Assessing Ecosystem Service loss due to infrastructure projects

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Introduction

On an annual basis, transport infrastructures and planning projects are responsible for the disappearance of large natural areas. Biodiversity and ecosystem services are not totally ignored from project's environmental assessments. However, reality shows that reducing impacts is more practiced than taking into account the cost of the damages that is produced by the project. Nowadays, providing an economical value to biodiversity and ecosystem services within Projects socio-economic assessment is a way to bring its inclusion into decision making processes for planning. However, if no value is given to these services for ethical reasons or for its inestimable character, it means that its value is worthless and considers that society does not benefit from it.

Egis has committed to a long running research program with a scientific partner that is specialized in economic sciences[1]. Our research resulted in the preparation of an operational tool called "Aulnes©". As a result of this tool, ecosystem services can be integrated into the assessment of land-based transport infrastructure projects. It allows for the attribution of an economic value to the loss of ecosystem services due to infrastructure projects. Environmental cost of different linear infrastructure alignment options can then be compared. This approach enriches environmental assessment and brings a new criterion to support decision making between various alignments.

Aulnes© consists of the following:

- A <u>toolkit</u> to reveal services provided by an area's ecosystem to its population. It creates a service offer map and highlights what might not have been visible, such as service production hotspots.
- A <u>method</u> to assess production fluctuations of ecosystem services. For example, in relation to:
    - Implementation of industrial and infrastructure projects,
    - Modifications to forestry or agricultural practices,
    - Management practices of natural areas.

Ecosystem service gains or losses are assessed through spatial analysis. Thus, it is possible to know where the gains or losses are located and which recipients are concerned. As a result of this information:

- Planners can design their project more efficiently with an eco-design focus.
- Participation processes around a project are strengthened thanks to the knowledge of ecosystem service gains or losses.
- Land owners can also improve their management practices.

[1] *Research studies were undertaken during Léa Tardieu's PhD Thesis financed and coordinated by Egis Environnement. Léa Tardieu was a PhD student at SupAgro, Montpellier, France. Three articles was published during the scope of this research (references below).*

Methodology

The methodology was defined and tested on a real-life large infrastructure project. The general objective was to limit operational constraints (planning and cost of the studies) and provide robust predictions. The operational approach was to make use of the database that was prepared for the environmental assessment. Overall, 15 services were studied across 14 different ecosystems.

The methodological approach is defined by 2 consecutive steps:

<u>1st Step</u>: Outline the services provided by an area's ecosystem.

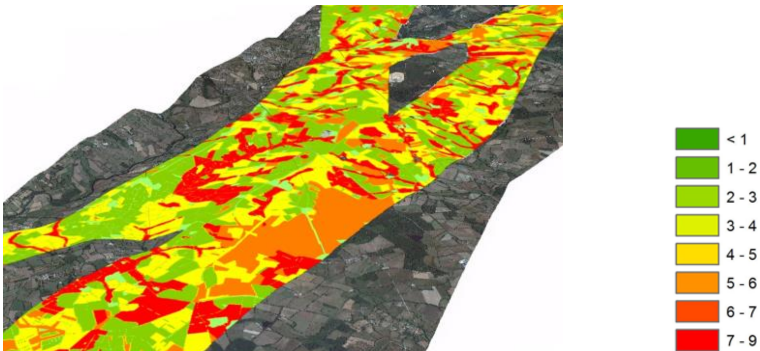
Based on the ecosystem concerned by the project, ecosystem services produced within the study area were defined. In the absence of site-specific valuation date, we rely on the benefit transfer method. The results based on a benefit transfer method should be interpreted with caution. That's why we minimize as much as possible the generalization error by adapting values to the local context by using as much local information as possible.

We sought the most appropriate quantification method for each service based on available data and existing models:

For certain services, their production and importance were evaluated based on bibliographical information, while keeping spatial conditions into account. We made use of a common GIS tool (ArcGIS products from ESRI). As an example, a hedgerow is considered effective as a windbreak and can increase yields. Its service is evaluated by comparing its influence zone; type of farming practiced in the study area; yield increase and agricultural production values adapted to the local context.

For other services, such as regulation services, complex models have been used. This is the case for ground water replenishment, pollination and protection against erosion. For these last 2, models developed by InVEST (Integrated valuation of ecosystems services and tradeoffs) were followed.

