Universitatea *Transilvania* din Braşov

HABILITATION THESIS

ECOSYSTEM SERVICES VALUATION USING TARGETED SCENARIO ANALYSIS – ECOSYSTEM SERVICES VALUES FOR DECISION MAKING

Domain: FORESTRY

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CONTENT

List of abbreviations

AAC	Annual Allowable Cut
ANP	Apuseni Natural Park
ANAR	National Agency "Romanian Waters"
ANRM	National Agency for Mineral Resources
BAU	Business as Usual
BEF	Biomass Extension Factor
CBA	Cost Benefit Analysis
CBD	Biodiversity Conservation Convention
CIFOR	Center for International Forest Research
CNPA	Carpathians Network of Protected Areas
CS	Consumer Surplus
ENPI – FLEG	European Neighborhood and Partnership Instrument – Forest Law Enforcement and Governance
ES	Ecosystem Service
ESA	Ecosystem Services Approach
ESV	Ecosystem Services Valuation
EU	European Union
FES	Forest Ecosystem Service
FMP	Forest Management Plan
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Green House Gases
GIS	Geographical Informational System
IUCN	International Nation for Conservation of Nature
IPCC	International Panel on Climate Change
INCDT	National Institute for Tourism Development Research
IUCN	International Union for Conservation of Nature
LAC	Latin America and the Caribbean
LSU	Livestock Unit
LPA	Local Public Administration
LULUCF	Land Use, Land Use Change and Forestry
MNP	Maramures Mountains Natural Park
MA	Millennium Assessment
MDL	Moldavian currency
MP	Management Plan
NBSAP	National Biodiversity Strategy and Action Plan
NBT	Nature Based Tourism
NEF	National Ecological Fund
NFA	National Forest Administration – Romsilva
NFF	National Forest Fund
NGO	Non-Governmental Organization
NTFP	Non Timber Forest Products
NPV	Net Present Value
NEF	National Environmental Fund
NOS	National Office for Statistics
PA	Protected Area
PAME	Protected Areas Management Effectiveness
PCNP	Piatra Craiului National Park
PEN	Poverty Environmental Network
PES	Payments for Ecosystem Services
PPP	Purchasing Power Parity
PV	Present Value
ReNP	Retezat National Park
REA	Romanian Ecotourism Association
RFI	Relative Forest Income
SFS	Sustainable Financing Strategy
SRF	Short Rotation Forestry
SEM	Sustainable Ecosystem Management
TEV	Total Economic Value
TSA	Targeted Scenario Analysis

UNDP	United Nations Development Programme
VAT	Value Added Tax
VNNP	Vanatori Neamt Natural Park
WWF	World Fund For Nature
WTP	Willingness to Pay
WTTC	World Travel and Tourism Council

(A) Rezumat

Teza de abilitare prezintă o parte din rezultatele activității de cercetare desfășurate în domeniul fundamental *Ştiinţe Inginereşti*, subdomeniul *Silvicultură*, după susținerea publică a tezei de doctorat intitulate *Cercetări privind fundamentarea reconstrucției ecologice a arboretelor degradate din Podișul Covurlui*, în anul 2006, în cadrul Universității Transilvania din Brașov. Teza de abilitare este structurată după cum urmează: rezumat, realizările profesionale și științifice, planul de dezvoltare a carierei și bibliografie.

Începând din deceniul 6 al secolului trecut, un interes aparte în domeniul economiei mediului a fost reprezentat de aplicarea conceptului serviciilor ecosistemice. Acest concept, foarte repede adoptat de oamenii de știință, a devenit cel mai important cadru pentru înțelegerea capitalului natural ca fiind un mijloc fix atât din perspectivă socială cât și economică. Definite ca fiind beneficiile pe care le poate obține societatea umană de pe urma ecosistemelor, serviciile ecosistemice au devenit din ce în ce mai semnificative atât pentru cercetare cât și pentru luarea deciziilor, fapt demonstrat de publicarea Raportului Millenium Ecosystem Assessment (2005), o lucrare monumentală care a reunit munca a peste 1300 oameni de stiință. Principala provocare pentru implementarea conceptului serviciilor ecosistemice este evaluarea acestora pe baza legăturilor dintre ele și bunăstarea oamenilor. Statisticile și evaluările din trecut luau în mod tradițional în considerare numai acele valori care au preț și piață. Conceptul serviciilor ecosistemice recunoaște însă, în mod explicit, că multe dintre valorile serviciilor ecosistemice nu au preț sau piață de desfacere, fiind valori indirecte. Soluția găsită este luarea în considerare a tuturor valorilor generate de către ecosisteme, cadrul teoretic fiind acela al valorii economice totale a serviciilor ecosistemice.

După mai multe decenii de eforturi și inovații în ceea ce privește evaluarea serviciilor ecosistemice, opinia generală a experților este aceea că evaluarea serviciilor ecosistemice nu a atins întru totul așteptările în ceea ce privește aplicarea practică, în procesul de luare a deciziilor. Acest context este cel care a determinat elaborarea unei metodologii de evaluare inovative - Targhet Scenario Analysis (TSA) – pentru captarea și prezentarea valorii serviciilor ecosistemice pentru decidenți într-un mod care să creeze o conexiune mai strânsă între nevoile procesului de luare a deciziilor și efortul de evaluare a serviciilor ecosistemice. Metodologia este bazată pe compararea a două scenarii de management, Business as Usual (BAU) și Sustainable Ecosystem Management (SEM). Aceste scenarii sunt elaborate prin consultarea factorilor interesați în managementul ecosistemelor, cercetare sau reglementare sau sunt principali beneficiari ai serviciilor ecosistemice.

Aplicarea metodologiei TSA în România, descrisă în capitolul 3 al tezei de abilitare a însemnat realizarea evaluării serviciilor ecosistemice în 5 parcuri naționale și naturale. Cercetările s-au realizat în cadrul mai extins al proiectului GEF-UNDP *Improving the Financial Sustainability of the Carpathian System of Protected Areas*. Cercetările au țintit să exploreze dacă pot fi obținute beneficii pe termen lung prin managementul sustenabil al ecosistemelor forestiere din ariile protejate, în comparație cu beneficiile imediate ale continuării modului de lucru actual. Valoarea economică totală a serviciilor ecosistemice este estimată prin utilizarea unor tehnici comune de evaluare, sub umbrela inovatoare a metodei TSA, care introduce concentrarea sectorială, scenariile alternative de management și dimensiunea temporală procesului de evaluare. Indicatorii economici determinați prin aplicarea modelelor definite de scenariile BAU și SEM, rezultați ca urmare a unui process complex de colectare de date și aplicare a tehnicilor corespunzătoare de evaluare, arată că, după 30 ani, activitățile din sectorul silvic în scenariul SEM depășesc valorile scenariului BAU în ceea ce privește contribuția la economia națională. Prin luarea în considerare, pe lângă sectorul forestier, și a altor sectoare economice, cercetările

deschid noi oportunități pentru identificarea unor mecanisme financiare care să ajute la obținerea unei sustenabilități reale a demersului de conservare a biodiversității.

Implementarea fazei a doua a proiectului ENPI-FLEG (*European Neighborhood and Partnership Instrument – Forest Law Enforcement and Governance*) în Republica Moldova a creat oportunitatea realizării evaluării serviciilor furnizate de ecosistemele forestiere din această țară, utilizănd aceeași metologie – TSA. Utilizată cu rezultate foarte bune încă din 2013 (evaluarea comparativă a scenariilor BAU și SEM, realizată cu ocazia elaborării strategiei Republicii Moldova în domeniul conservării biodiversității a furnizat argumentele necesare pentru aprobarea în 2015 a bugetului acestei strategii), metoda s-a bazat, de seamenea, pe colectarea de date și analizarea acestora utilizând tehnici de evaluare în cadrul scenariilor BAU și SEM. Spre deosebire de situația din România, studiile din Republica Moldova au permis chiar colectarea directă de informații prin implementarea unor chestionare pentru evaluarea dependenței de resursele forestiere a populației rurale. Capitolul 4 al prezentei teze de abilitare prezintă rezultatele estimării valorii economice a serviciilor furnizate de ecosistemele forestiere. Sunt prezentate caracteristicile principale ale sectorului forestier în Republica Moldova rezultatele studiilor privind dependența de pădure a populației rurale precum și valorile serviciilor ecosistemice pentru scenariile BAU și SEM pentru sectoarele turism, agricultură, managementul apei, dezastre naturale și silvicultură. Concluziile studiului arată că ecosistemele forestiere furnizează valori impresionante pentru sectoarele economice analizate. Valorile serviciilor ecosistemelor forestiere se manifestă în multiple sectoare ale economiei, având un efect economic multiplicator substantial. Există oportunități ce nu sunt încă valorificate și care pot crește valoarea serviciilor ecosistemelor forestiere, în timp ce ecosistemele forestiere gestionate durabil pot reduce semnificativ costurile produse de inundații, eroziunea solului sau alunecările de teren. Concluziile cercetărilor sunt traduse în recomandări aplicate pentru managementul ecosistemelor forestiere și pentru modificările care se impun în ceea ce privește reforma instituțională și normativă a sectorului forestier în Republica Moldova.

Teza de abilitare prezintă de asemenea, pe baza cercetărilor descrise (și nu numai), tematica și direcțiile de cercetare pe care autorul le are în vedere, precum și un plan de dezvoltare a carierei academice, toate reunite în secțiunea B-ii a lucrării.

(B) Scientific and professional achievements and the evolution and development plans for career development

(B-i) Scientific and professional achievements

1. Introduction

1.1. Ecosystem services approach (ESA) and the need for evaluating ecosystem services

The term "ecosystem services" was used for the first time in 1981 (Ehrlich and Ehrlich 1981), but the concept itself is older. In 1977, Westman suggested that the social value of the benefits that ecosystems provide could potentially be enumerated so that the society can make more informed policy and management decision (Westman 1977). There are numerous attempts to define the term (Daily 1997, Constanza et al. 1997) but the literature still contains doubts and different views on how ecosystem services (ES) should be defined (Barbier 2007). The concept was very quickly adopted by the scientist, mainly environment economists, and it has become an important frame for understanding the natural capital as a societal and economic asset. The fundamental hypothesis of the concept is that nature conservation and care should not affect our way of life but sustain it in the condition of proper development decisions.

The concept has become increasingly significant both in the research and decision making, this fact being witnessed by the publication of the Millennium Ecosystem Assessment (MA 2005), a monumental work involving over 1300 scientists (Fisher et al. 2007). First Millennium Ecosystem Assessment Report (MA 2005) revealed that 15 of the 24 ecosystem services investigated globally are in a state of decline.

The definition adopted by MA (2005) is the most commonly cited one: *the benefits people obtain from ecosystems* (MA 2005). The Millennium Ecosystem Assessment (MA 2005) presents a framework to assist in the identification of ES, classifying them into the following four categories: *i) p**rovisioning services** relate to the tangible products, such as timber, non-timber forest products (NTFPs), fish and pharmaceuticals products provided by ecosystems; ii) r**egulating services** refer to an ecosystems natural processes such as carbon sequestration and water regulation that contribute to social wellbeing; iii) **cultural services** relate to the non-material benefits obtained from ecosystems, for example, through tourism and educational use; and, iv) s**upporting services** are necessary for the production of all other ecosystem services (e.g. soil formation or nutrient cycling). They differ from the other services in that their impacts on people are either indirect (via provisioning, regulating or cultural services) or occur over a very long time.*

The challenge triggered by the ESA is the valuation of the ES. The trend of ecosystems becoming increasingly scarce can be attributed partially to the lack of valuation because is impossible to manage what we do not value (TEEB 2009, Liu et al. 2010). The ecosystem services valuation (ESV) has faced therefore the challenge of provoking society to acknowledge the value of ecosystem services (Ehrlich and Pringle 2008) and is considered as the tool that can tackle such a challenge (Liu et al. 2010).

ESV is based on the linkages between the ES and the human wellbeing. Understanding these linkages is the first and the most important step in ESV (Figure 1.1-1).

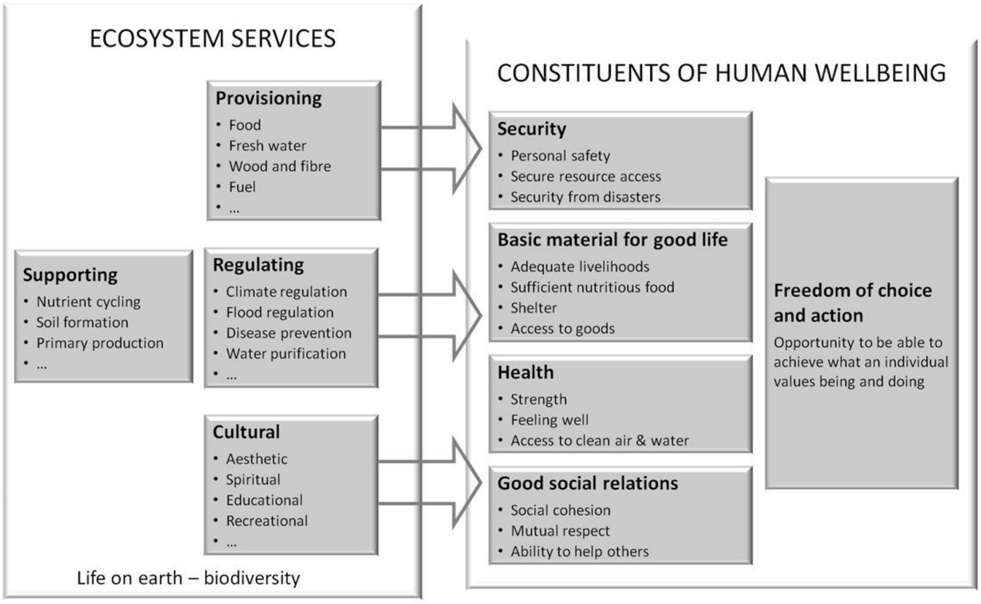


Figure 1.1-1. Ecosystem services and human wellbeing (adapted from MA 2005)

Being able to express these economic linkages requires that ES can be adequately valued and this has traditionally posed something of a problem to economists (Emerton 2011). One important reason for undervaluation is that the economists who generate the statistics and evaluations aiming to inform decision making have conventionally taken into consideration only of those values for which there is a clear market and price (TEEB 2010). This created a problem because the ESA is explicitly recognize that many ES are not priced or marketed (Emerton 2011), many of the values of the ES being indirect values. ESA recognizes that ecosystem's contribution extends beyond the provision of goods such as timber to the natural regulating functions such as carbon sequestration. The ESA therefore provides a framework for considering whole ecosystems in decision making and for valuing the services they provide (Popa and Bann 2012).

The solution that has become the most widely used framework for evaluating of ES in a way that all the values are captured is the use of the Total Economic Value (TEV) concept. The TEV concept is the fundament of the ESV and it extends beyond just physical products and marketed commodities. TEV framework considers the full range of economically important services associated with ecosystems, categorizing them into direct, indirect, option and existence values (Emerton 2006).

The process of ESV, in the framework defined by the TEV, involves identifying the ES that ecosystem generates, tracing through the ways these impact on human and economic wellbeing and demonstrating the value of these linkages in economic terms (Emerton 2009).

ESV can fulfill multiple purposes (Liu et al 2010): to provide for comparisons of natural capital to physical and human capital in regard to their contribution to human welfare, to monitor the quantity and quality of natural capital over time with respect to its contribution to human welfare, to provide for evaluation of projects that propose to change natural capital, to provide information regarding potential economic gains or loss in different ecosystem management scenarios (Popa and Bann 2012), etc.

Table 1.1-1. Total economic value of ecosystems (Adapted after Emerton 2014)

Total Economic Values		Definition	Examples
Use values	Direct values	Raw materials and physical products that are used for production, consumption and sale	Timber, minerals, fiber, fish, fuels, building materials, medicines, fodder, recreation, etc.
	Indirect values	Ecological functions which maintain and protect natural and human systems	Watershed protection, nutrient cycling, pollination, flood attenuation, climate regulation, protection against natural disasters, etc.
	Option values	The premium placed on maintaining ecosystems for future possible uses some of which may not be known now	New industrial, agricultural or pharmaceutical applications, future tourism and recreational development, novel possibilities for resources, etc.
Non –use values	Existence values	The intrinsic value of ecosystems regardless current or future possibilities to use them	Historical or cultural sites, spiritual places, beautiful landscapes, items of national heritage etc.

In undertaking an ESV, a range of valuation approaches may be adopted to estimate the market and non-marketed ecosystem services provided. These approaches are well documented in the environmental economics literature. This section provides an overview of available valuation approaches along with references to other sources where more detail on key valuation approaches may be found. The main categories of valuation approaches are as follows (Popa and Bann, 2012):

- ***Market price approaches***: Consider *use values* associated with ecosystem goods and services that are bought and sold in actual markets.
- ***Productivity approaches*** (Taylor 2003, Maler 1974)***:*** Focus on the relationship between an ecosystem service (e.g. the provision of clean water) and the production of a market good (e.g. agricultural crops). The *use value* of ecosystem service is inferred by changes in production that result from changes in the ecosystem as an input to production (e.g. quantity or quality).
- ***Revealed preference methods*** (Bockstael and McConnell 2006, Ward and Beal 2000, Kanninen 2006): Estimate the *use value* of ecosystem non-market goods and services by observing behavior related to market goods and services that can be linked to the ecosystem service in some way. For example the travel cost method may be used to value tourism in protected areas (PAs) where there are no entrance fees through the cost (both money and time) incurred in undertaking the tourism activities.
- ***Stated preference methods*** (Arrow et al. 1993, Bateman et al. 2002): These survey based approaches create hypothetical markets to determine the value of non-market goods and services. Individuals are typically asked what they would be willing to pay or accept for a specified change in the provision of an ecosystem service. Stated preference techniques are the only approaches that can estimate all the various components of TEV - direct and indirect use value and non-use value.

Broadly speaking, market price and productivity approaches are ordinarily applied to value *market goods and services*, while revealed preference and stated preference approaches are applied to value *non-market goods and services* (Liu et al. 2010). However, there can be overlaps between methods and often combinations of methods are required for informed decision-making for specific management issues. Table 1.1-2. summarizes the scope of the different valuation methods.

Table 1.1-2. Scope of Economic Valuation Methods (adapted from EFTEC 2009)

Valuation Method	Scope – Component of TEV	Scope – types of goods and services
Market pricing methods	Use value (direct and indirect)	*Market goods and services and market substitutes (for non-market goods and services)* Direct use value: limited to commodities (e.g. fish, timber) or the contribution of ecosystem services such as water provision to marketed products (e.g. agriculture, forestry, fisheries, manufacturing, power generation) Indirect use value: estimating avoided damage (e.g. from flooding) or marketed substitutes (e.g. cost of water treatment) or tangible impacts (e.g. cost of illness)
Production input methods (e.g. production function approach)	Use value (direct and indirect)	*Market goods and services* Use value: Limited to the role of ES as an input to production processes (e.g. the effect of water quality on agriculture).
Revealed preference methods		
Hedonic pricing (e.g. hedonic property pricing)	Use value (direct and indirect)	*Non-market goods and services* Use value: The contribution of ES to environmental amenity that can be observed from markets (e.g. property market).
Travel cost method	Use value (direct and indirect)	*Non-market goods and services* Use value: The contribution of ES to recreation and tourism activities that is revealed by the travel costs incurred by users.
Multi-site recreation demand models	Use value (direct and indirect)	*Non-market goods and services* Use value: The contribution of ecosystems to recreation activities that is revealed by the choice decisions (i.e. whether to visit a specific site or not) and travel costs incurred by recreation users.
Stated preference methods		
Contingent valuation	TEV (use and non-use value)	*Non-market goods and services* TEV: The contribution of ecosystems to most non-market goods and services can be captured by contingent valuation.
Choice modeling (e.g. choice experiment)	TEV (use and non-use value)	*Non-market goods and services* TEV: The contribution of ecosystems to most non-market goods and services can be captured by choice modeling approaches.
Benefits transfer		
Unit value transfer / function transfer	*TEV (use and non-use value), depending on evidence used*	*All of the above depending on the type of study from which evidence is sourced.*

After decades of studies dedicated to ESV, important practical applications can be identified (Liu et al 2010, Bagstad et al. 2013). For instance cost benefit analysis of water and resources-use planning in the United States (Adamowicz 2004), ESV in natural resources damage assessments (Liu et al. 2010), natural capital accounting (Green 2003, Matero and Saastamoinen 2007), designing or implementing payments for ecosystem services (PES) (Engel et al. 2008, FTEM 2008).

Still, the opinion that the results of the ESV didn't met the initial expectations is accepted by more and more scientists (Seppelt et al. 2011, Laurans et al. 2013), and many of them are now sending the signal that ESV researchers will have to transcend disciplinary boundaries and synthesize tools, skills and methodologies from various disciplines; ESV research has to become more problem driven rather than tool driven (Liu et al. 2010) because the success of ESV will be judged on how well it facilitates real-world decision making. Daily et al. (2009) consider that ESV scientists should find means to better integrate with decision making process, allowing the ES concept to better deliver on its promise of supporting more sustainable decision making. This context is the one that determined the design and use of the Target Scenario Analysis as an innovative approach to capturing and presenting ecosystem services values for decision making (Alpizar and Bovarnick 2013) and thus to create a closer connection between the needs of the decision making process and the efforts of ESV.

1.2. Research results that are at the base of the habilitation thesis

Present habilitation thesis is based on the results published in scientific papers published in ISI Thompson indexed journals (2), in scientific articles published in International Data Base indexed journals (4), in consultancy reports elaborated for international United Nations Organizations (3) and books published at recognized publishing houses in Romania (2) as follows:

1. **Popa B.,** Bann C. 2012. An assessment of the contribution of ecosystems in protected areas to sector growth and human wellbeing in Romania, United Nations Development Programme, Bucharest, 122p.
2. **Popa B.,** Coman C., Borz S.A., Niță M.D., Codreanu C., Ignea G., Marinescu V., Ioraș F., Ionescu O. 2013. Total economic value of natural capital – a case study of Piatra Craiului National Park, Notulae Botanicae Horti Agrobotanici, 41(2): 608-612.
3. **Popa B.,** Pascu M., Niță M.D., Borz S.A., Codrean C. 2013. The value of forest ecosystem services in Romanian protected areas – a comparative analysis of management scenarios, Bulletin of the Transilvania University, Series II, Vol 6 (55) 2: 53-62.
4. **Popa B.** 2013. What the protected area worth to the tourism sector. Maramureș Mountains case study, Bulletin of the Transilvania University, Series V, Vol 6 (55) 1: 1-8.
5. **Popa B.,** Borz S.A. 2013. Mecanisme de plăți pentru serviciile ecosistemice în România, Ed. Lux Libris, Brașov, 117 p.
6. **Popa B.** 2013. The economic value of ecosystem services in Republic of Moldova and final input on financials of NBSAP. United Nations Development Programme, Chisinau, 84 pp.
7. **Popa B.,** Borz S.A. 2014. The contribution of the forest sector to the national economy and human welfare in the Republic of Moldova – an argument for sustainable ecosystem management, Bulletin of the Transilvania University of Brașov, Series II, Vol 7(56) 1:37-42.
8. **Popa B.** 2014. Possible scenarios of ecotourism evolution in the Republic of Moldova from the perspective of ecosystem services, Bulletin of the Transilvania University, Series V, Vol 7(56) 1:131-38.
9. **Popa B.** 2014. Evaluarea serviciilor ecosistemice în Republica Moldova, Ed Lux Libris, Brașov, 250p.
10. **Popa B.,** Zubarev V., Moșnoi E., Lozan A. 2014. Forest dependency based on surveys conducted in three villages of Moldova, FLEG II (ENPI East), Chișinău, 31p
11. **Popa B.,** Borz S.A., Niță M.D., Stăncioiu P.T., Lozan A. 2015. Evaluation of forest ecosystem services in the Republic of Moldova, FLEG II (ENPI East), Chișinău, 85p.
12. **Popa B.,** Borz S.A., Niță M.D., Ioraș F., Iordache E., Borlea F., Pache R., Abrudan I.V. 2016. Forest ecosystem services valuation in different management scenarios: a

case study of Maramureș Mountains, The paper has passed the review/revise process, to be published in Baltic Forestry.

2. Target Scenario Analysis – conceptual and methodological approach

Target Scenario Analysis (TSA) refers to an analytical framework for the presentation of evidence in favor and against sustainable ecosystem management when compared to business as usual. This is done for a particular productive or consumptive sector, and with a specific decision maker in sight. The TSA should facilitate decision making under complex circumstances involving both monetary and non-monetary criteria. TSA is an innovative analytical approach, developed by United Nations Development Programme (UNDP) that captures and presents the value of ES within decision making to help make the business case for sustainable policy and investments choices (Alpizar and Bovarnick 2013). Even if the ecosystem services valuation was considered as the best process of assessing the contributions of ecosystem services to sustainable scale, fair distribution and efficient allocation (Liu et al, 2010), different surveys of literature have revealed that the contribution of ESV to ecosystem management has not been as significant as hoped nor as clearly defined. TSA tries to address this scarcity of the traditional ESV approaches by bringing the results of the valuation closer to the decision makers. The way TSA is designed and implemented tries to make ESV more problem-driven rather than tool-driven thus facilitating real world decision making and the conservation of natural capital (Liu et al 2010).

The TSA methodology is consistent with The Economics of Ecosystems and Biodiversity (TEEB), capturing the value of ES through the market and different productive activities but it differs from traditional methods in that it provides information on the results of specific decision and management practices as a continuous, long-term analysis, showing relative change over time or key monetary and non-monetary indicators, rather than as a static single value (Alpizar and Bovarnick 2013). This is very important for decision making because decisions cannot be made based on numbers in isolation, but rather by comparing at least two options over time.

The detailed description of the TSA 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, Popa and Bann 2012, Popa 2013a). The method introduces the analysis at sector level, but begins with an understanding and quantification of ecosystem services. The core part of the TSA approach is the comparison of two scenarios: Business as Usual (BAU) and Sustainable Ecosystem Management (SEM). The TSA approach has been developed to explore situations where the BAU is not sustainable management. In contrast to the BAU, the SEM intervention will always involves 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 TSA 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 TSA 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 TSA 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. Thus, the TSA 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 TSA 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 TSA 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 (Popa et al. 2016). 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, Popa et al. 2016).

Data availability and reliability are still among the limitations of the approach because the TSA 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 TSA 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 TSA approach in a simpler and more accessible manner (Popa et al. 2016).

The analysis lends itself to the generation of politician-friendly data. An ecosystem-centric approach cuts across sectors and ministerial mandates, whereas a sectoral approach aligns with the organization of Ministries. It can therefore be used to facilitate the incorporation of ES values and their management into economic planning, policy and investment at the sectoral level (Popa et al. 2015). Rather than determining the general value of a particular resource or ecosystem service, TSA looks at ES from a stakeholder point of view (Alpizar and Bovarnick, 2013). This makes the approach demand driven, rather than supply driven asking: What information do decision makers need in order to judge the importance of a particular ES and the benefits of enacting a particular policy or management options that maintains it.

3. Ecosystem services evaluation for protected areas in Romania using Targeted Scenario Analysis

3.1. Background

This section of the habilitation thesis presents the results of the research undertaken in the UNDP – GEF project "Improving the Financial Sustainability of the Carpathian System of Protected Areas" The overall objective of the project is to secure the financial sustainability of Romania's Carpathian network of PAs, as a model for replication across the entire Carpathian Network of Protected Areas (CNPA). More specifically, the research aimed to generate evidence of how a sustainably managed CNPAs supports productivity in key sectors such as tourism, forestry and/or industry, using key indicators such as employment, job creation, tax revenue, foreign exchange earnings and equity aspects. The study also seeks to demonstrate the costs associated with unsustainable management. This evidence was projected to convince public / private decision-makers of the importance of PAs to growth and productivity in key sectors of the Romanian economy and to the welfare of the population in general (Popa and Bann 2012).

At present, there is little policy-relevant information on the economic value of PAs in Romania, and PAs are accorded a low budgetary and economic policy priority. Public and corporate decision makers, facing increasing pressure on funding, tend to allocate less financial resources to PAs relative to other sectors, which are perceived to be more productive in development terms. Over the past 10 years the Carpathian PAs in Romania has been underfunded; the 5 pilot PAs selected for study received around €950,000 in funding in 2010, while €1,600,000 is considered to be necessary to meet basic needs and around €2,550.000 to optimally manage the sites (Birda, 2011) Therefore, PAs managers face a challenge in communicating the linkages between PA biodiversity conservation and the wider welfare benefits to communities and the economy in general.

The research described in this thesis aims to address this challenge by demonstrating that PAs are an important and productive asset providing a significant flow of economically valuable goods and services. Economic studies drawing out the significance of these services in monetary terms and their contribution to local, regional and national economies can be a powerful way of demonstrating the significance of PAs to decision makers (Popa and Bann 2012).

This research has attempted to apply the TSA approach to 5 pilot PAs in Romania's Carpathian Mountains. The pilot sites are Apuseni Natural Park (ANP), Retezat National Park (ReNP), Piatra Craiului National Park (PCNP), Vanatori-Neamt Natural Park (VNP) and Maramures Mountains Natural Park (MNP). Evidence has been gathered to demonstrate how ecosystem services provided in and around these PAs support productivity and growth in key sectors of the economy under two scenarios – BAU and SEM.

The research obtained in the above mentioned project were continued and improved during the next years, leading to results that are more detailed.

The research relies also on support, information and ideas from many individuals, although any errors remain those of the author alone. Many thanks to the technical team of the project (Mihai Zota, Marlon Flores), implementation team: Dragoş Mihai and Robert Pache from National Forest Administration - Romsilva and the members of the Park Administrations for the many insights they provided to the current paper. Thanks are also due to Monica Moldovan and Doru Irimie of UNDP Romania, who coordinated the project. Last, but not least, mention should be made of (and gratitude expressed to) Lucy Emerton, who generously contributed her time and energy to transfer information on the valuation techniques, data collection and interpretation.

3.2. Briefly about the Romanian Carpathians PAs & Forestry

The Carpathian Mountains extend over an area of 210,000 km^2 in Central and Eastern Europe covering seven countries: The Czech Republic, Hungary, Poland, Romania, Serbia, Slovakia and Ukraine. The Mountains are included in the WWF “Global 200” Ecoregion list and host Europe's most extensive tracts of montane forest, the largest remaining natural mountain beech and beech/fir forest ecosystems, and the largest area of virgin forest left in Europe. In addition to forests, which cover about 90,000 km^2[1], the area hosts semi-natural habitats such as montane pastures and hay meadows, which are the result of centuries of traditional management of the land. One-third (3,988 plant species) of all European vascular plant taxa are found in this region, 481 of which are endemic. The Carpathians form a 'bridge' between Europe's northern forests and those in the south and west and thereby provide a vital corridor for the dispersal of plants and animals throughout Europe. It is also the last region in Europe to support viable populations of large carnivores supporting an estimated 8,000 brown bears, 4,000 wolves, and 3,000 lynx (UNDP 2009).

The high conservation value of the Carpathian PAs 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 areas 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 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 PAs 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 PAs and their present day level of funding (Birda 2011).

Romania holds 54% of the Carpathian mountain range of medium elevation (1,136m on average) with just a few peaks exceeding 2,500 meters in altitude. Under the Carpathian Convention established at The Conference of Kiev in May 2003[2] all seven range states have taken measures to protect this ecoregion. The Carpathian Network of Protected Areas (CNPA) is comprised of 285 protected areas that cover 31,978 km^2. However this network of PAs is considered to be

[1] Romanian Carpathian forest: 55,000 km^2, Slovakia Carpathian forests: 17,500 km^2; Ukrainian Carpathians: 15,000 km^2, Poland Carpathian forests: 4,800 km^2.

[2] The Carpathain Convention states that: “The parties shall cooperate in developing an ecological network in the Carpathians, as a continuant part of the Pan-European Ecological Network, in establishing and supporting a Carpathian Network of Protected Areas, as well as enhancing conservation and sustainable management in the areas outside of protected areas”.

insufficient in terms of scale, connectivity and management to prevent the irreversible loss of biodiversity in the Carpathian ecoregion. Only 17% of the ecoregion is protected, which is very low when compared with the Alpine Bioregion of Europe that has 35% coverage by the network of Natura 2000 sites. In general, the northwest of the Carpathians is more effectively covered and managed than the southeast portion (UNDP 2009). Figure 3.2-1. illustrates the distribution of Romania’s Carpathian PAs.

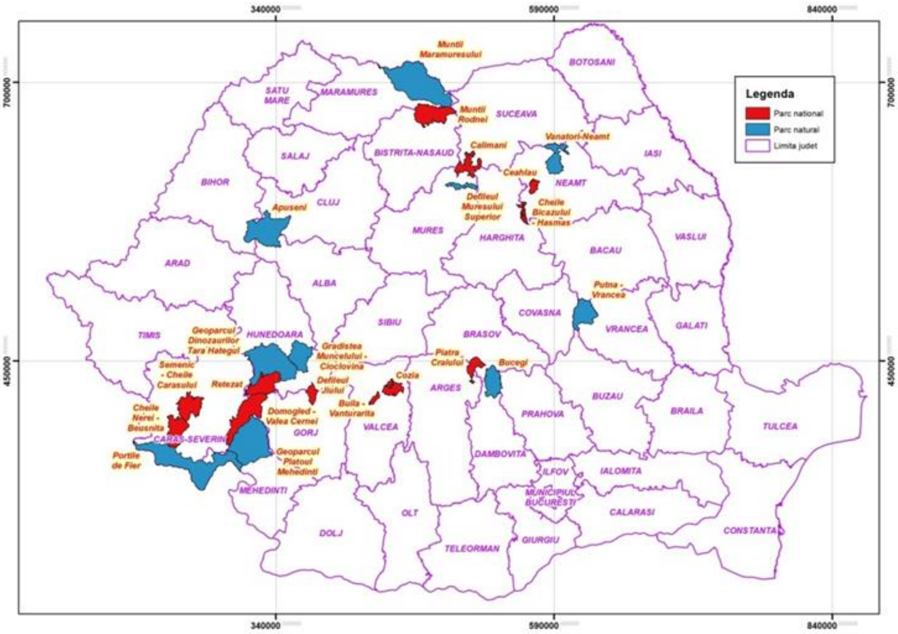


Figure 3.2-1. Distribution of Romania’s Carpathian Parks (Popa and Bann 2012)

The PAs management plans (MPs) are, theoretically, the basis of the PAs management, but in practice the enforcement of those plans is not sufficiently effective due to a number of factors: not all the MPs 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 PAs and the extension of protected forests (Popa and Bann 2012). The process of forest restitution started in 1991 and which has been now almost finalized, triggered important institutional and legal changes (Stăncioiu et al. 2010) as well as illegal logging and unsustainable forest harvesting in some areas (Strâmbu et al. 2005). A more or less stable system is now in place with almost all the PAs 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 (FMPs), which are reviewed every 10 years, and are theoretically based on sustainable principles such as biological diversity conservation (Stăncioiu et al. 2010). The FMPs divide forests into categories[3]. 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

[3] *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.

(MO 2006), but payments were made for a relatively short period (2008-2010) and then were interrupted mainly due to lack of budgetary allocation (Popa et al. 2016).

