Valuation of the Contribution of the Ecosystems of NorthernVelebit National Park and Velebit Nature Park to Economic Growth and Human Well-being: Croatia

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Summary and key findings

The valuation of the contribution of ecosystems of Northern Velebit National Park and Velebit Nature Park to economic growth and human well-being was supported by WWF's Dinaric Arc Ecoregion Project. The study has two main objectives. First, inform environmental fiscal reform (EFR) specialists, decision makers, and business professionals about the risks and opportunities of undertaking productive activities that use and are impacted by services provided by ecosystems in and around protected areas (PAs); and second, provide a analytical tool to enable stakeholders to assess the role of ecosystem services (ES) in productivity and incorporate ES into sector-level development and investment policies.

The World Conservation Union defines a protected area (PA) as "*An area of land and/or sea especially dedicated to the protection of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means.*" Ecosystems in PAs provide critical ES that support human prosperity and survival: clean and abundant water, flood and storm control, nursery grounds and replenishment zones for fish stocks, pollination services, and carbon sequestration. Ecosystem services are the conversion of natural assets – such as trees, snow cover, and soil fertility – into valuable benefits such as wood products, winter tourism, and arable land (Schroter et al., 2005). PAs provide the best continuous natural habitats for ecosystems to be able to function and continue to deliver critical services.

The study uses an innovative methodology, **SSA (Sector Scenario Analysis**), which includes two generic concepts as a basis for assessing the economic values of the ES of PAs in terms of growth and human well-being: The benefits from sustainable ecosystem management (SEM) ecosystems in PAs are known to be broadly distributed, long-term, and non-market (although some are market-driven such as tourism, water, and carbon sequestration), while business as usual (BAU) benefits from resource-depleting interventions are concentrated, immediate, and market-driven, e.g. extensive agriculture, extensive cattle ranching, encroaching (by farming) and logging.

The Licko-senjska County is home of four major PAs: Northern Velebit National Park (SVNP), Velebit Nature Park (VNP), Plitvicka jezera National Park (UNESCO World Heritage Site), and Paklenica National Park. The ecosystems within the SVNP and VNP PAs are the target of this study. In the current BAU situation, both parks face major threats and pressures such as: unplanned tourism, unsettled disputes regarding land tenure and use rights, conversion of land use, vegetation succession, fires, forestry and inadequate forest management, inadequate water and watershed management, poor waste management, illegal hunting and fishing, and mining.

Further, the majority of PAs in Croatia lack operational management plans and financial management tools. In general, most PAs have insufficient funding in Croatia; for instance, although the NVNP has the minimal funding required for basic conservation, the park faces a significant annual gap for the optimal conservation level, estimated at USD 1.3 million (or 978,465.42 Euros).

Is Section 2, using a sectoral approach, the study assessed the benefits provided by ES from NVNP and VNP. Key sectors include tourism and nature-based tourism (NBT), hydropower, agriculture, brewing (beer making), fisheries, and forests.

Tourism in Croatia represents a very important sector that contributes to the economy with 15.7% GDP-a (2009) and directly employs 5.8% (including only hotels and restaurants) of total work force. In addition, tourism covers as much as 76.4% of the national trade deficit (2009). In Licko-senjska County, tourism is a very important economic branch; in the year 2009 Licko-senjska County was visited by 387.000 tourists, which represented an increase for 5.7% in comparison to 2008.

A recent UNDP report notes that without the natural attractions provided by PAs, around which NBT is organized, PA-based NBT will not be possible. PAs provide continuous habitats with wild plants and animals, exotic foods, fresh water and air, landscapes, and cultural services essential to NBT. Tourism development in Croatia, as well as Licko-senjska County, will require significant improvements in the next years. To date, nature-degrading incidents are common and related to illegal building in and around PAs, absence of adequate visitation facilities and safety, and a lack of wastewater treatment facilities.

The study discusses three major tourism types: coastal, inland, and winter tourism, which are linked to ecosystems in and around PAs. Additionally, the study briefly discusses the potentially negative impact of golf tourism. The study estimates that under BAU, coastal tourism annual loss is approximately 13.7 million Euros, and that shifting to SEM could increase revenue from 3,492,047 Euros to 17,217,714 in a 5-10 years period.

Similarly, revenue from SEM inland tourism could increase up to 60% without degrading ecosystems by i) strategically increasing accommodation, ii) strengthening the connection between coastal and inland tourism, iii) improving the offer of local products to increase tourist spending, and iv) improving local foods availability through effective branding and marketing. Revenue from SEM inland tourism could grow from 2.3 million Euros to 5.5 million Euros in a 10-year period.

Coastal tourism also has a great potential under SEM. The study estimates that the potential annual revenue in the region, including spending on fuel, telecommunication, trade and other connected costs, is over 2 million Euros. Further, in an optimal SEM scenario, winter/mountain tourism can provide even higher revenues than coastal tourism, when opting to further develop ski tourism. The study also discusses how revenue from mountain tourism in the winter can be more profitable and less damaging than tourism associated with golf; and the high multiplier effect of tourism in the economy.

Hydropower is discussed in Section 2.2. Ecosystems sustain hydropower by regulating rain cycles, ensuring water quality and catchment capacity, reducing accumulation, and many other factors important for hydropower production. There are two large hydropower plants (HPP) in the region that depend on water services from the PAs in Velebit, Senj, and Sklope HPPs. Although ES are indispensable, there is little funding to protect forest ecosystems in and around PAs, and limited or no investment from hydropower companies in watershed management. Consequently, the study considers hydropower production to be under BAU. The study estimated that Senj and Sklope HPPs generate annual net revenues of approximately 63 million Euros and state taxes on the order of approximately 18 million Euros. If by neglecting fresh water, ecosystem management continues under BAU and the net revenue could decline to 53 million Euros in the next years.

Agriculture is reviewed in Section 2.3; this sector includes pollination services, and the production of fruits, berries, liquors, and honey. Agriculture employs approximately 16% of all employed, but with about 1.4 billion of gross added value, the sector contributes only about 3% of the total GDP.

Almost every third citizen of Croatia lives in agricultural households. In addition, many rural and urban households depend on their allotments in the countryside for survival. However, agriculture practices such as burning fields to eliminate weeds in the spring or autumn causes many forest fires, which affect biodiversity.

Regarding pollination, it is known that at least one-third of the world's agricultural crops require insect or animal pollination services. Bees are one of the principal pollinators of fruit trees and major staple crops. Bees are abundant in Velebit's PAs that provide the pristine habitat for their survival. There is a range of economically important plants in the Velebit region that require pollination services from wild bees and domestic bees. In planned pollination, bee pollination is by far the best way to pollinate crops successfully. It has been estimated that 500 solitary female bees, wild bees, or three hives (60,000 working bees) are needed to pollinate one ha of commercial apple orchard. Experts estimate that two-three hives per a hectare are sufficient to pollinate most crops. The study estimates that the value of the pollination service provided to orchard owners and cattle owners is approximately 2.9 million Euros.

Plums and apples are the largest fruit production in Licko-senjska County as well as administrative territories of Velebit and its surroundings – Gospic, Karlobag, Senj, and Otocac. Most of the fruit production is carried out in small family farms for self-consumption. Consequently, there are no official records of productivity.

The most serious threats to improving production of plums and apples are the dispersion of orchards, and poor maintenance and management. Therefore, plum and apple production is considered in the BAU scenario. However, production can be optimized by improving nurturing and pollination (SEM). Currently, the net revenue from plums and apples is low: 169,432 Euros for plums and 15,237 Euros for apples. In the SEM scenario, it is assumed that all registered trees are yielding at an optimal level of nourishment and pollination in a 10-year period. The study estimates that the shift to SEM could result in approximately 3.7 million Euros of net revenue and 762,382 Euros to state taxes, approximately 4.5 million Euros in total.

Another important example of the impact of pollination service is the production of wild berries, which are used to produce traditional liquors. Wild berry plants in Velibit support small- and medium-sized businesses. It is estimated that over 840 tons of berries, herbs, and other natural products are harvested every year, without any sustainability plan, in the NVNP.

Currently, in this BAU scenario, approximately 1 million bottles of liquor are produced and it is expected that in a five-year period, production will reach 5 million bottles annually. The expected gross value of sales for 2011 is USD 1.8 million (900,000 Euros net, estimated at 50%); and 4.5 million Euros net by 2016. Although this business sounds promising, it is likely that the increased production will have a negative impact on Velebit's ecosystems. No analysis has been made yet to determine if the current capacity of the ecosystem can provide the resources needed to increase and sustain liquor production at the expected levels. The introduction of SEM, in this case, represents an insurance policy to partly protect the investments and benefits to the people involved in the entire production and marketing chains, and, ultimately, to end-consumers.

Fresh water for brewing is another tangible benefit. Velebit's Ričina Spring supplies water to the local brewery. "Velebitsko" beer is considered to be the best quality beer in Croatia by many experts and this is largely attributed to the clean, high quality, water from VNP. Currently, total state revenue in taxes, from the beer production exclusively from Velebit water supply is estimated at 799,491 Euros yearly, which, according to state officials, is almost double the companies' net

revenue. There are seven large beer producers in Croatia that benefit from fresh water ecosystems. In addition, there are also three large water bottling plants, and over 100 small wineries that use fresh water ES to provide high quality products to 4.5 million Croatians. However, little or nothing is invested by producers or paid by end-users to support fresh water ecosystems management in Velebit's parks. Brewing is reviewed in Section 2.4.

Marine and coastal ES linked to VNP are critical to sustain sea fisheries and fish-farming in the region. Unsustainable fishing practices took place for decades, with partly-implemented bans leading to declines in fish stocks. Under BAU, fishing practices resulted in the elimination of fish varieties such as sharks, star gazers, and monkfish.

Under the current BAU scenario, based in the limited information available, it is estimated that the total current benefits, to local people and small enterprises, from fisheries is over 2 million Euros; in addition, 2.3 million in the form of taxes to the State, as well as 17,500 Euros tax income to local government. Contrast the BAU scenario with the SEM scenario: it is estimated that with medium investments, the annual net revenue could be four times higher than BAU, i.e. almost 10 million Euros and as much in taxes. In the same time frame, local authorities would earn more than 70,000 Euros annually from concessions. In addition, the potential employment increase could result in significant savings from reducing spending on social benefits in the area, which is currently troubled with high unemployment (20.8% unemployment rate in Licko-senjska County in 2010). Fisheries are reviewed in Section 2.5

Forest services are discussed in Section 2.6. Forest ecosystems provide valuable services such as: i) control of soil erosion, ii) wood products (timber), iii) carbon storage, iv) health services – production of clean air, and v) natural disasters mitigation. This section addresses soil erosion, wood products, and carbon sequestration. The estimated economic value of standing forest is 40 times higher than its value as timber and forest by-products. Despite this, forest services in Velebit are threatened by the impact of poorly monitored forestry and other development activities that may advance encroachment of PAs and disruption of ecological corridors.

Forests are more important in terms of mitigation and adaptation to climate change. According to FAO, 7,000 ha of Croatia forest are classified as primary forest, the most biodiverse and carbon-dense form of forest. Although it is supply-driven, the estimated total value of the carbon stored in VNP could be as high as 15.5 million Euros. Croatia ratified the Kyoto Agreement in 2007, passing regulations and taking actions toward fulfilling both its obligations toward the United Nations Framework Convention on Climate (UNFCC), as well as the EU, in the area of climate change and greenhouse gas emissions reduction. Carbon storage services are critical to fulfill such obligations.

Section 3 discusses the links between ecosystems with livelihoods and human-well being, and the contribution of ecosystems to poverty alleviation.

Fresh water is assessed in Section 3.1. The company Vodovod Senj Ltd. is primary distributor of water in the Velebit region. The water is supplied by River Lika through an underground tunnel that transfers water from the Lika to the River Gacka. It is estimated that 35% of this water originates from the Velebit catchment; over 75,000 people benefit from clean water from PAs in Velebit. No treatment is needed other than chlorine that is added by distributors. In other regions, where no such clean water is available, as in Osijecko-baranjska County in Northern Croatia, the cost of water treatment before distribution is estimated at 0.44 Euros/m^3, while in Velebit, the investment required for water treatment before distribution is only 0.0037 Euros/m^3. This represents additional savings in Licko-senjska County of 155,322 Euros (0.43 Euros/m^3).

Losses in the water distribution network in Licko-senjska County are high, estimated at 59%, which is not the highest in Croatia. In addition, water prices are subsidized. Consequently, fresh water management is considered BAU. The value of annual water production is estimated at 949,000 Euros (at 0.26 Euros/m^3), however, in more realistic terms, considering the EU average, the value is 18.5 million Euros, which could pay for some of the mentioned externalities.

Forests can help to prevent and mitigate natural disasters; particularly, forests on krast formations. Deforestation-related erosion in krastic areas is costly and a long-term activity, however, it is payable and rewarding. For example, at the national level in 2005, 9.5 million kunas (1.3 million Euros) were invested to landslide recovery at local and regional roads in Croatia. All local-level investments in reforestation for Licko-senjska County at Senjska draga is already showing beneficial results by reducing wind gusts, abating floods and torrents, reducing climate extremes, creating conditions of occurrence of drinking water, and increasing the touristic value of the landscape. In Licko-senjska County, the average annual spending on landslides is estimated at only 4,110 Euros. A brief discussion on prevention of natural disasters is included in 3.2.

Section 3.3 focuses on ES and poverty alleviation. Discussed are grasslands, livestock and dairy production, honey production, and crops, with attention paid to the additional income from nature based-tourism.

Grassland ecosystems are important to sustain livestock and dairy production, and consequently support the livelihoods of rural families. There are over 200 small producers in Velebit. Ecosystem services of Velebit PAs provide most of the inputs for native cattle breeds and dairy production elements such as clean water and good forage for animals. Although these services are evident, the government pays insignificant subsidies to support the reintroduction and breeding of endemic grazing species. The annual net revenue from Buša milk and cheese in Velebit is 77 % higher than in other places in Croatia, where conventional breeds are used. In addition, it is estimated that Velebit's dairy sector currently contributes with 4,089,842 Euros to the state tax (VAT).

Velebit's honey is highly appreciated, commanding a higher market price compared to other areas, excluding honey from Dalmatia. Local production is not able to meet market demand and, therefore, Croatia is importing honey from China. The profit margin for local honey production is very high at 69%, and the production cost is low. The estimated total annual gross revenue per hive is 179 Euros (123 Euros net). However, production may decrease due to overuse of pesticides, intensive agriculture, development of golf terrains, and other threats. In the current BAU scenario, the net value of the annual production of honey is estimated at Euros 235,809. In the SEM scenario, assuming that appropriate policies and basic investment is provided to preserve bee habitat and stock, the net value of honey production may increase to 466,195 Euros. This shift is estimated to be possible in a 5-10 year period. Further, with the significantly higher production, it would be possible to diversify production to organic wax, cosmetics, and other honey-based products.

Lastly, the study briefly reviews crops that are mainly used for self-consumption, and how crops benefit from forest services such as pollination and regulation of rain cycles. It is worth mentioning that for all sectors analyzed in this study, ES contribute to generate employment and income; nature-based tourism is a case in point. This is critical to sustain the livelihoods of thousands of people in the Velebit region.

Based on the above analysis, Section 4 of the study provides sector-level conclusions and a set of general recommendations related to further research and information needs, PA policy and finance, and institutional aspects.

Key findings

- NVNP and VNP provide indispensable services that sustain the economic benefits of tourism and nature-based tourism (NBT) in Velebit.
- Under BAU, inland NBT, like coastal tourism, are impacted by economic loses.
- In an optimal SEM scenario, winter/mountain tourism can provide even higher revenues than coastal tourism, when opting to further develop ski tourism instead of golf tourism.
- Tourism/NBT both have a high multiplier effect.
- The shift from BAU to SEM in fresh water ecosystems management is indispensable to secure water flow, savings (from avoided replacement and maintenance costs), and economic benefits from hydropower generation.
- Water resources from VNP provide the indispensable natural resource (fresh water) to support a promising subsector of the economy in the region: beer production.
- VNP and NVNP's ecosystems are economically important to agriculture.
- Pollination services from wild and domesticated honeybees are indispensable to sustain agriculture, particularly the production of fruits and berries.
- SEM pollination services are indispensable to sustain the current and potentially increased production of plums and apples in Velebit.
- Non-timber forest products of NVNP, berries, and herbs, under BAU, support a local liquor industry.
- Carbon storage in forests could be instrumental in helping Croatia to fulfil potential forthcoming obligations toward UNFCC, as well as EU, in the area of climate change and greenhouse gas emissions reduction when Croatia enters the EU.
- Forest ES in Velebit may be threatened by the impact of forestry activities that result in encroachment of PAs and disruption of ecological corridors.
- SEM fresh water ES are indispensable to sustain fisheries, both coastal and inland.
- SEM forests are essential to save costs or minimize the economic impact of natural disasters.
- SEM ES from PAs are important to sustain and increase government's income from tax collection.
- SEM fresh water ES from PAs are indispensable to provide a sustainable supply of drinking water and maintain cost-savings.
- Ecosystems services from NVNP and VNP are indispensable to improving livelihoods in and around the parks.

1. Introduction

1.1 Study background and methodology overview

Study background

It is well-known that people and economies benefit from healthy ecosystems in protected areas (PAs). However, knowing that ecosystems services (ES) are valuable is of little use if this knowledge does not lead to tangible investments to conserve the natural systems that provide these services.

Economic arguments are critical building blocks to achieve the goals and objectives of WWF's Programme "Protected Areas for a Living Planet." To this end, WWF's Dinaric Arc Ecoregion Project funded the "Valuation of the contribution of ecosystems of Northern Velebit National Park and Velebit Nature Park to economic growth and human well-being." This report has two main objectives. First, inform environmental fiscal reform (EFR)[3] specialists, decision-makers, and business professionals about the risks and opportunities of undertaking productive activities that use and are impacted by services provided by ecosystems in and around PAs; and second, provide a analytical tool to enable stakeholders to assess the role of ES in productivity and incorporate ES into sector-level development and investment policies. This tool is known as "Sector Scenario Analysis" (SSA) and it is discussed in the next section. In addition, the study provides:

- Specific content to improve understanding and build awareness of the value and contribution of healthy ecosystems to human well-being;
- A platform for the debate and promotion of sectoral economic analysis of ecosystems;
- Economic arguments to lobby senior government and legislative representatives to increase budgetary appropriations to PAs and other conservation initiatives; and
- Support to develop PA business plans.

[3] The term environmental fiscal reform (EFR) refers to a range of taxation or pricing instruments that can raise revenue, while simultaneously furthering environmental goals. This is achieved by providing economic incentives to correct market failure in the management of natural resources and the control of pollution. Broadly speaking, EFR can: 1) mobilize revenue for governments; 2) improve environmental management practices and conserve resources; and 3) reduce poverty. By encouraging more sustainable use of natural resources, and reducing pollution from energy use and industrial activities, EFR can address environmental problems that threaten the livelihoods of the poor. The revenues raised by EFR can also be used to finance poverty reduction measures. EFR can therefore contribute to poverty reduction, and in turn, help achieve the Millennium Development Goals of "halving absolute poverty by the year 2015" and "reversing the loss of environmental resources" (World Bank, 2005).

Methodology overview

The innovative **SSA (Sector Scenario Analysis)**[4] uses two general yet key concepts as a basis for assessing the economic value of ES in terms of growth and equity: Business as Usual (BAU) and Sustainable Ecosystem Management (SEM).

Traditional data on the value of ecosystems and biodiversity to production is re-organized based on the BAU/SEM framework. In this approach, the values of biodiversity and ecosystems are not seen as static (time-bound) data points, but, rather, as variables that respond to degradation, sustainable management, and other interventions. BAU and SEM are flexible concepts. The use of these "generic" terms is recommended because they provide a practical framework for grouping and analyzing information to simplify the analysis and presentation of findings. The term BAU refers not to all current activities but those activities that damage or deplete ES. The BAU approach is characterized by a focus on short-term gains (e.g., < 10 years), externalization of impacts and their costs, and little or no recognition of the economic value of ES, which are typically depleted or degraded. It is recognized that there are different levels of BAU, with not all BAU scenarios necessarily highly degrading to ecosystems. Under SEM, the focus is on long-term gains (> 10 years); also under SEM, the costs of impacts are internalized. Ecosystem services are maintained, thus generating potential for a long-term flow of ecosystem goods and services that can enter into decision making. Activities that are SEM practices tend to support ecosystem sustainability, not for ideological reasons, but, rather, as a practical, cost-effective way to realize long-run economic profits. Common SEM practices include watershed management, agro-forestry and silvo-pastoral production methods, low-impact logging, nature-based income diversification, and organic farming.

The sectoral approach – by type of economic activity – is used to ensure relevancy to policy makers. A range of sectors closely tied to renewable natural resources has been selected for analysis. This sectoral analyses draw on technically-sound economic and ecological data from published material, mainly based on site-based studies (microeconomic data) as well as ad hoc new case studies prepared when needed (not for this report). Each sector analysis explores the economic relations between production practices, ES, other inputs, and sectoral outputs, as well as shows feedback loops (e.g., pesticide application to crops can damage pollinator populations, thereby lowering pollination rates and, in turn, agricultural output). Examples are given of ecosystem degradation that lowers outputs, and the costs associated with these lowered outputs are discussed. Then, management practices that avoid actions that damage ecosystems are identified, with the economic benefits to the sector from maintaining ES highlighted. The SSA uses a range of indicators such as those shown in Table 1.

Table 1. Sample indicators used to construct BAU/SEM scenarios

Sector and subsector indicators (5-10 years trends)
• Employment (# of jobs): direct, indirect, and induced • Income level trends • Fiscal impacts (tax revenues, subsidies, and green taxes)

[4] Adapted from Flores, M. in Bovarnick, A., F. Alpizar, C. Schnell, Editors. The Importance of Biodiversity and Ecosystems in Economic Growth and Equity in Latin America and the Caribbean: An economic valuation of ecosystem, United Nations Development Programme, 2010.

- Foreign exchange (investments, exports)
- Green market/income opportunities & innovation potential
- Opinion polls
- Sector investment trends (public and private)
- Damage costs and avoided damage costs
- Returns on investment
- Production trends (volume and value, as % of GDP)
- Productivity (return to labor, land, capital)
- Market values
- Changes in natural capital (# ha under protection)
- Equity impact on the poor/distribution of benefits

In addition, when possible, the study will use BAU and SEM to distinguish the benefits and management capacity of PAs.

Further, in terms of threats to PAs, SEM leads to minimize the impact of threats but not necessarily threat elimination. In addition, BAU and SEM may be linked to low and optimal levels of ecological representativity. General characteristic of the BAU and SEM management approaches is included in Table 2.

Table 2. General characteristic of the BAU and SEM management approaches

BAU (business as usual)	SEM (sustainable ecosystems management)
• PA management plans are not based on threats assessment and abatement needs. • PA tourism infrastructure does not meet the demands of tourism visitation. • PA investment in tourism infrastructure is below basic needs. • Critical ecosystems that support tourism are under threat. • Unregulated tourism visitation. • Tourism industry is not supporting PA tourism infrastructure development and PA tourism programs. • Industrial waste discharges from food processing industry and tourism development causes eutrophication. • No water treatment facilities. • Carbon objectives are not incorporated into forest management and timber production-based models. • Centralized decision-making with limited stakeholder participation in NNRR management.	• PA management plans address specific threats assessment and abatement needs. • PA tourism infrastructure meets the demand of tourism. • PA investment in tourism infrastructure meets needs. • Tourism government agencies support PA tourism and ecosystem protection programs. • Tourism industry supports PA tourism infrastructure and ecosystem protection programs. • Critical programs to conserve ecosystems are fully funded, and threats are minimal. • Pollution fees are high. • Water treatment facilities installed and fees charges. • Environmental externalities are included in water tariffs and tourism's service charges • Carbon sequestration objectives are incorporated into forest management planning models. • Decentralized decision-making stakeholder participation.

The SSA has been developed to align the information gained through this BAU/SEM framework with the sectoral work of ministries and public agencies. The sectoral approach has some constraints: the approach disaggregates the economic value of each type of ES and fragments system-wide values to show specific sectoral inputs (UNDP, 2011). The integration of the overall effects of ecosystems and their services on the economy as a whole (national level) is possible, but it is less relevant to sector-level policy makers. A more detailed description of the methodology is included in Annex 1.

In order to implement the BAU and SEM valuation approach, the study team completed the following steps:

a) Develop common understanding of the methodology.
b) A questionnaire was applied to a range of stakeholders to identify key ES and links to productivity by sector, determine location and sources of available information on conventional ES valuations; and determine information needs for immediate research.
c) Based on the available information and indicators data, construct BAU and SEM scenarios and carry out comparisons, using the SSA approach described earlier.
d) Aggregate data to estimate overall value of ES in terms of productivity.
e) Draft a set of recommendations including policy options linked to sector-base opportunities to develop the payment for ecosystem services (PES). These recommendations will be used to start discussions on PES to support conservation programs in PAs.

1.2 Protected Areas, Ecosystems and Ecosystem Services

The World Conservation Union[5] has defined a protected area as "*An area of land and/or sea especially dedicated to the protection of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means*"; and the Convention on Biological Diversity (1992) describes a protected area as "*a geographically defined area, which is designated or regulated and managed to achieve specific conservation objectives.*" These ecologically accurate definitions are not indicative of the importance of PAs in economic and social terms. They reinforce the common understanding (outside of the conservation sector) that PAs are mostly a refuge for species of plants and animals unable to survive in intensely managed terrestrial and marine landscapes.

The Millennium Ecosystem Assessment[6], however, notes that PAs help provide critical ecosystem services (ES) that support human prosperity and survival: clean and abundant water; flood and storm control; nursery grounds and replenishment zones for fish stocks; pollination services; and carbon sequestration. This statement is more accurate in economic and social terms.

The main PAs of Croatia are the eight national parks, the ten nature parks, and two strict reserves. The total area of all national parks in the country is 994 km^2 (384 sq mi), of which 235 km^2 (91 sq mi) is sea surface. Each of the national parks is maintained by a separate institution, overseen and funded by the government ministry of nature conservation and spatial development. The State Institute for Nature Protection provides centralized oversight and expertise.

[5] IUCN 1994 – Guidelines for PA Management Categories.
[6] http://www.millenniumassessment.org

PAs provide unique shelter to a large variety of biodiversity and ecosystems. An ecosystem is a natural unit consisting of all plants, animals and micro-organisms (biotic factors) in an area functioning together with all of the non-living physical (abiotic) factors of the environment; it is a completely independent unit of interdependent organisms which share the same habitat. PAs provide the best continuous natural habitats for ecosystems to be able to function and continue to deliver these services. Ecosystem services are the conversion of natural assets – such as trees, snow cover, and soil fertility – into valuable benefits such as wood products, winter tourism, and arable land (Schroter et al., 2005).

Ecosystems services are not exclusively dependent on biodiversity and ecosystems within and around PAs, for example, carbon sequestration, water cycles, and erosion control. However, large and small ecosystems sometimes overlap and are often interdependent. Major global ecosystems are known as biomes, for example, an alpine forest may be considered as a mid-sized ecosystem, which contains a range of smaller ecosystems. These layers of ecosystems are in dynamic interaction with each other, and influence the balance of the services they provide[7]. This is particularly evident in Croatia, where ecosystems in and around PAs provide a wide range of services. Table 3 provides examples of the ES provided by PAs in the Licko-senjska County, which is home to four important PAs including NorthernVelebit National Park and Velebit Nature Park. A brief description of these two parks, the target of this report, is provided in Section 1.4.

Table 3. Ecosystems services provided by PAs in the Licko-senjska County

Protected Areas	Ecosystem Service													
	Freshwater (watershed services)	Food (Wild meats, fruits, berries, greens, fresh water fish and seafood)	Grasslands	Marine & coastal	Timber, fuel (fire wood), and fiber	Novel products	Biodiversity regulation / conservation (habitat for plant/animal species)	Nutrient cycling	Air quality and carbon sequestration	Human health	Detoxification	Natural hazard regulation	Cultural	Sport fishing, hunting, skiing, hiking, nature & wildlife viewing
Northern Velebit National Park	?	?	?	?		?	?	?	?	?		?	?	?
Velebit Nature Park	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Paklenica National Park	?	?		?		?	?	?	?	?		?	?	?
Plitvicka Jezera National Park	?	?				?	?	?	?	?		?	?	?

The wide range of ES provided by Croatian PAs result in greater sector productivity and other benefits related to human well-being: for instance, water (irrigation, hydropower, and human consumption), provision of habitat for pollinators and valuable wild species, supply of natural resources (food) to people, provision of nature-based attractions for tourism, contribution to climate-change mitigation and adaptation, and protection of cultural and spiritual resources.

Nevertheless, the benefits from ecosystems in PAs are known to be broadly distributed, long-term, and non-market (although some are market-driven such as tourism, water provision, and carbon sequestration), while benefits from resource-depleting interventions are concentrated, immediate and market-driven, e.g. extensive agriculture, extensive cattle ranching, encroaching (by farming), and logging. This argument is too often used by politicians and decision makers to justify limited investment in PAs (and sustainable ecosystems management) (UNDP, 2010).

[7] The Sustainable scale project: http://www.sustainablescale.org/ConceptualFramework/UnderstandingScale/BasicConcepts/EcosystemFunctionsServices.aspx

1.3 The economy of Croatia and Licko-senjska County

Once one of the wealthiest of the Yugoslav republics, Croatia's economy suffered badly during the 1991-95 war as output collapsed and the country missed the early waves of investment in Central and Eastern Europe that followed the fall of the Berlin Wall. Between 2000 and 2007, however, Croatia's economic fortunes began to improve slowly, with moderate but steady GDP growth between 4% and 6% led by a rebound in tourism and credit-driven consumer spending. Inflation over the same period has remained tame and the currency, the "Kuna" (Kn) stable. Nevertheless, difficult problems still remain, including a stubbornly high unemployment rate, a growing trade deficit, and uneven regional development. The State retains a large role in the economy, as privatization efforts often meet stiff public and political resistance. While macroeconomic stabilization has largely been achieved, structural reforms lag because of deep resistance on the part of the public and lack of strong support from politicians. The EU accession process should accelerate fiscal and structural reform. While long-term growth prospects for the economy remain strong, Croatia will face significant pressure as a result of the global financial crisis. Croatia's high foreign debt, anemic export sector, strained state budget, and over-reliance on tourism revenue will result in higher risks to economic stability over the medium term.

After almost a decade of stabile and continuous growth, the Croatian economy in 2009 had fallen into recession as a result of global economic crises but also due to structural problems. In 2009 Croatian GDP had decreased for 5.8%[8] and for the first time after 1999 growth rate was negative. It has been predicted that Croatian economy will record a fall of GDP for 1.5%[9] in 2010 also. A first small growth of GDP is expected to happen in 2011. Total Croatian real GDP in 2009 was USD 63,076 million[10] and GDP per capita was USD 14,242. As a result of a decrease of the GDP, GDP per capita has also decreased for 9% in one year. From the production side of Croatian GDP, GVA (gross added value) in 2009 has decreased for 4%[11] in relation to the 2008 figure, which indicates that the recession has reflected on all the economic sectors in Croatia.

Nevertheless, Croatia is considered a stable economy and one of the most developed economies in South Eastern Europe. The economy's main industry is its service sector, which is currently 60.7% of the total GDP. The industry sector is made up of shipbuilding, food processing, and the chemical industry. Tourism is very important in the country but it only contributes to the economy in summer during the peak holiday season. The Croatian economy is expected to continue growing especially when it enters the EU. The main industries include: chemicals and plastics, machine tools, fabrication, metal, electronics, pig iron and rolled steel products, aluminum, paper, wood products, construction materials, textiles, shipbuilding, petroleum and petroleum refining, food and beverages, and tourism. Industry (including mining and quarrying) is the most important sector in Croatia and makes the backbone of the Croatian economy.

