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Assessing and mapping global climate regulation service loss induced by Terrestrial Transport Infrastructure construction

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ABSTRACT

The purpose of this paper is to broaden the Terrestrial Transport Infrastructure (TTI) assessment process into the field of Ecosystem Services (ES), *i.e.*, the benefits people derive from ecosystems. Taking into account ES in an *ex ante* assessment of public infrastructure projects is of critical importance for the improvement of transportation decision-making tools, such as Environmental Impact Assessment (EIA) and Cost–Benefit Analysis (CBA). For EIA, the integration of an ES based approach opens the possibility of measuring a loss in ES supply (and its economic value); this provides a means of selecting among different possible pathways for the infrastructure. For CBA, since the ES loss induced by the selected pathway is expressed in monetary terms, it can be integrated as a standard social cost in the analysis, permitting a more efficient control of natural capital loss. We illustrate these points by assessing the loss of a global climate regulation service due to the soil tillage and sealing caused by a TTI construction, using the example of a high-speed rail in Western France. We select three optional routes among the proposed routes and analyse which route has the least impact on the global climate regulation service and its economic value.

1. Introduction

Terrestrial Transport Infrastructures (TTI) are often considered as essential for economic development due to their contribution to time gains, comfort, safety, and regional accessibility, yet they have major impacts on the natural areas they cross. These impacts can involve direct, indirect and cumulative effects (Tricker, 2007). The conversion of natural areas into artificial areas, as a result of TTI construction, causes habitat loss and fragmentation with consequent declines in biological diversity (Quintero and Mathur, 2011). As a consequence, the compromise between social gains from TTI construction and the ecological and social losses induced by the environmental alteration requires analysis.

Recent improvements to Environmental Impact Assessment (EIA) of TTI construction projects provide much-needed guidance to public policies. In many countries, TTI projects are assessed regarding several criteria (flora, fauna, fragmentation, etc.) in order to avoid or minimize their environmental impact. However, and despite improvements to the process, the criteria used remain mostly qualitative. Moreover, the approach consists of weighting the different impacts with impact scores and assessing the overall impact by summing these scores (Geneletti, 2005). These scores are thus of critical importance, and as Geneletti (2006) argues, the process acts as if the scores have additive properties. In addition, at the present time, the loss of an Ecosystem Service (ES), *i.e.*, the benefits people derive from ecosystems, due to TTI construction is not quantified and is usually regarded as having little influence on the main infrastructure choices, such as time gains or the perceived economic viability of the project (Chevassus-au-Louis et al., 2009). The process of TTI projects' evaluation is usually performed through Cost–Benefit Analysis (CBA). When CBA is used to enlighten decision-making for projects that impact the natural environment, monetary indicators of external effects have to be included in the assessment process for a greater efficiency.

Economists have developed a variety of methods that allow the construction of monetary indicators of non-market value loss associated with environmental and ecosystem impacts (TEEB,

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