Forest Ecosystem Services Valuation in Different Management Scenarios: a Case Study of the Maramures Mountains

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Abstract

The paper aims to explore whether long run benefits can be obtained through the sustainable management of forest ecosystems within protected areas when compared to immediate benefits of doing business as usual. Total economic value of forest ecosystems services is estimated using commonly used valuation techniques under the innovative umbrella of the Sector Scenario Assessment methodology, introducing sectorial focus, alternative management scenarios and time dimension to the evaluation process. The methodology is based on comparing two management scenarios, Business As Usual (*BAU*) and Sustainable Ecosystem Management (*SEM*). They were designed by consulting with stakeholders involved in protected areas management, research and regulating or are main beneficiaries of ecosystem services. The economic indicators determined by using the models defined by those scenarios for the next 30 years, results of a complex data collection process and application of appropriate valuation techniques, show that, after 30 years, forestry activities under *SEM* exceed the values of the *BAU* scenario in terms of added value to the economy. For the forestry activities in the Maramures Mountains Natural Park, the estimated present value of provisioning ecosystem services is EUR 32.4 million for the *BAU* scenario, and EUR 32.0 million for the *SEM* scenario. By focusing not only on forestry related but also on other sectors related ecosystem services, the paper may open doors for considering more complex incentive/financing mechanisms that helps secure biodiversity and ecosystem services more broadly.

Key words: forestry, ecosystem service, valuation, protected area

Introduction

Background

The four categories of ecosystem services (*ES*) recognized by the Millennium Assessment (MA 2005) are: 1) provisioning services such as timber, food, non-timber forest products (*NTFPs*); 2) regulating services that affect climate, floods, waste and water quality; 3) cultural services that provide recreational, aesthetic and spiritual benefits, and 4) supporting services such as soil formation and retention, primary production and habitat provision. The human well-being is inextricably linked to the provision of a wide range of ecosystem services (Yapp et al. 2010) and the development of society is increasingly affecting the capacity of the ecosystems to meet societal demands for goods and services (MA 2005). This has led to the need for assessment and valuation of ecosystem services. Numerous attempts have been made in developing a framework for *ES* valuation (de Groot et al. 2002, Howarth and Farber 2002, Turner et al. 2003, Wallace 2007, Fisher and Turner 2008, Fischer et al. 2009, Tschirhart 2009, Bateman et al. 2011, Christie et al. 2012, Tuan Vo et al. 2012). A number of methods have been developed for exploring the economic value of *ES* (TEEB 2010) and new approaches are expected to be developed (Parks and Gowdy 2013). Total Economic Value (*TEV*), defined as the sum of all types of use and non-use values for *ES*, has become the most commonly used framework for identifying and categorizing *ES* values (Emerton 2009) taking into account the values that have traditionally been omitted from economic and financial decision-making. There are numerous techniques that have been developed to estimate economic values of non-market goods/services (e.g. travel cost, contingent valuation method etc.). The methodology used in this study, Sector Scenario Assessment (*SSA*), is based on the *TEV* approach but has some key characteristics that make it useful for decision makers. By having a comparison of two alternative management scenarios rather than an isolated estimate of benefits for just one scenario, the decision maker is faced with the relative merits of two courses of action over time (Alpizar and Bovarnick 2013). The results of *SSA* track the evolution of certain indicators over the scenario time horizon, while the decision makers care about the relative merits of the analyzed scenarios over time. Another important added value of the *SSA* approach is the fact that it focuses on specific sectoral changes resulting from concrete policy interventions in which a specific decision maker is interested rather than the value of an ecosystem in its entirety, often irrelevant for a decision maker in a certain sector (Alpizar and Bovarnick 2013). These particularities are in line with the needs for better informing the decision makers in relevant economic sectors about the economic gain of investing in sustainable management of Protected Areas (*PA*) (Ruckelshaus et al. 2015).

Ecosystem valuation related studies have been undertaken in Romania in recent years starting from the beginning of post-communist reform (Poynton et al. 2000) to the present day preoccupations regarding *PA*s value estimations (Dumitras and Dragoi 2006, Ceroni 2007, Ceroni and Dragoi 2008, Dumitras 2008, Dumitras et al. 2011) showing an increasing interest in this matter.

Aim of the study

Carpathian *PA*s face pressures that include overexploitation of forest resources (Knorn et al. 2012) as well as the underfunded *PA*s management (Birda 2011). These pressures need to be addressed by promoting sustainable management of resources in different economic sectors. For this, public/private decision makers need better and scientifically based information regarding the potential value of services provided by sustainable managed ecosystems in *PAs* and *ES* contribution to growth and productivity in economic sectors in the long run (Bann and Popa 2012). This information can enable them to make decisions that are favourable to sustainable management of *PA*s and the continuous flow of *ES*. This was the purpose of a study conducted in 5 pilot *PAs* in the Romanian Carpathians (Maramures Mountains Natural Park, Vanatori Neamt Natural Park, Piatra Craiului National Park, Apuseni Natural Park and Retezat National Park), aiming to evaluate the ecosystem service and reveal whether the ecosystem services provided in the sustainable ecosystem management scenario have values that are attractive for performing economic activities in key sectors such as forestry. The working hypothesis was that long run economic growth can be obtained through the sustainable management of ecosystems when compared with immediate benefits of doing business as usual that may trigger ecosystem degradation over time and decrease the contribution of *ES* in different productive sectors.

This paper presents a part of the results of this study, particularly those referring to one of the pilot *PA*s – Maramures Mountains Natural Park (*MNP*). Although other forest ecosystem services were also assessed (through their contribution to sectors such as ecotourism, water supply and climate change), the main focus of the paper is on the assessment of primary wood production and the value of *NTFP*s associated with the active management of forests in *MNP*.

