Revisiting the EIS of a mining project using ecosystem services

Rosa[1], J. C. S.; Sánchez[2], L. E.

1. Introduction

A research enquiring at the challenges of incorporating an ecosystem services approach (ESA) to environmental impact assessment (EIA) and gauging its possible contribution is being conducted using a large mining project in Brazil as a case study.

Ecosystem services (ES) are goods and products that humans obtain from the ecosystems (Hassan *et al.*, 2005). This concept is now widely spread in both academia and industry after the Millennium Ecosystem Assessment adopted the ecosystem approach (Hassan *et al.*, 2005) and the Convention of Biological Diversity recommend its application in EIA (CDB, 2004). In addition, the 2012 update of the Environmental and Social Performance Standards adopted by the International Finance Corporation and the Equator Principles banks also recommend its adoption for environmental and social assessment purposes.

Companies and ES are intimately linked in two ways. Firstly, corporations need ES to improve the performance of their projects; secondly, most projects have negative impacts on ecosystems and their services. These impacts can affect other projects and the beneficiaries of the services (Hassan *et al*, 2005). Although the concept received much attention in recent years, especially in business risk strategy development and in projects performance assessment, an ESA concept has yet to find its way to fit into actual Environmental Impact Studies (EIS), despite the development of theoretical proposals on its application to EIA (Landsberg *et al.*, 2011; Rounsevell *et al.*, 2010; Slootweg *et al.*, 2010).

2. Methods

The research used a case study to test the ESA in comparison to the traditional approach to EIA. In this context, a traditional approach is meant to represent current practice in Brazil, as required by regulations. Document review, interviews and a rapid appraisal were used to collect data and information. The main source of information was the EIS (MMX Brandt, 2007) and supplementary information provided by the proponent for the government environmental approval process. The initial research steps were (Figure 1):

(A) compiling from the baseline featured in the EIS a summary description of the present environment conditions with an emphasis on identifying affected ecosystems and their services;

(B) compiling from the project description featured in the EIS a list of major project activities;

(C) identifying ES that could be affected by the project;

(D) adjusting the identification of ES to the results of a rapid appraisal;

(E) identifying, from the rapid appraisal, beneficiaries of ES;

(F) reviewing all impacts described in the EIS and searching for possible matching with ES.

[1] MSc student, University of São Paulo. jcsrosa@usp.br
[2] Professor, University of São Paulo. lsanchez@usp.br
Grant 2012/13770-6, São Paulo Research Foundation (FAPESP).

Information obtained from the EIS review was updated and checked against observations made during a site visit and interviews conducted in the neighbor communities (rapid appraisal).

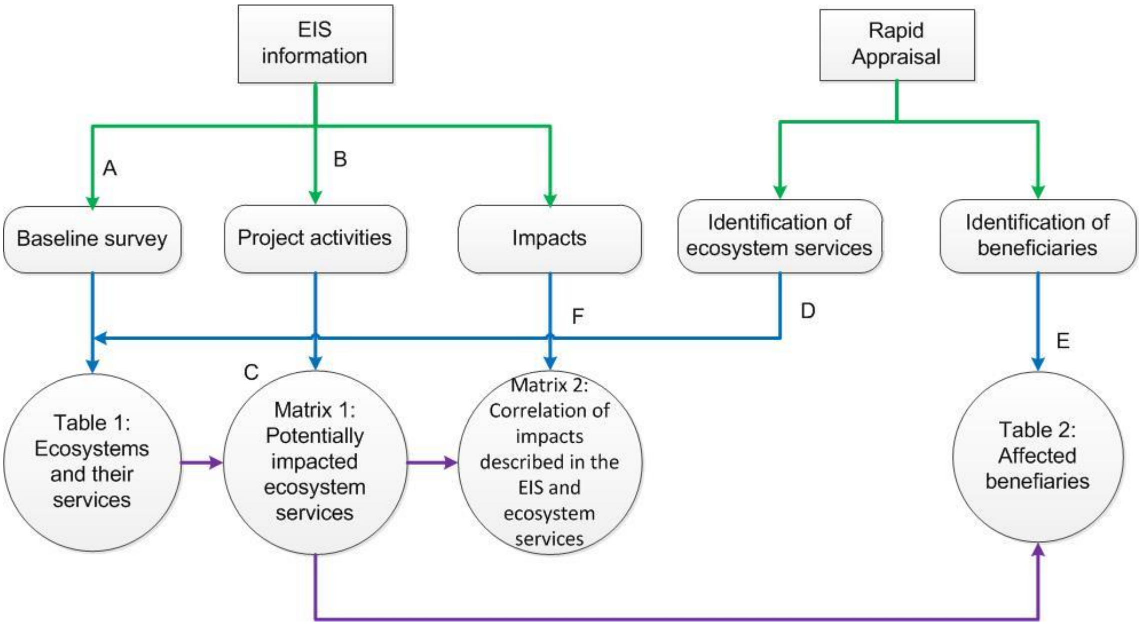

Figure 1: Summary of research steps

The ES classification followed in this research is adapted from Landsberg *et al.* (2011), an adaptation of the classification of the Millennium Ecosystem Assessment. This classification organizes the ES in four categories: provisioning services, regulating services, cultural services and supporting services.