Timber harvesting is the most important activity within the forestry sector with potential impact on biodiversity and the ES provided by PAs, such as carbon sequestration, air quality, water and soil erosion regulation, nutrient retention, landscape, and the production of NTFPs (Popa and Bann 2012). Therefore, sustainable forest management is crucial for the effective provision of PAs 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 (Strâmbu et al. 2005). Besides the timber, although not among the specific reasons for PAs establishment, the use of NTFPs 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 NTFPs is economically viable.

3.3. Qualitative assessment of ES provided by pilot protected areas

The main features of the five Carpathian pilot PAs are summarized in Table 3.3-1. (Popa and Bann 2012).

Table 3.3-1. Key features of the pilot sites (VNNP 2010, RNP 2008, PCNP 2008, MNP 2008, ANP 2008)

PA	Area (ha)	Location	Key characteristics
Apuseni Natural Park (ANP)	148,850	Western Romania, Central-North Western side of Apuseni Mountains, covering parts of Cluj, Bihor and Alba Counties	Biodiversity, karst landscape, local tradition in wood processing, cultural heritage
Maramures Mountains Natural Park (MNP)	148,850	North Romania, covering almost all the area of Maramures Mountains, northern – eastern part of Maramures County	Biodiversity, mountain landscape, local tradition in architecture and natural products, cultural and historic heritage
Piatra Craiului National Park (PCNP)	14,773	Meridional Carpathians, Central Romania, stretching over the counties of Brasov and Arges,	Longest lime edge in the country, local traditions and architecture, biodiversity
Retezat National Park (ReNP)	38,138	Western part of Romania, part of the Retezat – Godeanu massif, stretching over the counties of Hunedoara, Caras – Severin and Gorj.	Glaciar lakes, mountain landscape, biodiversity, local traditions
Vanatori Neamt Natural Park (VNNP)	30,818	North-western part of Romania, eastern slope of the Oriental Carpathians (Neamt Mountains) and under mountains hills of Neamt, stretching over the county of Neamt	Vegetation low mountains landscape, local ethnic and spiritual traditions, historic and cultural heritage of the communities, biodiversity, *Bison bonasus* repopulation

Natural and National Parks in Romania's Carpathians provide a wide range of ES, which support the productivity of many sectors and benefit individuals. The differences between parks in terms of the ecosystem services they provide are not significant, but it is possible to identify ES of particular importance for each PA. The variation between parks in terms of ecosystem services provision is a result of the differences in their natural features, protection and conservation goals, maturity based on when the park and park administration were established, and management efforts and processes in place (Popa and Bann 2012).

At the beginning of the project, 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) risk of ES flow diminishing due to exploitation pressures (Popa et al. 2016). The results of the ranking (qualitative assessment of the ES provided by the pilot PAs) can be seen in the table 3.3-2.

Table 3.3-2. Qualitative assessment of PA services and benefits at Pilot Sites (Popa and Bann 2012)

ES Type	**Service**	**Benefit / outcome**	**Significance**					**Sectors supported by ecosystem service**	**Sectors impacting / influencing the provision of ecosystem service**
			ANP	**MNP**	**PCNP**	**ReNP**	**VNNP**		
Provisioning Services	Food	Commercial and subsistence crops; breeding products	**	*	**	**	**	Households Fishery, Tourism, Agriculture	Households, Fishery, Agriculture, Industry
	Wood	Timber, traditional wood products, commercial processed wood products	**	**	**	*	**	Households, Forestry, Wood processing industry	Forest administration, households, wood processing industry, Forestry
	Water	Public water supply, mineral waters for commercial use, water for industrial and agricultural usage	**	**	*	*	*	Industry, households, tourism	Agriculture, Industry, Forestry
	NTFPs	Natural medicines, forest fruits, forest fruits based products	**	**	*	*	**	Forest administrators, households, industry	Forest administration, Households, Industry, Forestry
	Source of energy (fuel etc.)	Energy provision e.g., hydropower	**	_	_	**	_	Energy	Forestry, Breeding
Regulating Services	Regulation of GHGs	Carbon sequestration	*	**	*	*	*	Potentially all	Potentially all
	Micro-climate stabilization	Air quality	**	**	**	**	**	Potentially all	Industry, Forestry
	Water regulation (storage and retention)	Flood and landslide prevention	**	**	**	**	**	Tourism, Industry, Households/ Urban Settlement, agriculture	Forestry, Agriculture, Breeding
	Soil erosion regulation	Improved water quality ,	*	**	*	*	_	Households, Urban settlements, hydropower	Forestry, Agriculture, Breeding

	Nutrient retention	Improved water quality	*	*	*	*	*	Fisheries, Agriculture, water supply	Forestry, Agriculture, Breeding
Cultural Services	Spiritual, religious, cultural heritage	Local traditions, Churches and monasteries, Archaeological ruins (historical not recreational value). Use of environment in books, painting, folklore, national symbols, architecture, advertising	**	**	**	*	**	Tourism, Households	Potentially all
	Educational	A 'natural field laboratory' for understanding biological processes	?	?	*	*	*	Households	Potentially all
	Recreation and ecotourism	Recreational fishing and hunting, birdwatching, hiking, Holiday destination (aesthetic views), archaeological ruins (historical not recreational value)	**	**	**	**	**	Tourism	Potentially all
	Landscape and amenity	Property price premiums due to views	?	?	*	*	_	Tourism	Potentially all
	Biodiversity non-use	Enhanced wellbeing associated for example with bequest or altruistic motivations	?	?	*	*	*	Potentially all	Potentially all

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

It is evident from the table above that the majority of ES is provided across the sites, with micro-climate stabilization, water regulation and recreation and tourism considered to be important at all sites. The qualitative assessment also identifies the sectors that benefit from the provision of a given ES and the sectors that may impact the provision of ES through their activities. For example, industry, households and the tourism sectors benefit from water provision, however the quality and quantity of water will be impacted by, for example, agricultural practices (such as the use of agrochemicals) and forestry (extraction practices) (Popa and Bann 2012).

3.4. Research regarding the forest ecosystem services valuation in different management scenarios: a case study from Maramures Mountains

3.4.1. Introduction

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 ESV (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). 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 (Popa et al. 2016). Based on the link between ecosystem services and human wellbeing, the study overlies the framework that has now long been used by environmental economists to categorize and define the total economic value of ecosystems and biodiversity. The innovation is, from an economist's perspective, that this recognizes that biodiversity and ecosystems generate values that far exceed those that have conventionally been calculated by economists, and included in decision-making – they do not just support commercial resource uses, but also generate a wide range of non-market values, and broader sources of support to production, consumption and wellbeing (Popa 2013b). A second framework that the research draws on is that provided by TEEB – the EU-sponsored initiative on "The Economics of Ecosystems and Biodiversity". This has recently gained a great deal of publicity and currency with decision-makers (TEEB 2010). TEEB suggests an approach which has three stages: identifying and assessing ecosystem services, estimating and demonstrating their value in economic terms, and capturing these values and seeking solutions (TEEB 2010). The present valuation research deals with the first two of these steps, while the future initiatives may also extend to the third (Popa 2013b).

There are numerous techniques that have been developed to estimate economic values of non-market goods/services (e.g. travel cost, contingent valuation method; see Table 1.1-2., etc.). The methodology used in this study - TSA 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 TSA 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 TSA 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 PAs (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 PAs value estimations (Dumitraș and Drăgoi 2006, Ceroni 2007, Ceroni and Drăgoi 2008, Dumitraș 2008, Dumitraș et al. 2011), showing an increasing interest in this matter.

Carpathian PAs face pressures that include over exploitation of forest resources (Knorn et al. 2012) as well as the underfunded PAs 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 (Popa and Bann 2012). This information can enable them to make decisions that are favorable to sustainable management of PAs and the continuous flow of ES. This was the purpose of the research study conducted in 5 pilot PAs in 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 (Popa et al. 2016).

This section of the habilitation thesis presents a part of the results of this study, particularly those referring to one of the pilot PAs – Maramures Mountains Natural Park. 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 research is on the assessment of primary wood production and the value of NTFPs associated with the active management of forests in MNP.

3.4.2. Materials and methods

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 surface of 133,354 ha and is located in North Romania (Figure 3.4-1.).

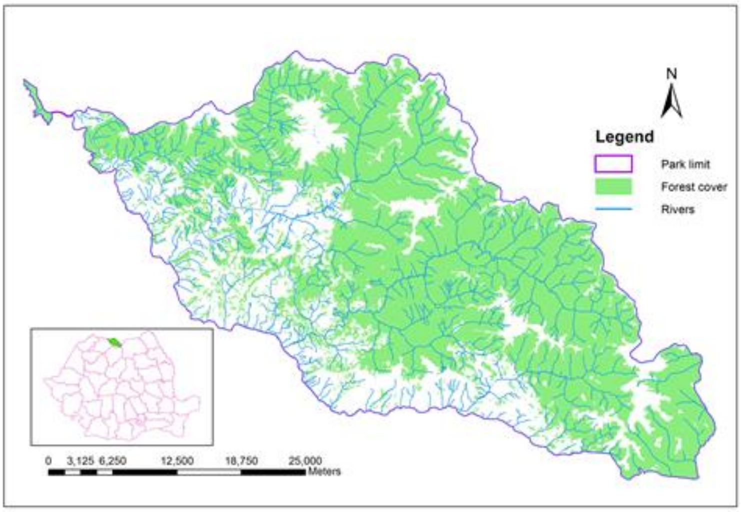


Figure 3.4-1.Maramures Mountains Natural Park – location at country level and forest areas (MNP 2008)

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 mill 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 (Popa et al. 2016).

Methodology for assessing the value of forest ecosystem services

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

Step 1: Definition of the scope of the assessment. 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) 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 NTFPs 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 3.4-1.).

Table 3.4-1. Ecosystem services identification and indicators selection (Popa et al. 2016)

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

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 (FMPs), all these being supplemented by a review of the available literature on the economic value of MNP or other PAs in Romania or in the countries in the region (Forster et al. 1987, Birda 2011, Ceroni 2007, Dumitraș and Drăgoi 2006, Ceroni and Drăgoi 2008 , Dumitraș 2008, INCDT 2009, Getzner 2009, Dumitraș et al. 2011) (Table 3.4-2.).

Table 3.4-2.Data nature and sources (Popa et al. 2016)

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, Dumitraș and Drăgoi 2006, Dumitraș 2008, Dumitraș et al. 2011, Getzner 2009)
	Consumer surplus	

Step 3: Definition of the BAU and SEM scenarios. A scenario description was organized through a workshop in September 2012 under the guidance of the research team 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 visiting sector): 2 PAs managers, 2 environmental experts from NFA, 4 forest managers, 3 non-state forest owners' representatives, 2 members of the central authority for forestry and environment, 4 biologists and forest habitats specialists. After the organizers presented drafts of the SEM and BAU scenarios, and the principles behind the TSA 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 organizers, but also proposed by the workshop participants: forestland zoning, level of compensatory payments, legal and illegal logging, evolution of NTFPs production and potential, number of visitors, entry fee level and soil erosion level (Table 3.4-3.). Every 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 PAs financing and forest administration in order to address the stated limitations regarding the reliability and the validity of the TSA 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 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 (Popa et al. 2016).

Step 4: The analysis. The economic value of ES has been calculated using the selected valuation techniques (Table 3.4-1.) and the collected data (Table 3.4-2.) 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 the 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’s 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 every 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 NTFPs 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 (Popa et al 2016).

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 Biomass Extension Factor used 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, 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 (Dumitraș 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 Dumitraș (2008) and Dumitraș et al. (2011). All values from previous years were adjusted to 2011 price levels, applying a consumer price index (CPI) deflator (Popa 2013b). The valuation estimates presented in this research are not comprehensive, and depend on many assumptions. The study also relies to some extend on extrapolating the few data that are available for Romanian system of PAs, and of necessity employs “value transfer” techniques. There are many limitations to the value transfer approach which are mainly to do with the credibility of applying data about a particular site or ecosystem to another context which might have very different biological, ecological and socio-economic characteristics (Emerton 2011, Popa 2013b).

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% (Popa et al. 2016).

3.4.3. 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, NTFPs, clean water for public use), regulating services (carbon sequestration, water regulation, soil erosion) and cultural services (recreation and ecotourism) (See table 3.3-2.). 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 3.4-3 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 to improve NTFPs usage, while, due to possible degradation of ecosystems, the potential of NTFPs 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 (Popa and Bann 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 NTFPs. Timber harvesting reduction will encourage increasing the use of NTFPs (guided by studies on sustainable use). Enforced PAs MPs, together with a better enforcement of forestry specific regulations will lead to a reduction in illegal logging and increasing interest in recreation activities (Popa et al. 2016).

Table 3.4-3. BAU and SEM scenarios – summary (Popa 2013b, Popa et al. 2016)

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
NTFPs		
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 1EUR/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

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 €1.3 mill in 2011. The results of a study undertaken in 2005 (Dumitraș et al. 2011) to estimate the economic value of recreation in 5 PAs in Romania, showed that the average consumer surplus per visitor was €42, and consequently, the total consumer surplus equaled €0.7 million in 2011 prices. The PV (at the higher discount rate used for sensitivity analysis – 10%, Table 3.4-4.) of the recreational ecosystem services (including consumer surplus) is estimated at €22.5 million in the SEM scenario and €14.2 million in the BAU scenario, indicating a significant difference in favor 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 PAs 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 PAs carrying capacity is reached. Figure 3.4-2. illustrates the different trajectory for the tourism value under BAU and SEM (Popa 2013b, Popa et al. 2016)

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

Table 3.4-4. Present value of ecosystem services for different sectors and scenarios, using various discount rates (30 years, million EUR) (Popa et al. 2016)

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

Water supply

The value of water supply was estimated at € 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 € 3200 in 2011.

Carbon sequestration

For the 2010-2011 period, 266,881 tons of additional CO_2 were sequestered, with a total value of €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 3.4-4.) over the next 30 years is estimated at circa €8.0 million indicating a significant difference in favor 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 €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 3.4-2.).

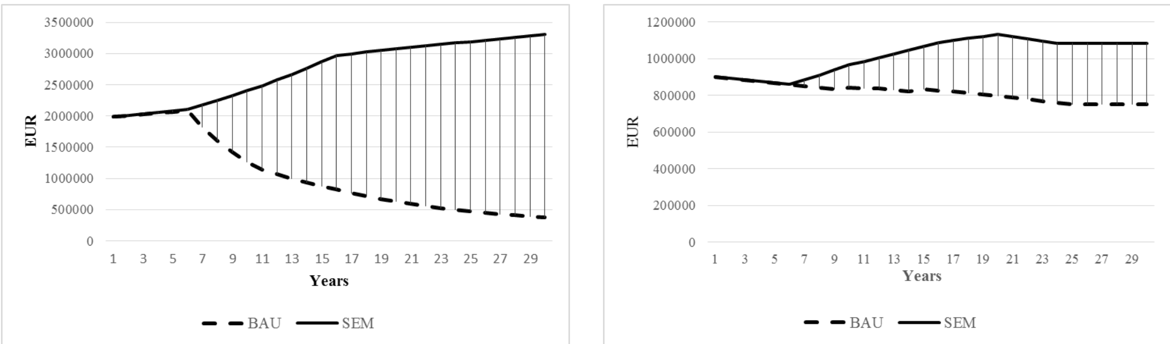


Figure 3.4-2. Maramures Mountains Natural Park forest ecosystem values for tourism (left) sector and carbon sequestration (right) under BAU and SEM (Popa et al. 2016, Popa 2013b)

Forestry

The total 2011 value of forest provisioning services within forestry sector in *MNP* can be seen in Table 3.4-5. (including the distribution of this value among the main two beneficiary's categories) (Popa et al. 2016).

Table 3.4-5. Baseline value of forestry ecosystem provisioning services in Maramures Mountains Natural Park, 2011 (Popa et al. 2016)

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

The estimated PV of provisioning ecosystem services in the 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 € 65.45 million for the BAU scenario and € 65.3 million for the SEM scenario (Table 3.4-4). 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 3.4-3.) (Popa et al. 2016, Popa 2013b).

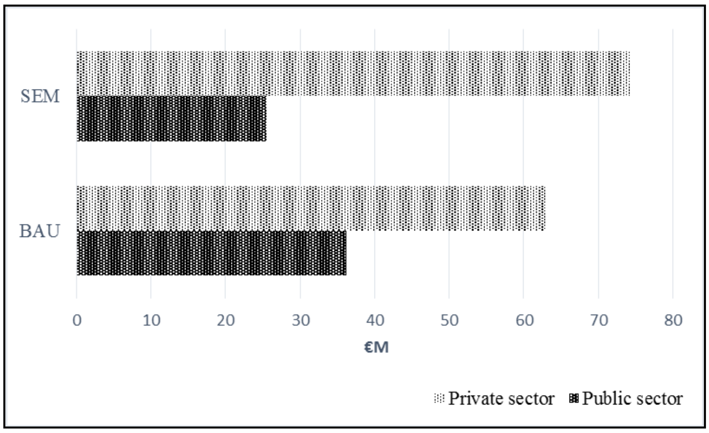


Figure 3.4-3. Gains to beneficiary groups - *SEM* over *BAU*; *BAU* - Business as Usual, *SEM* - Sustainable Ecosystems Services (Popa et al. 2016)

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 NTFPs. The productivity of NTFPs is underpinned by healthy ecosystems and biodiversity. The rate of growth eventually slows as optimal NTFPs harvesting rates are reached, and is constant in the long run. While BAU is equivalent or superior to SEM (Figure 3.4-4.) in the short term, in the medium to long term SEM is the more beneficial.

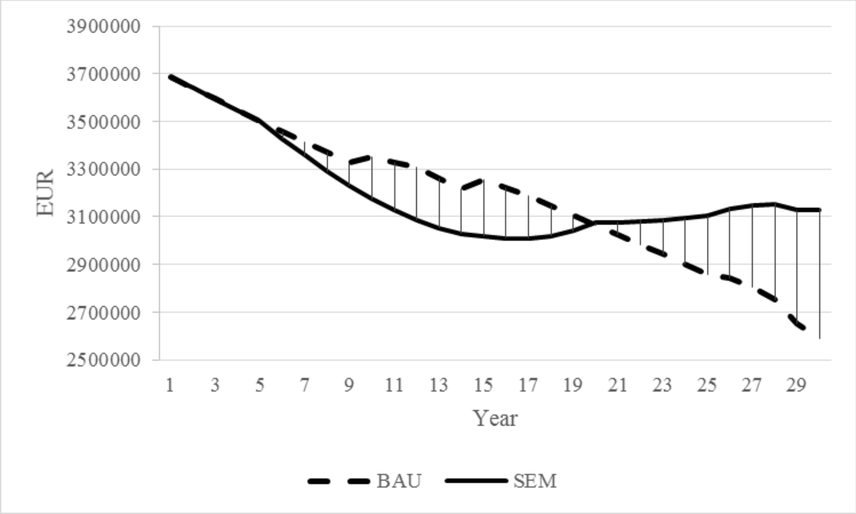


Figure 3.4-4. Maramures Mountains Natural Park forest ecosystem provisioning values under BAU and SEM; BAU - Business as Usual, SEM - Sustainable Ecosystems Management (Popa et al. 2016)

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 (Popa et al. 2016).

3.4.4. Discussion

A very important aspect worth discussing regarding the TSA approach used for this study is the fact that the validity and reliability of the results depend on the agreement of experts (practitioners, scientists or decision makers) regarding BAU and SEM scenarios description. Getting to such an agreement can be very difficult, the entire TSA 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 favorable 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 PAs 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 PAs 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 (Popa et al. 2016).

The difficulty of developing the scientific basis or the policy and finance mechanisms for incorporating natural capital into resource-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 TSA 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 TSA studies. Still, within the UNDP project Protected Areas Budget Negotiation Support Project, as a result of the TSA study done for Latin and Central America (Bovarnick et al. 2010) in Chile the Government decided to increase financing for PAs 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 PAs 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 TSA approach study can be found in Republic of Moldova where the budgeting of the National Biodiversity Conservation Strategy and Action Plan (NBSAP) was based on a TSA approach study (Popa 2014b), and this triggered the approval of the NBSAP (including the budget) in 2015 (GD 2015).

The purpose and the specificity of the TSA 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 (Popa et al. 2016).

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 (Popa et al. 2016).

3.4.5.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 NTFPs. 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 PAs 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 study 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 (Popa et al. 2016).

3.5. Research regarding the total economic value of natural capital – Case study of Piatra Craiului National Park

3.5.1. Introduction

Although the primary goal of PAs is biodiversity and ecosystem conservation, they typically leave a substantial economic footprint (Constanza et al. 1997, Daily 1997, Emerton 2009, MA 2005, Sacs et al. 2009, TEEB 2010). The substantial values generated by biodiversity and ecosystems accrue across many sectors and beneficiaries groups (TEEB 2010), and can be captured in monetary terms by ESV, this being considered an increasingly important aspect of effective conservation and development policies (Christie et al. 2012, TEEB 2011).

According to the Millennium Ecosystem Assessment framework, there are four basic categories of ecosystem services (MA 2005): provisioning, regulating, cultural and supporting services, all of them constituents of human wellbeing (MA 2005, Yapp et al. 2010). Being able to express these linkages requires that PA goods and services be adequately valued and the results be properly presented to the decision makers. In standard economics, the value of every good is defined to be nothing else than its price (Spangenberg and Settele 2010) and the fact that many of the ecosystem are not priced or marketed (Emerton 2011) posed a problem to economists. Thus, over the last two decades, a suite of methods has been developed for dealing with the economic value of ES (Ruzzier et al. 2010, TEEB 2010). TEV has become the most commonly used framework for identifying and categorizing ES values (Emerton 2009) taking account of those values that have traditionally been omitted from economic and financial decision-making. TEV framework considers not only the *direct values* of the provisioning services (raw materials and physical products that are used for production, consumption and sale) but also *indirect values* (ecological functions which maintain and protect natural and human systems), *option values* (the premium placed on maintaining ecosystems for the future possible uses, some of it may not be known now) and *existence values* (the intrinsic value of ecosystems regardless of current or future possibilities to use them) (Emerton 2009). The aim of TEV framework is to determine public and private decision makers to treat PAs as economically valuable assets when they are compared to other investment options, and also to better recognize the opportunities that investing in PAs brings to the economy (Emerton 2011, TEEB 2011).

Romanian PAs are known for their high conservation value, with very valuable and diverse habitats, including a significant surface of old growth primary forests (Knorn et al. 2012) and the largest European population of brown bear, grey wolf and lynx (Ioras et al. 2009). After a major surface expansion and important reorganization process in the recent years (Abrudan et al. 2009, Ioja et al. 2010, Knorn et al. 2012, Stăncioiu et al. 2010), Romanian network of PAs includes 27 national and natural parks (Ioja et al. 2010) besides the newly implemented Natura 2000 network. However, the PAs management is considered as insufficiently efficient (Ioja et al. 2010) and different studies point out that it suffers from severe underfunding (Birda 2011; Ioras et al. 2009; Knorn et al. 2012). This situation triggered the experts interest for valuing ES in Romania, in classical market prices approach (Poyton et al. 2000) or, in the last years, using TEV framework (Ceroni 2007, Ceroni and Drăgoi 2008, Dumitraș and Drăgoi 2006, Dumitraș 2008, Dumitraș et al. 2011). However, there is a general sense of need to continue the research in the field (Dumitraș et al. 2011) as well as to better disseminate the results among decision makers.

In the attempt to follow the above-identified needs, the aim of this research was to create a viable frame for assessing the TEV of PAs under current Romanian data availability conditions and present the PAs assets in a friendly manner for decision makers. By using different valuation techniques the results presents the TEV of the ES in Piatra Craiului National Park (PCNP), generating also distributional analysis for decision makers to assess and design proper PES mechanisms (Popa and Borz 2013).

3.5.2. Materials and methods

PCNP is located in the Meridional Carpathians, Central Romania. The list of important protected species in the park includes "garofița pietrei craiului" (*Dianthus callizonus*) the symbol of the Piatra Craiului massif, *Taxus baccata*, *Angelica arhangelica, Nigritella nigra* and *N. rubra, Papaver alpinum ssp. corona-sancti-stefani; Linaria alpine, Leontopodium alpinum, Trolius europaeus, Rhododendron mytifolium, Gladiolus imbricatus, Gentiana lutea, Daphne blagayana, Daphne cneorum*, etc. PCNP houses an impressive number of mountain orchids, 48 species out of the 53 species found in Romania. Due to the high declivity of the mountain slopes, the vegetation layers formed according to the altitude are best noticeable here, the massif being surrounded, from the bottom towards the ridge, by hay fields, forests, bare rocks and alpine meadows. PCNP also holds a significant population of large carnivores. PCNP management objectives are ranging from biodiversity conservation to tourism promotion and development and local traditions conservation and awareness. PCNP area has a strong history in traditional breeding and forest harvesting. In the last decade, there was a significant development of agro-tourism, villages and towns in the area being considered as having a very high untapped development potential (PCNP 2008).

Assessing the total value of PAs means considering all its features as an integrated system, extending beyond just physical products and market commodities (Emerton 2011). Thus, the approach used involved firstly identifying the ES that PCNP generates. This *first step* was accomplished through a series of workshops with relevant experts and PCNP management team, resulting also a rapid assessment on data availability for choosing appropriate valuation techniques. The ES identification relied on the following criteria (developed during the workshops): i) importance of ES for local livelihoods; ii) development and investments opportunities for the future; iii) importance for maintaining traditional use of land and iv) risk of

ES flow diminishing due to exploitation pressures. The identification of ES also allowed tracing the ways they impact on human wellbeing. The economic sectors and activities considered as being affected or affecting the flow of ES, as resulted after the workshops, are tourism and recreation, forestry and hunting, agriculture, urban water supply and climate change mitigation (see also table 3.3-2.).

The *second step* entailed by the applied approach was assessing the economic values of ES, based on their impact on human activities. Data collection was carried out mainly as a desk work, being based on statistical records of different institutions (National Institute for Research and Development for Tourism – INCDT, Romanian Waters), 2008 edition of the management plan of PCNP (PCNP 2008), records that are routinely kept by park management, studies performed during PCNP management plan elaboration, statistical and operational reports of Forest Districts in the area, Forest Management Plans (FMPs), all of those supplemented by a review on the available literature on the economic value of PCNP or another PAs in Romania or in the countries from the region (Table 3.5-1.). A range of valuation methods (Table 3.5-1.) were adopted to estimate the market and non-market values of the ES, all the approaches being well documented in the environmental economics literature (Arrow et al. 1993, Bateman et al. 2002, Bockstael and McConnell 2006; Kanninen 2006, Maler 1974, Taylor 2003, TEEB 2010, Ward and Beal 2000).

Table 3.5-1. Summary of valuation methods and data used for valuation of ES (Popa et al. 2013a)

Ecosystem service	Valuation method	Data used
Food/ agriculture products	Market pricing	Market price for agricultural products, support capacity of the pastures, area of pasture, average over grazing or actual overgrazing data, (PCNP 2008) milk prices/earnings (assuming that earnings are unitary based on LSU (Livestock Unit) indicator for pastures and hay production areas)
Wood and NTFPs	Market pricing, transfer benefit	GIS data base of the PA administration, forest qualitative and quantitative data, harvested wood and NTFPs quantities and market prices, illegal logging values and quantities, game management and NTFPs revenues in similar conditions in the region (Ceroni 2007).
Water	Market pricing	Water consumption/capita/year and population paying for water and price paid per cubic meter of water.
Regulation of GHGs	Market pricing	Estimated CO2 sink, based on standing wood volumes and increments, CO2e market prices.
Soil erosion regulation	Market pricing, Production inputs, benefit transfer	Vegetation maps (Corine Land Cover), surface, slope, soil quality (GIS data base from PCNP administration and forest management plans), urban water quantities used, prices for urban water, treatment costs, links between water treatment costs and water quality (Forster 1987).
Recreation Educational Spiritual, heritage	Benefit transfer, travel cost, contingent valuation	Visitor numbers (INCDT 2009), Visitor expenditure (Ceroni 2007), consumer surplus (Dumitraș and Drăgoi 2006, Dumitraș et al. 2011)

For agricultural provisioning services and urban water provisioning services, values were estimated by simply computing the market value of products. For forestry provisioning services (wood production) harvested wood volumes and prices, illegal logging quantities were extracted from official records of forest districts and the Territorial Inspectorate for Forest Regime and Hunting Cluj Napoca. Compensation payments values were calculated based on official Government approved formula (M.O. 2006). Values for hunting and non-timber forest products (NTFPs) were transferred using benefit transfer techniques from other studies (Ceroni 2007), benefit transfer methods using surface extrapolation (Popa et al. 2013a).

The CO_2 accumulated stock was calculated for every species and production class. Standing volumes were estimated using standard volume calculation equations (Giurgiu et al. 1972, Leahu 1994). The Biomass Extension Factor used 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 corresponding coefficients for carbon concentration within wood biomass are based on IPCC guidelines.

For soil erosion regulation service, 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 soil eroded quantity. The TEV was calculated based on the cost reduction for local water operator due to decreasing soil erosion leading to a decrease turbidity of water and thus reduced treatment costs. For tourism sector data recorded in PCNP management plan or found in studies done for PCNP (visitor numbers, average number of tourist camping, visitor expenditure) were combined with data collected in regions more or less similar to PCNP area (consumer surplus). Where benefit transfer techniques have been used, a conservative approach has been taken and all values have been adjusted to 2012 price levels, applying a consumer price index deflator (Popa et al. 2013a).

ES values were assessed by economic sectors due to the recognized need (Popa and Bann, 2012) for an accessible way of presenting the results to the decision makers; representatives of every sector will find data relevant for their sectors enabling them to better link PAs intrinsic values with their day-by-day activities. Results were grouped on several beneficiaries' categories, looking forward for possible attempts to design and implement PES mechanisms (Popa and Borz 2013).

The study is based on a desk study and no field data collection was implied. The resulting analysis should therefore be seen as being a courageous first (still incomplete) attempt to estimate the economic value of ES provided by PCNP. The results are estimative, and involve many assumptions. When new data become available, or as more detailed studies are undertaken, the figures presented in this paper can be improved and updated.

3.5.3. Results and discussion

The contribution of PCNP to key sectors

Tourism.

Tourism is an important sector for the Piatra Craiului region and an important economic development priority (INCDT 2009). In 2009, around 100,000 visitors were recorded (INCDT 2009). Visitor expenditure on entrance fees, travel, accommodation and souvenirs, etc. can make an important economic impact. Still, in 2010 only few PAs in Romania generated revenues from park entry fees, PCNP not being among them (Birda 2011), but PCNP visitors spent money on accommodation and meals. The only available study on tourism expenditure was the one done for Maramures Mountains National Park (MNP) (Ceroni 2007). This study calculates average visitor expenditure per visit on food and accommodation at RON 483.5 in 2007. Considering an average duration of visit of 5 days the total daily expenditure per visitor can reach €27.1 (Ceroni 2007). Similar studies in the region prove that this estimate is rather conservative. For example in Slovensky Raj National Park total visitor expenditure averages €54 per person day (Getzner

2009). Based on the data from INCDT study (INCDT 2009) referring to the proportion of visitors camping vs. number of visitors using hotels, in PCNP, the majority of tourists (60%) use tents while trekking around the high altitude areas. Based on the number of visitors multiplied by the percentage of tourists with longer stays multiplied by the total expenditure per visit, direct spending on hotels was accounted (Table 3.5-2).

Table 3.5-2. Value for ES in PCNP per sector/activity (Popa et al. 2013a)

Sector/category	Value (EUR)
Tourism	
Direct spending on hotels and restaurants	5,991,810
Visitor consumer surplus	4,864,200
Revenues to PA administration	0
Total	10,856,010
Forestry	
Income to public forest administrators	162,052
Income to private forest administrators and owners	241,586
Income to NEF	9,634
Income from illegal logging	16,056
Total	429,329
Agriculture	
Equivalent income to animal breeders	1,829,288
Carbon sequestration	
Additional CO_2 value 2009-2010	128,802
Water	
Revenues to water operators	227,893
Value of soil erosion regulation services	880
Total	228,773
Total economic value	13,472,202

The total economic value of PAs tourism is greater than the amount of money people actually spend because some tourists would be willing to pay more than they do to enjoy the tourism experience of a PA. This "consumer surplus" is measured by a visitor's maximum willingness to pay for the PA tourism experience less their actual expenditure (Popa and Bann, 2012). The results of a study done in 2005 (Dumitraș 2008; Dumitraș et al. 2011) to determine the economic value of recreation in several parks in Romania, using the contingent valuation and travel cost method to calculate the consumer surplus, shows consumer surplus is €44.3 for PCNP, and consequently, the total consumer surplus equals €4.9 mill in 2012 prices (Popa et al. 2013a).

Forestry

The pilot PAs have a total forest area of 9,602 ha with a total standing volume of 5,042,000 m^3, consisting of fir, spruce, birch, oak, and other hard and softwood species (PCNP 2008) (Table 3.5-3.).

Table 3.5-3. Information on forests in PCNP (Popa et al. 2013a)

Species	Area (ha)	Standing volume (,000 m^3)	Volumes extracted 2010 (m^3)	Average prices(standing wood, RON/m^3)
Resinous	5,535	2,907	9,272.8	84.73
Birch	4,026	2,114	6,745.0	69.04
Oaks	0	0	0.0	114.8
Other hardwood species	0	0	0.0	75.08
Other softwood species	40	21	67.6	58.63
TOTAL	9,602	5,042	16,085.3	

In terms of wood production, the value of forests in PCNP equals €0.42 mill in 2012 (Tab. 3). Compensatory payments for privately owned protection forests are influenced by the decreased percent (40%) of the publicly owned forests. Both private and public forest administrators contribute 3% of the value of standing wood sales to the National Environmental Fund (NEF). This added an additional € 0.01 million to public revenues from forestry in 2012. Illegal logging is estimated at around €16,056 accounted to the private sector in 2012 (Popa et al. 2013a).

The value for NTFPs was calculated using benefit transfer techniques based on the data provided by the study done in MNP (Ceroni 2007). The total NTFPs production under sustainable conditions is estimated at €0.09 million in PCNP. Ceroni (2007) estimates hunting in MNP at RON 0.1 million, but there are some doubts regarding the sustainability of this activity (Popa and Bann, 2012). Using benefit transfer techniques in a conservative manner (reducing by 25% the data as corresponding to a sustainable gaming level), the Ceroni (2007) figure is equivalent to €3,305 for PCNP in 2012 (Table 3.5-2.).

Agriculture

In PCNP for a total pasture area of 379 ha the carrying capacity was estimated at 260 Livestock unit (LSU) in 2000 (i.e. 1.4 LSU/ha), while there were 566 LSU using the pastures, suggesting overgrazing of 218% (PCNP 2008). Assuming that a LSU produces 15 liters of milk per day (MARD 2011), an average producer price of RON 0.7 per liter in 2008 (CC 2009), and that the number of animals is more or less constant between 2007 - 2011 the derived value is €1,829,297 all accounted for private sector in 2012. A large amount of the money is staying in the local economy, especially if local food industry initiatives integrate the benefits (Popa and Bann, 2012). The fact that the support capacity is severely overpassed requests urgent measures to decrease greasing to the support capacity levels. A sustainable economic value of the considered ecosystem service is calculated at € 0.8 mill, while the actual value is 218% bigger (Popa et al. 2013a).