Briefly about the Romanian Carpathians PAs and Forestry

The high conservation value of the Carpathian *PA*s in Romania derives from the fact that it houses the largest European population of *brown bear, grey wolf* and *lynx* (Ioras et al. 2009), contains highly valuable forest and grassland habitats including a significant surface of old-growth, primary forests (Knorn et al. 2012) including the last intact natural forest landscape in Europe. In the last 20 years, the protected area surface in Romania increased significantly due to the establishment of an important number of natural and national parks (Knorn et al. 2012) that are managed with the aim of meeting social and environmental needs of the society, in the context of sustainable natural resources (including timber) use. Presently, 23% of the territory and more than 10% of the forested areas are under some form of protection, including 13 national parks and 14 natural parks (Ioja et al. 2010). However, this network of *PA*s is considered to be insufficient in terms of effectiveness in preventing irreversible loss of biodiversity due to pressures faced by the recently established park administration (e.g. overexploitation of forest resources and habitat degradation caused mainly by an infrastructure that is not properly planned and implemented) (UNDP 2009). Furthermore, a substantial gap has been identified and recorded between the basic needs of the *PA*s and their present-day level of funding (Birda 2011).

The *PA*s management plans (*MP*s) are, theoretically, the basis of the *PA*s management, but in practice the enforcement of those plans is not sufficiently effective due to a number of factors: not all the *MP*s are officially approved by the central authority; private forest owners are not compensated for harvesting restrictions and as a consequence forests continue to be harvested for wood, which may be having a number of negative effects on the provision of important *ES*; the absence of a comprehensive biodiversity inventory is a barrier against the internal zoning of *PA*s and the extension of protected forests (Bann and Popa 2012). The process of forest restitution that started in 1991 and which has been now almost finalized, triggered important institutional and legal changes (Stancioiu et al. 2010) as well as triggering illegal logging and unsustainable forest harvesting in some areas (Strambu et al. 2005). A more or less stable system is now in place with almost all the *PA*s forest being administered by the National Forest Administration (*NFA*) Romsilva or by private forest districts (Abrudan 2012). These forest districts (private or *NFA*) manage the forests through implementing Forest Management Plans (*FMP*s), which are reviewed every 10 years, and are theoretically based on sustainable principles such as biological diversity conservation (Stancioiu et al. 2010). The *FMP*s divide forests into categories: *T1* - no cuttings allowed except in very special circumstances; *T2* - conservation cuttings allowed, no production purpose; *T3* - cuttings allowed with low intensity, multiage stands; *T4* - regeneration cuttings allowed, regeneration under forest - one age stands; *T5* - clear-cuttings followed by artificial or vegetative regeneration. In *T1* and *T2* categories there are important restrictions regarding timber harvesting activities. The Government has prepared a legal framework for compensating *T1* and *T2* private forest owners (MO 2006), but payments were made for a relatively short period (2008-2010) and then were interrupted, mainly due to the lack of budgetary allocation.

Timber harvesting is the most important activity within the forestry sector with potential impact on biodiversity and the *ES* provided by *PA*s, such as carbon sequestration, air quality, water and soil erosion regulation, nutrient retention, landscape, and the production of *NTFP*s (Bann and Popa 2012). Therefore, sustainable forest management is crucial for the effective provision of *PA*s ecosystem services. Official statistics regarding illegal logging indicate quite low quantities (WB 2011). However, the illegal clear cuttings in some areas of the Carpathians created problems in the past and it remains as a potential threat (Strambu et al. 2005). Besides the timber, although not among the specific reasons for *PA*s establishment, the use of *NTFP*s can have a real sustainable contribution to the local economy, but the main problem is that the full potential of this sector is not used due to the manner the activity is managed (Ceroni 2007), not even in the areas, in which harvesting and processing of *NTFP*s is economically viable.

Materials and Methods

Sector Scenario Assessment

The detailed description of the *SSA* methodology has only recently been made available to practicing specialists (Alpizar and Bovarnick 2013), although it has been used in different studies (Bovarnick et al. 2010, Bann and Popa 2012). The method introduces the analysis at sector level, but begins with an understanding and quantification of *ES*. The core part of the *SSA* approach is the comparison of two scenarios: Business as Usual (*BAU*) and Sustainable Ecosystem Management (*SEM*). The *SSA* approach has been developed to explore situations where the *BAU* is not sustainable management. In contrast to the *BAU*, the *SEM* intervention will always involve a change in the status quo, with actions taken to reduce or reverse the negative effects of *BAU* on the relevant ecosystems (Alpizar and Bovarnick 2013). The scenarios are compared in order to illustrate how *ES* could contribute to economic growth of different productive economic sectors. The SSA methodology does not eliminate the ecosystem from the central position in the valuation attempt. It only differs from other approaches by taking sector specific approach to valuation, to reflect the perspective and remit of policy makers and companies from specific sectors. In the evaluation, the SSA approaches the ecosystem services from a stakeholder point of view instead of determining the general value of a particular ecosystem service. In this way the SSA methodology is capturing and presenting ecosystem services values for decision makers in certain sectors to help them make the business case for sustainable policy and funding choices. Therefore, the SSA approach is closer to increasing the likelihood that the data resulting from valuation will be used to make policy and management decisions that result in effective and sustainable management of ecosystems (Alpizar and Bovarnick 2013). The estimation of value in the SSA approach must therefore be linked to specific stakeholders who, in principle, can put the wheels in motion to avoid the costs or enjoy the benefits by encouraging the move from BAU to SEM. This particularity of the SSA approach reflects on the choice of stakeholders involved in the process of comparative BAU and SEM scenarios description. They will be, on one side, government officials or business managers, who generally come from targeted specific productive sectors (Alpizar and Bovarnick 2013) and, on the other side, experts that can define the healthy status of the ecosystems that are the object of evaluation.

The analysis can show the impact of certain policy options or management practices on specific ecosystem services or resources, to help decision makers understand the circumstances, in which maintaining ecosystems and their services may generate greater value than promoting economic processes that degrade and deplete ecosystems. At the same time, the methodology recognizes that for policy/decision makers, static (time bound) point data is of limited value: in a situation, where choices must be made between different types of management and development practices, data on how much an ecosystem is valued – specifically at a certain moment in time under the current management system – tells the manager nothing about how that value might change over time as a result of doing nothing or as a result of implementing an intervention (Alpizar and Bovarnick 2013). It is, therefore, important to evaluate how *ES* might be reduced through damaging management practices or enhanced through sustainable management over an appropriate time horizon (Bovarnick et al. 2010).

