# The Role of Governance in Managing Ecosystem Service Trade-offs

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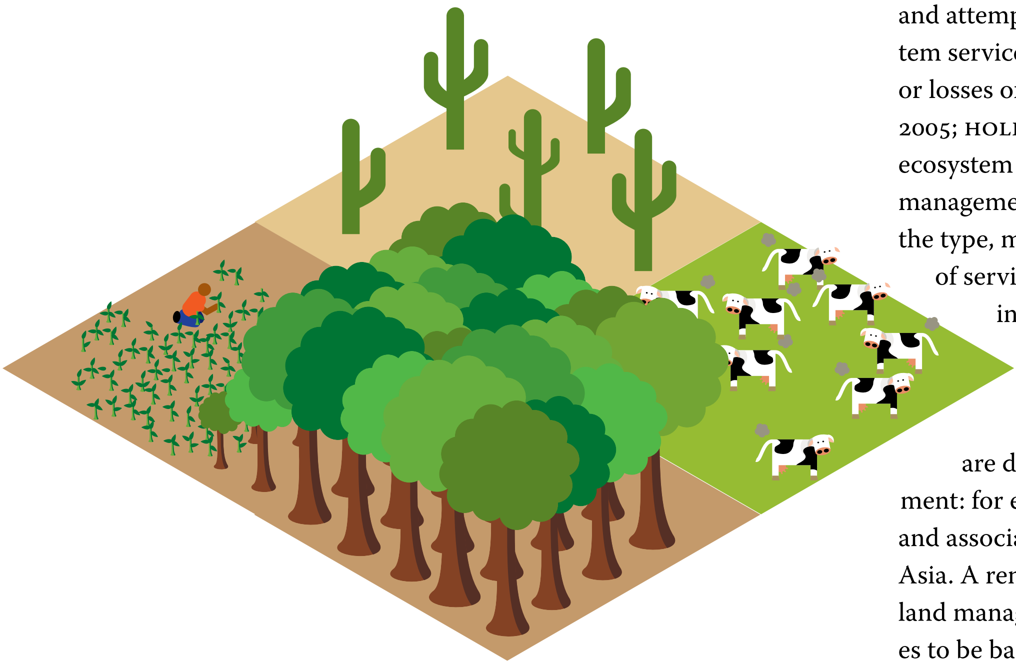

## Introduction

At the beginning of the 21st Century, the science and policy communities undertook a synthesis of knowledge about global ecosystems and their capacity to support human well-being in the Millennium Ecosystem Assessment, popularly referred to as MA (MA 2005; CARPENTER ET AL. 2009). Since the completion of the MA, new research efforts have been directed to diverse facets of human-environment interactions, including improved understanding of the dynamics of land change (TURNER ET AL. 2007); linkages between ecosystem services and human well-being (DAILY & MATSON 2008; ICSU-UNESCO-UNU 2008); and the role of governance in the maintenance of ecosystems (NRC 2005; BIERMANN 2009).

Ecosystem services refer to the benefits we derive from nature. They are usually classified as provisioning services (e.g. food, fibre, freshwater); regulating services (e.g. climate regulation, erosion control); supporting services (e.g. nutrient dispersal and cycling, seed dispersal, primary production); and cultural services (e.g. cultural and spiritual inspiration, recreational experience, scientific discovery) (MA 2005). The concept of ecosystem service was introduced primarily to find solutions that would both conserve biodiversity and further human welfare (TALLIS ET AL. 2009). Humans have always relied on ecosystem services, whether intermediate or final, to enhance their well-being (RODRIGUEZ ET AL. 2006; COSTANZA 2008). The MA framework rests mainly on the perception that human condition is tightly connected to environmental condition, with the implication that conservation and development activities should be able to achieve both ecological improvement and social progress, without detracting from their respective goals (TALLIS ET AL. 2009). In practice, such win-win solutions (ROSENZWEIG 2003) are hardly attained because ecosystem services are not independent of each other and attempts to optimise one ecosystem service often lead to reductions or losses of others (PEREIRA ET AL. 2005; HOLLING & MEFFE 1996). Such ecosystem service trade-offs arise from management choices that transform the type, magnitude, and relative mix of services provided by ecosystems in a given area (RODRÍGUEZ ET AL. 2006). It should be pointed out that not all cases of human influence are detrimental to the environment: for example, swidden farming and associated practices in Southeast Asia. A renewed interest in traditional land management shows these practices to be based on a sound understanding of the landscape, ecosystem, and regenerative capacity of the vegetation. Loss of such land use practices results in the homogenisation of crops and varieties and land quality (PADOCH ET AL. 2007). Thus, an explicit detailing of trade-offs would enable effective and sustainable management of ecosystem services. The objective of this article is to highlight some of the asymmetries in ecosystem service trade-offs, the causes, and possible management responses to them.