Croatia's tourism industry has significant growth potential, with the latest research from Euromonitor International predicting arrivals to Croatia to grow by 42% between 2005 and 2010. Growth in the next few years is expected to be driven by the arrival of budget airlines and the expectation of EU membership. But despite this promise, there are several obstacles that need to be addressed in order to secure the future of this industry. Croatia's tourism sector contributed to almost 20% of GDP in 2005 and growth in tourism receipts has outpaced growth of GDP in 8 of the

[8]Estimation of GDP growth in 2009 in Croatia; *Croatian Bureau of Statistics*
[9]Estimations of economic growth in Croatia in 2010; *Institute for Economy Zagreb; World Bank in Croatia*
[10]The real GDP for Croatia in 2009; *Croatian Bureau of Statistics*
[11]The calculation of GVA for Croatia in 2009; *Croatian Bureau of Statistics*

past 12 years. The government's strategy is to position Croatia as a top-end destination and this is paying dividends.

Licko-senjska County

Licko-senjska County is a southern Croatian county located between Primorsko-goranska County in the southwest, Karlovac County in the north, Zadar County in the south and southeast, and Bosnia and Herzegovina to the east. The County is placed in the mostly mountainous part of Croatia and, to the smaller extent, at the Croatian coast. The county center Senj is 160 kilometres from Croatian's Capital of Zagreb. Licko-senjska County borders Bosnia and Herzegovina on its northwest. Administratively it includes four towns (Gospić, Novalja, Otočac, and Senj) and eight municipalities (Brinje, Donji Lapac, Karlobag, Lovinac, Perušić, Plitvice Lakes (headquarters Korenica), Udbina i Vrhovine).

Licko-senjska County importance lies primarily in the function of the intersection between the top three spots in the geographically-polarized country – Zagreb, Rijeka, and Split – as well as smaller centres Karlovac and Zadar. Furthermore, the area is valued as a geostrategic and ecological center as well as an autochthonous economic resource for development of forestry, agriculture, water-use, and maritime resources as well as mountain tourism. A special place in the ecology of the County belongs to Velebit Mountain and rivers of the area – Gacka, Lika, Una, and Korana for their importance in water supply of high quality.

Although Licko-senjska County has the most preserved natural resources in Croatia, it is the least populated county, with only 10 inhabitants per km^2, 53.677 inhabitants in total. A combination of harsh climate, desertification, war, and a lack of development vision has resulted in negative population growth rates. This has had a significant impact on economic development.

Traditionally considered an undeveloped county, Licko-senjska has recently started to improve its economy. In 2007, the gross domestic product (GDP) was 411 million Euros, which counted for only 1% of total Croatian GDP, which stagnated during 2008 as well. Although 1% seems low, when related to number of inhabitants, Licko-senjska County took the seventh place amongst Croatian counties (out of 21) for GDP per capita, which amounted to 9,725 Euros in 2008[12]. From the European perspective Licko-senjska County may still be viewed as a less developed region, considering that its GDP represents only 50% BDP per capita of the European Union average[13]. The key sectors of the County's economy are indicated in Table 4.

Table 4. Key economic sectors Licko-senjska County (2010)

Sector	% of revenue	Employment %
Trade, repair services	33.6	17.8
Processing industry	14.6	18.1
Construction	11.3	13.3
Hotels and restaurants	10.5	12.6

Source: Licko-senjska County official web pages (2010)

[12] Licko-senjska County development strategy 2011.-2013.
[13] Croatian Bureau for Statistics, First release No. 12.1.2., February 2011

Total export of Licko-senjska County accounts for only 0.07% of the Croatian total or 5.7 million Euros (43 million kunas). Most of the exported goods are those from the wood production and processing industry (excluding furniture)[14]. Therefore, forest ecosystems in PAs are an indispensable input to the wood processing sector in Licko-senjska County. For example, the public institution managing Plitvicka-jezera National Park is by far the most successful forest entrepreneur in the county (based on the 2010 revenue).

There are 2,114 companies registered and 984 active in the County according to 2009 data from the Croatian Bureau of Statistics. Active companies are engaged in trade, tourism and related services, construction, and wood processing and forestry. The majority (95%) of companies are small. The greatest share of revenue was earned by trade and motor repairs (41%). In 2009, the County contributed to 0.06% in total Croatian exports. In 2010 there were 3,350 unemployed persons in the County[15] and the unemployment rate was 20.8%, in 2010, which is showing stagnation (compared to 20,6% in 2003).

In 2008, the national GDP was 343,159 million Kunas (45,610 million Euros) and of Licko-senjska County 3,553 million Kunas (474 million Euros) or 1% of national GDP. Table 5 shows the Licko-senjska's GDP breakdown in 2006[16].

Table 5. Licko-senjska GDP breakdown in 2006[17]

Activity	% of County GDP
Agriculture, forestry, fishery, hunting	11.3
Industry, mining, infrastructure	9.0
Construction	42.1
Trade and wholesale	6.0
Hotels and restaurants	4.2
Transport and communications	8.4
Financial mediation and real estate	3.0
Public sector services	16.0
Total Licko-senjska	100%

The study "Long-term development of Ličko-senjska County 1995 – 2015" identifies agriculture, tourism, and wood processing industries as strategic development activities. However, investments to the County are low. For example, in 2009, out of almost 10 billion Euros investment (73 billion kunas) at national level in value of gross fixed capital formation in new fixed assets, only 0.8% or 84.3 million Euros (624 million kunas) was invested to Ličko-senjska County and again, mostly to trade[18].

1.4 Protected areas in Licko-senjska County

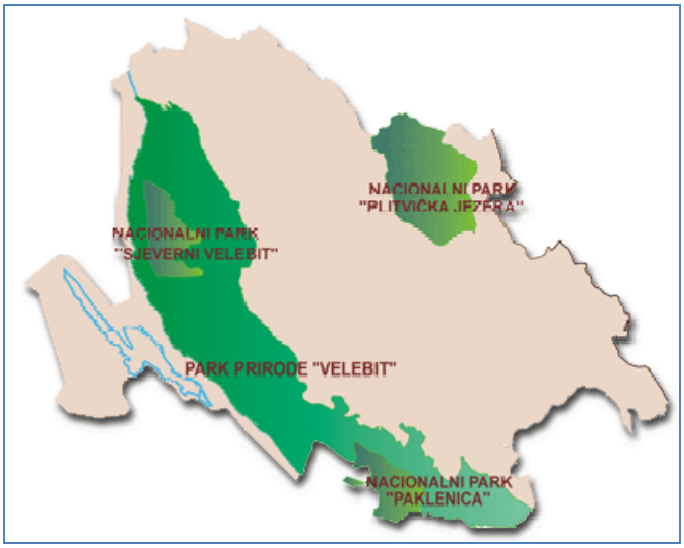
Licko-senjska County is the biggest county in Croatia (9.4% of the total territory) and has the largest surface under protection, and contains one of the highest numbers of protected nature

[14] Ibid
[15] Croatian Bureau of Emploment, Monthly Statistical Bulletin, I 2011
[16] Croatian Bureau of Statistics, 2007
[17] Ibid
[18] Croatian Bureau of Statistics, 2010

features and locations. The total area of the County is 5,353 km^2 where 2,368 km^2, or 44%, belongs to PAs. This represents as much as 58% of the total PAs in Croatia (National Parks and Nature Parks only). The county also encompasses a northwest part of the Pag Island 2.29 km^2 in size, as well as part of the Adriatic Sea (596.6 km^2 or 2% of the total territorial sea).

The Licko-senjska County is home to four major PAs: Northern Velebit National Park (SVNP), Velebit Nature Park (VNP), Plitvicka jezera National Park (UNESCO World Heritage Site), and Paklenica National Park. See Map 1. The ecosystems within the SVNP and VNP are the target of this study. A brief description of these parks is included below, and their threats are discussed in section 1.5.

Map 1. Protected areas in Licko-senjska County



Soure: Licko-senjske County

The Northern Velebit National Park was designated in June, 1999, and the Public Institution was established in September 2001. The park was designated because its richness in karst formations, outstanding biodiversity, and exquisitely beautiful nature in a relatively small area. The Park covers 109 km^2 (10,900 ha), and includes the Hajdučki & Rožanski Ledges Strict Reserve, famous for its geomorphologic phenomena – the pits. There are more than 150 pits, of which the most famous is Luke's pit, discovered in 1992. The Visibaba and the Zavižan-Balinovac-Velika botanical reserves are part of the park. The latter includes the widely known Velebit Botany Garden, founded by the pharmacology professor Fran Kušan in 1967.

The Park is crossed by many mountaineering trails. The most famous and widely known is the Premužić's trail, which runs through the most beautiful and the most interesting parts of the park. From the numerous peaks in the surroundings, there is a magnificent view to the Adriatic Sea and these islands: Pag, Rab, Goli, Prvić i Krk. The view is stunning on the continental side as well. The Park's cultural value is present in a form of many ruins of the so-called "summer lodges," which bear witness to the ages passed and long forgotten, when Velebit was inhabited by a population of shepherds and cattle farmers. On its coastal banks, lie the ruins of houses, lodges, and stone walls, which once marked the specific lifestyle of the local population.

Velebit Nature Park encompasses 200,000 ha of land including two national parks. It stretches through three counties – Licko-senjska County, Zadarska County and a small part of the Sibensko-kninska County. The Park encompasses the entire forest eco-system of Velebit Mountain that includes forest cover from Senjsko Bilo at the northern edge of Velebit to Zrmanja River, at the southern mountain slopes, as a natural border of the park. On the east side, the forest ecosystem is disconnected by ecosystems of planes (for example, the Lika plane), and on the west by the Adriatic Sea. Forest cover is predominant, covering 110,494 ha or 55% of the Velebit Nature Park. The area under a special protection is a forest reserve at Stirovaca Plane and there is a plan to put under stricter protection 17 more locations within Velebit Nature Park[19]. The ES provided by these two targeted parks are shown in Table 1, Section 1.1.

1.5 Threats, pressures, and financial challenges to protected areas

An assessment of the management effectiveness of PAs in Croatia was completed in October 2008 by using WWF's Rapid Assessment and prioritization of protected area management (RAPPAM) method[20]. Graphic 2 show the threats and pressures to PAs in Croatia according to the RAPPAM assessment.

Pressures are defined as activities that have already had a detrimental impact on the park, and threats defined as activities whereby a detrimental impact on the park is likely to occur in the future. Pressures and threats are relative to the objectives of PAs and are scored on the basis of their extent, impact, and permanence, using scores from 1-4[21].

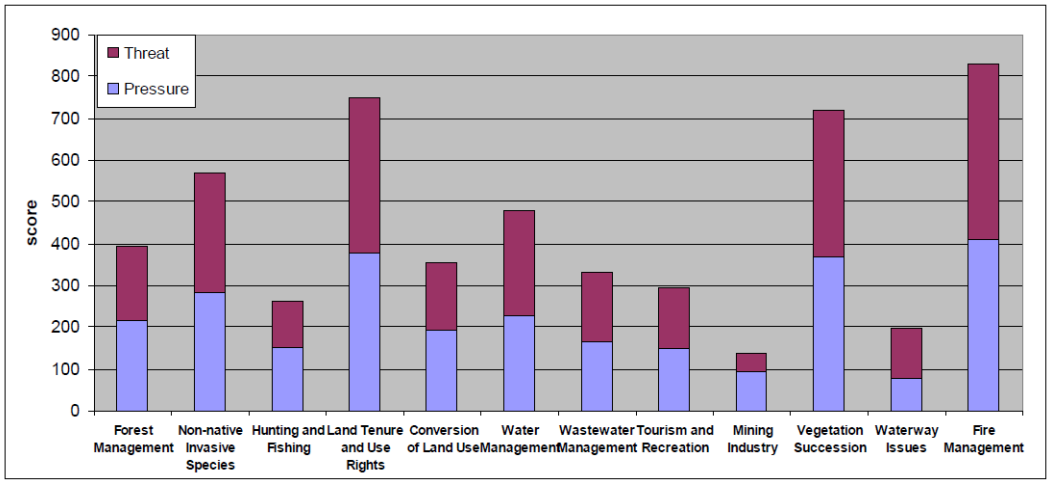
The assessment was carried out in collaboration among the Ministry of Culture's Nature Protection Directorate, the State Institute for Nature Protection, and WWF's Mediterranean Office. It involved all nine National Parks and 10 Nature Parks including. The analysis concluded that PAs in Croatia are impacted by a range of threats and pressures, as shown in Graphic 1.

[19] Nature Park Velebit official web pages

[20] Porej, D. & Rajković, Ž., 2009, Effectiveness of Protected Area Management in Croatia: Results of the First Evaluation of Protected Area Management in Croatia Using the RAPPAM Methodology, Ministry of Culture of the Republic of Croatia.

21 Extent: Throughout = 4, Widespread = 3, Scattered = 2, Localized =1; Impact: Severe = 4, High = 3, Moderate = 2, Mild = 1; and Permanence: Permanent = 4, Long term = 3, Medium term = 2, and Short term =1. The degree of each threat and pressure is the factor of all three elements. For example, a pressure that is widespread (3), has a moderate impact (2), and has a short-term recovery period (1), would have a degree of 6 (3 x 2 x 1). Each threat and pressure will have a degree of between 1 and 64. Source: Porej, D. & Rajković, Ž., 2009, Effectiveness of Protected Area Management in Croatia: Results of the First Evaluation of Protected Area Management in Croatia Using the RAPPAM Methodology, Ministry of Culture of the Republic of Croatia.

Graphic 1. Threats and pressures to PAs in Croatia (RAPPAM, 2009)



Source: RAPAM, 2009.

Both Sjverni-Velebit National Park and Velebit Nature Park are terrestrial PAs; and both face major threats. According to the above-cited RAPPAM, these threats include, in order of importance:

- Unplanned tourism
- Unsettled disputes regarding land tenure and use rights
- Conversion of land use
- Vegetation succession
- Fires, forestry, and inadequate forest management
- Inadequate water management planning
- Inadequate waste management planning
- Hunting and fishing
- Mining

Furthermore, despite the growing area under protection, the current PA network is believed to be insufficient to curb biodiversity loss and ecosystems degradation in Croatia. This situation is aggravated by the existing gaps in representation (critical areas for biodiversity that are not protected), as well as these factors: unprotected ecosystems in ecological corridors that support productivity, poor management capacity, lack of appropriate legal and regulatory frameworks, limited understanding of the economic costs of loss of ES, and the historical lack of funding, which results in under-staffed and poorly-equipped PA units.

Further, the majority of PAs in Croatia lack operational management plans and financial management tools. Further, when available, management plans are often outdated and they are not supported by system-level financial plans (and site-level business plans). The financial situation of PAs is discussed next.

Financial challenges

The Directorate for Nature Protection is the competent authority that directly manages and controls the Public Institutions (PI) established to run all national and nature parks. The Counties have the same authority and responsibilities with respect to the County Public Institutions

established to manage all "other protected areas." Twenty Counties have so far established protected area Public Institutions (out of twenty one Counties). In addition, the State Institute for Nature Protection (SINP) is another public institution, established in 2002 and subordinated to the Ministry of Culture (MoC), which undertakes the scientific activities related to nature protection, providing expert advice and input to all PAs.

A recent World Bank supported study[22] reviewed the financial sustainability of Croatia's PAs. According to the study, national and nature parks are funded by a mix of national Government budgets, their own self-generated income, and various international sources. Self-generated income is predominantly derived from visitor fees, as well as concessions for recreational activities, and at some sites from hotels, restaurants, and camping areas owned by the park's Public Institutions. 100% of entrance fees for all national and nature parks are retained by the parks. However, the majority of national parks and all nature parks in Croatia require financial assistance from the MoC to be able to operate. Central funding from the MoC supports the "Annual program for protection, maintenance, conservation, promotion and use of protected areas," which covers the material costs; a separate process is used to determine salaries and other associated costs.

Box 1. The Financial Sustainability Scorecard for National PA Systems was developed by UNDP in 2007 to assist governments, donors and NGOs to assess significant aspects of a PA financing system – its accounts and its underlying structure – to show both its current status and to indicate if the system is moving towards an improved financial situation. The scorecard could also be used by sub-national units or networks. It has three parts:
Part I – Overall financial status of the PA system, including basic PA data and a financial analysis of the national PA system.
Part II – Assessing the finance system.
Part III – Scoring.

According to the cited study, a total of HRK 94,845,678 (12.3 million Euros or USD 19 million) was allocated for nature protection activity in the State Budget for 2008 (Ministry of Culture, 2008). Of this, 44 million was used for the administration and management of national parks, nature parks and SINP; 17 million was used for construction, maintenance, and equipment relating to visitor infrastructure; 13 million to assist the establishment of the "Natura 2000" network (EU Phare Project); 10 million for nature protection (e.g. scientific research and inventory listing to ensure good quality data for drafting management plans); 2 million for compensation caused by protected animals; and 1 million for fire protection. Nevertheless, PAs face serious financial shortfalls in Croatia. For example, in 2009, of the 22.7 million Kn requested by PI, 46% was approved; similarly, in 2008, of the 33.7 million Kn requested in 2008, only 41% was approved.

The UNDP Financial Sustainability Scorecard for National Systems of Protected Areas[23] (Box 1) was applied in 2009 in NVNP, to assess the financial needs and gaps of the park. According to the Scorecard, NVNP has the funding required for basic conservation; however, the park faces a significant gap for the optimal conservation level, estimated at USD 1.3 million (or 978,465.42 Euros)[24]. This illustrates the financial situation of PAs in Croatia. NVNP's estimated financial needs and gaps are shown in Table 6.

[22] Sustainable Financing Review for Croatia's Protected Areas, Spurgen et al. EMR Ltd. (March, 2010)
[23] UNDP's Sustainable Finance Scorecard for National Protected Area System, 2009 results (WWF, 2009)
[24] The basic conservation scenario describes the minimum level of funding and management capacity required to operate key conservation programs that will sustain essential ecosystem functions in the PA (PINR). The optimal scenario corresponds to the level of funding and capacity needed to achieve fully satisfactory operation and coverage of all PA programs optimally, to reach and sustain optimal functioning of the ecosystems and their services. It describes an ideal state of the programs if all needed funding, personnel, equipment, and other resources were available to attain the short-,

Table 6. NVNP's estimated financial needs and gaps (2009)

NVNP: Estimated income , needs and gaps (in USD), 2009				
Total income (State plus own income:	Needs for basic level	Needs Optimal Level	Gap for basic level	Gap for optimal level
582,357	603,873	1,903,792	**21,516**	**1,321,435**

According to Croatian Law, the Northern Velebit National Park (NVNP) is a public institution, and funding comes mostly from the MoC. The MoC contribution is the largest and most secure source of funding for all PAs institutions and this is not different for Northern Velebit National Park. The funding from The MoC requires three annual funding agreements: i) Agreement on use of MoC financial resources for regular activities (salaries, material expenses, and financial expenses. This agreement does not cover all salaries since it cannot cover temporary or part-time employment which is then covered from the Public Institution's own revenues; ii) Agreement on funding nature protection programmes; the amount is based on the Annual Programme of Protection of the Northern Velebit National Park drafted by Public Institution Northern Velebit National Park (yearly work plan); and, iii) Agreement on funding investment programmes; the amount is based on the Annual Programme of Protection, Maintenance, Conservation, Promotion, and Use of the Northern Velebit National Park These funds are used only for new investments and no repairs nor improvements.

There are 18 people employed, on a permanent basis, in the Public Institution Northern Velebit National Park. Thirteen employees are employed in the Conservation Service Unit and five in the Ranger Service Unit. Their salaries are covered by the Agreement on Use of Ministry of Culture Financial Resources for Regular Activities (Contract No. 1) based on the national civil servants collective agreement. Since the collective agreement does not recognise part-time employment, the Public Institution finances the cleaning service, and a part-time technical service as well as seasonal assistance from its own funds. This has resulted in staff shortfalls. For instance, until 2009 the park had a summer information office in Senj (which is a Ličko-senjska County centre), however it was closed in 2010 due to lack of funding; the current income is insufficient to provide adequate protection from the above discussed threats (Section 1.5). Most of the PAs in Croatia face a similar financial situation.

2. The value of the contribution of ecosystems to growth

2.1 Tourism and nature–based tourism

Tourism is, globally, one of the fastest growing industries with 3.7% growth in 2007 with some countries, such as China, exceeding 15% of growth (World Travel and Tourism Council). In Croatia tourism represents very important economic sector that contributes to the economy with 15.7%

medium-, and long-term goals for the PAs, in accordance with the highest environmental, social and economic standards (Flores et al., 2008).

BDP-a (2009)[25] and directly employs 5.8% (including only hotels and restaurants) of total work force. In addition, tourism covers as much as 76.4% of national trade deficit (2009)[26].

Tourism in Licko-senjska County is a very important economic branch; in the year 2009 Licko-senjska county was visited by 387.000 tourists, which represented an increase for 5.7% in comparison to 2008. The number of overnights in 2009 was 1.5 million with an increase of 7% in comparison to the previous year. In addition, many of tourists pass through the County on their way to other tourism destinations, and visit the national parks. This adds value to tourists coming to the region. As noted in Section 1.4, there are three national Parks in Licko-senjska County: Plitvicka jezera, Sjeverni Velebit (UNESCO World Biosphere Reserve), and Paklenica. Together, these PAs are visited by almost a million visitors every year. However, 96% of the visitors come to Plitvicka jezera[27] (Unesco World Heritage Site). About 37% of the County is protected within Nature Park Velebit, including Sjeverni Velebit and Paklenica.

It is estimated that tourism and related services employ 7% of the employed population in the County (e.g. tour operators, hotels, and restaurants)[28]. In addition, there are approximately 11,000 privately-owned accommodation units (excluding Pag Island), thus the percentage of people employed in tourism is much higher. In total, in 2006, the County's income from tourism was estimated at 119.5 million Euros[29]. Most of the tourism infrastructure is available in Pag Island, Novalja Municipality, and Plitvicka jezera Municipality, following the coastal areas of Karlobag and Senj Town.

Tourism in Licko-senjska County can be divided to maritime tourism, mountain tourism, winter tourism, and other sectors (including fishing and hunting); however, all sectors represent nature-based tourism (NBT). For instance, the results of the Tomas Summer's tourism research (2004) in Licko-senjska county note the following trends:

- 53% are newcomers to Licko-senjska County
- 52% are searching for active holidays (only 23% of Croatian tourists)
- Relatively high ratios of those surveyed are involved in cycling, fishing, horse riding, free climbing, alpinism, etc.
- Visitors, generally, expressed a very low satisfaction with the offer of tourist activities and quality, while the value for money related to accommodation is rated as average
- Domestic visitors in 2006 presented only 11% of all overnights[30]
- 60% finished secondary school and more, and 28% hold university degrees
- Tourists come to their destinations by car (81%), therefore, are very mobile; the number of activities tourists participate in is also increasing.

According to the above-indicated study, the average stay of tourists in Licko-senjska County is 3.8 days, shorter than the average stay in Croatian (5.3 days), which confirms that there is a lack of tourist products and infrastructure that could extend tourist stays and spending in Licko-senjska County[31].

[25] Ministry of Tourism of the Republic of Croatia, 2010. *Tourism in Numbers – 2009 Overview*
[26] Croatian Chamber of Commerce, 2010. *Croatian Economy in 2009*
[27] Ibid 1
[28] Licko-senjska County Economic Overview in 2003. Licko-senjska County official web pages
[29] AED s.a. 2007.*Tourism Master Plan for Karlovac County and Licko-senjska County, Croatia*
[30] Ibid, 2007
[31] Licko-senjska County Economic Overview in 2003. Licko-senjska County official web pages.

To date, tourism development in Croatia, as well as Licko-senjska County, has been built on the 3S model (sun, sea, and sand); most of Croatian tourism activity takes place at the coast (94% of tourist arrivals) and is dependent on natural resources and these ES – clean seawater, clean freshwater, exotic sea food, favourable climate, and beautiful landscapes. Nevertheless, tourism entrepreneurs lack awareness in sustainable ecosystems management and sustainable tourism development. There is an increasing number of nature-degrading incidents such as illegal building in and around PAs, absence of adequate visitation facilities in PAs, and lack of waste water treatment facilities. Further, PA's tourism management programs are poorly developed and implemented due to insufficient funding. Consequently, the current tourism management approach is considered BAU. It is estimated that 92% of tourism in Licko-senjska County is concentrated on approximately 18%[32] of the County's territory; therefore, the pressure on area is high.

PAs are instrumental to enable NBT, and NBT has a significant role in expanding the economic and social footprint of tourism. According to UNDP (2010)[33], NBT, also known as ecotourism, offers experiences directly related to natural attractions. NBT is often combined with other categories of tourism.[34]

The above-indicated UNDP report notes that without the natural attractions provided by PAs, around which NBT is organized, PA-based NBT will not be possible. PAs provide continuous habitats with wild plants and animals, exotic foods, fresh water and air, landscapes, and cultural services essential to NBT. Tourists find NBT experiences – trekking, wild life viewing (including bird-watching and whale watching), scuba diving, sport fishing, hunting, whitewater rafting, sea-kayaking, and canoeing – more valuable when they take place in healthy ecosystems, such as those found in PAs. A recent study of 138 Caribbean destinations found that the establishment of marine PAs (MPA) significantly increased scuba-diving tourism.[35]

Nature-based tourism is one of the fastest growing segments of the tourism industry with an annual growth rate of 10%-30%; currently, over 40% of all international tourists are nature tourists[36]. For example, the majority of responses in surveys of tourists in the UK and Germany indicate that:

- tourists prefer peaceful destinations with beautiful scenery, fresh air, and exotic foods
- tourists want to experience nature first-hand
- environmental conditions are important when selecting a destination
- tourists would like more environmental information about their destination before departure
- holidays should not damage the environment and tourists are prepared to contribute to local conservation projects near their destinations

There is a range of ES that support such tourism in the Velebit region, even under the BAU scenario. See examples in Box 2.

[32] County Development Strategy, 2010
[33] Flores, M. in Bovarnick, A., F. Alpizar, C. Schnell, Editors. The Importance of Biodiversity and Ecosystems in Economic Growth
and Equity in Latin America and the Caribbean: An economic valuation of ecosystem, United Nations Development Programme, 2010. Chapter 10.
[34] Inclusive tourism categories according to GNABTA: ethnic, cultural, historical, environmental, recreational & business.
[35] Worm et al. (2006).
[36] WTO.

Box 2. Other ecosystems services provided protected areas in Velebit

Fresh water. Coastal tourism in Velebit Channel is using the clean water that comes from Velebit water system. There are many freshwater springs along the Channel[37] and although its influence has not been determined, it can be illustrated by that the channel water's is so brackish (fresh) that it is possible to grow trout in the sea.

Unique **Krastic beaches.** The coast is 65.5 km long, mostly stone (karstic), and there are also many bays with natural pebble beach.

Clean sea water of Velebit Channel is very clean; according to the results of the 2010 Sea Water Quality Testing at Beaches of Croatian Adriatic Coast, water in the Channel has excellent water quality, both in accordance with national as well as EU Directives' criteria in 26 coastal locations[38]. In 2008 all samples taken at Licko-senjska County, unlike at other Counties, were within limits of Regulation on Sea Water Quality at Beaches. However, none of the beaches at the Velebit Channel has been awarded with the eco-label "Blue Flag"[39, 40]. Further, Licko-senjska county coastal areas have, by far, the lowest number of visitors and overnights than other coastal Counties.

Drinkable water catchment provides fresh water for the local population, but also tourists. Steady drinkable water supply is vital to development of recreational tourism keeping in mind tourists spend 3-5 times more water than locals this service is indispensible. Alternatives such as piping the water from other areas present enormous expense.

Energy is also a service that is indispensible for tourism. Energy is needed for air-condition, cooking, cooling and storing food, heating in the winter. It is know that an average tourist spends more energy than locals. Velebit area provides energy – electricity from the hydropower stations Senj and Sklope, as well as plenty heating energy from woods used in inland and winter tourism for need as well as for atmosphere. The vicinity of the source makes the energy sources also easy to access.

Local exotic foods. Licko-senjska county is famous for the dairy products, lamb, fish and shrimps. There are many restaurants that offer local food. Fish from Velebit Channel supplies the rest of the Licko-senjska County, e.g. Novalja (Island of Pag) as well as the other places at the Croatian coast. Lamb and dairy products of the area are famous and there are many restaurants offering this food for boarding, but also transit tourists. Croatian Ministry of Tourism developed a label to brand Croatian islands' products. The similar label for restaurants serving home-grown and homemade food is being prepared. In general, local food products of Croatia lack eco-labelled and proper marketing, and Licko Senjska County is no exception.

[37] Andrej Stroj. 2010. Underground Streams of Karst Hinterland Springs in the Area of Velebit Channel, Doctoral Dissertation

[38] Ministry of Environmental Protection, Physical Planning and Construction. Results of Sea Water Quality Testing at Beaches of Croatian Adriatic Coast in 2010.

[39] The Blue Flag is a voluntary eco-label awarded to over 3650 beaches and marinas in 44 countries across Europe, South Africa, Morocco, Tunisia, New Zealand, Brazil, Canada and the Caribbean. The Blue Flag Programme is owned and run by the non-government, non-profit organisation the Foundation for Environmental Education (FEE). The Blue Flag works towards sustainable development of beaches and marinas through strict criteria dealing with Water Quality, Environmental Education and Information, Environmental Management, and Safety and Other Services. http://www.blueflag.org/.

[40] http://www.mzopu.hr/doc/publikacije/Brosura_HR_2008.pdf

NBT-related activities in PAs have an economic value derived from direct use of or interaction with the ES of the PA. Such value can be measured using different indicators such as spending, employment, tax revenues, and foreign exchange earnings.

For purposes of this report, it is also assumed that NBT in the Velebit Region is undermined by insufficient investment within and around PAs (BAU scenario, characterized by significant negative externalities).

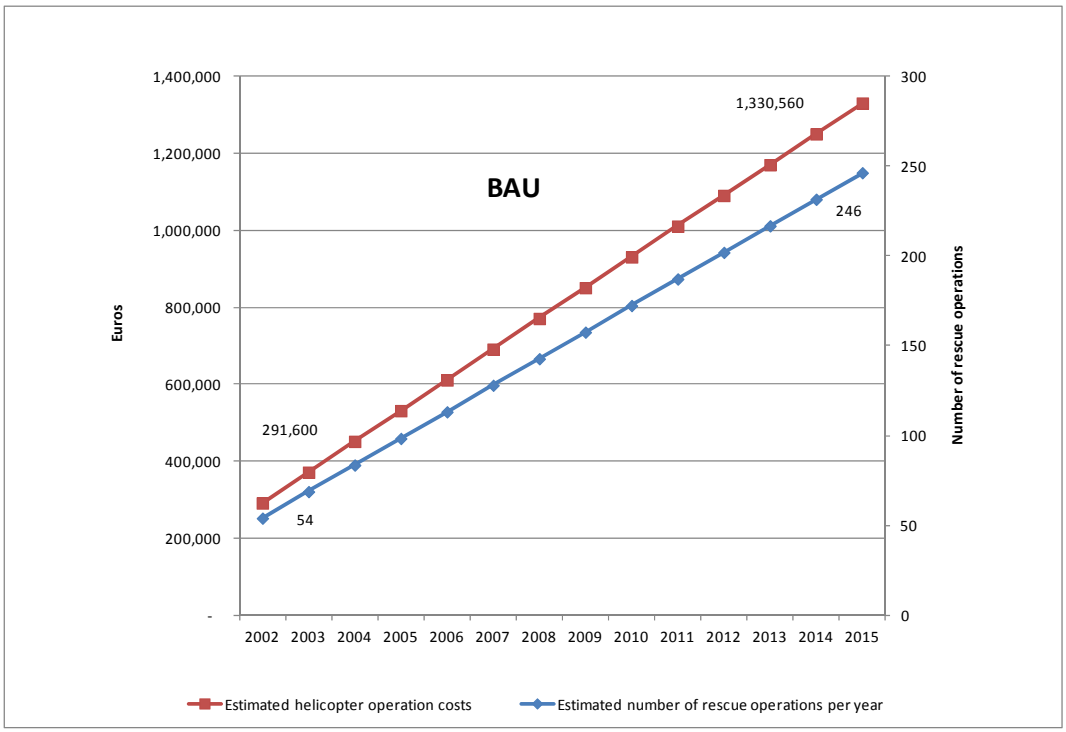
A typical example of BAU in NBT is visitation safety. Safety is still an issue in VNP, and it is the result of poor visitation planning (including assessment of safety needs) and limited investment. Thus, for the purpose of this study, the visitation safety is considered under the BAU approach.