Data availability and reliability are still among the limitations of the approach because the *SSA* is using recognized valuation techniques that have limitations. Another important to mention limitation of the methodology is the validity of the assumptions made to describe the two scenarios. For the declared purpose of the SSA approach, the scenario description must be undertaken in a participative way, involving especially participants that would be able to keep close contact with the perspective of the stakeholders from the targeted sectors. This approach might not be able to capture the whole range of effects of the ecosystem services (that would require consulting a wide range of stakeholders including, for example, local communities) and, therefore, induce certain limitations in the assumptions made for scenario description but it serves the purpose of the SSA approach in a simpler and more accessible manner.

Study area

Maramures Mountains Natural Park was chosen as a pilot *PA* considering its range and complexity (one of the largest and most complex *PA* in the Carpathians). Established in 2005, *MNP* has a total area of 133,354 ha and is located in North Romania (Figure 1).

The objectives of park designation vary from biodiversity values: different layers of vegetation starting with mixed beech and oak forests through all the layers up to mountain meadows, a wide variety of fauna and flora species including seven invertebrate taxa identified for the first time in Romania within the *MNP* area (*Rhaphium ensicome, Rhaphium rivale, Argyra spoliata, Diaphorus halteralis, Hilara albitarsis, Empis nuntia, Empis planetica)* and also the well-known large carnivores: *grey wolf* (*Canis lupus*), *lynx (Lynx lynx*), *brown bear* (*Ursus arctos*) (MNP 2008) – to the very specific rural landscape with special local traditions related to wood processing, architecture, food etc. (MNP 2008). Woodcraft, showcased in the architecture of local houses, is a special feature of the area. All these features of *MNP* are important touristic attractions. The importance of forestry in *MNP* emanates both from tradition (MNP 2008) and from the dramatic changes that accompanied the restitution process of forest areas in the region (Abrudan 2012). The state owns 42% of the *MNP* area and 65% of the forest land within the park, the rest of the forest land being owned by communities, local municipalities and private persons. *MNP* has a total forest area of 86,374 ha with a total standing volume of 26,550 million m^3, consisting mainly of *fir, spruce, beech* and *oak*. Some 12,089 ha of forest, of which 77% is state owned, are included in the special protection zone meaning that there are no interventions permitted in this area. The annual cut for the forest lands outside the special protection zone, is 185,000 cubic meters.

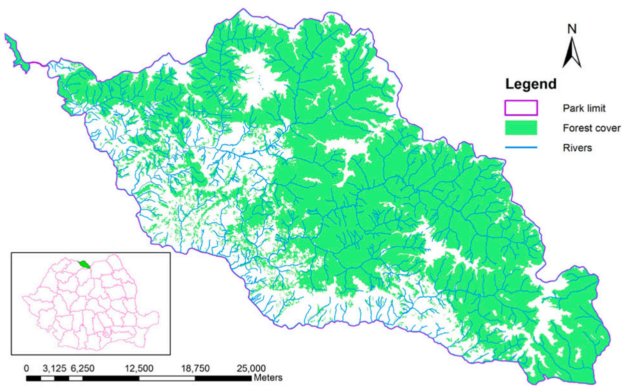

Figure 1. Maramures Mountains Natural Park: its location at country level and forest areas (MNP 2008)

Methodology for assessing the value of forest ecosystem services

The application of the *SSA* methodology has entailed 4 steps as outlined below.

Step 1: Definition of the scope of the assessment. In June 2012, managers of 21 national and natural parks and 4 members of the protected areas coordinating team in the *NFA* were asked, based on their qualified expertise, to identify and assess the presence and significance of the *ES* provided by the forest ecosystems within the respective protected areas, by completing a qualitative questionnaire. The respondents were asked to rank the *ES* based on the following criteria: i) importance of *ES* for local livelihoods; ii) development and investment opportunities for the future; iii) importance for maintaining the traditional use of land, *and* iv) the risk of *ES* flow diminishing due to exploitation pressures. Based on the results of the qualitative assessment, the team established what aspects of *ES* groups will be taken into consideration: wood and *NTFP*s to represent the provisioning services, water for public use and carbon sequestration to represent the regulating services and recreation to represent the cultural services. For these *ES*, the project team assessed the data availability and based on this, selected the appropriate evaluation techniques, variables over time and possible indicators that can be determined using the selected techniques, grouped per economic sector (Table 1).

All chosen evaluation techniques are well documented in the environmental economics literature (Maler 1974, Ward and Beal 2000, Bateman et al. 2002, Bockstael and McConnell 2006, TEEB 2010).

Step 2: Desk-top research. Data collection was critical and carried out mainly through desk work, being based on statistical records of different institutions (National Institute for Research and Development for Tourism – *INCDT*, National Agency for Romanian Waters), 2008 edition of the management plan of *MNP* (MNP 2008), records that are routinely kept by park management and forest districts, studies performed during *MNP* management plan elaboration, statistical and operational reports of Forest Districts in the area, Forest Management Plans (*FMP*s), all these being supplemented by a review of the available literature on the economic value of *MNP* or other *PA*s in Romania or in the countries in the region (Forster et al. 1987, Birda 2011, Ceroni 2007, Dumitras and Dragoi 2006, Ceroni and Dragoi 2008 , Dumitras 2008, INCDT 2009, Getzner 2009, Dumitras et al. 2011) (Table 2).

Step 3: Definition of the *BAU* and *SEM* scenarios. A scenario description was organised through a workshop in September 2012 under the guidance of the authors and the international and national experts involved in the *GEF-UNDP* project "Improving the Financial Sustainability of the Carpathian System of Protected Areas" and using the Delphi method (Linstone and Turoff 2002) adapted to the available resources and the topic. The participants included representatives of stakeholders from main targeted sectors (PAs management, forest administration and PAs

Table 1. Ecosystem Services identification and indicators selection

Ecosystem service	Valuation technique	Sector focus	Indicators to be determined
Wood and NTFPs	Market pricing	Forestry	Production (volume and value), Distribution of benefits, Fiscal impacts
Water for public use	Market pricing	Water supply	Value for urban water, Distribution of benefits, Fiscal impacts, Income trends
Carbon sequestration	Market pricing	Wellbeing	Value of carbon sink, Distribution of benefits, Income trends
Recreation	Contingent valuation, Market pricing	Tourism	Expenditures, Consumer surplus, Distribution of benefits, Fiscal impacts, Income trends