## Forms of Ecosystem Service Trade-offs

The two major forms of ecosystem service trade-offs are spatial and temporal[1]. Spatial trade-off occurs

1 RODRIGUEZ ET AL. (2006) identify four types: spatial, temporal, reversibility and trade-offs across ecosystems.

Illustration: Louise Smith

when the provision of one ecosystem service at a given location leads to a decrease in the other, at that or surrounding locations. Actions to increase food production often involve reduced water availability for other uses; degraded water quality from excess fertiliser; reduced biodiversity; and release of greenhouse gases. Spatial trade-off also implies a situation in which the burden and risk of ecosystem service use are borne by non-beneficiaries. Different stakeholders have different levels of trade-offs to make with respect to the use and contribution to their well-being. For instance, payments made for the survival of the Giant Panda comes from a global pool of human resources, who do not directly gain from the species, but contribute to mitigating the risk of its extinction. Another manifestation of spatial ecosystem service trade-off is when people living in an area benefit from ecosystem services that are generated from distant locations. For example, urban dwellers benefit from agricultural production in remote rural areas (MARCOTULLIO ET AL. 2008). Another form of spatial trade-off that is often neglected in policy decisions is the nutrient and virtual water found in internationally traded agricultural commodities. West Asia, North Africa, Southeast Asia and sub-Saharan Africa, are net importers not only of nitrogen, phosphorus and potassium but also of virtual water in agricultural produce (GROTE ET AL. 2008). In sub-Saharan Africa, widely recognised nutrient depletion and soil fertility problems persist, as the nutrients imported are commonly concentrated in cities, creating waste disposal problems, rather than alleviating soil deficiencies in rural areas. Among other factors, GROTE ET AL. (2008) suggest trade liberalisation and nutrient and virtual water trading schemes, as some of the global-level policy responses to nutrient and virtual water flows.

