



Food and Agriculture  
Organization of the  
United Nations



# TECHNICAL REPORT

Maximize the production  
of goods and services  
of Mediterranean forest  
ecosystems in the context  
of global changes

April 2016



**Assessment of the socio-economic  
value of goods and services  
provided by Mediterranean  
forest ecosystems**

**Düzlerçami Forest - Turkey**

This report is the result of work conducted by Plan Bleu and the Secretariat of Comité Silva Mediterranea (FAO) as part of the “Optimizing the production of goods and services by Mediterranean forest ecosystems in a context of global changes” project, funded by the French Global Environment Facility (FFEM) for the period 2011 to 2016.



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## **AUTHOR AND NATIONAL EXPERT OF COMPONENT 2**

Dr. Özge Balkız (Doğa Koruma Merkezi)

Contact: [ozge.balkiz@dkm.org.tr](mailto:ozge.balkiz@dkm.org.tr)

## **PROJECT FOCAL POINT**

Ayse Ayata Kelten (Ministry of Forestry and Water Affairs General Directorate of Forestry Foreign Relations, Training and Research Department)

Contact: [ayseayatakelten@ogm.gov.tr](mailto:ayseayatakelten@ogm.gov.tr)

## **THEMATIC EXPERT OF COMPONENT 2**

Nilgün Temerit (Ministry of Forestry and Water Affairs General Directorate of Forestry Foreign Relations, Training and Research Department)

Contact: [nilguntemerit@ogm.gov.tr](mailto:nilguntemerit@ogm.gov.tr)

## **NATIONAL TECHNICAL SUPPORT AND REVIEW:**

Akın Mızraklı (Ministry of Forestry and Water Affairs General Directorate of Forestry Antalya Regional Directorate of Forestry)

Dr. Can Bilgin (Middle East Technical University)

Dr. Çağlar Başsüllü (Ministry of Forestry and Water Affairs General Directorate of Forestry Foreign Relations, Training and Research Department & LULUCF Working Group)

Eray Özdemir (Ministry of Forestry and Water Affairs General Directorate of Forestry Foreign Relations, Training and Research Department & LULUCF Working Group)

Dr. Ersin Yılmaz (Ministry of Forestry and Water Affairs General Directorate of Forestry Western Mediterranean Forest Research Institute)

Dr. Güven Kaya (Ministry of Forestry and Water Affairs General Directorate of Forestry Central Anatolia Forestry Research Institute)

Havva Kahya Işık (Ministry of Forestry and Water Affairs General Directorate of Forestry Antalya Regional Directorate of Forestry)

Prof. Dr. Murat Türkeş (Middle East Technical University)

Prof. Dr. Nebiye Musaoğlu (İstanbul Technical University)

Dr. Neşat Erkan (Ministry of Forestry and Water Affairs General Directorate of Forestry Western Mediterranean Forest Research Institute)

Dr. Nicolas Robert (European Forestry Institute Mediterranean Regional Office)

Ramazan Bali (Ministry of Forestry and Water Affairs General Directorate of Forestry Foreign Relations, Training and Research Department)

Semiha Demirbaş Çağlayan (Doğa Koruma Merkezi)

Dr. Ufuk Coşgun (Ministry of Forestry and Water Affairs General Directorate of Forestry Western Mediterranean Forest Research Institute)

Prof. Dr. Uğur Soytaş (Middle East Technical University)

Dr. Uğur Zeydanlı (Doğa Koruma Merkezi)

Prof. Dr. Ünal Asan (İstanbul University)

Prof. Dr. Yusuf Güneş (İstanbul University)

**CONTRIBUTORS:**

Ahmet Ateş (Ministry of Forestry and Water Affairs General Directorate of Forestry Antalya Regional Directorate of Forestry)

Dr. Cumhuri Güngöroğlu (Ministry of Forestry and Water Affairs General Directorate of Forestry Western Mediterranean Forest Research Institute)

Cüneyt Akkaşoğlu (Safaris Caprinae)

Dr. Deniz Özü (Doğa Koruma Merkezi)

Emine Ataş (Ministry of Forestry and Water Affairs General Directorate of Forestry Permission and Easement Department)

Emine Esra Er (Ministry of Forestry and Water Affairs General Directorate of Forestry Antalya Regional Directorate of Forestry)

Ercan Velioğlu (Ministry of Forestry and Water Affairs General Directorate of Forestry Forest Tree Breeding and Seeds Research Institute)

Erdal Doğan (Ministry of Forestry and Water Affairs General Directorate of Forestry Nursery and Seed Department)

Fahrettin Ay (Ministry of Forestry and Water Affairs General Directorate of Forestry Nursery and Seed Department)

Fatih Sançam (Ministry of Forestry and Water Affairs General Directorate of Forestry Forest Management and Planning Department)

Fatma Usta (Ministry of Forestry and Water Affairs General Directorate of Nature Conservation and National Parks Antalya Branch Office)

Gediz Metin Kocaeli (Ministry of Forestry and Water Affairs General Directorate of Forestry Forest Management and Planning Department)

İlhan Siddık Sözeri (Ministry of Forestry and Water Affairs General Directorate of Forestry Nursery and Seed Department)

Kemal Ayan (Ministry of Forestry and Water Affairs General Directorate of Forestry Antalya Regional Directorate of Forestry)

Kenan Akyüz (Ministry of Forestry and Water Affairs General Directorate of Forestry Forest Production and Management Department)

Meryem Sözsahibi (Ministry of Forestry and Water Affairs General Directorate of Forestry Forest Production and Management Department)

Mitat Uyan (Ministry of Forestry and Water Affairs General Directorate of Forestry, Antalya District Forest Directorate)

Mithat Koç (Ministry of Forestry and Water Affairs General Directorate of Forestry Forest Management and Planning Department)

Mustafa Tuğrul Şahin (Ministry of Forestry and Water Affairs General Directorate of Forestry Antalya Regional Directorate of Forestry)

Nasip Yurdal Kazak (Ministry of Forestry and Water Affairs General Directorate of Forestry, Antalya District Forest Directorate)

Nuri Özbağdatlı (UNDP Turkey)

Osman Yıldırım (Ministry of Forestry and Water Affairs General Directorate of Forestry Forest Cadaster and Ownership Department)

Osman Yöntem (Ministry of Forestry and Water Affairs General Directorate of Nature Conservation and National Parks Antalya Branch Office)

Selim Karaca (Ministry of Forestry and Water Affairs General Directorate of Nature Conservation and National Parks Game Management Department)

Semra Yalçın (Middle East Technical University)

Serhat Yıldırım (Ministry of Forestry and Water Affairs General Directorate of Nature Conservation and National Parks Antalya Branch Office)

Sıtkı Öztürk (Ministry of Forestry and Water Affairs General Directorate of Forestry Combating Forest Pest Department)

Şengül Kaymaz (Ministry of Forestry and Water Affairs General Directorate of Forestry, Antalya District Forest Directorate)

Tahsin Etili (Ministry of Forestry and Water Affairs General Directorate of Forestry Nursery and Seed Department)

Ümit Bolat (Ministry of Forestry and Water Affairs General Directorate of Nature Conservation and National Parks Wildlife Department)

Ümit Turhan (Ministry of Forestry and Water Affairs General Directorate of Forestry Foreign Relations, Training and Research Department)

## TECHNICAL SUPPORT AND REVIEW

Magali Maire, Forestry Expert, UN Food and Agriculture Organisation (FAO), Forestry Department, Forestry Policy and Resources Division (FOA), Italy.

Contact: [magali.maire@fao.org](mailto:magali.maire@fao.org)

### Additional contribution from:

Hamed Daly Hassen Ph.D., Regional expert, Research Director at the Institut National de Recherches en Génie Rural, Eaux et Forêts (INRGREF) of Tunis, Tunisia

Contact: [dalyhassen.hamed@iresa.agrinet.tn](mailto:dalyhassen.hamed@iresa.agrinet.tn)

## COORDINATION AND PROJECT MANAGEMENT

Nelly Bourlion, Forest ecosystems & biodiversity Programme Officer, Plan Bleu. France

Contact: [nbourlion@planbleu.org](mailto:nbourlion@planbleu.org)

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## Executive summary

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Düzlerçamı Pilot Site is a sub-district forest unit located inside the Antalya Regional Directorate of Forestry in Turkey with 17,688 ha of forested and 11,480 ha of unforested area. Like all forested areas in Turkey, forests of Düzlerçamı are state owned and managed by the General Directorate of Forestry of the Ministry of Forestry and Water Affairs. The site hosts diverse ecosystem goods and services: recreation, biodiversity protection, wood production, carbon sequestration, and generates different benefits to society. In this project we aimed at assessing the socio-economic value of goods and services provided by the forest ecosystem in the Düzlerçamı Pilot Site, to support effective decision-making and strengthen actions to support the sustainable management of these ecosystems. Studies towards valuation of ecosystem goods and services are unfortunately rare in Turkey. Furthermore, cases where valuation assessments are incorporated into natural resources management practices and decision-making processes are even rarer. In the framework of this project, the primary ecosystem goods and services present in the forest ecosystem of the Düzlerçamı Pilot Site were identified and valued. Despite the methodological and data limitations, goods and services such as wood production (16.15 €/ha/year), biodiversity protection (4.57 €/ha/year), recreation and tourism (18.73 €/ha/year) and carbon sequestration (59.74 €/ha/year) were valued for the first time in the Düzlerçamı Pilot Site. Furthermore, both the impact of a local management decision (opening a new recreation spot to respond to increasing local demand), and the impact of a change driven at the global level (climate change) have been assessed on the primary ecosystem goods and services. The outcomes of this study have shown that opening a new recreation spot over 29 years have yielded profitable results for all of the relevant parties. Among the different alternatives explored to assess the impact of changes in certain parameters and discount rates through the sensitivity analysis, only a reduction in the expected number of the visitors coming to the new recreation spot by 65% gave negative results, in all other alternatives tested the investment remained profitable socially. The Cost Benefit Analysis also highlighted the detrimental impact of climate change on the ecosystem goods and services provided by the Düzlerçamı forest ecosystem. A hypothetical 1% decrease in the annual increment rate of trees due to climate change was estimated to cause a cost of 114 €/ha over 29 years to the global community, due to a decrease in the carbon sequestration service and a decrease in the harvest of wood products.

At a next step, site-specific assessments should be carried out towards the Düzlerçamı Pilot Site to estimate how much investment would be needed to mitigate and/or adapt to expected impacts of climate change on the forest ecosystems goods and services. Measures such as establishing genetic islands using trees adapted to expected harsher climatic conditions can be taken in the pilot site. This way, the 114 €/ha damage cost expected can be decreased effectively. Adopting such a long-term vision on managing forests vis a vis climate change is of prime importance for not only Turkey but all Mediterranean forest ecosystems.

An important limitation of the project was not being able to value one of the most important – if not the most important – ecosystem good and service, namely biodiversity protection service in detail and not being able to account the impact of different management practices on this good and service. Furthermore, not all of the ecosystem goods and services present in the pilot site could be assessed socio-economically due to a diversity of reasons. In the future it is of prime importance to find ways of overcoming such limitations and taking into account all the goods and services present in ecosystems to generating more complete and sound results and thus, identifying fine-tuned management decisions in the future. Despite these limitations, overall, this study has high potential to be replicated in other sub-district forest units in Turkey and can be an important tool for shaping management decisions at the national and Mediterranean Region scales. This model can thus serve to monitor management decisions taken in the long term, e.g. to assess the impact of allocating more area to ecological functions, or more area to intensive production, on ecosystem goods and services and would permit identifying those actions that will serve to increasing the sustainability of natural resources in the forest ecosystems and incorporating them in the management plans.



# Context

## STUDY CONTEXT

The main goal of the project “Optimized production of goods and services by Mediterranean forest ecosystems in the context of global changes” was to incentive an improved management and/or restoration of the Mediterranean forest in a perspective of sustainable provision of environmental goods and services. The specific aim of the project was to assess the socio-economic value of goods and services provided by the forest ecosystem in the Düzlerçamı Pilot Site in Turkey, to support effective decision-making and strengthen actions to support the sustainable management of these ecosystems.

Assessments towards socio-economic valuation of ecosystem goods and services are rare in Turkey, furthermore cases where assessments are incorporated into natural resources management practices and decision-making processes are even rarer. This project sets a good example, detailing how socio-economic value of ecosystem goods and services can be incorporated into different steps of management practices. Every 10 years, management plans of state-owned forests are being updated. Through this approach, efforts can be focused on monitoring the impact of management decisions taken in the long term, e.g. to assess the impact of allocating more area to ecological functions, or more area to intensive production, on ecosystem goods and services and would permit identifying those actions that will serve to increasing the sustainability of natural resources in the forest ecosystems and incorporating them in the management plans. This approach can thus be adopted as a model by public and private managers of forest ecosystems, and even other type of ecosystems, at national scale and at the level of the Mediterranean Region.