Carbon sequestration

The accumulated quantity of CO2 is great in the protected forests as well as in the youngest stands. The calculations being done only for the additional CO_2, the result for the period 2011 - 2012 is 35,983 tons of CO_2. In order to determine the potential value of those additional quantities the average price (\$4.5/tCO_2e) for CO_2 reported by New Energy Finance and

Ecosystem Marketplace for Clear Development Mechanism under Kyoto protocol was used (Ecosystem Marketplace 2013). Thus, the total estimated value is €128,802.

Urban Water supply

Urban water for 17,900 inhabitants in Zărnesti town comes entirely from PCNP. Average urban consumption in Romania is 110 liters per person per day (Rowaters 2010). Consumers pay the local water operator, a tariff of €0.08 per m^3. It was assumed that these charges include fees paid to Rowaters (Romanian State Water Administration Company) plus the treatment and distribution costs and a gross profit of 10%. Provisioning ecosystem services (water supply) is evaluated at €227,893, while soil erosion regulating services are estimated based on cost reduction approach at €900 between 2011 and 2012 (Popa et al. 2013a).

Distribution of PA values

PCNP generate economic benefits for a wide range of groups and economic sectors. Summarizing all the benefits gives us a total estimated value of € 13,472,202 distributed among sectors (Figure 3.5-1.). The biggest part of this value is associated with tourism (80%), followed by agriculture. Tourism revenues are undoubtedly a key value generated or possible to be generated by PCNP, and their importance should be underlined. At the same time, it is tourism activities for which we benefited from the most accurate and the biggest amount of data available − and thus the valuation is fairly comprehensive as compared to other sectors (such us soil erosion regulation services for which it has been impossible to fully value the wide range of economic impacts).

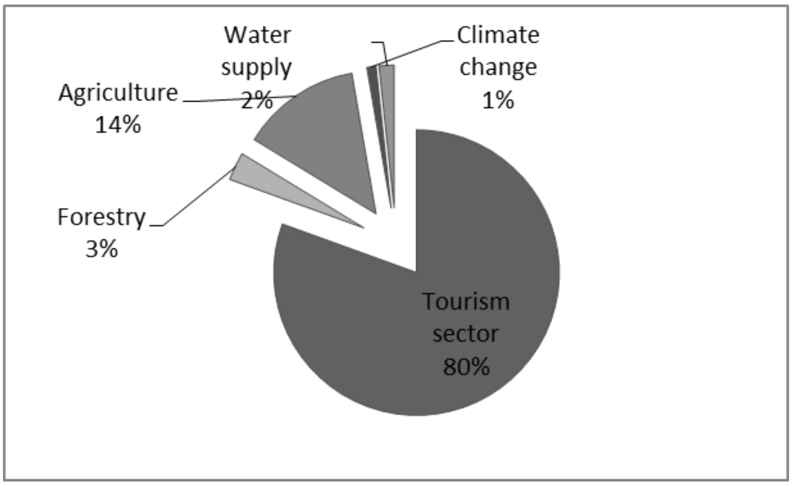


Figure 3.5-1. Contribution of different sectors and activities to PCNP value (Popa et al. 2013a)

In the same time, the estimated ES values create benefits for a wide range of stakeholders groups. In this study they were grouped in three categories: i) public beneficiaries, meaning public agencies and institutions, ii) private beneficiaries meaning private enterprises or individuals and iii) noncommercial beneficiaries, meaning possible beneficiaries of the untapped economic values. Expressing similar caveats concerning the data availability, we can observe that half of the value accrues to noncommercial beneficiaries: mainly local communities and visitors (Figure 3.5-2.). A big share of this value represents consumer surplus that should and can be captured by the tourism sector, meaning a high potential of economic benefit for local communities. Carbon trading is an opportunity that should be explored and can bring some benefits to private forest owners, especially in medium term. The private sector, mainly small-scale entrepreneurs in tourism, non-state forest owners and administrators is also a significant beneficiary of PCN goods and services. The small share of the public beneficiaries can be explained by the fact that taxes and other governmental contribution associated to other beneficiaries were not accounted as public revenues (Popa et al. 2013a).

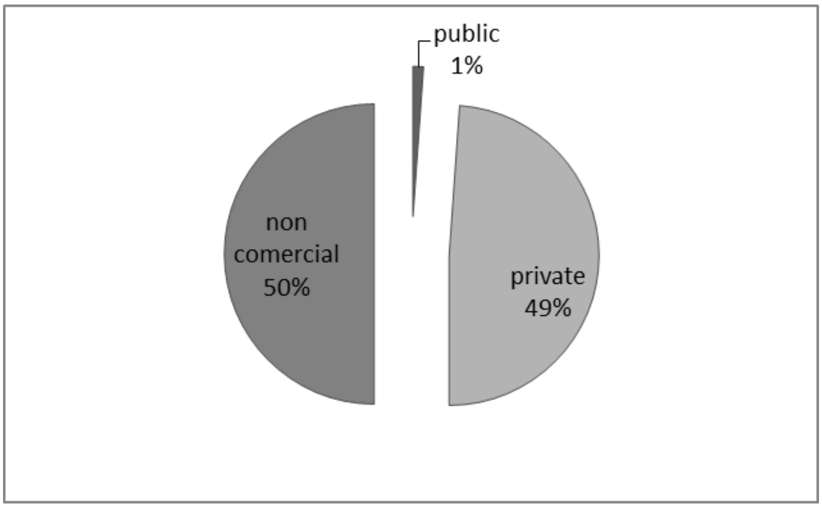


Figure 3.5-2. Distribution of PCNP value across beneficiary groups (Popa et al. 2013a)

3.5.4. Conclusions

PCNP generates consistent values and supports different sectors of the local economy, including tourism, water, agriculture, forestry and climate change mitigation. A very low economic effect mirrored in the earnings of the PA administration and this translates in a low cost recovery. In tourism sector especially, many services are provided at zero price for users willing to pay for them, this being a potential market for PCNP management and owners of local touristic infrastructure. Increased priority in policy can help capture those values in monetary terms.

3.6. Research regarding the value of forest ecosystem services in Apuseni Natural Park, Retezat National Park, and Vanatori-Neamt Natural Park – a comparative analysis of management scenarios

3.6.1. Introduction

The Romanian forest management system was known for its performance during the communist period, all the forest belonging to the state and being managed following sustainability principles (Strâmbu et al 2005). After 20 years of structural changes triggered by an extended process of restitution, a more stable system is now in place with almost all the forest (6.0 million ha out of 6.3 million ha) being administrated by National Forest Administration Romsilva or by private forest districts (Abrudan 2012, Ioras and Abrudan 2006). Forests managed based inter-alia on biodiversity conservation principles (Stăncioiu et al. 2010) created, in the last 20 years, the opportunity to develop a PA network that is covering 23% of the total territory of the country and almost 30% of the forests (WB 2013, Popa et al. 2013b).

However, the poor financing of this extended network of PA (Ioja et al. 2010, Knorn et al. 2012) triggers the need for a better assessment of ecosystem services values and a better way to communicate these findings to decision makers, to support their decisions in terms of forest management and biodiversity conservation funding. The frame for this assessment and communication effort is created by the ESV initiatives (MA 2005). Millennium Assessment (MA, 2005) recognize four types of ES: *provisioning* services such as timber, food, NTFP, *regulating* services that affect climate, floods, waste and water quality; *cultural* services that provide recreational, aesthetic and spiritual benefits; and *supporting* services such as soil formation and retention, primary production and habitat provision (TEEB 2010, Emerton 2011).

Wood harvesting, collection and sale of NTFP and hunting are the most important activities within the sector that can be economically counted as direct use values – forest ecosystems provisioning services, since these goods are rewarded by the existing markets. Forest harvesting is a complex activity with potential impacts on biodiversity and the ES provided by PAs such as carbon sequestration, air quality, water and soil erosion regulation, nutrient retention, landscape conservation, and the production of NTFP. Therefore, sustainable forest management is crucial for effective provision of PAs ecosystem services.

In theory, forest ecosystems within the PAs are managed, in Romania, according to the forest and parks management plans (MP), but in reality these plans are not always fully enforced due to a range of factors (Popa and Bann 2012): i) not all PA MPs are approved; ii) there is no compensation for harvesting restrictions within private forests and owners therefore have no incentive to limit harvesting; iii) in some of the PAs there may be the need to extend the area of protected forests, but in the absence of a comprehensive biodiversity inventory and monitoring system, and with resistance from forest administrators and owners, these forests continue to be harvested for wood, which may entail a number of negative effects on the provision of important ES; iv) while there is a good legal framework in place, enforcement of the law is weak and in many cases over cutting and illegal logging is evident (Popa et al. 2013b)

NTFP are potentially important for local economy (Popa and Bann 2012). However, even in areas where the collection and processing of NTFP is economically significant (Ceroni 2007), those products are not managed and harvested in a way that captures their full potential. Forest administrators often concentrate on wood harvesting and processing and pay little attention to the economic potential of NTFPs (Ceroni 2007).

In terms of revenue generation, hunting is less important compared with wood production. Nevertheless, recreational hunting is an important service offered by forests. In spite of a legal framework that controls hunting, due to enforcement problems, the extent of illegal hunting is still high (Popa and Bann 2012).

The primary goal of PAs is biodiversity conservation but the ecosystems under special protection regime usually have other benefits for human wellbeing, including economic returns from direct use of the products. Still, there is the need for a clear distinction between ecological and biodiversity capital and the stream of economic benefits produced by this capital (MA 2005).

The present research is an argument for a sustainable management of PAs including large forest areas showing that, by assigning a price for biodiversity and ecosystem services, on long term, forestry sector can gain also important economic benefits (Popa et al. 2013b).

3.6.2. Material and method

The valuation study (Popa and Bann 2012) on which this research is based focuses on pilot PAs: Apuseni Natural Park (ANP), Retezat National Park (ReNP), and Vanatori-Neamt Natural Park (VNNP). The study involved analysis of provisioning forest ecosystem service values for each of the 3 PAs and looked at the economic linkages between PA ecosystem services, production practices and outputs in forestry. At the same time, the study looked at how economic costs and benefits are distributed within and between socioeconomic groups identifying winners and losers from alternative PA/ecosystem management approaches and scenarios.

The TSA was applied in a major study by United Nations Development Programme (UNDP) in the Latin American and the Caribbean in 2010 (Bovarnick et al. 2010). A guidebook for its broader application is currently under development. A core part of the TSA approach is the comparison between two scenarios, Business as Usual (BAU) and Sustainable Ecosystem Management (SEM), to illustrate the contribution of ecosystem services to key productive sectors of the economy.

Under BAU, planning and management functions are typically supported by limited human, financial, institutional, and informational resources (Lockwood et al. 2006). Too often, PA conservation goals and objectives are poorly linked to conservation programs and costs, and existing budgets are not linked to programmatic priorities (Popa and Bann 2012).

Under SEM, funding and capacity are available to meet basic to optimal protection needs. In SEM, protected area's conservation goals and objectives are linked to ecosystems conservation programs and are realistically linked to funding. As a result, ecosystems status improves and their benefits, in terms of increased productivity and equity, expand (Popa and Bann 2012).

Table 3.6-1. BAU and SEM scenarios description (Popa et al. 2013b)

Scenario	**T1 and T2 areas – strictly protected areas**	**T3, T4 and T5 areas**	**All areas**	**NTFP and recreational hunting**
BAU	No compensatory payments T1 and T2 areas remain constant	Legal logging at national 2010 average (i.e. 59% of annual increment)	Illegal logging at 5% of annual allowable quota	NTFP harvested at present levels and declining over time. Decreasing potential for recreational hunting
SEM	Compensatory payments in place. Increase in T1 and T2 areas	Legal logging at national 2010 average (i.e. 59% of annual increment) decreasing 7% per year between 2016 and 2030. Constant after 2030. Decrease in T3 and T4 areas.	No illegal logging after 5 Years	Increase in NTFP harvest levels over time up to sustainable limit. Decreasing potential for recreational hunting

In the table above T1 represents areas with 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.

The analyzed scenarios are based on assumptions developed by the authors and refined through meetings with relevant stakeholders: in SEM scenario: the strictly protected forest areas (T1 and T2) will increase due to better knowledge regarding biodiversity in the forest ecosystems, there are financial compensations for private restricted forests, no illegal logging after 5 years and NTFP harvested at a sustainable level. In BAU scenario, management continues in the present conditions (Table 3.6-1.).

The research relies on collection and interpretation of existing data from PAs management plans (ANP 2008, RNP 2008, VNNP 2010), forest management plans, different reports made by forestry authorities at central and local level (MEF 2010, WB 2011), as well as form different literature sources (Ceroni 2007, Ceroni and Drăgoi 2008, Giurgiu et al. 1972, Emerton 2011). In undertaking a social cost benefit analysis of the BAU SEM management scenarios, two valuation approaches were adopted to estimate the market and non-marketed ecosystem services: *market price approach* - consider *use values* associated with ecosystem goods and services that are bought and sold in the existing markets (Heal et al. 2005) and *productivity approach* - focus on the relationship between an ecosystem service and the production of a marketable good (e.g. wood) (Howarth and Farber 2002). All values have been adjusted to the 2012 Romania price levels, applying a consumer price index deflator to account for domestic inflation. For comparison reasons, the present values (PV) for the streams of revenues in both scenarios were calculated (Popa et al. 2013b).

3.6.3. Results and discussion

The value of forests in terms of wood harvested in the pilot PAs (both private and state owned forests) was €3.0 million in 2010. Income to public forest administrators	3,236,600
Income to private forest administrators*	1,032,572
Income from illegal logging	145,585
Income to NEF	87,351
Total Value	4,095,162
Public sector revenues	3,252,005
Private sector revenues	843,157

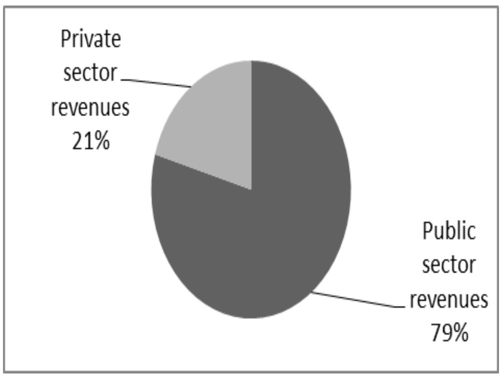


Figure 3.6-1. 2010 baseline value and beneficiaries distribution (EUR); * - value containing compensations (Popa et al. 2013b)

The valuations presented in this section are not comprehensive, as long as they rely only on available data without involving any fieldwork and they depend on many assumptions. The study also relies on a certain extend on extrapolating the few data available on the sustainable levels of NTFP, and of necessity employs benefit transfer techniques. It is to be hoped that, when new data becomes available, the results presented in this paper can and will be updated and improved.

The pilot PAs have a total forest area of 94,137 ha with a total standing volume of 27,600 m^3 (2010), consisting of fir, spruce, birch, oak, and other hard and softwood species.The percentage of publicly owned forest within the pilot PAs varies from 58% in VNP to 97% in ANP. This influences public expenditure on compensatory payments under SEM across the PAs, i.e. where private forests are significant (e.g. VNNP), compensatory payments should be higher. Public revenue from harvested wood – state owned forests - in 2010 for the three PAs was around € 2.4 million (1.6 in ANP, 0.6 in ReNP and 0.2 in VNNP), including the revenues coming from the state owned forests.

Both private and public forest administrators contribute 3% of the value of standing wood sales to the National Environmental Fund (NEF). This added an additional € 0.1 million to public revenues from forestry in 2010. Illegal logging is estimated at around €145,585 accruing to the private sector in 2010. Recent studies (Ceroni 2007) estimate the value of non-timber forest products harvested (NTFP) under sustainable conditions and sold at €1.0 million (€0.6 million in ANP, € 0.1 million in ReNP and € 0.3 million in VNNP) (Popa et al. 2013b).

Hunting values in 2010 was estimated based on data reported by the hunting areas administrators and studies done in other PAs (Ceroni 2007) but transfer benefit techniques were used in a conservative way, considering that 75% of the value corresponds to a sustainable hunting level. In 2010 prices this is equivalent to €27.636 (13,278 for ANP, €6,910 for ReNP and €7448 for VNNP). The total baseline value of the PAs can be seen in the Figure 3.6-1. (including the distribution of this value among the main beneficiaries).

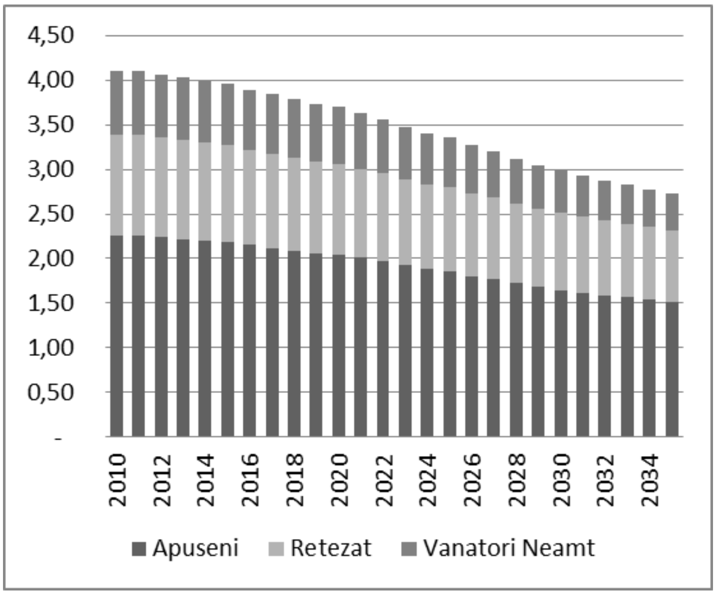


Figure 3.6-1. Forestry sector values BAU - € mill. (PV=€34.43 mill) (Popa et al. 2013b)

A continuation of BAU in the three PAs results initially in a more or less constant value for the forestry sector. The quantity of harvested wood falls over time due to the change in age class structure but this is also taken into consideration in the SEM scenario. The limited use of NTFP is the main factor determining a decrease in forest sector value under BAU relative to SEM. The present estimated value of ecosystems in the 3 PAs for the BAU scenario is €34.43 million (Figure 3.6-2.).

SEM will result initially in a decrease in forest sector values, as wood harvesting declines due to a reduction in T3 and T4 areas and in the percent of the annual increment being harvested, and as compensation increases in line with the increase in T1 and T2 areas. Overtime, the PAs forest related value steadily increases, recovering the value lost through the reduction in wood harvesting, due to the increased value of NTFP. The productivity of NTFP is underpinned by a healthy ecosystem and biodiversity. The rate of growth eventually slows as sustainable NFTP harvesting rates are reached, and is constant in the long run. The PV (10% rate over 25 years) for the 3 pilot PAs is estimated at €33.7 million (Figure 3.6-3.).

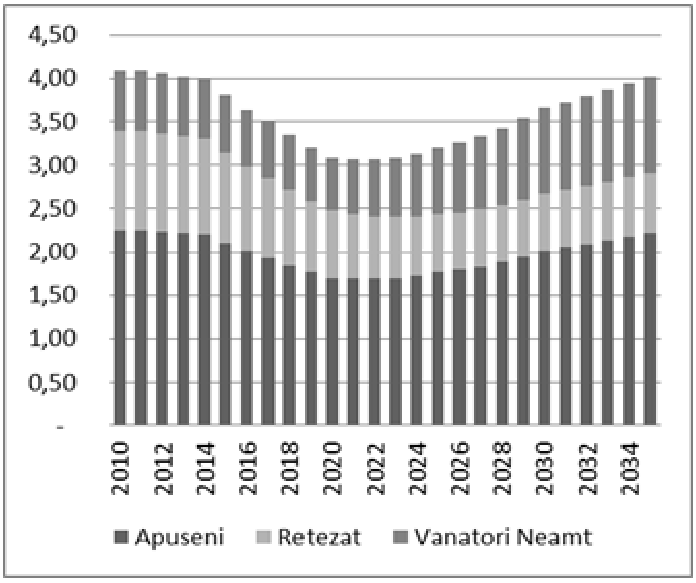


Figure 3.6-3. Forestry sector values SEM - € mill. (PV=€33.7 mill)(Popa et al. 2013b)

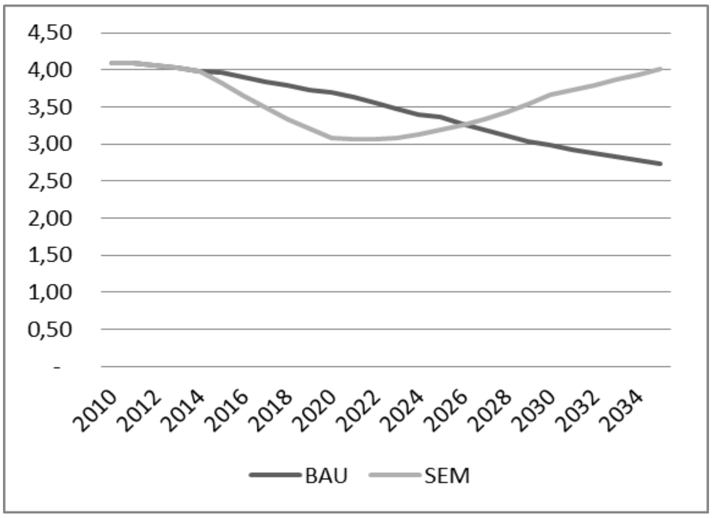


Figure 3.6-4. Scenarios comparison - BAU vs. SEM (Popa et al. 2013b)

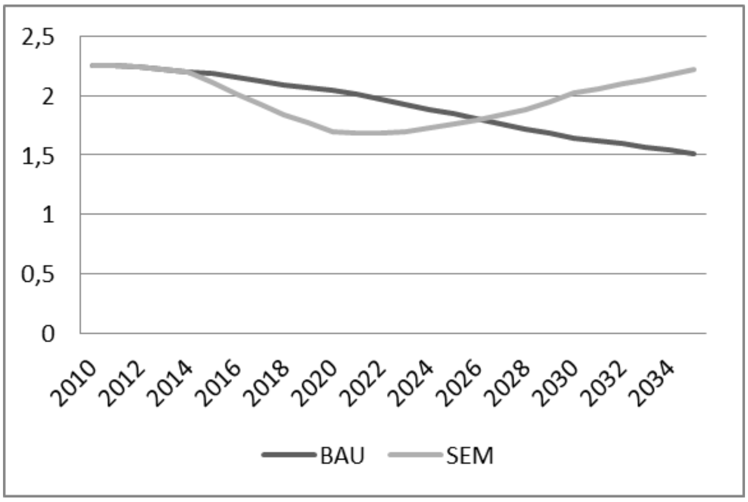


Figure 3.6-5. Scenarios comparison - BAU vs. SEM in VNNP(Popa et al. 2013b)

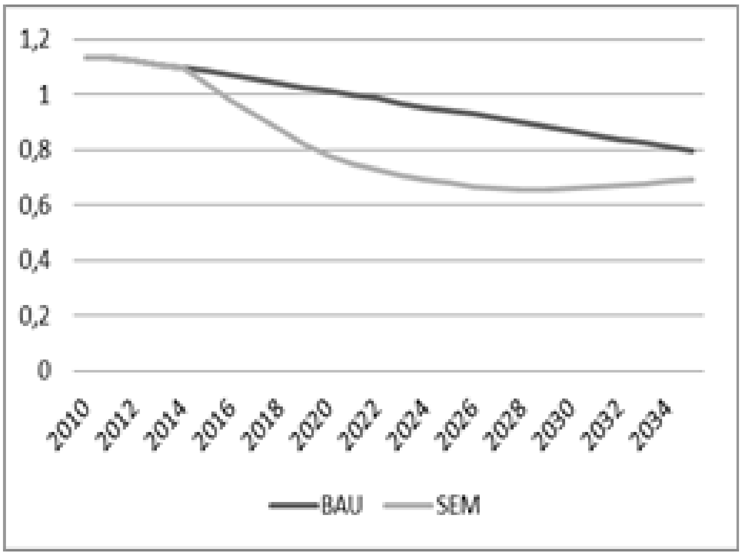


Figure 3.6-6. Scenarios comparison - BAU vs. SEM in ReNP(Popa et al. 2013b)

As illustrated in Figure 3.6-4, while BAU is equivalent or superior to SEM in the short term, in the medium to long term SEM is more profitable. Furthermore in the long term under BAU values continue to decline, while under the SEM the (high) value becomes constant through time reflecting the sustainable management of the areas (Popa et al. 2013b).

The profiles for the BAU and SEM scenario are not the same for all PAs. It is worth noting the situation for ReNP and VNNP. In VNNP, SEM is equivalent or superior to BAU over the 25 year assessment period and also shows significant gains in the medium to long term (Figure 3.6-5.). This is due to the influence of NFTP. In VNNP the natural conditions (lower altitude, water availability, forested and non-forested areas, a suitable habitat for traditional fruits and an existing tradition in NTFP collection) support greater weight of NTFP values compared to standing wood. In ReNP the situation is the opposite – higher altitude, mountain plateaus supports lower provision of NTFP. As a result the BAU scenario remains superior over the long term (Figure 3.6-6.).

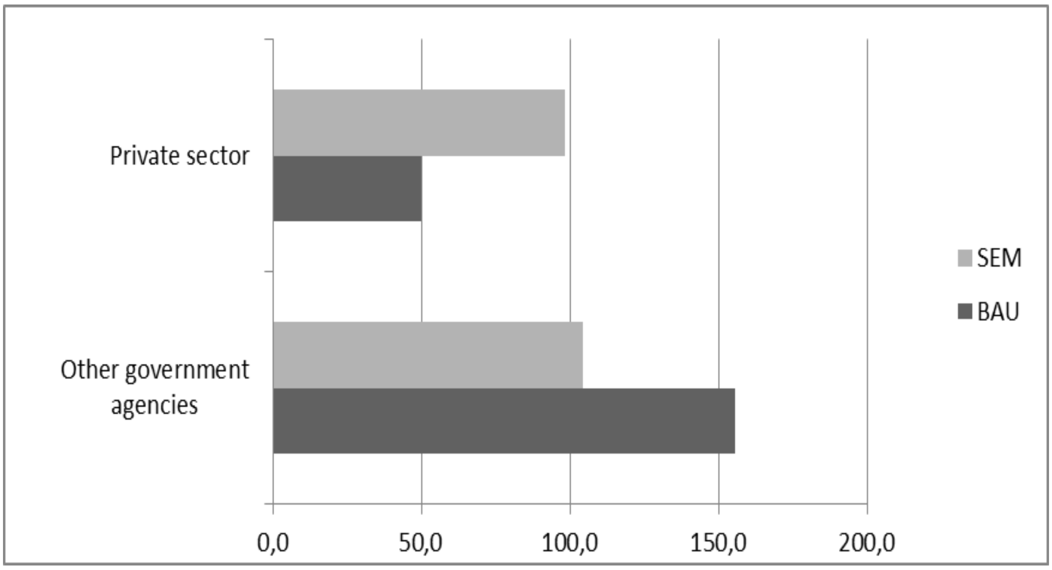


Figure 3.6-7. Beneficiaries of ES in BAU and SEM scenarios (Popa et al. 2013b)

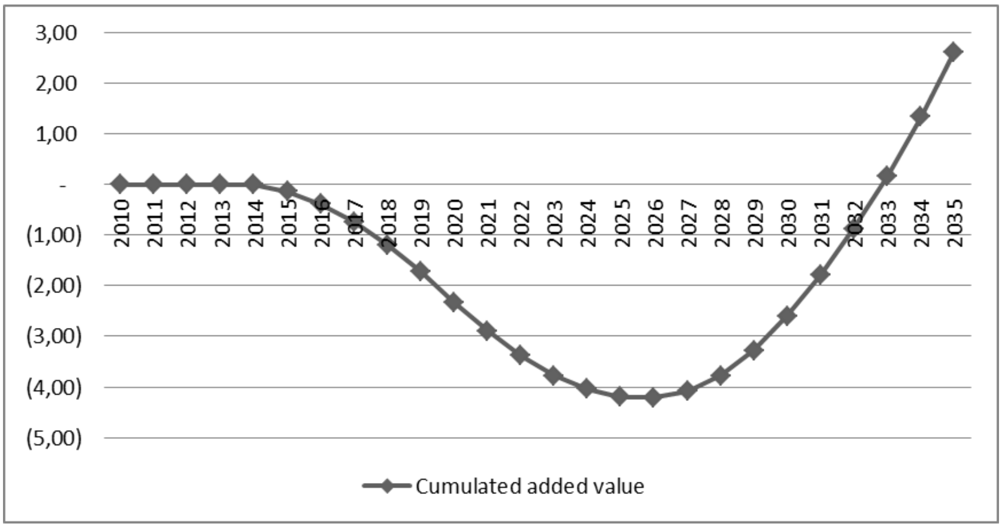


Figure 3.6-8. Cumulated added value SEM over BAU (Popa et al. 2013b)

It is to be mentions that SEM scenario implies costs that accrue to the state budget – due to the necessity of compensatory payments (Figure 3.6-7.). Therefore, when compared with the BAU scenario, SEM means lower total values in the first years. After a certain period (16 years for VNNP, more than 25 years for ReNP), SEM values recover the difference and SEM pays for the initial costs. In the long run, the value of PAs under the SEM scenario will recover, and is projected to generate higher values beyond a 25 year horizon. In addition other ES generated / maintained by sustainable forestry (e.g. carbon sequestration, water and soil erosion regulation, landscape) are ensured (Popa et al. 2013b).

SEM is superior to BAU over the 25 year time horizon, generating an additional €2.6 million (Figure 3-6-8.). However, given the gains to other sectors supported by sustainable forestry (e.g. tourism revenues are partly contingent on undisturbed forests which contribute to landscape values and a range of regulating services such as water and soil retention support agriculture and industry and carbon sequestration), this gain can still be considered underestimated.

All the figures show that the private sector is the main beneficiary, indicating again the potential to develop payments for ecosystem services arrangements with the private sector.

PA authorities are not represented among the beneficiary groups as neither BAU nor SEM includes revenues to PAs authorities.

Under SEM forest administrators lose revenue due to the decline in timber production and increase in compensatory payments but gain from NTFP production. Sustainable ecosystem management implies a decrease in PA values in short term and a fall in public income due to compensatory payments (Popa et al. 2013b).

3.6.4. Conclusions

The results of the research open gates to discussion regarding the design and implementation of PES mechanisms as means of operationalizing in practice the concept “internalization of forest externalities”. The private sector is the main beneficiary in SEM, being represented by private forest administrators as well as companies dealing with NTFP commerce.

Medium and long term policy implications can be envisaged for both forestry and biodiversity sectors. In depth studies regarding the biodiversity in conjunction with evaluations of the economic implications of the sustainable management of forest ecosystems will be able to develop a strong base for decision making in sectors with apparent opposite interests as forestry and biodiversity conservation, in order to gain mutual benefits (Popa et al. 2013b).

4. Forest ecosystem services evaluation in Republic of Moldova using Targeted Scenario Analysis

4.1. Background

This section of the habilitation thesis, offers an analysis of the Forest Ecosystem Services (FES) in the Republic of Moldova. The research is based on existing information and data of Moldovan economy sectors relevant to forests, findings from meetings and discussion with Moldovan institutions responsible for forestry, results of background studies undertaken during the implementation of both phases of the ENPI FLEG Program, and materials from other projects and initiatives in the Republic of Moldova (Popa 2013a, Botnari et al. 2011, Căpățână 2012, Galupa et al. 2011, Moldsilva 2013, RT 2014, SYRM 2013, Zubarev 2012, WB 2014, WTTC 2013, ENPI FLEG 2011). This work includes also FES approach and experience of other countries (Popa and Bann 2012, Terente 2008, Ernst et al. 2004, etc.)

The research identifies, describes and evaluates the main FES that are beneficial to Moldovan people, using the TSA approach (Alpizar and Bovarnick 2013). It offers facts and conclusions regarding the relationship between local communities and FES. The economic, social and environmental benefits are presented based on both data collected during the surveys done in the communities and data offered by different institutions and other sources (statistics, researches etc.) in the country. The focus of the research is put on rural communities (54% of Moldova’s population is concentrated in rural areas) having an intimate relationship with the forest ecosystems (Popa et al. 2015).

The study focused on several important economic sectors having cross-sectional linkages with forests, such as agriculture, water management, tourism, natural disaster risk and climate change mitigation. The sector approach is an important methodological aspect of the research as it aimed at processing and presenting information that are quantifiable and relevant for specific decision makers in each studied sector. Some sectors, such as forestry, are benefiting from the provisioning services forest ecosystems deliver. However, the majority of them – agriculture, water management, tourism – are benefiting from the regulatory and support services, far more difficult to quantify. Disaster prevention (including attenuation and mitigation of climate change) can be considered a special case: even if it is not exactly an economic sector, it is significantly benefiting from FESs.

4.2. Snapshot on the forestry sector of Moldova

Moldova has relatively low cover of forest vegetation (circa 450,000 ha or 13,7% of country’s territory), while forest cover is only 11% or 379300 ha. This is significantly lower than the European average (45%), but comparable with other European Countries (UK - 12%, Denmark -13%). Forests tend to occur in hilly areas with the majority of forests located in the central part of Moldova, with slightly less forests in the north and even fewer in the south

(Figure 4.2-1.). The forests are mainly broadleaved (oak, ash, hornbeam, black locust and poplar being the most significant species, Figure 4.2-2.) (WB 2014, Popa et al. 2015).

