstances of real-world developments.

Tactic 2: Start early. Debating a project after it has gained strong public support or largely surmounted the legal approval process is a failing strategy [9,13]. Developers try to 'railroad' projects through the approvals process, leaving project evaluators and stakeholders with little scope but to fine-tune the details or suggest questionable mitigation measures.

Tactic 3: Build a strong narrative. Humans have been telling intriguing stories around campfires for millennia; it is how we recall, understand, and process complex information. Those raising

concerns about a specific infrastructure project need to make a compelling and coherent case.

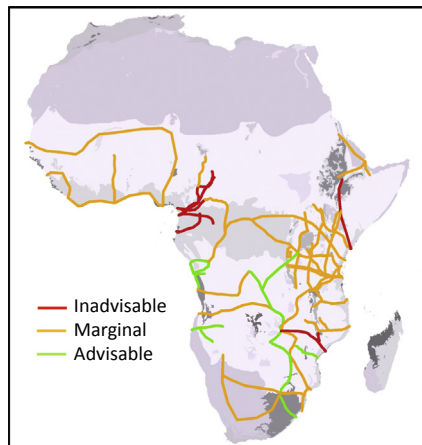
Disclose

The messages below contain important truths that can be tailored to specific projects and circumstances while 'building a broad church': conveying messages not just for scientists or nature lovers, but for the full breadth of society.

Message 1: Avoid the first cut into intact habitats [7]. The worst effects of infrastructure typically occur when a project penetrates undisturbed habitats, opening a Pandora's box of disruption, such as increasing forest fires, wildlife poaching, illicit land colonization, illegal logging and mining, land grabbing, and land speculation [7–10]. The net effect can be catastrophic for ecosystems and biodiversity. In Amazonia, 95% of all deforestation occurs within 5.5 kilometers of a legal or illegal road [11]. Proliferating roads in central Africa have allowed ivory poachers to slaughter two-thirds of all forest elephants [14]. More than any other proximate factor, the dramatic expansion of roads is determining the pattern and pace of habitat disruption and the decline of nature [10,11].

Message 2: Environmental impact assessments (EIAs) for infrastructure are usually superficial, failing to evaluate the long-term or indirect impacts of projects, while missing many rare species or other key attributes [10,15]. Most EIAs are myopic, considering each project in isolation from other existing or planned developments [7]. Hence, EIAs alone are rarely adequate for planning infrastructure projects or for assessing their broader environmental, social, and financial impacts [9,13].

Message 3: An urgent need is strategic land-use planning, guided by a broad geographic vision for conservation priorities and success. Proactive approaches



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Figure 1. Many Infrastructure Projects are Inadvisable or Marginal if Evaluated in Realistic Cost-Benefit Frameworks. The colored lines show 33 proposed or ongoing 'development corridors' that would total over 53 000 kilometers in length in sub-Saharan Africa (adapted from [12]).

such as Global Roadmap (<https://www.global-roadmap.org>) [7] or strategic environmental assessments [9] can help to spatially prioritize land-uses to optimize human benefits, while limiting new infrastructure in areas of intact or critical habitats. Global Roadmap is presently being used in many nations in the Asia-Pacific and Africa to devise land-zoning schemes structured around planned infrastructure [7]. A key priority is to incorporate such strategies integrally into real-world decision making.

Message 4: In most nations, corruption benefitting certain decision makers creates a systematic bias in favor of project approval [9]. In addition, cost-benefit analyses of projects (Figure 1) are often biased to favor project approval, by failing to consider key factors such as the price of servicing project debt, long-term environmental and social costs, losses of revenues to illegal cartels involved in project construction, and high ongoing maintenance costs for many projects [9,10].

Message 5: Infrastructure projects are high-risk ventures [10]. The biases and

gaps inherent in most cost-benefit analyses compound risks to private investors, such as corporations or investment funds, as well as multilateral banks or governments with broader development mandates. Investors rely crucially on having a realistic understanding of the risk-reward profiles for their investments [9,10]. Unfortunately, for many large infrastructure projects, scores of hidden financial and political shoals can damage or sink projects, leading to public debt, reputational impacts on investors and governments, stranded assets, and serious investor losses.

Message 6: Too much funding is being earmarked for the construction of ambitious new infrastructure projects, and too little for their ongoing maintenance [9,10,13]. Few roads are adequately engineered for challenging local conditions, especially in steep or high-rainfall environments [9] (Figure 2). Furthermore, many roads suffer from shoddy construction because some road contractors cut corners on raw materials while siphoning off construction funds [9,10]. The take-home message is: to avoid major financial losses, scale down ambitious development schemes and focus on the highest-quality projects that have assured funding streams for long-term maintenance.