A map is then prepared taking the quantification of each service into account. This map is based on a combined indicator expressing the presence and importance of the said service and provides a holistic view of the study area. Services that offer "hot spots" can thus be visualized. This approach contributes to the development of the preliminary mitigation measures.



<u>Figure 1</u>: Map of the service offer expressed through a presence/importance indicator over a large area.

2nd Step: Assessment of the service production variations

This step is to assess gains and losses generated by a project or by land management practice changes. Our approach is particularly focused on this second point and is specifically unusual as we take into account direct and indirect effects of a project. We keep in mind that indirect effects can be quite significant.

Direct effects: A complete loss of services is considered for all ecosystems within the project area. For some services, such as recreational services, the direct loss can go beyond the project area. For example, we can consider the visibility impact of a project. On the other hand, we would also consider the noise affected area for a transport infrastructure project.

Indirect effects: for some services and some ecosystems the loss can also go beyond the area of the project. It is either linked to the ecosystem's profile and its project area through a threshold effect or linked to an ecosystem present within an ecological network.

Overall, for each type of ecosystem and per type of project, a complex matrix is shown that is comprised of services that are present and the predicted impacted areas.

A map of service losses associated with a project also allows the location of the most important losses and offers possibilities of adapted mitigation measures. It can thus be used as a support for the eco-design of a project. The study of ecosystem service losses brings added-value to the assessment of planning projects.

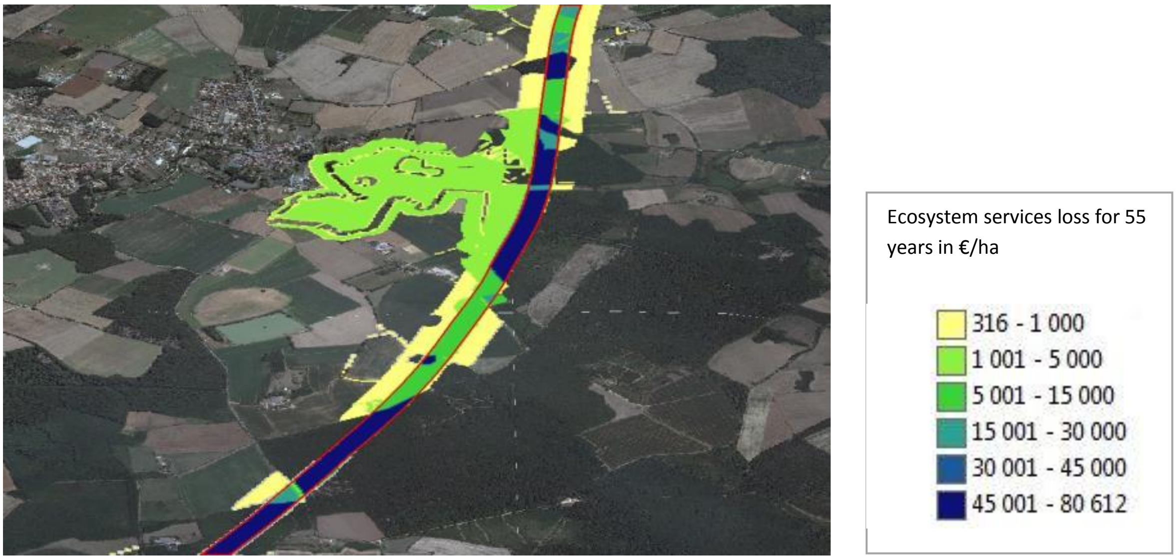


Figure 2: Map of service losses linked to a High Speed Rail project.

Results following the application of the tool to a linear transport infrastructure:

We conducted a test on a 20km section. The project's gross loss ("ecosystem service footprint") varied between 228 K and 293 K €/year (2010) depending on the 3 alignments that were studied. One could consider this loss as minimal compared to the overall services provided by Nature within the region. It is nevertheless interesting to show that choosing the solution with the least impact could reduce the ecosystem service loss by 20% (65 K €/year). It is clear that there is a point in putting in place these avoidance approaches based on this criteria within a more holistic multi-criteria analysis (Environmental, Technical and Economical).