Table 2. Data nature and sources

Ecosystem service	Data used	Data sources
Wood and NTFPs	GIS database of forests within the MNP including detailed description of the stands (species composition, age, volume, annual increments, planned cuttings etc.)	FMPs of the forest districts managing forests within MNP.
	Quantities of harvested timber by species and cuttings interventions in 2009, 2010, 2011. Average prices for standing wood by species and cuttings interventions in 2009, 2010, 2011	Official statistical reports of the Maramures branch of NFA
	Quantities of NTFPs harvested during 2009, 2010 and 2011 and selling prices for NTFPs. The NTFPs considered were: berries, mushrooms, Christmas trees, and medicinal plants	
	Potential for NTFPs in MNP	Literature review (Ceroni 2007)
	Illegal logging quantities in forests within MNP	Territorial Inspectorate for Forest Regime and Hunting (ITRSV) Cluj Napoca
Water for public use	Average water consumption /capita/year in Somes Tisa water basin	Romanian Waters Agency (ROWATERS 2010)
	Estimated number of urban water consumers from the basins in MNP, Water tariffs payments to local water operator per m^3 of water	
	Effect of the level of erosions in water treatment cost	Literature review (Forster et al. 1987).
Carbon sequestration	Estimated CO_2 sink, based on standing wood volumes and increments, CO_2e market prices.	FMPs of the forest districts managing forests within MNP. Literature review (Ecosystem Marketplace 2011).
Recreation	Visitor numbers	Literature review (INCDT 2009)
	Visitor expenditure, consumer surplus	Literature review (Ceroni 2007, Dumitras and Dragoi 2006, Dumitras 2008, Dumitras et al. 2011, Getzner 2009)
	Consumer surplus	

visiting sector): 2 *PA*s managers, 2 environmental experts from *NFA*, 4 forest managers, 3 non-state forest owners' representatives, 2 members of the central authority for forestry and the environment, 4 biologists and forest habitats specialists. After the organisers presented drafts of the *SEM* and *BAU* scenarios, and the principles behind the *SSA* methodology, the participants were divided into two groups containing at least one member from each category and every group was asked to reach consensus on the description of both the *BAU* and *SEM* scenarios. In addition to the narrative description and explanatory comments, every group provided the estimated evolution of relevant variables that are supposed to change over the next 30 years depending on the management scenarios. The variables were in part suggested by the draft scenarios presented by the organisers, but also proposed by the workshop participants: forestland zoning, level of compensatory payments, legal and illegal logging, evolution of *NTFP*s production and potential, number of visitors, entry fee level and soil erosion level (Table 3). Each group presented to all participants the summary of the group forecasts as well as the reasons for their judgments. Then, the groups were asked to revise their earlier forecast in the light of the other group results. After three rounds of presentations and revisions, the consensus between groups led to a final description of the *BAU* and *SEM* scenarios. The adopted participatory process for scenario description was designed to reflect those management interventions that are relevant for triggering actions from specific decision makers in *PA*s financing and forest administration in order to address the stated limitations regarding the reliability and the validity of the *SSA* approach in terms of scenario-description. The variables used for the description of the scenario were deliberately chosen in a way that allows one to easily assess their future evolution in the *BAU* scenario using the trends of the last decade of forest administration and *PAs* management evolution and to easily assess their necessary improvement in an envisaged *SEM* scenario. The chosen variables also influenced the participants categories: they were mainly involved in forest management and *PAs* management (including *PAs* visiting activities) as long as the variables refers mainly to forest management and visiting, but having evolutions that impact on multiple sectors.

Step 4: The analysis. The economic value of *ES* has been calculated using the selected valuation techniques (Table 1) and the collected data (Table 2) for the next 30 years by applying the quantitative projections determined by the participants in the workshop for the scenarios description. The theory behind the economic value is the *TEV* approach (TEEB 2010).

For 2011, the economic value of wood has been computed using the production and prices for standing wood by species and nature of cuttings. Due to limited accessibility, only a share of the annual allowable cut is harvested in *MNP*, every year. Therefore, the *BAU* scenario did not consider that the allowable cut is exceeded in the years to come. Instead, for the next years, in the *BAU* scenario, the harvested volumes were calculated considering that the 2011 harvested share of annual increment will be harvested annually, in each subsequent year. Based on a stand species composition, age and productivity class, the evolution of standing volumes and increments were estimated using standard volume calculation equations (Leahu 1994). Prices of standing wood were calculated based on real prices by species and nature of cuttings for the years 2009, 2010 and 2011. Calculations were made for each stand and summarized for every year. In the *SEM* scenario, certain areas are gradually included in the *T1* and *T2* categories thus the volumes envisaged to be harvested decrease over time; besides that, the computation followed the same pattern.

The description of *BAU* and *SEM* scenarios gave the evolution of *NTFP*s production in the following years. The prices were calculated in a similar fashion as for the wood.

Illegal logging volumes were assessed using official data reported by the Territorial Inspectorate for Forest Regime and Hunting – Cluj Napoca and the models established during the description of scenarios. The economic value for illegal logging was calculated using the average price for standing wood for the main species (beech). Compensatory payments to private owners were calculated based on the formula approved by the Government for this purpose (MO 2006), based on area, national average price for wood reported by the central forest authority, average increment of the main species at harvesting age and a correction factor depending on the main species in the composition. The increasing evolution of the *T1* and *T2* areas will result in an increase in the compensatory payments in the *SEM* scenario, assuming that the necessary payment mechanisms and funds will be available in the future. Protected private forest areas compensatory payments, as well as the contribution (up to 3% of the value of the wood sold) of the forest administrators to the National Environmental Fund (*NEF*) are elements included in the economic value of forestry provisioning ecosystem services that influence the distribution of the total value between the two main beneficiary categories: public bodies or agencies and the private sector.

The CO_2 accumulated stock has been calculated for each species and yield site. Standing volumes were estimated using standard volume calculation equations (Leahu 1994). The used Biomass Extension Factor was 1.2, this value being the minimum value proposed by the Intergovernmental Panel on Climate Change (*IPCC*) Guide (IGES, 2006). The average wood density values used and the corresponding coefficients for carbon concentration within wood biomass are based on *IPCC* guidelines. The economic value of the sequestered carbon was calculated based on the reported average price for CO_2e, estimated by the New Energy Finance and Ecosystem Marketplace (Ecosystem Marketplace 2011) for Clean Development Mechanism under the Kyoto protocol, is active in Romania since 1999.