In the period between 2006 and 2010 there were, altogether, 50 rescue operation in the Velebit parks. Some operations took place wholly within the borders of Velebit Nature Park and some only partially within borders. The average annual number of rescue actions was 10. All rescue operations are conducted by the Croatian Mountain Rescue Service (CMRS) at no charge to the park. Most CMRS members are volunteers. The Nature Park does not have information what are the real costs of rescue operations, which are paid by the State[41]. In 2002 and 2003 there were nine operations involving a nine-day helicopter support (three hours per day); six within VNP[42]. Considering an average helicopter cost/hour at 4,000 Euros[43], the cost of the above-noted rescue operation was approximately 108,000 Euros. Rescue operations are critical to prevent fatalities. However, under BAU, the number of fatalities increased from 1 in 2003 to 3 in 2006[44].

At nationallevel, the number of rescue operations is steadily increasing from 54 in 2002 to 128 in 2007[45]. Thus, it is estimated that if that trend continues, the number of rescue operations could be over 187 by the end of 2011, and 246 by 2015. In the BAU scenario, using the above indicated estimated cost of a helicpter rescue operation, by 2015, the annual cost of rescue operations could increase to approximately 1.3 million Euros. Improving visitation safety (SEM) could dramatically decrease this potential cost. Graphic 2 below represents this potential trend.

[41] Information received from Velebit Nature Park Administration.
[42] Registration of Rescue Actions and Acton Analysis of Croatian Mountain Rescue Service actions in 2002 and 2003. Official Croatian Mountain Rescue Service web pages
[43] Didic, M. , Markovic, I., 2011. Drunken alert that cost 44.500 kunas. Slobodna Dalmacija. 12 May 2011
[44] "Croatian Mountain Rescue Service Report 2002/2003"
[45] Ibid 2

Graphic 2. Estimated national trends in rescue operations and cost of helicopter rescue operations in the SEM scenario.



Source: Authors (based on variours sources ands using own estimates)

Current expenditure on visitation safety in Velebit is minimal, although there is no information on actual needs. The study team visited NVNP and observed that the park needs to improve investment in basic infrastructure such as information signs, alert signs, bridges, fences, save trails, refugees, guided tours, communications, patrolling, and expanded insurance coverage, etc). For example, currently, visitors pay 1 kuna (1 Euro=7.3 kunas) to cover insurance when visiting the Cerovacke Caves, with other areas of the park not covered. In average, in the past five-year period NVNP paid 7,000.00 kunas yearly (approx. 1,000 Euros a year). In the period from 2006–2010 the amount of money invested in insurance was 35,000 or approx. 5,000.00 Euros. In the same period, NVNP's investment in safety was 222,000 kunas (30,411 Euros). It included various small safety investments:

- small bridge on river Zrmanja's 5th waterfall, 5,000 kunas (685 Euros)
- safety wall in Zavratnica bay, 2,000 kunas (274 Euros)
- safety fence at Zavratnica bay, 3,000 kn (411 Euros)
- safety fence at Krnjeza river, 2,500 kn (343 Euros)
- reconstruction of bridges and paths at Lower Cerovac Cave 57,500.00 kn (7,787 Euros)
- path between Lower and Upper Cerovac Cave 152,000.00 kn (20,823 Euros)

To further illustrate the differences in value under the BAU and SEM scenarios, three major tourism types are considered below: a) coastal tourism in the Velebit Channel, b) inland tourism (currently being religious and hiking tourism), and c) winter tourism in Krasno and Baske Ostarije (existing

ski slopes). All three types are linked to natural resources in and around PAs. Additionally, this report briefly analyses the potential of golf tourism.

Coastal tourism in the Velebit Channel has increased 5.3% between 2008 and 2009. During the very short tourism season (approximately three months), the coast of the Velebit Channel area with a population of 9,151 inhabitants (Census 2001)[46] is visited by 84,229 tourists; this means that, on average, the population during that three months increases from 33% to 90%[47]. In the BAU scenario such population causes environmental stresses such as:

- Higher CO_2 emissions due to road and air traffic (over 90% of visitors come to coastal destinations by car). Two major southern roads pass the County – Zagreb – Dubrovnik motorway and regional coastal road.
- People place pressure on fresh water resources (drinkable water). As a comparison, in Spain, the average citizen spends 96.6 litres of water daily (EU 150); a tourist spends 300 – 500 litres[48].
- Tourism infrastructure's places pressure on water resources (for irrigation). Each of the existing and planned golf courses in the coastal, Mediterranean region, use daily as much water as a typical European town of 11,400[49] inhabitants yearly.
- Noise – from traffic and seasonal population increase
- Increased solid and liquid waste. Although, there is no accurate data, the situation in Velebit channel could be compared with similar areas. Tourists generate twice as much solid and liquid waste than locals. In some cases, such as Croatia, waste water may go untreated to the sea. For instance, marine littering in Catries Port, St Lucia in the Caribbean results in annual losses of USD 333,000 for the fisheries, ports, and tourism sector[50]. The research conducted by Starigrad Municipality, Zadar County in 1991 indicated the pollution of the northern part of the Velebit Channel with non-degradable waste is also considerable; as much as 1.7 tonnes of waste was found by trawling per ton of fish catch[51]. Further, the indicated research found that in 2008, 1,925 local inhabitants in 665 accommodation units produced 563 tons of municipal waste while 1,396 of tourists produced 1,187 tons during the three-month season[52]; this is twice the waste that locals produce in one year, in a three-month period. These environmental externalities are not included in the assessment of tourism costs and revenues due to lack of empirical data.
- Life quality – shift from traditional ways of living to economic monoculture (increasing economic vulnerability).

Coastal tourism

In the BAU scenario, **Costal tourism's revenue loss** is estimated at 13.7 million Euros. As indicated before, the average tourist in Croatia spends 55 Euros a day in total, which includes 2.97 Euros for a

[46] Croatian Bureau of Statistics, Statistival Yearbook 2008
[47] AED s.a. 2007.Tourism Master Plan for Karlovac County and Licko-senjska County, Croatia
[48] WWF, 2004. Freshwater and tourism in the Mediterranean
http://assets.panda.org/downloads/medpotourismreportfinal_ofnc.pdf
[49] Za igralište od 50 hektara (prosijek) i potrošnu 12,500m^3
[50] Binger, A. 2011. Economic Opportunities in Waste Management in Small Island Developing States. Csd intersessional conference on building Partnerships For moving towards zero waste
[51] Morsko ribarstvo; časopis za pitanja ribarske privrede na moru, 1991, broj 4, „Ribolovni bonitet resursa Velebitskog kanala" (Marine Fisheries; Magazine for fishery and marine fishing industry, 1991, No. 4 „State of fish-stock in Velebit Channel")
[52] Waste Management Plan, Starigrad Municipality, Zadar County.

day trip, 6.97 food outside the boarding and total of 27.81 for non-boarding costs[53]. According to 2006 data, it is estimated that in the Velebit Channel area, tourist spend a daily average of 21 Euros, with tourists in the Velebit Channel coast staying 3.3 days on average[54]. In 2006, there were approximately 57,526 arrivals in the Velebit Channel area generating 275.051 overnights (Karlobag and Senj results excluding hostels, company resorts, and mountain lodges)[55]. Consequently, hotels and restaurants earned 3,492,047 Euros[56]. If the share of overnights and daily expenditure increase to the same level of the rest of Croatia (55 Euros), coastal tourism in the region could have earned approximately 17,217,714 Euros including 4,555,749 Euros in accommodation and restaurants. Today, in the BAU scenario, with inadequate marketing and infrastructure, it is unlikely that tourists will stay more than 3.3 days in average, and the level of spending will remain similar due to the lack of more diversified tourist products and relatively low growth in the number of tourists visiting the region.

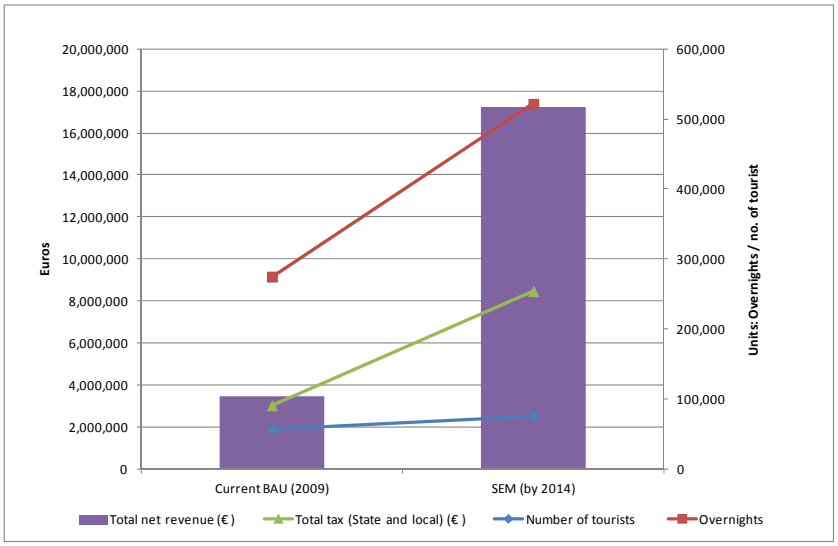
In the SEM scenario, it is assumed that, in costal tourism, in a period of 5-10 years, externalities are reduced or eliminated, more tourist products are incorporated – including products linked to historical sites and PAs (Velebit Nature Park and Northern Velebit National Park, Bear Refuge in Kutarevo), eco-gastronomic products are improved, and both adequate marketing and communications are in place. As a result of such changes (shift from BAU to SEM) there will be improvements in the following indicators:

a) Length of tourists stays: from 3.3 days to 4.3 days per a visitor
b) Average tourist spending per a day increases from 21.16 Euros to 55 Euros
c) Annual arrivals and overnights increases by 8%[57].

Based on the above SEM trends, without expanding the existing infrastructure, coastal tourism's annual net revenue could increase from 3,492,047 Euros to 17,217,714 Euros or five times in the indicated period of 5-10 years. The total number of employed people (direct and indirect) would also increase from 440 to 1,717, and state tax could increase from about 2.7 to over 8 million Euros. The potential losses and gains from the BAU and SEM scenarios in coastal tourism are presented in Graphic 3 and shown in Table 7.

[53] Tomas istraživanje
[54] Tomljenovic, R., Kust, I. 2008. *Masterplan for Development of Tourism in Karlovacka and Licko-senjska County, ADE, Grontmij/CarlBro*
[55] Ibid, 2008
[56] County Development Strategy 2011-2013
[57] Ministry of Tourism of the Republic of Croatia, 2010. *Tourism in Numbers – 2009 Overview*

Graphic 3. Trends of losses and gains from the BAU and SEM scenarios in coastal tourism



Source: Authors (based on various sources and using own estimates)

Table 7. Potential losses and gains from the BAU and SEM scenarios in coastal tourism

Estimated annual benefits form costal tourism in VNP's surrounding areas (in Euros)	Current BAU	SEM
Coastal	**2009**	**By 2014**
Total No. tourists	57,526	75,900
Total No. of overnights	275,051	521,749
Gross revenue	5,820,079	28,696,190
VAT	1,338,618	6,600,124
No. of employed	130	190
Employees gross income	1,195,236	1,739,993
Net income	849,946	1,237,328
Income tax	345,290	502,665
Local tourist tax	247,546	469,574
Total state tax	1,683,909	2,557,181
Total net revenue	3,492,047	17,217,714
Coastal tourism multiplier effect		
Employment additional	308	1,521
Net income	2,443,036	12,045,513
Tax on salaries @30%	1,103,068	5,438,731
Coastal total benefits		
Total local tax	**247,546**	**469,574**
Total state tax	**2,786,977**	**7,995,912**
Total net revenue	**3,492,047**	**17,217,714**

Source: Various sources[58]

Inland tourism

Basic empirical data on **inland tourism** is extremely scarce, e.g. arrivals and overnights. However, based on basic information provided by staff from Velebit Nature Park (Table 8), it is estimated that between 2007 and 2009, an average of 28,306 tourists that visit VNP, and generate about 21,700 overnights annually. Mostly during the peak summer season (30 days in July-August); the rest of the year visitation is reduced by at least 50%. It is estimated that VNP uses its full capacity for only 60 days per year. Similarly, in the same period, an annual average of 13,587 visitors came to in the Northern Velebit National Park. These visitors rarely stayed for longer than a day[59]. For both parks, it is a typical BAU scenario.

[58] Masterplan for Tourism Development in Karlovacka and Licko-senjska county, AED, 2007; Farr, H., et al., 2000. The Economic Impacts of Different Types of Tourism In Upland and Mountain Areas in Europe, Tourism Development in Mountain Regions; Croatian Bureau of Statistics, Statistical Yearbook 2008; Tomas; Corak, S., et al., 2007. Tomas-Summer 2007 Research on Tourists' Opinion and Spending habits in Croatia; Tomas Summer research 2004.
[59] http://www.mint.hr/UserDocsImages/090922-T-brojke08-w.pdf

Table 8. Visits to Velebit Nature Park (VNP)

Year	No. of tickets sold	No. of visitors
2007	19,828	26,636
2008	19,683	30,831
2009	12,400	27,451

Source: VNP Annual Programme of Protection, Maintenance, promotion and Use of Nature Park Velebit in 2010

Nevertheless, there is a steady increasing trend in number of visitors to national parks of Ličko-senjska County. For example NVNP visitation is increasing at an average rate of 12.7%, which is the highest growth rate between 2007 and 2009 (See Table 9). The most visited park is the Plitvice Lakes, which is UNESCO protected site, and lies on the regional road to the North and Central Dalmatia and very near the motorway. Dalmatia is the most developed tourist region in Croatia. Paklenica National Park is located at the coast so this explains the larger proportion of foreign visitors. Although none of these parks' carrying capacity has been determined, expert opinion is that National Park Plitvicka jezera has reached or passed its carrying capacity[60]. Therefore, it is critical that other parks develop the adequate infrastructure to be able to absorb a larger share of visitation. Efforts to direct tourists from oversaturated areas to those with low visitation are neglected and state tourism strategies lack in-depth nature-based tourism analysis. This is a typical characteristic of the BAU scenario.

In other areas, such as Krasno, a small village with the VNP, annual overnights are estimated at 23.796. However, this visitation is not necessarily related to tourism in the NVNP.

Table 9. Visitation to national parks, including NVNP 2007-2009

National Park	2007			2008			2009			2007-2009 trend %
	National	Foreign	Total	National	Foreign	Total	National	Foreign	Total	
Northern Velebit	6,786	5,163	11,949	9,824	3.820	13,644	10,147	5,021	15,168	12.7%
Paklenica	15,550	94,778	110,338	17,702	98,241	115,943	15,037	97,861	112,898	1.2%
Plitvice Lakes	86,795	840,866	927,661	81,199	867,692	948.891	78,910	883,412	962,322	1.9%

In the inland tourism SEM scenario, it is assumed that there is an increase in visitation to Krasno, to the average level of Croatia (42% filled accommodation capacity), which produces an increase in revenue by 9%. Such an increase will have limited environmental impact. For instance, water consumption would increase only 3%. According to several tourism stakeholders interviewed during the study, a higher increase may be possible if there is additional investment in developing and marketing new tourist products. This is also corroborated by the Tourism Master Plan for Karlovac and Licko-senjska Counties (ADE, Grontmij, and Carl Bro, 2008), which recognises a range of opportunities and threats in tourism development. See Box 3.

[60] Author intervew with Ministry of Culture, Department for Nature Protection, 1 April 2011.

In addition, in the SEM scenario, it is assumed that tourism to the NVNP is packaged together with costal and religious tourism to the Catholic Sanctuary of Krasno (this is further discussed in Section 4). In 2010, 100,000 people visited the Sanctuary located 15 kilometres from the NVNP[61]. Current visitors generate only 5,000 overnights due to the limited capacity of the only hotel in the area, Svetište Majke Božje od Krasna, which is a part of a Sanctuary. The hotel has the capacity of 80 beds, and there are additional 115 beds in other small pensions is Krasno. Currently, the tourist average stay is only 1.6 days. Locals estimated that with the adequate infrastructure development, overnights could increase significantly.

Box 3. Opportunities and threats to tourism development (Tourism Master Plan for Karlovac and Licko-senjska Counties, 2009).

Opportunities

- Rich natural and cultural resources
- National parks
- Landscape diversity
- Rich water resources (rivers, lakes, waterfalls)
- Sea and islands
- Interesting local gastronomy.

Threats

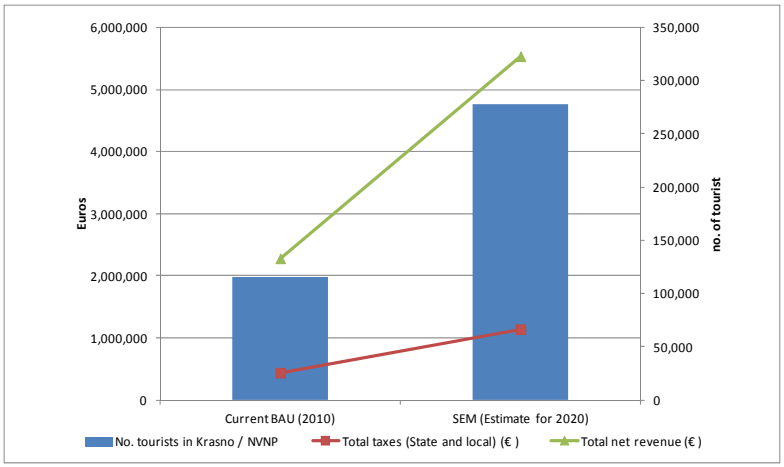
- Progressive degradation of natural resources
- Further degradation of historical sites
- Uncontrolled tourism development
- Insufficient investment of private

Increased benefit under SEM is based on: a) a strategic increase in the number of accommodations available, b) a strengthened connection between the coastal and inland tourism, c) improved offer of local products to increase tourist spending by diversified tourist products, and d) improved local food offer through effective branding and marketing.

In the SEM scenario, it is assumed that in the period 2011-2015, Northern Velebit National Park and the Krasno Sanctuary will reach 25,577 (at 12.7% increase rate) and 250,000 visitors respectively, totalling 277,577 visitors. In this scenario, the number of overnights may reach 243994, calculated at 42% filled accommodation capacity (average level for Croatia). It is also assumed that during the peak season, tourists will seek park accommodation due to the limited accommodation capacity outside the park. In the SEM scenario, as a result of the planned increase of visitation benefits, tourism revenue will increase approximately 60%. For instance, net income from tourism could grow from 2.3 million Euros to 5.5 million Euros in a 10-year period (calculation includes multiplying effect to the national economy). Additional key indicators such as employment and taxes to the government and multiplier effect are provided in Graphic 4 and Table 10, which represents the benefits under BAU and SEM.

[61] Information provided by Rev. Nikola Komušanac, Krasno Sanctuary, in March 2011.

Graphic 4. Trends of benefits under BAU and SEM in inland tourism.



Source: Authors (based on various sources and using own estimates)

Table 10. Estimated annual benefits in BAU and SEM scenarios, inland tourism

Estimated annual benefits form inland tourism in NVNP and surrounding areas (in Euros)	Current BAU (2010)	SEM (Estimate for 2020)
Inland tourism		
Number of tourists in Krasno plus NVNP	115,168	277,577
No. of visitors (not staying overnight)	102,148	243,994
No, of possible overnights (max capacity in the season)	13,020	33,583
Estimated spending for day-visitors	766,110	1,829,956
Estimated spending for those who spend the night	390,600	1,007,488
Estimated spending total	1,156,710	2,837,444
VAT	266,043	652,612
Annual water consumption in litres*	35,852,400	86,631,409
Water cost	50,193	121,284
Number of people employed	12	24
Gross income	110,160	220,320
Net income	78,336	78,336
Income tax	31,824	141,984
Tourist tax (local tax)	12,499	32,240
b) Subtotal (no multiplicator effect)		
Total net earning	684,233	1,660,553
Total state tax	297,867	794,596
Total local tax	12,499	32,240
Total employment	12	24
c) Multiplying effect		
Total earning food and agriculture	456,156	1,107,035
Total earning trade	228,078	553,518
Total earning petroleum and other	570,194	1,383,794
Total earning communication and transport	342,117	830,276
Employment from multiplication	36	88
Tax from employment multiplication	129,681	314,721
d) Total (including multiplicating effect)		
Total people emploted	**48**	**112**
Total local tax	**12,499**	**32,240**
Total state tax	**427,549**	**1,109,317**
Total net revenue	**2,280,778**	**5,535,175**

Various sources[62]

In addition, there is a large number of cave ecosystems which makes another strong feature of Velebit. This has resulted from the influence of water on karst and other rocks. The most famous

[62] Sources: Farr, H., et al., 2000. The Economic Impacts of Different Types of Tourism In Upland and Mountain Areas in Europe, Tourism Development in Mountain Regions; Croatian Institute for Tourism; Radnić, Ante, et al., 2002. Tourism and the Croatian development. Strategy of development. Croatia in 21st century, Institute for tourism, Croatia; Licko-senjska County; Masterplan for Development of Tourism in Karlovacka and Licko-senjska County; Local stakeholders; TOMAS research on tourism spending

are the Ceroavacke Caves, which actually present a system of three karst caves and are a geomorphologic reserve within Nature Park Velebit. Two are opened to visitors. In addition to the Cerovačke Caves, speleologists found over 150 caves in the small area of Crnopac (approximately 35 km^2) – the northern part of Southern Velebit. The estimated touristic value of these natural formations has not been estimated yet and, therefore, further research in needed.

Winter tourism

In addition to coastal and inland tourism, there is great potential in winter sports/skiing tourism. There are two ski lifts in the Velebit Mountains; one near Krasno and the other in Baske Ostarije near Karlobag. According to one former concessioner, the ski lifts in Baske Osatarije were closed due to lack of interest of a new hotel/ski lift owner, and in Krasno due to the lack of snow and lack of support to the local concessioner. In Krasno, ski slopes are located at the latitude that does not guarantee snow; to prolong the season and make it profitable, snow-guns are needed to supply snow. However, the local authorities have not provided the financial support needed. Although the infrastructure is there, it is deteriorating, and replacement and maintenance costs are increasing. These facilities have been out of service since 2008. This is another typical BAU scenario.

In the season 2005-2007 the ski lift in Krasno was operating (providing transport) to the 1.6 kilometres of ski slopes for the visitors[63]. Although it is a small ski lift and slope, it is ideal for small children and families, and beginners and is in nearby the motorway and large towns of Karlovac, Gospic, Otocac and Senj, as well as the City of Zagreb. There are also additional services such as food and beverage catering, and accommodation in nearby towns.

In 2006, the winter was average in the area: 60 days of snow (importantly, during the school break). According to the local tourism association, approximately 500 people visited the ski centre Krasno. Many of the visitors had to come for one day only, due to the limited accommodation facilities[64]. It is estimated that the 60-day winter season in 2006 generated over 600,000 Euros in revenue. Such revenue benefited concessioners, local accommodation owners (including Croatian Forests), restaurant owners, local tradespeople, the electric power company, and Senj town administration[65]. In the current BAU scenario, the annual losses for the local community, due to both ski lifts being out of service, are estimated at 672,000 Euros. In addition, the lost multiplier effect is estimated at 1.2 million Euros.

In the SEM scenario, if existing infrastructure is rehabilitated and further developed (investment in snow guns to supply additional snow and extend ski slopes, accommodation, and the opening of new slopes[66]), revenue may increase significantly with potential positive environmental externalities. For example, there are sites, near Krasno, with potential ski slopes in Velebitska Plješivica, a peak outside the National Park at 1,650 meters height with lasting snow and view to the Adriatic Sea. There are also abandoned army facilities nearby; therefore potential sites and basic infrastructure already exist[67]. Moreover, a revenue-sharing scheme could be introduced to finance ecosystems management, as well as sustainable tourism development.

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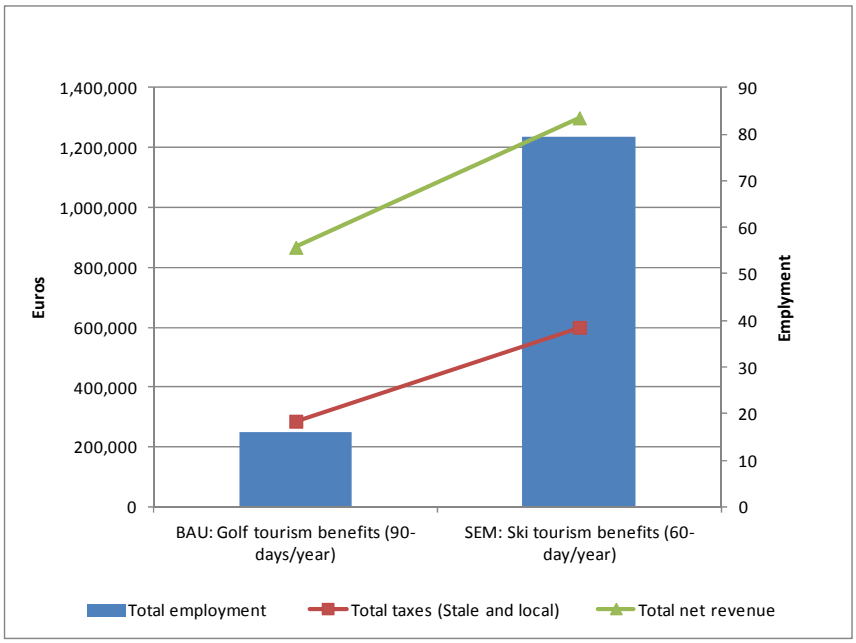
[63] Tourism Association Senj official web pages.
[64] Interview with Mr Vladimir Tomaić, Tomaić Commerce Ltd, Concessioner from 2005 to 2007
[65] Ibid, 2011 (based on 2005-2007 data)
[66] **Snowmaking** is the production of snow by forcing water and pressurized air through a "**snow gun**" or "**snow cannon**", on ski slopes. Snowmaking is mainly used at ski resorts to supplement natural snow. This allows ski resorts to improve the reliability of their snow cover and to extend their ski seasons. http://en.wikipedia.org/wiki/Snowmaking
[67] Ibid 144, 2011

In the SEM scenario, when using the national average daily spending in winter sports (16 Euros) to estimate potential revenue in the region, including spending on fuel, telecommunication, trade and other connected costs, the potential revenue could be estimated at over 2 million Euros of total winter tourism effect in Krasno[68]. Further, in an optimal SEM scenario, winter/mountain tourism can provide even higher revenues than coastal tourism, when opting to further develop ski tourism. According to the results of a recent research study, the average daily spending in 2000 in mountain tourism in Europe was 46.6 Euros (the highest was 89.9 in Portugal)[69]. When comparing these with potential benefits from a golf course, the results indicated that mountain tourism is more beneficial and is a model of SEM. The estimated BAU/SEM trends for a golf course (BAU scenario) vs. winter sport (skiing), in terms of net revenue, employment and taxes, are presented in Graphic 5 and in Tables 11 and 12.

Graphic 5. Estimated BAU and SEM trends of winter sport (skiing)



Source: Authors (based on various sources and using own estimates)

[68] Callculation: data from the last concessioner and assuming full capacity in 60 day season. In addition to almost 700,000 euros to the local economy, the multiplication effect would produce additional 1.2 million Euros on the national level.
[69] Farr, H., et al., 2000. The Economic Impacts of Different Types of Tourism In Upland and Mountain Areas in Europe, Tourism Development in Mountain Regions; =total net earnings/100,000*5.3+No of employed in tourism.

Table 11. Estimated revenue from a golf course

Estimated annual net revenue from a golf course. BAU scanario (in Euros)	
1 golf resort gross revenue	1,200,000.00
VAT	276,000.00
Employment	13.00
salaries gross	117,936.00
water	337,500
fertilisers	9,520
Estimated net value	**459,044**
Estimated multiplier effect of golf course: 1 Golf Course (Euros)	
Multiplied revenue	408,000
Multiplied gross salary	27,448
Multiplied Net salary	19,518
No. of emplyoees	3
Income tax	7,930
Estimated total economic effect of golf course: 1 Golf Course (Euros)	
Total net revenue	**867,044**
Total employment	**16**
Total taxes	**286,803**

Various sources[70]

Table 12. Estimated revenue from winter skiing tourism (SEM)

Estimated annual net revenue from the existing Ski slopes in Baske Ostarije and Krasno - (in Euros) - 60 days snow season such, 2006 data.	
Gross earning outboard	846,600
Gross earning accommodation	414,036
Total gross earning	1,260,636
Net earning	630,318
VAT	289,946
Employees (average)	13
Employee gross income	19,812
Employee net	14,404
Local tourist tax	28,011
Multiplier effect	
Total earning food and agriculture	420,212
Total earning trade	210,106
Total earning communication and transport	315,159
Emplyoment	67
Taxes from employment	59,063
VAT	217,460
Total tax multiplier	276,523
Total net revenue multiplier	668,954
Total ski lifts	
Total local tax	**28,011**
Total state tax	**571,877**
Total net revenue	**1,299,272**

Various sources[71]

[70] Sources?
[71] Sources?

Finally, there is also a great potential in Nordic skiing (cross country) on Velebit, including National Park Northern Velebit, and adventurous skiers can ski along the trails, however, there are no maintained ski paths for more classical cross country skiing (there was in Baske Ostarije). Very successful Croatian cross country skier Jakov Fak (and Olympic medallist) regularly held his trainings in Mrkopalj, in similar conditions to Velebit. In the BAU scenario, cross country skiers on Velebit remains sporadic and rare. Unfortunately, this potential has not been recognised and there is no data on skiers that practice cross-country on Velebit.

Golf tourism

The Spatial Plan of Licko-senjska County[72] includes plans to build a golf course near the town of Otocac (although the national guideline requires that each county includes two golf courses in their development plans). This brief analysis highlights some water usage-related aspects of this potential tourism-related investment, and the potential environmental externalities that may need to be addressed. It is not the purpose of this report to determine the feasibility of the investment in golf courses.

