Tax internationally traded commodities to safeguard biodiversity

Keywords
Biodiversity loss, agriculture, ecological tax, compensation

Introduction

In the face of increasing global biodiversity loss and ecosystem degradation, available funding for biodiversity conservation is woefully inadequate. Achieving effective conservation within the current global protected area (PA) network will require roughly doubling available funds for marine ecosystems (Balmford et al. 2004) and tripling funds for terrestrial ecosystems (Balmford et al. 2003). The lions share of additional financing is required in developing (tropical) countries, where biodiversity is disproportionately concentrated and funding shortfalls most severe (Balmford et al. 2003).

A large proportion of biodiversity loss can be attributed to the production of agricultural products in developing countries of the "Global South", often exported to the "Global North" (Shandra et al. 2009, Lenzen et al. 2012). Lenzen et al. (2012) estimate the share of global species threats caused by land use (habitat loss) driven by international trade at 30%. This highlights the need to tackle the problem of biodiversity loss as its source: overconsumption and unsustainable social metabolism in the Global North facilitated by ecologically unequal exchange with the Global South.

In this paper, we present a framework to quantify and resolve the problem of cost shifting by Northern consumers via a system of international compensation payments. Such payments would be enforced through improved regulation of internationally traded goods in the form of an ecological value added tax applied at the point of export or import.

Methods

Our framework is adapted to uncertainty regarding the origin of traded commodities (e.g. for most traded commodities, only country of origin information is generally available). We illustrate this using an example region of East Africa, where it is assumed traded commodities are produced, but the exact location (or even country) may be unknown.

The first step is to quantify potential impacts, wherever they may occur. We used habitat suitability models (HSMs) from a recent Global Mammal Assessment (GMA) for 575 extant mammal species occurring in the study region (Rondinini et al. 2011). Impacts were quantified according to anthropogenic land use classes of the ESA Globcover (2009) land cover package, vers 2.3 (Bontemps et al. 2011). Impacts represented the difference between current patterns in species' ranges and a reference condition, which represents an approximation of the species' range in the absence of human land use (de Baan et al. submitted). The unit of loss, or "biodiversity metric" was rarity and threat weighted species richness, where rarity is the inverse of the species global range (rescaled to 0-1), and threat is the IUCN threat status, rescaled to 0-1.

We assumed for an impact to be compensated, an equal unit of conservation value must be created through a compensation project, implemented as part of an overall strengthening of the regional protected area system. This represents a variation on the concept of biodiversity offsets, but applied to past impacts (i.e. already occupied agricultural land), and implemented in line with regional conservation priorities (Moilanen et al. 2009a). We assumed compensation projects are implemented in the form of "conservation landscapes" (Hanski 2011), which in our analysis was an improvement of the protected area network in Central Kenya, determined through a conservation prioritization exercise using the software *Zonation* (Moilanen et al. 2009a), aiming for 25% species range coverage of all mammal species in the landscape.

Future or planned conservation interventions are uncertain and risky (e.g. protection measures may not be sufficient to prevent threats or poaching, planning laws may change), especially if they involve a time delay (e.g. habitat restoration may fail) (Moilanen et al. 2009b, Maron et al. 2012, Curran et al. 2014). Therefore we discounted future conservation gains at discount rates of 1% for protection (based on the annual rate of habitat loss in Kenya) and 4% for restoration (Overton et al. 2013), with a time horizon equal to estimated biodiversity recovery times, predicted for habitat restoration using the models of Curran et al. (2014).

For each unit of impact quantified at the regional level, we matched a unit of (discounted) gain at the local project level. By integrating economic cost data from a previous study (Curran et al. submitted), we could determine the economic cost of compensating an average ha of agricultural land. By integrating production and price statistics from the Food and Agricultural Organization (FAOSTAT 2013), we could further allocate compensation to tonnes of agricultural products (a production-weighted mix of commodities drawn from FAO statistics).