An analysis of the distribution of economic value among beneficiaries was also conducted in order to understand who the winner is and who the loser is under the different scenarios.

For soil erosion regulation services, watershed identification and mapping was based on a digital elevation model, while soil erosion was quantified using the universal soil loss equation (Terente 2008). Vegetation land cover was the variable influencing the eroded soil quantity. The economic value was calculated based on the cost reduction for local water operators due to decreasing soil erosion leading to decreased water turbidity and, as a consequence reduced treatment costs (Forster et al. 1987).

For the tourism sector, data recorded in the *MNP* management plan or found in the studies undertaken for the *MNP* (visitor numbers, average number of tourists camping, visitor expenditure) were combined with data collected in regions more or less similar to the *MNP* area (consumer surplus). Visitor expenditures include accommodation and meals (Dumitras 2008). Consumer surplus – the difference between what consumers are willing to pay during their park visit and the real costs of the visit – was derived from Dumitras (2008) and Dumitras et al. (2011). All values from previous years were adjusted to 2011 price levels, applying a consumer price index (*CPI)* deflator.

There are no purely economic guidelines for choosing a discount rate, the responsibility to future generations being difficult to include in a discount rate (TEEB 2009). Studies have shown that the choice of discount rate can influence the outcomes very strongly and that the discussion on the appropriate discount rate is still not resolved (TEEB 2009). Therefore the authors of the study decided to carry out a sensitivity analysis by using several alternative discount rates for the Present Value (*PV*) calculation within the range 0% to 10%.

Results

Ranking ES

The results of the qualitative questionnaire applied in Step 1 showed that the most significant *ES* provided by forest ecosystems are provisioning services (wood, *NTFP*s, clean water for public use), regulating services (carbon sequestration, water regulation, soil erosion) and cultural services (recreation and ecotourism) (Table 3). These *ES* were considered significant by all the respondents and, in consequence, were focused by the data availability assessment.

Description of BAU and SEM

Table 4 presents the evolution of the variables under the *BAU* and *SEM* scenarios as envisaged by the consultations undertaken. Under *BAU* the protected forest areas (*T1* and *T2*) will remain at the same level, without any compensation in place for forest land owners. Thus, the benefits will continue to be intensively supported by timber harvesting. The continuation of extended forest harvesting does not encourage forest administrators

Table 3. Outcomes of the ES ranking for *MNP*

ES Type	Service	Benefit / outcome	Significance	Sector supported by ES
Provisioning services	Food	Commercial and subsistence crops; breeding products	*	Households Fishery, Tourism, Agriculture
	Wood	Timber, traditional wood products, commercial processed wood products	**	Households, Forestry, Wood processing industry
	Water	Public water supply, water for industrial and agricultural usage	**	Industry, households, tourism
	NTFPs	Natural medicines, forest fruits, forest fruits based products	**	Forest administrators, households, industry
	Source of energy	Energy provision, e.g. hydropower	_	Energy
Regulating services	Regulation of GHGs	Carbon sequestration	**	Potentially all ones.
	Micro-climate stabilization	Air quality	*	Potentially all ones.
	Water regulation (storage and retention)	Flood and landslide prevention	**	Tourism, Industry, Households/ Urban Settlement, agriculture
	Soil erosion regulation	Improved water quality	**	Households, Urban settlements
	Nutrient retention	Improved water quality	*	Fisheries, Agriculture, water supply

	Spiritual, religious & cultural heritage	Local traditions, Churches and monasteries, Archaeological ruins (historical not recreational value). Use of environment in art, folklore, national symbols, architecture	**	Tourism, Households
	Educational	A 'natural field laboratory' for understanding biological processes	?	Households
	Recreation and ecotourism	Recreational fishing and hunting, birdwatching, hiking, Holiday destination (aesthetic views), archaeological ruins (historical not recreational value)	**	Tourism
	Landscape and amenity	Property price premiums due to views	?	Tourism
	Biodiversity non-use	Enhanced wellbeing associated, for example, with bequest or altruistic motivations	?	Potentially all ones.

Code: ** service important, * service provided, - service not relevant, ? uncertain of provision.

to improve *NTFP*s usage, while, due to possible degradation of ecosystems, the potential of *NTFP*s decreases. Within the present limited levels of protected forest areas (*T1* and *T2*), the potential threat to biodiversity (which is not yet properly assessed due to ongoing lack of funding for proper identification and monitoring of flora and fauna) will lead to continuous degradation of potentially valuable ecosystems, hindering the development of recreation, tourism and educational activities. At the same time, negative impacts on water nutrient and soil, landscape and air quality will continue (Bann and Popa 2012). The *SEM* scenario would mean a reduced focus on wood production: the studies on biodiversity will be likely to justify the process of gradually extending the *T1* and *T2* areas; private owners compensated for forest harvesting restrictions; improved management of *NTFP*s. Timber harvesting reduction will encourage increasing the use of *NTFP*s (guided by studies on sustainable use). Enforced *PA*s *MP*s, together with a better enforcement of forestry specific regulations, will lead to a reduction in illegal logging and increasing interest in recreation activities.