As noted in Melton (2006) [73], about 0.0014 percent of the Earth's land mass is dedicated to golf courses and about 1 percent of the population of the earth plays golf. The influence of golf and golf courses is not only an issue that directly affects a local community but, rather, affects the global community. For the purpose of this report, golf courses are considered under BAU because of several factors:

- Potential high negative externalities and consequently degradation of natural resources, if externalities are not addressed. For example, a golf course requires large quantities of water for irrigation, which may result in pressure on water availability and infrastructure. According to the WWF (2004), an eighteen hole golf course requires a similar daily amount of water than for a town of 11,400 people[74]; Melton (2006) notes that, on average, a golf course uses about 1.2 million liters of water a day, which is about the same amount of water that forty-eight thousand people use in a day. Considering that Otocac has 10,411 inhabitants, the addition of one eighteen hole golf course will require a significant investment in water infrastructure in order to at least double the existing supply of water. For example, according to Croatian Waters (2010)[75] a recently built water-well for Northern Baranja (including two wells and a water tank) cost as much as 5,127,000 Euros.

- High risk of benefit leakages (revenue). In general, golf clubs are exclusive tourism resorts owned by foreign investors. In this case, most revenue (profits) could leak out of the country to foreign owners, in addition to the salaries of foreign experts and professionals, and imported exclusive foods and beverages. Only low-paid service sector salaries may remain in the region.

- Use of pesticides and herbicides present additional threats to water quality of the area as well as causing eutrophication in the sea, which then might endanger tourism in the coastal

[72] Licko-senjska County Spatial Paln, 2002.
[73] Charles Melton, SID# 995678055. The Environmental Effects of Golf Courses (2006).
[74] WWF, 2004. *Freshwater and tourism in the Mediterranean*
[75] Croatian Waters. 2010. Project Internal Waters, Information on Subproject Norther Baranja, Croatian Waters official web pages

area. The minimal amount of fertilizers used is estimated at 280 kg per hectare and use of herbicides and insecticides is also significant[76].

- High water consumption could disrupt fresh water ES with irreversible consequences, e.g. if the water courses to the coast are disturbed, underground aquifers might lose water-body volume, thereby lowering the water level, which might cause the penetration of saline water to aquifers making water springs as well as the surrounding soil around saline.

- Potential escalation in water treatment costs: If water quality is reduced, that means large costs that the society will bear through the emerging need for water treatment where there was not one.

- With the high consumption and usage of water by golf courses, that amount of water is not able to be used by other users. In areas where water is plentiful and easily accessible, the large amount of water consumption by a golf course may not be a threat to the environment. However, in areas where water is scarce or not abundant, environmental damage can occur (Melton, 2006). This may jeopardise tourism and the water supply with organic agriculture and honey production definitely suffering costs and reduced yields; large quantities of pesticides will firstly cause a reduction in bee number because insecticides are not selective, with reduced pollination and subsequently crop production. The bordering arable land will suffer a drop in quality and most probably could not satisfy requirements for organic food production. For instance, in Japan, a regular-sized golf course uses anywhere from three to four tons of germicides, herbicides, and pesticides every year.

- According to Melton (2006), the construction of a golf course also causes equal environmental degradation. For example, in Japan, the majority of golf courses are built in the mountains (to some extent with similarities to Velebit's mountains). During the construction of the golf course, forest is cleared and bulldozers level the hilltops. Consequently, the alteration of the natural barrier that the forests and mountains provide is diminished by the construction of a golf course. Forests provide a natural dam as they are able to store some rainwater in the leaves and soil. In contrast, golf courses only have one fourth the water retention capacity of an equivalent forested area. Because the water is not held back in golf course, as it is in forested areas, water may flow across the fairways and greens of the golf course, and flooding downstream may occur.

Furthermore, the financial efficiency of the planned golf courses will require detailed analysis. For example, the average golf course in the nearby Istria region is expected to host 20.000 rounds per season at 60 Euros per round. The season in Istria is much longer and the weather is much more favourable. Using this reference and excluding the cost of peripheral infrastructure investment because the current regulations on golf courses require the local government to pay for access roads, water piping and sewage systems, and electricity infrastructure. After 2013 (expected completion of the golf course), this golf course can attract about 4,000 visitors per year at best[77], because Velebit has a much shorter season (three months). The total net revenue for this golf resort is estimated at 867,044 Euros annually (per season). Further, golf courses in the Velebit region will face severe competition from places like Istria and nearby Italy.

[76] Sosic, l., et al., 2007. Golf Channel Solutions; Golf and Environment.
[77] Sharman, M., 2011. *A white ball, a 9-iron and Delhi's "tee" tourism.* Hindustan Times

Finally, high-end golf courses are known for hosting golf tournaments and championships. Such events could generate millions in revenue (and foreign exchange gains). However, given the limitation in Velebit, it is assumed that a golf course in the Velebit region may not have any high profile events in the near future. Nevertheless, a golf course opens the possibility of organizing smaller-scale, high-profile charity events with famous golfers (e.g. celebrities). Such events could be used to mobilize funding to support ecosystems management in the Velebit PAs. This opportunity will require in-depth analysis to assess its feasibility. The BAU trend for a golf course is presented above, in Graphic 5 and Table 11.

The multiplier effect of tourism

The multiplier effect in Croatian tourism is very high. It is estimated that for each Euro spent in tourism only 30% is spent directly in tourism, meaning accommodation and restaurants while 10% is spent in trade, 15 in transport and telecommunications, 20% for food and agriculture, 5% for gasoline and 25% benefits other sectors[78]. Also, the number of jobs per 100,000 Euros is 4.2 and 5.3 in the core and extended areas respectively[79].

In 2006, hotels and restaurants contributed to total GDP with 4.2% directly[80]. However, tourism, being a result of various interconnected activities rather than a single economic activity, has a great multiplying effect to other sectors. It is, however, important to emphasise it is estimated that 25% of total tourist revenue pays for imported goods and services[81]. This is a BAU situation.

2.2 Hydropower

Renewable sources of energy represent 40% of the energy produced and used in Croatia. Out of this, hydropower has the largest share (31%). The rest includes wood fuel (8.5%) and geothermal, wind, solar (0.6%). The high share of hydropower has favoured Croatia in the negotiations for EU membership. EU requires up to 20% of total electricity consumed, and Croatia is at the 11% level. Therefore, hydropower is a priority strategy for Croatia[82].

Ecosystems sustain hydropower production in many ways. The presence or absence of certain ecosystems, forest, soils, and rocks especially, will determine water content of an area, catchment capacity and direction of the streams, watershed formation, terrain and the possibility of water accumulation, and many other factors important for electricity production from water.

Forests growing in the PAs indirectly influence water quality, sediment levels as well as water abundance and water courses. Forests keep soils in the place and ensures its functions of filtering and producing clean water. In the same way, forests abate soil erosion and prevent sediments entering ground and surface waters. If sediments are high, hydropower plants have increased costs in at least three ways:

[78] Radnić, Ante, et al., 2002. Tourism and the Croatian Development. Development Strategy. Croatia in 21st Century, Institute for Tourism, Croatia.
[79] Ibid 31.
[80] Croatian Bureau of Statistics, 2006
[81] http://bib.irb.hr/prikazi-rad?&lang=en&rad=122674
[82] Energy in Croatia in 2009, Ministry of Economy, Labour and Entrepreneurship oft he Republic of Croatia, 2010

- Water with high sediment content needs pre-treatment before entering hydropower turbines. Clean water extends the lifespan of hydropower infrastructure (dams)[83].
- Sediments accumulate on lake floors, and gradually decrease a lake's capacity and subsequently, related energy production[84].
- Sediment removal adds high costs to hydropower production.

Sediment in water is the biggest threat globally to hydropower production due to the cost of removal and the reduction of energy production; sediment remediation results in financial loss. Hydropower Plants (HPP) in Latin America and South Asia (India and China) are typical examples of the damaging effect of sediments. Sediment content from erosion, could be as high as 80,000 PPM and on average, it reduces the storage capacity of the accumulation lake by 1% annually[85]; some rivers in China lose 2-3% of capacity[86].

The size of problem can be easily illustrated on the case of Alta Florida HPP in Chile where the hydropower plant after opening, continued to work for only 2,000 hours or 83 days before had to be closed due to silt damage[87]. Table 13 shows the impact of siltation in hydropower productivity in Baira Siul HPP (supplying energy to New Delhi)[88]. These are typical BAU scenarios where power companies invest nothing or too little in watershed management.

Table 13. Impact of siltation in hydropower productivity, Baira Siul HPP, New Delhi

Silt content (PPM)	Operating time (%)	Generation (%)
0-300	68	55
300-1000	25	36
1000-2000	4	4
Above 2000	3	5
	100	100

Source: 2nd International Conference Silting Problems in Hydro Power Plants, Thailand.

Although the soil cover on Velebit is thin and cannot be compared to areas with rich soil content in other regions, sedimentation is a risk and it is minimised by the ES provided by PAs in the region. The team was not able to find empirical data on siltation at the time of this study. Therefore, further research is needed in this area. In Velebit, treetops smooth the rainfall, which then reaches the ground with reduced force, thereby preventing erosion. The forest produces microclimate that is partly responsible for the rainfall[89]. Forest and the forest ground are responsible for existence of the watercourse. For example, after a great forest fire in Romania, and Bosnia and Herzegovina in the 1950s, 55 water springs in the area dried out[90]. The same change would most probably occur with the deforestation.

[83] Naidu, B.S.K., 2002. *Silting Problems in Hydropower Plants*. National Power Training Institute and Central Power Research Institute, India. Proceedings of 2nd International Conference on Silting Problems in Hydropower Plants
[84] Ibid 3
[85] Naidu, B.S.K., 2002. *Silting Problems in Hydropower Plants – A Comprehensive Overview.* Readings of the 2nd International Conference on Silting Problem sin Hydropower Plants
[86] Ibid 7
[87] Naidu, B. S. K., 2001. *Silting Problems in Hydro Power Plants – A comprihensive overview*, Principal Theme Paper, 2nd International Conference Silting Problems in Hydro Power Plants, Thailand
[88] Ibid 14
[89] Croatian Forestry Institute
[90] Centre for Ecology and Energy, Influence of Forest on Water Circulation

Licko-senjska County is one of the most significant energy providers of electric energy in Croatia[91]. There are two large HPPs in the region that depend on water services from PAs in Velebit: Senj HPP and Sklope HPP. Senj is using the water from the Lika and Gacka rivers, which provide water to Gusic Lake where Senj HPP is located; Sklope HPP uses water from the Lika River, which provides water to Krusicko Lake where this HPP is located.

Most electricity production in the Velebit catchment comes from River Lika. Specific details are not yet determined precisely, however, hydro-geologists estimate that about 35% of the River Lika water body comes from Velebit forests[92] River Lika is an extremely clean river[93] due to absence of human activity through the most of its catchment, as well as the specific vegetation cover and stone formation. Senj HPP on the River Gacka also receives water from the Lika (65%)[94]. Therefore, it is estimated that Velebit catchment provides approximately 23% of the water needed at Senj HHP. This service is fundamental to sustain power production of these HPPs. The production for hydropower in Licko-senjska County is shown in Table 14.

Table 14. Production of hydropower in Licko-senjska County (2009)

Hydropower plant	Average production	2009 production
Senj (216 MW installed capacity)	972 GWh	984.4 GWh
Sklope (22.5 MW installed capacity)	85 GWh	88 GWh

Source: Official pages of Hrvatska Elektroprivreda (HEP) – Croatia Electricity Company

In 2008, Croatia produced 12,325, 6 GWh of electricity. Out of this, 43% or 5,300 GWh came from hydropower[95]. Currently, the Senj and Sklope HPPs contribute to the national electricity production with 7.8% and 0.69%, respectively. The total revenue from electricity production on the national level in 2008 was 21 billion Kn (2.8 billion Euros)[96]. This is the gross value of water services in the hydropower sector.

The combined Senj and Sklope HPP contribution is estimated at 24.5 million Euros yearly in the current condition of low silt. An additional 43.5 million Euros is earned in energy distribution. This estimation is based on production cost of small and large hydropower plants at the level of 15 Euros for large and 6.7 Euros for small hydropower plants[97]. Prices to distributors (so-called high voltage buyers) on average in 2009 were 42 Euros per MWh and 96 Euros per MWh for households[98].

The value of water ES to the hydropower sector could also be estimated in terms of avoided coast (or avoided losses). At high siltation levels up to 300 PPM, the efficiency of a HPP would drop to only 55%. For Senj and Sklope HPPs, the accumulative annual loss in production could be 12.3 billion Euros; in addition, consider the over 20 million Euros of loss revenue from distribution. Such losses has been avoided to date, due to clean water from the Velebit catchments. Consequently, for

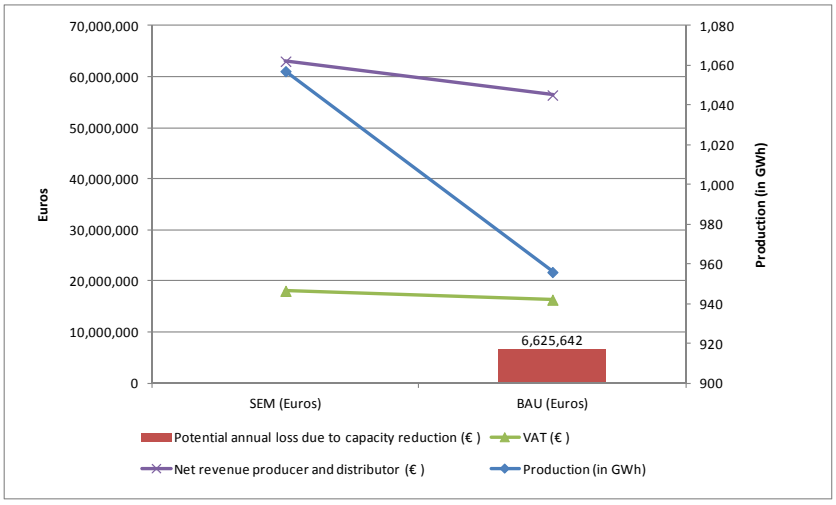
[91] Licko-senjska County Spatial Plan, 2002
[92] Stroj, A., 2010. *Undercurrents in the Hinterland of the Coastal Karst Springs in the Area of Velebit Channel.* Doctoral dissertation. Mining, Geology and Petroleum Engineering Faculty, University of Zagreb, Croatia
[93] Spatial Plan of Licko-senjska County, 2002.
[94] Ibid 7
[95] Ministry of Economy, Labour and Entrepreneurship of the Republic of Croatia, 2009. *Energy in Croatia – Annual Energy Report for 2008*
[96] Croatian National Bank exchange rate list No. 63, Issued 30 March 2011; USD 1=5,244
[97] Alfredo, V., 2009. *Electricity Production Cost Comparison*. Technical University of Rijeka, Croatia
[98] HERA - Croatian Energy Regulatory Agency. Annual Report for 2009

the purpose of this report, water supply in Velebit is considered under the SEM scenario (although accumulation lakes are cleaned periodically). However, the lack of funding to protect forest ecosystems in and around PAs, and the limited or no investment from hydropower companies in watershed management, must be considered BAU.

Senj and Sklope HPPs started operations in 1965 and 1970, respectively[99]. Considering the siltation-related capacity loss at 1% annually, the capacity of these HPPS would be reduced by 45% and 40%, respectively. Also, both HPPs are by now approaching the end of their lifespan (typically 40 to 50 years[100]). However, due to the high quality of the water from Velebit, both HPPS are still operating at above 50% of their capacity, and an extended lifespan is expected. However, this excludes periodical maintenance and parts replacement due to normal wear and tear. Most likely, both HHPs have been amortised and one can comfortably assume there are no related costs.

The study team found no available data to calculate precisely how much siltation removal would cost at the Senj and Sklope HPPs. However, the yearly repair and maintenance (requiring accumulation lake dry-out) is estimated at 659,447 Euros[101]. However, this kind of maintenance is undertaken every 10 years[102]. In addition, due to siltation, the possible loss in revenue (at 1% annual decline rate) would result in a near 6.6 million Euros loss in revenue annually. Under the current SEM scenario, Senj and Sklope HPPs generate net revenues of approximately 63 million Euros and state taxes in the order of approximately 18 million Euros. If by neglecting fresh water ecosystems management, due to the potential above-estimated reduction in power capacity, net revenue will decline to 53 million Euros. Such a loss is now avoided because of clean water from the ecosystem. Graphic 6 below presents the benefits and potential losses under the current SEM and potential BAU scenarios; and Table 15 provides supportive data.

Graphic 6. Annual SEM benefits and potential losses under BAU, hydropower



Source: Authors (based on various sources and using own estimates)

[99] Croatian Electricity Company, Official web pages
[100] Vattenfall AB http://www.vattenfall.com/en/hydro-power_107233.htm
[101] Duka V. 2011. Revitalizacija HE Trebinje: Počeo remont, Nezavisne novine (Revitalisation of HPP Trebinje, Independent News)
[102] HEP. Ispražnjeno jezero Kruščica. 2010, Croatian Energy Company official web pages

Table 15. Estimated loss (BAU) and cost-savings (SEM) in hydropower production

Estimated annual benefits from the hydropower sector, Velebit catchment	BAU (Euros)	SEM (Euros)
Hydroenegry production at HPP Senj and HPP Sklope		
Production (in GWh)	956	1,057
Total gross revenue	40,627,104	44,922,500
Production cost	18,376,093	20,317,500
Net revenue (excluding cost o silt removal)	22,251,011	24,605,000
Taxes, benefits and other state and local givings	4,594,023	5,079,375
Cost of silt removal		
Silt removal	659,447	65,945
Total net revenue (after taxation and silt removal cost)	**16,997,541**	**19,459,680**
Retail price of energy (distributor)		
Gross revenue	**91,769,458**	**101,472,000**
Net revenue (before taxation)	**51,142,354**	**56,549,500**
Taxes (VAT)	**11,762,741**	**13,006,385**
Net revenue of elecricity distributor after taxation	**39,379,613**	**43,543,115**
Total (production and distribution)		
Total net revenue	**56,377,154**	**63,002,795**
Total cost due to increased siltation	**6,625,642**	**65,945**
Taxes	**16,356,765**	**18,085,760**

Various sources[103]

2.3 Agriculture

A**griculture** is one of the sectors that have significant potential for the development, however structural problems and slow transition from traditional agriculture to modern production is keeping this economic activity below the expected rate. In 2009, agriculture (including also forestry, fisheries, and hunting) represented 6.7% in the total gross value added[104] (GVA).

Agriculture employs approximately 16% of all employed, but with about 1.4 billion of gross added value, it contributes only about 3% of the total GDP. Almost every third citizen of Croatia lives in

[103] Faculty of Chemical Engeneering and Technology, University of Zagreb; Plan of GHG Emissions Allocations of the Republic of Croatia (OG 76/09); Plan for Land Use and Land Use Changes, Ekonerg Ltd; HEP - Croatian Electricity Company; HERA - Croatian Energy Regulatory Agency. Annual Report for 2009. Alfredo, V., 2009. Electricity Production Cost Comparison. Technical University of Rijeka, Croatia.

[104] **Gross Value Added (GVA)** is a measure to estimate the value of goods and services produced in an area, industry or sector of an economy. GVA is linked as a measurement to Gross domestic product (GDP), as both are measures of output. The relationship is defined as: GVA + taxes on products - subsidies on products = GDP

agricultural households. In addition, many rural and urban households depend on their allotments in the countryside for survival. Working on their land or by helping relatives or friends in agricultural activities enables them to get "social credit" in return, and to take along cheaper or free food (fruit and vegetables for immediate consummation or for processing for winter, diary and cured meat products, wine, brandy, etc.). This is also a typical situation around Northern Velebit National Park; households do not take agriculture as their primary economic and earning activity, however, they keep cattle and work on small plots of land mostly for their own needs.

As much as 90% of the members of Croatian agricultural household have elementary school or no formal education. Only 2% of agricultural households have some sort of agricultural education. Consequently, in addition to the lack of oversight by the Ministry of agriculture, farmers do not have adequate training and, therefore, practice outmoded agricultural systems that cause pollution and loss of biodiversity; this is a typical BAU scenario.

For example, in the BAU scenario, the traditional practice of burning fields in order to eliminate weeds in the spring or autumn causes many forest fires, which affect biodiversity. Death of native plants and animals, loss of habitat, erosion and landslides, and water pollution are a consequence of forest fires. In the past 10 years, fires destroyed 195,860 hectares of land, which is almost the size of Velebit Nature Park. Forest fires occur mostly in the karst areas (98%), which make reforestation and recovery extremely difficult[105]. Another BAU example of biodiversity impact is gene loss. This occurs as a result of shifting from local to introduced cattle breeds. In Croatia, four cattle breeds are now endangered and at least one in on the brink of extinction[106]. Agricultural stakeholders and entrepreneurs have failed to recognize the economic potential of these breeds. The lack of local breeds in mountain areas is causing overgrowth of meadows and grasslands, and subsequently (since biodiversity of these areas are greater than those of forest) loss of biodiversity.

Recently, nationwide, legislation and infrastructure for organic food production has been introduced, including a national eco-label for organic food production. The Ministry of Economy, Fisheries and Rural Development is preparing the *Action Plan for the Ecological Agriculture Development in the Republic of Croatia.* The draft plan proposes that 8% of agricultural areas should be cultivated in ecological-management manner by the year 2016[17]. This is an indication of a shift from BAU to SEM.

The following sections include analysis of three subsectors of agriculture: pollination, fruits, and berries and liquor production. In addition, other subsectors such as livestock and dairy production, and honey production are discussed in Section 3.2.

Pollination

It is known that at least one-third of the world's agricultural crops require insect or animal pollination services[107]. According to Prescott-Allen (1990), bats, wild bees, and other insects are the principal pollinators of fruit trees and major staple crops including potato, cassava, yam, sweet potato, taro, beans, coffee, and coconut. PAs are likely to house essential pollinators, particularly wild species that require pristine habitant for their survival. There are three main benefits from the ES of pollination and bee activities that are critical to the local economy: i) production of fruit – pollination, ii) production of honey; and iii) production of forage and vegetables.

[105] Croatian Environmental Agency, 2005
[106] Croatian Environmental Agency, agricultural census 2000
[107] www.mekong-protected-areas.org/mekong/docs/tlp-10.pdf

Pollinators such as wild and honey bees (domestic) feed on nectar from flowers that are abundant within PAs; and particularly during the spring in template mountain areas such as Velebit. Honeybees use nectar to make honey. Nectar is almost 80% water with some complex sugars. Bees harvest nectar from flowers like clover, dandelion, as well as from berry and fruit tree blossoms. These sources are more abundant in wild areas.

Wild and honey bee species depend on floral resources provided by the parks in Velebit. Conserving natural habitats, providing access to clean water, creating or conserving nesting sites, and reducing bee exposure to pesticides are indispensable elements to sustain agricultural productivity in the region.

In the BAU scenario, use of harmful agriculture pesticides, habitat fragmentation, and invasive species are among the threats to the sustainability of the ES provided by wild pollinators and bees in Velebit. For instance, in the United States, The National Academy of Sciences report (2006) concluded that there is a significant decline in pollinators nationwide; honey bee colonies in the United States declined from 5 million colonies in the 1940s to only 2.5 million. This has a significant negative impact on productivity. Californian almond farms, every year, need 1.2 million of colonies from January to March for a successful pollination[108]. Furthermore, the number of managed honey bee colonies in the United States decreased 32% and 36% in the winters of 2006/2007 and 2007/2008 respectively, and 29% in the 2008/2009 winter[109]. The commercial value of honey bees as commercial pollinators in the United States is estimated at USD 15 billion annually; the 36% loss suffered in 2007/2008 represents a loss of approximately USD 4.5 billion[110].

Specific data on pollination services in direct relation to PAs is limited. Examples that illustrate the benefits from wild crop pollination services in the Latin America and Caribbean (LAC) region include pollination of coffee adjacent to forests in Costa Rica, of fruits and coffee in Brazil, and of various crops in Mexico (UNDP, 2010).

There is a range of plants in the Velebit region that require pollination services from wild bees and domestic bees. These plants are significant for economic activities as well as biodiversity conservation: forage and legume crops such as buckwheat; fruit crops including apples, berries (blackberry, blueberry, cranberry, gooseberry, raspberry, and strawberry), cherries, pears, and plums; and vegetable seed crops such as carrots, cauliflower, celery, collard, cucumber, dill, eggplant, garlic, kale, kohlrabi, leek, beans, onion, parsley, pepper, pumpkin, radish, squash, and turnip[111]. Table 18 provides an overview of the selected plant's dependence on pollination[112]:

Table 18. Velebit's plants dependence on pollination services and percentage

Plant	Dependence on pollination
Apples	100%
Plums	90-100%

[108] Pettis, J., *Colony Collapse Disorder (CCD) affecting honey bee (Apis Mellifera) colonies,* USDA-ARS Bee Research Lab. Beltsville, Maryland, USA
[109] Ibid 11
[110] Ibid 11
[111] Caron, D. M., 1999. *Pollination,* Cooperative Extension, University of Delaware, College of Agriculture and Natural Resources, USA
[112] Ibid 11

Almonds	100%
Citrus	20-80%
Onions	100%
Broccoli	100%
Carrots	100%
Sunflower	100%
Honey melon	80%
Berries	90-100%
Cauliflower, celery, cucumbers, legumes	90-100%
Other fruits and nuts	10-90%
Other vegetables/melons	70-100%
Other field crops	10-100%

Source: Renee Johnson, Honey Bee Colony Collapse Disorder, Congressional Research Service, 2010.

In planned pollination, bee pollination is by far the best way to pollinate crops successfully. It has been estimated that 500 solitary (wild) females bees or three hives (6,000 working bees)[113] are needed to pollinate 1 ha of commercial apple orchard. Wild bees are more abundant in wild areas and. Therefore, agriculture nearby PAs receives the most benefit from this valuable ES.

In the United States, 1,295 million hectares of agricultural land depend on the service of bee colonies and bees depend on healthy ecosystems for their survival. Farmers in the United States pay owners of bee hives for their pollination services: a single hive to rent is approximately USD 50 for 3-6 weeks, depending on a crop/fruit (e.g. ApisHive Co.), the timeframe needed to complete most pollination actions[114]. Bumblebee-pollinated tomatoes are proven to bring higher yields, higher number of seeds, better weight-size correlation, higher specific gravity, and higher fruit firmness than tomatoes supported by other pollinating agents[115]. In addition, the relative low cost of bee pollination, especially when using wild bees and honey bees combined with organic farming principles, can lower the prices of organic food making it more competitive and accessible.

Experts estimate that two-three hives per hectare are sufficient to pollinate most crops[116]. In 2010, a total of 79,560 ha in Licko Senjska County was under crops that need pollination to yield successfully (orchards, meadows, fields, gardens, and vineyards)[117]. Considering the average price of USD 50 or 37.5 Euros for the service of one hive yearly (seasonally), the pollination service the ecosystem provides to orchard owners and cattle owners, as well as to collector of herbs, is estimated at 2.9 million Euros. This presents a gain from the "free" ES of pollination.

The National Academy of Sciences (US) in its 2006 report concluded that all pollinators are in decline; honey bee colonies in the United States declined from 5 million colonies in the 1940s to only 2.5 million. Just for illustration, Californian almond farms, every year, need 1.2 million of colonies from January to March for a successful pollination event[118]. Furthermore, the number of managed honey bee colonies in the United States decreased 35.8% and 31.8% in the winters of

[113] Sevar, M., 2006. *Solitary Bees*. Croatian Bureau for Agricultural Consulting
[114] Virginia Department for Agriculture and Consumer Services
[http://www.vdacs.virginia.gov/plant&pest/statelist.shtml]
[115] Ibid 3 (Banda, Paxton, 1991; Ravestijn van, Steen van der, 1991; Morandin et al., 2001; Al-Attal et al., 2003)
[116] Somerville, D., 1999. *Honey Bees in Cherry and Plum Pollination,*. NSW Agriculture. Department of Primary Industries. New South Wales, Australia
[117] Licko-senjska County, 2010
[118] Pettis, J*., Colony Collapse Disorder (CCD) affecting honey bee (Apis Mellifera) colonies,* USDA-ARS Bee Research Lab. Beltsville, Maryland, USA

2007/2008 and 2006/2007, respectively. The estimated loss in the 2008/2009 winter was 28.6%[119].

Since the commercial value of honey bees as commercial pollinators in the United States is estimated at about USD 15 billion annually, the 30% loss suffered in 2007/2008 represents a loss of USD 4.5 billion[120]. Returning to Croatia: in the region, there have been dramatic incidents of negative impacts on bees. For instance, in 2008 in Slovenia, as many as 2,000 colonies of bees were affected by pesticides. A similar incident occurred again in 2011. In this incident, most probably, a corn pesticide caused deaths of millions of bees[121]. An incident of this magnitude could wipe out the entire bee community in Licko Senjska County. There are 1,327 bee colonies in the region, according to Agricultural Census of 2003[122].

Bees are the most economically-valuable natural pollinators of agricultural crops worldwide[123] and this condition is well documented. Honey bees have a long flight range and if finding good forage, they can gather honey from 8 to 11 kilometres distance[124]. Managed pollination by bees has become standard for large-scale agriculture in temperate areas and is indispensable to support subsistence farming.

Fruit production

Production of plums (Licka bistirica) and apples is the largest fruit production operation in Licko-senjska County, as well as the administrative territories of Velebit and the surrounding areas – Gospic, Karlobag, Senj, and Otocac. Most of the production is carried out in small family farms for self consumption[125], in a semi-professional manner, thus, during the last agricultural census in 2003 there was only one plum and no apple farms registered[126]. Consequently, there are no records of productivity; however, for the purpose of this report; the team used the number of trees as the basis for assessing production.

The most serious threats to improving plum and apple production are the dispersion of orchards and poor management[127]. Therefore, plum and apple production is considered in the BAU scenario. However, production can be optimized by improving nurturing and pollination (SEM). For example, huge production improvements were noticed in the northern areas where bee-hives were introduced to plum cultivation areas: 375% improvement[128]. Currently, there is no data on the level of pollination needed and what is actually provided.

For the purpose of this study, the team considered two BAU scenarios (current and potential) and one SEM scenario. The current BAU scenario represents in-use practices, in which the net value of the production of plums, including the derived products of jam and brandy is estimated at 169,432 Euros. The potential BAU scenario illustrates potential losses if BAU deteriorates. In this scenario, it

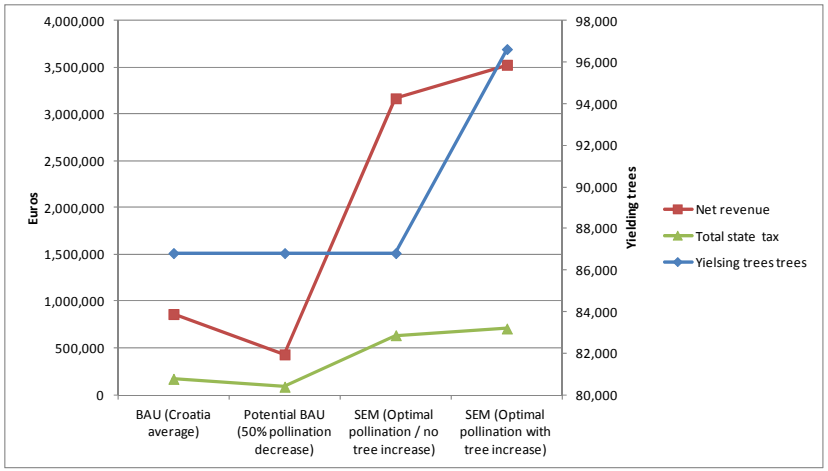
[119] Ibid 11
[120] Ibid 11
[121] April, 2011.*Klotadin to be blamed for Deaths of Bee sin Slovenia,* The Beekeepers Association to Promote Bees and Beekeeping
[122] Croatian Bureau for Statistics, 2004
[123] Johnson, R., 2010. *Honey Bee Colony Collapse Disorder.,* CRS Report for US Congress. Congressional Research Service
[124]Ribbands C.R., 1951., *The Flight Range of a Honey Bee.* Bee Research Department, Rohamsted Experimental Station, Harpenden, Journal of Animal Ecology
[125] *Agro-ecological Regionalisation of Fruit production in Licko-senjska County*, 2009, Agricultural Faculty, University of Zagreb
[126] Croatia Bureau for Statistics
[127] Ibid 14
[128] *Plums in 48 hours on Adriatic markets*, S-Link, Agroclub Web Magazine for Agriculture Services

is assumed that the production will drop about 50% (while the production of forage and beans could suffer a 25% loss). Consequently, in the potential BAU scenario, the net value of production will decline to 84,716 Euros (50%). However, in the SEM scenario, the net value of plum production may increase to 707,191 Euros. This scenario represents a shift from BAU to SEM. This shift is estimated to be possible in a 10-year period.