## PILOT SITE DESCRIPTION

### Pilot site description

Düzlerçamı Pilot Site is a sub-district forest unit located inside the Antalya Regional Directorate of Forestry in Turkey (Coordinates in Annex 1; Table 21). Like all forested areas in Turkey, forests of Düzlerçamı are state owned and managed by the General Directorate of Forestry under the Ministry of Forestry and Water Affairs. The incomes generated through natural resources use in state owned forests of the area do belong to the treasury. In the pilot site, there exist 11,188.5 ha of productive and 6,499.6 ha of unproductive state owned forests where wood production is carried out by the state, with a higher intensity in the productive forests. Furthermore, an unforested area of 11,480.1 ha (made up of forest soil not yet afforested, private owned agricultural lands, settlements, etc.) exists inside the pilot site. The total surface area of the pilot site is thus 29,168.2 ha. Düzlerçamı Pilot Site is located very close to Antalya Province, one of the biggest cities of Turkey and tourism hotspots of the Mediterranean Region. Different administrative levels are present in the pilot site, with Döşemealtı Municipality being the largest province in terms of surface area (see details in Musaoğlu et al., 2014).

Figure 1 : The map showing the location of the Düzlerçamı Pilot Site in Turkey, where black polygon indicating the borders of the Antalya Regional Directorate of Forestry.



Düzlerçami Pilot Site hosts maquis ecosystems and one of the largest pine forests on flat land in Turkey, where the dominant species is the Turkish pine (or Calabrian pine; *Pinus brutia*). According to the information presented in the forest management plan of the pilot site, there exist 430 plant taxa, of which 33 are endemic to Turkey (Antalya Orman Bölge Müdürlüğü, 2012). Furthermore 24 of the plant species in the pilot site are listed as threatened by IUCN (International Union for Conservation of Nature) and two species are listed in the Bern Convention appendices (namely *Cyclamen coum* and *Alkanna pinardii*).

Protected areas of different types with different legal restrictions do exist inside the boundaries of the site (one wildlife reserve, 10 natural, archeological and urban SIT<sup>1</sup> areas). One national park, namely Güllük Dağı-Termessos National Park (of 6,600 ha) is located at the western border of the pilot site. Parts of the site also overlap with one of the best-known wildlife reserves in Turkey (namely Düzlerçami Wildlife Reserve) and home to a rare population of fallow deer (*Dama dama*). The pilot site acts as a genetic reserve for the only autochthonous population of fallow deer (*Dama dama*) in the world. This population was put under protection in mid 1960s, and recently was used as the source for two reintroductions elsewhere in the country through translocations. Wild goat (*Capra aegagrus*) is another key asset since they form the main target for game hunting practices in the site. Accordingly, the presence of fallow deer and wild goats were identified as the key components of the biodiversity the site hosts in the plan. Other wildlife such as wild boars (*Sus scrofa*), golden jackal (*Canis aureus*), caracal (*Caracal caracal*), lynx (*Lynx lynx*) and badger (*Meles meles*) increase the biodiversity value of the pilot site.

The Düzlerçami Wildlife Reserve was designated in 1974, and borders were redefined in 2005, for the conservation of fallow deer and wild goat. The reserve covers approximately 29,000 ha and 47% of this overlaps with the pilot site. Also inside the reserve, a breeding station for the fallow deer was established firstly in 1966 (namely Düzlerçami Alageyik Üretim İstasyonu) covering an area of 25 ha, which was then moved to another location in 2002 and currently is covering an area of 521 ha. The breeding station was established specifically targeting the protection of fallow deer. A zoning study has been carried out inside the wildlife reserve to identify sites with different types of restrictions to human activities, as detailed in the management plan of the reserve (Çevre ve Orman Bakanlığı, 2011). Hunting other than game hunting is not allowed inside the wildlife reserve and management practices are carried out towards conservation of wildlife. Finally, game hunting is offered to local, national and foreign hunters by private companies (who applies to the Ministry to acquire these rights through a bidding procedure), under the surveillance of the Ministry of Forestry and Water Affairs, General Directorate of Nature Conservation and National Parks. In these practices, 20% of the income generated is given to local district legal entity (former village entities) where the hunting took place. Furthermore people helping hunters are usually from the local villages, providing additional income.

Located very close to Antalya, the Düzlerçami pilot site is also influenced by recreation and tourism activities. Güver Cliff is one of the tourist attraction points inside the pilot site, visited regularly by both national and international tourists. Furthermore, the forest itself is used by recreation purposes (more specifically for picnicking purposes) regularly with the presence of a couple of recreation spots rented to public or private bodies by the General Directorate of Forestry (Picture 1).

Picture 1: Photographs from the Yukarıkaraman recreation spot rented by the Döşemealtı Municipality<sup>2</sup>

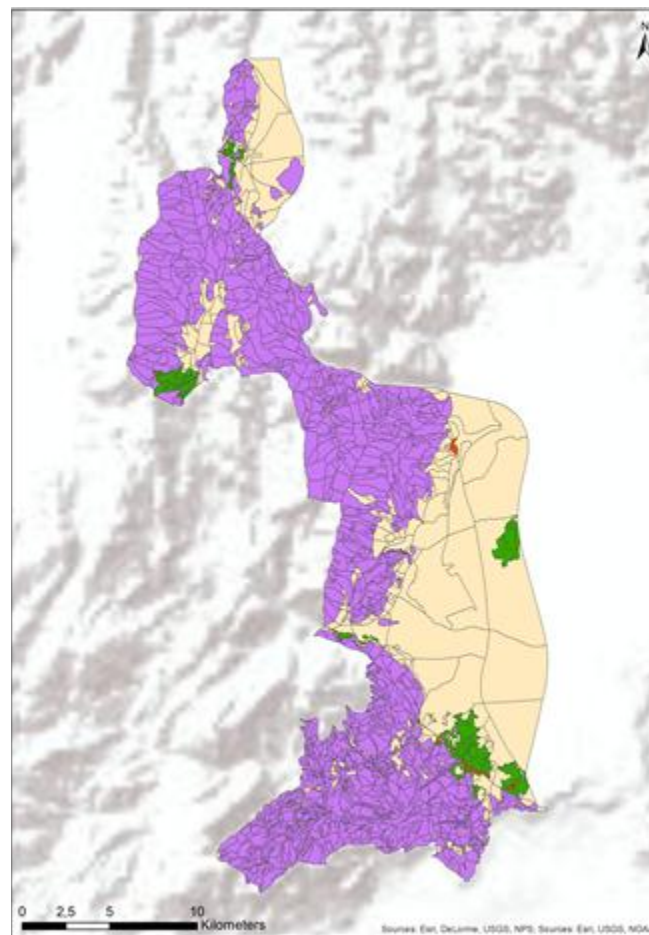


<sup>1</sup> This is a type of protected area in Turkey, previously managed by Ministry of Culture and Tourism. Prohibits human activities and designated for cultural, or natural or archeological values of sites. Mainly are small area but strictly protected areas.

<sup>2</sup> <http://fotopanorama360.com/dosemealti-belediyesi-duzlercami-mesire-alani-antalya/>

At a regional perspective, the site is important not only for wood production by the state, but also for the conservation of natural resources. Under the functional planning approach of the General Directorate of Forestry (GDF), "Economical, Ecological and Social and Cultural Functions" are assigned to sub-district forest units. The economical functions are assigned to areas where intensive wood production is foreseen, furthermore to afforestation areas and areas where non-wood forest products production is foreseen. The ecological functions are assigned to areas with formal protection status (Wildlife Reserves), areas with poor habitats, areas holding seed orchards and archeological SIT areas. The Social and Cultural Function is assigned to areas with water resources protection, with recreation potential and areas where forest research activities are carried out. In the pilot site "Ecological Functions" are assigned to a big proportion of the pilot site (Fig. 3). Wood production does still take place in the areas with ecological functions, yet intensive production does not occur. In this respect, the amount of allowable cut assigned to the pilot site in the final planning period (covering the period 2012-2021) has decreased by 68% (totally 80,150 m<sup>3</sup>) in comparison to the previous management period (covering the period 1997-2006). The main reason of this was an increase in the surface area allocated to ecological functions in the pilot site. As a conclusion, even if the pilot site is actively managed towards wood production and other services by the state, the primary focuses remains sustaining the forest health and soil protection.

Figure 2



The map showing areas assigned to different functions in the pilot site, where purple refers to ecological functions, green refers to economical functions, red refers to social and cultural functions and yellow is made up of forest soil not yet afforested, private owned agricultural lands, settlements, etc.

In comparison to other sub-district forest units in the region, the Düzlerçamı Pilot Site is a rather well protected sub-district forest unit through the collaborative efforts of the General Directorate of Nature Conservation and National Parks and the General Directorate of Forestry under the Ministry of Forestry and Water Affairs. The main challenge of the site is the increasing urbanization pressure, which manifests itself through intensification of housing pressure and also increased pollution from human activities in the site. While illegal hunting activities do occur in the pilot site, the intensive



measures taken in the wildlife reserve are effective; fines collected from illegal hunting activities in 2013-2014 correspond to more than 100,000 € (Source: General Directorate of Nature Conservation and National Parks).

Non-wood forest products are being collected in the forest where the priority of the state is generating income to local people. Furthermore, animal husbandry practices are carried out by local people using and/or benefiting from the natural resources present in the pilot site. Grazing might be prominent in parts of the pilot site, however overgrazing is no longer threatening the natural resources of the site in comparison to the past periods (Musaoğlu et al., 2014; Türkeş et al., 2015). It is well acknowledged that the number of livestock is decreasing in the pilot site due to diverse factors (e.g., low market demand, migration, and the common fact that young people not willing to work on farms as in most of the rural areas and villages (Musaoğlu et al., 2014; Türkeş et al., 2015). As a conclusion, overgrazing is not impacting negatively the forest resources in the pilot site.

Forest fires, a common phenomenon of Mediterranean forests, does also take place in the site, with the most harmful one occurred in July 21<sup>st</sup> 1997, destroying 1,715 ha of forest area inside and outside of the pilot site. However, since then, there have not been any big forest fires in the Düzlerçami Pilot Site. On the contrary, the potential for the great forest fire has been decreasing due to the investments and the measures implemented by the General Directorate of the Forestry (Musaoğlu et al., 2014; Türkeş et al., 2015). Furthermore, the pilot site is located within the application zone of a project realized towards enhancing the resistance of forests to forest fires in 2011 (YARDOP Project: Yanan Alanların Rehabilitasyonu ve Yangına Dayanıklı Ormanlar Tesisi Projesi). In this framework, a total of approximately 5,500 ha land was managed towards opening fire prevention roads, and mainly broad-leaved trees (e.g. cypress, fruit trees, oak and oleanders) were planted near the roads. Also the establishment of the "International Forest Fires Training Center" in 2013 did in the pilot site did enhance the forest fire fighting capacity of the pilot site and the Antalya region overall. Finally, the establishment of recreation spots rented to private or public bodies did contribute positively towards monitoring human activities in the site and preventing human induced fires in the site. All of these actions on the ground do support the decreasing possibility of encountering big forest fires in the site in the future.

One of the main challenges on the natural resources of the pilot site is the impact of climate change in the region. According to the 4<sup>th</sup> Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007), the Mediterranean Region is one of the regions expected to be very negatively impacted by climate change. Among these impacts, decrease in water resources, increased drought, forest fires, deaths related to heat waves, ecological degradations, erosion, changes in the agricultural productivity and increases in the vector related diseases are listed.

One of the main reasons, which motivated the choice of this site in this project was the fact that the forest management plan of the pilot site has recently been finalized. The final management plan of the pilot site covers the period 2012-2021, permitting a moderate to good level of knowledge to exist about the site. Even though in their existing structure the ecosystem goods and services are not included in the management plans, there is possibility to translate the information on the goods and services into the planning process.

Studies towards valuation of ecosystem goods and services are unfortunately rare in Turkey. Furthermore, cases where valuation assessments are incorporated into natural resources management practices and decision-making processes are even rarer. Yet, Turkish Forest Service as a corporate body of the Ministry has competent organizations at central and rural levels for sustainable forest management. The approach of perceiving the forest as an ecosystem bearing diverse goods and services is gaining importance in the General Directorate in general terms. This project sets a good example in Turkey, detailing how socio-economic value of ecosystem goods and services can be incorporated into different steps of management practices. Therefore, in the Düzlerçami Pilot Site bearing up to date management data, it was possible to carry out this model project, which aims at supporting management decisions at the Düzlerçami Pilot Site through socio-economic valuation of ecosystem goods and services. Every 10 years, management plans of state-owned forests are being updated. Through this approach, efforts can be focused on monitoring the impact of management decisions on ecosystem goods and services and accordingly preparing management plans and taking decisions towards increasing the sustainability of natural resources in the pilot site.

## Management objectives and project issues

As stated above, the Düzlerçami Pilot Site is a rather well protected forest site managed towards sustainable wood production. The future changes expected to occur in the site are mainly in line with increases in urbanization pressure and negative impacts of climate change. Even if the pilot site is actively managed towards production of wood and other products, the overall management objective of the General Directorate of Forestry in the Düzlerçami Pilot Site remains the sustainable management of national forest resources and thereby contributing to the wealth of the society and sustainable development of the country.

In the management plan of the pilot site, specific areas are allocated towards different types of activities, such as protection of water resources, provision of ecotourism and recreation activities, protecting biodiversity (through presence of different types of protected areas), promoting research (through an existing research forest), etc. (Table I).