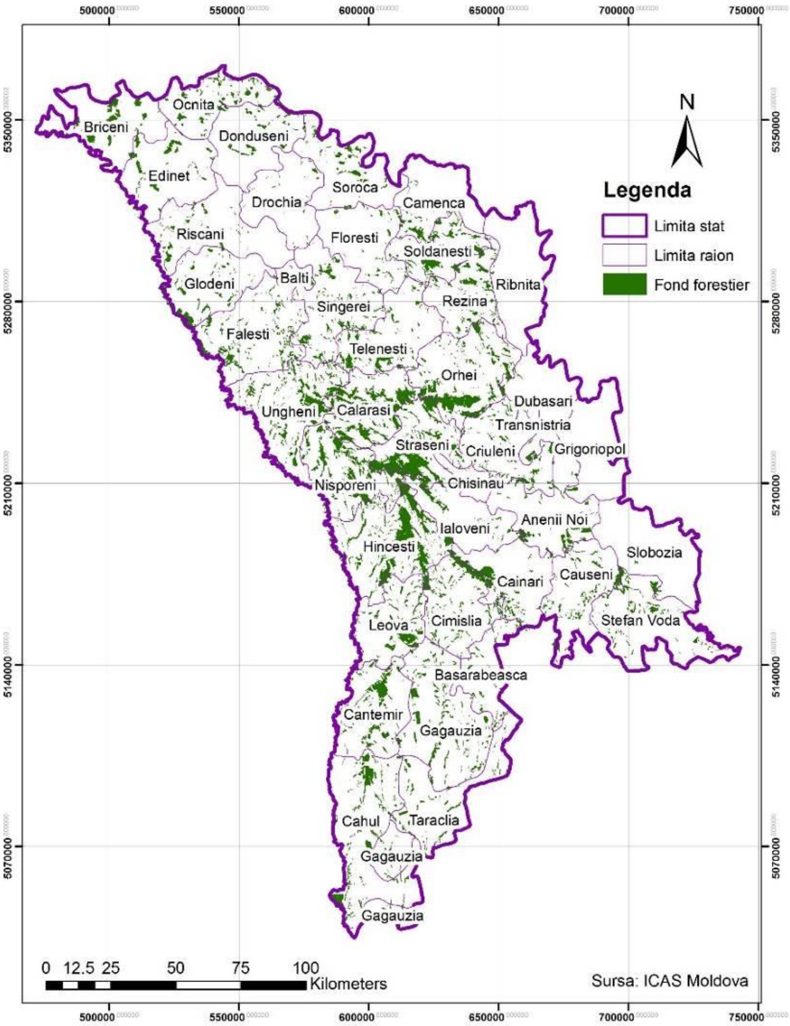


Figure 4.2-1. National Forest Fund (NFF) of the Republic of Moldova (Popa et al. 2015)

The National Forest Fund (NFF) of Moldova is composed of forests, land meant for afforestation and other land designated as forest by the existing legal and normative frame (Moldsilva 2013). The NFF is the main strategic forest resource of the country; it includes most of existing forest vegetation (circa 800 forest bodies ranging from 5 to 1500 ha) and some insignificant forest vegetation outside the NFF (mainly represented by shelterbelts or spontaneous forest vegetation). Generally, forests are distributed non-uniformly and are highly fragmented (Moldsilva 2013, Popa et al. 2015).

Oak-type forests have historically been the most representative in the country and nowadays only 27% of oak stands are regenerated from seeds (generative origin), while the rest regenerated vegetatively as a result of former coppice management.

According to the National General Cadaster Registry, 81.1% of the NFF is owned by the state (through Agency Moldsilva and its forest units), 18.3% by Local Public Authorities (LPAs), circa 4% are properties of other state institutions (e.g. Botanical Garden, Central Authority for Waters), and private ownership is low and represents circa 0.6% now (but it is likely to grow after afforestation and forest expansion campaign).

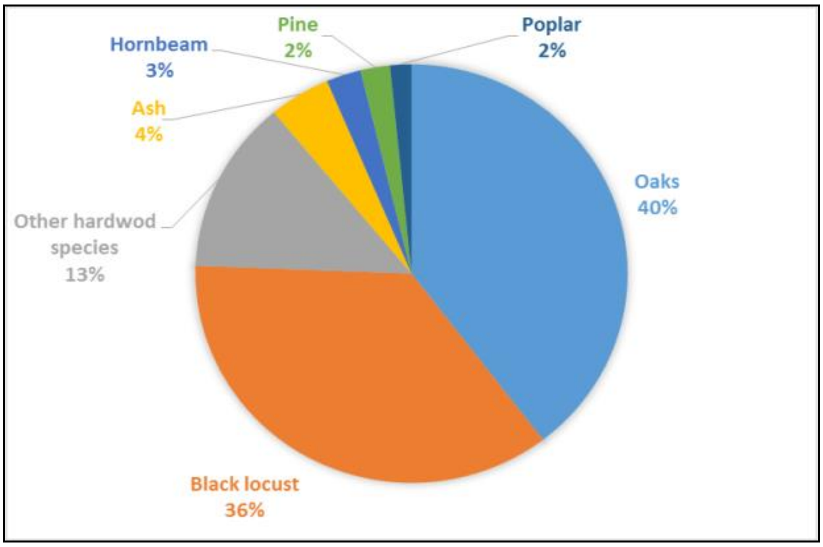


Figure 4.2-2. Species distribution in the Moldovan NF (WB 2014)

According to the Forest Code (1996), the main function of forests is the protection of environment and, thus, all forests are considered primarily to have protective functions and, then, production functions. There are five protection subcategories: water protection (1.6%), soil and land protection (7.9%), climatic and industrial damaging factors protection (47.4%), recreational (26.4%) and scientific interest or genetic resources protection (16.7%) (Botnari et al. 2011).

Agency Moldsilva (www.moldsilva.gov.md) is the central public authority in the country with responsibilities for implementing state policy in forestry and hunting. Moldsilva also has both management as well as regulatory and administrative functions. Moldsilva manages most of the NFF (circa 85%), being essentially a self-financing institution since 1998, it does almost not receive support from the state budget and it is not subject to state subventions. Moldsilva had revenues and expenditures in 2013 of $20.46 and $21.51 million respectively (Popa et al. 2015).

The forest sector's direct economic contribution is relatively small at just 0.27% to GDP in 2010. Additionally, the forests provide critical habitats for biodiversity (GD 2015) and other essential environmental benefits such as soil protection, water regulation and carbon sequestration. Most sector analyses highlight the underused potential of the forestry sector. In particular this refers to (a) carbon sequestration valued at $460000 in 2011, (b) ecotourism, which is valued at $7.9 million (Popa 2013a) per annum and employing circa 1400 persons (WTTC 2013), (c) watershed management reducing soil erosion and water costs valued at an net present value of $27.8 million over 25 years, (d) flood disaster mitigation valued at $19.7 million, (e) wood energy, which could be worth circa $2.25 million annually (5000 ha, yields of $15m^3$ per ha annually and current fuelwood prices), and also its contribution to emission reductions targets.

The challenges to increasing the economic contribution of the forestry sector include (a) institutional centralized system, (b) poor management (e.g. coppice management in the past) at all property level, namely of the LPA forests, (c) unsustainable levels of forest use (ENPI FLEG 2011), and (d) the scale of illegal forest activities (Galupa et al. 2011).

Forests managed by Moldsilva have up to date forest management plans (FMPs), while most of LPA forests do not have such. Moldsilva has capacity and staff to manage their forests, whereas LPAs are hampered by lack of trained staff and available resources.

Consequently, a more disproportionate and unregulated harvesting occurs in LPA forests. In the absence of FMPs and arrangements for their active management and protection, LPA forests will continue to degrade and be over-exploited.

The state forest policy is promoted through a legal frame that includes the Constitution of the Republic of Moldova, circa 20 laws, a number of regulatory acts approved by the Government, and other regulatory documents that are approved on sectoral level. The main policy document in the country is the “Strategy for the sustainable development of the forestry sector of the Republic of Moldova” (approved by Parliament Decision no. 350/2001). In 2003, the Government issued a law on the implementation of the Strategy for the sustainable development of the forestry sector of the Republic of Moldova (no. 739/2003), which was abrogated in 2012 by the Government along with other policy documents (through Governmental Decision no. 796/2012) (WB 2014).

Existing legal frame encourages the expansion of areas covered with forest vegetation through afforestation of degraded and affected by sliding lands, creation of protection shelterbelts for water, rivers and other water bodies.

Specific requirements are implementing the state policy through a technical regulatory framework. The forest normative framework is more or less applied in Moldsilva’s forests, but less or almost not applied over forestlands outside Moldsilva (such as community or LPAs, private and other types of forest vegetation).According to recent analyses (WB 2014), Moldovan forests are likely to be significantly impacted by climate change. Researchers expect that even small changes in temperature and precipitation could greatly affect future forest growth and survival. Within the 2010-2039 period, the phytosanitary conditions will change significantly in the north of the country where it is expected that areas susceptible to die back (trees drying out) will expand by circa 15-25% (WB 2014). By 2040-2069, conditions will deteriorate further extending southwards. Building stable, diversified forests adapted to climate change presents a significant challenge and will require ongoing measures including research on species selection, adaptive provenances and genotypes (Popa et al. 2015).

Soil degradation in the wider landscape has increased due to unsustainable agricultural practices and/or poor management of waters and the degradation of forest belts. The agricultural sector is crucial for Moldova, both as an important part of the economy and as a source of rural employment. Moldova has unique agricultural land resources, characterized by productive soils, a high utilization rate (>75%) and rugged topography. Many of Moldova’s pastures are either degraded or in poor condition, with 47% of agricultural land classified as degraded. A new program for conservation and increasing the soil fertility for 2011 – 2020 has been approved. The National Plan on extending forest vegetation for 2014 – 2018 envisages the afforestation of 13000 ha of degraded lands and water protection forest belts with funding from the National Environmental Fund and other donors.

The total growing stock is estimated at 46 million m^3 representing an average of 124 m^3/stocked ha. The average age of the forest is 40 years, but the age class distribution is uneven being skewed towards the younger age classes as a result of previous management / exploitation practices and the fact that more than 2/3 of stands are of coppice origin (Moldsilva 2013). Total annual increment is estimated at 1252000 m^3 (or 3.3 m^3/stocked ha). In addition, the annual increment of the forest outside the NFF is estimated at 110000 m^3. The annual allowable cut (AAC) in the forests administrated by Moldsilva is approximately 45% of the annual increment compared with a European average of 64% for 2010 (SEF 2011). The officially reported annually harvested volumes are in line with the AAC.

Between 2006 and 2010 timber represented an average of only 10.3% of harvested wood volume, the balance being firewood (Botnari et al 2011). This timber was mainly processed by the state enterprises under the umbrella of Moldsilva. Between 2006 and 2010 Moldsilva processed 28000 m^3 annually or 7% of the total harvested wood volume with the balance processed by private entities outside Moldsilva.

As a parallel process to the implementation of Moldovan forestry policy, the ENPI FLEG Program (www.enpi-fleg.org) in Moldova focused on building capacities for forest institutions and strengthening sustainable forest management practices. Harvesting of NTFPs (fruits, berries, herbs etc.) is an important activity undertaken by entities subordinated to Agency Moldsilva. Volumes of NTFPs harvested vary depending on environmental factors and market requirements. While harvesting and marketing of NTFPs have certain potential for expansion and an increased level of added value, it will require further market research and investments in technology as well as development of more efficient supply chains and improvement of the skills of involved personnel (Popa et al. 2015).

An important and as yet untapped potential of the forests in Moldova is their recreation function. In the absence of attractive tourist places, the increasing tendency and demand of the population is to spend their leisure time in forest areas, usually during holiday people go to the forests for picnics. The potential of ecotourism market is estimated at \$7.9 million per year (direct and indirect expenditures, including \$2.4 million public investment, \$1.4 million capital investment in excess as well as 1400 full time equivalent jobs (WTTC 2013)). The better the forest ecosystems are managed, the bigger the increase in number of visitors is and the bigger the contribution to local economy can be.

This untapped value of the forest could be considered as a starting point for future payment mechanisms for ecosystem services. This will also help protect forests from visitors dumping their refuse, especially during holiday periods.

4.3. Preliminary assessment of ES provided by forest ecosystems in the Republic of Moldova

4.3.1. Ecosystem services (ES) identification

Based on the list of ES associated to forest ecosystems of Moldova, a qualitative assessment was made to see what are the FES, what are the benefits from FES, what are the economic sectors supported by the ecosystem services and what are the sectors influencing the provision of ES. Data were collected from various sources, including partially through interviews and discussions with stakeholders or their representatives - Ministry of Environment, Agency Moldsilva, Moldovan State University, Forest Research and Management Institute, Institute of Geography and Ecology, Institute of Botany, forest and forest-hunting enterprises, PA management units, NGOs (Biodiversity Office, Ecological Movement of Moldova, Ecological Society Biotica) and other experts. 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) risk of ES flow diminishing due to exploitation pressures (Popa et al. 2015). The results are summarized in the Table 4.3-1.).

Table 4.3-1. Results of the qualitative assessment of ES provided by forests (Popa et al. 2015)

ES Type	**Service**	**Benefit / outcome**	**Significance**	**Sectors supported by ecosystem service**	**Sectors impacting / influencing the provision of ecosystem service**
Provisioning Services	Food	Commercial and subsistence crops; breeding products	*	Households Fishery, Tourism, Agriculture	Households, Fishery, Agriculture, Industry
	Wood	Fuel wood, timber, traditional wood products, commercial processed wood products	**	Households, Forestry, Wood processing industry	Forest administration, households, wood processing industry, Forestry
	Water	Public water supply, mineral waters for commercial use, water for industrial and agricultural usage	*	Industry, households, tourism	Agriculture, Industry, Forestry
	NTFPs	Natural medicines, forest fruits, forest fruits based products	**	Forest administrators, households, industry	Forest administration, Households, Industry, Forestry
	Source of energy (fuel etc.)	Energy provision e.g., hydropower	-	Energy	Forestry, Breeding
Regulating Services	Regulation of GHGs	Carbon sequestration	**	Potentially all	Potentially all
	Micro-climate stabilization	Air quality	**	Potentially all	Industry, Forestry

	Water regulation (storage and retention)	Flood and landslide prevention	**	Tourism, Industry, Households/ Urban Settlement, agriculture	Forestry, Agriculture, Breeding
	Soil erosion regulation	Improved water quality ,	*	Households, Urban settles	Forestry, Agriculture, Breeding
	Nutrient retention	Improved water quality	*	Fisheries, Agriculture, water supply	Forestry, Agriculture, Breeding
Cultural Services	Spiritual, religious, cultural heritage	Local traditions, Churches and monasteries, use of environment in books, painting, folklore, national symbols, architecture, advertising	**	Tourism, Households	Potentially all
	Educational	A 'natural field laboratory' for understanding biological processes	?	Households	Potentially all
	Recreation and ecotourism	Recreational fishing and hunting, birdwatching, hiking, Holiday destination (aesthetic views)	**	Tourism	Potentially all
	Landscape and amenity	Property price premiums due to views	?	Tourism	Potentially all
	Biodiversity non-use	Enhanced wellbeing associated for example with bequest or altruistic motivations	?	Potentially all	Potentially all

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

4.3.2. Description of ES that Moldovan forests provide

Provisioning Services

Food – Though forests of Moldova are providing small amount of food subsistence products (due to the an overwhelming share of agriculture in rural activities), there is an old tradition to plant fruit trees that normally lead to establishing plantations of certain species, which can be used as food and/or market products. The walnut tree (*Juglans regia*) is a typical example[4]. There are walnut plantations within the state forest enterprises under Moldsilva, but the trend in the country is in favor of the many privates (individuals or companies) that have recently created many walnut plantations based on local or introduced varieties. Usually, companies are purchasing walnut fruits that are mostly exported, also consumed domestically by local population or marketed (Moldsilva 2013). The main feature of Moldovan landscapes is easily recognizable by the walnut tree belts along the roads that are used by population for free. Republic of Moldova, one of the largest European walnuts exporters, provides walnuts to more than 25 countries across the world (Popa et al. 2014).

[4] Walnut plantations seem to be expanding and by 2020 will likely reach at least 14000 ha (Popa et al. 2014).

Wood – There is wood consumed/used from domestic sources, imported wood/timber (e.g. Ukraine, Russia, and Belarus) used mainly for construction, and wood/timber in transition. Data collected from local stakeholders (Moldsilva 2013) and from independent reports (WB 2014, ENPI FLEG 2011) show that the main source of wood for local population in Moldova is the Moldovan Forest. Though there is a small amount of timber (industrial wood) reported by official sources (Moldsilva 2013), the largest portion of domestically harvested wood is used for primary energy (heating and cooking); however, the timber wood, especially that of hard essence (oak, ash, hornbeam etc.), is still an important forest product (for maintaining agricultural plantations, construction, manufacture, and other household needs) (ENPI FLEG 2011). According to official statistics (Moldsilva 2013), timber is estimated at 7 to 10% of the total annually harvested wood. Recent studies on the real level of domestic wood harvesting in Moldova (ENPI FLEG 2011) rise questions on the quality of wood estimations. In any case, timber is a scarce product in Moldova and, therefore, important from the perspective of the ecosystem services provision (Popa et al. 2015).

Water – Forests of Moldova are not literally a large water provisioner, but are rather known as leisure areas for their curative springs. Water provisioning can be explain by the fact that due to geomorphological conditions, most of forest bodies contain water springs that are traditionally perceived as clean and pure. The forests are not, of course, a direct water provisioner, but its role in water regulation (see below) is ascertained and can also be modelled. Many local communities are using natural phreatic water, which originates in forested hilly areas, as a source of drinking water, irrigation water within households as well as for sanitation. Water has now become a major issue in the country, especially in the dry seasons and during drought periods, which occur more frequently (Popa et al. 2015).

NTFPs – such forest goods as fruits/berries, mushrooms or plants/flowers as well as forest soil are largely used by population for various household needs (Popa et al. 2014). The forest dependency of the rural population is rather low compared with other countries that have larger forest resources (Popa et al. 2014), but this dependency is more sensitive to external factors. Legal frame allows NTFPs to be harvested/collected by rural population for personal consumption, so often locals are collecting NTFPs (such as mushrooms, berries, spring flowers/plants) and sell them either on roads or street markets. State forest units of Moldsilva are organizing NTFPs collection against money, attracting local population in collecting fruits (e.g. dog rose), tree flowers (e.g. lime tree) and other medicinal plants. Fruits and flowers are collected in certain periods of the year by poorer families to be able to complete the cash needs for their families. Game/hunting activities and products are also included in this category (Popa et al. 2014). Provisioning services originated from hunting activities don’t have significant value but there is an increased interest for this kind of activities. According to Hunters and Fisherman’s Society of Moldova (Popa et al. 2015), there are 15000 authorized hunters in the country, this meaning that the interest and demand for hunting activities is significantly bigger than the actual game resource of the country.

Energy wood (fuelwood) – the most important energy/fuel source for heating and cooking in rural areas of Moldova is the firewood. The annual allowable cut (AAC) and the officially recorded actual harvest is around 400000 - 500000 m^3/per year (Moldsilva 2013). This equates to circa 45% of the annual increment (EU average is 64%, SEF 2011). Moldsilva, the main supplier of energetic biomass, undertakes the majority of its own harvesting and operates a centrally approved price list. However, an ENPI FLEG analysis (ENPI FLEG 2011) estimated in 2010 a consumption of domestic fuelwood around 1 million m^3/year. This consumption figure almost matches the total annual increment - which accounts for circa 1,2 million m^3/year (WB 2014). Another ENPI FLEG study (Galupa et al. 2011) revealed a small amount of recorded illegal logging, but it uncovered a trend in illegal logging activities occurring mainly in forest vegetation outside Moldsilva. The gross value of this unofficial harvest is conservatively estimated as being $15-17 million per year (Popa 2013a). While there can be a number of contributory factors to the imbalance between estimated consumption and official wood supply (Galupa et al. 2011), the scale of such imbalance indicates significant volumes of illegal harvesting. These levels of unofficial removals are unsustainable as these harvests will be concentrated in areas of easy access and where there is limited control and monitoring, resulting locally in significant forest/land degradation (Popa et al. 2015).

Regulating Services

Regulation of GHGs – carbon sequestration function of Moldovan forests is widely recognized; moreover, in the last decade it was sustained through the implementation of various carbon-based projects done by Moldsilva (including its forest units) in cooperation with LPAs and the BioCarbon Fund of the World Bank (WB 2014). Moldova gained valuable experience in the design, implementation and monitoring of LULUCF carbon projects under the Non-polluting Development Mechanism of the Kyoto Protocol, notably (a) the “Soil Conservation in Moldova” Project, and (b) the “Development of the Community Forestry Sector in Moldova” Project (WB 2014). This experience will help position Moldova to source additional carbon projects that could support the strategy for reducing emissions. This is also in line with the forest cover target of 15%[5] by 2020, stipulated by the Strategy for sustainable development of the forestry sector of Moldova (2001), as well as with recent governmental incentives of forest protection shelterbelts extension[6] and rehabilitation[7]. The total value of this ecosystem services (based on calculations and increment data and growth predictions done by Moldsilva) is estimated at $0.5 million /year (Popa 2013a), meaning that carbon sequestration functions of forests could generate an additional $2.1 million (cumulative value over 25 years) (Popa 2013a), if only started incentives and projects are continued, counting only the sequestration capacity. There is a significant difference between the annual allowable cut (AAC) and the increment of state forests estimated through the present management plans – officially the AAC make only between 40 to 50% of the increment (Moldsilva 2013). Nevertheless, the differences between estimations of wood consumption and the AAC (Botnari et al. 2011) raise a promising potential for carbon sequestration and, as a result of this, a sustainable management of forests.

Carbon sequestration economic benefits can be easily evaluated. Though there is a significant potential for such activities, it is likely that local communities will not be a direct beneficiary.

[5] Actual forest vegetation cover is nearly 13,7% (almost half of it are plantations, Moldsilva 2012).
[6] According to a Governmental National Plan for forest vegetation extension 2014-2018 (GD 101/2014), circa 13000 ha of degraded lands and protection belts will be afforested or reforested.
[7] A World Bank „Agricultural Competitiveness Project” is now reversing circa 2500 ha of degraded shelterbelts in the southern region of the country (WB 2014).

It seems that local communities will benefit only indirectly and from the perspective of climate change mitigation services provided by forests (Popa 2013a).

Micro-climate stabilization – scientifically proved function, especially for ensuring local biodiversity and indirectly other subsistence needs for the population. In the surveys done within the research, all interviewers mentioned it as very important, but yet unclear service that the forests are providing (Popa et al. 2014). The forest can create an important micro-climate for agriculture, including conditions that influence agricultural production and enhance biodiversity. This service is very important and is being also supported by the rehabilitation campaign of circa 31000 ha of agriculture land protection forest belts (GD 2015). Such a micro-climate stabilization program has not only the purpose to rehabilitate forest belts or to create new ones, it is based on studies proving that agriculture effectiveness and efficiency may be increased if forest belts can perform their protection function (Popa et al. 2015).

Water regulation (storage and retention) – this is a very important ecosystem service that forests of Moldova can provide. The climatic features of Moldova and predictions for changes in environment (e.g. climate change, WB 2014) describe a high frequency of drought phenomena during the last two decades, especially in the southern part of the country. If managed sustainably, forest ecosystems can contribute to the regulation of water reservoirs and thus can mitigate the effect of droughts. In drier areas of the country forests traditionally are regarded as water supplier (e.g. drinking water for humans and cattle in remote areas), and in wetlands the forests act as sponges by intercepting water.

Soil erosion regulation – landslides and floods are among the most severe natural disasters (Zubarev 2012) causing huge economic losses. Moldovan forest vegetation helps keep soil intact and prevent it from eroding into other landscapes. Forest quality is directly linked to capacity of soil to regulate erosion. Soil erosion in an undisturbed forest is extremely low, but any disturbance can increase erosion processes. Soil erosion regulation does not impact only the frequency of natural disasters, but also our day-to-day life. Urban water treatments and other used water are undoubtedly influenced by the erosion regulation capacity of Moldovan forests. The better the natural filters are (e.g. forests in good conservation status), the lower the costs for treating and distributing the urban water are (Popa et al. 2015).

Nutrient retention – another very important ecosystem service provided by Moldovan forests is their nutrient retention. The soil richness is considered one of the most important natural resource of Moldova and the forests can highly contribute to soil nutrient retention by stopping the erosion and flow of the superficial soil layer. Solid and sustainable forest ecosystems can provide this service not only in the forests per se, but also in the pasture and agriculture systems nearby or downhill the forest bodies. The agriculture sector of Moldova seems to be facing a very dangerous degradation process. Almost 40% of the agricultural land (i.e. 858000 ha, according the National Bureau of Statistics, 2013) are affected by degradation, where 12% of them cannot support any agricultural activities (WB 2014). These degradation phenomena occur partially because of a reduced capacity of forest and pasture ecosystems to provide effectively the nutrient retention, which is crucial for the soil erosion regulation service.

Landslides and floods prevention

Floods and landslides rank among the major natural hazards facing Republic of Moldova. Annual average incidence of major flood related events in Moldova is 1.2 events/year (Zubarev 2012). The costs of damages produced by floods are estimated at $4.6 million annually (Zubarev 2012). Official statistics (SYRM 2013) reveal that a total of 84000 ha are affected by landslides annually, with a total cost of damages estimated at $1.3 million. Eroded areas across the country are estimated at 1.074 million ha (data of 2011[8]) with a total damage costs of $127.8 million (Zubarev 2012). Flooding is particularly intense in hilly areas and low-lying floodplains. It is likely that the frequency and severity of these events will increase in the future, both due to on-going ecosystem degradation and because of climate change (WB 2008).

With the increase in environmental changes (induced by humans or naturally occurring), economic losses through natural disasters may increase too and would require a clear understanding of the condition of forest ecosystems. The quality and quantity of forest ecosystems could significantly impact the occurrence of natural disasters. Multiple forest services ensured though a proper ecosystem protection under SEM scenario could play a significant role in hazard regulation and loss risk reduction. If the upstream protection functions of the forest ecosystems serve to minimize the impact of floods by just 10% below what it would have been in the absence of the protective functions, then the value of flood control in terms of damage costs avoided (projected on a *pro rata* basis) equates to an average of $13.4 million a year (Popa 2013a). All those economic values can be accounted as direct benefits of the local communities, even though the costs are also referring to some infrastructure damages avoided.

Forest ecosystems alone are not the only factor influencing the magnitude and frequency of the natural disasters. The mixture of forest and agricultural lands (pastures, orchards, vineyards) is typical and traditional for Moldova, therefore it is difficult to assess the share of the impact these two main sectors may have of reducing disasters. An integrated management of the agriculture and forested landscape must be envisaged. Though rather complex, decision making process (including appropriate institutions and coordination among them) to mitigate the effects of various hazards is extremely important (Popa et al. 2015).

Cultural Services

Spiritual, religious, cultural heritage – Moldova is recognized for its religious and spiritual heritage represented by a number of very nice monasteries of the Orthodox Church (RT 2014), most of which located within forested areas. Those monasteries are visited by thousands of people (tourists or locals) every year. Historically, Moldova’s forests served as a refuge for religious people (RT 2014) and, thus, most of monasteries gained protection for centuries. Many historical (including archaeological) and cultural monuments are located within forests, some included in protected areas. Evaluation of the benefits, especially in monetary terms, associated with cultural/religious activities in forests is an insurmountable problem; however, social benefits of such important linkage are undisputable (Popa et al. 2015).

[8] http://date.gov.md/ro/system/files/resources/2013-08/Cadastrul-funciar_2011.xls

As the recreation/tourism, it was easier to evaluate the indirect values that can be captured by local communities in terms of (eco-) tourism benefits. According to data provided by the Tourism Agency of Moldova (central authority responsible for the monitoring of touristic activities), there is a large potential for visitors and the main touristic product offered would be the amalgam of natural and man-made features. The PAs administrators (mainly those located within Moldsilva) recorded a number of tourists visiting PAs of Moldova that increased from 6266 in 2008 to 9020 in 2010 (Popa 2014a). However, according to Tourism Agency of Moldova, the total number of tourists (with main scope of vacations, recreation and resting) decreased from 243906 in 2008 to 210809 in 2011. It is therefore obvious that there is a certain orientation of the general tourism industry towards eco-tourism or rural-tourism. Tourists visiting Moldova are increasingly appreciating places where natural resources are protected, but this is not yet the central interest of tourists as it seems that winery[9] sector represents a true attractiveness for the most of visitors (Popa 2014a).

Accommodation facilities slowly started to grow near or in the immediate vicinity of areas where natural landscapes may attract potential tourists. Yet the main problem is how touristic activities are organized. Generally, the tourism is still unorganized across the country and most of involved companies do not have sufficient resources to optimize their activity in terms of finding a balance between promoting tourism in natural areas and avoid unwanted effects of anthropic pressure on biodiversity (Căpățână 2012). An example is the natural-historic complex of Saharna (Rezina rayon), a well-known locality that was promoted by a number of NGOs and tourism companies, but due to an increased and highly unorganized tourism the valuable habitats for a number of species (e.g. rare plants, bats and reptiles) were severely affected in the last decades (Popa 2014a).

There is clear evidence that spending on hotels in areas with attractive natural landscapes tend to be greater than in other places. Work carried out in Croatia by the Institute of Tourism has, for example, found that there is a premium of as much as 24-32% attached to the price that visitors are willing to pay for hotels located in forest areas(Pagiola 1996), and that landscape is a decisive factor in visitors' choice of hotels (Popa 2014a)

The potential for (eco-) tourism in connection with forest PAs or just with forest landscape can immediately be seen in term of economic opportunities for local communities. According to some experts and per our own observations, the real potential of the economic multiplication effect on the development of nature/forest associated tourism is very high (WTTC 2013, Popa 2014a).

Educational – Though it is very difficult to capture this ecosystem service, it is obvious that the presence and variety of forests are important raising awareness milestones.

Recreation and (eco-) tourism – Tourism sector is considered the second, after the agriculture (Popa 2013a), largest beneficiary of the forest ecosystem services. Most of PAs in the country are located within forest ecosystems and many of them represent a conglomerate of natural, historical and cultural monuments (e.g. National Park Orhei). According to experts analysis (RT 2014), PAs (namely those associated with forests) that include churches and monasteries within are one of the major tourism attraction. The forests are seen traditionally as places where people can rest and spend some leisure time. The total ecosystem services

[9] http://wine.md/

value (not only forest ecosystems) is estimated (Popa 2013a, Popa 2014b) at $7.9 million in 2011. It is obvious that forests ecosystems are the most important for tourism, but the value of this service is still to be determined.

Moldova is primarily an agricultural country, where fewer forest ecosystems are the best preserved ecosystems out of other remnants of natural habitats (e.g. wetlands, steppes). The landscape architecture of vineyards and orchards, combined with a range of other land features and human settlements, creates true amenities that one cannot miss. The process of ES identification for the landscape amenity and biodiversity non-use as valuable ecosystem services as well as their magnitude and economic value need further analysis (Popa et al. 2015).

Economic Impact of Forest Ecosystem Services (FES)

Recent studies, triggered by the process of National Biodiversity Strategy and Action Plan (NBSAP) elaboration, made estimations of the monetary value of the forest ecosystems (Popa 2013a, Popa and Borz 2014, Popa 2014b). The studies were based on comparing two scenarios:

(a) Business as Usual (BAU) meaning the continuation of current practices – wood harvesting continuing to support wood consumption at present levels, with high incidence of illegal logging and under potential use of NTFPs, while forest ecosystems are likely to degrade and have a decreasing regulatory capacity in terms of water nutrient and soil erosion (Popa and Borz 2014);

(b) Sustainable Ecosystem Management (SEM) meaning a lower emphasis on wood production and more exploitation of the NTFPs at a higher sustainable level, while the illegal logging is significantly decreased due to a better institutional, legal and technical framework. However, this is not entirely feasible unless there are alternative energy supplies for the rural population, e.g. short rotation forestry (SRF) crops, energy plantations, or increased afforestation.

Based on our research, the value of forest ecosystems services (wood, NTFP, etc.) is estimated at $28.3 million per year (Popa 2013a).

Under BAU scenario, forestry activities may add some $0.6 million over the next 25 years to Moldova's economy (Popa 2013a). However, this revenue will disappear after 27 years as the capacity of ecosystems to generate economically valuable wood and NTFP is eroded. This ignores the considerable losses in other forest ecosystem services such as carbon sequestration, water and soil erosion regulation, landscape provision and tourism.

SEM implies a decrease in wood/timber and NTFP values in the short term, but will display a significant change in terms of illegal logging reduction, as well as increase in scientific forests area. Nevertheless, in the long run, the value of FESs under the SEM scenario will recover and, thus, generate a higher net present value (NPV) beyond a 25 year horizon. In addition, other ES generated/maintained by sustainable forestry (e.g. carbon sequestration, water and soil erosion regulation, landscape) will be ensured (Popa 2013a).

As the main users of the forest ecosystem services are local communities, the values described above represent net socio-economic benefits (Popa et al 2015).

4.4. Benefits of FES to local communities

4.4.1. Introduction

The dependence of Moldovan rural population of forest products was subject to a separate research (Popa et al 2014). In this way, the application of TSA methodology for evaluating the FES was not based only on desk research for data but also on field surveys.

There is a long tradition in the rural population to collect forest resources ranging from the tree branches to flowers in the spring. Forest fruits are collected and sold by the forest administrators (i.e. Agency Moldsilva) (Moldsilva 2006, Moldsilva 2011, WB 2014) as well as by the community members in rural areas. The forest administrators record the collection and sale of the forest products, which allows the economic effect of these transactions to be estimated easily. There are no records of the collections from the rural population, which makes it difficult to quantify the relationship between the rural population and the forest products (Popa et al. 2014).

Currently, Moldsilva manages more than 84% of the forested areas (Moldsilva 2013). State forests are managed exclusively by the state, which has authority over the use rights of the forest resources. Moldsilva itself or subcontracted companies harvest the wood, and the products are sold on the market as timber (less than 10%) or fuelwood (Moldsilva 2013). Any other wood harvested from the forest is considered to be logged illegally. Illegal logging is considered contravention and is sanctioned by Moldsilva personnel and by the State Ecological Inspectorate. In accordance with legal regulations, Moldsilva calculates the volume of wood (or other forest products) harvested from the forest, and the State Ecological Inspectorate verifies and approves the volumes provided by Moldsilva. This system acts to control illegal logging by monitoring the amount of wood that is officially documented. Moldsilva’s forest units employ the help of forestry personnel, which includes foresters and some members of the local population, to collect a range of non-timber forest products (e.g. flowers, berries, medicinal plants), which are sold on local markets or for export. There are some forest units with revenues that make up 10-20% of the total turnover (Popa et al. 2014).

As for the forests that are not owned by the state, Moldsilva manages some within the same system as described above, while municipalities manage others. The communal council determines who has the rights to the forest products, according to forest management plans put out by Moldsilva (through a specialized institution – the Forest Research and Management Institute (ICAS)). The majority of communal councils do not have the resources for proper forest management or law enforcement, which puts these forests at risk of illegal logging. Except in a few communities[10], most of the community forests are young forests planted with black locust in 2002 or earlier (WB 2014). The wood that can be harvested in these newly created plantations is therefore not very desirable. As these communal forests mature however, effective management becomes a potential issue due to illegal logging.

[10] There are a few exceptions in the country, such as Boghenii-Noi or Sinesti communities, which also have natural forests and which are managed collectively.

4.4.2. Methodology and materials

Study area

The study area included the following three villages (see map in Figure 4.4-1.):

- Central Region, Nisporeni rayon, Cioresti village;
- South Region, Cahul rayon, Borceag village;
- North Region, Soroca rayon, Alexandru cel Bun village.

