SOCIO-ECONOMIC BENEFITS

Buskett-Girgenti Natura 2000 site

PRE-PROJECT ASSESSMENT

E-CUBED CONSULTANTS
Economics for Creative Solutions

Table of Contents

This report has been produced by E-Cubed Consultants Ltd (Ms. Stephanie Vella and Ms. Maria Cini) with environmental assistance provided by ADI Associates (Ms. Krista Farrugia)

List of Figures

List of Tables

List of Abbreviations

AQI	Air Quality Index
CBA	Cost-Benefit Analysis
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CV	Conservative Value
CVM	Contingent Valuation Method
EC	European Commission
ELC	Environmental Landscape Consortium
EU	European Union
EU-ETS	European Union Emission Trading Scheme
FEE	Foundation for Environmental Education
GHG	Greenhouse Gas Emissions
Ha	Hectares
hm^3	Cubic hectometre
IPM	Integrated Pest Management
Kgs	Kilograms
LEAF	Learning about forests
LULUCF	Land use, land use change and forestry
MBP	Marginal Benefits to the Private
MBS	Marginal benefits to Society
MEPA	Malta Environment and Planning Authority
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxide
NSO	National Statistics Office
O_3	Ozone
PAH	Polycyclic aromatic hydrocarbons
PM	Particulate Matter
PPP	Public-Private Partnership
SAC	Special Area of Conservation
SEERAD	Scottish Executive Environmental and Rural Affairs Department
SO_2	Sulphur Dioxide
SPA	Special Protection Area
TEV	Total Economic Value
TSV	Total System Value
VOC	Volatile Organic Compounds
WTP	Willingness To Pay
YRE	Young reporters for the environment

Executive Summary

L-Inħawi tal-Buskett and tal-Girgenti Special Area of Conservation (SAC), having a total surface area of 226 ha, is one of the largest SACs in the Maltese Islands. It is also one of the richest and most diverse in biodiversity, supporting a variety of rare and endemic species. It hosts one of the largest woodlands in the Maltese Islands, where only 0.7% of land cover is registered as a forest area.[1] The area consists of three valley systems, Wied l-Isqof, Wied il-Luq and Wied il-Girgenti, each of which has a permanent watercourse running through it, supporting the highest concentration of riparian woodlands in the Maltese Islands.

The protection and the maintenance of the Natura 2000 site is deemed of utmost importance, as highlighted in the Natura 2000 Management Plan. It is a natural asset that provides a range of benefits in the form of ecosystem goods and services. The Millennium Ecosystem Assessment has led to increasing recognition of the value of these assets. In the absence of appropriate interventions, these assets may be vulnerable to over-exploitation, lack of conservation and environmental damage.

This report derives the economic value of the ecosystem goods and services provided by the natural environment of 'L-inħawi tal-Buskett u l-Girgenti' in order to provide a pre-project assessment of the Life + Nature project entitled 'Life Saving Buskett'. This report presents a detailed review of the fundamental natural elements of the area and where possible quantifies the ensuing socio-economic benefits with respect to each and every ecosystem service. The methodology used in this report is based on the Toolkit issued by the Institute for European Environmental Policy (IEEP)for Assessing Socio-Economic Benefits of Natura 2000.

The services considered in this research are subdivided into the following categories:

1. Provisioning services;
2. Recreational services;
3. Regulating services; and
4. Supporting services.

The assessment of these ecosystem services encompasses qualitative and quantitative elements, leading to the derivation of monetary estimates where relevant and possible. The qualitative aspect involves a thorough assessment of the importance of the site and its contribution to each service, based on available literature and consultations with key experts. From a quantitative perspective, relevant data pertaining to the specific sections is collated from available primary and secondary information sources. Where possible and relevant, monetary estimates of benefits are derived on the basis of transferable prices sourced from available literature, including estimates based on willingness to pay approaches and avoided cost methods.

[1] CAP context indicator, European Commission (2014).

Provisioning Services

The relevant provisioning services to consider for the purposes of this study encompass water, food and biomaterial.

Water is the most important provisioning service offered by the SAC, which is a significant consideration given the relative scarcity of water resources in the Maltese Islands, the high dependence on desalination and the vulnerability of groundwater resources. The site is located within the confines of a perched aquifer and the mean seawater aquifer. There are three permanent watercourses running through the site and one of the watercourses has been identified as being directly dependent on springs flowing from the Rabat-Dingli groundwater body. The economic value of water provisioning in the site is estimated at €3.5 million per annum, reflecting the important contribution in terms maintenance of good water quality status and in the reduction of groundwater abstraction for agricultural use.