**Table I: The different classes of production identified in forested areas in the management plan of the pilot site**

Production Classes	Surface Area (ha)
Intensive industrial wood production	882.9
Non-wood forest products production	36.2
Wildlife reserve	13,100.9
Poor habitat conservation (Soil protection)	3,601.1
Seed orchards	19.5
Archeological SIT <sup>3</sup> areas	0.1
Water resource protection	15.8
Provision of ecotourism and recreation opportunities	23.3
Research forest	8.3
<b>Total</b>	<b>17,688.1</b>

Source: Antalya Oman Bölge Müdürlüğü, 2012

More specifically, objectives identified in the framework of the project by different stakeholders (including experts from the Düzlerçamı Sub-District Forest Unit, from the South West Anatolia Forest Research Institute, from the General Directorate of Forestry headquarters in Ankara, academicians working on the pilot site and the other thematic and national experts of the project) in terms of ecosystem goods and services production related to forest management and territorial development are:

- Sustaining wood production,
- Further developing tourism and recreation activities in the area,
- Enhancing industrial wood production practices in the area,
- Enhancing the non-wood forest products collection and production in the area.

## **ECONOMIC AND SOCIAL VALUE ESTIMATE FOR THE SERVICES PROVIDED BY MEDITERRANEAN FOREST ECOSYSTEMS OF THE MEDITERRANEAN FORESTS SOCIOECONOMIC VALUATION**

### **Objective of the socioeconomic study in the pilot site**

The objective of the socioeconomic study in the pilot site is to support the management direction and monitoring of management actions impacts. As mentioned above, every 10 years management plans of state-owned forests are being updated. By taking into account the economic and social value for the ecosystem goods and services the forest ecosystem provide, the impacts of the management decisions on the goods and services can be monitored in the long term. This project therefore has the potential to be adopted as a model on the management of forest areas in Turkey and accordingly preparing management plans and taking decisions towards increasing the sustainability of natural resources.

### **Goods and services provided by the pilot site**

According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services' (IPBES) Preliminary guide regarding diverse conceptualization of multiple values of nature and its benefits, including biodiversity and ecosystem functions and services (deliverable 3 (d)), non-anthropocentric and anthropocentric types of values related to nature, nature's benefits and a good quality of life do exist (IPBES, 2014). In this report, we will adopt the classification following The Economics of Ecosystems & Biodiversity (TEEB). Under this framework, different stakeholders of the Düzlerçamı Pilot Site (including experts from the Düzlerçamı Sub-District Forest Unit, from the South West Anatolia

<sup>3</sup>This is a type of protected area in Turkey, previously managed by Ministry of Culture and Tourism. Prohibits human activities and designated for cultural, or natural or archeological values of sites. Mainly are small area but strictly protected areas

Forest Research Institute, from the General Directorate of Forestry headquarters in Ankara, academicians working on the pilot site and the other thematic and national experts of the project), have identified the ecosystem goods and services present in the site (Table 2). The information collected under the framework of Component 3 of the project<sup>4</sup> was also in agreement with this list of goods and services. While identifying the ecosystem goods and services, only the forest ecosystems in the pilot site and the goods and services related to the forest ecosystems were taken into consideration.

**Table 2: Different type of ecosystem goods and services identified in the Düzlerçamı pilot site in the forest ecosystem**

Type of good and service	Classification under TEEB			
	Provisioning Services	Regulating Services	Supporting Services	Cultural Services
Wood production	X			
Biodiversity protection			X	
Fodder and forage	X			
Food products	X			
Water regulation		X		
Recreation and tourism				X
Carbon sequestration		X		
Hunting and game products	X			
Historical and educational services				X
Air quality regulation		X		

A prioritization of the identified ecosystem goods and services were carried out in earlier phases of the project (Table 3). In this respect both the importance of the ecosystem goods and services as perceived by different stakeholders was assessed and also the presence of data and information which would permit valuating and integrating the goods and services to the Cost-Benefit Analysis was carried out. As a result of this exercise, the ecosystem goods and services, which were going to receive the primary focus in the project, were identified.

**Table 3: The corresponding beneficiaries of the ecosystem goods and services identified in the pilot site and their priorities**

Type of good and service	Corresponding beneficiary(ies)	Priority
Wood production	State	X
Biodiversity protection	Society in general	X
Fodder and forage	Animal breeders in the local communities	-
Food products	Local communities	-
Water regulation	Society in general	-
Recreation and tourism	Visitors (national and foreign)	X
Carbon sequestration	Global community	X
Hunting and game products	Local communities, hunters, enterprises (game tourism companies)	-
Air quality regulation	Society in general	-

**Wood production:** The Düzlerçamı Pilot Site is a state owned and managed sub-district forest unit, where the wood production (including timber and fuel wood) is carried out. Therefore one of the priority goods and services identified in the site was the wood production by the state. All of the management decisions to be taken and implemented by the General Directorate of Forestry in the pilot site will thus have a direct impact on this ecosystem good. Furthermore, detailed data exists at local and regional scale on this good.

**Biodiversity protection:** Given the presence of a wildlife reserve in the site and the allocation of a high proportion of the pilot site to ecological functions (thus not intensive wood production by the state), biodiversity protection was identified as one of the key services delivered by the forest ecosystems in the Düzlerçamı Pilot Site. This service was identified as bearing the highest priority in the Sensitivity Analysis carried out under the framework of Component 3 (identified as

<sup>4</sup>Component 3 Title : Improve modes of governance for Mediterranean forest ecosystems at territorial scale – Test of a methodological approach on the Düzlerçamı pilot site in Turkey



Environmental Values). However, in the framework of the project, due to time and budget constraints, stated preference methods were not employed to value the biodiversity protection ecosystem good and service in the pilot site.

**Fodder and forage:** Goat breeding is a common practice in the region and in some villages cattle-raising is also carried out. During 1980s, conflicts between goat breeding and forestry practices were prominent, which has led to sharp decreases in the number of domestic goats kept in the area. The information supplied on grazing in Türkeş et al. (2015) indicates a sharp decrease in the number of goats between 2002 and 2008 and only a slight increase - even in the presence of state subsidies - in the following period. In order to regulate grazing pressure, annual grazing plans are prepared by the Governorate of Antalya and the Ministry of Food, Agriculture and Livestock, detailing the sites where grazing is allowed and others where it is forbidden, yet overgrazing can still happen in the pilot site. Even if fodder and forage is one of the most important ecosystem services identified in the pilot site, given the complex socio-economic dynamics, which shape the animal husbandry practices in the local, regional and national level, we have decided to exclude it from the assessment. In other words, no direct links between the management practices taken by the General Directorate of Forestry and the animal husbandry practices at the local scale could be established in the framework of the project, which would permit assessing the impact of alternative management approaches towards forestry on this good.

**Food products:** Non-wood forest products collection is carried out in the pilot site by local people. As detailed in the management plan, a small part of the forest (36.2 ha) which is mainly made up of stone pine (*Pinus pinea*) and almond (*Prunus dulcis*) trees, is dedicated to non-wood forest product function. The almond production sites are private forestation sites rented to private people/companies whereas the stone pine production is carried out under the non-wood forest production function. Furthermore, again in the management plan of the pilot site, presence of 47 economically important non-wood forest products are identified. Yet, no estimates on the distribution, economic value or the intensity of collection on these products could be presented. Even if non-wood forest production is a topic gaining importance at the national scale, inventories on different species are yet to be carried out to collect relevant information.

**Water regulation:** In the management plan of the pilot site, an area of 358.9 ha (out of which 15.8 is forested area) is allocated to water regulation function. The forests and maquis land to the north of the site with this function are chosen mainly because they serve at cleaning ground water and water in streams, rivers and lakes. Furthermore the presence of forests with high forest closure in the pilot site does contribute to controlling floods in the region, like the Güver Cliff where water flows pass through the forest area. Furthermore forest ecosystems can have an impact on the reduction of siltation of reservoirs downstream. Yet, there exist no underlying assessments about the intensity and extent of water regulation specifically for the pilot site.

**Recreation and tourism:** Antalya and its surroundings are one of the key tourism hotspots in Turkey. According to the Prime Ministry Investment Support and Promotion Agency, 25 million passengers flew to Antalya Airport in 2012; 20 million of these passengers were passengers on international flights. The airport has more than 50 different airways flying from/to more than 75 destinations and is ranked as the 21<sup>st</sup> busiest airport in the world by number of international passengers. Located very close to Antalya, the Düzlerçamı Pilot Site is influenced by recreation and tourism activities. Yet, it was also acknowledged by different stakeholders that other than Güver Cliff - one of the tourist attraction points inside the pilot site visited regularly by both national and international tourists - the forest area itself was not used frequently for tourism purposes but was mainly used for recreational purposes - namely picnicking. There exist sites allocated for picnicking purposes, which are rented by the General Directorate of Forestry to public or private bodies for a certain duration (29 years) following a bidding procedure. If needed (if canopy closure is 1), maintenance work is carried out prior to renting by the General Directorate of Forestry and at times - when needed - this work can be continued. However no wood production is carried out in these sites once they are declared as recreation spots. Thus, belonging to the state, the management decisions in the pilot site have a direct impact in these recreation spots.

**Carbon sequestration:** The Düzlerçamı Pilot Site is made up of majorly Turkish pine (or Calabrian pine; *Pinus brutia*) forests. The global role of forests in carbon sequestration is well acknowledged in the literature (Nabuurs et al., 2007). Therefore one of the prioritized services in the pilot site was carbon sequestration. The carbon sequestered by the forests of the pilot site is prone to be directly influenced by the management decisions taken by the General Directorate of Forestry at the local scale, e.g. the intensity of harvest, intensity of planting, species planted, harvest rotation, etc. Furthermore, detailed data exists at local and regional scale on this service.

**Hunting and game products:** Düzlerçamı Pilot Site is among the first established game tourism sites in Turkey. Under the Ministry of Forestry and Water Affairs, General Directorate of Nature Conservation and National Parks, the Central Hunting Committee (made up of ministry experts, NGO representatives, academicians and representatives of hunting organizations) meets each year towards identifying hunting permitted areas, annual quotas in hunting, game species, fines and game tourism sites and quotas. In Düzlerçamı Pilot Site, for every year with permitted game tourism, specific quotas are given to identify how many wild goats (*Capra aegagrus*) - one of the priority species for which the Düzlerçamı Wildlife Reserve was established - can be hunted. Given its protection status, Düzlerçamı Pilot Site is not among the sites

where a heavy hunting pressure is prevailing and the pressure is not foreseen to change drastically in the future. Even if the wildlife reserve and the pilot site do overlap geographically with a high proportion (app. 50%), the decisions towards hunting and game products are taken by a different general directorate than General Directorate of Forestry. Therefore because the link between the forestry management decision and their impact on hunting and game products is not explicit, this ecosystem service was excluded from the assessments in the project.

**Air quality regulation:** The Düzlerçami Pilot Site is closely located to one of the biggest cities in Turkey, namely Antalya. Given the high forest coverage of the pilot site, one of the ecosystem good and services was identified as the air quality regulation. Management decisions taken by the General Directorate of Forestry on the forest ecosystems thus have a direct impact on this ecosystem good and service. Yet, in the absence of any quantitative data on this topic, we have excluded it from the assessments in the project.

# Socioeconomic estimate of prioritized goods and services: a 2 steps assessment

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## SOCIOECONOMIC ESTIMATE IN THE REFERENCE STATE

### Methodology

#### Wood Production

As justified under Section 2.3.2, wood production is one of the prioritized ecosystem's goods in the Düzlerçamı Pilot Site. We have employed the "Market Price Method" to estimate the value of wood production in the pilot site. The method is employed when the actual market for the good and service exists and is the valuation is carried out on the basis of observed market prices (Plan Bleu, 2014). The value of wood production was assumed to be equal to the market price of wood products minus the cost of harvesting and transportation. For this, 2014 data was used on different type of wood products and fuel wood produced by the state in the pilot site. Site-specific data on annual production amounts and related costs were also brought together. We have employed the quantity of wood products produced on the ground and the site-specific expenses related to these productions in order to come up with the unit production expenses for 2014 for each product type in Düzlerçamı Pilot Site. While doing these, we have assumed the absence of any additional fuel wood collection in the pilot site other than the official figures presented.

There exists no site-specific data on income generated from sales of the wood products; the annual income generated from the wood products in the production tables gathered at the regional scale and do not correspond to the annual wood production directly at the sub-district forest units. This is due to the fact that the products of one year can be kept and sold another year; also products from different sub-district forest units (especially those in the close surroundings) can be brought together and be sold from the same storing unit. Therefore, to present the income generated from wood products and thus to be able to come up with the unit value of wood products, Antalya Region's annual planted tree average sales price in 2014 for Turkish pine was used for different type of products.