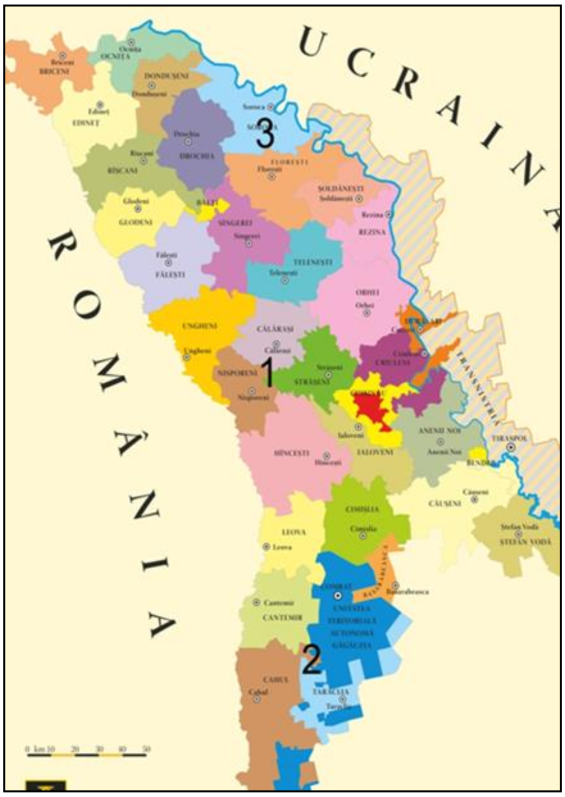


Figure 4.4-1. Geographical positioning of the three sample villages (Popa et al. 2014)

Alexandru cel Bun village in Soroca rayon is located 2 Km from the Ocolina forest, which is one of the largest forests in the area. The distance to Soroca, the nearest town, is 7 Km, and the distance to Chisinau is 148 Km. The village is 0.86 Km^2, with 596 inhabitants (2004 census). The village was founded in 1924. The rayon Soroca is located in the north east of the Republic of Moldova, on the Nistru Plateau. Forests cover 8.3 % of the region. The total population of the rayon is 100,100 inhabitants (96 inhabitants/Km^2) (SYRM 2013).

Cioresti village is in Nisporeni rayon, and is located 2 Km from the Codri forest. This village is also a commune and is located 20 Km from the nearest town of Nisporeni, and 65 Km from Chisinau. The village covers a surface of 2.99 Km^2 and has an estimated population of 3363 inhabitants (according to 2004 census data). The village was founded in 1545. The Nisporeni rayon is located in central Moldova and has 24.6% forest coverage. The rayon has 62,300 inhabitants, or 99 inhabitants/Km^2 (SYRM 2013).

Borceag village in Cahul rayon is close to the Borceag forest. The distance to the nearest town, Cahul, is 30 Km while the distance to Chisinau is 101 Km. The village has a total surface area of 2.28 Km^2 with a population of 1602 inhabitants (according to 2004 census data). The village was established in 1770. Cahul rayon is located in the lower Prut river meadow, has 12% forest coverage. The rayon has 119,200 inhabitants, or, 77.2 inhabitants / Km^2 (SYRM 2013).

The rural age structure in 2013 across the three sample villages (SYRM 2013) was the following: less than 15 years – 19.1%, between 16 and 64 years – 70.2%, 65 years or more – 10.6%. The average age was 36.6 years and the dependency ratio[11] was 55.9%. Life expectancy in the rural area of the Republic of Moldova is 69.6 years (SYRM 2013), which has increased slightly in the last period (Popa et al. 2014).

Low wages and the absence of jobs have led people to emigrate from this region to find work abroad. Based on National Office of Statistics (NOS) data (SYRM 2013), 26.9% of the active population in the North region, 28.7% in the Central Region and 33.7% in the South region have left to find work abroad. More than half of those seeking work abroad are between the ages of 25 and 44, with a rather high education level (47.4% college or University graduates). 67% of the migrated people working abroad or looking for a job abroad are in the Russian Federation, 15.2% in Italy, 1.6% in Ukraine, 1.2% in Portugal and 1.1 % in Romania (SYRM 2013). The population increase rate is low: from 2008 till 2012 it varied from 1.1 to 2.3 persons for every 1000 inhabitants (Popa et al 2014).

The poverty rate in the rural areas of the Republic of Moldova is 25% (ME 2012), which is 3 times greater than the poverty rate in urban areas. 82% of poor people in the Republic of Moldova live in rural areas. In 2012, the average number of persons in rural families was 2.5 persons. Only 24% of the households consisted of more than 4 persons. In 99.2% of the cases the families owned the houses. The average surface area of the houses in 2013 was as follows: 24.8 m^2 in Soroca rayon, 19.9 m^2 in Nisporeni rayon, and 22.1 m^2 in Cahul rayon (ME 2012, Popa et al. 2014).

In 2013, the available monthly average revenue per person in rural areas was 1406.7 MDL. 28.3% of the revenue comes from salaries, 21.3 % form delivery of services, 17.9% from individual agricultural activity, 6.1% from individual non-agricultural activity and 22.9 % from remittances. It should be noted that there are some disparities between regions regarding this data. Available monthly revenue in the north region is around 1498.2 MDL, 1369.9 MDL in the Central Region and 1352.0 MDL in the South region (ME 2012). Depending on social status and employment, average monthly revenues vary: 973 MDL for farmers, 1254.6 MDL employees of the agricultural businesses, 1672 MDL employees in the non-agricultural sectors, 2145.6 MDL for entrepreneurs, and 1319.5 MDL for retired people (ME 2012, Popa et al. 2014).

In 2013, average expenditures per person, in rural areas was 1515.25 MDL, with the following structure: food – 44.9%, alcohol and tobacco – 1.7%, clothing – 11.6 %, household maintenance-- 18.1%, household equipment – 4%, health – 5.9%, transportation – 4%, communications- 3.9%, education – 0.7%, agreement – 0.9%, restaurants – 0.6%, other –

[11] Dependency ratio is the ratio of dependents to the working-age population (proportion of dependents per 100 working-age population).

3.8%. There are differences between the regions regarding household expenditures as well: 1462.6 MDL in South region, 1541.4 MDL in the North region and 1541.7 MDL for a person in the Central region (SYRM, 2013).

According to the NOS (SYRM 2013), in 2013, the unemployment rate for the Republic of Moldova was 5.1% (rural areas – 4.1%). In the North region the rate was 3.8%, in the Central region it was 4.9% and in the South region it was 5.6%. The most affected groups are 15 to 24 year-olds, and people with medium to high education.

The majority of people in the communities are involved in the agricultural sector. Very few of them are industrial workers and even fewer work in the forestry sector. The number of industrial workers dropped dramatically after the fall of the communist regime once the biggest state-owned companies closed. In the forest sector, the low number of workers is explained by the fact that the forest cover in the Republic in Moldova is rather small.

Economic activities in Nisporeni and Cahul are profitable (Popa et al. 2014), whereas they are unprofitable for Soroca rayon, due to the low performance of the rayon's large companies.

Agriculture. Ecological conditions are suitable for agriculture in the Republic of Moldova therefore this sector is the main source of raw materials for the food industry as well as an important source of biomass for energy production. The north region specializes in the production of sugar beets, cereals, fruits, and tobacco. Black soil dominates the area, but grey forest soil makes up approximately 10% of the soil in the region. The central region specializes in grape and wine production. Forest soils cover 40% of the surface. The South region specializes in the production of grapes and wine, as well as corn and sunflowers. The area is mostly flat with a low percentage for forest soils. 44,000 ha of the land in Soroca rayon, 2000 ha in Nisporeni rayon and 52,900 ha in Cahul rayon is used for agriculture. In Soroca rayon, the agricultural production surpasses the national average (with the exception of potatoes and grapes). The other two rayons in this study (Nisporeni and Cahul) are rather behind in terms of agricultural productivity with the exception of cereals in Cahul and grape production in both regions. With the exception of milk production in the Cahul rayon, the regional production of animal products does not meet the region's population's demand.

Industry. Based on data reported by the NOS (SYRM 2013) there were 90 industrial companies with a total production value of 898,000 MDL in Soroca rayon, 50 companies with a total production value of 105,900 MDL in Nisporeni rayon, and 107 companies with 362,300MDL total production value in Cahul rayon. In the three rayons, 2-26% of the regional industrial capacity and 0.2-2.5% of the national industrial capacity is satisfied. The food and beverage industry is dominant in these areas.

Forestry. Between 2005 and 2012, the average annual volume of legally harvested wood in the Republic of Moldova reached 400,000 m^3 (Moldsilva 2013) This annual allowable cut represents nearly 40% of the total forest annual increment. Wood harvested for industry represents only 7.7% of the legally harvested wood due to the low quality of forests, with the rest of the harvest being mainly fuelwood used for heating, cooking and occasionally for small rural constructions. Still, there is much pressure on forests from the rural population because fuelwood is the main source of heating. The studies conducted by the FLEG (Botnari 2011, Galupa 2011) project shows that the consumption for heating in the rural areas of

Moldova is surpassing the total amount of legally harvested fuelwood on the market (Popa et al. 2014).

Remittances. In 2012, the value of money transfers to Moldova through banking institutions from individuals totaled 1,494 million USD, which increased by 51 million USD from 2011. Historically, the highest level of remittance money recorded was in 2008 when the total amount of remittance received in Moldova by citizens working abroad was 1,660 million USD. The republic of Moldova ranks 5th in the world in terms of remittance as percent of the GDP (25-30%). Compared to households that do not receive remittances, remittance-receiving households are less likely to fall below the poverty line. However, it should be noted that people in extreme poverty do not have access to migration; hence, they are excluded from the benefits of migration (WWR 2014) The share of remittances in the revenue of the average household in the Central region is estimated at 22%, in the North region up to 24.5% and in the South region up to 26.3%. It should be noted that only 40% of the returning migrants are able to find work in Moldova. While the country level data suggests a higher level of remittances, this is not the case for the sample villages of Alexandru cel Bun, Ciorasti and Borceag, where revenues from this source are much lower (Popa et al 2014).

According to official records (SYRM 2013) 9.1% of the land in Alexandru cel Bun is covered by forests, which is more than the rayon average but less than the country average. Pastures cover approximately 17% of the area available to the community and all the pastures belong to the local council. 65% of the land is agricultural land, with vineyards making up a significant share. The rest of the area is degraded land. Cioresti village is located in a more forested area, with forests covering 28% of the land, which is more than the rayon average and almost double the country average. 36% of the land is used for agriculture, as most of the land is used for vineyards. Pastures represent 25% of the land, the rest consisting of degraded lands or other categories. Borceag village is made up of 11% forests, 8% pastures, 72% agricultural land and the rest is considered degraded land.

Method of sampling

The republic of Moldova is divided into three zones based on a planning framework for the evaluation and implementation of regional development policy:[12] North, Center and South. These development regions are different in terms of natural conditions as well as social and economic development. The first selection criterion was the accurate representation of each of the three regions. Alexandru cel Bun village represents the North region, Cioresti village represents the Central region and Borceag village represents the South region.

The proximity of the forests to the villages was the second selection criterion. Aexandru cel Bun village is located near a forested steppe, Cioresti village is located near old oak forests and Borceag village is located near a wet forest in the lower meadow. These three types of forests represent the main forest types in the Republic of Moldova (Popa et al. 2014).

The households were randomly selected using a sample plot step of three houses. In every village, 50 households were visited and 150 interviews took place. The focus groups were

[12] Law nr. 438/2006 regarding the regional development of Republic of Moldova

made up of community representatives from the ages of 25 to 65 years old, with equal representation from both women and men. The members of the focus groups represented the main occupations in the villages as well. The focus groups consisted of 13 persons in Ciorasti and Borceag and 11 persons in Alexandru cel Bun.

The survey in Cioresti was initiated on the 1st of May 2014 and was completed on the 15th of May. In Borceag the interviews were conducted during the entire month of July and in Alexandru cel Bun the survey was organized during August and was completed on the 25th of August.

The survey was conducted using a Poverty Environment Network (PEN) questionnaire of the Centre for International Forest Research (CIFOR) derived questionnaire (CIFOR 2007) (the PEN questionnaire was adapted to local conditions mainly in terms of local specific forest products).

The main problem encountered was the refusal to answer to section 2B of the household questionnaire, which asked respondents to declare their assets and the value of their possessions. Only 48 % of respondents in Borceag and 58 % of respondents in Alexandru cel Bun answered the question successfully (Popa et al. 2014).

4.4.3. Results and discussion

Income share by source

Figure 4.4-2. shows income share by source for all three villages combined as well as for every village individually. The main source of income is agriculture (more than 64% of the income is generated by agricultural activities). In Alexandru cel Bun village, sugar bean, cereals and fruits are the most important crops, with grapes being secondarily important. For Cioresti, grape production is the most important followed by fruit and corn production. In Borceag, grapes are again the most important crop, followed by corn and sunflowers. The figures show the strong agricultural orientation of the rural areas in the Republic of Moldova, which is represented in official governmental reports as well.

The forest is the third highest source of income, which is rather impressive considering the forest only covers a small share of the land. It is noteworthy that in Cioresti village (located in the area with the highest share of forest) the income generated from the forest is greater than the average (18.2%) while agriculture represents a lower share (32.5%) of the income. In both forestry and agricultural related activities, all the members of the family are involved (Popa et al. 2014).

It is also interesting to note the low impact of businesses in the rural areas studied. When comparing wages as an income source, we see a uniform level across the three sample villages, which are reflected in statistical data provided by the NOS in Chisinau as well.

Other income sources represent a significant share of the total income with the main source of income being pensions. Those data show that mostly retired people populate the villages, due to the fact that large portions of young people leave the villages to work abroad. When comparing the figures for the three villages, the region with the highest population of retired people is in the south.

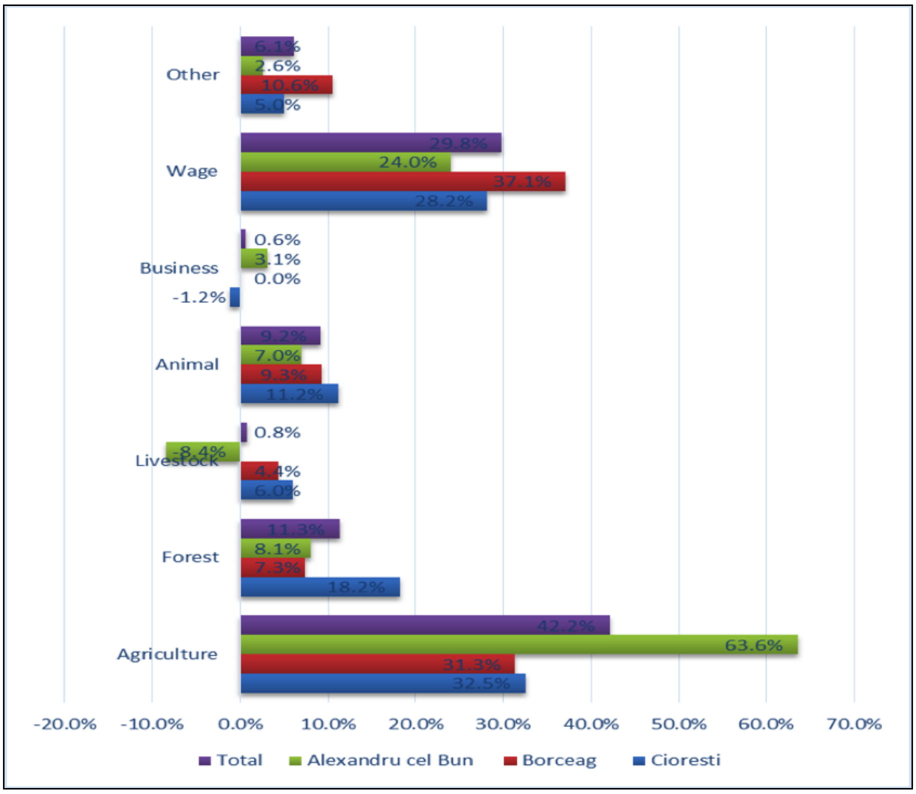


Figure 4.4-2. Income share by source (Popa et al. 2014)

Frequency and value of forest resources

Figure 4.4-3. and Figure 4.4-4. show the frequency of collection and the total value of forest resources based on the results of the surveys in the three sample villages.

Nuts, collected in all the sample villages, represent the most valuable forest resource (53% as value) as well as the most often collected resource (17% as frequency). The walnut has always been considered a very valuable species in the Republic of Moldova. During the former Soviet regime, legislation from the 1950's called *The Law of the Walnut* was heavily enforced and as a result, Moldova became one of the biggest exporters of walnuts in the world. Even today, important walnut plantations exist in the forests, and serve as protection belts along some roads. Walnuts are used for personal consumption and are sold on local markets (or regional markets, with Ukraine and/or Romania), but mostly walnuts are sold to companies in the Republic of Moldova that specialize in the export of the nuts abroad. These businesses collect the nuts from rural populations for resale, and centralize and export the collected quantities. All family members collect the walnuts, especially when they are being collected for sale (Popa et al. 2014).

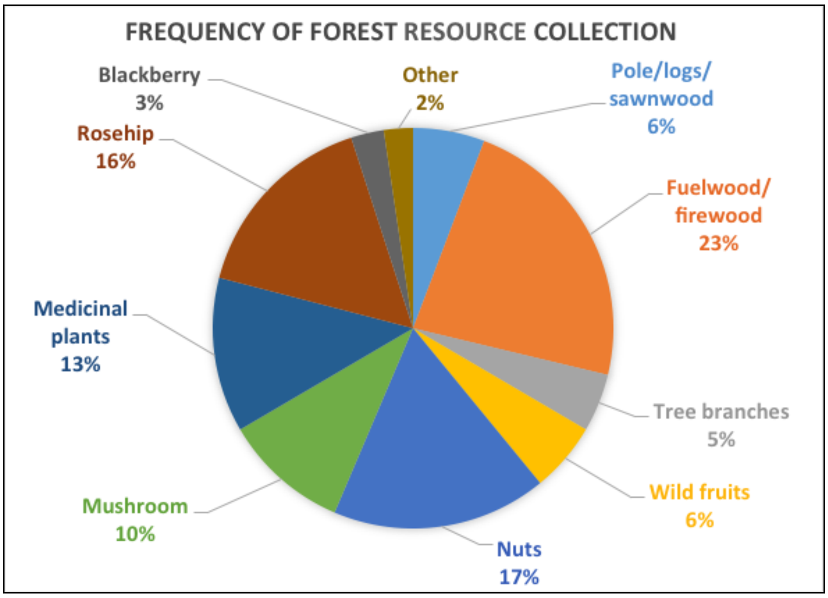


Figure 4.4-3. Frequency of forest resource collection (Popa et al. 2014)

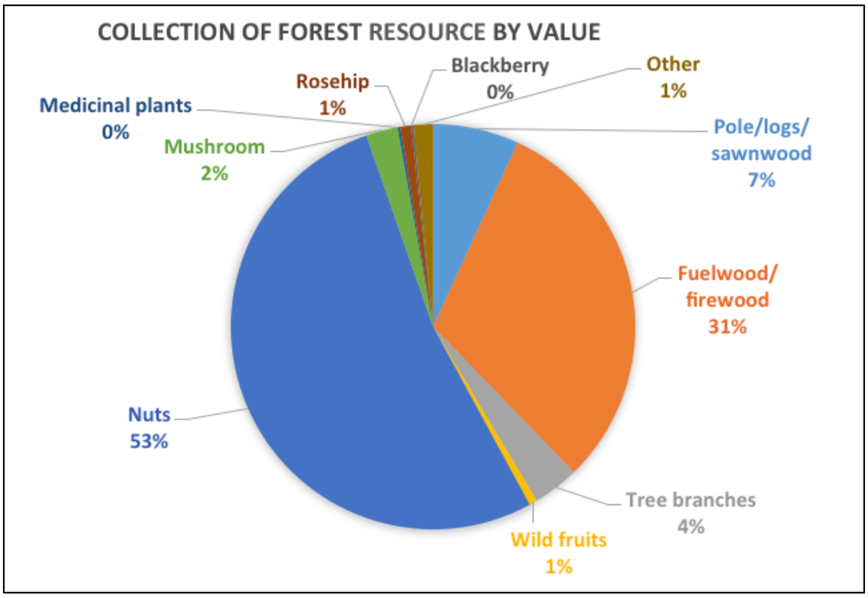


Figure 4.4-4. Collection of forest resources by value (Popa et al. 2014)

The rosehip and the other forest fruits, along with mushrooms, are frequently collected by the sample communities, however, they are considered to have a low value because they are mainly collected for consumption rather than for sale.

Wood is used as fuel for heating or cooking and/or small rural constructions and aside from nuts, represents the most valuable and frequently collected forest resource. Fuelwood is the only source of fuel for the majority of rural areas in the Republic of Moldova. Because these resources are limited, forest resource management is very important to the rural communities in Moldova.

The official quantity of fuelwood sold by the forest administrators is approximately half of the total wood consumed for heating. That discrepancy indicates that there are other sources of heating fuel and raises questions of whether illegal logging is occurring.

Officially, community members buy fuelwood and wood for rural constructions and tree branches from the forest district representatives while harvesting activities take place in the forest. Considering that Moldsilva regulates the harvest and sale of fuelwood, the fact that households take the wood without payment to Moldsilva and perceive this harvesting activity as revenue suggests that illegal logging is taking place. This sheds light on the scarcity of Moldova's forest resources and raises questions of sustainable resource use.

Cash and subsistence value for forest resources

Figure 4.4-5. below shows the value of forest resources in terms of monetary value as well as the value for subsistence use and shows that nuts are collected namely for sale, while wood products are used for subsistence. Nut collection (primarily walnuts), represents an important share of rural incomes due to its long regional tradition, established supply chains and the abundance of walnut trees in the region. Households collect the nuts for subsistence use and for sale. The share of collection for all other resources is very low, and members of the studied communities rarely collect them for sale.

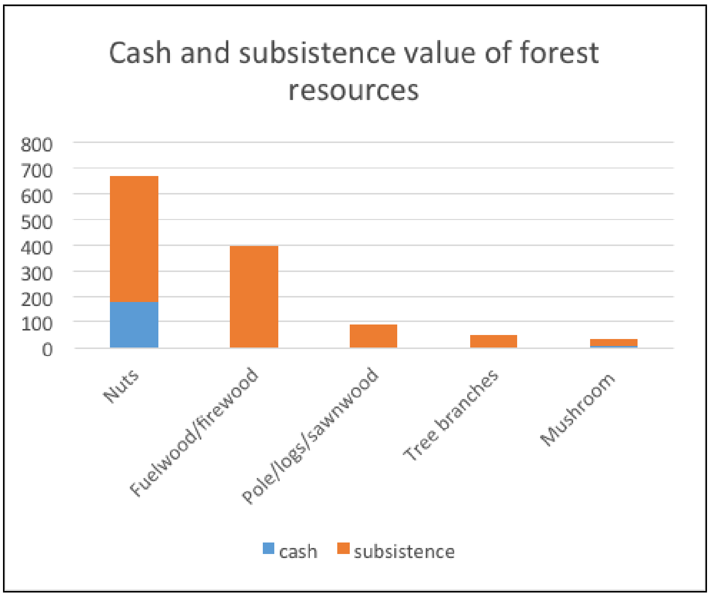


Figure 4.4-5. Cash and subsistence value of forest resources (Popa et al. 2014)

RFI across income quintiles

Figure 4.4-6. represent the relative forest influence (RFI) across income quintiles for the total survey region.

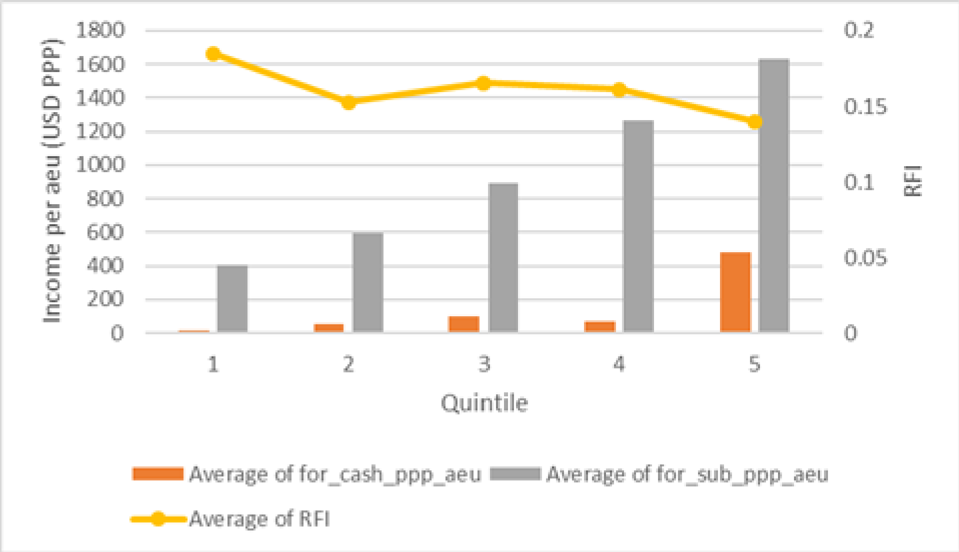


Figure 4.4-6. RFI over income quintiles – centralized results for the three sample villages (Popa et al. 2014)

All the figures shown confirm the hypothesis that in poor rural communities, the lower the household income, the higher the dependence on the forest. Our results show an RFI between 1% and 35% across all of the study regions. Other activities, especially agriculture, represent significant and diverse sources of income. A high RFI indicates a relative closeness to the forest as well as less diversified sources of income. A decrease in the RFI slope is related to general access to agricultural resources.

For Cioresti village (the highest in elevation and located in the area with the most forest coverage) the RFI range is smaller than in the south (between 14% and 19%). In this case, the agricultural resources are smaller for the households (the smallest share of income related to agriculture was recorded in this village). As long as all the inhabitants are using the forest resources, total income is less related to the dependence on the forest. This is evidenced by the data in Alexandru cel Bun village, where the RFI rank was between 0.5% and 32% (Popa et al. 2014).

The main income for all the households comes from agricultural activities. Households mainly use the forests for fuelwood and some wood for rural construction so the forest income does not differ greatly among households in the region. The differences in income are primarily related to revenues from agriculture. Wealthier households (i.e. those with greater revenues from agriculture) have a smaller share of forest resources in their income. It is difficult to identify why the RFI is greater in the 4^{th} quintile, but it seems that the differences between the 4^{th} and the 5^{th} quintile are primarily related to wages. Based on this data, we see that forest resources tend to have the same influence on total income across the regions.

Revenue related to forest activities increases slightly with each quintile, meaning that households with a greater overall income receive a greater portion of their income from the forest. A possible explanation for this is that households with more intensive agricultural activities need more wood for subsistence use (e.g. rural construction for livestock or for the storage of agricultural products). There is no direct relationship between the total income and revenue from the forest, however, because the RFI decreases in this quintile.

Most Important Product

In all three studied communities, the forest is an important source of heating fuel in the winter. Wood resources are the most important resources collected from the forest. Nuts are uniquely important for the Republic of Moldova due to the regional and cultural importance of the walnut tree and the established supply chain that encourages nut collections for sale. The tradition of using the nuts for different deserts and for other consumptive uses influences collection and consumption patterns as well (Popa et al. 2014).

In terms of the perceptions on the increase or decline of wood resources, the perception across all of the villages is that the quantities are declining (explained by the high dependence on fuelwood), which contradicts with the official statistics on the fuelwood market, which indicates stable quantities. Respondents indicated that there are three major reasons as to why the quantities of fuelwood are declining, which carry roughly equal weights. The RFI decreases from the first to the fifth quintile, meaning that the wealthiest people in the fifth quintile are less dependent on forests and the poorest people in the first quintile are the most dependent on the forests. This difference in forest dependency may explain the discrepancy between official statistics and the household responses.

4.4.4. Conclusions

Based on the data analysis, there appears to be a mismatch between the households' and the administration's perspectives on the use of forest resources. With the exception of nuts, wood resources, especially when used as a heating source, are the most valuable and the most frequently collected resource. This shows that from a household perspective, the forest is used primarily to meet households' needs and secondarily as a resource to supplement their income. Moldsilva or their subcontracted companies harvest wood and the wood resources are sold on the market as industrial goods (less than 10%) or fuelwood. Any other wood taken from the forest is considered to have been logged illegally. Illegal logging is considered contravention and is sanctioned by the rangers of Moldsilva and by the State Ecological Inspectorate. There is no permitting system. The forest administration considers the quantity of wood logged illegally to be lower than what it actually is. Officially, there should not be any sources of wood other than those marketed by Moldsilva. The fact that households take the wood without payment to Moldsilva and perceive this harvesting activity as revenue indicates that illegal logging is taking place (Popa et al. 2014).

The present research as well as a study done within ENPI FLEG I on fuelwood use and illegal logging in rural areas of Moldova (Galupa et al. 2011) raises questions about unsustainable resource use and highlights the need to promote sustainable heating source alternatives.

The most important forest resource to the communities is fuelwood, which implies that the main factor which determines the use of this resource is linked to basic needs such as heating. All other resources, such as nuts and other forest fruits like rosehip, strawberry, etc. have a use that, whether linked to cash or not, is driven more by the tradition or other socio-economic factors than by financial incentives.

Fuelwood is obtained from annual tree felling regardless of whether the state forest administration is paid for this activity or not. The fact that respondents included fuelwood in their net incomes when officially all the wood for heating can only be acquired through the market for value, favors the conclusion that there are other sources of wood other than official ones on the market, including possible illegalities in logging that have been allowed by the forestry personnel. Considering the magnitude of these phenomena, despite the severe resources shortages of the marketed goods, these illegal activities may be driven by tradition (Kobernic-Gurkovskaya 2011).

The official annual allowable forest harvest in Moldova is less than 40% of the annual increment. Therefore, even if a portion of the fuelwood is not entirely legally sourced, the supply of fuelwood may still be stable considering the decrease in population and the practice of traditional harvesting tactics. Nevertheless, the results of this study should spark questions regarding sustainable resource use and may help to accelerate existing efforts to encourage sustainability in the rural areas of the Republic of Moldova (WB 2014).

Regarding the use of walnuts, it is refreshing to see that such a long tradition is still being upheld despite the problems that have been associated with walnut management and use in the past, specifically with regards to the push for the utilization and promotion of the nuts by regulatory bodies. The nuts are a traditional food and an important source of income, not only for households with lower incomes, but for most of households in the country as well (Popa et al. 2014).

4.5. The use of TSA approach in forest ecosystem evaluation

The TSA approach (Alpizar and Bovarnick 2013) considers the ES provided by forests as inputs into a country's economic sectors and presents data on the economic value of ES to each sector. It also recognizes that humans are part of the ecosystem and we depend on it as well as our activities affect the ecosystem. It is important to acknowledge that ecosystem functions result in ecosystem services, so for Moldova this is crucial to understand when considering forest ecosystem quality and the potential for providing products/services (Popa et al 2015).

Forest ecosystems of Moldova provide multiple ES, such as water provision and regulation, soil fertility, pollination, pest control, growth and reproduction of food species, storm mitigation, climate regulation and waste assimilation, which directly and indirectly provide inputs into the production of key sectors in country's economy. Key sectors benefiting from the ES provided by forests are - agriculture, forestry, nature-based tourism, human settlements, health and natural disasters reduction.

The logic to drawing out the contribution of FES under different management regimes to key sectors is that it can provide a comprehensive and tailored argument to present to sector Ministries. This can facilitate the integration of ecosystem management and protection into key sector plans and strategies, and aid negotiations with other Ministries were the management of an ES by one sector clearly impacts its provision to another (for example, the tourism sector may be adversely impacted by unsustainable agricultural or forestry practices). Table 4.5-1. highlights how FES can contribute to different sectors.

Table 4.5-1. Overview of how sectors benefit from FES and management challenges (Adapted after Popa and Bann 2012)

Sector	Key ES	Management challenges / Issues
Agriculture	A sustainable, high-quality water supply depends on well-maintained ecosystems that are often preserved within forests. Water is critical for irrigation, farming and other uses. Agroforest farming, when communities use both forest vegetation and pastures (or other agro-systems) for their cattle, also using them as forage (e.g. hay provision). Forest ecosystems provide natural habitats for genetically-important crop wild relatives. Many species pollinate both crops in agriculture and plants (trees, shrubs) in forests, and vice-versa. Forests provide shelter for a number of biodiversity that contribute to the biological control of pests and livestock diseases.	These services are frequently under-valued and provided for free encouraging overuse. Further research is needed to assess the links between reduced water quality, lower flows, and forest ecosystem management. Forest ecosystems can be of use in developing solutions to degradation in freshwater ecosystems. Agroforestry (or silvopastoral) approach is still underestimated, but it is a real solution for a rational use. Using appropriate species or varieties in agriculture is directly linked with the pest/disease distribution, and pests are using both forest and agriculture species as hosts.
Forestry	Moldovan forests represent a very important remaining of natural hill oak forest type (with circa 80% of country's biodiversity within) that is under a high anthropic pressure. Forests therefore provide an important carbon storage service. Payments for carbon storage could mean significant revenues (i.e., foreign exchange transfers and funding to pay for the transition to SEM). The argument for that is valid if forest ecosystems are under direct threat of deforestation.	Under BAU, direct threats to forests include illegal logging and infrastructure development. Furthermore, current Income from taxes, timber, and forest products is low sending incorrect signals to the market and negatively impacting government expenditure for forest management. Taxes and fees on timber and other forest products need to be set at appropriate levels, so that the Government has a vested interest in sound forest management, sustainable commercial logging, and prevention of illegal activity, to ensure future revenue flows. This is relevant to forest management units that allow sustainable use of forest resources.
Nature Tourism	Forest ecosystems contribute to nature-based tourism (NBT)/ecotourism. This depends on the natural attractions provided by forests, such as the habitats (with wild plants and animals), traditional food from forest products (berries, mushrooms), fresh water and air, views capes, and cultural services essential to NBT. Tourists find NBT experiences, trekking, wild life viewing (including bird-watching), hunting, more valuable when they take place in healthy ecosystems, such as those found in PAs (Bovarnick et al. 2010).	Under BAU, PA-based NBT is undermined by insufficient investment in the conditions required to manage NBT and the supporting PA well resulting in negative external costs. It is assumed that if PAs shift to SEM practices, NBT will generate greater economic value. Moldovan authorities and forest management institutions/companies do not yet realize that investing into forest PA is likely to bring benefits under SEM scenario, so maintaining a forest under its natural conditions (with excluded intense management for wood/timber, often illegal) will be much more effective from economic perspectives (with more revenue) due to an increased demand from tourism.
Human Settlements	Human settlements benefit from forest ecosystems through the provision of a variety of critical services such as the provision of fresh water, regulation of natural hazards, and natural mitigation of climate change. Forests provide cheap, clean drinking water to countless rural and urban populations, including a third of the world's most populated cities (Dudley et al. 2010). Well-managed natural forests almost always provide higher quality water, with less sediment and fewer pollutants than water from other catchments (Aylard 2000). Research has shown that about a third (33 out of 105) of the world's largest cities obtain a significant portion of their drinking water directly from PAs (Dudley et al. 2010).	Watershed conservation can greatly improve water quality and quantity, reducing water treatment costs. Authorities do not yet see the linkage between the quality of water and forest vegetation, and once this is realized things may change. Forest vegetation can greatly reduce risks from flooding, which is not properly understood by local administrations.

4.5.1. Targeted sectors and evidence of economic FES benefits

The valuation research used five key sectors (or sub-sectors): tourism/recreation; forestry/hunting; agriculture; water management and disaster risk reduction. The study provides a detailed description of the full range of forest ecosystem-economic benefits and costs associated with each sector/sub-sector, and the monetary quantification of key costs and benefits accruing to them.