With respect to the provision of food, agricultural land represents approximately 61% of the entire SAC and is estimated to generate an output of about €600,000 per annum. The provisioning of food in the woodland area is relatively limited, consisting of fruit-bearing trees, in particular citrus trees.

The provisioning of biomaterial is relatively limited. There are legal restrictions on the collection of biomaterials such as wood for fuel. Reed (*Arundo donax*) is harvested in Buskett, but this is considered to be an alien species.

Recreational Services

One of the most important services offered by Buskett is its recreational, cultural and inspirational value. This in good part stems from its uniqueness as a woodland site in Malta. According to a Topic Paper by MEPA Buskett has a population catchment of 34,000 persons within a radius of 5km. On top of this, the site plays a central traditional heritage role in hosting the annual feast of Imnarja, which attracts about 52,000 visitors. From a historical perspective, the summer residence of the Grand Masters of the Hospitallier Order of St. John of Malta is located within Buskett (now serving as a Presidential Palace, used mainly for hosting diplomatic and other landmark functions, as well as a recreational/tourist attraction) and there are a number of other scheduled architectural and heritage assets located within the site.

The site is also important in terms of educational services, with over 600 students visiting Buskett on an annual basis. Specific activities blending elements of environmental and culture/heritage-based educational and recreational also take place regularly within the site. This is notable within the context of national strategies to diversity Malta's tourism offering to include cultural, educational and rural tourism spread into the shoulder period.

Buskett is an ideal site for bird watching as it is the largest wooded area and because of its high altitude. Indeed, birds of prey can be observed roosting in large numbers during the migratory season between August and October.

While a monetary estimate of this benefit has not been undertaken due to the lack of detailed information on the number of users and non-users who appreciate the value of the woodland, an overview of international literature on the willingness of individuals to pay has been undertaken. It is interesting to note that visitors are typically willing to pay between €4 and €10 per visit to a woodland taken to reflect the economic value of a recreational site. This also falls within the value of non-working time estimated in Malta at about €5.44 per hour. Furthermore, individuals are willing to pay approximately between €27 and €50 per person for conservation of heritage.

Regulating services

This section focuses on the environmental contributions of the SAC. In particular, an assessment of the importance of the site in terms of climate change, air quality, soil erosion, biological control and genetic species maintenance is undertaken.

Buskett woodlands cover an area of 47ha, equivalent to 30% of the total forest area in Malta. A high level estimate of the carbon sequestration potential of Buskett is undertaken through an assessment of the land use, land use change and foresty data. Based on this assessment, it is estimated that Buskett absorbs about 150 tonnes of CO_2, on an annual basis which translates to an economic value of €4,000. The site also contributes towards enhancing air quality through the removal of particulate matter.

Another important service provided by the SAC is the prevention of soil erosion, thereby lessening stormwater runoff, conserving groundwater, reducing the rate of low water flow during the dry season and siltation, and sustaining water quality in watercourses. From a quantitative perspective it is estimated that the total length of rubble walls in the SAC amounts to 56.9km. A capitalised monetary value of this service based on the replacement cost approach amounts to about €8,200,000.