Similarly, in the case of apple production in the current BAU scenario, the net value of the production of apples is estimated at 15,237 Euros. In the potential BAU scenario, the net value of production will decline to 7,618 Euros (50%); and in the SEM scenario, the net value of apples production may increase to 55,191 Euros. As indicated above, SEM represents a shift from BAU to SEM. In this case, this shift is also estimated to be possible in a 10-year period. The fluctuations in BAU and SEM benefits for plums and apples are represented in Graphics 8 and 9, with Tables 19 and 20 including the respective available data.

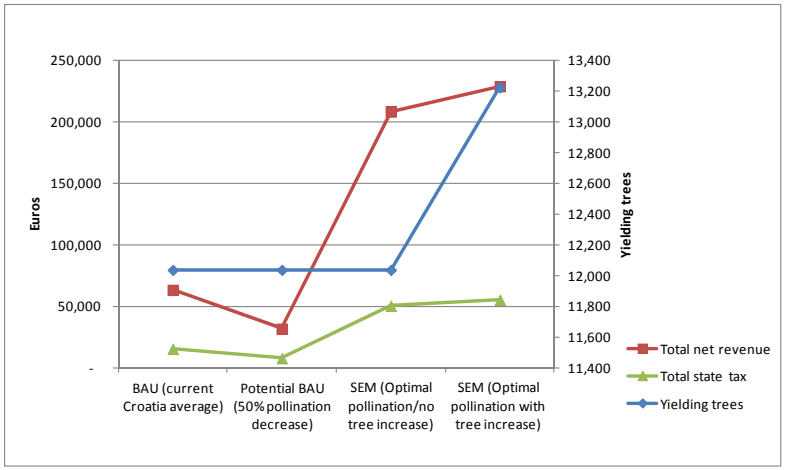
In terms of employment, this shift from BAU to SEM may not increase the number of people employed since most of plum and apple production in the Velebit region is based on family-owned small plots. However, it is expected that the shift will increase livelihood security to a great extent. It is estimated that 4,241 households are currently engaged in plum and apple production (some for household consumption only).

Graphic 8. Potential gains and losses from plum pollination under BAU and SEM



Source: Authors (based on various sources and using own estimates)

Graphic 9. Potential gains and losses from apple pollination under BAU and SEM



Source: Authors (based on various sources and using own estimates)

Table 19. Estimated annual benefits from pollination to plum production in BAU and SEM scenarios

Estimated annual benefits from pollination: PLUMS, 2009 (In Euros)	Current BAU	Potential BAU	SEM	
Plums	**County's average productivity**	**50% decrease in pollination**	**a) Optimal pollination without tree increase**	**b) Optimal pollination and tree rehabilitation**
No. of yielding trees (same for BAU/SEM)	86,813	86,813	86,813	96,626
Productivity per a tree (kg p/tree)	4	2.0	15.0	15.0
Total annual production	347,252	173,626	1,302,195	1,449,390
Total gross revenue	343,779	171,890	1,289,173	1,434,896
VAT	79,069	39,535	296,510	330,026
Multiplier effect	476,478	238,239	1,786,794	1,988,766
Production cost	24,308	12,154	156,263	173,927
Total state tax	79,069	39,535	296,510	330,026
Total net revenue	716,881	358,440	2,623,194	2,919,709
Brandy production	**60% of total production**	**60% of total production**	**60% of total production**	**60% of total production**
Total production in litres	20,835	10,418	78,132	86,963
Total revenue producers	143,762	71,881	539,109	600,047
Total-revenue - 10%cost	129,386	64,693	485,198	540,043
Alcohol fee	79,173	39,587	296,900	330,461
VAT	(25,590)	(12,795)	(95,961)	(106,808)
Total net revenue	75,802	37,901	284,259	316,390
Total state tax	53,584	26,792	200,939	223,652
Jam production	**20% total prod.**	**20% total prod.**	**20% total prod.**	**20% total prod.**
Input in kilograms	69,450	34,725	260,439	289,878
Kilograms of jam	43,407	21,703	162,774	181,174
Total revenue gross	56,428	28,214	211,607	235,526
VAT	9,784	4,892	36,689	40,837
Total net revenue	46,645	23,322	174,917	194,689
Total state tax	9,784	4,892	36,689	40,837
Retail of plums	**20% total prod.**	**20% total prod.**	**20% total prod.**	**20% total prod.**
Input in kilograms	69,450	34,725	260,439	289,878
Gross revenue	117,371	58,686	440,142	489,894
VAT	26,995	13,498	101,233	112,676
Total net revenue	23,005	11,502	86,268	96,019
Total state tax	26,995	13,498	101,233	112,676
Total benefits from plums and related products				
Total revenue	**862,333**	**431,166**	**3,168,638**	**3,526,808**
Total state tax	**169,432**	**84,716**	**635,371**	**707,191**

Various sources[129]

[129] State Bureau of Statistics, Agriculture Overview 2003; Karic, M, et al., 2004. Cost Benefit Analsysis for Decision Making in Plum Farms Investing; Agroclub; Novak, V. Fruit Producer; Konzum Ltd.

Table 20. Estimated annual benefits from pollination to apple production in BAU and SEM scenarios

Estimated annual benefits from pollination: APPLES, 2009 (In Euros)	Current BAU	Potential BAU	SEM	
Apples	**County's average productivity**	**50% decrease in pollination**	**a) Optimal pollination without tree increase**	**b) Optimal pollination with tree increase**
No. of yielding trees	12,036	12,036	12,036	13,224
Productivity per a tree (kg p/tree)	6.4	3.2	21.1	21.1
Total annual production	77,030	38,515	253,960	279,026
Total gross revenue	42,367	21,183	139,678	153,465
VAT	9,744	4,872	32,126	35,297
Production cost	14,680	7,340	48,398	53,175
Net revenue	17,942	8,971	59,154	64,992
Total state tax	9,744	4,872	32,126	35,297
Multiplier effect	32,296	16,148	106,476	116,986
Total net revenue	50,238	25,119	165,630	181,978
Estimated retail benefits				
Total annual production	77,030	38,515	253,960	279,026
Total gross revenue	66,246	33,123	218,405	239,963
VAT	5,492	2,746	18,107	19,895
Revenue	12,984	6,492	42,807	47,033
Other cost	47,770	23,885	157,491	173,035
Total state tax	5,492	2,746	18,107	19,895
Net revenue	12,984	6,492	42,807	47,033
Total apple production benefit				
Total net revenue	**63,223**	**31,611**	**208,437**	**229,011**
Total state tax	**15,237**	**7,618**	**50,233**	**55,191**

Various sources[130]

Plums and apples will not self-pollinate and require the activity of pollination agents such as bees. Therefore, almost 100% of plum and apple yields can be attributed to pollination services of Velebit; this service has an approximate value of 1.5 million Euros, including about 325,449 Euros in tax, which goes to the government.

In the SEM scenario, it is assumed that all registered trees are yielding at an optimal level of nourishment and pollination. Using an inexpensive method to revitalise trees (no capital investment needed) and increased pollinator services, the financial contribution to the four administrative units in the Nature Park (Gospić, Otočac, Senj, Karlobag) and around it could reach

[130] State Bureau of Statistics, Agriculture Overview 2003; Agroclub; Novak, V. Fruit Producer; Market Informational System in Agriculture, Ministry of Agriculture, Fisheries and Water Management; Agro-ecological Regionalisation of Fruit production in Licko-senjska County, 2009, Agricultural Faculty, University of Zagreb.

approximately 3.7 million Euros of net revenue and 762,382 Euros to state taxes, approximately 4.5 million Euros in total. In the long-term SEM scenario, revenue could continue to increase.

Berries and traditional liquors

Another important example of the impact of pollination service, discussed above, is the production of wild berries, which are used to produce traditional liquors. Wild berry plants in Velibit support small- and medium-sized business. It is estimated that over 840 tons of berries, herbs, and other natural products are harvested every year, in the NVNP (See list in Box 4).

Most of this production is used by local liqueur manufacturing companies such as "DEGENIJA Ltd. CROATIA," which produces wormwood liqueur, herbal liqueurs, rum, vodka, and cherry brandy (See sample in Box 5).

The company's planned production for 2011 is approximately 1 million bottles and it is expected that in a five-year period, production will reach 5 million bottles annually. In today's market in Croatia, liqueur sells at an average of 1.8 Euros per bottle. Therefore, the expected gross value of sales for 2011 is USD 1.8 million (900,000 Euros net, estimated at 50%); and 4.5 million Euros net by 2016 (calculated at an annual average growth of 38%). Although this business sounds promising, it is likely that the increased production will have an impact on Velebit's ecosystems. No analysis has been made yet to determine if the current capacity of the ecosystems under the current management regime (BAU) can provide the resources needed to increase and sustain liquor production at the expected levels. This is a typical BAU scenario. In this scenario by 2016, 3,570 tons of berries will be needed annually to sustain the proposed growth of liquor production. This is unlikely and, therefore, the business prospect is highly uncertain. Considering a conservative 10% decline in production from 2016 forward, by 2020 the business may lose profitability and the ecosystem will be exhausted.

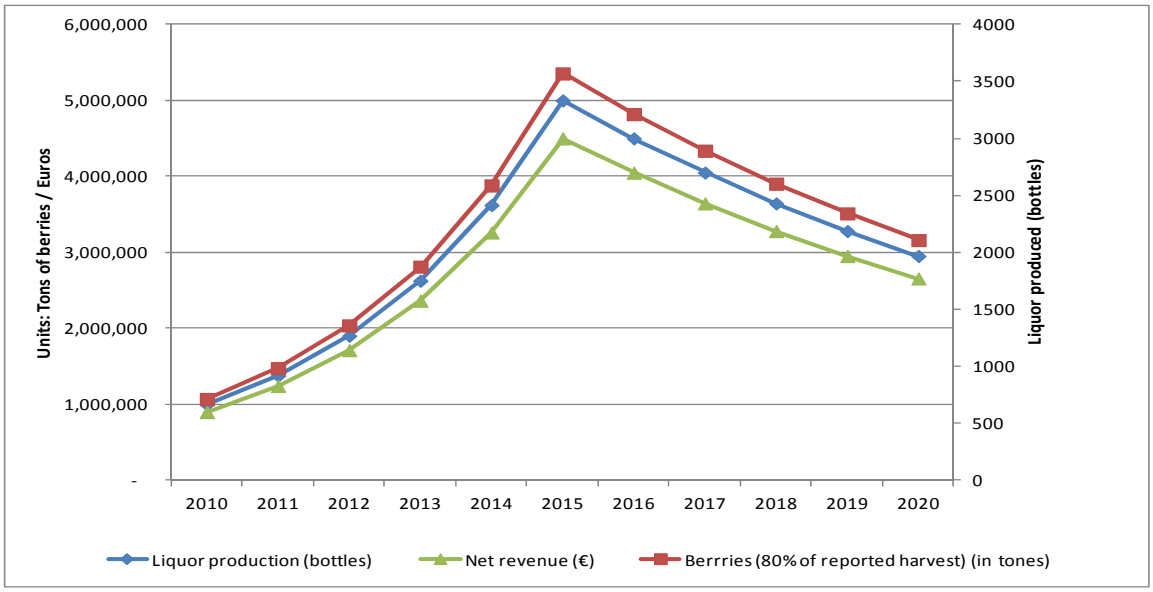
Box 4. Natural herbs and fruits from NVNP

Natural herbs and fruits from NVNP and surrounding areas	Tons/year
Natural herbs	
Angelica - *Angelica archangelica*	50
Anise seeds - *Pimpinella anisum*	50
Borovnica	20
Calamus - *Acorns calamus*	50
Centaury - *Centaurium umbellatum Gillb*	30
Elecampane - *Inula helenium*	30
Fennel - *Foeniculum vulgare Mill*	50
Gorki pelin - *Artemisia absinthium*	30
Hyssop - *Hyssopus officinalis*	30
Izop, Miloduh - *Hyssapus officinalis*	30
Kl eka - *Juniperus anisum*	10
Korijander - *Cariandrum sativum*	50
Marigold - *Calendula officinalis*	50
Marjoram - *Majorana hortensis Moench*	30
Melissa - *Melissa officinalis*	50
Mountain germander - *Teucrium montanum*	30
Peppermint - *Mentha piperita*	50
Rosemary - *Rosmarium officinalis*	20
Sage - *Salvia officinalis*	30
Sumska	50
Thyme - *Thymus serpyllum*	50
Subtotal	790
Fruits	
Lemon zest - *Citrus limonium*	10
Orange zest - *Citrus aurantium*	10
Plums - *Prunus domestica*	10
Apple - *Pirtus malus*	10
Grapes - *Vitia vinifera*	**10**
Subtotal	**50**
TOTAL	**840**

Source: *N. Komusanak, Cuvar Svetista, Majke Bozje od Krasna*, 2011.

Under BAU with the current practices, it is likely that the production of pollination and NTFP (berries, herbs, and fruits) will decline in the next years, due to increased demand for and supply of these liqueurs, unless a SEM management regime is introduced. Graphic 10 represents the potential short-term gain and long-term loss in the BAU scenario.

Graphic 10. Potential short-term gain and estimated long-term loss in BAU, liquor production

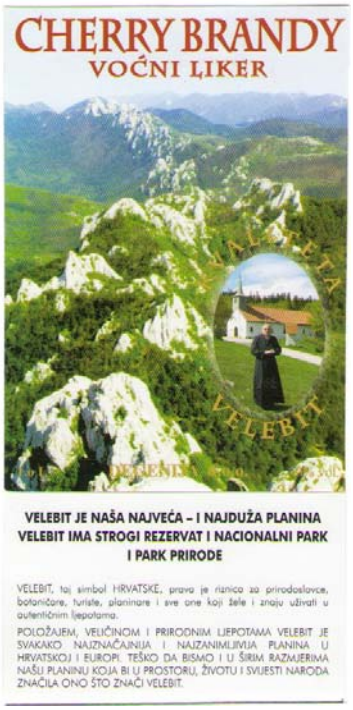


Source: Authors (based on various sources and own estimates)

Without the herbs, berries, and fruits from the Velebit Mountains, the production of liqueurs will not be possible; and neither the liqueur manufacturers nor the consumers are currently contributing to support the management of the ecosystems that provide these critical ingredients to sustain production and profits. Further, the region's production of wild herbs, berries, and fruits depends highly on wild pollinators that, in turn, depend on the pristine habitats of the Velebit Mountains; and as noted before, the populations of wild pollinators are considered under threat. However, further studies are needed to determine the impact of such threats.

The introduction of SEM, in this case, represents an insurance policy to protect, in part, the investments and benefits to the people involved in the entire production and marketing chains, and ultimately to end consumers. The bottling company could support the assessment and conservation of the ecosystems that provide the raw material for their products (berries and water) by adding a fractional environmental charge to the price per bottle, e.g. 0.10 Euro. This will represent an annual contribution to support ecosystems management at NVNP of 500,000 Euros (considering an annual production of 5 million bottles).

Box 5. Chery Brandy brand, Krasno, Velebit



2.4 Brewing

In addition to hydropower and domestic water supply, Velebit's Ričina Spring supplies water to the local brewery. The brewery is relatively new, founded in 1997; however, in a short time it has became a relevant player due to the high quality of its beer. "Velebitsko" beer is considered to be the best quality beer in Croatia by many experts and this is largely attributed to the clean, highest quality, water used.

Beer contains 91% water, 5.5% alcohol, 4% dry matter, and 0.5% carbon dioxide. On average, it takes 4-8 hectolitres of water to produce a hectolitre of beer[131]. In 2009, the annual production reached 1 million litres, and it is planned that production will grow to 15-20 million litres by 2012[132].

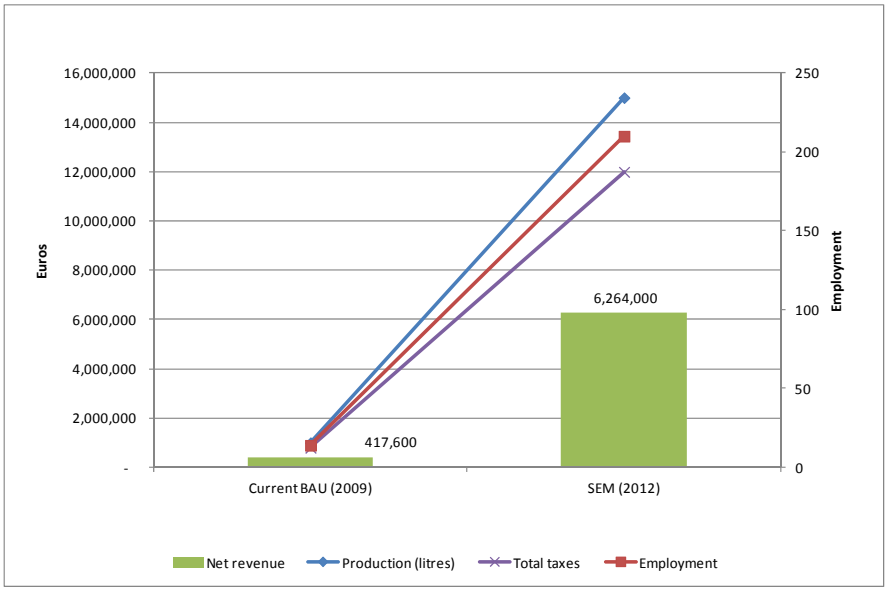
Currently, total State revenue from the beer production exclusively from the Velebit water supply is estimated at 799,491 Euros yearly, almost double the companies' net revenue.

Velebitsko Brewery is positively contributing to local development, not only through employment (in an employment-depressed area) and tax revenue to the government, but also because its wastewater could feed the waste water treatment plant for Gospić Town, currently not operating. The local government built this wastewater treatment plant with a high capacity. However, it is not operating because there is not enough flow of wastewater and biochemical oxygen demand (BOD) for the plant to grow bio-culture to digest waste. Thus, increasing the production of beer or even investing in new breweries could bring multifold benefits – to the economy as well as the environment if the plant becomes operative.

The brewery's production depends directly on an ES (clean fresh water) from the local PA. However, the brewery is not investing in fresh water ecosystems conservation; therefore, for the purpose of this report, the current operation is considered to be under the BAU scenario. In order to shift to the SEM scenario, for example, the brewery could directly contribute to a fund established to support fresh water ecosystems in the VNP. This contribution could be established by redirecting (allocating) a small percentage (1%) of the current tax being paid by the brewery to the local government, into the fund. Graphic 11 presents the BAU and SEM scenarios of the brewery operation, and Table 21 shows the aggregated benefits. Limited information was provided by the brewery to the study team and, therefore, the numbers are only indicative.

[131] "Is Beer to Expensive?" Svijet piva (World of Beer), Vecernji list, 2009 (beer production cost analysis)
[132] Poduzetništvo – web portal for Entrepreneurship, Interview with Karlo Starcevic, the owner of Licanka Brewery: *Ličanka Will Produce 15 Million Litres of Beer Yearly. 2009*, [http://www.poduzetnistvo.org/news/licanka-ce-godisnje-proizvoditi-15-milijuna-litara-velebitskog-piva]

Graphic 11. BAU and potential SEM scenarios of the brewery operation



Source: Authors (based on various sources and using own estimates)

Table 21. Aggregated benefits from beer production in BAU and SEM

Estimated annual benefits from beer production, 2010 (in Euros)	Current BAU	SEM
Production (litres)	1,000,000	15,000,000
Employment	14	210
Retail price (average)	1.8	1.8
Gross revenue	1,800,000	27,000,000
Transport and retailer's fee (@11,7%)	210,600	3,159,000
Taxes and levies (@41,9%)	754,200	11,313,000
Production cost (@ 50%)	417,600	6,264,000
Net salaries	103,562	1,553,429
Tax on salaries	45,291	679,367
Net revenue	**417,600**	**6,264,000**
Total taxes	**799,491**	**11,992,367**

Various sources [133]

[133] Sources: Chemical Leasing in Beer Production, Croatian Cleaner Production Centre, Technical Report, 2011; Karlo Starcevic, Owner of Pivovara Licanka Intervju to Vecernji list (relevant daily newspaper), Poduzetništvo (web portal for entreprenuers), Pivnica.net (web portal specialised for beer thematic); interview with key beer producing experts large and small breweries; "Is beer to expensive" Svijet piva (World of Beer), Vecernji list, 2009 (beer production cost analysis); Croatian Bureau of Statistics, Statistical Yearbook 2009

It is worth mentioning that there are several large beer producers in Croatia. Pivovara Licanka is one of the small breweries but is planning to take a larger share of the market. In addition, there are also three large water bottling plants, and over 100 small wineries that use fresh water ES to provide high quality products to 4.5 million Croatians[134]. However, little or nothing is invested by producers or paid by end users to support fresh water ecosystems management in Velebit's parks and PAs.

2.5 Fisheries

Marine and coastal ES provided by ecosystems in and around Velebit Nature Park (VNP) are critical to sustain sea fisheries and fish-farming in the region. The western and southwest borders of Nature Park Velebit reach the shores of the northern Adriatic coast; therefore, the coastal sea waters next to the VNP are considered part of the VNP ecological corridor and buffer zone, including the Velebit Channel, which stretches from Novljanska Žrnovnica Bay to Novsko Ždrilo Bay (entrance to Novigradsko Sea) in the northeast to islands of Krk, Prvic, Grgur, Goli Otok, Rab, and Pag in southwest.

Administratively, most of the Velebit Channel belongs to Licko-senjska County, while County's coastal waters belong to Licko-senjska County in the full length of total 110 km. The county also encompasses 596.6 km^2 of national territorial waters[135]. The coast beneath Velebit Mountains is preserved in its original form. In addition there are several islands such as Rab, Pag, and far southeast is Krk Island on the western side of the Channel. There are many small islands, beaches, and bays which are most convenient for swimming and docking[136].

The VNP's forest and fresh and underground water ecosystems are the most influential ecosystems. Rivers Lika, Novčica, Otešica, and other tributaries of the Lika River from the Velebit catchment are contributing to brackish waters of the Velebit Channel through its discharge south of Senj. Moreover, many underground streams of the Lika River Basin[137] and many small streams that originate mostly from the Northern Velebit, and the western and southwest coastal Velebit slopes catchment, sink underground to enter the Adriatic Sea, either as coastal springs or submarine underground water discharges along the full length of Velebit Channel[138]. See Annex 2 for additional details on fresh water services from VNP.

Due to underground and coastal freshwater discharges, the water in Velebit Channel is much colder than that the rest of the Adriatic coast. It is also brackish. The coldness and brackishness makes this water, apart from containing the usual sea fauna of Croatian Adriatic Sea, suitable for farming mussels and trout. Little is known of the marine ecosystem of Velebit Channel; therefore, further research is needed[139].

Unfortunately, the lack of data on fish stocks in the Velebit Channel makes it difficult to assess these benefits. For example, the Croatian Bureau of Statistics has combined economic data for fisheries, forestry, and agriculture, which is difficult to desegregate. Furthermore, fishermen from Licko-

[134] Chemical Leasing in Beer Production, Croatian Cleaner Production Centre, Technical Report, 2011
[135] Licko-senjska County Bureau for Spacial Planning. *Licko-senjska County Spatial Plan, 2002.*
[136] Ibid, 2002.
[137] Andrej Stroj, 2010. Underground Streams of Karst Hinterland Springs in the Area of Velebit Channel, Doctoral Dissertation
[138] Andrej Stroj, Croatian Geological Institute, Interview via the questionnaire
[139] Licko-senjska County Bureau for Spacial Planning, 2002. *Licko-senjska County Spatial Plan*

senjska County fish in Velebit Channel and elsewhere along the Croatian coast, as do fishermen from other Croatian counties. Therefore, it is almost impossible to make conclusions about the state of benefits linked to the Velebit Channel. There is little published data on fish stocks in the Channel, and data of fish stock recovery after bans in not available. Consequently, it is difficult to establish and assess if and how fish stocks are recovering.

Sea fisheries

Unsustainable fishing practices took place for decades and an uncontrolled, partial ban existed before 1990; these lead to a decline in fish stocks. Subsequently, another partial ban on trawling[140] in Velebit Channel came in effect in 1997 (northern part), and finally a total ban in 2009[141]; this could be considered a progressive shift from BAU to SEM. Under BAU, fishing practices resulted in the elimination of fish varieties such as sharks (*Chondricthyes*), star gazers (*Uranoscopus*) and monkfish (*Lophius*)[142]. Today, the last two species have somewhat recovered. Today, there are fourteen economically-relevant species of fish in the Velebit Channel:

- Hake (*Merluccius merluccius*)
- Mullet (*Mullus surmuletus*)
- Weever Fish (*Trachinus draco*)
- Cephalopods (*octopodiae*) (octopus, squid, cattlefish, etc.)
- Red Gurnard (*Aspitrigla cuculus*)
- Whiting (*Micromessistius pantossou*)
- Scrimp (*Nephros norvegicus*)
- Ray fish (*rajidae*)
- Dog fish (*Scyliorhinus canicula*)
- Monkfish (*Lophius budegassa*)
- John Dory (St Pierre) (*Zeus faber*)
- Streaked Gurnard (*Trigloporus lastoviza*)
- Stargazer (*Uranoscopus scaber*)
- Annular bream (*Diplodus annularis*)

A study by Ibid (1991)[143] showed that the ratio of the catch of Northern Velebit Channel consisted of 30% ray fish, 30% common pandora, among other species; edible catch was 24% and top quality fish only 3%. However, Northern Velebit Channel, showed high variation in biodiversity for species. The rest of the Chanel showed better results in edible fish catch, on the range of 60-90%. The ban on trawling, according to the research, had no positive impact on economically-usable fish stock (other damaging techniques were used such as non-selective nets), however, the ban increased overall biodiversity.

[140] Trawling is a particularly damaging fishing technique that ploughs the seabed, destroying flora and fauna as well as kelp -- the usual spawn sites for fish. In addition, it is not a selective technique; therefore, a large portion of catch is not usable for it is either smaller than commercial size or not a commercial specie at all. In this way, trawling destroys young fish that will not reach full potential and breeding size as well as destroys spawning sites.
[141] (Ordinance on Special Fish and other Sea Organisms Habitats and Regulation of Fishing in Velebit Channel, Novigrad and Karin Sea, Prokljan Lake, Marinsko Bay and Neretva Channel, OG 148/04, 152/04 , 55/05, 96/06, 123/09 and 130/09).
[142] Jurkić and Crnković, 1974, "Fish-stock under Velebit" (Croatian: Bonitet Velebit)
[143] Ibid 11

In Croatia, in 2009, there were 66,619 tons of fish catch and farmed fish (farmed was 9,500 in 2005), and 12,700 tonnes of freshwater fish is farmed, mostly trout and carp[144]. The Croatian Adriatic is relatively poor in fish stocks, but rich in species. In 2009, the total catch was about 49,000 tonnes of fish and other sea organisms; 90% of it was small oily fish, which is mostly canned or used in tuna-farms as feed[145]. According to data from 2007, fisheries represent only 0.2% of BDP[146] (88,880.96 Euros). The number of large fishing vessels is small (boats over 12 m in length and weight of over 15 GT): 445 in 2009. The production has increased from 44,111 tons in 2005 to 66,619 in 2009. See Table 22.

Table 22. Fish production in Croatia in tons

Year	Total catch (in tons)	Crustaceans	Shellfish	Fish
2005	44,111.00	258.00	4.184.00	39,669.00
2006	52,037.00	298.00	5,036.00	46,703.00
2007	51,819.00	451.00	5,254.00	46,114.00
2008	60,187.00	461.00	3,996.00	55,730.00
2009	66,619.00	529.00	3,294.00	62,796.00

Source: Statistical Yearbook 2010, Croatian Bureau of Statistics.

Although Croatia is a Mediterranean country with great fishing and sailing tradition, Croatia has a very low consumption of fish per capita, three times lower than the EU (22 kg/capita/year) and even lower than the world average (10 kg/capita/year)[147], only 8,7 kg/capita/year[148]. Thus, the Croatian fishing industry, as well as fish-farming. is orientated mostly towards export. Exports are higher than imports; therefore, fisheries hare generated a foreign trade surplus for the past few years. As much as 65% of exported fish is accounted to tuna farming and fishing, and is predominantly sold to Japan. In 2009, exports generated 71,788 Euros, as shown in Table 23.

Table 23. Export and import of fish

Exports (in Euros)		Imports (in Euros)	
2008	2009	2008	2009
64,770.55	71,788.22	16,522.05	8,522.74

Source: Statistical Yearbook 2011, Croatian Bureau of Statistics

In addition, because of the healthy water ecosystems in the region, shellfish farming is also an economic activity with great potential. An economic analysis of shellfish-farming for Licko-senjska County is being carried out. Other areas with less privileged ecosystems such, as Starigrad and Malostonski Bay, shellfish development is constrained by:

- Degraded water quality due to fecal pollution, again due to lack of adequate sewage and wastewater treatment facilities

[144] Croatian Bureau of Statistics, Yearbook 2011
[145] "Fishery and Fish Processing", Croatian Chamber of Economy, Agriculture, Food Industry and Forestry Department, July 2010
[146] Statistical Yearbook 2010, Croatian Bureau of Statistics.
[147] Van der Walle, G., 2007, *Future Prospects for Fish and Fishery Products* 4. Fish consumption in the European Union in 2015 and 2030 Part 1. European overview Food and Agriculture Organisation of the United Nations
[148] Ibid 2

- Introduction of infected shells from other farms
- Possible lower productivity than EU countries (lack of branding)
- Inadequate nature protection in parts of Croatia, and Bosnia and Herzegovina (e.g. Malostonski zaljev)[149].

Fisheries contribute to employment in the region. In 2011, the total number of artesian fishermen in Licko-senjska County is 68, one fishing company, and 389 subsistence fishermen (people who supplement their income or diet with small-scale fishing), who may not be able to continue such activity under EU Directives[150]. The number of people employed in the fishing company is minimal and decreased from 22 to 18 between 2005 and 2008[151].

In 2008, the average national gross salary in the fishing and fish farming sector (as well as agriculture and forestry) was 873 Euros monthly (net 632,47 Euros), which presents the lowest of all economic sectors[152]. The total annual net income benefit from fisheries is estimated at 1.1 million Euros, including subsistence fishermen monthly income estimated at 100 Euros). Fisheries in Croatia account for 0.2% BDP; and fisheries, together with agriculture, mining, and forestry, account for only 1.75% of the total county's revenue (2009)[153]. Although as a percentage of total DBP it is low, fisheries is an important factor for accomplishing food security, employment, domestic income, and the provision of tourism services.

Sea fisheries are considered in the BAU scenario for the purpose of this report, mainly because the sector is poorly developed and regulated (BAU practices) and there is no data on enforcement, compliance, and impact of the bans from 1997 and 2009, and other-related fisheries regulations.