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Figure 2. Road Risks. Infrastructure projects in wet or steep areas bring serious financial risks. Trillions of dollars are currently being invested in road construction in high-rainfall tropical environments, where rapid (A) flooding, (B) slumping, and pot-holing can render expensive paved roads virtually impassable in just a few years (adapted from [9]).

Debate

Beyond the tactical points above, broad misconceptions about developments of all sorts, commonly reinforced by project proponents, need to be actively countered because these views are, at best, highly debatable. Effective arguments by informed scientists can be highly influential in blunting such dubious dogma.

Misconception 1: Many believe incorrectly that any proposed development is inherently desirable, because it will generate jobs and economic growth. This misperception must be countered vigorously because some projects become major money losers, creating large public debts, the costs of which must ultimately be borne by taxpayers. Crucially, the magnitude of project benefits is highly variable and depends greatly on local context [10]. Large projects are notorious for generating inequitable benefits, with politically connected individuals and land speculators acquiring great wealth while most people receive little advantage or suffer from growing public debt and inflated living costs [9,10,12]. For such reasons, the World Bank has characterized large infrastructure projects as a 'blunt instrument' for aiding the poor [9].

Misconception 2: Another flawed argument is that infrastructure projects in

Box 1. Smart Infrastructure Is Smart Politics

Many decisions about infrastructure priorities are misguided or poorly informed [9,10,13,15]. Scientists can aid decision makers by explaining issues in terms they readily understand.

In most regions, the greatest priorities for new or improved roads—those that will benefit the largest number of people at the lowest per-capita cost—are in urban, peri-urban, and previously settled lands in broad haloes around cities, where most of the native vegetation has already been cleared or heavily degraded [7,10]. Cities are growing explosively in number and size across the developing world, greatly increasing demand for affordable, reliable food supplies for their urban populations.

Farmers who can access such expanding markets will benefit substantially. This is where investments in transportation infrastructure can have the greatest per-capita benefits—by reducing transportation costs, times and crop spoilage for farmers, while ensuring that people in cities have affordable, quality food. Better roads linking rural food producers and urban consumers will improve rural livelihoods, increase financial investments and social services in rural areas, and improve farm production and efficiency—while incurring only modest environmental costs [7,9,10]. In this manner, well-connected agricultural lands can also function as ‘magnets’ to attract colonists away from environmentally vulnerable frontier regions [9].

Crucially, politicians who advocate such infrastructure strategies—benefitting the largest proportion of their citizenry while also being affordable, realistic, and low-risk in nature—should increase their attractiveness to voters, enhancing their chances of winning or remaining in elected office. This is a message that can be delivered emphatically to decision-makers, because it involves a ‘currency’ that they immediately value and understand.

remote areas positively advance the built frontier and the spread of ‘civilization’. In reality, many projects in remote locales instigate illegal activities such as timber theft, illegal mining, land grabbing, illegal road building, and land speculation that defraud governments of direly needed revenues [7–10]. Illicit drug production, wildlife poaching, and illegal harvests of natural products are also common consequences [9,10]. Indigenous communities can be destabilized by sudden influxes of aggressive interlopers, such as gold miners, loggers, and drug growers, which can dominate and dispossess local communities. Local protesters against projects may be persecuted by governments or other project proponents [9].

Misconception 3: A particularly disingenuous argument is that people in remote areas have an inherent right to roads and infrastructure. This ignores the reality that such demands are typically made by very small communities that expect governments and taxpayers to heavily subsidize their infrastructure, so that they can live remotely while enjoying

mainstream social benefits delivered at someone else’s expense. No government can possibly afford to build infrastructure to all its remote communities, nor should it strive to do so (Box 1). On a cost-benefit basis, many remote infrastructure projects are economically irrational, uncompetitive with decentralized approaches (such as local electrification), ineffective at integrating remote groups into mainstream economies, and likely to have severe environmental effects [10,15].

Delay

Opposition to proposed infrastructure projects is far from hopeless. Many proposed projects grind to a halt or are heavily modified because of shifting economic factors, changing political priorities, or growing public disapproval [10]. Nonetheless, the current tsunami of proposed projects is so massive that many dubious and destructive ventures still proceed.

For high-risk ventures, among the most effective strategies is to delay the project; slow down the approval process to provide opportunities for greater public

education and debate. Sustained opposition is effective because many project proponents, such as corporations or governments, have short-term goals for profits or fixed political terms that have limited tolerance for project delays [13]. In such instances, time becomes an ally rather than the enemy and provides an opportunity to identify and expose serious flaws in proposed ventures.

Collectively, the tactics identified here—disclose, debate, delay—provide a framework for opposing powerful and often-vested proponents of big infrastructure projects. Such a strategy is in every sense defensible because it provides better opportunities for publicly transparent and rational decision making to advance more sustainable, profitable, and socially equitable development.

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