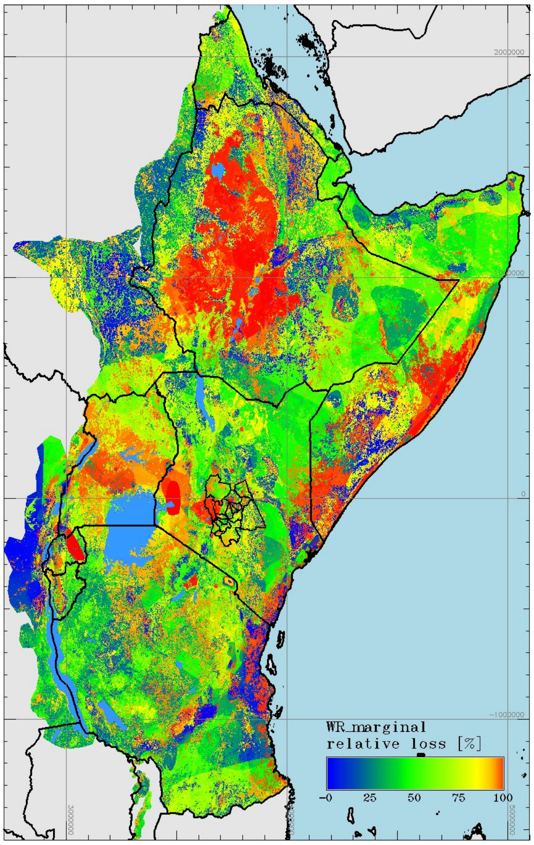

Figure 1: Relative loss of biodiversity value (Weighted Richness, WR) in the study region (in % loss) from the potential baseline to the current situation. Black polygon within Kenya represents location of hypothetical "conservation landscape" conservation project.

Results and Discussion

Differences in impacts were observed across ESA Globcover 2009 land use classes, but results varied spatially and were scale-dependent (Fig. 1). At the East Africa scale, the mosaic forest–agriculture land use class, received the highest impacts, reflecting the loss of habitat specialist (threatened and rare) species in forest ecosystems via fragmentation and conversion.

We quantified offset ratios for each land use class in terms of hectares of project area required to offset predicted impacts, correcting for uncertainty, risk and time lags of future conservation gains. Integrating the cost per unit area protected for our conservation landscape, we derived compensation costs per unit of land (ha). We allocated these compensation costs to land use products (tonnes of crop equivalent and ha of development land) under four cost scenarios (Fig. 2). This led to median price increases generally below 100%, but ranging up to ca. 250% depending on the cost scenario (upper quartiles reached almost 500%).

When interpreting our estimated price premiums, it is useful to consider the relationship between farm-gate production costs and final consumer prices along a value chain. Producer prices make up a only about 10% to 20% of the total value added in agricultural value chains in trade between developing and developed countries (Kaplinsky 2000). Final price increases for Northern consumers are therefore likely to be significantly lower than what is reported. This implies that the range of median compensation premiums of ca. 5% to 250% (Fig. 2) would only constitute price increases of ca. 0.5% to 50% in the developed world, matching ranges found in consumer willingness to pay studies (Jacobsen and Hanley 2009, Bateman et al. 2010, Mahé 2010).

Based on our data from Kenya, when existing protected areas are taken into account only about ca. 10% to 20% of total crop area would need to be compensated to fund a comprehensive regional conservation network. This level of uptake could be achieved by targeting export and niche markets for cash crops (e.g. coffee, tea, pineapples, flowers etc.), leaving local prices in developing countries essentially unchanged. Shifting the costs of conservation to Northern Consumers via an ecological value added tax at the point of import/export would institutionalize the system (Farley et al. 2010). Such a scheme would both reduce overconsumption in the developed world via higher prices, and massively increase finances for global conservation efforts in the biodiverse tropics. Under a scenario of economic degrowth, or more precisely contraction and convergence of national economies to a sustainable aggregate scale, such a tax would provide a constant source of consumption-based income, while decreasing the overall volume of trade. While many political and institutional hurdles remain (e.g. WTO rules), the research demonstrates that optimally protecting biodiversity is an achievable goal, provided the Global North is willing to pay a little more for its imports.

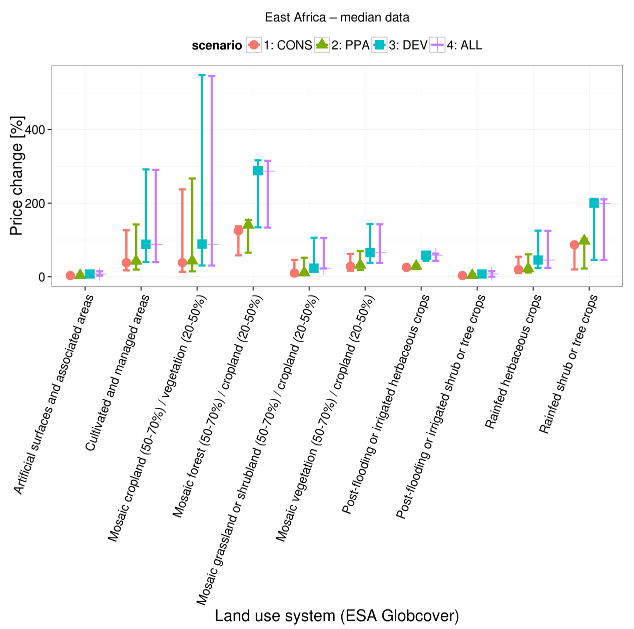

Figure 2: East Africa scale predicted farm-gate price premiums for a product of land use (tonne of crop equivalent, ha of development land) for ESA Globcover land cover classes. Results shown for four cost scenarios (CONS = only non-PA land considered, PPA = support for public PA cats 5 & 6, DEV = includes development budget, ALL = includes both development budget and public PPA support). Data range represents median and inner quartiles (25 and 75 percentiles). PA = Protected Area

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