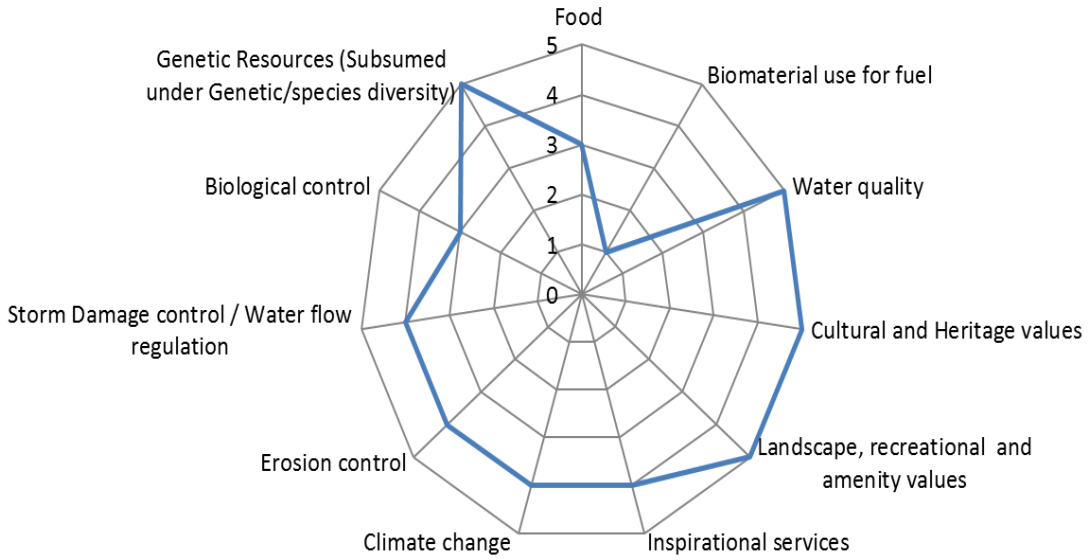
This report also highlights, qualitatively, the importance of the site in terms of the provision of habitats for biological control agents such as bats. Furthermore, the SAC is one of the most diverse and richest in biodiversity, supporting a variety of rare and endemic species. This has allowed the area to receive designation both as an SAC and an SPA

Supporting Services

Supporting services underpin the processes and availability of all other services. This function is essential and its value is obvious, but no separate economic valuation is provided in this respect as this is considered to be subsumed within the estimates of the ecosystem services described above. This is consistent with the methodology suggested by the Natura 2000 toolkit.

A summary of the importance of the socio-economic benefits of the Buskett Girgenti area is shown in the Figure E.1 below, clearly highlighting the importance of the site particlarly in the priovision of recreation, cultural and heritage, maintenance of water quality, and protection of genetic resources.

Figure E. 1: Ecosystem services offered at Buskett/Girgenti (Natura 2000)



1: Least Important
5: Most Important

The benefits studied in this report are subject to threats as identified in the Management Plan. The most notable ones relate to the provision of regulating services including collapsing rubble walls leading to soil erosion and to the build-up of silt in the watercourse, the invasive nature of alien species as well as the destruction of flora and fauna.

It is on account of these threats that PARKS has embarked on the Life+ project to specifically address these threats and to safeguard and maintain the socio-economic benefits of Buskett. This report provides the basis upon which the interventions of the project will eventually be assessed in the post-project assessment.

1. Introduction

The scope of this report is to present an assessment of the socio-economic benefits of Buskett and its surrounding area serving as a pre-project assessment as required under Action D3 of the LIFE Saving Buskett Project (LIFE12 NAT/MT/00182). The objective of the pre-project assessment is to assess and quantify the impact of the measures covered in the project prior to the actual adoption of the measures thus providing a baseline against which interventions are to be assessed. This is undertaken through an assessment of the social and economic benefits provided by Buskett and the surrounding area and the extent to which the proposed interventions through the project will contribute towards the protection and restoration of the value of the site.

As such, this study is a distinct and separate exercise from the final socio-economic impact study which focuses on the ex-post evaluation of interventions, and which is identified as a separate deliverable in the project.

The aim of the pre-project assessment is to contribute towards an improved understanding of the ecosystems functions that will be impacted by the project and ensuing, *a priori*, social-economic costs/benefits that are expected to be derived following the planned interventions of the project. The pre-assessment report will indicate whether the actions identified in the project are justified through an identification of the threats which are likely to impinge on the preservation of the socio-economic benefits of Buskett and its surrounding area.

It is to be highlighted at the onset that the interventions expected to be undertaken as part of the project are aimed at strengthening the ecosystem services provided by Buskett and in the process of doing so resulting in an indirect enhancement of the environmental and recreational value of the area. This report therefore focuses more intently at providing an assessment of the socio-economic benefits of Buskett and its surrounding area to highlight its importance from a socio-economic perspective and to ensure that the interventions result in the protection and enhancement of these benefits.

The methodology adopted to derive the socio-economic benefits of Buskett and its surrounding area is based on the Guidelines published by the European Commission on the socio-economic benefits of the Natura 2000 network (2009).