Fact-finding research about these six sectors has, after in situ visits and meetings held with forest institutions or other forest experts, concluded that (Popa et al. 2015):

- ***Tourism/recreation*** sector valuation would be extensively based on additional value-added by sustainable forest ecosystem management. This includes primary production, value-added in the marketing chain and secondary economic impacts and multipliers associated with forest and nature-based recreation. It also considers traditional aspects when population is used to spend leisure time in forests during holidays as well as religious and cultural traditions that local population links to forest areas (e.g. so-called saint or curative springs in the forests near monasteries).
- ***Forestry/hunting*** sector valuation tackled additional value-added by sustainable forest and agriculture management too, which included the primary production, value-added in the marketing chain and secondary economic impacts and multipliers associated with the active management of forests, and with hunting carried out in and around forests (i.e. sectoral direct values or provisioning services). Forest existence values (supporting, regulating and cultural services) are covered via their contribution to other sectors.
- ***Agriculture*** sector valuation regarded this closely linked to forestry sector and focused mainly on the additional value-added by sustainable forest ecosystem management. This included the primary production, value-added in the marketing chain and secondary economic impacts and multipliers associated with the active management of forests and agricultural lands surrounding forests. In the past, many forested areas were converted into agriculture, and nowadays some degraded lands (unused for agriculture) are afforested. Also, agricultural sector is extensively using the practice of forest protection shelterbelts, which are believed to contribute to an increased productivity and to provide habitats/refugees for biodiversity.
- ***Water management*** sector valuation will consider watershed protection services (associated with run-off/erosion control and soil stabilization) in terms of their impacts of water flow regulation and water quality maintenance for water supply facilities, fish farms, bottled water companies. It will mainly focus on the costs, losses and damages avoided by sustainable ecosystem management.
- ***Disaster risk reduction*** valuation considered the climate change mitigation, flood attenuation and landslide protection services. It focused mainly on the costs, losses and damages avoided by sustainable forest management.

Sectoral studies done under UNDP Project "*National Biodiversity Planning to Support the Implementation of the CBD 2011-2020 Strategic Plan in Republic of Moldova"* (Popa 2013a) fully recognize the economic benefits that different sectors of the economy can draw from ecosystem services in general, and forest ecosystem services in particular. Table 4.5-2. presents the main findings of the study.

Table 4.5-2. Overview on how sectors benefit from ES (Popa 2013b, Popa and Borz 2014, Popa 2014b)

Sector	Key ES
Tourism	The interest for eco-tourism in Moldova is increasing and the number of visitors in protected areas (PAs) increased from 6266 in 2008 to 9020 in 2010. Eco-tourists are increasingly appreciating places where natural resources are protected, thus the tourists being beneficiaries of cultural services (landscape, recreation). Undisturbed ecosystems will continue to attract tourist while their willingness to pay for biodiversity conservation is increasing and can be captured. ESs in eco-tourism sector estimated a total value of $5.9 million in 2011 and a PV (10%, 25 years) of $79.8 million in sustainable ecosystem management scenario. In 2011, the contribution of eco-tourism at national GDP was estimated at $7.9 million.
Forestry	Forests provide important provisioning services due to wood/timber and NTFPs that are entering the economy. Besides important regulating ES (e.g. water supply and disaster risk mitigation), the value of forest provisioning ES in 2011 was estimated at $28.3 million. Currently the sector is affected by illegal logging and a small emphasis on NTFP. Under SEM scenario, with decrease of illegal logging and increased interest for NTFP, the NPV for a 25 years horizon (10% rate) is estimated at $578.8 million. Although the contribution of forest provisioning services to Moldova's economy may decrease in the near future, after 27 years the benefits will pass the losses.
Agriculture	Agricultural ecosystems are providing provisioning services that were estimated at $3,998.8 million in 2011. This value does not consider the regulation services (water and soil retention, carbon sequestration, pollination, etc.) considered in other sectors. The main provisioning services are animal breads and livestock species. Biodiversity conservation means an active management of pastures and plantations (e.g. orchards, vineyards), by keeping them at the carrying capacity through a sustainable management, by extending the eco-agriculture and diversification of cultures. SEM in agriculture can add $1,883.3 million to the economy in the next 25 years.
Water supply	By conserving biodiversity and ecosystems, they will provide regulation services as: water retention, soil erosion control etc. Reducing the soil erosion, it transfers into reducing treatment costs of domestic water suppliers. Baseline value of those avoided treatment costs was estimated in 2011 at $3.4 million, while in the scenario of keeping the ecosystem integrity by conserving biodiversity, would add to the economy nearly $3.5 million.
Disaster risk mitigation	By providing regulatory ES (such as water retention, soil erosion regulation, nutrient control etc.) the ecosystems can produce important effect in mitigation of floods, landslides and soil erosion. If the upstream, protection functions of ecosystems serve to minimize the impact of disaster by 10% below what it would have been in the absence of the protective functions, then the ecosystems' value of flood control in terms of avoided damage costs (projected on a pro rata basis) equates to an average of $13.4 million a year – $19.7 million a year based on a damage cost avoided and preventative expenditure approach respectively. Carbon sequestration functions of the forest under SEM could generate an additional $2.1 million (cumulative value over 25 years), if only present afforestation/regeneration incentives are continued.

4.5.2. Management scenarios design

The next methodological step was to properly define and describe the system-wide BAU versus SEM scenarios. The first draft of the BAU and SEM description was consulted in two rounds during January 2015 with representatives of relevant stakeholders. Based on an adapted Delphi method, the consensus was reached (Popa et al. 2015) and the results are presented in the following pages of this thesis.

The scope and the content of the process of BAU/SEM description was to define and describe the key characteristics of BAU and SEM scenarios, then to justify the scenarios in terms of their links to current economic and policy trends, investment patterns and ecosystem threats. Based on the stakeholder consultations the future trends have been identified and described, as follow (Popa et al 2015):

- Forest sector expenditure and investment;
- Key parameters relating to forest land management, including changes in area, utilization regime, investment and expenditures, etc.; both general trends and changes specifically related to the scenarios were differentiated;
- Key parameters relating to ecosystem status and use in broader landscapes, including changes in land and resource use, vegetation cover and quality, etc.; general trends were distinguished from changes specifically related to the scenario;
- Key parameters relating to economic production in broader landscapes, including changes in production patterns, sectoral activities, participation in business and industry, infrastructure and communications, markets, etc.; general trends were distinguished from changes specifically related to the scenario;
- Key parameters relating to the economy and wellbeing that are unrelated to ecosystem management and status, including changes in real prices, GDP growth, exchange rates, population and demography etc.

The TSA approach aims to present data on a set of economic indicators to compare the costs and benefits of BAU and SEM. Based on data availability and considering the possible indicators and evaluation techniques used in similar studies (Bovarnick et al 2010, Popa and Bann 2012), several indicators were chosen for this study (Table 4.5-3.). The table also presents the evaluation techniques used to estimate the level of indicators.

Table 4.5-3. Indicators and valuation techniques (Popa et al. 2015)

Ecosystem service	**Valuation technique**	**Sector focus**	**Indicators**
Wood and NTFPs	Market pricing	Forestry	Present value, Production (volume and value), Distribution of benefits, Fiscal impacts
Water for public use	Market pricing	Water supply	Present value, Distribution of benefits, Fiscal impacts, Income trends
Carbon sequestration	Market pricing	Wellbeing	Present value, Distribution of benefits, Income trends
Recreation	Travel cost, contingent valuation	Tourism	Present value, Distribution of benefits, Fiscal impacts, Income trends
Food (Agriculture)	Market pricing	Forestry	Present value, Production (volume and value), Distribution of benefits, Fiscal impacts

Possible indicators include the NPV, income, employment, production output, food security, tax revenues, and the impacts on low income and marginalized populations. The approach therefore seeks to provide evidence across a range of indicators in addition to NPV of the BAU /SEM cost benefit analysis (although this remains a core indicator) (Popa et al. 2015).

General description of BAU and SEM scenarios

Business as Usual (BAU)

Under BAU, forest ecosystem management activities are underfunded as they lack management capacity and face severe threats. Forests are unlikely to provide basic protection to biodiversity and ecosystems functions. This is the case in Moldova, where the central public authority for forestry and hunting, i.e. Agency Moldsilva, was almost not supported from the state budget and it hardly received 2-3% from its annual turnover during the last decade (Moldsilva 2011, Moldsilva 2013). This funding gap, meant to provide a basic level of conservation and proper management, is underlined by all stakeholders we held discussions with. Moreover, such situation seems to encourage illegal activities as most of forestry personnel and silvicultural activities are underfunded.

Under BAU, planning and management activities are typically supported by limited human, financial, institutional, and informational resources. PA conservation goals and objectives are often poorly linked to conservation programs and costs, and existing budgets are not linked to programmatic priorities. Altogether, this makes it difficult to measure effectiveness, estimate realistic needs, and determine financial gaps. Further, at national levels domestic funding for forest management is often stagnant as a result of constrained national budgets, lack of transparency, corruption, poor accountability, as well as a lack of political will to support “greening” of national development plans. BAU is characterized by short-term gains (e.g. < 10 years), externalization of impacts and their costs, and little or no recognition of the economic value of ES (Popa et al. 2015).

Sustainable Ecosystem Management (SEM)

Under SEM, funding and capacity are available to meet optimal protection needs. SEM is understood as an advanced management approach in which FE management functions are more aligned with human, financial, institutional, and informational resources. In SEM, protected area’s conservation goals and objectives are linked to ecosystems conservation programs and are realistically linked to funding. As a result, ecosystem health improves and their benefits, in terms of increased productivity and equity, will expand. By and large, the benefits of SEM outweigh its costs.

Under a SEM scenario, the focus is on long-term gains (10-20 years or more), while the costs of impacts are internalized. Degradation of ES is avoided, thereby generating potential for a long-term flow of ecosystem goods and services. SEM practices tend to support ecosystem sustainability, not for ideological reasons, but rather as a practical, cost-effective way, to realize long-run profits.

SEM brings an additional dimension of ecosystems management, namely a better understanding of the economic costs of ES loss in FE. A key feature of SEM is adequate funding, and the SSA approach aims to build economic arguments to promote increased funding to protect biodiversity and ecosystems.

4.6. Results and discussions regarding the evaluation of FES

4.6.1. BAU and SEM scenario description

Tourism

Business As Usual (BAU) is defined as a continuation of underfunding and a disconnection between the increasing interest in eco-tourism and the quality of the ecotourism experience being offered at sites. In spite of PAs remarkable natural and cultural resources, the lack of biodiversity studies make it impossible to known and manage sensitive areas and describe new features and species; damage to biodiversity through tourism may therefore occur and/or tourists may lose interest if biodiversity information is lacking. The absence of facilities for visitors also restricts the proper management and accounting of tourist flows. Poor access, visitor facilities, tour guides and management and low diversification will discourage/shorten the duration of visits and willingness to pay. Poor marketing further works against tourists in choosing Republic of Moldova as an eco-tourism destination.

In the BAU scenario, the absence of biodiversity conservation measures properly identified through PAs management planning may lead to ecosystem degradation, which will negatively affect tourism demand. Poor water management will impact water quality, and industry may affect the air quality, while uncontrolled infrastructure development may result in a loss of traditional architectural styles typically favored by tourists[13]. As a consequence of BAU, ecotourism does not develop and visitor numbers and willingness to pay (WTP) decline (Popa et al. 2015).

Sustainable Ecosystem Management (SEM) reflects a situation in which the increasing interest for ecotourism is matched with measures that encourage and optimize its potential. With proper funding, natural sites administrators are able to develop and enforce MPs. The MPs provide for the ongoing evaluation of biodiversity, development and diversification of access and visitor facilities, implementation of special conservation measures, use of compensatory payments, proper control of industrial development and natural resources use, pro-nature education and development of the tourism strategy and management. Under these conditions it is reasonable to count on an increase in tourist numbers, longer visiting periods and increased expenditures and WTP.

Enforcement of MPs, with proper promoted compensation payments or mechanisms, creates the bases for strong relationships with community members, who will benefit from the increased eco-tourism both economically and socially. SEM also means better promotion of the natural sites.

Better enforcement of building regulations will increase the attractiveness of areas and, over time, will demonstrate that newly adopted architectural styles are likely to lead to reduced earnings relevant to the conservation of tradition style accommodation and traditions, which

[13] In Orheiul Vechi, accommodation facilities based on the local architectural styles are more profitable and attract tourists compatible with an eco-tourist profile.

will attract tourists. Overtime tourism related damages will decline, based on a strong collaboration between tour operators, communities and natural sites administration in terms of tourism management. The key features of the BAU and SEM scenarios adopted are summarized in Table 4.6-1.

Table 4.6-1. Key features for BAU and SEM scenarios for tourism sector (Popa et al. 2015)

	BAU					SEM				
TOURISM	2014-16	2017-21	2022-26	2027-31	2032-38	2014-16	2017-21	2022-26	2027-31	2032-38
Total leisure visitors	2%	2%	1%	0%	0%	2%	2%	1%	0%	0%
Total visitors to Pas and monasteries	4,00%	3,50%	2,00%	0,00%	0,00%	2,00%	2,00%	1,00%	0,75%	0,25%
PA entry fee per person	No change					No change				
Average expenditures per visitor per visit (food & hotel &transportation)	0%	-1%	-2%	-2%	-1%	0%	1%	1%	0%	0%
% PA tourists spending on food & hotels &transportation	0%	-1%	-2%	-2%	-1%	0,00%	0,00%	0,33%	0,20%	0%
Average contribution to conservation per visitor	0%	-1%	-3%	-4%	-2%	0%	1%	2%	0%	0%
Total PA tourist consumer surplus per visitor	0%	-1%	-3%	-4%	-2%	0%	1%	2%	0%	0%

Forestry

Under **Business as Usual (BAU**) wood harvesting will continue to support a number of forest related industries and wood consumption, but under increased level of ‘uncounted’ wood (ENPI FLEG 2011). Due to the limited extent of qualitative forests within the PAs, biodiversity losses may occur in some areas, while protected forests stay at the same level, including the level of harvesting from natural reserves. At the same time, negative impacts on water, nutrient and soil erosion regulation, landscapes and air quality will continue. Ineffective enforcement of the legal framework will result in ongoing illegal activities (illegal logging, poaching, pollution etc.). Cutting every year much more higher levels (volumes) that effectively match (or probably beyond) the annual increment will reduce the potential of forests to produce wood/timber and, thus, will decrease in the annual allowable cuts, and all this will lead to an increase in illegal logging. BAU does not encourage optimal management of NTFPs, and the potential of those products will decrease due to ecosystem degradation (Popa et al. 2015).

With the present limited levels of protected areas, 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.

The **Sustainable Ecosystem Management (SEM)** scenario involves less emphasis on wood production supported by: (i) an expansion of valuable (including natural reserves forests taking into account their biodiversity significance; (ii) decrease in illegal logging while the same quantities are harvested legally and sustainably at a reasonable portion of the annual increment and, (iii) optimal harvesting of NTFPs. The reduction of forest harvesting will create opportunities for NTFP (guided by studies on sustainable use) and encourage small individual or other private businesses. Enforced FMPs in protected areas, together with a better enforcement of forestry specific regulations, will lead to a reduction in illegal activities (Popa et al. 2015).

The annual allowable cut in BAU scenario stays at present level of forest increment (under 50%), but will decrease in absolute values due to decreased annual average increment. The illegal logging will continue to represent an important share of the total wood market and will lead to decreasing quality of forest ecosystems thus decreasing increment rates. Continuous degradation of forest ecosystems will lead to decreased provisioning ecosystem services from NTFPs, decreasing forest contribution to rural communities, decreasing values for hunting and forest leasing. In BAU scenario, the surface of forest is constant.

Table 4.6-2. Key features for BAU and SEM scenarios for forestry (Popa et al. 2015)

	BAU					SEM				
FORESTRY AND HUNTING	2014-16	2017-21	2022-26	2027-31	2032-38	2014-16	2017-21	2022-26	2027-31	2032-38
Harvested quantities for wood:										
for heating	0,0%	0,0%	-0,5%	-0,5%	0,0%	-1,00%	3,00%	1,50%	0,00%	0,00%
for other purposes	0,0%	0,0%	-0,5%	-0,5%	0,0%	-1,00%	3,00%	1,50%	0,00%	0,00%
Average price for wood (standing stands):										
for heating	0,0%	0,0%	0,0%	0,0%	0,0%	0%	0%	0%	0%	0%
for industry	0,0%	0,0%	0,0%	0,0%	0,0%	0%	0%	0%	0%	0%
Harvested quantities from NR										
for heating	0,0%	0,0%	-0,5%	-0,5%	0,0%	-1,00%	3,00%	1,50%	0,00%	0,00%
for other purposes	0,0%	0,0%	-0,5%	-0,5%	0,0%	-1,00%	3,00%	1,50%	0,00%	0,00%
illegal logging	0,0%	0,0%	-0,5%	-1,0%	-0,5%	0,0%	-10,0%	-9,0%	-8,0%	-5,0%
Value for NTFP	0,0%	-2,0%	-2,0%	-1,0%	-0,5%	1,00%	-1,00%	-1,00%	2,00%	2,00%
Surface of forests	0,0%	0,0%	0,0%	0,0%	0,0%	5%	2%	0%	0%	0%
Value from hunting	0,0%	-2,0%	-2,0%	-1,0%	-0,5%	1,00%	-1,00%	-1,00%	2,00%	2,00%
Value from land leasing	0,0%	-2,0%	-2,0%	-1,0%	-0,5%	1,00%	-1,00%	-1,00%	2,00%	2,00%

Value from NTFP	0,0%	-2,0%	-2,0%	-1,0%	-0,5%	1,00%	-1,00%	-1,00%	2,00%	2,00%
Budget allocation to forest management	0,0%	0,0%	-1,0%	-1,0%	-0,5%	0%	0%	-2%	-2%	-1%
% income to budget from forestry & NTFP	0,0%	0,0%	0,0%	0,0%	0,0%	0%	0%	0%	0%	0%
Direct income to communities	0,0%	-2,0%	-2,0%	-1,0%	-0,5%	1,00%	-1,00%	-1,00%	2,00%	2,00%
% added value to on the economic chain, forestry connected industry	0,0%	0,0%	0,0%	0,0%	0,0%	0%	0%	0%	0%	0%

For the SEM scenario it is envisaged that the annual allowable cut is increasing in terms of share of the increment, without passing 65%[14] (in line with the stands quality). It will allow the forest sector to better cover the demand for wood. This measure, accompanied with severe measures to reduce illegal activities, will allow dramatic decrease in illegal logging and taxation of all harvested wood in the market, with effects on the state budget revenues. The area covered with forest vegetation is expected to increase in line with the set target of the sector to reach at least 15% afforestation of the territory. Low level of illegalities and sustainable harvesting will allow forest ecosystems to better furnish NTFPs and the interest for hunting and rational forest use will increase (Popa et al. 2015). The description of both scenarios is shown in the Table 4.6-2.

Agriculture

The **BAU scenario** is based on existing practice of grazing cattle, when most of communities' herds and animals are normally grazed on community pasturelands or usually on other agricultural fields after autumn harvesting (such as grains, sunflower etc.). However, time by time herds/animals are illegally (unauthorized) grazed in the forests or forest plantations, thus causing serious damage to forest vegetation. Per our observations, a large proportion of fodder requirement is met from the forest resources in the form of direct grazing or cut fodder. It is important to distinguish industrial cattle and cattle owned by community members. Though official data say the number of cattle has reduced by 52% during 2002-2014, the impact from community cattle (which differs from the industrial cattle or stall animas) on forest vegetation is unlikely to be reduced and will, probably, stay on the same level. Actual Moldova's pasturelands are almost not managed and community grazing is not organized[15], which implies a low productivity of pastures and their further degradation.

Under such circumstances, BAU assumes that even though the number of animals will decrease (probably in line with the population, lack of suitable vegetal conditions and poor pasture conditions), the under-grazing practice will continue with probably same consequences on the carrying capacity and damages to biodiversity due to extremely poor

[14] Which is the average in EU countries (SEF 2011)
[15] Though existing Regulations on grazing and mowing (GD 667/2010) stipulates that every pasture lands should have a management plant, the law is not enforced and there are no such plans in the country.

pasture management. An the same time, intensive agriculture will lead to an increase in vegetal production during the first decade, but then it will decrease due to low capacity of the land and also of the increase in population in rural areas (Popa et al. 2015).

The **SEM scenario** assumes that, if invested in the pastureland management and if an optimal number of cattle is respected, in the short run the grazing reaches its carrying capacity and is maintained at this level into the long term (Hoffman et al. 2014). At the same time, the development of ecological agriculture will trigger higher vegetal production as well as higher added values along the marketing chains. Table 4.6-3. summaries the BAU and SEM scenarios for the food production supported by ecosystems in the agricultural sector.

Table 4.6-3. Key features for BAU and SEM scenarios for agriculture (Popa et al. 2015)

	BAU					SEM				
AGRICULTURE	2014-16	2017-21	2022-26	2027-31	2032-38	2014-16	2017-21	2022-26	2027-31	2032-38
No of UVM	1%	-1%	-2%	-1%	-1%	0%	-1%	2%	2%	1%
Total pasturing surface	0%	0%	-1%	-1%	0%	0%	0%	1%	1%	0%
Milk production for UVM (litters per day)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Price per litter of milk	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Milk productive period in year (days)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Support capacity (UVM per ha)	0%	-1%	-2%	-1%	0%	0%	-1%	1%	0%	0%
Added value from animal product	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Costs due to soil erosion	0%	1%	1%	1%	1%	0%	0%	-1%	-1%	0%
Percent of forest influence over the soil erosion	1%	1%	-1%	-3%	-2%	-1%	0%	1%	2%	1%
Total vegetal production	3%	2%	-1%	-4%	-1%	-1%	-2%	1%	4%	2%
Income to Budget from agriculture	1%	1%	-1%	-4%	-1%	-1%	-1%	1%	4%	2%
Forest percent	0%	0%	0%	0%	0%	5%	2%	0%	0%	0%
Forest quality	0%	0%	-1%	-1%	-1%	0%	0%	1%	1%	1%
Forest influence	0,00%	0,00%	0,00%	0,00%	0,00%	-1,00%	-1,00%	1,50%	1,50%	0,50%

Water management sector

Well-maintained forest ecosystems play a major role in water retention and regulation of surface water flows, which in turn influence soil erosion and sediment transportation, and water filtering which helps maintain water quality. The Moldovan ecosystems are the main source of qualitative water for a large part of the country.

The study made an attempt for a quantification and monetary estimation of the contribution of FES, such as water regulation and soil erosion prevention, to water users in urban areas. Its main focus was the costs avoided by SEM and the benefits of clean water.

Reduction in forest area and even clear cutting in some cases, together with an over utilization of pastures, have resulted in a decrease in the ability of the landscape/ecosystem to retain water and ensure protection against soil erosion. The optimal provision of regulating services requires SEM, which will sustain forest and agriculture ecosystems.

For our BAU and SEM scenarios we used models that are based on the relationship defined by a study done elsewhere in 2004 on 27 water operators (Ernst et al. 2004). The study done in the USA discovered that for every 10% increase in forest cover of the basin, the cost for water treatment decreases with 20%. It did not refer to basins with more than 60% forest coverage around. Nevertheless, the authors of the study suggested that those treatment costs are at the cut-off level of the equation when the forest coverage is between 70 and 100%. Approximately 50-55% of the treatment costs variation was explained by the forest coverage percent from the water basin. The rest of circa 50% was assigned to different practices of treatment, the magnitude of the treatment installation, and development features and agricultural practices within the water basin. Based on the findings of this study as well as the forestry sector BAU and SEM scenarios in terms of forest coverage and forest quality, we identified the influence of forests ecosystems to the profitability of water operators. Both scenarios are based on the fact that anticipated decrease of population is met by the increase of water consumption per capita, thus the total water consumption is constant. In BAU scenario, the forest influence is initially increasing due to the development of the newly established plantations, but afterwards is decreasing due to stable degradation of stands. In SEM scenario the degradation of stands is absent (Popa et al. 2015).

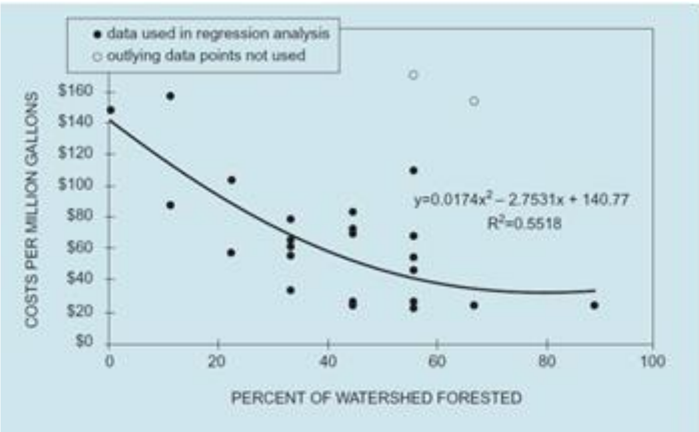


Figure 4.6-1. Relationship between forest cover (%) and water treatment cost (Ernst et al, 2004)

Disaster risk reduction

The BAU and SEM models for carbon sequestration follow the patterns defined in the Moldovan forestry sector due to the fact that the total CO_2 sequestered quantities are linked with the forest increment and wood removals from the forest.

The assumptions are based on the fact that under the BAU scenario, the unsustainable management of the forests and the inactive management of pastures (or overgrazing in some case) will decrease the water retention functions within. This translates into a higher incidence of disasters and an increased cost of damages. After reassessing the parameters that we use for calculating the economic value, the figures regarding soil erosion were taken into consideration under vegetal production in agriculture, and for disaster risk sector only floods and landslides were considered. Opinions from various experts were used for estimating the forest influence on the incidence and magnitude of floods and landslides (Popa et al. 2015).

4.6.2. Monetary valuation of FES

4.6.2.1. Tourism

Baseline value

Visitor numbers. The baseline value was calculated for 2014, based on the records kept by Moldsilva on the number of visitors in the PAs they manage. The number of (eco-) tourists that visited these PAs in 2014 was 8778. Statistics on the number of visitors per country have been derived from the National Office of Statistics (RT 2014). Considering the fact that Moldsilva is recording only visitors in the PAs it manages (mainly four Nature Reserves, which are de-facto forestry enterprises subordinated to Moldsilva) and also that, often, visits to PAs are bundled with monasteries, the total number of (eco-) tourists considered for our calculation was 25% bigger than the number of visitors recorded by Moldsilva.

Visitor expenditures. The National Office of Statistics (RT 2014) provides data on total revenues in tourism sector per person in 2014: 776.1 MDL/day/person[16]. This is the figure that was taken into consideration despite the fact this approach is rather conservatory because it is based on the reports made by local tour operators and for internal tourism, and thus it may not include other expenditures made by tourists for different services such as transportation, souvenirs etc. In 2014, PAs administrations (under the coordination of Moldsilva) generated direct revenues of $5939, basically from PAs entry fees, but visitors to these areas also spent money on hotels and restaurants across the country (Popa 2014a).

Data from the Registry of Tourism (RT 2014) show that tourists spend on average $309.8 per visit, and the average number of nights per visit was 5.9 (RT 2014). That would mean a daily expenditure of $52.5/day. The figure for the same variable estimated for 2011 (Popa 2013a) was $56.1. Those figures for the tourist daily expenditures are comparable with other countries in the region. For instance, a study of Durmitor National Park in Montenegro revealed a gross turnover of €1.6 million for hotels and restaurants, translating into an

[16] In 2014 the rate of MDL (Moldovan Leu, the local currency) against $ was around 12 MDL per 1 $.

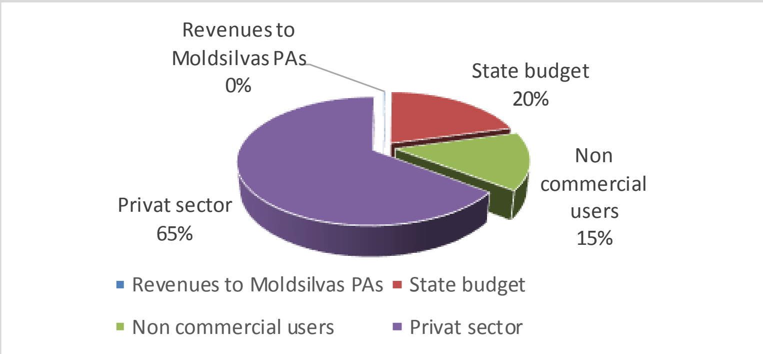
average accommodation fee of €12.6, plus typical spending on food, drinks and other services of €46.0 per visitor day (Emerton 2011). In Tatra National Park in Poland visitors spend around €45 per day, and in Slovakia's Slovensky Raj National Park total visitor expenditure averages €54 per person day (Getzner 2009). However, not all tourists are camping and staying in hotels.

There is an important percent of one-day tourists that are visiting the PAs and perhaps the monasteries around them (and thus paying the entry fee, but not spending money on restaurants and accommodation facilities). Therefore, for the calculation of a baseline value for FES in tourism, the likely proportion of one-day visitor needs to be estimated. Recent studies (Popa 2013a) mentioned that 75% of tourists in natural sites stay in hotels, pensions or other accommodation facilities. This figure was based on interviews of Moldsilva's PA managers done in 2012. For our study we decided to use, based on consultations with stakeholders plus the evaluation made by several tour-operators, a more conservative figure – 55% (Popa et al. 2015).

The state budget share of the total revenues coming from the (eco-) tourists was calculated based on the fiscal revenues for one visitor/visit, data that are reported by the National Office of Statistics (RT 2014).

Table 4.6-4. Baseline for FES – Tourism ($, 2014)(Popa et al. 2015)

Specifications	Value ($)	%
PA entry fees	5939	
Visitors expenditures for food and accommodation	1869608	
WTP for conservation	4751	
Consumer surplus	316023	
TOTAL	2196321	
Value distribution		
Revenues to Moldsilvas PAs	5939	0,27
State budget	450702	20,52
Non commercial users	320775	14,61
Privat sector	1418906	64,60
TOTAL	2196321	100,00



Consumer surplus of visitors. The total economic value of tourism is greater than the amount of money people actually spend. This is because some tourists would be willing to pay more than they do (on entry fees, hotels and restaurants, travel costs etc.) to enjoy the tourism experience of a natural site. This “consumer surplus” is measured by a visitor’s maximum willingness to pay for the PA tourism experience minus their actual expenditure (Popa and Bann 2012). Studies done in 2013 (Popa 2013a) estimate, based on transfer of benefits technique, a value of $28.8 per visit. This figure was also included in the calculation of the total amount being accounted for non-commercial beneficiaries.

Based on date above, the baseline value of FES for tourism sector was calculated and a breakdown of it can be seen in Table 4.6-4. The direct FES value for tourism sector in 2014 was estimated at $1.9 million, while the total economic values is estimated at $2.2 million (Popa et al. 2015).

The conclusions agree with the data of the previous study done within the NBSAP project (Popa 2013a) - existing Nature Reserves benefit from a small amount of the total baseline value of the FES provided for the tourism sector, evaluated at 0.27% of the total value. The private sector (tour operators, hotels, pensions, restaurants) cashing for accommodation and food is the main beneficiary. Thus, the private sector is the key stakeholder to engage with in the development of any potential mechanisms of payments for ecosystem services (Popa et al. 2015).

FES value for tourism sector in BAU and SEM scenarios

In order to evaluate the evolution of FES value for tourism sector in the next 25 years, the scenarios described in Table 4.6-1. were applied. For both scenarios the PV of the revenues flow was calculated. The chosen discount rate was 10%. This apparently high discount rate is fed by the fact that the responsibility to future generations are hard to include in a discount rate (TEEB 2009). The choice was also influenced by the fact this study is measuring, in both scenarios, the benefits of development rather than environmental costs of such development (Fisher and Krutilla 1975). The results of the BAU and SEM modelling can be seen in Figure 4.6-2. And Figure 4.6-3.

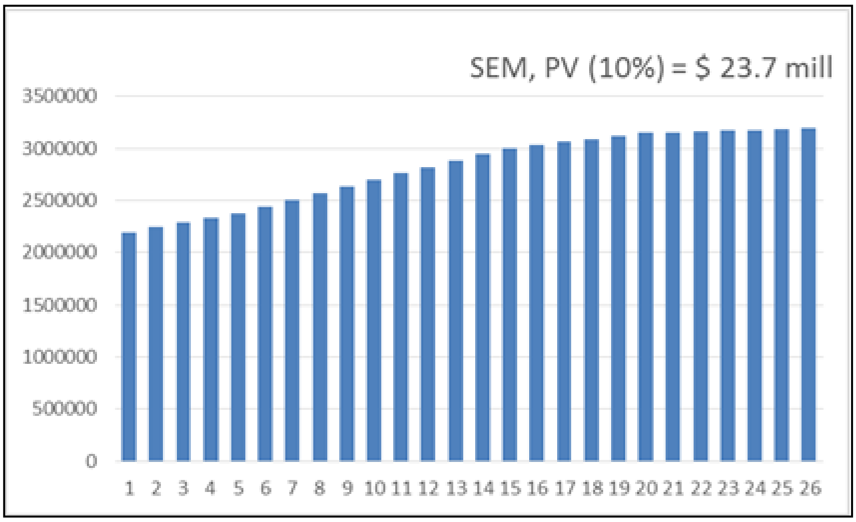


Figure 4.6-2. Tourism sector FES values in BAU scenario ($/years)(Popa et al. 2015)

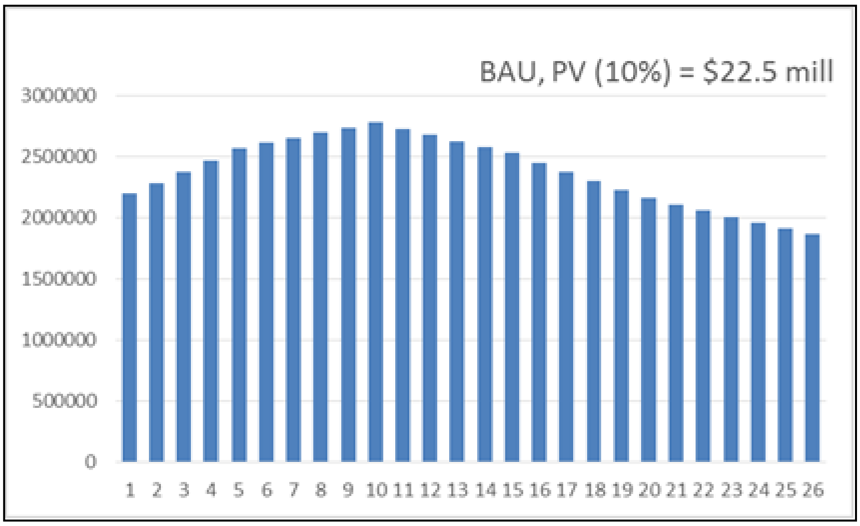


Figure 4.6-3. Tourism sector FES values in SEM scenario ($/years)(Popa et al. 2015)

BAU continuation will determine an increase in FES value for the first 10 years due to an increase in number of total tourists. The increase will be followed by a progressive decline due to rapid degradation of ecosystems determining a decrease in attractiveness to tourists, and thus decreasing revenue to all FES beneficiaries. The present value of FES under BAU for the (eco-) tourism in the Republic of Moldova is $22.5 million.