Tourism

For the tourism sector, based on the number of visitors multiplied by the percentage of tourists with longer stays (visitors that stay more than one day or visitors that are camping with tenths that usually do not spend on accommodation and meals) multiplied by the total expenditure per visit, direct spending on hotels and meals was estimated to be EUR 1.3 million in 2011. The results of a study undertaken in 2005 (Dumitras et al. 2011) to estimate the economic value of recreation in 5 *PA*s in Roma-

Table 4. The *BAU* and *SEM* scenarios: summary

Variables	BAU	SEM
Wood harvesting and Carbon sequestration)		
T1 and *T2* areas	No compensations, constant areas	Compensatory payments in place. Increase in *T1* and *T2* areas (2.2% per annum from 2017 to 2026, 2 % per annum from 2027 to 2031).
T3, *T4* and *T5* areas	Logging at 2011 average level (*i.e.* % of annual increment)	Legal logging at 2011 average (*i.e.* percent of annual increment) decreasing in line with the increase of *T1* and *T2* areas.
All areas	Illegal logging increasing 2% /year from 2017 to 2040	Illegal logging decreasing 2% per annum from 2017 to 2021 and 5% per annum from 2022 to 2036.
*NTFP*s		
NTFP potential	Declining over time (2% per annum from 2017-2021 and 5% per annum from 2022 to 2040).	Increase in harvest levels over time up to maximum estimated potential (Ceroni 2007).
Tourism		
Recorded number of visitors to *PA*	Years 1- 5 a 1% increase; Years 5-10 - 0.8% increase; Years 10-15: 0.7% increase, stagnant thereafter.	Increasing: year 1-5: 1%, year 5-10: 2%, year 10-15: 2%, stagnant thereafter.
PA entry fees	No change - no entry fee value	Introducing entry fee in 2015 at 1 EUR/visit. Revenues increase up to a point where 50% of the visitors are paying.
Soil erosion level	No change	Decreasing due to improved vegetation land cover

Note: (*T1* - no cuttings allowed; *T2* - conservation cuttings allowed, no production purpose; *T3* - cuttings allowed with low intensity; *T4* - regeneration cuttings allowed, regeneration under forest; *T5* - clear-cuttings followed by artificial or vegetative regeneration) nia, showed that the average consumer surplus per visitor was EUR 42, and consequently, the total consumer surplus equalled EUR 0.7 million in 2011 prices. The *PV* (at the higher discount rate used for sensitivity analysis – 10%, Table 5) of the recreational ecosystem services (including consumer surplus) is estimated at EUR 22.5 million in the *SEM* scenario and EUR 14.2 million in the *BAU* scenario, indicating a significant difference in favour of *SEM* even at a high discount rate. The continuation of *BAU* in *MNP* results in an increase in tourism values over the short term, followed by a progressive decline related to the degradation and loss of biodiversity and ecosystem services over time and the consequent decrease in visitors numbers. The *SEM* results in a progressive increase in tourism values, as both the quality of biodiversity and ecosystems and the tourism services offered improve. The increased number of visitors is the main determinant for the increase in *PA*s revenues. Although an increase in the value of tourism is sustained over the 30 years, the rate of growth slows as the ecosystem and biodiversity status is restored and as the *PA*s carrying capacity is reached. Figure 2 illustrates the different trajectory for the tourism value under *BAU* and *SEM*.

The results can be considered as conservative as long as the daily expenditures per visitor extend to EUR 27.1 in *MNP* (Ceroni 2007). For example in Slovensky Raj National Park, the total visitor expenditure averages EUR 54 per person day (Getzner 2009), in an almost similar economic context, considering the benefit transfer approach (Richardson et al. 2015).

Water supply

The value of water supply was estimated at EUR 0.8 million in 2011. It was assumed that these charges include fees paid to *ANAR* (National Agency of Romanian Waters) plus the treatment and distribution costs and a gross profit margin of 10%. Soil erosion regulating services are estimated at EUR 3200 in 2011.

Carbon sequestration

For the 2010-2011 period, 266,881 tons of additional CO_2 were sequestered, with a total value of EUR 0.9 million. Under the *BAU* scenario, the *PV* of the carbon sequestration service (for the highest discount rate used for sensitivity analysis – 10%, Table 5) over the next 30 years is estimated at circa EUR 8.0 million indicating a significant difference in favour of *SEM* even at high discount rates. Under the *SEM* scenario the *PV* of carbon sequestration over the next 30 years is just greater than EUR 8.6 million. Proper *PA* management and law enforcement under *SEM* will initially result in a decline in *PA* carbon sequestration value as the harvested volumes are not significantly smaller than in the *BAU* scenario during the initial years. After this, due to a fall in the volume harvested, carbon accumulation increases. By the end of the appraisal period, increased increments, together with relatively constant harvested volumes, result in a stable value. (Figure 2).

Table 5. Present value of ecosystem services for different sectors and scenarios, using various discount rates (30 years, million EUR)

Sector	Scenario	0%	2%	3%	5%	7%	10%
Tourism	BAU	31.62	25.84	23.59	19.97	17.23	14.20
	SEM	81.95	59.44	51.27	39.09	30.72	22.50
Carbon sequestration	BAU	24.48	18.45	16.22	12.83	10.43	8.00
	SEM	26.24	20.04	17.69	14.05	11.42	8.60
Forestry	BAU	99.04	74.48	65.45	51.75	42.12	32.41
	SEM	99.76	74.52	65.30	51.42	41.74	32.01

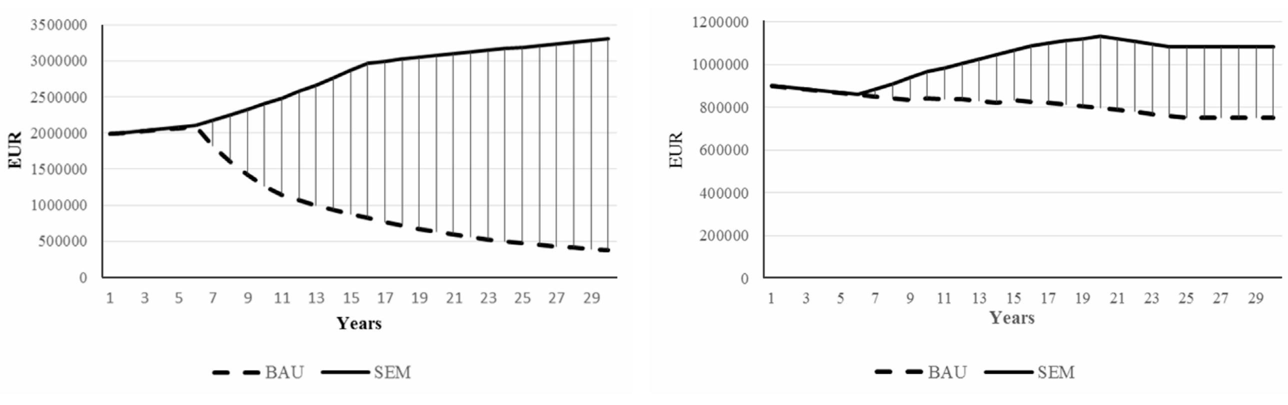

Figure 2. Maramures Mountains Natural Park forest ecosystem values for tourism (left) sector and carbon sequestration (right) under *BAU* and *SEM*

Forestry

The total 2011 value of forest provisioning services within forestry sector in *MNP* can be seen in Table 6 (including the distribution of this value among the main two beneficiary's categories).