Section 2, of this report, provides a description of the Buskett and Girgenti area specifying the ecosystem goods and services that are provided by the Natura 2000 site. This is followed by a detailed description of the methodologies available for the assessment of the ecosystem services. This serves as the basis for the formation of the methodology applied in this specific report which is explained in further detail in section 4. This methodology, based on a review of international literature, data collected and information gathered through interviews[2] with stakeholders, is applied in an attempt to highlight and where possible quantify the socio-economic benefits of the Buskett and Girgenti area. Results are presented in section 5 of this report while threats which may jeopardise these benefits are highlighted in section 6 providing a justification for the interventions to be implemented through the Life+ project aimed at safeguarding and enhancing the socio-economic benefits of the site.

[2] See list of interviews

2. NATURA 2000 SITE: Buskett and Girgenti Area

2.1 Description of the Natura 2000 Site

Buskett is a unique wooded area in the Maltese Islands situated to the western side of Malta (Figure 2.1). The Buskett and Girgenti area have a surface of 226 hectares (ha) with three valley systems; Wied l-Isqof, Wied il-Luq and Wied il-Girgenti. The area supports rare riparian community with adjacent woodland providing a living place for native assemblage of plants and animals (Epsilon-Adi, 2013).
The vision for the Buskett and Girgenti area is for:

'…all natural habitats, native vegetation and wildlife, including bird life, to flourish. The natural habitats and landscape will become even more diverse and natural with time.

Agriculture will be practised in harmony with the surrounding ecology. As stewards of the land, local farmers and land owners will actively participate in nature conservation of the area. Rural tourism and outdoor recreation will be practised in full synchrony with the site's conservation needs.

The site will receive full legal protection, in accordance with national legislation and local policies.'

(Epsilon-Adi, 2013)

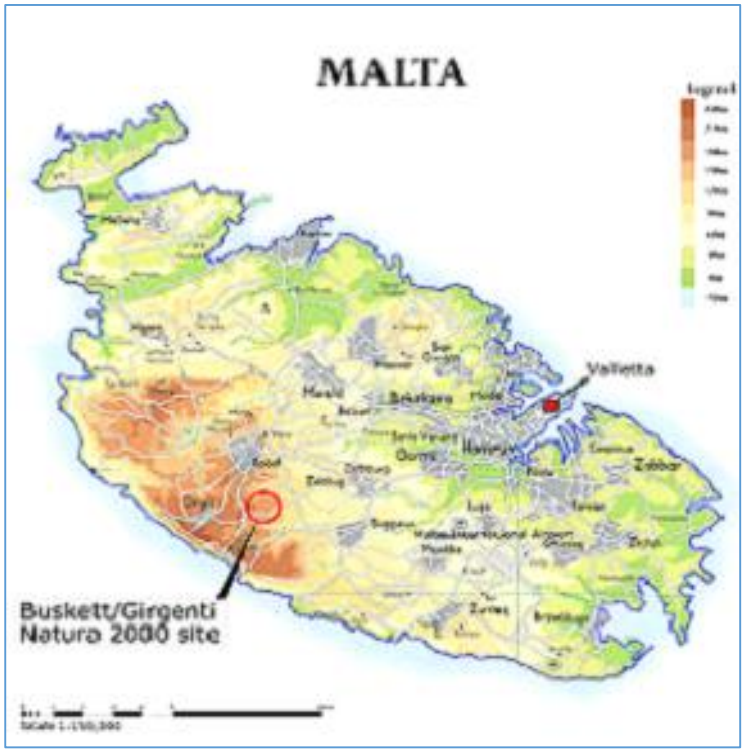
The Buskett and Girgenti area have been designated as a Natura 2000 site considered as '*a centrepiece of EU nature and Biodiversity policy'* (EC, 2014)[3]. Natura 2000 is an EU-wide network of nature protection established under the Habitats Directive in 1992 with the aim of protecting the '*survival of Europe's most valuable and threatened species and habitats'* and create a sustainable natural environment where human activities can continue to take place but not at the expense of the natural environment (EC, 2014). Natura 2000 aims to create a sustainable environment within which humans and nature can cohabit. It is comprised of two protection status (EC, 2014):

1. Special Area of Conservation (SAC)
2. Special Protection Area (SPA)

Malta has 27 terrestrial Special Area of conservation (SAC), 13 Special Protected Areas (SPA) and 5 marine SACs (Epsilon-Adi, 2014). 'L-inħawi tal-Buskett u tal-Girgenti' has been identified as both a special protected area (SPA) and a special area of conservation (SAC) (Epsilon-Adi, 2013).