SEM will mean a progressive increase in tourism values and offered services will improve over time. The main determinant of increased FES value for tourism in SEM scenario is the number of visitors. Tourism revenues could be further increased by raising prices/entrance fees over time. These changes were not considered in the SEM scenario. It is to be mentioned that the rate of growth slows as the sites carrying capacity is reached. Sustainable (eco-) tourism discourages an increase in tourists beyond the sites' carrying capacity. The PV (10% rate over 25 years) is calculated at $23.7 million level. 4.6-4. below illustrates the different trajectory for eco-tourism value under BAU and SEM for FES.

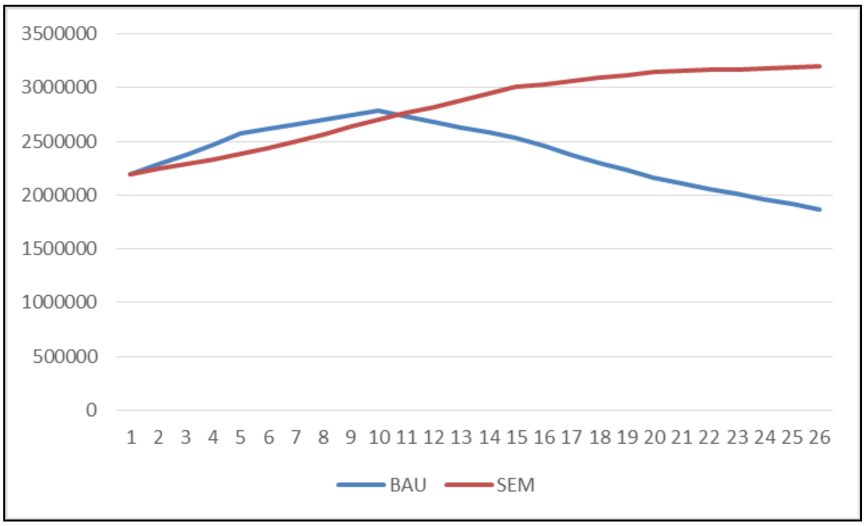


Figure 4.6-4. Eco-tourism FES value under BAU and SEM over 25 years ($)(Popa et al. 2015)

SEM implies sustained and increasing value supported by well-managed touristic activity, while a continuation of BAU results in long term loss of tourism value as the attractiveness of sites is eroded. These long-term losses outweigh the short-term gains.

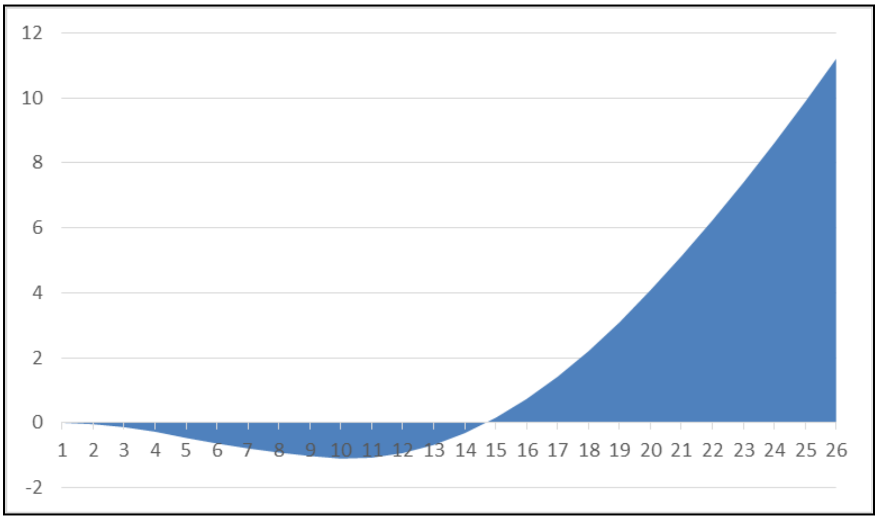


Figure 4.6-5. Cumulative FES value of SEM over BAU in tourism sector ($ million)(Popa et al. 2015)

4.6.2.2. Agriculture

Baseline value

The baseline calculation refers to estimated influence of forest quality and area over the quality of pastures and, therefore, on the total animal production. There are few scientific studies on this matter, so we had serious difficulties in assessing how much the forests would influence animal production. During consultations with agricultural/pasture experts, this influence was estimated at 7%, meaning that 7% of the total animal production can be reasonably considered due to forested areas. Consequent to a conservatory approach, the figure considered in the calculation was 5%. It is known that forest quality and the amount of forested areas can also influence the quality of pastures in terms of water retention, wind determined evapotranspiration, etc. Those influences were also considered in the economic value calculation. Data regarding the animal production (including added value in animal products food industry and state budget revenues from animal products) were collected from the reports of the National Office of Statistics (SYRM 2013).

In terms of vegetal production, we faced a similar problem of lacking specific studies dealing with the influence of forests on soil erosion. It is known that a higher quality degree of forests can determine a lower level of eroded soil. Based on the consultation with stakeholders and available literature (Terente, 2008), we adopted a conservatory approach and consider that the forests influence on soil erosion is estimated at 10% under the present vegetation (forest) quality. This value is an average derived from the Terente (2008) formula using the C coefficient described by Corine Land Cover. Data regarding the total cost of soil erosion, total vegetal production added value for vegetal food industry and state budget income from vegetal production and related industry were collected from the National Office of Statistics

(SYRM 2013). The erosion (tons/year/ha) was estimated per all country's territory (Figure 4.6-6.).

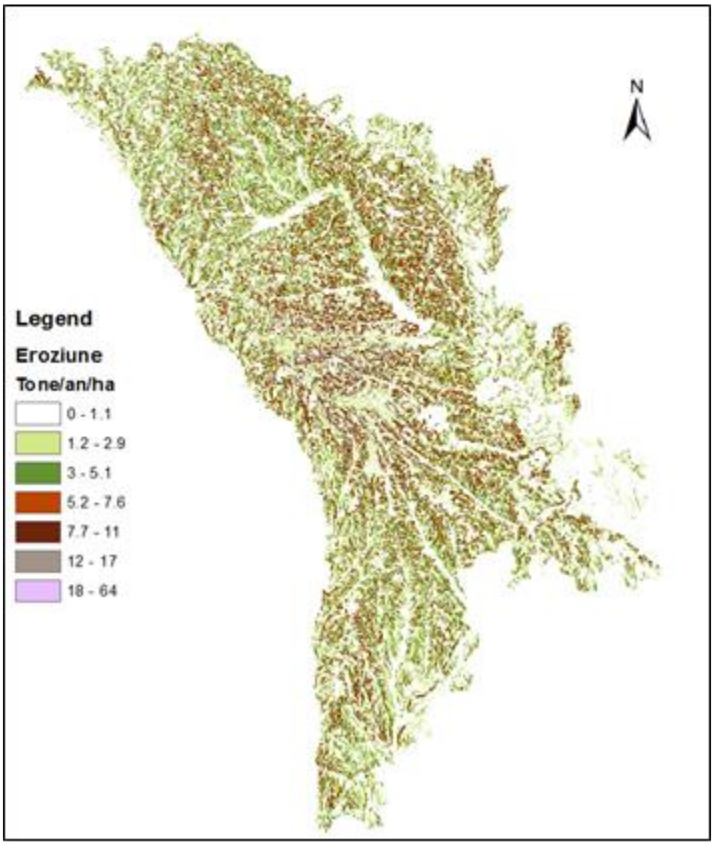


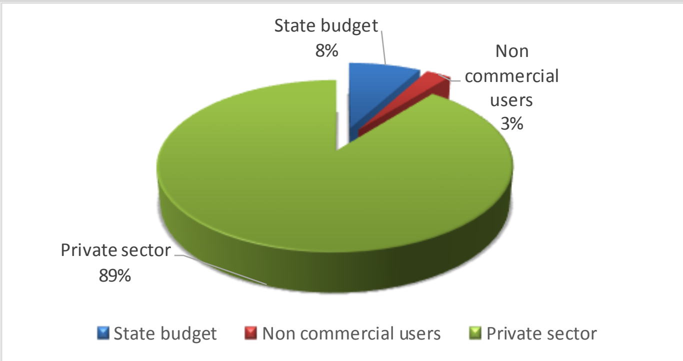
Figure 4.6-6. Soil erosion estimation at country level using Terente (2008) formula (Popa et al. 2015)

Using data and approaches described above, the baseline value of FES for agriculture sector was evaluated and a breakdown of it can be seen in Table 4.6-5.

Baseline value distribution described above is based on the fact that almost 90% of all agricultural land is privately owned, but there still are companies dealing with animal production. Adding values through processing chains are also considered as well as the animal production potential surplus due to underused carrying capacity of the pastures (Popa et al. 2015).

Table 4.6-5. Baseline for FES – Agriculture ($, 2014)(Popa et al. 2015)

Specifications	Value ($)	%
Animal production	2694792	
Added value from animal production and processing	2688821	
Production surplus due to bigger pasture support capacity	594642	
Vegetal production (avoided costs)	10148026	
Added value from vegetal production and processing industry	5629764	
Income to budget from agriculture and animal breeding	1052304	
TOTAL	21756045	
Value distribution		
State budget	1733905	7,97
Non commercial users	594642	2,73
Private sector	19427498	89,30
TOTAL	21756045	100,00



FES value for agriculture sector in BAU and SEM scenarios

In order to evaluate the evolution of FES value for agricultural sector in the next 25 years, the scenarios described in Table 4.6-3. were applied. For both scenarios the PV of revenues flow was calculated. The chosen discount rate was 10% (see reasons described in 4.6.2.1.). The results of the BAU and SEM modelling are presented in Figure 4.6-7. and Figure 4.6-8.

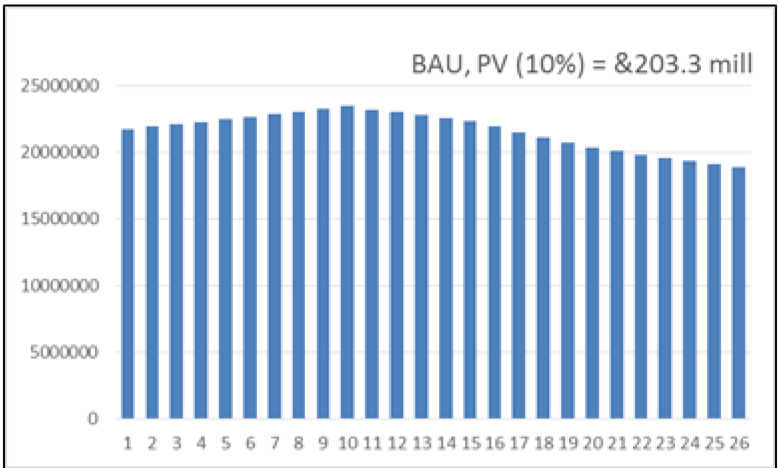


Figure 4.6-7. Agriculture sector FES values in BAU scenario ($/years)(Popa et al. 2015)

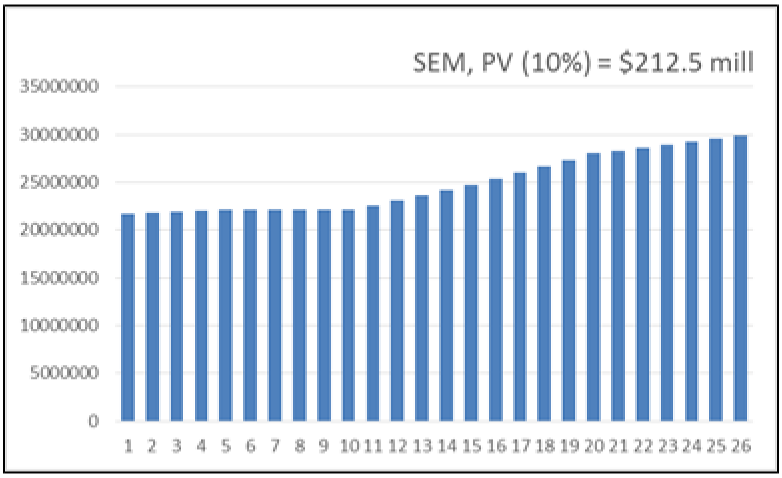


Figure 4.6-8. Agriculture sector FES values in SEM scenario ($/years)(Popa et al. 2015)

The continuation of BAU initially results in stable, even slightly increasing values. However, values start to decrease after 10 years because of two main reasons: (i) decrease in number of conventional cattle (due to decreasing population), decrease in pasturelands, increasing degraded land surface and decrease in carrying capacity of the pastures; (ii) decrease in vegetal production due to improper land management and use of intensive agriculture that determine an increase in soil erosion. Forest ecosystems are an important impact factor for both pasture quality and soil erosion. SEM means rather stable values in the first 10 years than increasing value due to increased forest surface and quality (Figure 4.6-9.).

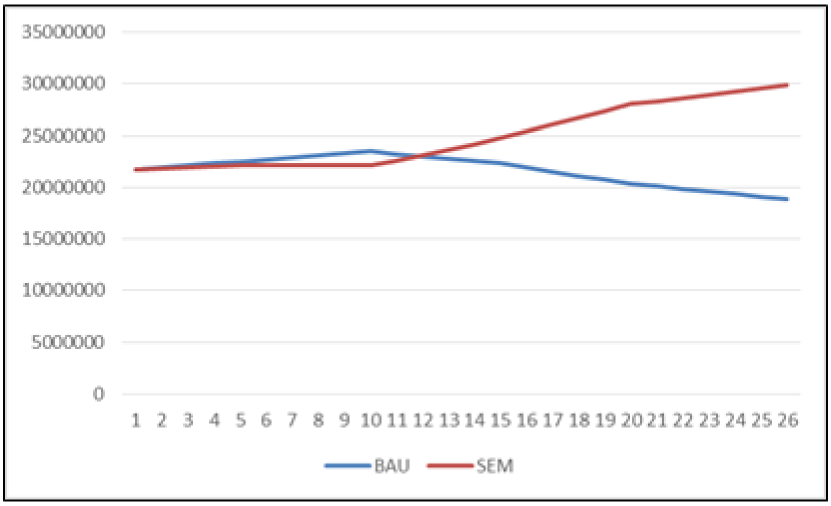


Figure 4.6-9. Agriculture FES value under BAU and SEM over 25 years ($) (Popa et al. 2015)

The total cumulated cost of continuing BAU practice over 25 years for the agricultural sector related to forest ecosystem influence is estimated at $84.1 million (Figure 4.6-10.).

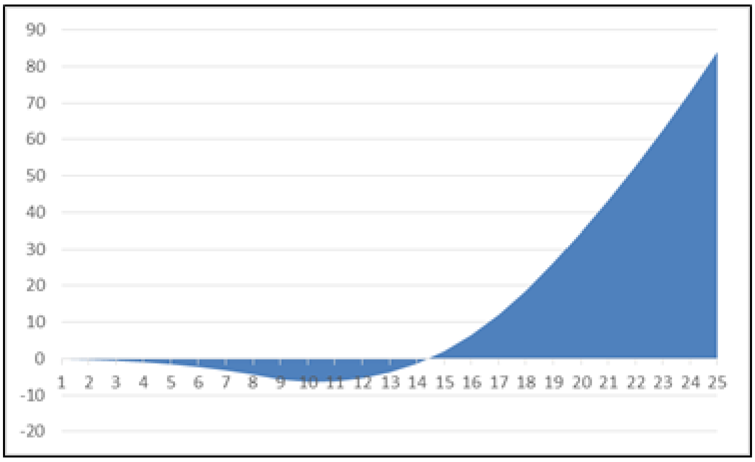


Figure 4.6-10. Cumulative FES value of SEM over BAU in agriculture sector ($ millions)(Popa et al. 2015)

4.6.2.3. Forestry

Baseline value

Forestry baseline values for FES were calculated based on market pricing by taken into consideration the following:

- Harvested quantities from both state owned forests (Moldsilva) and Local Public Authorities (LPA) owned forests along with an average price per sorts reported by Moldsilva;
- Illegal logging as reported by the ENPI FLEG study done in 2010/2011 (Galupa et al 2011);
- Value for NTFPs, hunting and forest leasing as reported by Moldsilva for 2014;
- Direct income to communities from forests (according to an earlier survey done by Transilvania University of Brasov) (Popa et al. 2014);
- Added value on the economic chain – forestry, and income to state budget from forestry, as reported by the National Bureau of Statistics in 2014.

Using all data and approaches described above, the baseline value of FES for forestry sector was evaluated (Table 4.6-6.).

Table 4.6-6. Baseline for FES – Forestry ($, 2014)(Popa et al. 2015)

Specifications	Value ($)	%
Income to public forest administrators	15125274	
Income to other administrators	872131	
Direct income to communities	6954343	
Income from illegal logging	9234949	
Income to Budget	5228853	
Value added - industry - private	2472962	
TOTAL	39888512	
Value distribution		
Local Public Authorities	872131	2,19
Communities	11571818	29,01
Budget (including Moldsilva)	20354127	51,03
Private sector	7090436	17,78
TOTAL	39888512	183,34

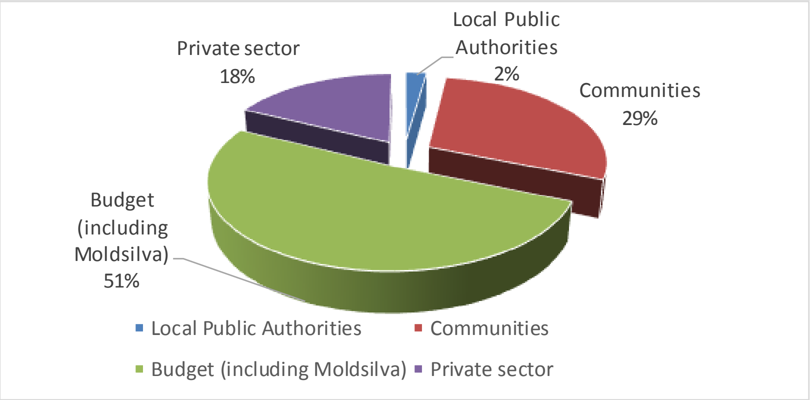


Table 4.6-6. also indicates the distribution of FES values between the main beneficiaries. Forest PA authorities benefit from selling the annual allowable cut (approximately $53/year/ha), Moldsilva (state governmental agency) is benefitting from revenues from selling wood (approximately $53/year/ha), NTFP processing, hunting, forest lease, taxation of primary and added value. The illegal logging values were accounted for the private sector as well as the added value along the economic chains, while the communities benefit from the estimated direct income from the forests (Popa et al. 2015).

FES value for forestry sector in BAU and SEM scenarios

By applying the BAU and SEM models described in Table 4.6-2., we assessed the forest ecosystems provisioning values' evolution in the two management scenarios for the next 25 years (Figure 4.6-11. and 4.6-12.).

Continuation of present practices under BAU scenario will determine a decrease in stands quality, which will trigger a decrease in annual allowable cut. This will also determine a decrease in potential income to local communities. This process is likely to persist and the values are expected to continue to decrease after 25 years horizon.

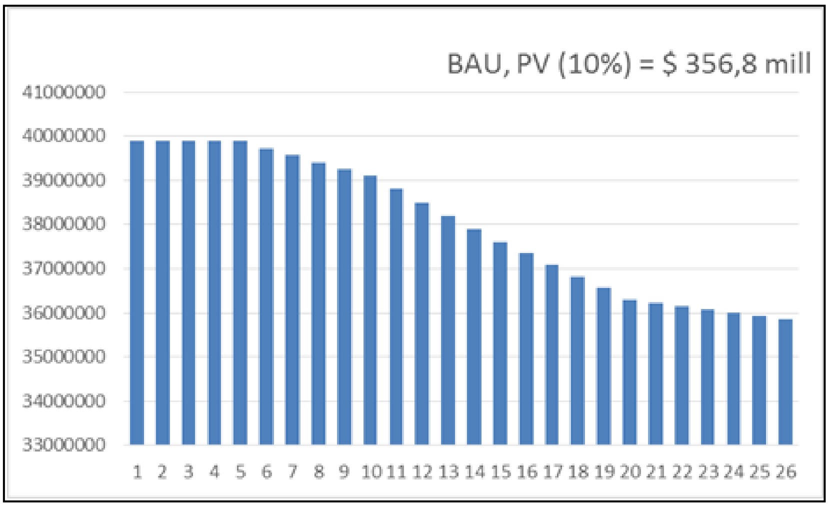


Figure 4.6-11. Forestry sector FES values in BAU scenario ($/years)(Popa et al. 2015)

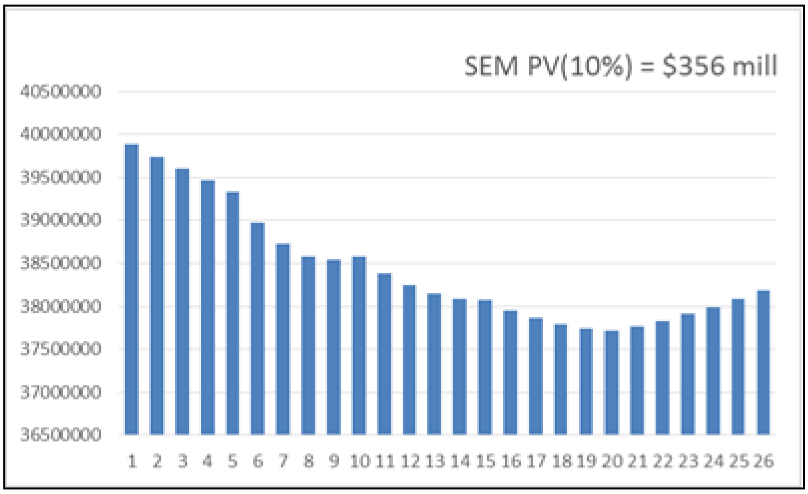


Figure 4.6-12. Forestry sector FES values in SEM scenario ($/years)(Popa et al. 2015)

SEM scenario means immediate decrease in total harvested wood by bringing gradually the illegally logged wood from the 'grey economy' to the fair (legal) and competitive market. The evolution of harvested wood quantities is sustainable in terms of share from the total forest increment, but the controlled cuttings will determine the decrease in degradation of stands. As a result of such evolution, the total economic value is decreasing steadily during the first 15-20 years. After that, due to qualitative forest and increased forest areas, the trend inverts. Total economic value is increasing in the last 5 years and it is expected to continue so (Popa et al. 2-15).

The PV calculated at 10% discount rate is bigger for BAU scenario (Figure 4.6-11. and 4.6-12). As illustrated in Figure 4.6-13., while BAU is equivalent or superior to SEM in the short term, in the medium or long term SEM is more profitable. Furthermore in the long run under BAU, the values continue to decline, while under the SEM the (high) value becomes constant through time reflecting the sustainable management of the forest ecosystems. If the same patterns of the SEM and BAU scenarios are applied for a longer period (at least 30years) the PV (at 10% discount rate) for BAU is lower than for SEM: PV for SEM is $368.3 mill while for BAU is $368.12 mill (Figure 4.6-14.).

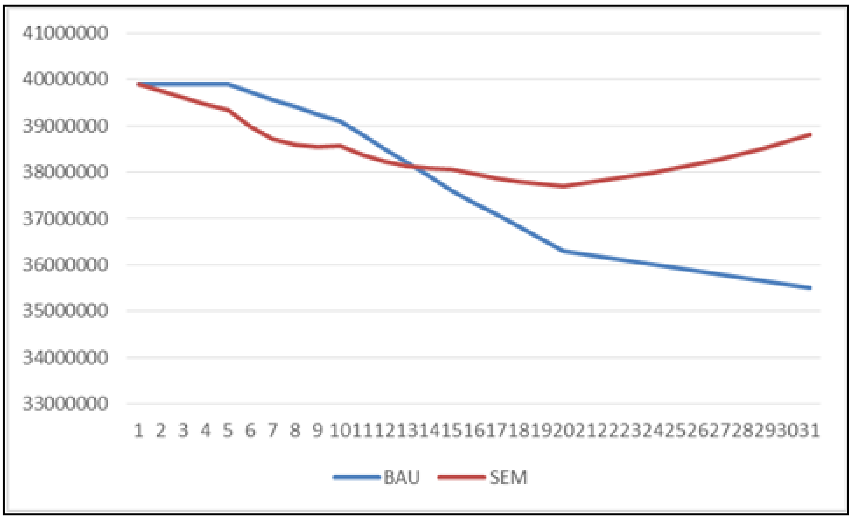


Figure 4.6-13. Forestry FES value under BAU and SEM over 25 years ($) (Popa et al. 2015)

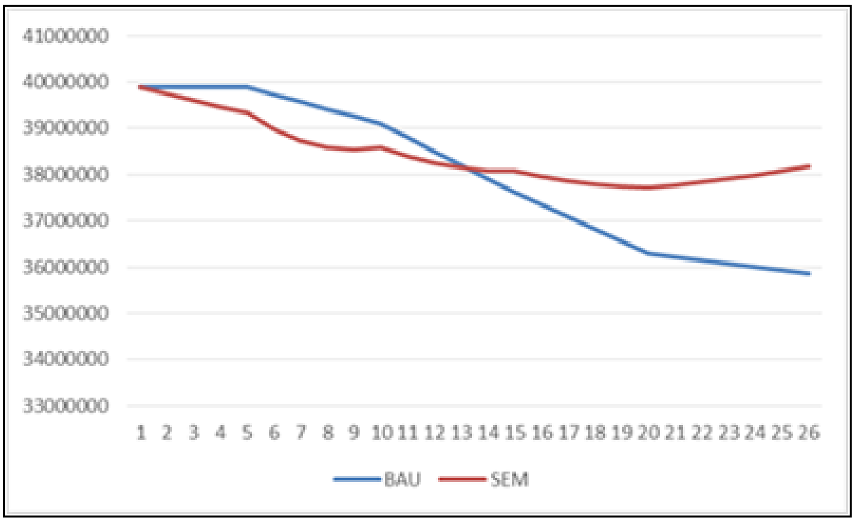


Figure 4.6-14. Forestry FES value under BAU and SEM over 30 years ($)(Popa et al. 2015)

4.6.2.4. Domestic water supply sector

Baseline value

Baseline value in our study represents the profit generated by water operators. The estimations are based on the methodology provided in the study mentioned in section 4.6.1. (Ernst et al. 2004), and it would definitely bring more accurate results if all country's territory is included. In Figure 4.6-15. the costs for water treatment and distribution is estimated at rayon (district) level.

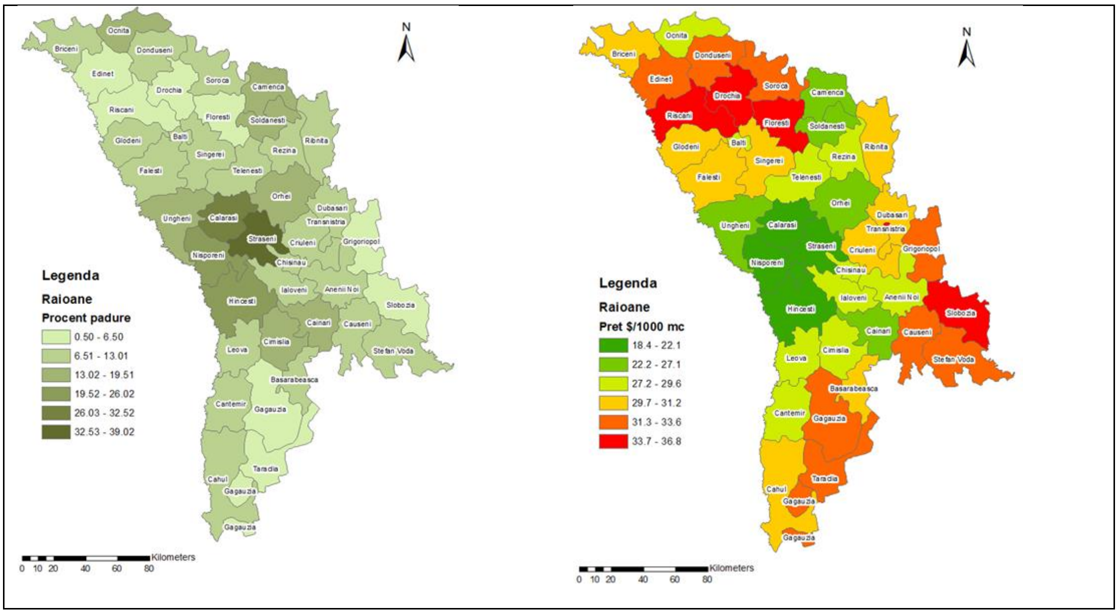
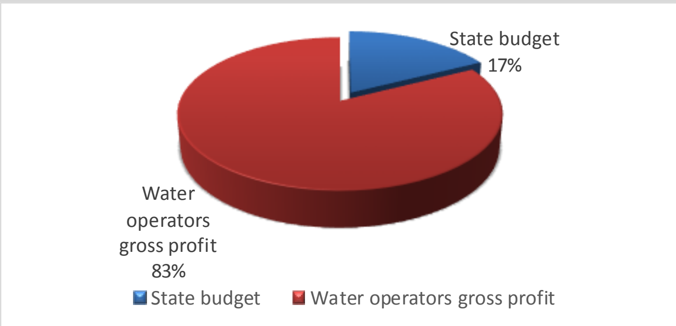


Figure 4.6-15. Relationship between forest coverage (%) and water treatment and distribution cost ($/1000 cubic meters) at rayon level (based on Ernst et al. 2004)(Popa et al. 2015)

Table 4.6-7. Baseline for FES – Domestic water supply ($, 2014)(Popa et al. 2015)

Specifications	Value ($)	%
Total value of water treatment and distribution	56487971	
Water operators gross profit	1890374	
Revenues to state budget	400847	
TOTAL	2291221	
Value distribution		
State budget	400847	17,49
Water operators gross profit	1890374	82,51
TOTAL	2291221	100,00



The results of FES valuation for domestic water supply sector can be seen in Table 4.6-7. Data regarding the treatments costs, production value and income to state budget were collected from the National Office of Statistics. The table also presents the distribution of benefits.

FES value for domestic water supply sector in BAU and SEM scenarios

The BAU and SEM scenarios values evolution can be seen in Figure 4.6-16.

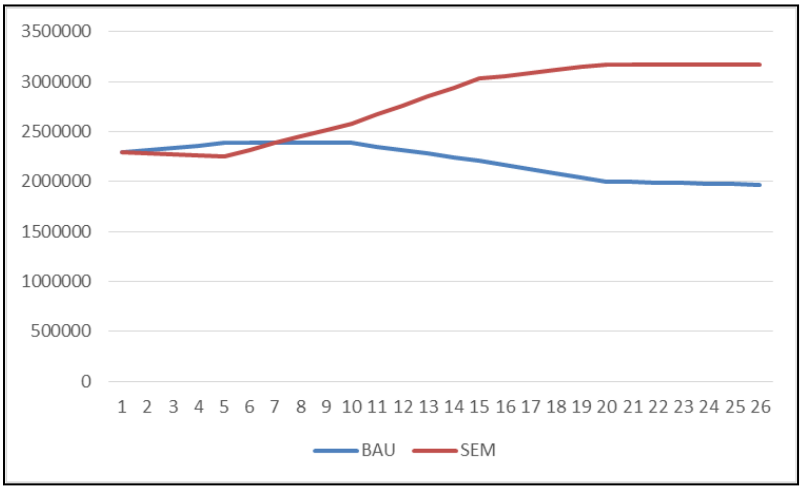


Figure 4.6-16. Domestic water supply FES value under BAU and SEM over 25 years ($)(Popa et al. 2015)

A continuation of BAU practices will result in ongoing soil erosion and, consequently, higher water treatment costs for domestic water supply. Under the BAU scenario, the net present value (NPV) of the economic contribution of ecosystems over the next 25 years is just under $20.9 million (Figure 4.6-17.).

Proper ecosystems management will result in a progressive increase in the quality of water supplied for urban use and will also gain a decline in soil erosion. Under the SEM scenario, the NPV of the cash flow of water operators' gross profit attributable to FES is estimated over the next 25 years at $23.4 million (Figure 4.6-18.).

Forest ecosystems provide valuable water regulation and soil erosion regulation services, which contribute to the provision of clean water. The total cumulative value to the economy of SEM relative to BAU, based on water treatment cost avoided, is estimated at $15.2 million over 25 years. Water operators are the main beneficiaries and potential partners in PES systems (Popa et al. 2015).

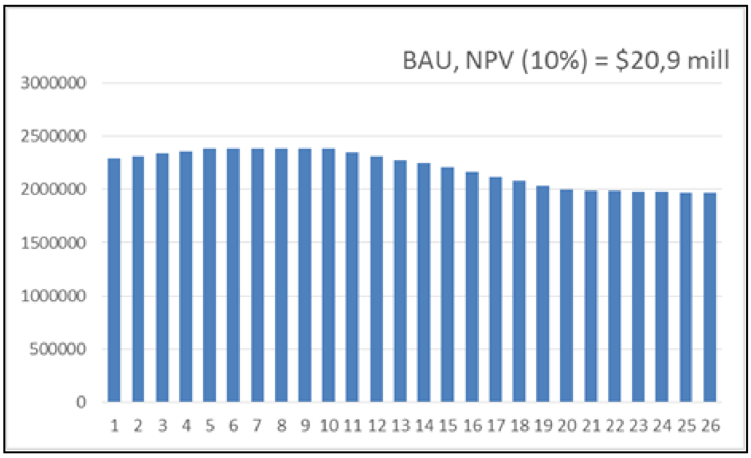


Figure 4.6-17. Water supply sector FES values in BAU scenario ($/years) (Popa et al. 2015)

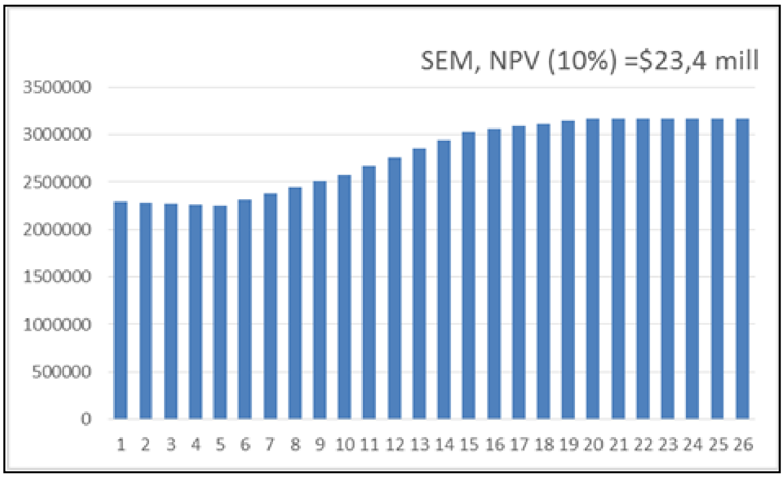


Figure 4.6-18. Water supply sector FES values in SEM scenario ($/years) (Popa et al. 2015)

4.6.2.5. Natural disaster risk and climate change mitigation

Baseline value

If the upstream protection functions of the forest ecosystems serve to minimize the impact of floods by just 10% and the impact of landslides by just 20% below what it would have been in the absence of the protective functions, then the value of flood control in terms of damage costs avoided (projected on a *pro rata* basis) equates to an average of $0.4 million a year (Table 4.6-8.). Data used for the total costs relevant to floods and landslides were collected from the National Bureau of Statistics. Baseline values are significantly lower that the figures determined in other studies (Popa 2013a) due to the fact that the damages induced by soil erosion were considered in the agriculture sector.