3. A short project description and the affected region

The proposed mine is located in a rural zone of Minas Gerais State, 160 km North from the State capital, Belo Horizonte. The “Sapo-Ferrugem” mine is part of a bigger US$ 8.5 billion undertaking called “Minas-Rio” that includes the construction of a 525 km long ore pipeline and a harbor in Rio de Janeiro State. This research reviewed only the mine project, composed of an open pit, a tailings dam, a waste rock dump, ancillary installations, a beneficiation plant and a water pipeline. The scheduled mine output is 26.5Mt/y. The project needs 2,500 m^3/h of water for ore treatment and pipeline pumping. The project footprint is approximately 3,880 ha (MMX/Brandt, 2007).

The proposed mine is located in an area recognized by UNESCO as a Biosphere Reserve, due to its high biodiversity and cultural values. The economy is largely based on subsistence agriculture and a growing ecotourism activity. Although the natural vegetation was significantly disturbed since the 18th century, important remnants of forest and natural grassland subsist. This region is well known for the quantity and quality of the water available both in rivers and in aquifers. A number of endemic and threatened fauna and flora species are found (MMX/Brandt, 2007).

A recent social baseline surveyed 177 people living in land uptaken by the project, whereas about 1,300 currently live near the area and are indirectly affected (Diversus, 2011). Landowners are either farmers actually living in cities or small subsistence farmers, the former employing local peasants who actually live in the area. Apart from cattle growing, subsistence produce include vegetables, fruits, cheese and sugarcane spirit. Public services are precarious. Communities and farmers manage their own water supply from springs or creeks, supplying schools and other government buildings. Sewage is infiltrated in the ground or discharged directly in the creeks and rubbish is collected once a week, but part is burned. Rivers are also used for recreation purposes, tourism and fishing.

4. Results

To compare the ESA with the traditional approach, the impacts described in the EIS were arranged in a matrix to show the correspondence with the impacted ES (Table 1). This procedure showed that: (i) some impacts identified in the EIS cannot be described by the ESA; (ii) some impacts are equivalent under both approaches and (iii) the ESA allowed the identification of several effects not identified by the traditional approach.

The EIS identified 10 physical, 12 biotic and 20 social negative impacts. In this test, all these biotic and nine physical negative impacts were identified also by the ESA, but only nine negative social impacts described by the EIS could be identified through the ESA. All impacted ecosystem services identified by the ESA are related to social impacts, because the ESA is an attempt of conceptualizing the nature-society relationship (Slootweg *et al.*, 2010). Nevertheless, some impacts described by the EIS do not seem to be associated with any ecosystem service, such as noise disturbance. In addition, the ESA allows to identity effects not identified by the EIS, in particular physical changes that in turn cause effects on society. For example, the impact "water quality disturbance" described by EIS, refers to disturbance in physical and chemical properties only and ignores the effect on water users; conversely, the ESA focus is on these effects. Similarly, in the EIS impacts related with habitat loss and threatened species did not consider their use by local communities or potential scientific interest, which are services considered by the ESA.

In addition, the EIS identified two physical, three biotic and 12 social positive impacts. All these physical and biotic positive impacts were also identified by ESA, but no social positive impact described in the EIS was identified by the ESA. The physical and biotic positive impacts are consequences of land rehabilitation. The social positive impacts refer to socioeconomic aspects, specially tax collection and income improvement that seemingly the ESA cannot identify.

5. Discussion

It has been argued that a weakness of the ESA is the inherent complexity of the approach (Baker *et al.*, 2012). This test confirmed this weakness, as its application requires an accurate understanding of not only concepts such as ecological process, biodiversity and the concept of ecosystem service itself, but also of its classification. The literature provides different lists of ES (de Groot, 1992; Slootweg *et al.*, 2010; Landsberg *et al.*, 2011). Therefore, to apply the ESA it would be useful to standardize the classification by creating a list of ecosystem services with a description of each of them, although it sounds likely that such a list would be adapted according to legislation and characteristics of each country. Furthermore, it is necessary to define what information it is necessary to collect in baseline surveys to identify the ecosystems and their services. In the ESA it is more important to recognize the function traits of species in the ecosystem than a list of species (de Groot, 1992).