Fish-farming

There is no precise data on the productivity of the two trout farms in the coastal area of Velebit Channel. These farms would not be possible without these specific conditions of brackish and colder water. According to the Spatial Plan of Licko-senjska County, there are plans for two California-trout farms, with an annual capacity of 1000 tons each, in Lukovo Šugarje and Senj. The Lukovo farm is fully functioning, while the Senj farm is expected to be operating in the second half of 2011. In addition, there are 17 more locations for fish-farming in the special plans of Senj, Karlobag, and Novalja. To this end, a feasibility study for concessions is being carried out. At full capacity, these two farms together could generate approximately 6,000 Euros in annual gross revenue (3 Euros /kilo[154]).

For the purpose of this report, fish-farming is also considered under BAU for various reasons. First, although there is a great potential for development of aquaculture in the region, there are no production facilities, either in the River Lika nor in its tributaries, nor plans to develop such farms. Second, there are no invasive species management plans. Foreign fish species that were introduced in the past, such as carp and California trout, alter fresh water features, thereby reducing available

[149] Bavcevic, L., et al., 2009, *Integral Plans for Shellfish Farming Development*. United Nations Development Programme Croatia
[150] Interview, Licko-senjska County, Department for Economy.
[151] Croatian Bureau for Statistics, Statistical Yearbook 2009.
[152] Ibid 2
[153] Licko – senjska County, County development strategy 2011 – 2013.
[154] http://www.aller-aqua.com/cms/upload/Price_development/Developments_in_European_Trout_Sector_June_2011.pdf

habitat for the native species. Third, wastewater discharges from the towns of Gospic, Otocac, and others are reducing water quality due to increasing industry, irrigation, or tourism development. For example, the planned golf courses, which are discussed in Section 2.1., are one emerging threat to water quality. Degraded fresh water quality and quality could endanger both existing and potential new coastal trout farms.

Currently, there is also no shell-fish farming in Velebit Channel, although there was oyster farming, as long as a century ago. The nearby Novigradsko Sea, a part of the Velebit Channel, is the largest catching area for wild mussels in Croatia. This is also a typical BAU scenario (missed opportunity).

Currently, 2,500 tons of mussels and 1,000,000 pieces of oysters are caught and farmed every year, respectively. Croatia is one of the rare areas where the endemic European Oyster (*Ostrea edulis*) has survived. In most other places in Europe, the Japanese Oyster (*Crossostrea giegas*) is used in oyster-farming. Today, the largest obstacle is the availability of spawn. Croatia is investing in research and development, e.g. The Bistrina R&D Centre has been successful at producing spawn in controlled conditions[155]. The pristine conditions of the water in the Velebit Channel provide the adequate habitat for spawn development and, therefore, a significant cost-savings potential.

There is no freshwater fish-farming in rivers in the Velebit water basin. However, there is a successful trout farm in the vicinity (Sinac, River Gacka), which has identical conditions. There are no known obstacles for its development in the Velebit region. The annual production of fish and fish products of this farm is estimated at 200 tons (85% California trout, 15% native brown trout[156]), with a gross value of 1,311,515 Euros in 2010[157].

In 2007, a study to assess the economic benefits (cost-benefit analysis) of the revitalization of endemic trout-farming in the Gacka River, which is applicable to the Lika River, as well as its tributaries because of its similar features (River Lika is a tributary of River Gacka), concluded that if a production of 200 tons per year is reached, the gross benefit will be approximately 2,310,586 Euros (calculated at 60 kn/kilo or 8.2 Euro per/kilo), and the tax benefit to the country was estimated at 1,149,451 Euros[158]. Wild trout prices carry much higher prices that that of farm trout.

Under the current BAU scenario, based in the limited information available, it is estimated that the total current benefits from fisheries is over 2 million Euros for the local population and small entrepreneurs, and 2.3 million in the form of taxes to the State, as well as 17,500 Euros tax income to the local government. Contrary, in the SEM scenario, it is estimated that with medium investments, the annual net revenue could be four times higher than BAU, i.e. almost 10 million Euros and as much in taxes[159]. In the same time frame, local authorities would earn more than 70,000 Euros annually from concessions. In addition, the potential employment increase could result in significant savings from reduced spending on social benefits in the area, which is currently troubled with high unemployment (20.8% unemployment rate in Licko-senjska County in 2010[160]).

[155] EKOFARM, 2007. Starigrad Municipality, *Development Project Plan for Starigrad Municipality*, Analysis of growing mussels and oysters in Starigrad Municipality
[156] Leko d.o.o. Official web page
[157] FINA – National Financial Agency; Register of Annual Financial Reports
[158] Čož-Rakovac, R., 2007. Revitalisation Model for Creek Trout Farming; Questionnaire - Licko-senjska County
[159] The calculation below is based on successful examples of trout farming in Sinac, River Gacka in almost identical natural and market circumstances that trout farms on River Lika would have. In the case of shellfish farms, calculations were made for southeast part of Velebit Channel that does not administratively belong to Velebit Nature Park, however, reflects all its natural features.
[160] Licko senjksa County Economy Overview 2010, Licko senjksa County official web pages

2.6 Forests

Over 44% of the country's territory is covered by forests[161]. The Croatian Forest Act (OG 140/05) recognises forests importance and therefore forests are protected. However, forest management programs to ensure adequate protection are underfunded. The Act identifies many eco-services that forests produce as beneficial functions such as:

- Protection of soil from water and wind
- Regulation of water cycles and prevention of torrents and high-water waves
- Purification of water by filtering through soil, as well as supplying underground streams and springs with drinking water
- Favorable impact on climate and agriculture
- Purification of polluted air
- Landscape attractiveness
- Creating favorable conditions for human health
- Ensuring space for rest and recreation
- Enabling development of eco-tourism, hunting, and rural tourism
- Preserving genetic resources
- Preserving biodiversity, ecosystem functions, and landscape
- Mitigation of greenhouse effects, carbon sequestration, and provision of oxygen
- Preserving valuable natural capital
- Importance to national defense and development of local communities.

There are vast forest communities in the National Park Northern Velebit (NPNV) and the Nature Park Velebit. Forest covers 60% and 55% of the territory of the parks, respectively. Table 24 includes a list of 15 forest communities present in the forest ecosystem of the Velebit Mountains.

Table 24. Forest communities of the Velebit Mountains

• downy oak and hornbeam forest • hop hornbeam forest • black pine and cotoneaster forest • hop hornbeam forest with heather • Jerusalem thorn and buckthorn patches • durmast oak and hornbeam forest • beech forest giant deadnettle • subalpine beech and sycamore maple forest • subalpine spruce forest with adenostyles • Downy oak and hornbeam	• black alder forest with white yellow sedge • beech forest with white vilburnum shrubs • maritime beech forest with autumnal moor grass • durmast oak forest with vilburnum shrubs • dinaric beech/fir forest • sycamore maple forest with perennial honesty • mountain spruce forests with forest agrimony • dinaric fir forests on limestone blocks • dwarf pine and honeysuckle forest

Source: Velebit Nature Park Management Plan, 2007.

In accordance to the Ordinance on the Internal Order of the Northern Velebit National Park (OG 75/00), logging and reforestation is strictly forbidden (Article 12). Sanitary logging and reforestation are allowed, exceptionally, for the purposes of preservation of human forest

[161] Mamut, M., 2011. Ties Between the Geographical and Social Geographical Features of Dalmatia With the Endangerment of Forest Fires – Forestry News No. 1–2, cxxxv (2011), 37-50

communities'. Collection of wood, reforestation, and sanitary logging is allowed for the landowners who still have land inside the National Park; however, they rarely use this privilege. Nevertheless, logging and timber production is the major source of income in the areas surrounding the parks, such as Krasno Polje village. There, two wood-mills operate at the level that it requires bringing in workers from the surrounding area.

Forest management and economic use is allowed in most of the Nature Park Velebit, however, not in National Park Paklenica (located within NPV). Management and economic use is allowed at the surface of 81,017 ha or 73.7%. Forestry and wood processing represents the most important economic activity and source of income for the local population, especially in the inland areas. Apart from forests in the national parks, forests in areas of soil erosion risk are also protected. These forests are usually located at the steep coastal slopes of predominantly rocky ground[162].

Forest ecosystems provide a valuable services such as: i) control of soil erosion, ii) wood products (timber), iii) carbon storage, iv) health services – production of clean air, and v) natural disasters mitigation. This section addresses soil erosion and carbon sequestration. According to B. Prpić, (2002) the estimated economic value of standing forest is 40 times higher than its value as timber and forest by-products; this includes all – anti-erosion, climate, greenhouse, and other values[163]. Other forest services, such as fresh water and natural disasters mitigation, are discussed in Section 3.

However, forest services in Velebit are threatened by the impact of forestry activities that result in encroachment on PAs and disruption of ecological corridors[164]. For the purpose of this report, "encroachment" is used to describe the advancement of structures, roads, railroads, improved paths, utilities, and other development; the removal or change in vegetation (e.g., agriculture and exploitation of forest resources); or an alteration of the topography of natural areas as mountain slopes, floodplains, river corridors, wetlands, lakes and ponds, and the buffers around these areas. These encroachments cause impacts to the functions and values of those natural areas, such as declines in ES like: water quality and quantity degradation, loss in habitat (both aquatic and terrestrial), loss of flood attenuation, or reduction of ecological processes[165]. Economic activities in and around PAs can lead to encroachment on PAs by local communities. Such situations are a consequence of traditional BAU practices in natural resources management.

According to the Food and Agriculture Organization (FAO) (2011), forestry includes a range of activities that may cause negative environmental impact when carried out without adequate environmental standards. Table 14 includes a list of these activities.

Table 25. Forestry activities with potential environmental impact

Activity*	Practiced in Velebit Region (close to PAs)**
Logging: clear-cutting and selective	YES (selective cutting)

[162] Nature Park Velebit, 2007. *Nature Park Velebit Management Plan*, Ministry of Culture of the Republic of Croatia

[163] Prpić, B., 1992. Ecological and Economical Value of Forest in Croatia, Forestry Faculty, Zagreb University, Monograph of Forest in Croatia

[164] Ecological Corridor is an environmental component or series of such components that allow the movement of populations of living organisms from one site to another.

[165] Based on Vermont Water Quality Division, US.
http://www.anr.state.vt.us/dec//waterq/wqd_mgtplan/stressor_encroachment.htm

Forest clearing with fire	NO
Forest roads, skid trails, and yarding areas (construction and use)	YES
Log hauling by road	YES
Logging camps	YES (e.g., Štirovača, within the NP)
Log floating (transport using waterways -rivers/lakes-)	NO
Sawmilling, charcoal making, and other wood transformation	YES (excl. charcoal making)
Demographic and economic expansions associated with forestry	YES (e.g., Krasno and Kutervo)
Reforestation, afforestation, and shelterbelt planting	YES

Source: *FAO (2010), ** Tihomir Devcic, NP Northern Velebit (Head Supervisor Ranger) and Ivana Maras, Forester at VNP

Logging alone (clear cutting and selective) may have a wide range of impacts on landforms and soils, climate and air quality, water resources, vegetation, wildlife and fisheries, traditional cultures, and subsistence economy, conservation, and epidemiology. An extensive list of potential impacts related to forestry is provided in Table 26.

Table 26. Potential impacts of forestry activities in and around protected areas

Landforms and Soils: - slope, bank or shore instability - rill, gully or shoes erosion - loss of nutrients and organic matter - decrease or alteration of micro-flora and fauna - decrease in action-exchange capacity - soil compaction - laterization - rutting and swamping of soils - - burial of downslope soils as a result of excessive erosion and sedimentation **Climate and Air Quality**: - higher ground temperatures - local and regional desiccation of the climate - release of duet and fumes - release of CO2	**Water Resources**: - decreased infiltration and groundwater recharge - increased storm runoff - decreased base-flow; loss of dependable year-round discharge - local pending of water - increased turbidity - accelerated eutrophication - contamination of waters with hydrocarbons, biocides and wood preservatives - increased sediment loads, with detrimental effects on channel stability, aquatic life, useful reservoir life, navigation.	**Vegetation**: - high forest may not regenerate itself - whole species may become extinct - genetic erosion as a result of selective cutting of superior trees - reduction of the total population of one species - undesirable secondary forest growth - influx of persistent weeds - seed trees may not survive mechanical damage and "isolation shock" - adjacent uncut forest may be damaged by machinery, wind-throw, fires, illegal felling, sedimentation, hydrologic changes and intensified shifting cultivation - regeneration may be affected by changes in the populations of animals that act as pollinators or seed vectors - regeneration of useful species may be aided by the culling of over- age or defective trees.
Wildlife and Fisheries: - some animals may be killed outright - nesting sites, including hollow trees, may be eliminated or damaged - feeding and breeding grounds may be eliminated - spawning and nursery areas and bottom organisms (benthos) may be damaged or destroyed by sediment or logging debris - animals may be displaced by noise and human presence - displaced animals can induce reproductive and other stress in existing animal populations in uncut forest - entire rare and endemic species can be eliminated - some animals can be favoured by new browse and habitats created by	**Traditional Cultures and Subsistence Economy**: - traditional shelter, food and other resources of forest dwellers could be reduced or eliminated - in remote areas, "culture shock, and attendant social unrest could occur - damage to or destruction of sites of religious or other heritage value - disruption of local non-cash economy (assuming that preservation of a subsistence economy is the desired goal of local residents) - temporary increase in fuel wood supply - long- term decrease in fuel wood supply - conflict over job opportunities or	**Conservation**: - damage to existing conservation areas (parks, game reserves, protection forests, etc.) either directly or indirectly by affecting the buffer zones around these areas - damage to conservation areas that have vague legal statue or that are poorly demarcated on the ground - disruption of conservation plane by affecting areas that have not yet been set aside loyally or administratively - reduction in the amenity value of a region through adverse visual effects (as perceived from roads, settlements, navigable rivers, vistas inside parks), increased turbidity of streams, debris in streams, heavy road traffic and displacement of fauna **Epidemiology:** - higher incidence of malaria (exposure of

logging; however, some of these animals can become pests or disease vectors - some herbivores can be displaced and made dependent on agricultural crops	lack thereof in the forestry sector - increase in shifting cultivation	stagnant water) and other diseases - more contact between vectors of arbovirus diseases and man - creation of habitats for potential animal vectors of diseases (mainly grasslands invaded by rodents) - introduction of diseases by forestry workers - - reduction of incidence of certain diseases through selective clearing (e.g. trypanosomisais)

Source: FAO (2010)

In Croatia, most of the forest is state-owned[166]. On the national level, only 26% of forest is privately held and, even in this case, forest owners need an approval from forest authority to carry out their forest management plans. Forest is governed by Croatian Forests Ltd., the state-owned company for forest management. All state-owned forests are Forest Stewardship Council (FSC) standards certified, which means that 74% of total Croatian forests are sustainably governed. FSC certification means that forests are being managed according to strict ecological, social, and economic standards[167]. Further, the long-term vision of the Ministry of Rural Development, Forestry and Water management (MRDFWM) is to extend certification to privately- owned forests in order to reach 100% FSC certification by 2020[168].

Based on the above discussion and for the purpose of this report, forestry[169] management in and around PAs in Velebit is considered under SEM. However, the team was not able to find evidence of how the potential impacts of forestry activities are carried out and, therefore, it is not possible at this point to estimate the impact of forestry in NVNP and VNP. For this reason, PA forest[170] management programs are considered under BAU.

Soil erosion prevention

It is known that standing forest controls soil erosion; deforestation can increase erosion, depending on the use that is made for deforested areas. Forests, – through the root system of trees and other plants in the forest ecosystem, which holds nutrients for disposal through treetops and branches, as well as through leaf ground cover, and by the capability to regulate water uptake – keep the soil fixed to a location[171]. In Velebit, this forest service results in less stripping and reducing of rock exposure. It also increases optimal sedimentation in the surface and underground water, part of which filters to the sea and improves breeding areas for fish; Forest also prevent the creation of ravines,[172] which would further destroy the landscape and groundcover. The role of forest in soil

[166] Ibid, 2011
[167] Croatian Forests Official Web Site
[168] Ministry of Regional Development, Forestry and Water Management
[169] **Forestry** is considered a professional productive activity that uses forest ecosystem services (timber) as raw material for wood products. However, "modern forestry" practices should involve a range of dimensions to ensure that forestry supports wildlife habitat, maintain fresh water quantity, nature-based recreation, landscape and community protection, employment, biodiversity protection, watershed management, erosion control, and climate change mitigation (sinks for CO2).
[170] **Forest management** refers to the overall environmental, economic, legal, and social aspects of protected forests, and with the scientific and technical aspects, especially protection and regulation. It includes management for specific purposes such as: aesthetics, recreation, water supply, wilderness, wildlife, non-timber products, forest genetic resources and other forest resource values.
[171] Ibid, 2010
[172] A "ravine" is a landform narrower than a canyon and is often the product of stream-cutting erosion.

erosion prevention is particularly important on steep terrains where the forest prevents erosion, but also reduces the erosion impacts of higher ground. The prevention of solid erosion is, in general, a beneficial function of forests, especially for settlements close to forested areas[173]. Table 16 illustrates the importance of forest in soil erosion reduction[174].

Table 27. Importance of forest in soil erosion

Vegetation cover	Agriculture field	Meadow	Unploughed field	Hardwood forest	Conifer forest
Annual loss of soil (Ton/km2)	1000	80	7	5	1

Source: Ursic, Dendyu (1985)

The experiment in Abrami (Istria, Croatia) set in 1970 showed how drastic is the influence of forest on aquatic erosion prevention. In Bracane drainage basin, at the Mirna River, at bare steep settings, the yearly erosion deposit was as much as 5,380 $m^3/km,^2$ while at greenish and woody land cover areas, it resulted 590 $m^3/km,^2$ and, finally, at oak forest locations, 624 m^3/km^2 [175].

The valuation team did not find data on soil erosion in the Velebit region, and Croatia has increased the amount of forest in recent years. According to FAO, 34.3% or about 1,920,000 ha of Croatia is forested. Of this forested land, 0.4% (7,000 ha) is classified as primary forest, the most bio-diverse and carbon-dense form of forest[176].

Nevertheless, NPV is considered highly threatened by one of the most severe soil erosion problems in Europe, caused by severe deforestation in the past that was never addressed. This is a major problem in the coastal part of the biosphere reserve of Velebit. In addition, current activities that contribute to soil erosion, in an already sensitive region, include: construction of new forest trails and roads, illegal hunting activities, increased tourism, severe tapping of water resources, collection of plants and butterflies, and expansion of urban areas along the coast[177]. This could lead to a significant decrease in tourism revenue as the park continues to neglect visitation and monitoring programs, due to a lack of adequate funding; this is a typical BAU scenario.

Carbon storage

Most recently, and in the light of governments taking action on mitigation and adaptation to climate change (CC), PAs have emerged as one of the strategies for climate change mitigation. PAs provide an important carbon storage service: millions of tons of carbon are accumulated in PA land covered by forest. The value of such service and possible payment for it is the center of current debate.

Globally, forest clearance contributes 20% of CO_2 emissions. Reducing forest loss lowers emissions and, thus, is a critical service provided by PAs. Payments for carbon storage in PAs could mean significant revenue to nations with standing forest (i.e. foreign exchange transfers and funding to

[173] Prpic, B., 2002. *General Beneficial Features of Park Forests Vrhovec, Jelenovac, Pantovčak, Prekrižje, Kraljevec, Zelengaj i Tuškanac – Dubravkin put – Cmrok*; Forestry Faculty, University of Zagreb.
[174] Ibid, 1985
[175] Prpic, B., 2002. *General Beneficial Features of Park Forests Vrhovec, Jelenovac, Pantovčak, Prekrižje, Kraljevec, Zelengaj i Tuškanac – Dubravkin put – Cmrok*; Forestry Faculty, University of Zagreb.
[176] http://rainforests.mongabay.com/deforestation/2000/Croatia.htm#03-deforestation
[177] http://www.campparadisodrage.com/english/surroundings/nature-parks/nature-park-mount-velebit.html

pay for the transition to SEM). The argument for that transfer is valid if PAs are under direct threat of deforestation. Direct threats mainly include illegal logging and, potentially, legal forestry activities within PAs, such as in the case of NPV.

The actual amount of carbon sequestered by a forest depends on a large number of factors, including the region of the country, the type and mixture of trees in the forest, the age of the trees, the site class (relating to the height of the dominant trees at 50 years of age), and the reference land use as a baseline (e.g., clear cut forest, cropland, or pasture). For example, the U.S. Environmental Protection Agency (EPA)[178] estimates that planting one acre of trees on marginal land would sequester 0.6 to 1.6 metric tons of carbon annually in the first five years of growth. Assuming that planting one acre of trees in the Southeast of the US will sequester about 1.0 ton of carbon each year (slightly less than the median of the EPA estimated range), and that 1.0 ton of carbon is contained in 3.67 tons of CO_2, then one acre of trees planted on marginal land will sequester (save, reduce, or prevent from escape to the atmosphere) about 3.67 tons of carbon dioxide each year during the first five years.

Currently, 2,135,000 hectares of Croatia's territory is covered by forest, and Velebit's forest is approximately 5% of the total forest in the country[179]. Velebit Nature Park (including SVNP) has over 117,034 hectares (or 289,074 acres[180]) of native forest, which are storing approximately 1,069,574 tCO_2 (1 acre=3.7 tCO_2); with a market value of USD 8,342,677 (6,061,097 Euros), considering a conservative market value of USD 7.8 Per/tCO_2 (Hamilton et al., 2010)[181]. However, under the Kyoto protocol, approximately 53,282 tCO_2 are recognized[182]. Thus, the market value of the Kyoto Protocol allowance is approximately USD 415,599 (302,436 Euros), considering the same conservative market value of USD 7.8 per tCO_2. If a higher price per tCO_2 is used (14.5 Euros)[183], the value will be 772,589 Euros. Assuming that all factors remain constant (price of carbon credit, minimal stock growth), this is the estimated value of the forest carbon storage service provided by VNP when Croatia enters the EU and ETS system (European carbon trading system) in 2013. The total value of the carbon stored in VNP, using the same 2009 European average, will be 15.5 million Euros. Therefore, for the purpose of this report, the carbon storage service provided by forest is considered under SEM.

To date, there are no emissions trading structures present in Croatia; however, the preparations are ongoing. Croatia ratified the Kyoto Agreement in 2007. Since then, it had passed regulations and took actions towards fulfilling both, its obligations towards UNFCC, as well as EU, in the area of climate change and greenhouse gas emissions reduction. Croatia passed a Regulation on Emission Quotas of Greenhouse Gas Emissions and Procedures for Emission Units Trading (OG 142/08, 113/10), which includes industry emissions, as well as emissions from the civil aviation and Greenhouse Gas Emissions Quotas Distribution Plan (OG 76/09). This was followed by the distribution of the national quota amongst industries.

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[178] http://www.epa.gov/

[179] FAO, Country Overview

[180] Conversion: 1 hectare = 2.47 acres

[181] According to Hamilton et al. (2010), prices for forest carbon credits ranged from \$0.65/tCO_2 to more than \$50/tCO_2, but over time, the volume-weighted average price was \$7.88/tCO_2 which is the price used for calculating estimated value.

[182] Estimation based on share of Velebit forest in total national forest and estimation of forest CO_2 intake recognised by Kyoto Agreement. Croatian Forests do not consider specific data on forest stock public.

[183] Forbes (2009). The estimated cost of carbon varies, but no matter who does the math, it is increasing. A. Sundaram of Dartmouth University's gives an average price of \$20 per ton of carbon dioxide – which is consistent with European Union prices over the past two years. Looking into the future, the not-for-profit Investor Responsibility Research Center prices carbon at \$28.24 per ton in the year 2012. http://www.forbes.com/2009/06/03/cap-and-trade-intelligent-investing-carbon.html

The Kyoto Protocol recognized less than 10% of total national carbon sequestration. Depending on the ongoing negotiations Croatia might soon be granted higher limit (972,000 tCO_2), which means each forest (including Velebit) will be granted higher contribution to the overall Kyoto target, thus acquiring higher value of proportional savings for Croatia, i.e. less investment or purchasing of carbon dioxide emission permits. Further, the price per tCO_2 continuous to increase (estimated at 16 Euros by 2010[184]), and therefore, the total value of carbon sequestration will probably be much higher[185].

3 Human well-being

This section discusses how ES contribute to human well-being by providing clean fresh water to sustain a healthy population and forest ES help to prevent and mitigate natural disasters. In addition, this section discusses how ecosystems contribute to poverty alleviation by supporting the production of livestock and dairy products, honey, and crops, and the additional income provided by nature-based tourism.

3.1 Fresh water

The Valebit Nature Park area is characterized by complex precipitation patterns. In the highest parts of Velebit, average annual precipitation exceeds 3,000 mm, which mostly falls in the most exposed area of southern Velebit (1,200–3,000 meters). Precipitation totals decline from southeast to northwest. In the outer edge of Lika, annual precipitation (1,884 mm) is higher than in the coastal slope of Velebit (1,188 mm). Almost two-thirds of the precipitation may occur in the winter half year.

In Velebit, the number of days with a snow cover higher than 30 cm varies widely. It is estimated that the highest parts of Northern Velebit are covered in snow for about 70 days a year, and the top of Southern Velebit is covered in snow for over 100 days a year. On the Lika slope of Velebit, snow cover may last between 20 to 40 days[186]. Part of the rainfall and snow melt in the VNP ends up in groundwater tanks and springs. Most of the water that falls in the western part of the National Park flows through underground channels to the Adriatic Sea, making the water of this coastal part brackish and extremely clean[187].

The company Vodovod Senj Ltd. is the primary distributor of water from the River Lika. Only chlorine is added to the water before distribution by local water distributors. There are four companies in the Licko-senjska County, as well as companies outside the County, which together supply water to almost 40,000 inhabitants. Vodovod Senj Ltd. supplies water to the continental part of Senj Town (as an administrative unit), and further sells to the towns/municipalities of Senj, Raba, Paga, Novalje, and Karlobag. Vodovod Senj Ltd supplies water directly to 25,316 people in these counties[188]. The Town of Gospić, with 12,980 inhabitants[189], also receives water from Vodovod Senj

[184] Estimation based on share of Velebit forest in total national forest and estimation of forest CO_2 intake recognised by Kyoto Agreement. Croatian Forests do not consider specific data on forest stock public.
[185] Ministry of Environmental Protection, Physical Planning and Construction, 2011. *Draft National Implementation Plan for Article 3.4 Kyoto Agreement.*
[186] http://www.campparadisodrage.com/english/surroundings/nature-parks/nature-park-mount-velebit.html
[187] Dubravka Kljajo, Geologist, Nothern Velebit National Park expert, Interview held 8 February 2011
[188] Vodovod Senj Ltd. water supplying company
[189] Croatian Bureau for Statistics, 2001 census.

Ltd. This company supplies water taken from the River Lika through an underground tunnel that transfers water from the Lika to the River Gacka. It is estimated that 35% of this water originates from the Velebit catchment[190]. In total, over 75,000 people benefit from clean water provided by PAs in Velebit.

The annual production of water varies from 3,500,000 m^3 – 3,800,000 m^3 (3,650,000 m^3 average). The price of water (m^3) is seasonal. For example, 0.27 Euros (1.98 Kn) are charged in July and August, and 0.26 Euros (1.89 Kn) the rest of the year. July and August are the months with the largest demand for water because of the tourism season. Further, the water price is dramatically low compared to the average in the EU. Currently, the typical water price/m3 in the EU is around 5 Euros (consisting of: Water: 20%, Wastewater: 44%, Water tax: 14%, Wastewater tax: 2%, and VAT: 20%)[191].

Further, losses in the distribution network in Licko-senjska County are estimated at 59%[192]. However, this is not solely the problem of Licko-senjska County, but for Croatia in general – the average loss in distribution in whole of Croatia is (46%)[193]. The highest loss recorded was in Municipality of Plaški, Karlovačka County, with 80% losses in distribution[194]. Subsidised water prices and losses in the distribution network are a typical BAU scenario.

On average, the value of annual water production is estimated at 949,000 Euros (at 0.26 Euros/m^3), however, in more realistic terms, considering the EU average, the value is 18.5 million Euros, which could pay for some of the mentioned externalities.

Wastewater treatment facilities are few and mostly out of service. This is another evident BAU scenario. It causes a severe negative externality. Most large settlements have no operating wastewater treatment facilities or completed sewage system, most of the surface waters (rainfall) as well as a large proportion of water from cesspits and open channel wastewater systems end up in rivers and streams. A case in point concerns the town of Gospic, the County Capital, which only has a partly-built sewage system that discharges waste water into streams and rivers (Novčica which presents the River Lika tributary) without any treatment.

For the purpose of this report, and based in the above environmental issues, current water management in Licko senjska County is considered under BAU. However, most of the negative impact takes place in the lower watershed. For example, this is the case in nearby towns such as Gospić, Lički Osik, Perušić, and Otočac, where water is not suitable for irrigating fruits, vegetables, and other agricultural products. This may results in significant economic losses and health-related problems to the local people. However, further downstream, water is purified due to more water input and natural purification through ecosystems.

In other regions, where no such clean water is available, such as in Osijecko-baranjska County in Northern Croatia, the cost of water treatment before distribution is estimated at 0.44 Euros/m^3,

[190] Stroj, *A. 2010. Undercurrents in the Hinterland of the Coastal Karst Springs in the Area of Velebit Channel.* Doctoral dissertation. Mining, Geology and Petroleum Engineering Faculty, University of Zagreb, Croatia
[191] Euro-Mediterranean Information System on know-how in the Water Sector, International portal. Water pricing in some EU countries. http://www.emwis.net/topics/waterpricing/water-pricing-some-eu-countries/
[192] Newsletter - Occasional Gazette of the Institute for Public finances (No. 37, July 2008)
Anto Bajo and Branimir Filipović: Distribution of Water Supply in Croatia
[193] Ibid 4
[194] Water Distribution System in Municipality Plaški Report, United Nations Develpoment Programme, Office Croatia, 2011

while in Velebit, the investment required for water treatment before distribution is only 0.0037 Euros/m^3. Clean water from PAs in Velebit represents additional savings to Licko-senjska County estimated at 155,322 Euros (0.43 Euros/m^3)[195].

The shift to the SEM scenario will require significant policy reform and investment (including approximation to EU directives and practices), which can partly be addressed through realistic water pricing policy.

3.2 Disaster prevention and mitigation

Box 6. 2010 stone slide in Makarska, Vrgorac, Dalmatian Coast, Croatia.

Forest on krast[196] formations is a particularly important to prevent erosion-related natural disasters. For example, after fire-related deforestation, soil erosion intensifies, due to the high water permeability of krast and land inclination. More than 75% of Mediterranean karst has an inclination degree of 5% which results in a high degree of mechanical depletion and interaction with water[197]. Forests, then, help address the erosion risk associated with krast land formation. Apart of soil erosion forest degradation in the case of karst forests influences water regimes as well as causing stone escarpment[198].

Poor forest management and the resulting deforestation-related erosion in krastic areas could be costly. One such example is a stone slide that occurred, November 2010, in Makarska, Vrgorac, on the Dalmatian coast where stones blocked traffic on the state road between Makarska and its hinterland. Croatian Roads (State road construction and maintenance company), noted that the short-term solution of removing the stones and installing nets to prevent slides will cost 328,737 Euros[199] (Box 6); and that, in the long term, it will be more cost efficient to build a tunnel than periodically remove the stones. In April this year (2011), tunnel construction, worth 3.4 million Euros, began[200]. At the national level, in 2005, 9.5 million kunas (1.3 million Euros) were invested in landslide recovery at local and regional roads in Croatia.

