Technical Note 6

ECOSYSTEM SERVICES AND RIVER RESTORATION

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CIREF
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About CIREF

The mission of the Iberian Centre for River Restoration is to revert the trend of degradation that river ecosystems undergo at present.

CIREF is an independent, non-profit organization. It is constituted by a group of professionals linked to river restoration in the Iberian Peninsula, coming from universities, authorities, private consultancies and non governmental organizations. For more information, visit:

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"Transformation of the climate crisis in a restoration economy is intelligent and profitable"

Serge de Gueldere[1]

1. Ecosystem services

Society depends on the goods and services produced by our planet's ecosystems. This dependent relationship between human well-being and the biophysical world is encapsulated by the relatively new notion of ecosystem services. The food we eat, the air we breathe, and the water we drink, all derive from ecosystem processes. However **our dependence on these ecosystems has not prevented us from stressing them and reducing their capacity to meet our needs** (MEA 2005).

To maintain our valuable ecosystem services intact, we must improve resource management and decision making. The ecosystem services framework promises to bring together the ecological and social sciences to meet this challenge. This research field seeks to develop new methods to help us articulate the benefits that ecosystems provide for society. Clarifying the values that ecosystems generate for society is essential for efficient economic management of our natural resources.

Journals are publishing new ideas about ecosystem services at an extraordinary rate (Fisher et al 2009). The degradation of ecosystem services could grow significantly worse during the first half of this century and is a barrier to achieving the Millenium Development Goals (MEA 2005). Rising to the challenge the field of ecosystem services needs more attention from governments and policy makers.

Some authors have proposed a cascade scheme that sets the value of the use and non-use of individuals and society gain or lose depending on how services are managed in the ecosystem (Figure 1).

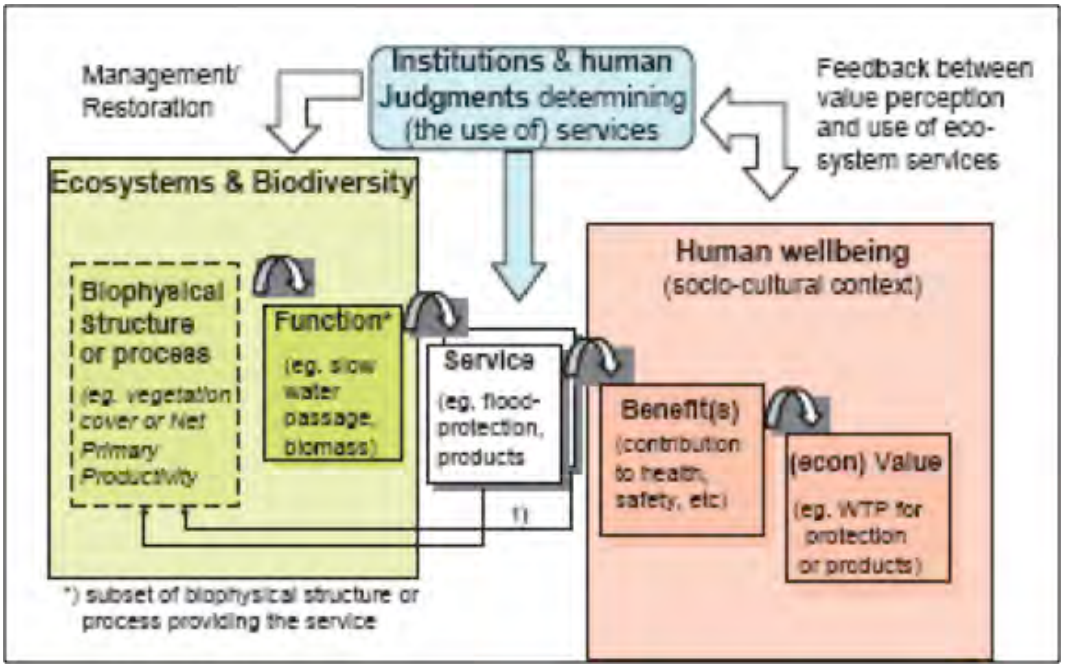

Figure 1. Cascade scheme of ecosystem services value (Original: Haines-Young and Potschin, 2010).