Table 1: Correlation of impacts described in the EIS and ecosystem services.

Examples of negative impacts as described in the EIS	Provisioning services														Regulating services											Cultural Services			Supporting services			
	Crops	Livestock	Capture fisheries	Aquaculture	Wild food	Timber and others wood products	Fibers and resins	Ornamental resources	Animal skin	Sand	Biomass fuel	Freshwater	Genetic resources	Biochemical	Regulation of air quality	Regulation of climate regional	Regulation of climate global	Regulation of water timing and flows	Erosion Control	Water purification and waste treatment	Regulation of pests	Regulation of soil quality	Regulation of diseases	Pollination	Regulation of natural hazards	Recreation and ecotourism	Ethical and spiritual values	Educational and inspirational values	Habitat	Nutrient Cycling	Primary production	Water cycling
Induction of erosive process*																																
Disturbance of water quality*																																
Disturbance of soil proprieties*																																
Reduction in surface water flows*																																
Habitat reduction and loss of fauna due to construction activities**																																
Reduction of plant metabolism due to dust fallout**																																
Habitat fragmentation and loss of connectivity**																																
Impacts on tourism potential***																																
Loss of agricultural production due to the land occupation***																																
Loss of employment in primary sector***																																

Legend: *Physical impacts. ** Biotic impacts. ***Social impacts. Blue – Impacts identified by the ESA but not considered in the EIS. Green – Impacts equivalent to ecosystem services.

The main differences between the ESA and the traditional approach found in this study are:

(i) The ESA helped to identify impacted areas starting from the perspective of affected communities, making it easier to adopt multiples scales of analysis (Landsberg *et al.*, 2011). Conversely, the traditional approach identified directly affected areas according to the project's boundaries.

(ii) The ESA allowed for the identification of negative effects that are not identify by the traditional approach, especially community consequences of physical changes.

(iii) The ESA focus in the project's negative effects (direct or indirect) on ecosystems and the consequences of these effects on human well-being (Slootweg *et al.*, 2010) and on project performance (Landsberg *et al.*, 2011). On other hand, the current Brazilian approach to EIA focus on potential losses or harm to environmental and cultural resources, often considered separately. Hence, baseline tends to be extensive and impact analysis focus on establishing cause-effects relationship (Landim and Sánchez, 2012).

(iv) The ESA promotes a more coherent and integrated impact analysis (Honrado *et al.*, 2013) because the baseline survey is done focusing on ecosystems.

Thus, the ESA could be a complement of the traditional approach, especially improving the analysis of biophysical effects on society and the identification of the affected population. On other hand, more research is required to describe each ecosystem service and it would be necessary to find easier ways to identify them if the approach is to be used by practitioners.

6- References

BAKER, J. *et al.* Ecosystem services in environmental assessment – Help or hindrance? *Environmental Impact Assessment Review*, 40: 3-13 2012.

Convention on Biological Diversity. *The Ecosystem Approach (CDB Guidelines)*. Montreal: Secretariat of the Convention on Biological Diversity, 2004, 50 p.

de GROOT, R.S. *Functions of Nature: Evaluation of* nature in environmental planning, management and decision-making. Groningen: Wolters-Noordhoff, 1992, 315 p.

DIVERSUS. *Socioeconomic survey of the directly and indirectly affected area of Anglo Ferrous Minas-Rio Mineração S.A.*, 2011. [internal report, in Portuguese]

HASSAN, R.M.; SCHOLES, R.; ASH, N. (eds.). *Ecosystems and Human Well-Being: current state and trends.* Washington: Island Press, 2005, 917 p.

HONRADO, J. P. *et al.* Can we infer about ecosystem services from EIA and SEA practice? A framework for analysis and examples from Portugal. *Environmental Impact Assessment Review*, 40: 14-24, 2013.

LANDSBERG, F. S. *et al. Ecosystem Services Review for Impact Assessment: Introduction and Guide to Scoping*. World Resources Institute, Washington DC, 2011.

LANDIM, N.T.; SÁNCHEZ, L.E. The contents and scope of environmental impact statements: how do they evolve over time? *Impact Assessment and Project Appraisal*, 30(4): 217-228, 2012.

MMX; BRANDT MEIO AMBIENTE. *Environmental Impact Statement.* Projeto Minas-Rio, MMX, 2007. 1150 p. [in Portuguese]

ROUNSEVELL, M. D. A. *et al.* A conceptual framework to assess the effects of environmental change on ecosystem services**.** *Biodiversity Conservation*, 19: 2823 – 2842, 2010.

SLOOTWEG, R. et al. *Biodiversity in Environmental Assessment: Enhancing Ecosystem Services for Human Well-Being.* New York: Cambridge University Press, 2010, 456 p..