There is no reforestation activities in the above indicated slide area, due to the fact that this karstic area consists of bare rock. In the past it is assumed that the rocks were covered with layers of soil

[195] Cost in Northern Croatia (0.44 Euros) minus cost in Velebit (0.0037 Euros)*average annual water production (3,560,000 m^3)
[196] Karst topography is a geologic formation shaped by the dissolution of a layer or layers of soluble bedrock, usually carbonate rock such as limestone or dolomite.
[197] Mamut, M., 2011. Ties Between the Geographical and Social Geographical Features of Dalmatia With the Endangerment of Forest Fires – Forestry News No. 1–2, cxxxv (2011), 37-50
[198] An **escarpment** is a steep slope or long cliff that results from erosion or faulting and separates two relatively level areas of differing elevations.
[199] Slobodna Dalmacija, News from Zagreb: Tunnel construction at Stupica to commence in a few days 1.4. 2011.
[200] Croatian Roads Press Release , April 2011

and forest[201], and centuries of unplanned logging and erosion resulted in total rock exposure, beyond repair[202].

On the other hand, in Licko-senjska County, the Department of Roads maintains and manages mostly inland roads of the County, where forest is the predominant soil cover. This average annual spending of the Department on landslides is estimated at 4,110 Euros. The average annual number of small rock slides is 30 in the 1,355.4 km of roads (75% of total county roads). The rest of the roads across VNP are local and State-owned. During 2010, there were no reports of landslide incidents neither in the VNP nor in the coastal area.

Although in 2010 Velebit Nature Park did not invest in reforestation, 11,644 Euros were invented in forest fire prevention. In Licko Senjska County and the rest of Croatia, however, a great deal of money is annually invested in regular maintenance as well as for fire control interventions. Table 28 shows the investment in State roads in Croatia, between 2001 and 2008.

Table 28. Investment in State roads in Croatia, between 2001 and 2008

Expenses (in million Euros)	2001	2002	2003	2004	2005	2006	2007	2008	Total
Regular maintenance	22.8	38.3	42.2	50.5	48.6	52.9	56.0	62.2	373.4
Unplanned/Interventions	14.9	29.9	31.1	46.2	42.7	53.6	53.2	99.8	371.5
Total	37.7	68.2	73.3	96.8	91.3	106.4	109.2	162.0	744.9

Source: Proceedings of the Fourth Croatian Road Maintenance Conference, 2009

Reforestation is expensive and a long-term activity, however, payable and rewarding. For example, investments in reforestation in Licko-senjska County at Senjska draga is already showing beneficial results in reducing wind gusts, abating floods and torrents, reducing climate extremes, creating conditions of occurrence of drinking water, and increasing the touristic value of landscape[203].

For the purpose of this report, the current situation with respect to rockslides is considered SEM. In this scenario, forest resources are an indispensable factor in generating cost-savings for road repairs.

3.3 Contribution to poverty alleviation

Assessing the effects of ecosystems in PAs on poverty is a complex task and requires attention to a range of issues related to rural poverty, like income, livelihood security, access to infrastructure and markets, education, empowerment, gender equity, health, and access to natural resources. Such issues exceed the limited scope of this report, which will focus on the benefits related mainly to agriculture.

Grasslands, livestock and dairy production

Ecosystem services of Velebit PAs provide most of the inputs for cattle and dairy production, such as clean water and good forage for animals. Thus, ecosystems ensure not only high quality products,

[201] Croatian Forestry Institute, 2011
[202] Croatian Forest, Forestry Administration Split, 2011
[203] Prpić, B., 1992. Ecological and Economical Value of Forest in Croatia, Forestry Faculty, Zagreb University, Monograph of forest in Croatia

but trust and loyalty from buyers who are increasingly concerned about the environment and quality of food products. In the Velebit region, there is a range of high and low grass vegetation, which constitute prime feed for cattle. See Table 29.

Table 29. Communities of meadows, heaths, and grass in Velebit.

Plant community of meadows and heats • Narrow-leaf blue grass and carnation grass turf (*As. Seslerio tenuifoliae-Carietum firmae*) – in the coldest and most exposed peaks of Velebit Mountains • Mountain swards of evergreen sedge and narrow-leaf moor grass (As. *Carici sempervirenti-Seslerietum tenuifoliae*) • Mountain turfs consisting of Kitajbel's sedge and alpine rockrose (As. *Carici kitaibelianae-Heliantehemum alpestris*) • Mountain turfs consisting of Kitajbel's sedge and Balkan rockrose (As. *Carici kitaibelianae-Heliantehemum canum f. balcanicum*) • Sharp fescue turf (As. *Festuceum bosniacae*) is the predominant turf at lower, warmer positions • Meadows of uspravnog ovsika and medium plaintain (As. *Bromo-Plantaginetum mediae*) • Sub-mediterranean viper's grass fields consisting of *Scorzonerion villosae* associations • Brackens – assemblage with *Pteridium aquilinum*	• Hard mat-grass fields (As. *Nardetum strictae*) growing on acidy, deep soils, often at bottom of depressions • Rocky tract pasture of red sedge and yellow knapweed (*As Carici-Cantaureetum rupestrisis*) • Heather and grassy bell (As. *Saturejo-Edraianthetum*) at sub-Mediterranean zones on exceptionally skeletal soils • Heaths (*Genista radiate*) • Moor grass *Juniperus nana* and *Arctostaphylos uva-ursi* **High grass communities** • Dinaric communities of As. Adenostylo and Austrian viper's grass (*Doronicetum austriacae*) • Thistle and wolfsbane community (As. *Carudo-Aconitetum*) • Mountain knapweed and victory onion (As. *Centaureo-Allietum victorialis*)

Source: Velebit Nature Park Management Plan

The Velebit regions provides the perfect habitat for the endemic Buša livestock (reads: Buscha). It is the only breed that can survive the harsh weather conditions in the winter and graze at high altitude, and it does not require much care or water. Buša is a smaller cow than conventional breeds such as Holstein and Simmental, with its productivity lower in almost every domain – it gives 700-800 litres of milk yearly, while the Licko-senjska average is 1994 per head and Croatian average 2,275 per head[204]. Therefore, Buša's dairy production costs are low.

Also, the Buša is critical for the ecosystem because they regulate natural meadows and grasslands. The dramatic decline of this endemic breed has resulted in loss of biodiversity habitat, as well as increased invasive species (forest and weeds). Forest is considered invasive species because in the absence of grazers (large game such as deer, chamois, and cattle), natural and domesticated, forest overtakes the meadows. Although meadows, heaths, and moors are not endemic (resulted from human activity over decades), they are now considered an integral value of the park.

The populations of other grazers (chamois, deer, etc) have also been reduced because they are intensively hunted, despite the hunting prohibition within the National Park and 500 meters around it. Although the park has plans to preserve native Croatian cattle breeds, they lack funding. In addition, by maintaining meadows and grass lands, grazers also contribute to maintain ski slopes

[204] Croatian Agency for Agriculture, 2010

and cross country ski routes. This has a cost reduction effect on winter tourism (ski) operations. Tourism is discussed in Section 3.4.

In Licko-senjska County there are as few as 50 Buša, while there are 7,320 livestock from different breeds[205]. The majority of Buša are in the most southern county of Dubrovacko-neretvanska but the population had decreased by 2010 to 25 bulls, 240 cows, and 185 calves, in the whole of Croatia[206].

Buša milk is of excellent quality with 4-6% milk fat[207]. For this reason, local cheese producers are very interested in increasing the number of Buša cows, and opening small farms and winter "stations" (in the summer Buša are taken to higher latitudes where mountain herbs provide a special taste to the milk). The whole production purchase was ensured and local cheese producers are confident that cheese from Buša milk can reach at least 100% higher price than other Velebit cheese[208]. In addition, farmers are confident that Buša will render similar benefits than those of the successful old Istrian cattle breed "Boškarin"[209], which has a much higher price than regular beef[210]. However, under the BAU scenario, there are significant obstacles to reintroducing Buša:

- There are many small plots of meadows or overgrown meadows that are not in use and the ownership is unknown or in dispute
- There are many small plots of meadows or overgrown meadows where owners are not willing to lease or sell them, therefore the forge sufficiency is in question, not because of lack of resources and land in general, but due to social and psychological reasons
- High starting cost (construction of winter shelters)
- Lack of breeding units
- Substantial reduction of financial incentives for keeping and breeding Croatian endemic breeds[211].

In the current BAU scenario, the government of Croatia is paying insignificant subsidies to support the reintroduction and breeding of endemic grazing species: for instance, 3,000 kn (405 Euro[212]) annual subsidies for endemic cattle (Lička buša is the most relevant in this case), 600 kn (81 Euro) for donkeys (Primorsko- dinarski magarac as the most relevant), and 350 kn annually (47 Euro) for sheep[213]. If properly managed, keeping donkeys has additional touristic potential (guided donkey-rides in the park).

In the BAU scenario, more and more family-owned farms are closing down, with mass conventional production supported, if not co-financed through systems of subventions to large farmers who can access international funds, e.g., IPARD[214]. If BAU continues, it is likely that the productivity of the

[205] Economic Overview of Licko-senjska County, 2003; Licko-senjska County Department for Economy
[206] Croatian Agency for Agriculture, 2010
[207] Croatian Agency for Agriculture, Interview
[208] Tommaic commerce, Runolist Dairy, Interview
[209] Boškarin is traditional, autochthonous, Istrian ox breed (Istria is a peninsula in the northern Adriatics). It is coming out of the extinction due to clever marketing of Boškarin products (especially meat) making the farming of Boškarin profitable
[210] AZZRI – Agency for Rural Development of Istria
[211] Measures 101 "Investing in Agricultural Units", 103 "Investments in Processing and Marketing Agricultural and Fishing Products" and 302 "Diversification and Development of Rural Economic Activities". Total IPARD fond available for the Republic of Croatia, in the period 2007-2011, is 179 million Euros (Source: Agency for Payments in Agriculture, Fisheries and Rural Development)
[212] Croatian National Bank exchange rate average in January 2011
[213] AZO [http://www.azo.hr/Default.aspx?art=538 consulted 25 February 2011]
[214] Measures 101 "Investing in Agricultural Units", 103 "Investments in Processing and Marketing Agricultural and Fishing Products" and 302 "Diversification and Development of Rural Economic Activities". Total IPARD fond available for the

Velebit and surrounding areas will fully shift to resource-depleting production activities, with the short-term gains and negative externalities[215] related to landscape deterioration and concurrent losses in both the quality of life and health of the local population.

Contrary to the BAU situation, in the SEM scenario, the adequate funding of conservation programs and increasing investment in "greening" agricultural practices will result in higher competitiveness, higher prices, and more sustainable profit margins for the producer. For example, in Velebit, the wholesale price of milk is as much as 22% higher for the price of milk and as much as 45% for the price of cheese[216]. Although productivity per a head is 12% lower than in the Croatian average[217], the price difference between conventional production in other places of Croatia and Velebit and surrounding can greatly overcome these disadvantages.

For example, when comparing the total annual production of milk and cheese between the Velebit region and other regions in Croatia, although the level of production is similar, in Velebit and surrounding areas, the annual net revenue is estimated at 4,766,922 Euros, 77 % higher than in other places in Croatia where conventional agriculture is practiced. In addition, it is estimated that Velebit's dairy sector currently contributes 4,089,842 Euros to the state tax (VAT). This illustrates that the shift to SEM is a critical step to increasing green productivity, and sustaining benefits such as employment of over 200 small producers, and eventually, in the long-term, contributing to reduce the demographic gaps in Velebit. Table 30 provides an overview of the difference between the two BAU scenarios and a potential SEM scenario with a production increase of 30% in a five-year period. Graphic 12 presents the potential growth under SEM.

Republic of Croatia, in the period 2007-2011, is 179 million Euros (Source: Agency for Payments in Agriculture, Fisheries and Rural Development).

[215] **Externalities** Measures 101 "Investing in Agricultural Units", 103 "Investments in Processing and Marketing Agricultural and Fishing Products" and 302 "Diversification and Development of Rural Economic Activities". Total IPARD fond available for the Republic of Croatia, in the period 2007-2011, is 179 million Euros (Source: Agency for Payments in Agriculture, Fisheries and Rural Development)
are defined as benefits or costs generated as an unintended by-product of an economic activity that do not accrue to the parties involved in the activity and where no compensation takes place. **Environmental externalities** are benefits or costs that manifest themselves through changes in the physical-biological environment. Negative externalities may result from many activities or products from PAs under BAU: unplanned tourism, land use or land conversion; use of water for irrigation, hydropower, industry and human consumption; the extraction of timber or minerals; and many others. To the extent that the ultimate consumer of these products does not pay these **environmental** costs, nor compensates people for harm done to them, they do not face the full cost of the services they purchase, and resources may not be allocated efficiently.

[216] Tommaic Commerce, Runolist Dairy, Interview

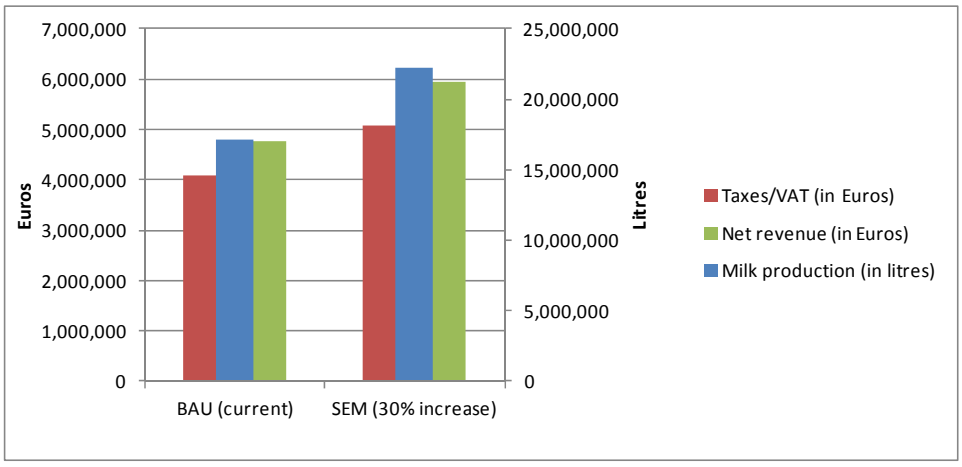
[217] Economic Overview of Licko-senjska County, 2003; Licko-senjska County Department for Economy

Table 30. Benefits of the dairy sector under different BAU scenarios

Estimated annual benefits from dairy sector - milk and cheese (in Euros)	BAU - Croatian average	BAU - Licko-senjska County	SEM - Licko-senjska County
Milk production	**2010**	**2010**	**30% production increase (by 2016)**
Milk production in litres	19,211,313	17,098,000	22,227,400
Milk price (Euros)	0.34	0.44	0.44
Gross revenue	6,531,846	7,523,120	9,780,056
VAT	1,502,325	1,730,318	2,249,413
Production cost	4,034,376	3,590,580	4,667,754
Net revenue	995,146	2,202,222	2,862,889
Cheese production 50% produced milk - wholesale			
Milk input (in litres)	9,605,656	8,549,000	10,258,800
Cheese production (in Kg)	1,372,237	1,139,867	1,367,840
Gross revenue	6,772,193	10,258,800	12,310,560
VAT	1,557,604	2,359,524	2,831,429
Net revenue	1,693,048	2,564,700	3,077,640
Total dairy			
Taxes (VAT only, excluding income tax)	**3,059,929**	**4,089,842**	**5,080,842**
Total net revenue	**2,688,194**	**4,766,922**	**5,940,529**
Increase as percentage compared to BAU Croatia		**77%**	**121%**

Various sources[218]

Graphic 12. Potential increase of benefits of dairy production under SEM, Velebit region



Source: Authors (based on various sources and using own estimates)

Overall, the extent of organic agriculture land almost doubled in two years (2007-2009) from 7,500 to 14,200 ha, and the share of organic culture regarding the whole agricultural land almost tripled in the same period, from 0.05 to 1.29 %; the number of organic farms almost doubled, from 477 in 2007 to 885 in 2009. Although this is considered a shift to SEM, funding to support the management

[218] Annual Report of the Croatian Cattle Selection Centre, 2001; Croatian Bureau of Statistics, Statistical Yearbook 2001 HSSC ; Holjevac Farm, Masaluk Vilage, Gospic, Licko-senjska County; Croatian Economic Guide; Grcic, Z., et al., 2005. Profitability Margin for Milk Production in Various Production Systems at Family Farms (most of the farms in Lika are small family farms), Stočarstvo 59:2005; Tomaic Commerce, Runolist Dairy; Glas Slavonije Daily; Brkanic, V. RRiF. Economic analysis; and "Retailers: DM with Highest Margins, Plodine Outgrew Metro's Revenue", October 2010.

of ecosystems that support organic agriculture with such services as pollination, fresh water, native species, etc. is neglected.

Honey production

Velebit's honey is highly appreciated and has a higher market price compared to honey of other areas (excluding siege honey from Dalmatia). Licko-senjska County has 91 bee-keepers. Local production is not able to fulfil market demand and, therefore, Croatia is importing honey from China, as well as continuously raising the prices of Croatian honey[219]. Honey products, especially from preserved areas such as Velebit, are well-positioned in Croatian traditional medical practices. Small producers are especially valued, and honey production is key to creating employment opportunities and supplement income for local people. The profit margin for local honey production is very high at 69%, with production cost low as well as the number of hours that needs to be dedicated to production[220]. The estimated total annual gross revenue per hive is 179 Euros (123 Euros net).

For the purpose of this study, honey production in the Velebit region is considered still under BAU. This is because production practices are still traditional, e.g., there is no investment in monitoring, research and development, and PAs lack specific conservation programs that aim at ensuring the sustainability of bee population services in the region. Under the BAU scenario, honey production may decrease due to, for example, overuse of pesticides, intensive agriculture, and development of golf terrains.

To date, there is no data on the status of pollination services in the Velebit region or in the Licko-senjska County. Unlike in Lika, in the northern counties (with extensive agriculture), the decreasing global trend on pollinators will be applicable. For instance, in 2008, the Association of Beekeepers of Osjecko-baranjske County assessed that the number of their colonies had decreased by half (Z. Panjic, President of Association of Beekeepers of Osjecko-baranjske County 2008).

Beekeeping is practiced successfully on a part-time basis, and yields a wide array of high-value products that can increase a farmer's income by 40-60%. The number of registered beekeepers in Croatia corroborates this. In 2007, there were 3,404 beekeepers with total of 313,978 beehives. Most of them were part–time beekeepers (53%), hobby beekeepers (37%) while professionals make the only 11%[221]. Beekeeping is also a relatively low-impact activity that can increase local people's income from native forest or conservation areas[222].

The rate for honey production requires a stocking rate of approximately one hive per 4–12 ha[223]. The total area that supports honey production in Licko-senjska County is between 14,800 and 4,400 hectares for total of 3,700 hives[224] or 6.3% to 18.8% of agricultural land of the County. In addition, 2,368 km^2 (44%) of the County's territory belongs to PAs, which provide vast floral resources to support bees during their breeding season (spring season).

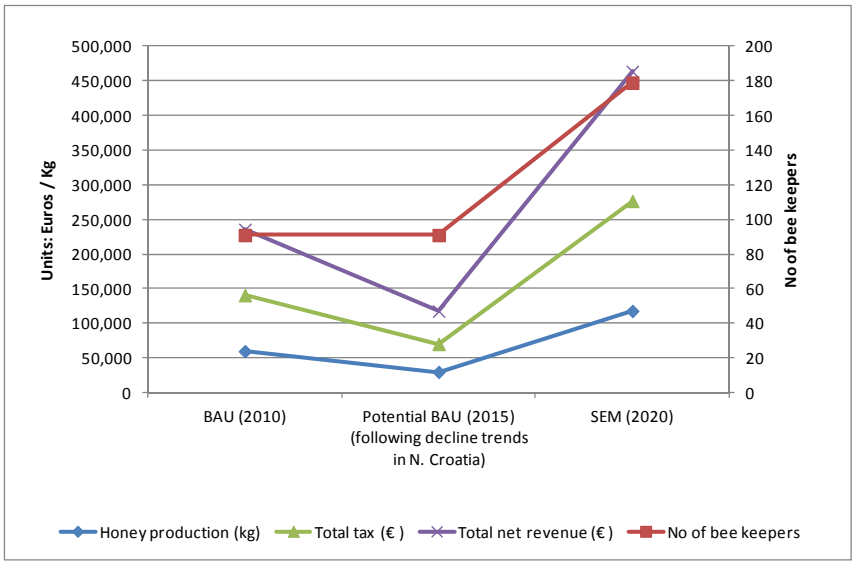
[219] Kezic, J., et al., 2008. "Economic Evaluation of Beekeeping in Karlovacka County"
[220] Kravarscan, Lj., 2003. *Economics of Honey Production*, Croatian Aliance for Agricultural Advisory Service, Croatian Agricultural Chambers
[221] Kezic, J., et al., Economic Evaluation of Beekeeping in Karlovačka County, Faculty of Agriculture, University Zagreb
[222] http://www.agroforestry.net/overstory/overstory40.html
[223] Somerville, D., 2002. *Lucerne Pollination*. NSW Agriculture. Department of Primary Industries. New South Wales, Australia
[224] Overview of Strategic Economic Sectors, Licko-senjska County, 2003

For the purpose of this study, the team considered two BAU scenarios (current and potential) and one SEM scenario to illustrate the benefits from honey production supported by ecosystems from the Velebit PAs. The current BAU scenario represents current practices in which the net value of the production of honey, including honey retail (jars) is estimated at 235,809 Euros. The potential BAU scenario illustrates potential losses if BAU deteriorates. In this scenario, it is assumed that the production will drop about 50%. Consequently, in the potential BAU scenario, the net value of production will decline to 117,905 Euros.

Back in 2002, the Licko-senjska County Spatial Plan stated that "it is necessary to regenerate bee stock and encourage beekeeping and that in every larger settlement in Lika there is at least one professional beekeeper, one point for honey production (separator) and one honey purchase station). In addition, the plan notes that the results in fruit production suggest that pollination levels are not optimal (BAU scenario). Poor pollination results in diminished production and economic loss.

In the SEM scenario, assuming that appropriate policies and basic investment is provided to preserve bee habitat and stock, the net value of honey production may increase to 466,195 Euros, considering a 100% increase in the number of beekeepers. This shift is estimated to be possible in a 5-10 year period. The fluctuations in benefits from BAU and SEM are presented in Graphic 13, and Table 31 includes the available supportive data.

Graphic 13. Potential gains and losses in honey production under BAU and SEM scenarios



Source: Authors (based on various sources and using own estimations)

Table 31. Estimated annual benefits from honey production in BAU and SEM scenarios

Estimated annual benefits from HONEY (In Euros)	Current BAU	Potential BAU (following decline trends in northern Croatia)	SEM
Honey production	**2010**	**2015**	**2020**
Honey production (kg)	59,969	29,985	117,961
No of bee keepers	91	91	179
Production (kg per a beekeeper)	659	330	659
Gross revenue	287,851	143,926	566,213
Total cost (variable and fixed)	90,788	45,394	178,584
Net revenue	197,063	98,531	387,629
Honey retail			
No. of 900g jars	66,632	33,316	131,068
Gross revenue	611,684	305,842	1,203,202
VAT	140,687	70,344	276,737
Net revenue	38,624	19,312	75,975
Total benefits			
Total tax	**140,687**	**70,344**	**276,737**
Total net revenue	**235,687**	**117,844**	**463,605**

Various sources[225]

The SEM scenario is based on an average honey price as well as an assumption that production can reach levels of the county neighbor Karlovacka County. Further, with the significantly higher production, it would be possible to diversify production to include organic wax, cosmetics, and other honey-based products.

Crops

There are no farming activities in the National Park Northern Velebit, although farming is permitted by Article 10 of the Ordinance on Inner Order of Northern Velebit National Park (OG 75/00). Generally, irrigation is low in Croatia; out of the total 863,023 ha under crops, only 3,091 ha or 0.36% is irrigated[226]. In the past, there was some traditional farming done on very small plots, however, all of these settlements have been long deserted. Traditional cultures in this area are rain fed-cabbage and potato plots. Further, there are no extensive farming activities in the surrounding areas of the NPNV, only small plots for household use. However, there are small scale cattle breeding, and milk and dairy production.

Because of the substantial quantity of forest in the Velebit region (e.g., NVNP and VNP include a total of 124,850 ha of forest, 7,540 ha and 109,494 ha respectively, as well as some bordering forest

[225] Sources: Licko- senjska County, Questionnaire to the Department of Economy; Konzum stores; Kezic, J., et al., 2008. "Economic Evaluation of Beekeeping in Karlovacka County"; Vidovic, A. Agro-club, "Rise in the Price of Honey", August 2010; Kravarscan, Lj. 2003. "Economics of Honey Production", Croatian Aliance for Agricultural Advisory Service, Croatian Agricultural Chambers; Brkanic, V. RRiF. Economic analysis. "Retailers: DM with Highest Margins, Plodine Outgrew Metro's Revenue", October 2010.

[226] Croatian Bureau of Statistics, 2010

area) it is assumed that rain is more frequent; therefore, the existing agricultural production of small agricultural plots benefits from and is sustained by abundant rain in the region. This is a service provided by forest ecosystems. The study team, however, was not able to find data on the level of productivity from cabbage and potato farming, and no evidence of a substantial use of water services (irrigation) from the park being used for farming inside and around the park.

Additional income to local people

There is tangible evidence that all the sectors discussed in Sections 2 and 3 generate employment and income for local people. In particular, nature-based tourism is a sector responsible for creating a range of activities related to tourism services that generates additional income to local people. For example, on the coastal side, there are five villages that benefits from NBT as well as Senj town and Karlobag. Over 700 people in Ličko senjska County[227] are engaged directly in tourism services (hotels and services), however, mostly in Plitvice Lakes and Novalja, Island of Pag, which are not Velebit regions. Private accommodation comprises a large portion of accommodation capacities (52% of overnights were made in private rooms and apartments); however, private accommodation owners are not included in this number; therefore, the official statistics underestimate the importance of tourism for the region. Some of Velebit's coastal tourist spots are mainly dependent on tourism. For example:

- Lukovo -population of 55
- Donja Klada – population of 33
- Starigrad – population of 22
- Jablanac – ferry port with developed tourism and fishery

Based on the national average, the estimated gross income of local people working in the tourism sector is 805 Euros monthly (565 Euros net). The number of people employed directly in tourism (hotels and restaurants) in 2008 was 730[228]. Therefore, in 2008, the total net annual benefit to local population is approximately 825,294 Euros. However, most of the tourist activity takes place in National Park Plitvicka Jezera and Island of Pag on the coastal side looking toward Italy.

Conclusions and policy recommendations

4.1. Conclusions

A major challenge to the study has been the limited or unavailable sectoral data, which when available, it is often partially updated, and often inconsistent among agencies; for example, information on tourism visitation, productivity, and revenue. There is also limited information on job creation, income, local and national tax revenues, and the role of PAs as drivers of foreign exchange earnings and investments (such as nature-based tourism). and how benefits from ecosystems of PAs in Velebit are distributed. Despite these limitations, the team found that the

[227] Croatian Bureau for Statistics, 2009
[228] Croatian Bureau for Statistics, 2009

existing evidence on the economic value of the ecosystems services (ES) provided by NVNP and CNP is strong.

This report provides evidence that in Velebit, as in many other places in Croatia, resource degradation under BAU, typically offers immediate returns in the form of marketable products such as agricultural products, coastal tourism, golf courses, cheap electricity, and free water supply; and the impact of ecosystem wear and tear under BAU practices may not be visible in the short term. Thus, those focusing on short-term gains (e.g., tourism operators and major resorts) can often "get away" with not addressing critical environmental externalities, despite damage to critical ecosystem functions. On the contrary, SEM is often less exploitative in the short term and can sustain benefits in a more permanent long-term frame.

Further, ecosystems management and sector productivity in Velebit, NVNP, and VNP are considered BAU. This is because ecosystems management is underfunded and sector productivity is characterized by significant negative externalities (e.g., degradation of habitat, increased waste water discharges, resource-degrading tourism, lack of investment in watershed management, and unsustainable agricultural practices (e.g., the burning of fields to eliminate weeds). In addition, NVNP and VNP lack adequate funding to move from the basic to a more optimal conservation level. Consequently, it is not possible to argue that the ecosystems, in both parks are adequately protected. Although BAU is not necessarily bad, if there is a transition to SEM in many of the sectors assessed in this report, accelerating the shift to SEM is critical to avoid potential losses.

In the Velebit region, ecosystems of the NVNP and NNP ensure the productivity of nature-based tourism (NBT), hydropower, agriculture, brewing (beer production), and fisheries with forests containing substantial carbon storage capacity. Ecosystems of PAs are also instrumental to providing employment and additional income to local people. Further, ecosystems are instrumental to generating substantial tax revenue to central and local governments. The shift from BAU to SEM is critical to both the sustainability and potential increase of these economic benefits.

Based on the preliminary results of this study, the following sector-based conclusions were reached.

- **NVNP and VNP provide indispensable services that sustain the economic benefits of tourism and NBT in Velebit**. This is true for coastal tourism in the Velebit Channel, and inland tourism and winter tourism. For example, according to 2006 data, hotels and restaurants in the coastal region earned 3,492,047 Euros. If the share of overnights and daily expenditure increase to the same level of the rest of Croatia (55 Euros), coastal tourism in the region could have earned approximately 17,217,714 Euros, including 4,555,749 Euros in accommodation and restaurants. To date, in the BAU scenario, the estimated loss is 13.7 million. This is the result of inadequate marketing and infrastructure, limited investment in PAs, and failure to connect inland tourism with coastal tourism. NBT is indispensable to increase employment. For example, in the coastal region in Velebit, with adequate investment, the number of people employed (direct and indirect) could increase from 440 to 1,717, and state taxes could increase from about 2.7 to over 8 million Euros.

- **Inland nature-based tourism, like coastal tourism is also suffering losses under BAU.** In the SEM scenario, it is assumed that in the period 2011-2015, Northern Velebit National Park and the Krasno Sanctuary will reach 25,577 (at 12.7% increase rate) and 250,000 visitors respectively, totaling 277,577 visitors. The estimated net income from tourism could grow from

2.3 million Euros to 5.5 million Euros in a 10-year period (calculation includes multiplying effect to the national economy).

- **In an optimal SEM scenario, winter/mountain tourism can provide even higher revenues than coastal tourism, when opting to further develop ski tourism instead of golf tourism.** According to the results of a recent research the average daily spending in mountain tourism in Europe was 46.6 Euros (the highest in Portugal, 89 Euros). In the SEM scenario, winter tourism could generate net revenue of approximately 1.3 million Euros. For comparison, winter tourism can be more profitable than the planned water-depleting golf courses in the coastal region. The average golf course in the nearby Istria region is expected to host 20,000 rounds per season at 60 Euros per round. The season in Istria is much longer and the weather is much more favorable. Using this reference and excluding the cost of peripheral infrastructure investment, after 2013 (expected completion of the golf course), the golf course can attract about 4,000 visitors per year at best, because Velebit has a much shorter season (three months). The total net revenue for golf resort is estimated at only 867,044 Euros annually (per season).

- **Tourism/nature-based tourism has a high multiplier effect.** It is estimated that for each Euro spent in tourism only 30% is spent directly in tourism, meaning accommodation and restaurants, while 10% is spent in trade, 15% in transport and telecommunications, 20% for food and agriculture, 5% for gasoline, and 25% benefits other sectors. Also, the number of jobs per 100,000 Euros is 4.2 and 5.3 in the core and extended areas, respectively.