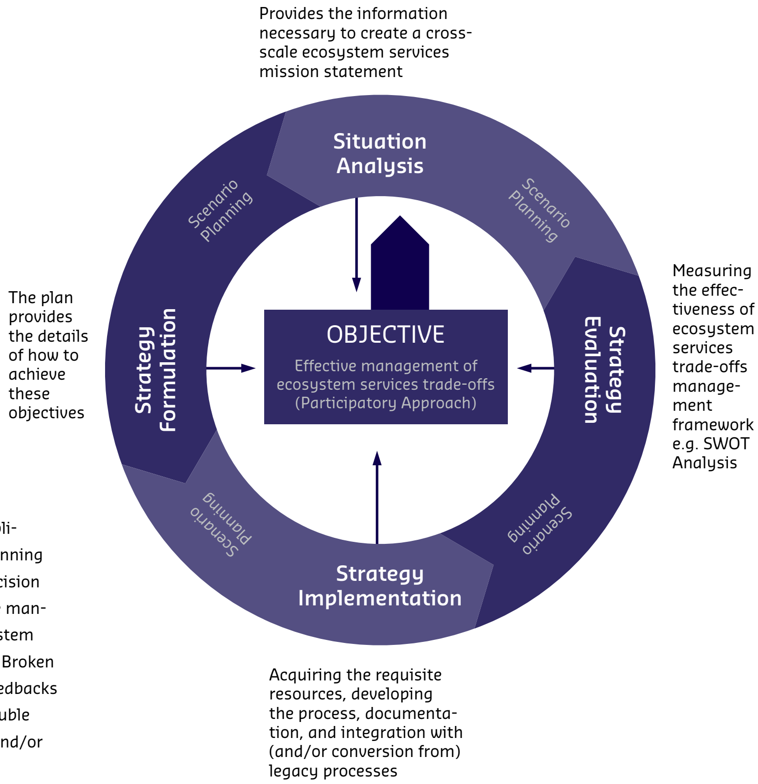


Figure 1: The Simplified Integrated Planning Approach (IPA) decision model for effective management of ecosystem service trade-offs. Broken arrows indicate feedbacks and the broken double line means close and/or open end.

Temporal trade-off is driven by the short term needs of the society. It refers to intergenerational inequities, whereby present consumption of ecosystem services is at the expense of the same or other services in future. The general increase in provisioning services over the past century has been achieved at the expense of regulation and cultural services (BENNETT & BALVANERA 2007). Some ecosystem services, such as soil formation and water and disease regulation that change imperceptibly over relatively long time scales, are subject to temporal trade-offs. Land degradation often occurs so creepingly that land managers hardly contemplate timely ameliorative measures (VLEK 2004). As such, soil quality management is not often considered a policy objective unless soil degradation threatens other developmental goals.

Temporal trade-off is usually addressed through discounting techniques, using rates such as the market rate of interest or the inferred social discount rate. Discounting addresses the problem of translating the values of ecosystem services from one time period to another. The discount rate assumes that the benefits derived from ecosystem services now, are worth more than the benefits that future generations will get. Note that this view may not be shared by future generations and the notion that future ecosystem service values should be discounted is currently debated (DASGUPTA 2008).

## Causes of Ecosystem Service Trade-offs

Recognition of the fact that governance and ecosystem services are interlinked at multiple scales, helps in identifying the causes of trade-offs. Often, there is a mismatch between the scale of ecosystem processes and the institutions governing them (CUMMING ET AL. 2006), resulting in a substantial loss of ecosystem services (MA 2005). Some of the processes that generate this mismatch include shifts in human production systems; increasing pressure on natural resources that accentuates the competition between individuals and organisations; shifts in governance towards nation states (that is, centralised institutions) that lack the flexibility to address local problems; and the use of inappropriate technology (CUMMING ET AL. 2006).

The depletion of environmental resources is often much greater than would be socially optimal due to the presence of many externalities, including the public good nature[1] of many ecosystem services; imperfect property rights; insufficient knowledge and information; policy distortions; lack of local participation in planning; and weak enforcement of regulations (HEATH & BINSWANGER 1996; LEBEL & DANIEL 2009; TIETENBERG 2006). Agricultural and environmental policies of governments usually fall into two categories: regulations and incentives (JUST & ANTLE 1990). Generally, in most developing countries, regulations have minimal effect due to a lack of monitoring and enforcement capacity within the government; thus leaving it to incentive policies to change behaviour. For instance, in Thailand, government regulations restricting expansion of farmlands in upper catchments, despite threats of resettlement, are not successful due to inadequate capacity and support of the state or available land for resettlement (LEBEL & DANIEL 2009).

Lack of or limited information on the costs and benefits of alternative policy options is another cause of trade-off. In a study in the Xizhuang Watershed, Yunnan China, JUN & JIANCHU (2009) observed that in the process of implementing policies to return farmlands to natural habitat, several other problems cropped up. One, intensive agriculture had to be practiced, which resulted in the rise of pesticide and pollution levels; two, men in the labour force left in search of alternatives to augment family incomes, thereby severely affecting the productivity of the lands; three, forest plantations were primarily focused on pine plantations that negatively impacted biodiversity and soil acidity, and reduced the access (of the dependent population) to non-timber forest products (JUN & JIANCHU 2009). Hence, while the benefits of the policy attempted to improve biomass, it also had several drawbacks for the environment and welfare of people dependent on the ecosystem.