[1]Mark Serge de Gueldere was part of Al Gore's team, his ambassador in Belgium, and personally trained to educate people about climate change.

2. Ecosystem services in the water cycle

Hydrologic, biogeochemical and ecological functions of river ecosystems provide a set of well-known ecosystem services. When ecosystems are maintained in good ecological condition, their ability to provide these services is greater, while the deterioration of aquatic ecosystems may reduce the viability of the provided services (MA 2005). **Intact river ecosystems are more effective at processing nutrients, breaking down waste, filtering water and providing habitat for fish**.

The economic valuation of ecosystem services can assist in the efficient management of water resources. Indeed, not valuing ecosystem processes has led to the degradation of valuable ecosystem services, because the value of the goods and services they provide are not incorporated into decision-making. In other words, when we do not value ecosystems and their services, their default value is zero.

Of course, **the valuation of ecosystems and their services is complex because it sits at the interface between ecosystems and society, and therefore the valuation exercise is subject to a high degree of uncertainty and assumptions** (Pearce and Turner, 1990). Monetary valuation can not always capture all the impacts of environmental policy decision (Martinez-Alier et al., 1997). Often, environmental services are not valued for lack of knowledge of ecological processes and the difficulty of establishing a common framework between ecology and economy. Perhaps the most common approach to value ecosystem services is the replacement cost method in which the value of an ecosystem is determined by the cost of the physical infrastructure that would have been used to provide the same service. This method was used to assert that the Adirondack mountains provided billions of dollars worth of water purification services for New York City (Daily and Ellison 2002). Similarly, the clearest illustration of this valuation approach is when cities rely on wetlands for wastewater treatment and they may avoid building a large waste water treatment facility (Bolund and Hunhammar 1999).

Cases in which nature was chosen over hard infrastructure have been shown to be financially advantageous, often because they require lower capital investments and have lower maintenance costs (Chichilnisky and Heal 1998). However replacement cost methods are disliked by economists because this approach confuses costs with benefits.

Estimating the full economic value of ecosystem services provided by rivers is not easy. Rivers provide, recreational opportunities, aesthetic values and even cultural values. Survey methods are usually used to estimate how people value ecosystems. And yet responses to these surveys show a wide range of variability. Economists are still working on methods to estimate social values. When possible, it is preferable to use revealed preference methods such as hedonics, rather than revealed preference methods, such as contingent valuation, which may be less reliable.

More work is needed to reduce or overcome the limitations that hinder the recovery of such services (conclusions of the First Iberian Congress Restauraríos River Restoration, León, October 2011).
Improving our understanding of the contribution of ecosystems to social welfare and environmental services can make more efficient their management and protection.

Quantification of ecosystem services can help support our proposals to recover river systems and can be justified as viable investments in the same way that it's now investing in built infrastructure, engineered solutions or sophisticated purification systems.

3. Ecosystem services and benefits provided by rivers

River systems and the hydrological cycle should be viewed as an integrative system rather than just our water supply. While the drinking water supplies is the most prominent and valued part of our river systems, rivers also provide recreational, scenic and cultural services. Moreover, rivers also serve as biological corridors that connect natural or urban areas, are reservoirs for biodiversity, provide nutrients for agriculture and more other biological services. In this sense, the flow of goods and services depends on proper functioning of the entire system.

River systems generate multiple services including supply services (water resource itself), regulating services (flood prevention), cultural services (spiritual enrichment of listening to the water flow, cultural

heritage) and support services (transportation of solid sediments) (MEA, 2005).

Below we highlight specific services for which there is a clear demand:

- maintenance of water quality,
- water Storage,
- transport of wastewater and derived-products of human economic activities,
- hydropower generation,
- forest resources with high productivity,
- habitat for flora and fauna (biodiversity) and observation and study of wildlife for recreational, educational or scientific purposes,
- recreational activities: fishing, hunting, gathering plants, hiking, water activities and sports, among others,
- power dissipation of water flow in extraordinary floods,
- carbon fixing and mitigation of climate change,
- groundwater recharge,
- flood zones that reduce damage during floods.