- **The shift from BAU to SEM in fresh water ecosystems management is indispensable to secure water flow, savings (from avoided replacement and maintenance costs), and economic benefits from hydropower generation.** Renewable sources of energy represent 40% of the energy produced and used in Croatia. Out of this, hydropower has the largest share (31%). The high share of hydropower has favored Croatia in negotiations for EU membership. The EU requires up to 20% of total electricity consumed be from hydropower and Croatia is at the 11% level. Therefore, hydropower is a priority strategy for Croatia. For example, the repair and maintenance of Senj and Sklope HPPs (requiring accumulation lake dry-out) is estimated at approximately 659,447 Euros, and the possible loss in revenue (at 1% annual decline rate) would result in near 6.6 million Euros annually. Under the current BAU scenario, Senj and Sklope HPPs generate net revenues of approximately 63 million Euros and state taxes in the order of approximately 18 million Euros. If neglecting fresh water management continues, the net revenue may decline to 53 million Euros. Such losses are currently avoided because of the clean water from the ecosystem. Although the cost of managing water sources at Velebit has not been estimated, it will be probably under 25% of the potential loss.

- **Water resources from VNP provide the indispensable natural resource (fresh water) to support brewing, a promising subsector of the economy in the region.** Velebitsko Brewery is positively contributing to local development by creating employment in an employment-depressed area, generating tax revenue to the government, and also by enabling wastewater treatment (See Section 3 for details). The brewery's production directly depends on an ES (clean fresh water) from the PA. However, the brewery is not investment in fresh water ecosystems conservation and, therefore, for the purpose of this report, the current operation is considered to be under the BAU scenario. In order to shift to the SEM scenario, for example, the brewery could directly contribute to a fund established to support fresh water ecosystems in the VNP. This contribution could be established by redirecting (allocating) a small percentage (1%) of the current taxes being paid by the brewery to the local government, to the fund. The sustainability of the brewery's current plan to increase production to 15,000,000 million liters

will require that water resources are adequately managed in the future, by a shift to SEM. The net value of the planned production is estimated at 12 million Euros.

- **VNP and NVNP's ecosystems are economically important for agriculture.** This true for grasslands, dairy production, pollination of fruits and berries, including the production of traditional liquors, and honey. For example, the total annual production of milk and cheese between the Velebit region and other regions in Croatia – although the level of production is similar – in Velebit and surrounding areas the annual net revenue is estimated at 4,766,922 Euros, 77 % higher than in other places in Croatia where conventional agriculture is practiced. In addition, it is estimated that Velebit's dairy sector currently contributes with 4,089,842 Euros to the state tax (VAT). This production is based on native cattle breeds of the Velebit region, which are considered an ES. Without them, production will collapse.

- **Pollination services from wild and honey bees are indispensable to sustain agriculture and the production of fruits and berries.** Wild bees are more abundant in wild areas; therefore, agriculture near PAs receives the most benefits from this valuable ES. The pollination service the ecosystem provides to orchard and cattle owners, as well as to collectors of herbs, is estimated at 2.9 million Euros. Bees are the most economically valuable pollinators of agricultural crops worldwide. However, little or nothing is invested in monitoring and protecting bee habitats in VNP and NVNP.

- **SEM pollination services are indispensable to sustain the current and potentially increased production of plums and apples in Velebit.** Plums and apples will not self-pollinate and require the activity of pollination agents such as bees. Therefore, almost 100% of plum and apple yields can be attributed to pollination services of Velebit; this service, under BAU, has an approximate value of 1.1 million Euros, including about 184,160 Euros in tax, which goes to the government. In SEM, with most fruitful trees at an optimal level of nourishment and pollination, the net revenue could increase to approximately 3.7 million Euros of net revenue and 762,382 Euros to State taxes, approximately 4.5 million Euros in total.

- **Non-timber forest products of NVNP, berries, and herbs – under BAU – support a local liquor industry that contributes with approximately 1.8 million Euros to the economy (1,000,000 million bottles).** It is estimated that in 2010, this sector produced a net revenue of 0.9 million Euros. Over 800 tons of berries are collected annually to produce the liquor that has an important niche in the national market. The plan for the next five is to increase production to 5 million bottles, which represent 4.5 million Euros net by 2016. Although this business sounds promising, it is likely that the increased production will have an impact on Velebit's ecosystems. In this scenario, by 2016, 3,570 tons of berries will be needed annually to sustain the proposed growth of liquor production. This increase is unlikely and, therefore, the business prospect is highly uncertain in the long-term. Considering a conservative 10% decline in production from 2016, by 2020, the business may lose profitability and the ecosystem will be exhausted. The shift to SEM is indispensable.

- **Forest ES in Velebit may be threatened by the impact of forestry activities that result in encroachment PAs and disruption of ecological corridors.** Based on the limited information on forestry that was reviewed during this study, forestry[229] management in and around PAs in

[229] The word "forestry" is used sometimes to refer to forest. However, for the purpose of this report, forests and forestry are not interchangeable terms. **Forestry** is considered a professional productive activity that uses forest ecosystem services (timber) as raw material for wood products. However, "modern forestry" practices should involve a range of

Velebit is considered under SEM. However, the team was not able to find evidence of how the potential impacts of forestry activities is carried out; therefore, it is not possible at this point to estimate the impact of forestry on NMVNP and VNP. For this reason, PA forest management programs are considered under BAU. For example, NPV is considered highly threatened by one of the most severe soil erosion conditions in Europe caused by severe deforestation in the past that was never addressed. This is a major problem in the coastal part of the biosphere reservation of Velebit. This could lead to a significant decrease in tourism revenue if the park continues to neglect visitation and forest monitoring programs, due to a lack of funding.

- **SEM forests are essential to save costs or minimize the economic impact of natural disasters.** For example, investments in reforestation in Licko-senjska County at Senjska Draga is already showing beneficial results in reducing wind gusts, abating floods and torrents, reducing climate extremes, creating conditions of occurrence of drinking water, and increasing the touristic value of landscapes.

- **Fresh water ES are indispensable to sustain fisheries, both coastal and inland.** The Croatian fishing industry, as well as fish-farming, is orientated mostly toward export. Exports are higher than imports, therefore, fisheries have generated foreign trade surpluses for the past few years. As much as 65% of exported fish is accounted to tuna farming and fishing, and is predominantly sold to Japan. In 2009, exports generated 71,788 Euros. The total benefits of fish- farming, under the current BAU scenario, and based on the limited information available, is estimated at 2 million Euros for the local population and small entrepreneurs, and 2.3 million in the form of taxes to the State, as well as 17,500 Euros tax income to the local government. In SEM, it is estimated that with medium investments, the annual net revenue could be four times higher than BAU, i.e., 10 million Euros and as much in taxes. In the same time frame, local authorities would earn more than 70,000 Euros annually from concessions. In addition, the potential employment increase could result in significant savings from reduced spending on social benefits in the area, which is currently troubled with high unemployment.

- **Ecosystem services from PAs can have a large impact on the government's income from tax collection.** The evidence provided in sectors such as tourism, hydropower, liquor production, brewing, and fisheries, corroborate that in places where ES support such activities, income from taxes is higher.

- **SEM fresh water ES from PAs are indispensable to provide a sustainable supply of drinking water and maintain cost-savings.** Over 75,000 people benefit from fresh and clean water from PAs in Velebit. This represents water treatment-related cost-savings of 155,322 Euros (0.43 Euros/m^3) in Licko-senjska County. The value of the annual production of water is estimated at 1.02 million Euros (approximately 3,800,000 m^3 at 0.27 Euros/m^3). Despite this important service for PA ecosystems, the current tariff is too low to cover the high-cost externalities caused by, for example, wastewater discharges, and support watershed management programs in the upper watersheds. The water price is dramatically low, compared to the average in the EU. Currently, the typical water price/m^3 in the EU is around 5 Euros.

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dimensions to ensure that forestry supports wildlife habitat, maintain fresh water quantity, nature-based recreation, landscape and community protection, employment, biodiversity protection, watershed management, erosion control, and climate change mitigation (sinks for CO_2). **Forest management** refers to the overall environmental, economic, legal, and social aspects of protected forests, and with the scientific and technical aspects, especially protection and regulation. It includes management for specific purposes such as: aesthetics, recreation, water supply, wilderness, wildlife, non-timber products, forest genetic resources and other forest resource values.

- **Ecosystems services from NVNP and VNP are indispensable to improving livelihoods in and around the parks.** Ecosystems contribute to poverty alleviation by supporting the production of livestock and dairy products, honey, crops, and additional income provided by sectors such as NBT.

- **There are barriers to transition from BAU to SEM.** These may include: a) limited participation and investment from the private sector, b) lack of reliable financial and economic data to assess the economic benefits of PAs to support establishing effective dialogue with decision makers, c) lack of sector-based case studies and need for research to further assess the cost of BAU, and d) poor allocation of resources to PAs.

4.2 Recommendations

Based on the initial assessments provided in Sections 2 and 3 of this report, the following recommendations are proposed. Recommendations are organized in three major categories: a) research and information needs, b) PA finance and policy, and c) Institutional (public and private).

Research and information needs

a) Define existing and potential stakeholders by sector, both public and provate, in order to negotiate, plan and program additional research. Stakeholder definition could be done at national and regional level.
b) Promote the following key assessments with full stakeholder participation: (1) investments required to achieve SEM, including definition of SEM targets for PA systems (including ecosystems), (2) priority areas for investment in PAs that could lead to cost-savings in sector-specific development strategies, (3) identify existing subsidies to BAU practices that are perverse and develop strategies to progressively phase them out, and (4) the feasibility of establishing protected ecosystems in areas critical to sustain sector-based productivity.
c) Assess sector-based options for environmental fiscal reform (EFR) and innovative payment for environmental services (PES) financing to close the financial gaps of NVNP and VNP; EFR option may extend to the network of PAs in Croatia.
d) In close cooperation with sector authorities and sector-based private enterprises, assess the feasibility and costs of establishing a pilot sector-based SEM Information System for PAs in Croatia. VNP and NVNP could be the pilot testing grounds. PA systems would provide a timely flow of sector-level information to decision makers (public and private) on matters such as ecosystem health, progress toward SEM targets, and the economic impact of PAs under SEM. These information systems could play an instrumental role in providing information to the central government on the benefits and costs associated with natural capital in the national accounts system; and could lay the foundation to establish strategies to establish partnerships with the private sector to "green" businesses at sectoral-levels.

PA policy and finance

e) Carry out detailed, and above all "realistic", assessments of NVNP and VNP financial needs and gaps (including aspects mentioned in Recommendation a (4); and continue to formulate PA financial strategies and business plans with increasing private sector support.

f) Promote results-oriented financial management policy for PAs focusing on four key areas: (1) linking PAs, ecosystems, and sectoral economic growth, (2) clearly defining PA management programs linked to ecosystems management, (3) developing diversification of financial mechanisms, and (4) improving financial management capacity, transparency, and accountability. NVNP and VNP could also serve as a pilot case.
g) Use the findings of this report to seek commitment from public and private sectors to introduce a phased, sector-based environmental fiscal reform strategy based on PES at the regional level. The regional strategy would target few sectors at a time (e.g., NBT, brewing, hydropower). The strategy could be designed using an "incremental approach" to avoid shocks and to distribute cost widely. Also important would be PES (that could contribute to green business) such as: tourism concessions, PA entry fees, water and energy pricing, environmental add-ons to local beer and liquors, environmental taxes, pollution fees, and forestry royalties to partly finance SEM.

Institutional (public and private)

h) Based on the results of recommendation (a), initiate a consultation process to socialize the preliminary results of the study, identify gaps and incorporate additional information when available; and provide input to recommendation (k).
i) Establish an ad hoc task force or coordination mechanisms (with nonpartisan research institutions, local governments, sectoral ministries, and private sector interests) at the County level. The task force could promote the introduction of ecosystem-based PA management policy (to be implemented through PA management plans in collaboration with sectoral authorities and the private sector). This could be tested in the tourism sector in coastal and inland tourism, beverages bottling sector, hydropower sector, and water companies.
j) Carry out a detailed sector-level assessment of local institutional and administrative reform to support SEM. As noted above, PA agencies could benefit from multi-sector shared responsibility for PA management costs. Pro SEM institutions are critical for the transition and sustainability of SEM.
k) Develop a communication strategy to communicate the results of sector-based valuations using conventional and virtual platforms. To this end, promote the creation of a PA business development unit at the regional level, e.g., Licko-senjska County. In addition to communications, this unit could support the implementation of business plans and business partnerships of NVNP, VNP, and other parks in the region.
l) Identify ecosystems "ambassadors" to lead the consultations and communication process. Ambassadors could include one or two nationally known, credible and well connected members of the Croatian society.

Annexes

Annex 1. Methodology (Sector Scenario Analysis)

The proposed approach to be used for this study is not a traditional ecosystem-centered approach[230]. The study, however, will use available information from conventional valuations. The study will build on the approach used by UNDP for the valuation of ecosystems services (ES) in the Latin American and Caribbean Region (2010), i.e. a sector-oriented approach that is relevant to policy makers responsible for sector development and investment policies. For the purpose of this report, the methodology is referred as SSA (sector scenario analysis).

Using this sectoral approach, the study team will select key productivity sectors such as agriculture, energy (hydropower), tourism and forests; and. in addition, subsectors related to human well-being such as drinkable water supplies, disaster prevention and mitigation, and equity. Each sector or subsector analysis explores the economic relations between production practices, ES, other inputs, and their respective sectoral outputs. The study will provide examples of: a) how ecosystem degradation lowers outputs and discusses the associated costs; and b) ecosystem-friendly management practices that avoid damages with economic benefits highlighted. These two different approaches, "Business as Usual" (BAU) and "Sustainable Ecosystem Management" (SEM), are used to facilitate the analysis and demonstrate the value of ES.

Depending on the availability of data, the selected indicators are used to assess BAU and SEM impact (See Table 1). Not all indicators are suitable for all the selected sectors or subsectors. Therefore, indicators are used when applicable.

[230] Conventional ecosystems valuations may focus on: i) Assess the value of the total flow of benefits from ecosystems, ii) Assess the net benefit of interventions that alter ecosystem conditions, iii) Assess the distribution of benefits and cost between deferent stakeholder groups, and iv) Identify potential financial sources to finance the intervention (World Bank, 2004). Although these approaches have a specific purpose, these approaches do not make a link between ecosystems and productivity, and therefore is very difficult to see how ecosystems are important to economic growth and why is important to fund sustainable ecosystems management. Consequently such approaches may not be too attractive for politicians/decision-makers.

Table 1. Sample indicators used to construct BAU/SEM scenarios

Sector and subsector indicators (5-10 years trends)
• Employment (# jobs): direct, indirect, and induced. • Income level trends • Fiscal impacts (tax revenues, subsidies, and green taxes) • Foreign exchange (investments, exports) • Green market/income opportunities and innovation potential • Opinion polls • Sector investment trends (public and private) • Damage costs and avoided damage costs • Returns on investment • Production trends (volume and value, as % of GDP) • Productivity (return to labor, land, capital) • Market values • Changes in natural capital (# ha under protection) • Equity impact on the poor/distribution of benefits

Traditional data on the value of ecosystems and biodiversity to production will be organized based on this BAU/SEM framework and will be compared. The values of biodiversity and ecosystems will not be seen as static (time-bound) data points, but, rather, as variables that respond to degradation, sustainable management, and other interventions. The term BAU does not refer to all current activities but those activities that damage or deplete ES.

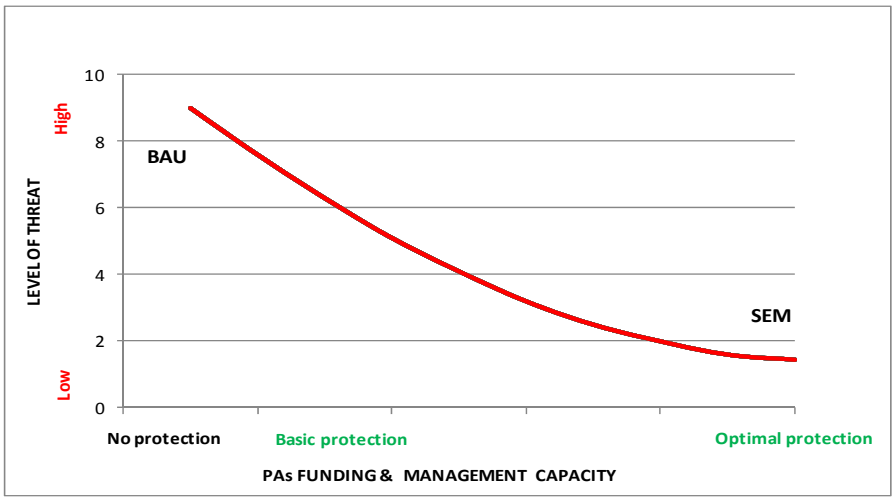
The BAU approach is characterized by a focus on short-term gains (e.g., < 10 years), externalization of impacts and their costs, and little or no recognition of the economic value of ES, which are typically depleted or degraded. Under SEM, the approach focuses on long-term gains (> 10 years); also under SEM, the costs of impacts are internalized. Ecosystem services are maintained, thus generating potential for a long-term flow of ecosystem goods and services that can enter into decision making. Activities that are SEM practices tend to support ecosystem sustainability, not for ideological reasons, but, rather, as a practical, cost-effective way to realize long-run profits. Common SEM practices include watershed management, agro-forestry and silvo-pastoral production methods, low-impact logging, nature-based income diversification, and organic farming (Bovarnick et al., 2010).

In addition, the study will use BAU and SEM to distinguish benefits and management capacity of PAs; and also refer to a "no PAs" situation. In the "no PAs" scenario, when threats are present, the habitats are not protected and, therefore, likely to be degraded. For the purpose of the study, the “no PAs” is considered BAU.

Graphic 1 below illustrates the difference between the BAU and SEM approaches when applied to PA management. When PAs are underfunded and facing severe threats, they are likely not able to provide a basic protection to biodiversity and ecosystem functions – in this case, PA management is considered Business as Usual (BAU). PAs in BAU have limited funding and lack management capacity; this label was chosen because most PAs are currently considered to be in this situation. On

the other hand, when funding and capacity are available to meet basic to optimal[231] protection needs, PA management is considered Sustainable Ecosystem Management or SEM. The shift from BAU to SEM takes place as funding and management capacity (to address threats) increases.

Graphic 1. BAU and SEM as a function of funding and capacity levels (and threat management)



Source: Flores in Bovarnick et al. (2010).

Further, it is assumed that PAs are means to control (manage) threats, but not to eliminate threats; rather, the elimination of threats may require policy reform, law enforcement and public and private sector action outside the PA. SEM leads to minimize the impact of threats but not necessarily to its elimination. In addition, the BAU and SEM approaches may be also liked to low and optimal levels of ecological representativity. General characteristic of the BAU and SEM management approaches is included in Table 2.

Table 2. General characteristic of the BAU and SEM management approaches

BAU (business as usual)	SEM (sustainable ecosystems management)
• PA management plans are not based on threats assessment and abatement needs. • PA tourism infrastructure does not meet the demands of tourism visitation. • PA's investment in tourism infrastructure is below basic needs. • Critical ecosystems that support tourism are under threat. • Unregulated tourism visitation.	• PA management plans address specific threats assessment and abatement needs. • PA tourism infrastructure meets the demand of tourism. • PA's investment in tourism infrastructure meets needs. • Tourism government agencies support PA tourism and ecosystem protection programs. • Tourism industry supports PA tourism

[231] The basic management scenario (basic level) describes the minimum level of funding required to operate key conservation programs while meeting basic program's requirements to sustain the functions of the ecosystems in the protected areas. The optimal management scenario (optimal level) describes the ideal level of funding required to operate all programs to reach and sustain optimal functions of the ecosystems in the protected areas. It describes the ideal state of the programs if all necessary funding, personnel, equipment, and other resources were available to achieve that state (CPM, 2002). This ensures the achievement of short-, medium-, and long-term goals for the protected area, in accordance with the highest environmental, social and economic standards (Flores et al., 2008).

• Tourism industry is not supporting PA tourism infrastructure development and PA tourism programs. • Industrial waste discharges from food processing industry and tourism development causes eutrophication. • No water treatment facilities. • Carbon objectives are not incorporated into forest management and timber production-based models. • Centralized decision-making with limited stakeholder participation in NNRR management	infrastructure and ecosystem protection programs. • Critical programs to conserve ecosystems are fully funded, and threats are minimal. • Pollution fees are high. • Water treatment facilities installed and fees charges. • Environmental externalities are included in water tariffs and tourism's service charges • Carbon sequestration objectives are incorporated into forest management planning models. • Decentralized decision-making stakeholder participation

The SSA approach in Croatia faces several limitations such as:

- The analyses will draw on technical economic and ecological data from the published material available. Such data is still scarce in Croatia.
- The sectoral approach disaggregates the economic value of each type of ES and fragments system-wide values to show specific sectoral inputs. The integration of the overall effects of ecosystems and their services on the economy as a whole is addressed in the conclusions section of the study.
- The lack of national and sector-level data (or outdated data) may limit the applicability of the selected range of indicators used to assess the impact of BAU and SEM practices.

Annex 2. NorthernVelebit National park's income and expenses 2010

Revenues in 2010

Revenue Category	Amount in kunas	Amount in Euro	Source
State grants	2,000.00	270.27	
Foreign grants	171,481.67	23.173.20	
From assets interests	1,451.03	196.09	
From performing basic activities	386,013.53	52,163.99	Tickets sale
From presentations and guiding	23,611.51	3,190.74	
Souvenirs	63,400.35	8,567.61	
Other PI Activities	2,845.50	384.53	
Rental	16,019.80	2,164.84	
Fines	200.00	27.03	
Ongoing donations from non-profit organisations	25,000.00	3,378.38	
Capital donations from non-profit organisations	15,000.00	2,027.03	
Revenues for financing costs of activities	454,992.00	61,485.41	Ministry of Culture agreement
Revenues for financing costs of salaries	1,318,371.87	178,158.36	Ministry of Culture agreement
Revenues for local transport	113,093.21	15,282.87	Ministry of Culture agreement
Revenues for conservation, promotion, inventarisation	290,000.00	39,189.19	Ministry of Culture agreement
Revenues for financing costs of Occasional giving (Christmas bonus, and other giving defined in the Collective Agreement for Civil Servants and State Employees	44,003.88	5,946.47	Ministry of Culture agreement
Revenues for purchase of non-financial assets	310,000.00	41,891.89	Ministry of Culture agreement

In addition, Public Institution own nonfinancial assets, being buildings and cars, in the amount of 6,450,003.31 kunas (871,622.07 Euros).

Costs in 2010

Cost Category	Amount in kunas	Amount in Euro	Source
Employment cost			
Salaries	1,220,404.85	164,919.57	Ministry of Culture agreement
Other costs of employment	271,187.72	36,646.99	Ministry of Culture agreement; own funds
Material costs		0.00	
Various other travelling	37,393.62	5,053.19	Ministry of Culture agreement
Local travelling (from and to work)	130,634.66	17,653.33	Ministry of Culture agreement
Seminars, symposiums, trainings and similar	3,525.12	476.37	
Stationery	16,533.25	2,234.22	Ministry of Culture agreement
Publications	37,524.22	5,070.84	Ministry of Culture agreement
Cleaning, hygiene, protection clothes	47,775.71	6,456.18	Ministry of Culture agreement
Utilities	148,207.70	20,028.07	Ministry of Culture agreement
Fee to Croatian Waters	112,226.89	15,165.80	Own earnings; tickets and souvenirs
Telephone and telefax	44,601.07	6,027.17	Ministry of Culture agreement
Maintenance (regular and investment)	87,708.79	11,852.54	Ministry of Culture agreement
Intellectual services	339,847.40	45,925.32	Ministry of Culture agreement
Publishing promotional and other materials	49,504.00	6,689.73	Ministry of Culture agreement
Other material costs	171,262.38	23,143.56	
Property purchase	357,575.10	48,320.96	23.500 kn investment in property that is not owned by NVNP (mountain lodges)
Equipment purchase	62,224.62	8,408.73	Ministry of Culture agreement
Loan costs	15,714.89	2,123.63	

Annex 3. Fresh water ecosystems in VNP

The central fresh water system on Velebit mountain includes one large river, the Lika, its tributaries Otešica, Novčica, Bogdanica, Bužimnica, Počiteljica, and numerous water springs as well as a large system of catchment distinctive for large number of fissures in the predominantly karsic area. Though there are no precise data, experts estimate that the Velebit water basin contributes to the River Lika. at about 30-40%. The rest of the water comes from other mountains surrounding the Lika Plane[232]. In general, water courses in Velebit and Lika Plane are very complex and not entirely researched and explained[233].

Velebit is one of the Croatian regions with the highest precipitation in Croatia (others being Velika Kapela Mountain, Gorski Kotar, Biokovo, and other)[234]. Average precipitation amounts total over 2,500 mm of rainfall at the higher ground[235]. At the peak zones rainfall amounts are over 3,000 mm. At the 900 altitude, average rainfall reaches amounts in the volumes of 2,000 mm, while the precipitation rate falls with the altitude, and the lowest rate of precipitation occurs at the coast "only"- 1,200mm. Maximum rainfall occurs in autumn yet the spring is also very "generous" in rain[236].

Very important role in the water supply and accumulation of the Velebit area is the snow cover. In low temperatures, the precipitation will turn into snow. Average annual temperatures at Zavižan (one of the Northern Velebit Peaks) are 3.5°C and in Gospic 8.4°C[237]. Snow cover stays for a considerable time even in the lower altitudes of Velebit; thus, snow cover of 30 cm thickness remains from 20 to 40 days in the lower areas of the Mountain and remains over 70 days in the apical parts[238].

Snowfall slows down infiltration and feeding of aquifers, which reactivate in the spring with the snowmelt. Both snowmelt and rainfall are filtrated through the thin layer of soil to the karst. to underground aquifers and streams, and, in some bare karst places, passing directly through the karst. In general, infiltration in the karst can be dispersed on the larger and concentrated in the form of underground streams. In the case of larger basins, such as dinaric karst, it is usually the combination of two[239]. Karst layers have a so called epikarstic zone, which is a particularly karstic underground area with walls thickness ranging 3-10 meters. Epikarstic zones contain water and can be described as a karst water tank of a "perched aquifer" that contain water streaming down the fissures in karst[240].

Because the River Lika arises at Velebit, the area encompassed by this study stretches over 1,570 square kilometres of the Lika catchment basin[241]. However, beside Lika, the study encompasses

[232] Andrej Stroj, PhD, Croatian Geology Institute, Interview via Questionnaire
[233] National Park Northern Velebit Official Web Site
[234] Ibid.
[235] Licko-senjska County Tourist Board official web pages [http://www.lickosenjska.com/index.php?option=com_content&view=article&id=22&Itemid=2]
[236] Nature Park Velebit. 2007. *Nature Park Velebit Management Plan*, Ministry of Culture of the Republic of Croatia
[237] Ibid.
[238] Nature Park Northern Velebit Official Web Pages [http://www.pp-velebit.hr/index.php?option=com_content&view=article&id=36&Itemid=12]
[239] Stroj, A. 2010. *Underground Water Flows In the Hinterland Of The Velebit Channel,* Doctoral Thesis, Faculty of Mining, Geology and Petrol Engineering, University of Zagreb
[240] Ibid.
[241] Official Internet pages of Gospic town

another large river of the area – the River Gacka, since the Lika is its large tributary. While the river Lika's source on Velebit Mountain at about 600 meters height, river Gacka spring receives its water from the catchment area of Mala Kapela (a mountain situated northeast from Velebit) and other mountains surrounding the Lika plane. However, the Lika River presents a large tributary to Gacka; After running through the Krusicko accumulation lake and passing the hydropower plant, the Lika River, through a built underground channel system, joins the Gacka River and at about 65%, contributes to the Gusic accumulation lake for the second power plant as well as to local water supply[242].

Using modern water tracing techniques it was established that both rivers, the Gacka and Lika, flow through a system of underground streams that stretch from Novljanska Zrnovnica near Novi Vinodolski town in Primorsko-goranska County (22 kilometres northern from Senj) to Kralić at Karlobag in the south of Ličko-senjska County. The number of major coastal springs that originate from the rivers Lika and Gacka from Novljanska žrnovnica to Karlobag is large, where they contribute to the famous cleanness and freshness of the brackish waters of Velebitski kanal[243].

The quality of water depends upon the quality of rainfall, water movement, type of soil, litho-logical properties of the aquifer, plant or forest cover, time spent underground, and the impact of sea water. In general, Licko-senjska County is self sustainable when it comes to satisfying water needs, both in the quantity and quality. The water is regularly tested for chemical and bacteriological content. In as much as 50% of water supply samples, the unprocessed water is suitable for drinking. After treatment this number reaches 93%. However, there is one watercourse endangered – River Novčica and, subsequently, the Lika River, that passes through Gospic town and Later Otocac. The primary polluters are non-functional sewage and wastewater systems, and cesspits. Sediments and metal content are not tested in most cases[244]. In the absence of heavy industry in the area, it is very probable that the content of metals is low.

The water from many underground springs originating from Lika and Gacka, as well as ones from the catchment of coastal Velebit slopes, contribute to the very clean water that the Licko-senjska County coast is famous for. In addition, there are two large accumulative lakes in the area; one feeding from river Lika (Hydropower Plant Sklope at Kruščićko Lake) and one from Gacka, located past the point of contribution from Lika (Hydropower Plant Senj, Gusić accumulation Lake).

In the underground and surface water systems, there are 10 amphibian species present. River Gacka, up to 1937, was hosting the following species: brown trout, pike, eel, and mudfish, as well as two kinds of freshwater crabs (both endangered). In 1937 Canadian trout was introduced. Later on, carp and more species that reduced the quality of water were introduced, but these actions also disturbed the biological balance of the river[245]. Today, there are seven edible kinds of fish in Gacka, trout being the most valuable ones.

In contrast to the River Gacka, biological values of River Lika are not well investigated; however, the fish that can be found in the Lika River are well known; from autochthonous species, one can find minnow, Jadova minnow, mudfish, and brown trout. The imported species are carp, tench, amur,

[242] Andrej Stroj, PhD, Croatian Geology Institute, Interview via Questionnaire
[243] Ibid.
[244] Development Agency of Licko-senjska County, 2010. *Licko-senjska County Development Strategy* 2011-2013
[245]Croatian Centre for Autochthonous Karstic Fish and Crab Species

pike, catfish, chub, redstart, cynprid, and more (4)[246]. In one of the underground streams (Markov ponor) a unique freshwater mussel "*Congeria kusceri*" is found[247].

One large mammal, otter, can be found as a part of the Velebit water ecosystem. Though there is not sufficient data available to be able to assess the population, otters were found to inhabit banks of the River Lika and four other rivers in the region. Otter is a protected animal on the entire territory of the Republic of Croatia. Otter represent the top of the food chain in water ecosystems: therefore: the fact that it inhabits the rivers and their banks is another indicator of very clean and healthy water ecosystem[248].

[246] Sport Fishing Association Lika official web Site [http://www.sru-lika-gospic.com/index.php?option=com_content&view=article&id=23&Itemid=2 last checked April 22 2011]
[247] Munic, J., Popovic, I., 2010. *Sinking Karst Pearls – HPP on Rivers Lika and Dobra*. Green Action/Friends of the Earth Croatia Report
[248] Nature Park Velebit, 2007. *Nature Park Velebit Management Plan*, Ministry of Culture of the Republic of Croatia