[3] http://ec.europa.eu/environment/nature/natura2000/index_en.htm

Figure 2. 1: Map of Malta showing the geographical location of Buskett/Girgenti Natura 2000 site

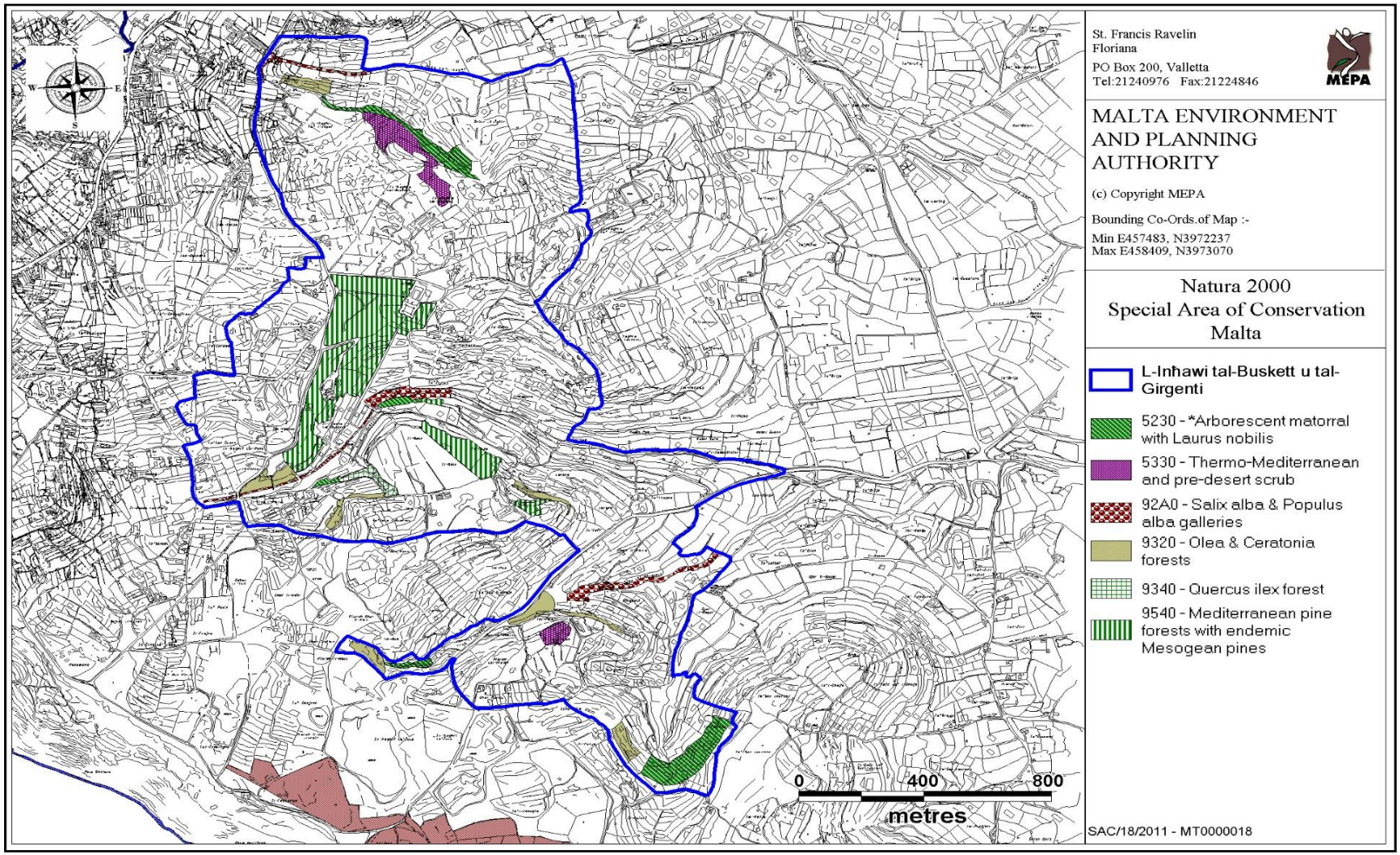


The Buskett and Girgenti area is highly rich in biodiversity. The area contains the largest part of **Mediterranean pine forests with endemic Mesogean pines** and Aleppo Pine woodland (9540), ***Olea* and *Ceratonia*** forests (9320), ***Quercus ilex* and *Quercus rotundifolia* forests** (9340) and **Arborescent matorral with *Laurus nobilis*** (5230). It is also one of the few locations in Malta for the occurrence of ***Salix alba* and *Populus alba* galleries (92A0)** and the only location for the ***Stinking Iris*** (Epsilon-Adi, 2013).

