Conservation Biology

Special Section Essay

Biodiversity Offsets and Infrastructure

JUAN DAVID QUINTERO* AND ARADHNA MATHUR†

*1811 Cliffe Hill Way, Rockville, MD, 20854, U.S.A., email juandavidquinterosagre@gmail.com
†5716 Callcott Way, Alexandria, VA, 22312, U.S.A.

Introduction

Infrastructure is an important catalyst for economic growth in developing countries. According to estimates by the Organization for Economic Cooperation and Development, developing countries may have to invest more than US$700 billion a year in infrastructure in the coming decade—increasing to US$1 trillion a year by 2030—to sustain rapid economic growth rates (World Bank 2007). The need for infrastructure expansion is becoming even more pressing due to the ongoing massive rural-to-urban shift of populations driven by this growth. For example, East Asian cities as a whole are projected to absorb two million new dwellers every month and triple the extent of their urban areas by 2030 (Gill et al. 2007).

Infrastructure development, however, invariably results in loss of biological diversity due to loss and fragmentation of species' habitats, increased accessibility of fauna to poachers, and changes in land use and land cover (Davenport & Davenport 2006; Peres 2010). Biodiversity offsets offer options for addressing effects of infrastructure projects on biological diversity and for leveraging additional funding for conservation.

The Concept of Biodiversity Offsets

Biodiversity offsets must be considered in the context of the mitigation hierarchy: avoidance, minimization, restoration, and offset. Avoidance measures are taken to prevent adverse effects on biological diversity. Minimization refers to reducing the duration, intensity, or spatial extent of effects that cannot be avoided. Restoration refers to rehabilitation of ecosystems adversely affected by infrastructure development. Offsets are measures taken to compensate for any adverse effects on biological diversity that cannot be avoided, minimized, or mitigated (BBOP 2009). They are intended to achieve no net loss and ideally lead to a net gain of biological diversity with respect to species composition, vegetation structure, ecosystem function, and people's uses of and cultural values associated with biological diversity (BBOP 2009; PricewaterhouseCoopers 2010) (Fig. 1). Well-designed biodiversity offsets are interventions that take into account the effects of a given project, availability of alternative sites for development, and funding to compensate for the loss of biological diversity (Rajvanshi et al. 2001).

Biodiversity offsets are also referred to as biodiversity compensation, environmental compensation, ecological compensation, and net conservation benefits. These terms reflect the fact that in practice there are at least four different types of offset mechanisms (BBOP 2009). The first are mechanisms to halt or reverse undesirable effects of infrastructure development, such as creating protected areas, establishing corridors and buffer zones, protecting species' habitats, and alleviating pressure on natural resources by introducing alternative means of income generation or substitute materials. The second type of offset is agreements with individuals to cede the right to convert land cover for profit. The third type is community-based programs such as compensation packages to local stakeholders, and the fourth is fund transfers from infrastructure projects to biodiversity conservation.

Offset mechanisms can be direct or indirect. Direct offset primarily refers to creation of equal or greater biological diversity than was lost, such as creating protected

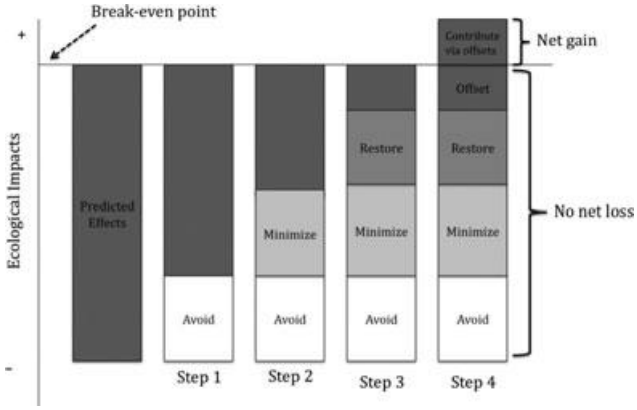

Figure 1. Stages leading to a gain in biodiversity during infrastructure development.

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areas, restoring native land cover, and expanding buffer zones (Ledec & Posas 2003; Darbi et al. 2009). For example, Fisheries and Oceans Canada's policy for the management of fish habitat requires habitat compensation when development projects cause authorized "harmful alteration, disruption, and destruction of fish habitat." In this case, the area of habitat and fishery productivity is the main criterion for determining compensation requirements (Harper & Quigley 2005).