#### Biodiversity Protection

As justified under Section 2.3.2, biodiversity protection is one of the most important ecosystem goods and services provided by the Düzlerçamı Pilot Site. Due to the project constraints, Stated Preference methods could not be employed to value the biodiversity protection ecosystem good in the pilot site. The assessment was rather carried out using Cost based method, by referring to the expenses incurred by the State to insure the protection of biodiversity. This value should be considered as a minimum value because it considers costs and not the willingness to pay of individuals. For this, we have employed the costs incurred by the Antalya Branch Office of the General Directorate of Nature Conservation and National Parks to manage the Düzlerçamı Fallow Deer Breeding Station (covering 521 ha). The costs incurred in the breeding station in 2013 were employed as a surrogate for assessing the biodiversity protection function of the pilot site. However it should be noted that this assessment remains very broad scale as the annual budget of the breeding station might not be the ideal budget required to covering all of the expenses of the station. Secondly, an alternative might have been to use the annual budget of the Wildlife Reserve (covering app. 29,000 ha) to better represent the biodiversity values of not only fallow deer but also other taxa in the pilot site. Thus, the outcomes of this approach should be seen as a minimum value of the biodiversity protection ecosystem service in the pilot site and more detailed assessments must be done to gain a better understanding of the biodiversity protection in the Düzlerçamı Pilot Site. Finally on a topic such as biodiversity protection, non-monetary values should also be acknowledged, such as the fallow deer genetic resource, intrinsic value of wildlife, and others.

#### Recreation and Tourism

As justified under Section 2.3.2, Düzlerçamı Pilot Site is used mainly for recreation purposes by the local people, i.e. picnicking activities. There exist 4 recreation spots in the pilot site 2 of which are no longer active. Among the actively run recreation spots, one is rented by the Döşemealtı Municipality (the biggest municipality in the pilot site), and the other is private. The most active recreation spot in the pilot site – which is perceived as a good model with potential to be replicated – is Yukarkaraman Recreation Spot, managed by Döşemealtı Municipality. This recreation spot (of app. 20

ha) has been rented from the General Directorate of Forestry to the Döşemealtı Municipality starting from 2006 and has been actively used as a picnicking area by the local community ever since.

In order to come up with the socio-economic value of recreation and tourism in the pilot site, "Benefit Transfer Method" was employed. Benefit Transfer Method is not a valuation method, but is a method that involves transferring economic estimates from previous studies presenting similar conditions (Plan Bleu, 2014). Due to the project constraints, detailed interviews towards the visitors of the Yukankaraman Recreation Spot were not carried out. To overcome this limitation, we have gathered information on the existing studies from the literature with a priority given to studies carried out in the Mediterranean Region, and more to studies carried out in the Antalya Province. As a result, a study focusing on a nature park called Kurşunlu Waterfall (in Antalya) was chosen as the model to work with (Ortaçesme et al. 2002). Kurşunlu Waterfall was chosen as it is a recreation spot located in Antalya, close to the city center (25 km) and with a size proportional with the pilot site (30 ha). In this study, the authors have employed the "Travel Cost Method" to come up with the recreational use value of Kurşunlu Waterfall and the Consumer Surplus was estimated as 0.53 TL as of 1999. In order to generate corresponding value of the consumer surplus in 2014, we have taken into account the inflation rate at the national scale between 1999 and 2014. By applying inflation rate as 8.49<sup>5</sup>, we have estimated the consumer surplus for 2014 as 1.6 € per visitor<sup>6</sup>. The inflation rate used to calculate the consumer surplus in 2014 was controlled from also a second source<sup>7</sup>, which gave a very similar estimate as 8.14 between 1999 and 2014. We have also double-checked the consumer surplus estimate from a second study, namely Belyakalı and Akpınar (2011). The authors have carried out a study in Yalova Thermal Spring towards estimating the Use Value of Ecosystem Services in the site, which are mainly recreation and tourism. In this study, the consumer surplus was presented as 1.4 € per visitor. Given the similarity of this value to the outcomes of Ortaçesme et al. (2002), we have concluded to continue using 1.6 € per visitor as the consumer surplus.

To estimate the number of people using Düzlerçamı Pilot Site for recreation purposes, we have employed information existing in the Yukankaraman Recreation Spot. Data about the number of visitors using the recreation spot does not exist and only data about the number of tickets cut to get in the site is collected. At the entry of the recreation spot, tickets of 5 TL are cut to vehicles without distinguishing their types and the number of visitors in the cars. Number of tickets to be cut to vehicles depended on their sizes and the number of visitors entering, but without a truly systematic approach. Therefore, we have assumed that on average 1 ticket was cut for every 4 visitors entering the recreation spot. Secondly, information existing on the use of the Güver Cliff (one of the tourism hotspots in the pilot site) was also incorporated into the study. Güver Cliff used to be a designated protected area (i.e. Nature Park) managed by the General Directorate of Nature Conservation and National Parks. However its status has since been removed and the site is currently managed by the General Directorate of Forestry. Under the management of the formal authority, entry fees were collected for the site, however no entry fees are currently being collected from visitors. Therefore the most up to date information on the visitors' number on the Güver Cliff is from 2010. Even if it is not up to date, this estimate was added to come up with the total number of visitors to Düzlerçamı Pilot Site. Data on the Güver Cliff existed in terms of tickets cut individually for visitors and for cars. For tickets cut for vehicles, we have again assumed that on average 1 ticket was cut for every 4 visitors entering the Nature Park. We have brought together these estimates from Yukankaraman Recreation Spot and Güver Cliff to come up with the number of visitors in the Düzlerçamı Pilot Site. Finally, there exists another important tourism attraction point, which is Karain Cave<sup>8</sup> on which visitor data exists. However, the tourism actions carried out in this site are not linked to the forest ecosystem since the visitors are coming to visit the cave instead of the forest ecosystem. Therefore we did not include data from this site to our assessment to measure the recreation activities linked to the forest ecosystem in the pilot site.

## Carbon Sequestration

As justified under Section 2.3.2, carbon sequestration is one of the priority ecosystem goods and services in the Düzlerçamı Pilot Site. In order to come up with the value of carbon sequestration, a "Shadow Price" of carbon was employed, which reflects the marginal opportunity cost of using a resource in the absence of market price (Plan Bleu, 2014).

In the framework of the National Inventory Report (NIR) annual carbon stock changes are calculated for all of the forests belonging to the state in Turkey. This is being carried out following the methodology of Intergovernmental Panel on Climate Change (IPCC) and Good Practice Guidance (GPG) 2003. The calculations specifically for the Düzlerçamı Pilot Site were provided in this respect by the experts responsible from preparing the national reports in the General Directorate of Forestry. An improved methodology at the national scale (which is under revision by IPCC currently) was used to carry out the calculations. In this respect, site-specific data on annual gains (from old and young stands), and annual losses (from wood production and fires) were gathered together for the period between 2008 and 2013.

<sup>5</sup> Calculated from the source: <http://www.indexmundi.com/g/g.aspx?c=tr&v=71>

<sup>6</sup> In the Project, a fixed exchange rate of 2.8 was used converting TL to €.

<sup>7</sup> <http://www.inflation.eu/inflation-rates/turkey/historic-inflation/cpi-inflation-turkey.aspx>

<sup>8</sup> [https://en.wikipedia.org/wiki/Karain\\_Cave](https://en.wikipedia.org/wiki/Karain_Cave)

Furthermore, national data on Harvested Wood Products (HWP) were extrapolated to Düzlerçanı Pilot Site to take into account the carbon not lost but stored in the wood products once the wood was transformed to various types of goods. This value was considered as a positive input to the annual carbon stock changes in our estimates. The average value of the annual net CO<sub>2</sub> (tCO<sub>2</sub>/year/ha) between 2008 and 2013 was calculated. Finally, for the valuation of the carbon sequestration service, "Social Cost of Carbon" was used as 30 USD/tons of CO<sub>2</sub> following the Guidance note of the World Bank Group staff (World Bank Group, 2014). A cross exchange rate between USD and € was used as 0.96 (2.7/ 2.8 as of 15.04.2015) to estimate the corresponding value of the service in terms of €.

## Phases of the approach and studied goods and services summary

Table 4

Type of goods and services	Method	Physical indicators	Monetary indicators	Beneficiaries
Wood Production (including fuelwood)	Market Price Method	Quantity (m <sup>3</sup> )	Economic Price	State
Biodiversity Protection	Cost Based Method	Forest surface area (ha)	Annual expenses related to management of the breeding station	Society in general
Recreation and Tourism	Benefit Transfer Method	Number of visitors	Consumer Surplus	Visitors
Carbon Sequestration	Shadow Price	Annual carbon stock change	Social Cost of Carbon	Global community

## Results

### Wood Products

2014 data was employed to carry out the assessments. The data was gathered from different sources including the Düzlerçanı Sub-District Forest Unit Accountancy Department, Antalya Regional Directorate of Forestry and Antalya District Forest Directorate.

Table 5

Data	Details	Holder	Update
Data on annual production amounts and related costs on Turkish pine	Amount of different types of wood products produced (in m <sup>3</sup> and stere) and expenses related to their production (including carrying out the cuts, carrying the materials to the storing units, etc.)	Düzlerçanı Sub-District Forest Unit Accountancy Department and Antalya Regional Directorate of Forestry	2014
Data on Turkish pine's planted tree average sales prices	Antalya region's annual planted tree average sales price for Turkish pine for different type of products detailing the type of sold (auction price, or others)	Antalya District Forest Directorate	2014

Table 6: Results in 2014

Product Type <sup>9</sup>	Produced (m <sup>3</sup> /year)	Unit production cost (TL/m <sup>3</sup> /year; realized on the ground cost)	Unit market price (TL/m <sup>3</sup> /year; Averages of Antalya)	Unit net income TL/m <sup>3</sup> /year	Unit net income (€/m <sup>3</sup> /year <sup>***</sup> )	Total income (€/year <sup>***</sup> )	Affected Forest Area (ha)	Value (€/ha/year)
Log	1,841.33	74.89	247*	172.11	61.47	113,183	17,688	6.40
Wire-telephone pole	0.82	68.53	239**	170.47	60.88	50	17,688	0
Mining Pole	822.88	82.12	187**	104.88	37.46	30,823	17,688	1.74
Small log (split)	1,489.19	73.94	179*	105.06	37.52	55,875	17,688	3.16
Pulpwood	1,046.15	73.12	176**	102.88	36.74	38,439	17,688	2.17
Standing tree	2,446.00	29.05	78**	48.95	17.48	42,761	17,688	2.42
Fuelwood	961.10	34.80	48**	13.20	4.71	4,531	17,688	0.26
<b>TOTAL</b>	<b>8,607.47</b>	<b>436.46</b>	<b>1,154</b>	<b>717.54</b>	<b>256.57</b>	<b>285,662</b>	<b>17,688</b>	<b>16.15</b>

## Biodiversity Protection

2013 data was employed to carry out the assessments on the biodiversity protection in the pilot site. The data was gathered from Antalya Branch Office of the General Directorate of Nature Conservation and National Parks and the Headquarters of the General Directorate of Nature Conservation and National Parks.

Table 7

Data	Details	Holder	Update
Data on management costs of the breeding station	Personnel costs and costs related to preparing a Species Action Plan for the Fallow deer	Antalya Branch Office of the General Directorate of Nature Conservation and National Parks	2013

Table 8: Results in 2013

Type of Cost	Costs (TL)	Cost (€)	Affected Forest Area (ha)	Cost €/ha
Personnel	173,700	62,036	17,688	3.51
Species Protection Action Plan	52,805	18,859	17,688	1.06
<b>Total</b>	<b>226,505</b>	<b>80,895</b>	<b>17,688</b>	<b>4.57</b>

## Recreation and Tourism

2010 and 2014 data was employed to carry out the assessments. Data of different sources were employed in assessing the socio-economic value of recreation and tourism, gathered from: Döşemealtı Municipality, Antalya Branch Office of the General Directorate of Nature Conservation and National Parks and Antalya Regional Directorate of Forestry.

Table 9

Data	Details	Holder	Update
Data on the number of visitors	Number of tickets cut in Yukarıkaraman Recreation Spot rented by the Döşemealtı Municipality	Döşemealtı Municipality	2014
Data on the number of visitors	Number of tickets cut in Güver Cliff	Antalya Branch Office of the General Directorate of Nature Conservation and National Parks and Antalya Regional Directorate of Forestry	2010

<sup>9</sup> The characteristics of the product types are given in Annex 1 of the report.



Table 10: Results in 2010 and 2014

Site	# tickets (cars)	# tickets (individuals)	# Visitor estimated	Value per visitor (€)	Total value (€)	Affected forest area (ha)	Average value (€/ha)
Yukarıkaraman Recreation Spot	43,690	-	174,760	1.61	280,847	17,688.1	15.88
Güver Cliff	1,350	7,500	31,350	1.61	50,380	17,688.1	2.85
<b>TOTAL</b>	<b>45,040</b>	<b>7,500</b>	<b>206,110</b>		<b>331,228</b>		<b>18.73</b>

## Carbon Sequestration

All data collected in this section was acquired from the General Directorate of Forestry. Data covered the period between 2008 and 2013.