In addition, there are other services for which there is an indirect use but important for human gain as maintenance of the food chain, psychic and spiritual welfare derived from the contemplation and enjoyment, water transport and dispersal of seeds and plant propagules and other non use services.

The study of environmental services may reveal economic reasons to restore our riparian ecosystems. The European legislative framework, the European Water Framework Directive (WFD), requires governments to restore river ecosystems to "good ecological status". Quantifying the value of ecosystem services can contribute to the justification of investments to help achieve good ecological status, as well as cost recovery, which is one of the elements required by the WFD.

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Case: The integration of environmental services on water management in Llobregat river in the Barcelona Metropolitan Region

The city of Barcelona relies on the Llobregat River for much of its drinking water. Two large treatment facilities treat surface water from the Llobregat and distribute it to the metropolitan area. Engagement with drinking water managers at these two treatment facilities allowed for the identification of ecosystem services relevant for decision makers. Discussions revealed that treatment costs were particularly sensitive to three water quality parameters: stream temperature, ammonium and conductivity. In particular, high stream temperature increased water treatment costs because of the water treatment technology used and the high concentration of disinfection by products during warm summer months (Valero and Arbós 2010).

Understanding the demand for reduced stream temperatures by water treatment managers allowed for the development of a targeted research program focusing on ecosystem structures that would reduce thermal heating in the Llobregat River. It was found that the restoration of riparian forests upstream would help recover ecosystem structures and functions, reduce stream temperature in the summer and therefore reduce water treatment costs. After modeling multiple restoration scenarios, nearly half of the investment in riparian river restoration could be recovered in a 20 year period through a reduction in water treatment costs (Honey-Rosés et al 2013). Figure 2 shows RIU VERD, a rehabilitation project that took place in the Medium Llobregat river and a source of information to calculate the cost for riparian restoration.

Furthermore, these economic benefits of river restoration were viable even after both treatment facilities had installed new and sophisticated water treatment technologies. In 2009, the water purification plant managed by Aigües Ter-Llobregat (ATLL) in Abrera installed an electrodialysis reversal, while simultaneously the water purification plant of Aguas de Barcelona (ABGAR) invested in a reverse osmosis system. Therefore, regardless of the technological context, investing in ecosystem services may make economic sense (Honey-Rosés, Schneider & Brozovic 2014).

Figure 2. RIU VERD Project in Llobregat river

Figure 3. Restoration of river sediment transport services and fisheries in the Segre river

Payment for environmental services

When ecosystem services are well known and quantified, it may be possible to arrange a payment for ecosystem services (PES) program between service providers and service beneficiaries. PES internalizes the costs of protecting or managing ecosystem services, and generates the financial resources necessary for an ecosystem's protection or restoration.

The use payment for environmental services (PES) in the field of water is still incipient, although there are already many international examples, especially in the area of fluvial custody and good agricultural practices contracts.

One example is the mineral water company Vittel in the Vosges Department (France) who paid farmers to protect water quality with agro-ecological practices. This program started in the 1990s to mitigate threats from pesticides and nitrates associated with livestock and negative agricultural practices upstream. After 10 years of negotiations, the company established a package of incentives for farmers to commit to sustainable actions to perform on their farms.

4. River restoration and ecosystem services

Understanding the economic and social value of ecosystem services in a river system can help prioritize river restoration projects. At the same time, it is also recommended wider use of cost-benefit analysis. In the last five years in Spain have made significant investments in the National Strategy for River Restoration. However, we do not know precisely which has been the economic or social return on these investments. The framework of ecosystem services can help to quantify some of these benefits, which until now, have not been counted. Therefore it is essential to improve our understading of the economic benefits generated by river ecosystems.

Currently, public administration does not consider river restoration projects as investments. **The funding for restoring natural capital is substantially lower than the funding available to build and maintain built infrastructure.** By reframing river restoration projects as restoration of natural capital we can attract the financial resources needed to restore our river systems and better integrate environmental and social values (Figure 3).

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