Table 6. Baseline value of forestry ecosystem provisioning services in the Maramures Mountains Natural Park, 2011

Specifications	Values (million EUR)
Income to public forest administrators	1.286
Income to private owners	2.387
Income from illegal logging	0.027
Contribution for NEF	0.109
SUB-TOTAL	3.700
Revenues to public agencies	1.356
Non-commercial users/ beneficiaries	0.00
Private sector	0.002

The value of harvested timber in *MNP* was EUR 3.70 million. Forest administrators contribute up to 3% of the value of timber sales to the National Environmental Fund. This added an additional EUR 0.03 million to public revenues from private forestry in 2011. Illegal logging is estimated at around EUR 26,639 and is accounted to the private sector. Estimated potential value of *NTFP*s harvested under sustainable conditions and sold was at EUR 1.0 million in *MNP*.

The estimated *PV* of provisioning ecosystem services in *MNP* is lower for *SEM* when compared with *BAU* for discount rates above 2.2%. For a 3% discount rate for instance, the *PV* is EUR 65.45 million for the *BAU* scenario and EUR 65.3 million for the *SEM* scenario (Table 5). The privately owned forests, representing 35% of total forest area, have a significant influence on public expenditure through compensatory payments under the *SEM* scenario. The state authorities have reduced revenues under *SEM*, firstly due to the decrease in timber harvesting and secondly due to the necessity for compensatory payments to private forest owners. (Figure 3).

The *SEM* scenario will determine, initially, a decrease in forest sector values, as timber harvesting declines due to the reduction in production forest areas (i.e. *T3* and *T4*) and as compensation increases in line with the increase in *T1* and *T2* areas. Nevertheless, in the long run, the value of forestry provisioning services under the *SEM* scenario will recover, and are projected to generate higher values beyond a 30 year horizon, due to the increased value of *NTFP*s. The productivity of *NTFP*s is underpinned by healthy ecosystems and biodiversity. The rate of growth eventually slows as optimal *NTFP*s harvesting rates are reached, and is constant in the long run. While *BAU* is equivalent or superior to *SEM* (Figure 4) in the short term, in the medium to long term *SEM* is the more beneficial.

Furthermore, in the long term under the *BAU* scenario, values continue to decline, while under the *SEM* scenario the (high) value becomes constant over time reflecting the sustainable management of *MNP*. When talking about the distribution of the value of provisioning *ES*, *PA* administration is not represented among the beneficiary groups as neither *BAU* nor *SEM* includes revenues attributable to it. The private sector is the main beneficiary, indicating the potential to develop payments for *ES* type arrangements within the private sector.

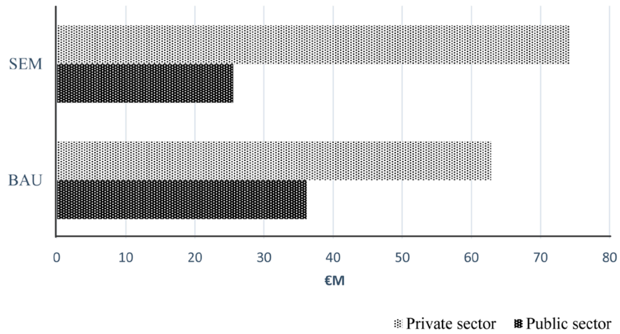

Figure 3. Gains to beneficiary groups: *SEM* over *BAU*;
Note: BAU - Business as Usual, *SEM* - Sustainable Ecosystems Services

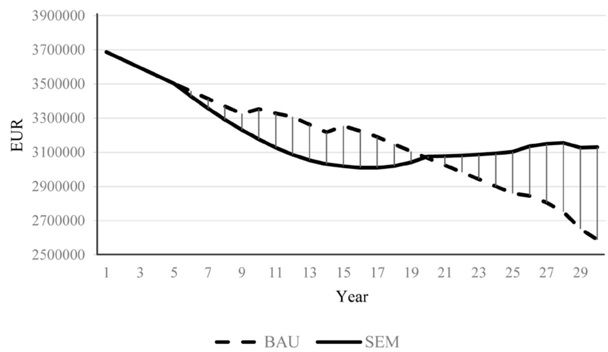

Figure 4. Maramures Mountains Natural Park forest ecosystem provisioning values under the *BAU* and *SEM*
Note: BAU - Business as Usual, *SEM* - Sustainable Ecosystems Management

Discussion

A very important aspect worth discussing regarding the *SSA* approach used for this study is the fact that the validity and reliability of the results depends on the agreement of experts (practitioners, scientists or decision makers) regarding the *BAU* and *SEM* scenarios description. Getting to such an agreement can be very difficult, the entire *SSA* approach could be rejected if it is judged that the available policy or management interventions were wrongly constructed (Alpizar and Bovarnick 2013). Although reaching consensus on broad generalities (e.g. overcutting should be avoided, resources must be used sustainably) is not difficult, they might not be specific enough for decision makers. The difficulty becomes acute when the analysis goes down to detailed policy and management interventions of the two scenarios. And, at this level of detail, there is a major chance of important disagreements among representatives of different stakeholders (Seppelt et al. 2011). In addition, there might be preferred management interventions of every stakeholder and the examination of each can become very difficult, sometimes impossible. For this reason, the study considered that it is essential to narrow the focus of the *SEM* intervention to a few policy or management practices that are both feasible and relevant to the interest of key decision makers and affected parties (Alpizar and Bovarnick 2013). This consideration have been addressed by the choice of the stakeholders involved in the *SEM* and *BAU* scenarios description, focused on consulting those stakeholders that are involved in decision-making.