Table 11

Data	Details	Holder	Update
Annual carbon stock changes	Loss, gain and Harvested Wood Products (HWP) data	General Directorate of Forestry	2008-2013

Table 12: Results between 2008 and 2013

Year	Gains (tC/year)			Losses (ton C/year)			Net C (tC/year)	Harvested Wood Products (tCO <sub>2</sub> /year)	Net CO <sub>2</sub> (tCO <sub>2</sub> /year)	Affected forest area (ha)	Net CO <sub>2</sub> (tCO <sub>2</sub> /ha/year)	Unit value (€/t CO <sub>2</sub> *)	Total Value (€/year)	Value (€/ha/year)
	Old Stands	Young Stands	Total Gain (tC/year)	Wood production	Forest Fires	Total Loss (tC/year)								
2008	13,748	647	14,395	2,055	2	2,057	12,338	3,344	48,584	17,688	2.75	29	1,405,453	79.46
2009	13,748	647	14,395	713	6	719	13,676	4,057	54,203	17,688	3.06	29	1,568,006	88.65
2010	13,748	647	14,395	3,079	16	3,095	11,300	3,766	45,199	17,688	2.56	29	1,307,528	73.92
2011	13,381	139	13,519	15,047	77	15,124	-1,605	4,448	-1,436	17,688	-0.08	29	-41,543	-2.35
2012	13,381	139	13,519	9,209	112	9,320	4,199	5,222	20,619	17,688	1.17	29	596,469	33.72
2013	15,450	185	15,635	3,112	1	3,113	12,522	6,069	51,984	17,688	2.94	29	1,503,826	85.02
<b>AVERAGE</b>											<b>2.06</b>	<b>29</b>	<b>1,056,623</b>	<b>59.74</b>

## Final results synthesis

### Pilot site economic value

Table 13

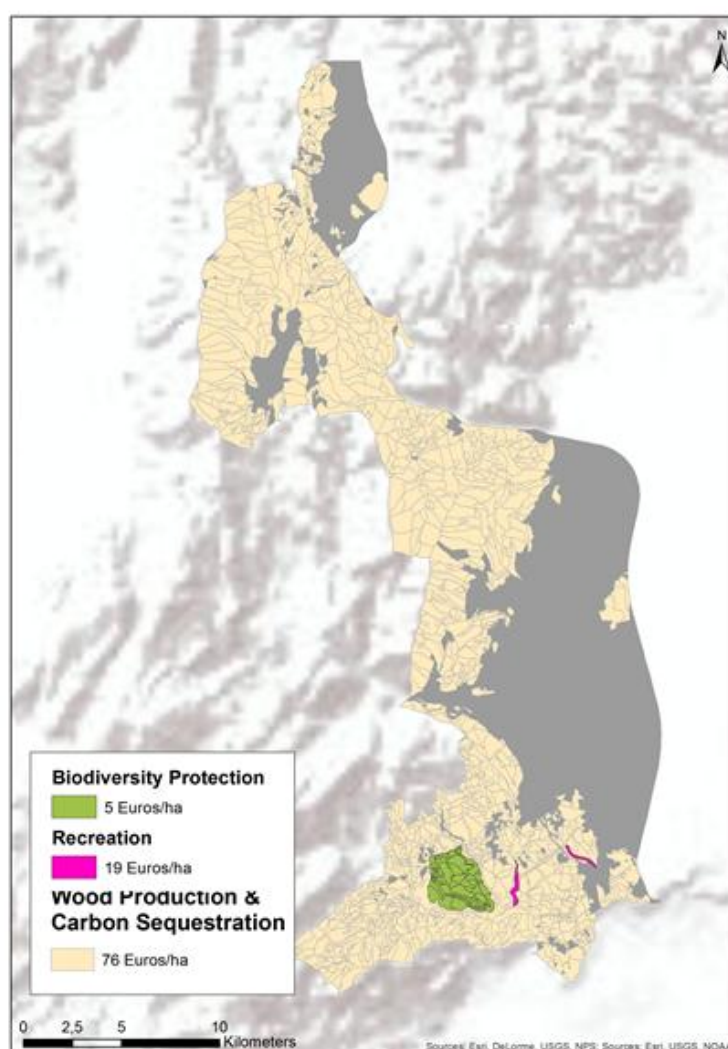
Goods or services	Data source	Assessment method	Physical quantity	Economic unit value	Total value/year	Value/ha
Wood Products	General Directorate of Forestry	Market Price Method	8,607.47 m <sup>3</sup>	256.57 Euro/m <sup>3</sup>	285,662 € (in 2014)	16.15 €/ha/year
Biodiversity Protection	General Directorate of Nature Conservation and National Parks	Cost Based Method	17,688 ha of forest (521 ha of breeding station in the forest area)		80,895 € (in 2013)	4.57 €/ha/year <sup>10</sup>
Recreation and Tourism	Döşemealtı Municipality	Benefit Transfer Method	206,110 visitors	1.61 euro/visitor	331,228 €/year (in 2014)	18.73 €/ha/year
Carbon sequestration	General Directorate of Forestry	Shadow Price	2.06 tCO <sub>2</sub> /ha/year (average from 2008-2013)	29 €/tCO <sub>2</sub>	1,056,023 €/year (average from 2008-2013)	59.74 €/ha/year

<sup>10</sup> The outcomes of this approach should be seen as a minimum value of the biodiversity protection ecosystem good and service in the pilot site and more detailed assessments must be done to gain a better understanding of the biodiversity protection in the Düzlerçamı Pilot Site.

### Lessons learned from these results

One important conclusion of the study was demonstrating that the Düzlerçamı Pilot Site forests can be allocated for the production of different goods and services, i.e. recreation activities, biodiversity protection, wood production and carbon sequestration which all generate different benefits to the society. Figure 3 represents the different goods and services provided in different parts of the pilot site and their values. Secondly, conflicts can exist between different uses of the goods and services, for example the increased allocation of forest area to recreation activities does decrease wood production and might have a negative impact on biodiversity protection and carbon sequestration. Therefore, when considering the impacts of the management decisions, it is important to take into account the unit values (per ha) provided by different goods and services for decision makers. Thus it is of high importance to be able to come up with values which represent the goods and services present in the pilot site and in this study, valuation of biodiversity protection good and service was one of the main limitations.

Figure 3



The different goods and services provided in different parts of the pilot site and their values. The added value for wood production and carbon sequestration is presented in the figure. Furthermore the Yukankaraman recreation spot and the former Güver Cliff Nature Park, whose data was used to estimate the value of the recreation service, are presented on the map.

The socio-economic valuation of the ecosystem goods and services present in the Düzlerçamı Pilot Site was limited for the biodiversity protection. It was acknowledged that more detailed assessments on these services would have been essential for the project. This was especially valid for biodiversity protection service, which has been identified as one of the most - if not the most - important ecosystem good and service in the pilot site. In order to compare the biodiversity

protection value of the pilot site generated using Cost-Based Method with other cases, we have explored different examples presented on several Mediterranean countries about values of forest biodiversity (in Merlo and Croitoru, 2005). The valuation methods presented in this study was Cost-Based Method and Contingent Valuation Method. In this review, the value linked to forest biodiversity changed from 2.0 €/ha to 59.7 €/ha in countries other than Turkey. As can be seen, up to 30 times difference existed among countries in the values estimated, which implies the dimension of discrepancies on this topic among different cases and why it should be treated with caution. In this study we have employed the costs incurred at the fallow deer breeding station in the pilot site, yet it should be noted that this assessment remains very broad scale as the annual budget of the breeding station might not be the ideal budget required for covering the expenses of the station. Secondly, an alternative might have been to use the annual budget of the Wildlife Reserve (covering app. 29,000 ha) to better represent the biodiversity values of not only fallow deer but also other taxa in the pilot site. Thirdly, if there existed a specific budget line allocated for activities towards biodiversity protection, it would have been the primary data that could be used to assess the value. Thus, the outcomes of this approach should be seen as a minimum value of the biodiversity protection ecosystem service in the pilot site and more detailed assessments are a must to present the biodiversity protection value of the Düzlerçamı Pilot Site. Finally non-monetary values should also be acknowledged on such a topic, such as the fallow deer genetic resource, intrinsic value of wildlife and others.

It is also important to highlight that there are other key ecosystem goods and services, which were identified in this site, yet whose socio-economic value assessments could not be carried out in this project framework. This in turn limits our conclusions on the socio-economic value of the ecosystem goods and services present in the pilot site, thus our results remain incomplete. Yet, it is important to replicate these studies with existing data at hand to be able to gain and national scale understanding of the ecosystem goods and services related to forests, which is so far very limited. Thus, case studies like this project are of prime importance in Turkey.

## COST-BENEFIT ANALYSIS OF THE MANAGEMENT SCENARIOS

### Methodology and study hypothesis

At early phases of the project, as detailed in Section 2.2.2, opinions on the management objectives in the Düzlerçamı Pilot Site were gathered from different stakeholders. Among these, one topic was chosen as the focus of the project and the center of the Cost benefit analysis; the allocation of more forest land to establish new recreation spots in order to meet the increasing recreation demand of the local community. Starting from this point, one scenario was prepared for the pilot site. The baseline case corresponded to the existing situation on the ground with moderate recreation activities taking place, and the alternative scenario was based upon expected changes to occur in the site, which will have an impact on the ecosystem goods and services, i.e. increased allocation of the forest land to recreation activities. In parallel, the impact of climate change was concluded to be an indispensable component of this project, therefore the alterations of the growth rate of trees was chosen as the way to assess the impact of climate change in the pilot site and the ecosystem goods and services it host.

Even if biodiversity protection is one of the most important – if not the most – ecosystem good in the Düzlerçamı Pilot Site, in the absence of detailed information, the impact of management decisions taken by the General Directorate of Forestry and climate change on the biodiversity protection could not be integrated into the Cost Benefit Analysis. Therefore, the impact of management decisions and climate change was assessed through the CBA integrating only 3 ecosystem goods and services.

Table 14

Drivers or levers	Expected impact on ecosystem goods and services (intensity: -, 0, +)		
	Wood production	Recreation and tourism	Carbon sequestration
Increased allocation of forest sites to recreation activities	-	+	0
Impacts of climate change	-	0	-

### Increased allocation of forest sites to recreation activities

For assessing the impact of increased allocation of forest area to recreation activities, we have assumed a new recreation spot opened in the pilot site with features similar to the existing Yukankaraman Recreation Spot. As detailed in the previous sections, the forest stands which are mature and which would not require maintenance work are mainly selected as good candidates for recreation spots. And once a stand is chosen as recreation spot, a bidding process is carried out where management of the site is rented for 29 years to the selected public or private body. If needed (if canopy closure is 1), maintenance work is carried out

prior to renting by the General Directorate of Forestry, and at times - when needed - this work can be continued. However no wood production is carried out in these sites once they are declared as recreation spots.

Our basic assumption, which was supported by the expert opinions collected in the project, was that the new recreation spots would increase the number of people using these sites given the high demand from local people. In other words, the establishment of a new recreation spot would not change the number of people using the existing one(s). Our interviews with the managers of the existing recreation spots did point out that the carrying capacity of the pilot site can support the establishment of 2-3 new recreations spots. Yet in this project, we have decided to assess the impact of 1 new recreation spot opening in the pilot site. Following expert opinions collected, we have taken 75,000 € as the initial investment required to establish a new recreation spot similar to Yukankaraman Recreation Spot, thus covering an area of 20 ha, and in the sensitivity analysis we have assessed the impact of a 33% increase in this amount. Again following expert opinions collected, we have assumed that in the 1<sup>st</sup> year following the investment, the new recreation spot will host visitors corresponding to 20% of the visitors coming to the existing recreation spot and by 20% increase every year, it will reach its full capacity (hosting the exact number of visitors of the existing recreation spot) in 5 years. In the sensitivity analysis, we have assessed the impacts of decreases in the number of visitors by 20, 50 and 65% in the new recreation spot.

Regarding the impact of increased allocation of forest area to recreation activities on wood production, we have assumed that wood production would no longer be carried out in a surface of 20 ha in the pilot site. After estimating the benefit of wood production per ha, we have decreased the overall benefit to the government by 20 ha in the analysis. And also, we have assumed that the management costs related to forest would decrease by the 20 ha allocated to recreation spot. Again after estimating the cost of management per ha, we have decreased it by 20 ha in the analysis. Finally, to assess the impact of a new recreation spot on carbon sequestration, we have assumed that in the absence of any harvest in these sites, carbon that would have been lost due to harvest was going to remain in the ecosystem. Therefore the carbon lost due to wood production per ha was calculated for the pilot site in order to come up with an estimate on the carbon stored in 20 ha in the absence of wood production.