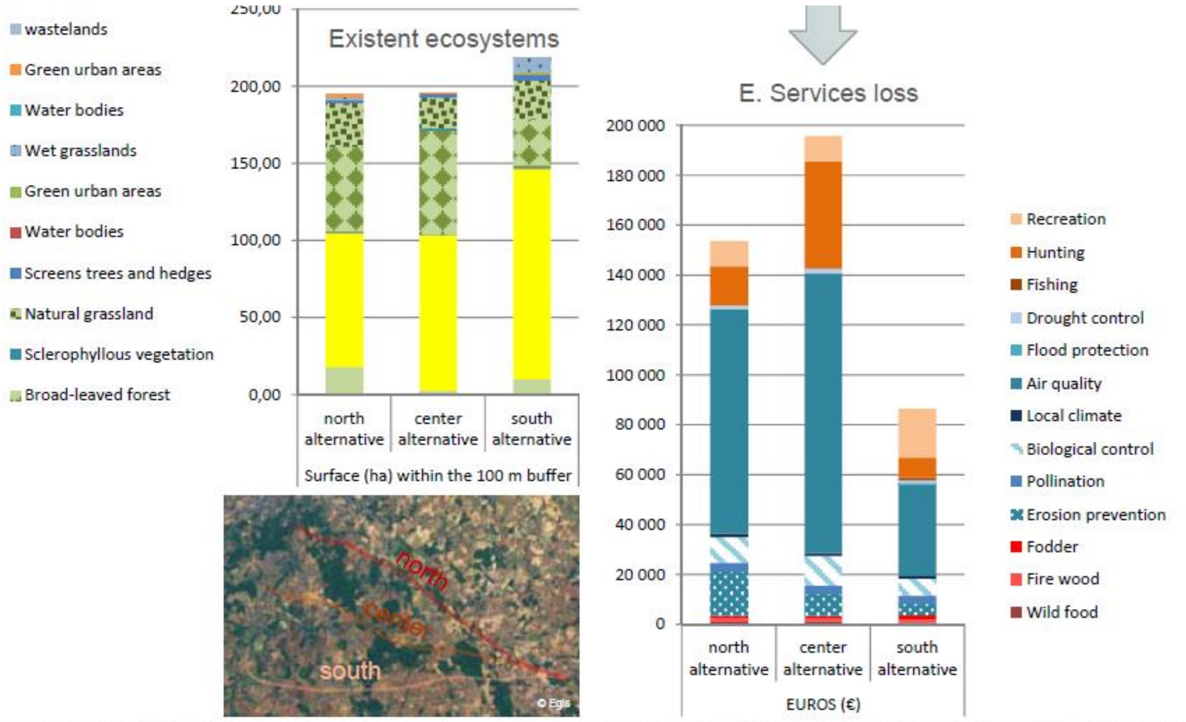


Figure 3: Comparison of alignment alternatives: Which of the options generates the least loss of natural capital?

Incorporating these service losses into the cost of a project significantly alters the socio-economic balance (a drop of around 20% of the discounted profit - a significant drop due to the low profitability of the project).

The approach also allows for paired comparisons, such as the benefits of a high speed rail line with a lower impact on air quality (since it reduces road traffic) compared with the cost generated by its construction in terms of the reduction of the peri-urban forest areas that regulate air quality. In our case, the benefit is fully offset by the cost, as it comprises 2/3 of the benefit taking into account the overall climate.

Conclusion

Taking into account ecosystem services highlights that some impacts are never considered or merely mentioned. For the first time, it connects biodiversity and socio-economic issues together within the scope of a project.

This approach will contribute to the improvement of the evaluation framework of the Avoid-Mitigate-Compensate process (AMC). Through this knowledge of the "ecosystem service footprint", a finer analysis of the ecosystem services loss typology allows for the proposition to our clients of innovative, bespoke socio-environmental solutions. These measures might include:

- Complementary and/or targeted measures for mitigation,
- Compensation measures.

Through the recognition of the value of biodiversity and ecosystem services, this approach helps authorities, project promoters and managers / owners of natural spaces, with information to support decision making, with the objective of maintaining biodiversity and associated ecological functions. It can result in value creation in terms of natural capital over a given area.

References:

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