The present study provides economic values and not only financial values, and the results prove that, for *MNP*, long term revenues that can be obtained in forest administration sector through the sustainable management of ecosystem services, are greater when compared with doing business as usual. This result is not unexpected at all when seen from a broad perspective: there are numerous studies for the forestry sector showing the high economic value of *ES* and the benefits of sustainable management based on limited intervention (Laurans et al. 2013). Basically, the long-term economic prevalence of the *SEM* scenario can be explained by the maintained capacity of the forest ecosystems based on their favourable status of conservation (Maes et al. 2012). What the study is innovating is the fact that rather than answering to the question: what is the value of this protected area in terms of the contribution to economic growth and human wellbeing, it is addressing the question: is it worth investing in raising the effectiveness of *PA*s management from the perspective of forest administration or other key productive sectors? As a consequence, the approach has not captured (and it was not intended so) all the effects of the ecosystem services but help decision makers in the targeted productive sectors (mainly forest administrators) build a business case on management measures that are agreed between them and *PA*s managers and ecosystem experts. By giving them the information that they consider important and needed they will judge the importance of the ecosystem services based on their own criteria and it is likely that the alternative of applying the envisaged *SEM* management measures will be taken into consideration.

The difficulty of developing the scientific basis or the policy and finance mechanisms for incorporating natural capital into resource-use and land-use decisions on a large scale is recognized, as well as the need for practical tools and integrated research into the development of new policies and institutions (Daily et al. 2009). The ecosystem service approach and ecosystem service valuation efforts have changed the terms of discussion on nature conservation, natural resource management, and other areas of public policy (de Groot et al. 2010). Ecosystem services valuations are abundantly produced and disseminated and always promoted on the assumption that they respond to the needs of decision makers. The use of the ecosystem services valuation studies is still an issue, the studies being informative rather than decisive (Laurans et al. 2013). Most of the decision makers felt that the time and cost requirements to run complicate ecosystem services models and tools remain too high for their widespread use in decision making (Bagstad et al. 2013). One of the solutions that are promoted is an active decision-making process with approaches that involve working with decision makers to identify critical management decisions and to develop scenarios to project how provision of services might change in response to those decisions (Daily et al. 2009). Ecosystem services research has to become more problem driven because the success of the ecosystem services valuation will be judged on how well it facilitates real world decision making (Liu et al. 2010).

In this context, even with the accounted limitations, the *SSA* is a new approach trying to better target the ecosystem valuation effort. Studies using this approach are still relatively scarce, as well as proofs of particular policy and management options enacted as result of *SSA* studies. Still, within the *UNDP* project *Protected Areas Budget Negotiation Support Project*, as a result of the *SSA* study done for Latin and Central America (Bovarnick et al. 2010) in Chile, the Government decided to increase financing for *PA*s system in 2013 and create a new budgetary line that will also facilitate the negotiations in the next budget cycles (Flores and Bovarnick 2016). In contrast, in Guatemala, the *PA*s budget increase requests were not supported by decision making appropriate indicators and the approach did not achieve its objective (Flores and Bovarnick 2016). Another example of the use of a *SSA* approach study can be found in the Republic of Moldova, where the budgeting of the National Biodiversity Conservation Strategy and Action Plan (*NBSAP*) was based on a *SSA* approach study (Popa 2014), and this triggered the approval of the *NBSAP* (including the budget) in 2015 (GD 2015).

The purpose and the specificity of the *SSA* approach did not take explicitly into consideration the evolution of natural resources demand into the context of general societal demands (Kroll et al. 2012) but the sustainability of the provisions of the *ES* helps improve societal welfare.

MNP is one of the biggest natural parks in Romania having the largest forest coverage and there are a lot of similarities with other Romanian Carpathian parks in terms of forest ecosystem quality. Nevertheless, the specific results of this study are strictly dependent on forest conditions in *MNP*, therefore the general adoption of the results is not appropriate.

A further limitation which should be noted may be the omissions on the cost side: the opportunity costs of protecting ecosystems could not be calculated on the basis of available information. These comprise the income from other land and resource use/development benefits foregone by choosing to conserve and sustainably utilize land and resources. These are likely to be substantial, and wide-ranging in their effects. In this instance however, the exclusion of opportunity costs is not considered to have a major impact on the resulting figures, as both scenarios refer to the same land area under the same basic management regime (the same land use under the same general frame for *PA* management) - it is conservation management effectiveness that varies between the two scenarios - and so this will imply similar opportunity costs.

Even with all the limitations described, the study indicates that it is possible to promote integration between timber production and provision of other ecosystem services and biodiversity conservation if temporary sacrifices in term of time and revenues from timber harvesting are accepted and better management of all types of forest resources is encouraged. In the long run, this approach can also improve societal welfare as long as the flow of important ecosystem services is brought and maintained at a high sustainable level. Being based on comparison between scenarios built upon management interventions agreed with the decision makers, the study helps in building a case that brings implementation of sustainable management closer.

Conclusions

In the case of *MNP*, over a 30 years horizon, the working hypothesis is verified: *SEM* implies a reasonable decrease in harvested wood values in the short time and a reduction in public income due to compensatory payments but, in long run, the value of the provisioning services under the *SEM* scenario will recover and the *ES* are projected to generate a higher *PV* when compared with *BAU*. In addition, other *ES* generated and maintained by sustainable forestry (e.g. carbon sequestration, water and soil erosion regulation, landscape) are ensured and, as the figures prove, also generate values for the economy. The biodiversity, water, soil and nutrient regulation gains under the *SEM* scenario are possible with the temporary sacrifice in terms of money and time, provided that efforts are focused on the improved management of *NTFP*s. The enlargement of the protected forests area should be done on the basis of scientifically sustained arguments and appropriate assessment. Otherwise, the idea of economically sound *SEM* could be compromised.

This type of study is useful to the public (political processes) in gauging revenue and public cost implications of different forest management regimes providing insights into complex ecological trade-offs (and implied economic trade-offs) in *ES* of these regimes. The studies regarding the economic effect of *PA*s sustainable management, together with biodiversity studies can, for the future, create a better foundation for decision making in sectors with conflicting interests such as forestry and biodiversity conservation. Therefore, this paper may be considered an attempt to describe the possibility for apparently opposing sectors (i.e. biodiversity conservation and other sectors dealing with resource utilization) to better plan and make decisions to their mutual advantages in the long run.

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