Determining criteria for direct offsets often requires classifying land cover. High-resolution classification can provide a more precise match between developed land and compensation areas, but it can be difficult to identify a match (Crowe & ten Kate 2010). Community programs are often combined with direct offsets because the creation of new protected areas may restrict a local community's access to resources and hence their earnings.

Practical matters may make direct offsets difficult to achieve. Land may not be available at or near the project site, the magnitude of a project's effects may be poorly understood, or adequate resources may not be available during project preparation to determine offset criteria. Increasingly, therefore, offsets are indirect. Indirect offset mechanisms encompass more types of compensation than direct offsets. Indirect offset mechanisms include in situ fees paid by the project proponent, research on the resources negatively affected by the project, and trading or banking biological diversity credits. The private sector often finds indirect offsets more straightforward than direct offsets because the costs can be set aside early in project preparation. An example of indirect offsets is mitigation banking for wetlands in the United States (Madsen et al. 2010). Offsets are transferred in the form of credits in a market involving developers, local residents, and bankers. Developers can fulfill their mitigation obligations by implementing their own conservation initiatives or purchasing credits from bankers, whereas bankers can create or restore a conservation area to earn credits and sell the credits at market rates to recapture their investments. Through trading offset credits, stakeholders gain financially from conservation (White & Ernst 2003; Fox & Nino-Murcia 2005).

A Multilevel Approach to Offsets

There is no dearth of literature on designing innovative biodiversity offset mechanisms, but less has been published on potential actions countries can take at the national, sectoral, and project levels. Project-by-project offsets may result in high costs and may not address the cumulative effects of infrastructure development.

At the national level, a range of regulatory policies and incentive programs can promote offsets. Offsets can be introduced as a new legal requirement for projects or can be incorporated into existing laws that require assessment of environmental impact, land-use planning, or strategic environmental assessment (Crowe & ten Kate 2010). Requiring offsets enables integration of conservation with the development process and avoids surprises for both developers and regulators. Planning at the level of development sectors (e.g., roads, oil and gas, mining, hydroelectric) assists in anticipating the long-term cumulative effects of a policy, plan, or program.

Once offsets are built into the regulatory process it is easier for developers to ensure offset funds are set aside. Developers may change the location of their project if the costs of offsetting the initial proposal are too high. For example, with a capital budget of US$2.1 billion for the Gasoduto Bolivia-Brasil (GASBOL) pipeline between Brazil and Bolivia, the project proponents determined it was profitable to pay US$7.5 million to finance 12 projects in Brazilian parks and protected areas and establish a trust fund of US$1 million in Bolivia to assist in the management of the Kaa-Iya National Park (Quinero 2006, 2007). Furthermore, policies that provide incentives for the private sector to invest in conservation, such as streamlined project approval processes, tax breaks, and funding for offset programs, could benefit the implementation of offsets (White et al. 2007; Crowe & ten Kate 2010).

We recommend that offset programs, including supervision and monitoring of implemented activities, be required for all development projects. Data from the United States show that most approved offset programs fail to meet their objectives (Matthews & Endress 2008). We think monitoring should include periodic review of whether offset programs have achieved their objectives, especially when offset estimates have high uncertainty. The results should inform decisions on whether adjustments to the design of the offset are needed. However, the capacity of the existing environmental regulatory system is an important consideration for countries thinking about requiring offset mechanisms. In particular, the extent to which the concept of the mitigation hierarchy is embedded in the regulatory system is important. Approving projects solely on the basis of proposed offset programs can lead to unsustainable exploitation of natural resources.

Via offsets, infrastructure projects have the potential to contribute significantly to conservation. They can provide much needed additional funds. Even a fraction of the revenues generated by large infrastructure projects may greatly exceed the current annual operating budgets for conservation in most developing countries. In Brazil, for example, every development project that is determined to have significant environmental impacts is required to financially support the establishment or maintenance of a conservation unit in the area of project influence. The compensation amount varies as a function of the intensity of undesirable effects, from a minimum 0.5% of total

project costs to more than 6%. The money is used to create and maintain protected areas (Young 2005; Quinero et al. 2010). Between 2002 and 2004, the Brazilian government netted US$60 million, with future revenues expected to double (Young 2005).

Both the knowledge and technology are available for infrastructure projects to conserve biological diversity. With funding and expert knowledge, infrastructure projects can play a vital role in protecting ecosystems and the species and functions they support.

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