Conflicts from trade-offs appear to stem, at least partially, from the lack of stakeholder consensus on the mechanisms for making the trade-offs, and on the adequacy of the information used. For example, the large scale conversion of tropical forest lands to oil palm plantations in Malaysia and Indonesia has resulted in the degradation of the forests, due to a loss of unique biodiversity within the ecosystems; and a loss of livelihoods and the subsequent welfare of the communities dependent on the forests (FITZHERBERT ET AL. 2008). However, there has been cause for hope with the adoption of sustainability principles as per the Roundtable on Sustainable Oil Palm (RSPO), which has the buy-in of several stakeholders.[2]

Often, incentives such as payments for conservation of ecosystem services could enable reducing trade-offs between environmental and development goals. However, such incentives need to be carefully designed, as trade-offs in ecosystem services could be related to decisions taken outside the system, and possibly due to a variety of factors including: improper enforcement of regulations; lack of or inadequate awareness of options to alternate land-uses; and lack of either adequate credit or sufficient power to govern resources through well defined property rights (ENGEL ET AL. 2008).

## Addressing Ecosystem Service Trade-offs

While it is possible to address each of the failures of either institutions or the market enumerated above through appropriate means, it would be important to note that one or the other approach would not be sufficient, as any trade-off is an outcome of the interplay of various factors and decisions. Thus, integrating these approaches where possible and adapting useful management analytical tools, while providing a level playing field for actors, will ensure the effective management of ecosystem services trade-offs in the face of global environmental change uncertainties. Here, we propose an Integrated Planning Approach (IPA); a decision-making framework with crosscutting strategies and cross-scale approaches to managing ecosystem services trade-offs. In achieving the goal of a well managed ecosystem services trade-off, IPA is applicable from two focal points: 1) trade-offs among current uses of ecosystem services, and 2) trade-offs between current and future uses of ecosystem services.

IPA seeks to plan for the protection of the whole ecosystem, not just its parts; make government and the private sector more transparent and accountable; and include ecosystem services protection in all policy decision-making. It is a participatory decision model based on the dynamics and uncertainties in ecosystem services. For instance, an analysis of forest policy at the national level is likely to focus on the value of timber to the national economy, and may consider flood control and water filtration. A local analysis is more likely to identify non-timber products, such as nuts and the cultural value of the landscape, as important services. Thus, assessments need to examine changes in ecosystem services over both the long and short-

1 A pure public good is one characterised by non-excludability and non-rivalry. An ecosystem service is a pure public good if users cannot be prevented from benefiting from it and if consumption by one user does not affect consumption by others.

2 http://www.rspo.org

term, because dramatic decline from which it is difficult to recover may occur as the ecosystem reaches tipping point, that is, the threshold at which rapid change occurs (Scheffer et al. 2001).

Put succinctly, the four major elements in the IPA (Figure 1) include: situation analysis, strategy formulation, strategy implementation, and strategy evaluation.

Effectively implemented, IPA (because of its participatory nature) may provide answers to the question of who 'wins' and who 'loses', as a result of ecosystem change that has not been adequately taken into account in management decisions. Similarly, it may also highlight inequities between stakeholder groups, such as indigenous people, traders, large scale businesses, government, etc, and suggest ways to reduce imbalances in accessing the services. IPA may help to provide alternatives to short-term benefits that could impact human and ecological well-being.

## Concluding Remarks

Trade-offs are inevitable within ecosystem services management decisions at all scales. Future programmes need to arm decision-makers with the information, knowledge, and skills, to make informed decisions based on awareness and analysis of such trade-offs. Society is coming to realise that ecosystem services are not only threatened and limited, but that the pressure to evaluate trade-offs between immediate and long-term human needs is urgent. Particularly important trade-offs involve those between agricultural production and water quality; land use and biodiversity; water use and aquatic biodiversity; and current water use for irrigation and future agricultural production. In this context, an Integrated Planning Approach seems promising.

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