## Impacts of climate change

According to the 4<sup>th</sup> Assessment Report of the Intergovernmental Panel on Climate Change, the Mediterranean Region is one of the regions expected to be one of the most negatively impacted from climate change (IPCC, 2007). Among these impacts, decrease in water resources, drought, forest fires, deaths related to heat waves, ecological degradations, erosion, changes in the agricultural productivity and increases in the vector related diseases are listed. We chose climate change to be the prime driver influencing ecosystem goods and services in Düzlerçami Pilot Site. Among other interactions (e.g., increase in the frequency of forest fires, increased diseases and pest infections), we have focused our efforts to assess the impact of climate change on annual increment rates of trees in the Düzlerçami Pilot Site. Our efforts to find case studies focused on similar forest ecosystems in the Mediterranean Region making predictions about the changes expected in the annual increment rates due to climate change did give very limited results. Therefore, we have decided to carry out an exercise to generate an estimate for the pilot site. Our aim was to make a regional comparison in the Mediterranean Region of Turkey towards assessing whether current climatic conditions in a given sub-district forest unit could be used as a surrogate for Düzlerçami forests' future conditions vis a vis climate change. The outcomes of the climate change assessments carried out under the framework of Component 1 and 4<sup>11</sup> of the project were employed in this respect. In these components, the experts have downscaled Regional Climate Model (RegCM) HadGEM2-ES scenarios RCP4.5 and RCP8.5 for the project area in order to assess the climatic conditions in Düzlerçami Pilot Site for the periods 2015-2030 and 2031-2050. To make a comparison in terms of the climatic conditions of different sub-district forest units in the region, we have employed 2 bioclimatic variables, namely the annual mean temperatures and annual precipitation. Using these variables, we have carried out an exercise using data in Adana Province, located east of Antalya, to identify sub-district forest unit(s): (i) located within the same altitudinal range as Düzlerçami Pilot Site, (ii) resembles the projected climatic conditions of the pilot site in 2050 as of today. As a result of this exercise, we compared the average annual increment rates of the selected sites with Düzlerçami Pilot Site. According to the outcomes of the Component 1 of the project, it was concluded that the present dry-sub humid climate dominated over the Düzlerçami District was very likely tend to change towards further much hotter, continental and drier climatology in the future periods and will become a semiarid climate in the period 2031 to 2050 under the high emission scenario RCP8.5 (Türkeş et al., 2015). This would imply a negative impact on the forest ecosystem and thus a negative impact on the annual increment rate was to be expected given these limiting climatic factors. Yet the sub-district forest units located in Adana, which were selected in the framework of our exercise, did have higher average annual increment rates than Düzlerçami Pilot Site (55,062 m<sup>3</sup> of total annual increment in the selected sub-district forest unit in Adana vs. 37,569 m<sup>3</sup> of total annual increment in Düzlerçami). This difference can be linked to better soil conditions in Adana leading to higher annual increment rates despite harsher climatic conditions they host. Therefore, even if this exercise was carried out with caution, the results were excluded from the Cost Benefit Analysis. As a conclusion, to

<sup>11</sup> Component 1: Integrate the impact of climate change into forestry management policies, and to achieve this, produce data and develop tools regarding both the vulnerability of forests and their ability to adapt; Component 4: Optimize and value the role of Mediterranean forests in climate change mitigation (carbon sinks), via the production of methodological tools to assign monetary values to ecosystem protection and rehabilitation efforts.



represent the impact of climate change on the forest growth in the pilot site, we have hypothesized a decrease in the annual increment rates of 1%. Furthermore we have assumed that the decrease of 1% annual increment would translate to 1% decrease in the wood production in the pilot site. Similarly, we have assumed that the decrease of 1% annual increment would lead to 1% decrease in the carbon sequestered in the pilot site.

Regarding the impact of climate change on recreation and tourism, the overall understanding in the Mediterranean Region is that this phenomenon will have a negative influence on tourism and recreational activities. The discussions held with different stakeholders in the framework of the project pointed out that the existing recreation spots in the pilot site were highly used by local community, given their location at higher altitudes and colder temperatures they offer to Antalya citizens. These sites might continue to serve as hotspots for recreational activities in the long term and no conclusions could be made with certainty on the changes in the recreational use of the pilot site due to climate change. Therefore, we have assumed that climate change would not have an impact on the recreational activities carried out in the pilot site.

Under this scenario, in order to carry out the Cost Benefit Analysis, we have gathered data about the related costs and benefits incurred by different stakeholders, i.e. the Government, Municipality renting the recreation spot, the Society and Global Community. We have identified the essential information needed for the analysis as: (i) management costs incurring in the pilot site by the General Directorate of Forestry, (ii) benefits attained by the General Directorate of Forestry from renting the recreation spot, (iii) management costs of the existing recreation spot for the Döşemealtı Municipality, (iv) the benefit of the recreational and commercial activities attained by the Municipality renting the existing recreation spot.

The management costs related to forestry activities were collected at the scale of the Antalya Region as this information is not hold at the sub-district forest units' districts level. To infer to the costs of management in the pilot site, we have used the costs incurred at the Antalya Region level, namely costs under titles of general management (referring mainly to personnel costs), firefighting, research and development costs (mainly referring to costs related maintenance of the forest stands). Assuming that the efforts to manage different sub-district forest units' districts in the Antalya Region is similar to one another, we have estimated Düzlerçamı Pilot Site's management costs by comparing its size to that of Antalya Region. As a result of this exercise, management costs incurring in the Düzlerçamı Pilot Site in 2014 was estimated.

Table 15

Data	Details	Holder	Update
Data on management costs	Costs incurred at the Antalya region level, listed under titles of general management (referring mainly to personnel costs), firefighting and research and development costs (mainly referring to costs related maintenance of the forest stands)	Antalya Regional Directorate of Forestry, Antalya Department of Forestry	2014

To estimate the benefits attained by the General Directorate of Forestry from renting the recreation spots, we have explored information on the rent costs of the Yukankaraman Recreation Spot. The 2014 rents paid to the General Directorate of Forestry in quarterly intervals were taken as the estimate for this (8,375 €).

To estimate management costs of the existing recreation spot, the annual expenses acquired by the Döşemealtı Municipality was taken into account. 2014 data on the operational costs (i.e., electricity costs, water costs, personnel costs and maintenance costs) were taken into consideration for this matter (177,857 €).

Lastly, we have estimated the benefit of the recreational and commercial activities attained by the Döşemealtı Municipality renting the Yukankaraman recreation spot. In the studied spot, Döşemealtı Municipality receives payments from the entry fees of the visitors and also the rents of the shops, which are present inside the recreation spot. We have used 2014 data to come up with the estimate of the benefits of recreational and commercial activities acquired by the municipality (218,229 €).

The time horizon of the project was chosen as 29 years corresponding to the duration the General Directorate of Forestry rents forest area as a new recreation spot. The discount rate for the Düzlerçamı Pilot Site was chosen as 5% as the opportunity cost of the capital (following European Commission, 2002). Furthermore alternative discount rates of 6 and 10 % were also applied in the sensitivity analysis. The Net present value (NPV), Internal Rate of Return (IRR) and Benefit-Cost Ratio (B/C) were used as CBA performance indicators in the assessment.

## Results and sensitivity analysis

We have carried out Cost Benefit Analysis to assess the impact of a new recreation spot of 20 ha opened in the pilot site and the intensified impact of climate change. Detailed outcomes of the Cost Benefit Analysis are presented in Annexes 3 and 4 of the report. Tables 4 to Table 8 are presenting the summary outcomes of the analysis using NPV as the performance indicator. We have employed the Net Present Value (NPV) to assess the management alternatives (when NPV>0; the benefits outweigh

the costs; PlanBleu, 2014). Furthermore, the outcomes per ha was also assessed by taking into account the surface area of productive and unproductive forest areas in the Düzlerçami Pilot Site, making 17,688 ha in total.

Table 16 presents the outcomes of the Cost Benefit Analysis carried out to assess the impact of opening a new recreation spot. The “Without” rows in the table corresponds to the baseline scenario and the “With” rows presents the Scenario of adding a new recreation spot. The Net Present Value for the baseline was calculated using the formula:

$$NPV(S) = \sum_{t=0}^T \frac{S_t}{(1+d)^t} = \sum_{t=0}^T \frac{B_t}{(1+d)^t} - \sum_{t=0}^T \frac{C_t}{(1+d)^t}$$

where  $S_t$  is the net benefit of the project at time  $t$ ,  $d$  is the discount rate and  $T$  is the time frame (the last year of the project). The net benefit of the project is the difference between the benefits ( $B_t$ ) and costs ( $C_t$ ) associated with the studied alternative (Plan Bleu, 2014).

As it can be seen from the “Gain” row of the table, the addition of a new recreation spot over 29 years have yielded profitable results for all of the relevant parties. The Gain/ha over 29 years resulted to be 7€ for the government, given the higher income generated from the rents of one new recreation spot and the decreased management costs. The investment was profitable also for the society with 233€/ha over 29 years with the establishment of new recreation possibilities for the local community. Overall, the investment was profitable for the society. Lastly the additional carbon sequestered in the unharvested forest in the recreation spot yielded high profit for the global community with a net present value of 260 €/ha over 29 years.

Table 16

29 YEARS	Government	Municipality (Existing)	New manager	Society	SOCIAL	GLOBAL
WITHOUT (NPV)	-4,010,334	484,460	-	5,015,150	1,489,277	17,487,685
WITH (NPV)	-3,878,850	484,460	332,019	9,141,916	6,079,546	22,088,007
GAIN (NPV)	131,484	0	332,019	4,126,765	4,590,269	4,600,322
GAIN (PER HECTAR)	7	0	19	233	260	260
WITHOUT (NPV; PER HECTAR)	-227	27	-	284	84	989
WITH (NPV; PER HECTAR)	-219	27	19	517	344	1,249

Comparison of Net present value between the baseline scenario and an improved recreation scenario in the pilot site, using a discount rate is 5%. The results are presented for a time period of 29 years in euros.

Secondly, we have integrated the impact of climate change to the cost benefit analysis, both to the Baseline and the Scenario of adding a new recreation spot (Table 17). Even in the presence of climate change impacts, the allocation of forest area to open a new recreation spot remained profitable for all relevant parties.

Table 17

29 YEARS	Government	Municipality (Existing)	New manager	Society	SOCIAL	GLOBAL
WITHOUT (NPV)	-4,438,766	484,460	-	5,015,150	1,060,845	15,474,545
WITH (NPV)	-4,306,797	484,460	332,019	9,141,916	5,651,599	20,074,356
GAIN (NPV)	131,969	0	332,019	4,126,765	4,590,754	4,599,810
GAIN (PER HECTAR)	7	0	19	233	260	260
WITHOUT (NPV; PER HECTAR)	-251	27	-	284	60	875
WITH (NPV; PER HECTAR)	-243	27	19	517	320	1.135

Comparison of Net present value between the baseline scenario and an improved recreation scenario in the pilot site with the increased impact of climate change incorporated, using a discount rate is 5%. The results are presented for a time period of 29 years in euros.

On the other hand, the impact of climate change especially in terms of the carbon sequestration’s service to the global community was evident in the pilot site (

Table 18). The damage cost, which corresponds to the difference between the baseline scenario and the climate change scenario, demonstrates the negative impact of climate change on the forest ecosystem of the Düzlerçami Pilot Site. As can be seen from

Table 18, a 1% decrease in the annual increment rate of the Turkish pine trees would correspond to a cost of 24 €/ha over 29 years for the government through the decrease in the harvest of wood products. The damage cost is much



higher for the global community, where a 1% decrease in the annual increment rate would be translated into a cost of 114 €/ha over 29 years in the carbon sequestered in the pilot site.

Table 18

29 YEARS	Government	Municipality (Existing)	New manager	Society	SOCIAL	GLOBAL
WITHOUT (NPV) in the Baseline	-4,010,334	484,460	-	5,015,150	1,489,277	17,487,685
WITHOUT (NPV) in the Scenario	-4,438,766	484,460	-	5,015,150	1,060,845	15,474,545
Damage Cost (Baseline - Scenario)	428,432	0	-	0	428,432	2,013,140
Damage Cost/Ha	24	0	-	0	24	114

Comparison of Net present value between the baseline scenario and an increased impact of climate change incorporated, using a discount rate is 5%. The results are presented for a time period of 29 years in euros.

In order to assess how the outcome of our Cost Benefit Analysis changed with variations in inputs, assumptions or the setup of the analysis, sensitivity analysis were performed by changing certain parameters and applying different discount rates:

- An increase by one third in the initial investment cost required to establish a new recreation spot (100,000 € in place of 75,000 €),
- A decrease in the expected number of visitors coming to the new recreation spot by 20%,
- A decrease in the expected number of visitors coming to the new recreation spot by 50%,
- A decrease in the expected number of visitors coming to the new recreation spot by 65%,
- An increase in the discount rate to 6%,
- An increase in the discount rate to 10%.

We have explored the impact of changes in certain parameters and discount rates on the investment towards establishing a new recreation spot. The table below presents the outcomes of testing an increase of 33% in the initial investment cost required to establishing a new recreation spot (100,000€ in place of 75,000€). As can be seen from the green highlighted cells, even when the investment cost to establish a new recreation spot is increased by one third (25,000 €), the investment remained socially profitable (Table 19).

Table 19

29 YEARS	Government	Municipality (Existing)	New manager	Society	SOCIAL	GLOBAL
WITHOUT (NPV)	-4,010,334	484,460	-	5,015,150	1,489,277	17,487,685
WITH (NPV)	-3,878,850	484,460	308,210	9,141,916	6,055,736	22,064,197
GAIN (NPV)	131,484	0	308,210	4,126,765	4,566,460	4,576,512
GAIN (PER HECTAR)	7	0	17	233	258	259
WITHOUT (NPV; PER HECTAR)	-227	27	-	284	84	989
WITH (NPV; PER HECTAR)	-219	27	17	517	342	1,247

Comparison of Net present value between the baseline scenario and the sensitivity analysis where an increase of 33% in initial investments are incorporated on the improved recreation scenario within the pilot site, using a discount rate is 5%. The results are presented for a time period of 29 years in euros.

When we have explored the impact of a decrease in the expected number of visitors coming to the new recreation spot by different proportions, we have observed that up to a decrease by 65%, the investment remained profitable and 65% decrease was the turnover (

Table 20).