The CO_2 accumulated stock was calculated based on the difference between forest biomass accumulation and wood removals. The Biomass Extension Factor used 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 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 New Energy Finance and Ecosystem Marketplace (Ecosystem Marketplace 2013) for Clear Development Mechanism under Kyoto protocol, active in the Republic of Moldova since 2000. The baseline value for carbon sequestration can be seen in Table 4.6-9.

Table 4.6-8. Baseline for FES – Natural disasters ($, 2014)(Popa et al. 2015)

Specifications	Value ($)	%
Damages avoided due to forest ecosystems influence	395773	
TOTAL	395773	
Value distribution		
State budget	100131	25,30
Private sector	295642	74,70
TOTAL	395773	100,00

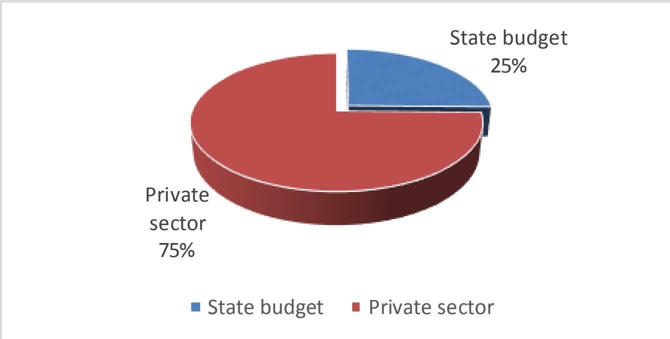


Table 4.6-9. Baseline for FES – CO2 sequestration ($, 2014)(Popa et al. 2015)

Specifications	Value ($)	%
Total CO2 value	2314828	
TOTAL	2314828	
Value distribution		
Non commercial users	2314828	100,00
TOTAL	2314828	

FES value for domestic water supply sector in BAU and SEM scenarios

For disaster risk reduction, a continuation of BAU in forest ecosystems will result initially in a more or less constant value decreasing from year 5 to year 25, with diminishing trend of decrease due to increased incidents of floods coupled with the reduced ecosystem protection capacity. Under the SEM scenario there is a slow increase in the damage costs avoided. Under the BAU scenario, the present value (PV) of the damage costs avoided by ecosystem services over the next 25 years is $3.6 million. The PV for SEM scenario is estimated at $ 3.7 million (Figure 4.6-19.). Even if the PV values for the two scenarios are rather close, the graphic in the reveals the fact that in BAU scenario the annual values of the avoided damages have the tendency to decrease while in SEM scenario the values are constantly increasing.

For climate change mitigation, the BAU values are slowly decreasing in the next 25 years, while SEM values are increasing continuously due to biomass accumulation from the forest increment and wood removal under SEM scenario (Figure 4.6-20.).

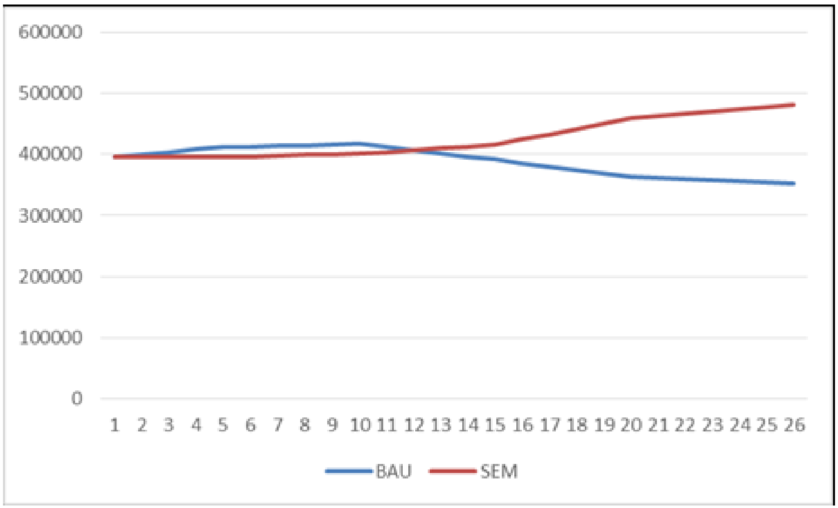


Figure 4.6-19. Disaster risk FES value under BAU and SEM over 25 years ($)(Popa et al. 2015)

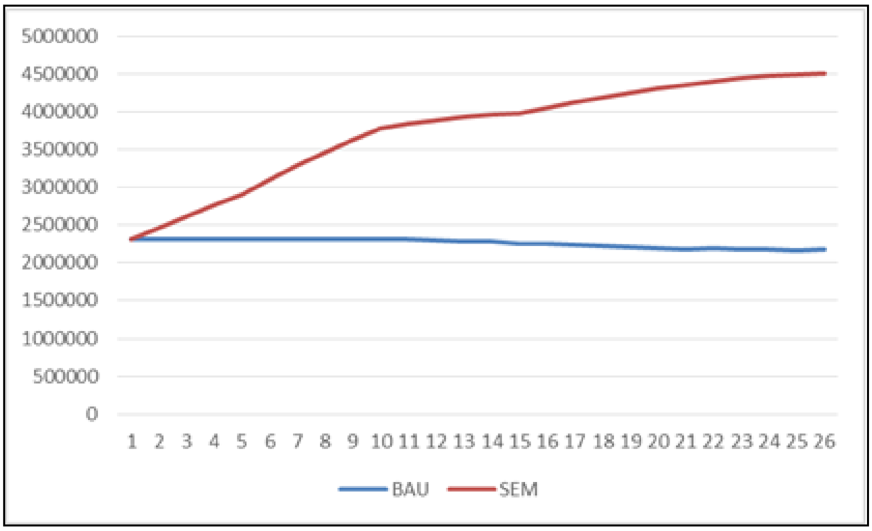


Figure 4.6-20. Carbon sequestration FES value under BAU and SEM over 25 years ($)(Popa et al. 2015)

4.7. Payments for Ecosystem Services (PES) mechanisms

The main benefiting economic sectors from FES are: tourism, agriculture, forestry, domestic water supply, disaster risk (including climate change)reduction as a cross cutting sector. In the sections above the value of the FES was estimated for each sector. For the baseline year 2014, the main beneficiaries of FES values were identified and their monetary benefits were estimated. The concise results of the study can be seen in Table 4.7-1.

Table 4.7-1. Summary of FES valuation in SEM and BAU scenarios (Popa et al. 2015)

ES Type	Service	BAU Value (PV @10%, 2014-2038, mill $)	SEM value (PV@10%, 2014-2038, mill $)	NPV (PV SEM – PV BAU) @10%, 2014-2038, mill $)	Main beneficiaries
Provisioning Services	Agriculture - Food / agriculture products	203,28736	212,501164	9,213804	Private sector
	Forestry - Wood & NTFPs	356,778254	356,045763	-0,732491	State budget
	Water supply (reduced treatment costs associated with regulating services of soil erosion and water flow regulation)	20,976257	23,381054	2,404797	Water operators (state or private)
	Source of energy (fuel etc.)	NA	NA	NA	
Regulating Services	Regulation of GHGs	21,000555	30,231996	9,231441	State (non-commercial)
	Micro-climate stabilization	NA	NA	NA	
	Water regulation (storage and retention) related to disaster mitigation	3,66461747	3,74057138	0,07595391	Private sector and state budget
	Nutrient retention	NA	NA	NA	
Cultural Services	Spiritual, religious, cultural heritage	NA	NA	NA	
	Educational	NA	NA	NA	
	Recreation, ecotourism and cultural tourism	22,544046	23,7058186	1,1617726	Private sector
	Landscape and amenity	NA	NA	NA	
	Biodiversity non-use	NA	NA	NA	
	TOTAL	**628,2510895**	**649,606367**	**21,35527751**	

Our results revealed that in all studied sectors, except for forestry, the private sector is the main beneficiary of the value of FES. For some sectors, the level of benefits for private sector is quite high and those benefits are likely to increase during the coming years under SEM scenario (Figure 4.7-1. and Figure 4.7-2.).

The conclusion is that the sectors recommended to be addressed by possible PES mechanisms are ***tourism*** and ***domestic water supply***. There is a potential for PES mechanisms to be identified, designed and implemented for the sectors of ***disaster risks mitigation*** and ***climate change***.

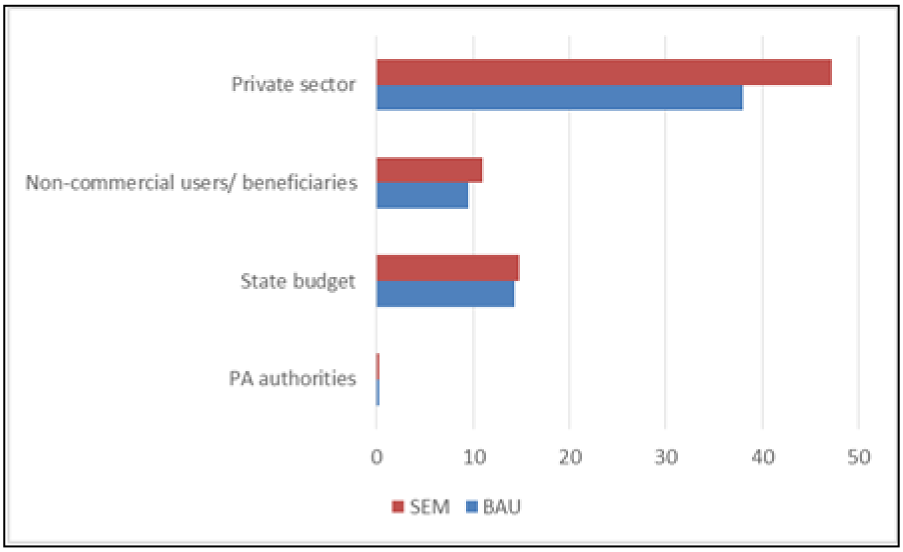


Figure 4.7-1. FES beneficiaries in Tourism sector (cumulated values for 2014-2038, mill Popa at al. 2015)

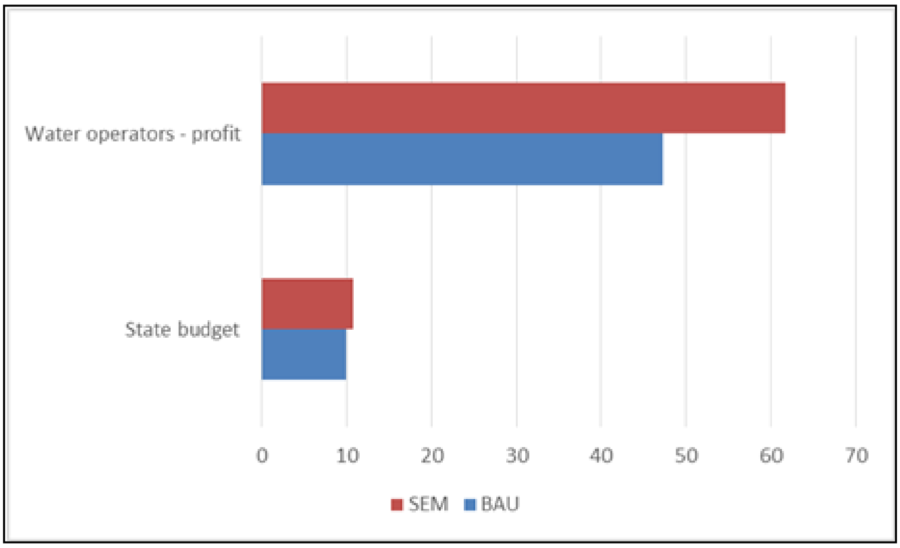


Figure 4.7-2. FES beneficiaries in domestic water supply sector (cumulated values for 2014-2038, mill $)(Popa et al. 2015)

As for agriculture sector, the benefits of FES are significant and the beneficiaries are also in the private sector, mainly through provisions of various services. We are talking about both physical and legal entities that benefits from forest ecosystems, but the chances to develop PES mechanism are small. One possibility that may be applicable but only in medium-long perspective would be the development/rehabilitation of the ***irrigation system*** (almost collapsed and very slowly recovering) that would, potentially, include some payments for FES in terms of irrigation tariff (Popa et al. 2015).

The Table 4.7-2. below presents the summary description of some possible PES mechanisms for tourism and water supply sectors.

Table 4.7-2. Summary description of possible PES mechanisms for tourism and water supply sectors (Popa et al. 2015)

ES	PES mechanism	Beneficiaries	Payers	ES secure	PES level
-Landscape -Microclimate -Cultural heritage -Education -Recreation /eco-tourism -Biodiversity	Tariffs for PAs visitation	PA administrations, forest owners	PA visitors	-Enhanced capacity to assure landscape biodiversity and traditions conservation -Development of visiting infrastructure Development of services offered by PA administrators for visitors	Local/ national
	Contributions from tourism operators and legal entities (tour operators, restaurants & hotels)	PA administrations, forest owners	Tour operators Restaurants Pensions Other touristic services companies		National/ regional
	Forest leasing	State forest management units	Forest land leasers	Improved institutional, legal and contractual frame for forest land lease	National/ regional
Water supply and water regulation	Contributions from water operators	Forest owners	Water operators (state or private)	Sustainable forest management to enhance the regulation role of forest ecosystems	Local/national

4.8. Conclusions

Several conclusions can be made and emphasized in order to give them the necessary importance as arguments for all those interested, mainly politicians and decision makers, in their attempt to uncover true values of forests and find mechanisms to contribute to sustainable development in general. All conclusions below can be used as strong arguments in favor of SEM and not in support of current BAU practices in the Republic of Moldova (Popa et al. 2015).

1. **FES generate considerable values**

The value of ecosystem services in tourism, forestry, agriculture, water supply, climate change and disaster mitigation were estimated at just under **$68.84 million** in 2014.

2. **FES play an appreciable role in the national economy and development**

In 2014, the quantified value of ecosystem services (taking into consideration only few sectors) equated to some **0.85% of GDP. This figure is 3 times bigger than the official figure representing forest sector contribution to national economy at 0.3%.**

3. **FES values accrue to multiple sectors, at many different levels of scale**

In 2014, both public sectors and private sector benefited from FES values. Thus, for eco-tourism sector a 20% of the value was earned by the national budget, while 65% (or $1.5 million) was earned by private companies. In agriculture sector, only 8% of the benefits were earned by the budget ($1.7 million), while the private sector earned 89%.

4. **Values generated by FES have a substantial multiplier economic effect**

The income, consumption, spending, employment and cost-savings generated by ecosystem services have wide-ranging and knock-on impacts on the economy. For example, only eco-tourism sector generate a total income, investment and spending in the tourist sector at $2.9 million, including capital investment in excess of $0.5 million, as well as some 500 full-time job equivalents.

5. **There remain untapped opportunities to increase the levels of revenues generated from FES**

Eco-touristic visitors are, for example, willing to contribute almost **$0.32 million** a year more than they are currently being charged as entry fees. Another example is from agriculture, where due to pasture under usage (under the carrying capacity) there is an untapped potential of **$0.6 million** a year**.** Increased public investment and policy action is required to capture these potential revenue streams.

6. **Continuing to grant FES a low policy and investment priority will incur long-term economic losses**

Continuing to carry out BAU practices may cost Moldova's economy and population more than **$21.3 million** in total, over the next 25 years.

7. **Law enforcement in Moldova is the first step to sustainable forest ecosystem management**

Our data reveal that if illegal logging will disappear, the value added to the economy by forestry sector and related industries may count for 30% of more income to the state budget from forestry, under the condition of not overexploiting the ecosystems and by implementing a long term SEM in forestlands.

8. **Well managed forest ecosystems may reduce significantly the damages produced by floods, soil erosion and land slides**

If the upstream protection functions of the ecosystems of ecosystems serve to minimize the impact of disaster by 10% below what it would have been in the absence of the protective functions, then the ecosystems' value of flood and landslides control in terms of avoided **damage costs** equates to an average of $0.4 million a year.

4.9. Recommendations

Based on quantifications and evaluations made, a number of recommendations have been identified to be potentially used by the forest policy making institutions as well as by other interested parties in order to facilitate the design of appropriate actions to sustainably manage Moldova's forest ecosystems. They are summarized below (Popa et al. 2015):

(Eco-) Tourism

The following approaches to improve FES contribution to tourism can be explored:

- Clear identification, mapping and evaluation of biodiversity. The great biodiversity, traditions, landscape and educational values of forest PAs should be better known. Thus, the visitor's flows and the visiting experience can be improved by increasing the interest in eco-tourism. Existing legal and regulatory framework should be improved in order to ensure proper implementation of management plans for PAs based on accurate biodiversity evaluation, planning tourism activities to confront with PAs values evaluation and continuous monitoring of these values.
- A diverse set of payment options could be explored in terms of visiting tariffs (e.g. internet, cash machines, accommodation operators, transport operators) and/or incentives (e.g. stickers) to encourage payment;
- Awareness campaigns are recommended to introduce news of any proposed higher entrance fees. Providing a wider range of destinations for ecotourism in the current PAs system and in the extended PA system and the National Ecological Network.
- Providing a wider range of recreation opportunities at destinations (based on careful market research), also taking into account local traditions (e.g. local food, manufacture etc.).

Further studies are needed in order to assess the potential for introducing tourism related PES mechanisms. Private tour operators are the main beneficiary from (eco-) tourism in the country. A possible mechanism is to explore the tourism operators paying for collaboration in terms of touring, hotels, infrastructure etc. Tourism operators (restaurants, hotels, tour operators, etc.) could pay some 0.5-1.5% of their revenues to the NEF, and this payment would be visible to tourist on receipts confirming the payment fee and its purpose (also tackle education and awareness aspects).

Forestry

At this moment, the annual allowable cut (AAC) is theoretically under the total annual increment in forest, which is mainly because of the fact that forest management plans are elaborated in a conservative way. In practice, the total fuelwood consumption is almost matching the total quantities of legally harvested wood (ENPI FLEG 2011). This indicates on serious management problems with the presence of extensive illegal activities. A solution for this may be a temporary increase of the annual allowable cut (which officially in Moldova is 50%) to at least the level of EU countries (which is 64% on average) to allow the use of more annual increment from the growing stock and ensure the placement of such volumes on fair (legal) market, and thus to gain more tax revenues from legalized forest management. This measure must be accompanied by more effective law enforcement in place in order to eradicate illegal activities. Thus, forest ecosystems could provide needed wood amount (mainly wood as primary energy), while the state is cashing its taxes and the management of forest ecosystem is sustainable. This measure, applied along with measures for increasing forest area (including energy plantations in the private sector), may be time limited. The forest area increase can cover the demand for energy wood in a certain period and the increase in AAC can be reassessed after that.

Sustainable forest management should be supported by a series of transformation measures that would trigger reforms in the forestry sector, namely focused on modernizing the forest institutions by separating the management, regulation and control functions; improving the management of other forest properties than the state (e.g. local public authorities, private), and enhance the management and associated market of NTFP’s (e.g. forest fruits/berries, game management, leisure/recreation etc.).

A very important recommendation refers to the continuation of implementation of national programs to increase forest area. Degraded lands, forest and water belts, energy plantations are potential areas that can help steadily increase forest cover and provide important ecosystem services flow in terms of provisioning of forest products, but also regulation services that can bring benefits to cross cutting sectors like agriculture, landscape management, disaster risks and climate change.

National registry for carbon should be kept, and reliable systems to attest the carbon sequestration within forests should be developed and implemented. Thus, forest owners (mainly the state and local public authorities) may be able to access the carbon market and cash the equivalent of Moldavian forests carbon sink. Forest sector of Moldova has important expertise in implementing carbon related projects. There is a need for exploring opportunities for the continuation of such projects and even designing new afforestation projects. This could bring the possibility to value the carbon sequestration associated with improving the forest coverage.

Agriculture

The key solution for a better FES management in agriculture is the landscape approach. Improved forests, managed in a sustainable way, will lead to an increased forest influence in the matter of soil erosion. Better pasture management and development/rehabilitation of forest belts can bring more value to vegetal and animal production. Landscape approach, along with better pasture management, can increase the carrying capacity of pastures.

Water resources

A potential PES schemes in the water resources sector can be applicable for water operators to pay a share of their revenues to the National Ecological Fund (or another appropriate transfer fund, e.g. Forest Development Fund), which would be used to finance projects focused on sustainable management of ecosystems that are providing regulatory services. Water operators’ contribution can be used to extend forest cover and further improve forest influence on water treatment costs.

Natural Disaster Management

The value calculated by this study is actually a non–commercial value, thus the estimates should serve for giving incentives to the public decision makers in order to start investing into sustainable forest ecosystem management.

(B-ii) The evolution and development plans for career development

1. Professional evolution

1.1. Education

1998-2006: Transilvania University of Brasov, Faculty of Silviculture and Forestry Engineering, PhD degree in Forestry with the thesis: *The fundament of the degraded forest stands ecological reconstruction in the Covurlui plateau*, scientific coordinator prof. Dr. Eng. Filofteia Negrutiu;

2005-2007: Romanian Canadian MBA program, Bucharest University of Economic Studies & Ottawa University, master degree in marketing (MBA);

1997-1998: Transilvania University of Brasov, Faculty of Silviculture and Forestry Engineering, master degree in Forestry;

1992-1997: Transilvania University of Brasov, Faculty of Silviculture and Forestry Engineering, engineering degree in Forestry.

1.2. Professional activity

After the graduation of University studies I worked for National Forest Administration – Romsilva (between 1997-2006) as a forest engineer in charge with forest fund, chief engineer, county brunch director and country branch technical director. I also worked for the Romanian Government as an operational director of the World Bank financed *Forestry Development Project*, between 2006-2009, and as a freelancer consultant: team leader of the project in charge with the applications evaluation for the Axe 4 - Nature Protection, Sectorial Operational Programme Environment (2009-2011) and other projects financed by UNDP, GEF and World Bank and other organizations in the field of forestry (2009-2016), finance, biodiversity conservation and climate change.

In 2011 I was employed by Transilvania University of Brasov, Faculty of Forestry and Engineering, under the Forest Management and Engineering Department. In time I was in different positions as follows: between 2011-2014 – lecturer and from 2014 till now – associate professor.

I perform my teaching activity in the field of Forestry (domeniul fundamental *Ştiinţe Inginereşti*, subdomeniul *Silvicultură)* delivering the courses and seminars for the following disciplines: *Management of Forestry Enterprise*, *Forest Products Commerce*, *Research Projects Management*, *Experimental Data Processing and Entrepreneurship in Forestry*.

I have also coordinated the master program *Technical Systems and Management in Forest Engineering* since 2013 and I was nominated as a member in one graduation commission (2013) and two master commissions (2014 and 2015).

I participated as a lecturer in two summer schools based on collaborations between Faculty of Silviculture and Forestry Engineering in Brasov and different academic partners.

1.3. Research activity

An important part of my own scientific research was published in books and scientific journals. There are results of the research activity that are still unpublished, some of them being described in the present habilitation thesis. During my professional activity I elaborated and published (excepting the doctoral thesis) the following papers:

- 5 books, two of them as first author and one of them as unique author; all the books were published in CNCS recognized publishing houses;
- 9 ISI Thompson Reuters indexed articles, two of them as first author or corresponding author. Another two articles have been selected by ISI Thompson Reuters journals for publishing, after successful reviewing/revising process, but are not yet published, one of them as first author; cumulated impact factor of the ISI Thompson Reuters indexed published articles is 6.002;
- 7 consultancy reports, elaborated in international projects financed by international organizations (UNDP, GEF, World Bank), published by these international organizations, 4 of them as coordinator author;
- 19 articles published in Journals or volumes of International Conferences, indexed in International Data Bases (BDI), 10 of them as first author.

During my professional career, I participated as coordinator or member of the experts team in 7 international research or consultancy projects (one of them as project coordinator) and 15 national consultancy or research projects (5 as project coordinator).

Academic and scientific work relevance can be proved by the following:

- Hirsch coefficients: Google Scholar ($h=3$, $i_{10}=1$), Scopus (***2***); ISI Web of Science (***1***);
- Reviewer of recognized ISI Thompson Reuters journals: *Forest Policy and Economics*
- Reviewer of other journals quoted in International Data Bases: *Revista Pădurilor*
- Reviewer and editor of the 16th International Symposium IUFRO 9.06.00.
- Reviewer of 3 doctoral theses in the Faculty of Silviculture and Forest Engineering.

2. Career development plan

2.1. Personal evaluation

My professional experience has been accumulated for 19 years , at the beginning in activities of forest administration and forest production - as an engineer within the National Forest Administration - then in management activities – as a coordinator of a National Forest Administration county brunch – in project management activities in forestry – as an operational director of the Forestry Development Project – or in forestry related areas – coordinator or member in the expert team of different projects in biodiversity, climate change, strategy elaboration, etc. My career offered me multiple opportunities of development and accumulations in what concerns my technical capacity, management of different organizations, international and national projects, but also teaching abilities.

Promoting and supporting collaborative approaches within the Faculty of Silviculture and Forest Engineering are important for me. I have been opened to actively involve in organizing, planning and teaching activities and I intend to keep this openness for the future. I am an organized professional, ready to take responsibilities, with certain research and consultancy orientation. All these qualities have been and will be offered in all possible collaborations with my colleagues. In my view, collaborations with colleagues, researchers and teachers, are the basis of getting to a synergic level of the whole activity in our Faculty and University.

I consider that I have serious competences in forestry, especially in strategic, organizational and management areas with applicability in forest administration, wood harvesting, forest products marketing and capitalization. In the same time, my qualifications in the economic field – business administration, project management – have proved to be able to add real value to different approaches in natural resources management, regulating and related research.

As a consequence of participating/coordinating in very important national scale projects for the forestry sector in Romania I have continuously increased my knowledge and abilities, thus I think that stepping into the teaching and research field is a higher level for me, allowing to be able to assure an effective transfer of knowledge to younger generations.

During my career I have accumulated deep abilities in the field of elaborating and evaluating financing applications as well as in the way of implementing research and consultancy activities. In many cases in the past, I promoted and evaluated projects in forestry or related fields of activity, I elaborated and presented numerous reports and papers. My working approach is reliable and I consider myself as being serious and responsible in achieving the intended goals, in close collaboration with all the members of the team. I like working in teams and I consider that the common effort is more valuable than the individual one. A have significant knowledges and capacities in integrating, at different level, of studies and research. I can have a significant contribution in performing economic analysis and evaluations, providing managerial decision support especially in the area of investments and financing.

2.2. Areas of interest in research activities

Regarding the research activities, my main interest areas were:

- Ecosystem services evaluation, aiming to determine and fundament a better and more sustainable financing policy of forest and protected areas management. Promoting payment for ecosystem services mechanisms, together with compensating the restrictions imposed on forest management are among the applications of the ecosystem services evaluation, in Romania or at international level;
- Effective management of forestry ecosystems from both productive and protective point of view;

- Identification and promoting of improved management approaches and tools at the level of forestry enterprises, aiming for improved efficiency and effectiveness in the context of the intended increased contribution of the sector to the national economy;
- Improving the traceability of the wooden products in Romania and other states, forest management and chain of custodies certification; access to new markets for Romanian forest products;
- Building capacity of forest products processers regarding implementation of modern marketing approaches;
- Improving the strategic and programmatic documents in Romanian forestry sector, for better adaptation to the dramatic changes triggered by the restitution process in Romania; promoting and assessing possibilities for a better transparency and dialogue relative to the forestry sector in Romania, between different stakeholders within and without the sector;
- Improving the utilization and performance of the investments analysis tools used in the forestry sector in Romania.

2.3. Opportunities regarding the involvement within the University and the Faculty

During my academic activity, in the last 5 years I was able to identify a series of opportunities of a better utilization of my personal abilities within the Faculty and the University:

- Promoting research and consultancy projects both in Romania and abroad, following an applicative approach in protected areas management and ecosystem services evaluation;
- Permanently informing the colleagues regarding the evolution of the forestry sector in Romania, interests and priorities of the central public authority in charge with forestry; in this way, together we can promote projects and researches that are addressing present issues and problems of applicative interest for the sector as a whole and for the central authority in charge, especially;
- Transfer of expertise in the areas of financing opportunities (especially European funds).

2.4. Future development in the teaching activity

As a member of the team of teachers and researchers of the Faculty of Silviculture and Forestry Engineering I have imposed a series of objectives that will held a central position in my career development plans. Continuity in relationships with my colleagues is one of the objectives, and its achievement can be reached through an efficient transfer of knowledge and information. There are many specific organizational and institutional activities within the University and my plans, as a member of the organization, is to get as familiarized as possible with those specificities and get involved whenever my capabilities can be of use. In this context I also plan to join professional associations or committees within the University, trying to make my contribution as valuable as possible. I consider that participation in the events organized by the University is also important for any member of the organization. Another important aspect is the adoption of the highest level or morality and ethics in all University related activities. Involving in promotion at national and international level or the achievements of the University will also be an important point in my agenda, along with using and maintaining all collaborations and contacts between the University and other academic, research or production entities, in Romania or abroad.

In the area of teaching, my concept is that the transfer of knowledge must reflect the professional experience of the teacher and therefore, my objectives are formulated around the idea of finding the best ways to transfer my professional experience to the students, of course in the limits of the disciplines I teach. My plans, in the immediate period, include:

- Facilitating better access to teaching materials for the students; using the unitbv.ro platform can be enriched with direct contact with students and encourage them to have a direct contact with the teacher;
- Permanent improvement of the teaching materials, keeping them topical and up to date;
- Elaboration and publication of brochures including courses notes for all the disciplines in my portfolio;
- Elaboration and publication of brochures including case studies for the seminars for *Management of Forestry Enterprise and Forest Products Commerce*;
- Permanent surveys for evaluating training needs of the students as well as their opinion on how good was the knowledge transfer; these approached are already implemented based on questionnaires, every year;
- Promoting the approaches based on guest speaking – inviting personalities of the sector to meet the students within the different courses (for example *Management of Forestry Enterprises or Forest products Commerce or Entrepreneurship in Forestry*).

I will continue the implementation of the modern and integrated teaching approaches, especially reflected in:

- Assuring the integration between the transferred information and the general study plan of the students;
- Promoting the use of specialized software, especially those that are generalized in the sector (for instance SUMAL, wood tracking);
- Utilization of interactive communication methods and other interactive approaches for knowledge transfer (for instance using the Internet in an interactive way, using case studies during the seminars, direct teacher to student dialog, team working).

Another important component of my teaching career development plan is the interest I am willing to pay for the integration of the quality and quantity of the transferred information with other universities in Romania or in other countries, of course without sacrificing the local specificity or traditions. I intend to continue and improve the collaboration with teachers in the same areas from other universities in Romania or in other countries, promote students exchange, etc.

With the specific of the disciplines I teach in mind, an important part of my future preoccupation is the increase of applicability of the theoretical notions, especially implementation of the theoretical notions by students in their own businesses or organizations, or for their diploma works.

2.5. Future development in research and consultancy area

The future development career plans, in the area of research will continue the way I already followed, being marked by the principle of improving the research performance, relevance and visibility. From this point of view, my operational plan of research career development will follow the main direction established at the level of the University, Faculty and Department. Main interest is to identify relevant areas of research, in close contact with the realities of the forestry sector in Romania, make efforts to find the most suitable financing opportunities for sustaining my own research and the research of the PhD students. The obtained results will be valorized in a way that can assure an effective visibility of the research, the Faculty and the University, especially publication in important, prestigious and recognized journals in forestry or related fields. Integrating students, PhD students, or master students in my research will be a priority, together with the integration of the research work with my colleagues in the Faculty. In my field of forest economics, my basic objectives for the research activity are subordinated to the idea of creating a research and consultancy team with the PhD students and other colleagues in the Faculty, the team being increasingly capable to continue or initiate synergic research direction in different research field, including the forest economics:

- Continuation in the matter of attracting funds for different research projects as well as responding positively to different consultancy request from organizations in forestry or related fields in Romania and abroad;
- Promoting common projects with research and consultancy centers in Romanian or in other countries;
- Continuous publication of articles in relevant, recognized and prestigious journals (ISI Thomson Reuters);
- Participation in international and national conferences;
- Elaboration of books or chapters of books and their publication at recognized publishing houses in Romania and abroad;
- Involvement in international collaborative projects (COST, IUFRO, etc.) in the areas of my specialization;
- Expanding the research directions that have been followed by now and promote cross disciplinary projects, in integrated teams including PhD students;
- Involvement in the development of the research center within the ICDT of our University;
- Supporting the efforts of the Faculty and University to organize different research events;
- Supporting and participating in different scientific international events, together with our international partners, in areas of my specialization;

- Organizing co-tutorial doctoral studies with relevant international Universities and research personalities;
- Promote connected and integrated doctoral areas of research for creating a synergic effect of the researches.

Regarding the future research areas, they will have the basis in the directions that have been followed so far. They are related to the integration of economic knowledges and approaches in the management of natural resources, especially forestland and protected areas. The forestry programmatic regulatory framework will also be in the center of my preoccupation as well as all possible applications of funding and investments in forestry. Due to heavy changes that toke place in Romanian forestry, the sector is still struggling to find the best way to regulate, control, manage and relate with other sectors. This forestry bordering area with other sectors will be the main focus of the research. Particularly:

- Protected areas management, natural resources conservation. This area will allow us to benefit from the high level of research in forestry and transfer benefits for evaluation of different ecosystem services. The approach will be oriented towards a better and sustainable funding of the forest management and protected areas management;
- Economic performance of the forestry sector is dependent on the relationship with adjacent sectors and domains. Lack of predictability and lack of market studies of the sector are forcing managers in the sector to take intuitive decisions. This is diminishing the contribution of the sector to the national economy. Therefore, one of the research directions that I envisaged is the study of the forestry economic environment, to be able to better inform the stakeholders and ultimately improve the influence of the sector in the national economy. Better dissemination of tested investments analysis tools are also included in this research direction;
- Social realities of today forestry are an important area of overlapping social sciences and forestry. The interest in the social dimension of the forest sectors is increasing and the relationship between these two environments (social and forests) is one of the future research preoccupation. The results are expected to better explain the relations between different stakeholders and the development of socially connected management tools both in forest management and forestry.

2.3. Career development framework

The framework for my career development is built on general recognized values as: professionalism, transparency, excellence, openness to new, teamwork. These values are traditionally promoted also by my department of Forest Management and Forest Engineering, my Faculty of Silviculture and Forestry Engineering and my University – Transilvania University of Brasov.

The career development plan presented in the pages above corresponds with the mission and vision of Transilvania University of Brasov and The Faculty of Silviculture and Forestry Engineering and their strategic and operational plans.

I am also basing my plans on the continuation of logistic and material support that have been assured by the Department, the Faculty and the University.

In my view, the same importance should be attributed to collaborative approach. I will not be able to achieve the above stated objectives outside of the team functioning now under in the Faculty of Silviculture and Forestry Engineering. All my plans have, at the basis, the support and collaboration of my colleagues, mainly from our University but also from other partner organizations.

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