Table 20

29 YEARS	Government	Municipality (Existing)	New manager	Society	SOCIAL	GLOBAL
WITHOUT (NPV)	-4,010,334	484,460		5,015,150	1,489,277	17,487,685
WITH (NPV)	-3,878,850	484,460	-12,646	6,459,518	3,052,483	19,060,944
GAIN (NPV)	131,484	0	-12,646	1,444,368	1,563,206	1,573,259

<b>GAIN (PER HECTAR)</b>	7		-1	82	88	89
<b>WITHOUT (NPV; PER HECTAR)</b>	-227	27		284	84	989
<b>WITH (NPV; PER HECTAR)</b>	-219	27	-1	365	173	1,078

Comparison of Net present value between the baseline scenario and the sensitivity analysis where a decrease of number of visitors by 65% is incorporated on the improved recreation scenario within the pilot site, using a discount rate is 5%. The results are presented for a time period of 29 years in euros.

When we have employed an increase in discount rate to 6 and 10%, the NPV remained still bigger than 0, therefore the investment remained socially profitable. Finally, in all of the assessments, Internal Rate of Return (IRR) and the Benefit-Cost Ratio (B/C) were employed to check whether the investment of creating a new recreation spot remained profitable for the Public or Private body renting the forest area. In all cases - except the sensitivity analysis assessing the impact of a reduction in the expected number of the visitors coming to the new recreation spot by 65% - the outcomes were positive, in other words B/C was superior at 1.

## Final results synthesis

The Cost Benefit Analysis carried out demonstrates that the addition of a new recreation spot over 29 years have yielded profitable results for all of the relevant parties. In the sensitivity analysis we have explored the impact of changes in certain parameters and discount rates on the investment towards establishing a new recreation spot. Yet, except the sensitivity analysis assessing the impact of a reduction in the expected number of the visitors coming to the new recreation spot by 65% gave – the outcomes were positive, in other words the investment remained socially profitable.

The Cost Benefit Analysis also highlighted the importance of the carbon sequestration service in the pilot site, with an NPV of approximately 15.99 million € (904 €/ha) over 29 years in the baseline scenario. Yet the impact of climate change had a drastic impact to the global community regarding this ecosystem and others. 1% decrease in the annual increment rate have led to a cost of 90 €/ha over 29 years to the global community on carbon sequestration. It also caused a cost of 24 €/ha over 29 years for the government through the decrease in the harvest of wood products, thus generating a cost of 114 €/ha over 29 years.

The 114 €/ha over 29 years corresponds to the Damage Cost or Inaction Cost, which is the amount of damage to incur during 29 years in the absence of any intervention. One important next step of this project will be to estimate the intervention cost; how much money would be needed to decrease the damage cost with to certain degree - if not fully - in the pilot site. Certain climate change mitigation and adaptation measures should be explored for the pilot site to identify ways of coping with climate change (e.g. establishing genetic islands using trees adapted to expected harsher climatic conditions). This approach would permit estimating Option Cost and developing site-specific management approaches vis a vis climate change. As a conclusion, the 114 €/ha damage to incur for the global community can be decreased by investing to climate change focused management practices. Costs of the intervention should be compared with the damage cost avoided.

Another important perspective of this project is to take into account the impact of different management practices on biodiversity protection, in other words, exploring ways of integrating biodiversity protection into the Cost Benefit Analysis in the future. This way, a more complete and sound assessment can be carried out for the Düzlerçami Pilot Site permitting fine-tuned management decisions to be taken. It is also important to assess the impact of increased recreation activities on the biodiversity protection in order to come up with some thresholds while identifying new recreation spots in the pilot site. Overall this study has high potential to be replicated in other sub-district forest units' districts in Turkey and can be an important tool for shaping management decisions.

As a conclusion, the different goods and services provided by the forest ecosystem are of benefit to different stakeholder from local to global level and forest management practices do have an impact on them. The forest administration in the pilot site is the public entity in charge of management for the State, who is incurring a high cost for the related activities required to manage the forest site (NPV of -227 €/ha over 29 years). On the other side, when the value of recreation is included in the assessments, the social value of forest ecosystems goods and services becomes positive (NPV of 84 €/ha over 29 years). And the allocation of more forest area to a new recreation spot further increases the gain socially (gain of 260 €/ha over 29 years). Also, our results showed that the creation of a new recreation spot could also reduce the cost incurred for the state (gain of 7€/ha over 29 years). Finally, the global value of the forest is much above the other goods and services in the pilot site, which demonstrates that the value of carbon sequestration is one of the most important service provided by the forest ecosystem in the pilot site (904 €/ha over 29 years).

# Presentation of synergies

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## **SYNERGIES WITH THE PROJECT'S OTHER COMPONENTS**

The possible connections and synergies identified between Component 1, 2 and 4 at earlier phases of the project were mainly towards exchange of data and information. More specifically towards information on the impacts of climate change on Mediterranean pine forests (e.g. annual increment changes, on disease and pest infection changes), forest fire risk projections to be produced specifically for the pilot site and vulnerability analysis outcomes. As a result of successful interactions during meetings of the projects and direct exchanges among experts of components, sharing literature data was successfully carried out. Furthermore, the outcomes of the vulnerability analysis were employed in finalization of the Component 2 activities (as detailed under Section 3.2.1). Also with other components of the project, site-specific data collected was shared successfully (e.g. information on the past forest fires, management plan of wildlife reserve, information from interviews with local experts on the use of recreation spots, etc.).

The main difference between the planned and actual synergies was due to the focus and time plan of different components of the project. For example, while assessing the impact of climate change on the annual increment rate of pine forests was an essential part of Component 2, it was not so for the analysis of the Component 1. Therefore their literature's survey did not specifically aimed at finding results on this parameter; and as a result, despite effective collaborations between the two components, this type of information could not be gathered from the literature survey and original work of Component 1. Similarly, even if the outcomes of the assessments of the Component 3 were taken into account in the framework of the Component 2 and given the mismatch between calendars of the two components, more effective interactions could not be made. Yet overall, the meetings organized in the project and the exchanges between the experts permitted effective exchanges to occur despite these limitations.

## **SYNERGIES WITH OTHER PROJECTS**

The GEF Funded GDF and UNDP Project, which started in 2014, Integrated Approach to Management of Forests in Turkey, with Demonstration in High Conservation Value Forests in the Mediterranean Region can benefit from the outcomes of this project. The GEF project will promote an integrated approach to management of forests in Turkey, demonstrating multiple environmental benefits in high conservation value forests in the Mediterranean forest region. More particularly, the project will demonstrate approaches to generate, measure, report on and verify carbon, biodiversity and socio-economic benefits generated through this integrated approach. The ecosystem goods and services provided by forests is a topic of increasing importance in Turkey. The new GEF funded GDF and UNDP Project is a prime example to this. Therefore the assessment of the socio-economic value of goods and services provided by Düzlerçamı forest ecosystems can be adopted as a measure integrating the ecosystem goods and services into management plans at the local, regional and national scales.

# Socioeconomic assessment critical analysis

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## STUDY INPUTS AND LIMITATIONS

The presence of up to date information on Düzlerçamı Pilot Site was one of the strongholds of the project. Given that all state forests are managed by the General Directorate of Forestry, access to the data on management issues of the pilot site was also unproblematic. Also, given the effective collaborations between different public bodies, data collection from different sources was also made possible in the framework of the project. Furthermore, another stronghold of the project is linked to the fact that Turkey's forests are state owned and they are all managed by management plans covering 10 years periods. So if the outcomes of the project are adopted, the approach and the methodology towards assessing the ecosystem goods and services present in the forests and assessing the impact of different management decisions on these goods can be disseminated to regional and national scale. Yet, there existed certain limitations in the study in terms of the data and methodology. Firstly, even if biodiversity protection is one of the most important – if not the most – ecosystem good and service identified in the Düzlerçamı Pilot Site, in the absence of data, the impact of management decisions and climate change on the biodiversity protection could not be integrated into the Cost Benefit Analysis. Secondly, due to constraints of the project, site-specific recreation value could not be estimated at the pilot site. Lastly, not all ecosystem goods and services identified in the pilot site were included in the study due to different constraints. This surely limits our conclusions on the socio-economic value of the ecosystem goods and services present in the pilot site, and the impact of management decisions on the forest ecosystem in the Cost Benefit Analysis.

## DIFFICULTIES ENCOUNTERED AND SOLUTIONS FOUND

Methodological solutions were brought into solving the majority of the problems encountered in the project, e.g. in the absence of site-specific information on the value of recreation activities in the Düzlerçamı Pilot Site, Benefit Transfer Method was employed, similarly in the absence of Stated Preference Methods used to value the biodiversity protection service in the pilot site, Cost Based methods were employed. Also, the external consultants involved in the project contributed significantly into solving the technical problems and enhancing the outcomes of the project.

# Valorization and replication of the socio-economic evaluation

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Forests in Turkey are managed through forest management plans, prepared and implemented by the Ministry of Forestry and Water Affairs and the General Directorate of Forestry. The forest management paradigm has evolved in the last decade towards the recognition of forest as an ecosystem with complex dynamics and not only as intensive wood production sites. This change in the vision has led the General Directorate of Forestry to adopting a new planning scheme in 2004, oriented around determining, planning and managing the forest's different functions. These forest functions are: economic, ecological and social and cultural functions, and the General Directorate of Forestry is identifying practical ways to assessing and integrating each of these into their forest management plans. Socio-economic valuation of ecosystem goods and services can efficiently support management of the forests in Turkey if it can be incorporated into these functional planning approaches. Turkish Forest Service as a corporate body of the Ministry has competent organizations at central and rural levels for sustainable forest management with special attention to the ecological functions beyond diverse goods and services of forest ecosystems. Therefore socio-economic valuation of forest ecosystems goods and services and assessing the impact of different management alternatives on these goods and services can feed effectively into this process as well as strengthening of support actions to the forest lands sustainable management. Since the respective authorities as well as the technical staff with adequate expertise available at the General Directorate of Forestry are developed to hold conserve perceptions of the changing environment and priorities affecting the sustainable forest management, there is no doubt that not only this approach but also new ideas can be taken into consideration.

The project carried out in the Düzlerçamı Pilot Site does provide a good model, which can be replicated in different sub-district forest units' districts in Turkey. Longer time periods allocated for more detailed assessments can allow gathering information for all of the ecosystem goods and services in forest ecosystems, and can permit enhancing further the methodologies used in this project. This was prominent for the valuation of biodiversity protection ecosystem good and service in our pilot site. More detailed assessments would thus permit obtaining more complete information about the forests ecosystem goods and services and in turn presenting more accurate estimates on the impacts of different management alternatives in Turkey's forests. This model can thus serve to monitoring the management decisions in the forests in the long term and taking decisions towards increasing the sustainability of natural resources in the forests.

## Conclusion

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In the framework of the project, the primary ecosystem goods and services present in the forest ecosystem of the Düzlerçamı Pilot Site were valued. Despite the methodological and data limitations, goods and services such as wood production (16.15 €/ha/year), biodiversity protection (4.57 €/ha/year), recreation and tourism (18.73 €/ha/year) and carbon sequestration (59.74 €/ha/year) were valued in the framework of the project for the first time in this pilot site. Furthermore, both the impact of a local management decision (opening a new recreation spot), and the impact of a change driven at the global level (climate change) have been assessed. The outcomes of this study have shown that opening a new recreation spot over 29 years to correspond to the increasing local demand have yielded profitable results for all of the relevant parties. Among the different alternatives explored to assess the impact of changes in certain parameters and discount rates through the sensitivity analysis, only a reduction in the expected number of the visitors coming to the new recreation spot by 65% gave a negative result, in all other alternatives tested the investment remained profitable socially. The Cost Benefit Analysis also highlighted the detrimental impact of climate change on the ecosystem goods and services provided by the Düzlerçamı forest ecosystem. The hypothetical 1% decrease in the annual increment rate of the trees due to climate change was estimated to cause a cost of 90 €/ha over 29 years to the global community due to a decrease in the carbon sequestration service. Furthermore, it led to a cost of 24 €/ha to the government through the decrease in the harvest of wood products, thus generating a cost of 114 €/ha over 29 years.

At a following step, site-specific assessments should be carried out to estimate how much investment would be needed to mitigate and/or adapt to expected impacts of climate change on the forest ecosystem goods and services in the Düzlerçamı Pilot Site. Measures such as establishing genetic islands using trees adapted to expected harsher climatic conditions can be taken in the pilot site. This way, the 114 €/ha (over 29 years) damage cost expected to be obtained by the global community can be decreased effectively. Adopting such a long-term vision on managing the forest of Turkey vis a vis climate change is of prime importance for not only Turkey but all Mediterranean forest ecosystems.

Another important perspective of this project is to find ways of socio-economically assessing all of the existing ecosystem goods and services present in the Düzlerçamı Pilot Site and finding ways of overcoming data limitations to present the value of the pilot site in a much more complete way. Also, taking into account the impact of different management practices on biodiversity protection, in other words exploring ways of integrating biodiversity protection into the similar studies in the future is of prime importance. This way more complete and sound assessments can be carried out for the Düzlerçamı Pilot Site permitting fine tuned management decisions to be taken. Overall, this study has high potential to be replicated in other sub-district forest units' districts in Turkey and can be an important tool for shaping management decisions at the national and Mediterranean Region scale. This model can thus serve to monitoring the management decisions in the forests of national and regional scale in the long term and would permit taking decisions towards increasing the sustainability of natural resources in the forest ecosystems.



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## ANNEX 1: COORDINATES OF THE DÜZLERÇAMI PILOT SITE

Table 21

No.	Latitude	Longitude
1	270439,3867	4088598,156
2	270439,3867	4126486,407
3	289291,2368	4126486,407
4	289291,2368	4088598,156

ED 1950 UTM Zone 36N

**ANNEX 2: LIST OF ACRONYMS**

Table 22

English Name	Turkish Name/Abbr.	Characteristics
Log	Tomruk/Tomruk	Min. 1,5 m in length and 19 cm in diameter, round log with quality features matching the production of sawnwood or veneer sheet.
Wire-telephone pole	Tel direk/Tel Direk	A kind of pole of whose top (needle point) is min. 11 cm in diameter and length is min. 6,5 m with certain quality features.
Mining pole	Maden direk/Mad. Dir	Pole with 1, 5-6 m in length and 8-18 cm in diameter.
Small log (split)	Yarma sanayi odunu/San.Od.	Round wood (round or split) with length 0,5-1,4 m, diameter min. 5 cm, suitable for production of sawnwood.
Pulpwood	Kağıtlık odun/Kağıtlık Od.	Round wood that will be used for the production of pulpwood (not matching the quality features required for log or round log) with 0,5-6 m in length and min. 5 cm in diameter.
Chipwood	Lif-yonga odunu/Lif Yonga	Roundwood that will be used for the production of particleboard or fibreboard with length min. 0,5 m, and with diameter min. 4 cm – max. 20 cm.
Standing tree	Dikili ağaç	Tree which is not felled.
Fuelwood	Yakacak odun/Yak. Odun	Round wood, which will be used as fuel for purposes such as cooking, heating or power production with min. 1 cm diameter bearing quality features not suitable for any kind of industrial wood.

### ANNEX 3: COST BENEFIT ANALYSIS OUTCOMES ASSESSING THE IMPACT OF A NEW RECREATION SPOT IN THE PILOT SITE

Table 23

Year	WITHOUT INTERVENTION												
	GOVERNMENT				MUNICIPALITY				SOCIETY		SOCIETY NET BENEFIT	GLOBAL COMMUNITY	GLOBAL NET BENEFIT
	Management COST	Wood production BENEFIT	Recreation rent BENEFIT	Net BENEFIT	Recreation rent COST	Recreation Management COST	Recreation entry fees + Rent of Shops BENEFIT	Net Benefit	Recreation Consumer Surplus BENEFIT	Net Benefit		Carbon sequestration SCC BENEFIT	
1	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
2	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
3	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
4	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
5	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
6	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
7	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
8	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
9	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
10	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
11	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
12	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
13	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
14	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
15	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
16	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
17	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
18	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
19	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
20	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
21	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
22	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
23	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
24	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
25	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
26	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
27	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
28	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
29	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983



Table 24

Year	WITH INTERVENTION																
	GOVERNMENT				MUNICIPALITY (Existing recreation spot)				NEW RECREATION SPOT ENTERPRISE (Municipality or private)				SOCIETY		SOCIEY NET BENEFIT	GLOBAL COMMUNITY	GLOBAL NET BENEFIT
	Manag. COST	Wood product. BENEFIT	Recreat. rent (new & existing)	Net BENEFIT	Recreat. rent COST	Recreat. Manag. COST	Recreat. entry fees + Rent of Shops BENEFIT	Net Benefit	Recreat.rent COST	Recreat. Invest. (1st year) & manage. COST	Recreat. entry fees + Rent of Shops BENEFIT	Net Benefit	Recreat. Cons. Surplus BENEFIT	Net Benefit		Carbon sequestration SCC BENEFIT	
1	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	75,000	0	-83,375	331,228	331,228	23,669	1,057,287	1,080,956
2	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	35,571	43,646	7,774	397,474	397,474	181,063	1,057,287	1,238,350
3	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	71,143	87,291	15,848	463,719	463,719	255,383	1,057,287	1,312,670
4	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	106,714	130,937	23,922	529,965	529,965	329,703	1,057,287	1,386,990
5	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	142,286	174,583	31,996	596,211	596,211	404,023	1,057,287	1,461,310
6	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
7	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
8	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
9	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
10	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
11	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
12	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
13	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
14	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
15	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
16	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
17	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
18	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
19	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
20	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
21	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
22	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
23	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
24	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
25	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
26	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
27	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
28	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556
29	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	470,269	1,057,287	1,527,556

## ANNEX 4. COST BENEFIT ANALYSIS OUTCOMES ASSESSING THE IMPACT OF A NEW RECREATION SPOT IN THE PILOT SITE WHILE THE INCREASED IMPACT OF CLIMATE CHANGE IS PRESENT

Table 25

Year	WITHOUT INTERVENTION												
	GOVERNMENT				MUNICIPALITY				SOCIETY		SOCIETY NET BENEFIT	GLOBAL COMMUNITY	GLOBAL NET BENEFIT
	Management COST	Wood production BENEFIT	Recreation rent BENEFIT	Net BENEFIT	Recreation rent COST	Recreation Management COST	Recreation entry fees + Rent of Shops BENEFIT	Net Benefit	Recreation Consumer Surplus BENEFIT	Net Benefit		Carbon sequestration SCC BENEFIT	
1	558,902	285,662	8,375	-264,865	8,375	177,857	218,229	31,996	331,228	331,228	98,360	1,056,623	1,154,983
2	558,902	282,805	8,375	-267,721	8,375	177,857	218,229	31,996	331,228	331,228	95,503	1,046,057	1,141,560
3	558,902	279,977	8,375	-270,549	8,375	177,857	218,229	31,996	331,228	331,228	92,675	1,035,596	1,128,272
4	558,902	277,178	8,375	-273,349	8,375	177,857	218,229	31,996	331,228	331,228	89,876	1,025,240	1,115,116
5	558,902	274,406	8,375	-276,121	8,375	177,857	218,229	31,996	331,228	331,228	87,104	1,014,988	1,102,092
6	558,902	271,662	8,375	-278,865	8,375	177,857	218,229	31,996	331,228	331,228	84,360	1,004,838	1,089,198
7	558,902	268,945	8,375	-281,581	8,375	177,857	218,229	31,996	331,228	331,228	81,643	994,790	1,076,433
8	558,902	266,256	8,375	-284,271	8,375	177,857	218,229	31,996	331,228	331,228	78,954	984,842	1,063,795
9	558,902	263,593	8,375	-286,933	8,375	177,857	218,229	31,996	331,228	331,228	76,291	974,993	1,051,285
10	558,902	260,957	8,375	-289,569	8,375	177,857	218,229	31,996	331,228	331,228	73,655	965,243	1,038,899
11	558,902	258,348	8,375	-292,179	8,375	177,857	218,229	31,996	331,228	331,228	71,046	955,591	1,026,637
12	558,902	255,764	8,375	-294,762	8,375	177,857	218,229	31,996	331,228	331,228	68,462	946,035	1,014,497
13	558,902	253,206	8,375	-297,320	8,375	177,857	218,229	31,996	331,228	331,228	65,905	936,575	1,002,479
14	558,902	250,674	8,375	-299,852	8,375	177,857	218,229	31,996	331,228	331,228	63,372	927,209	990,581
15	558,902	248,168	8,375	-302,359	8,375	177,857	218,229	31,996	331,228	331,228	60,866	917,937	978,803
16	558,902	245,686	8,375	-304,841	8,375	177,857	218,229	31,996	331,228	331,228	58,384	908,758	967,142
17	558,902	243,229	8,375	-307,297	8,375	177,857	218,229	31,996	331,228	331,228	55,927	899,670	955,597
18	558,902	240,797	8,375	-309,730	8,375	177,857	218,229	31,996	331,228	331,228	53,495	890,673	944,168
19	558,902	238,389	8,375	-312,138	8,375	177,857	218,229	31,996	331,228	331,228	51,087	881,767	932,853
20	558,902	236,005	8,375	-314,522	8,375	177,857	218,229	31,996	331,228	331,228	48,703	872,949	921,652
21	558,902	233,645	8,375	-316,882	8,375	177,857	218,229	31,996	331,228	331,228	46,343	864,219	910,562
22	558,902	231,308	8,375	-319,218	8,375	177,857	218,229	31,996	331,228	331,228	44,007	855,577	899,584
23	558,902	228,995	8,375	-321,531	8,375	177,857	218,229	31,996	331,228	331,228	41,693	847,021	888,715
24	558,902	226,705	8,375	-323,821	8,375	177,857	218,229	31,996	331,228	331,228	39,403	838,551	877,955
25	558,902	224,438	8,375	-326,088	8,375	177,857	218,229	31,996	331,228	331,228	37,136	830,166	867,302
26	558,902	222,194	8,375	-328,333	8,375	177,857	218,229	31,996	331,228	331,228	34,892	821,864	856,756
27	558,902	219,972	8,375	-330,555	8,375	177,857	218,229	31,996	331,228	331,228	32,670	813,645	846,315
28	558,902	217,772	8,375	-332,754	8,375	177,857	218,229	31,996	331,228	331,228	30,470	805,509	835,979
29	558,902	215,595	8,375	-334,932	8,375	177,857	218,229	31,996	331,228	331,228	28,293	797,454	825,747

Table 26

Year	WITH INTERVENTION																
	GOVERNMENT				MUNICIPALITY (Existing recreation spot)				NEW RECREATION SPOT ENTERPRISE (Municipality or private)				SOCIETY		SOCIETY NET BENEFIT	GLOBAL COMMUNITY Carbon sequestration SCC BENEFIT	GLOBAL NET BENEFIT
	Manag. COST	Wood product. BENEFIT	Recreat. rent (new & existing)	Net BENEFIT	Recreat. COST	Recreat. Manag. COST	Recreat. entry fees + Rent of Shops BENEFIT	Net Benefit	Recreat. rent COST	Recreat. Invest. (1st year) & manag. COST	Recreat. entry fees + Rent of Shops BENEFIT	Net Benefit	Recreat. Cons. Surplus BENEFIT	Net Benefit			
1	558,270	285,339	16,750	-256,181	8,375	177,857	218,229	31,996	8,375	75,000	0	-83,375	331,228	331,228	23,669	1,057,287	1,080,956
2	558,270	282,486	16,750	-259,034	8,375	177,857	218,229	31,996	8,375	35,571	43,646	7,774	397,474	397,474	178,210	1,046,714	1,224,924
3	558,270	279,661	16,750	-261,859	8,375	177,857	218,229	31,996	8,375	71,143	87,291	15,848	463,719	463,719	249,705	1,036,247	1,285,952
4	558,270	276,864	16,750	-264,655	8,375	177,857	218,229	31,996	8,375	106,714	130,937	23,922	529,965	529,965	321,228	1,025,885	1,347,113
5	558,270	274,096	16,750	-267,424	8,375	177,857	218,229	31,996	8,375	142,286	174,583	31,996	596,211	596,211	392,779	1,015,626	1,408,405
6	558,270	271,355	16,750	-270,165	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	456,284	1,005,469	1,461,754
7	558,270	268,641	16,750	-272,879	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	453,571	995,415	1,448,985
8	558,270	265,955	16,750	-275,565	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	450,884	985,461	1,436,345
9	558,270	263,295	16,750	-278,225	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	448,225	975,606	1,423,831
10	558,270	260,662	16,750	-280,858	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	445,592	965,850	1,411,442
11	558,270	258,055	16,750	-283,464	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	442,985	956,191	1,399,177
12	558,270	255,475	16,750	-286,045	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	440,405	946,630	1,387,034
13	558,270	252,920	16,750	-288,599	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	437,850	937,163	1,375,013
14	558,270	250,391	16,750	-291,129	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	435,321	927,792	1,363,112
15	558,270	247,887	16,750	-293,633	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	432,817	918,514	1,351,330
16	558,270	245,408	16,750	-296,111	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	430,338	909,329	1,339,666
17	558,270	242,954	16,750	-298,566	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	427,884	900,235	1,328,119
18	558,270	240,525	16,750	-300,995	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	425,454	891,233	1,316,687
19	558,270	238,119	16,750	-303,400	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	423,049	882,321	1,305,370
20	558,270	235,738	16,750	-305,781	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	420,668	873,497	1,294,165
21	558,270	233,381	16,750	-308,139	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	418,310	864,762	1,283,073
22	558,270	231,047	16,750	-310,473	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	415,977	856,115	1,272,091
23	558,270	228,736	16,750	-312,783	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	413,666	847,554	1,261,220
24	558,270	226,449	16,750	-315,071	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	411,379	839,078	1,250,457
25	558,270	224,185	16,750	-317,335	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	409,114	830,687	1,239,802
26	558,270	221,943	16,750	-319,577	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	406,872	822,380	1,229,253
27	558,270	219,723	16,750	-321,796	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	404,653	814,157	1,218,810
28	558,270	217,526	16,750	-323,994	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	402,456	806,015	1,208,471
29	558,270	215,351	16,750	-326,169	8,375	177,857	218,229	31,996	8,375	177,857	218,229	31,996	662,456	662,456	400,280	797,955	1,198,235