'L-inħawi tal-Buskett u tal-Girgenti' are surrounded by former cave dwellings (8310) which are today the habitat of rare bats like the Lesser horseshoe bat and the Mouse-eared bat (Epsilon-Adi, 2013) and scrubland (5330) dominated by Mediterranean shrubby species such as Wild Thyme. The habitats within the Natura 2000 siteare also importantfor providing shelter to protected species like the leopard snake, the petalwort, an endemic ant cricket and a wide variety of breeding, migratory and wintering birds.

The **Arborescent matorral with *Laurus nobilis*** (5230) and **Mediterranean temporary ponds** (3170) are priority natural habitat types in danger of disappearance under Annex I of the Habitats Directive. In view of the proportion of their natural range falling in the local territory, Malta has particular responsibility for their conservation.

Figure 2. 2: Map of Buskett and Girgenti Area



Source: Natura 2000 Management Plan

Buskett is also very rich in cultural heritage including the Verdala palace, the Knights' farmhouses, hunting lodge, chapels and even cart ruts. In fact, Buskett knows its origins to the knights of St. John as Buskett gardens. This is when Grandmaster la Vallette, during his reign between 1557 and 1568, commissioned the Verdala Palace and a small hunting lodge and stables in Wied il-Luq (Epsilon-Adi, 2013)). Over the years the area has been modified into gardens and woodland with irrigation works, fountains, fish tanks and reinforcement of banks in Wied il-Luq, by dry stone and ashlar walls, becoming an artificial channel through Buskett.

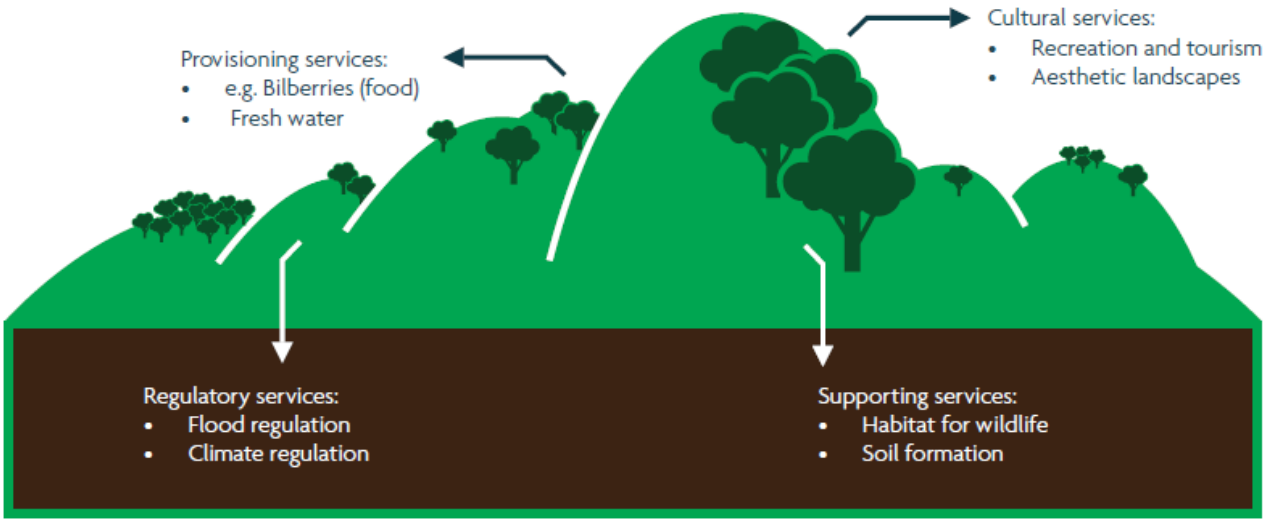
Buskett and Girgenti are considered sites of Ecological Importance (1996), a Site of Scientific Importance (1996), an Area of High Landscape Value and a Scheduled Woodland (1996). Certain restricted locations, due to the specific flora and fauna which are only found in these areas in Malta, have been granted specific protection status. Ġnien il-Kbir, il-Buskett and Wied il-Girgenti have been designated as a Tree Protection Area (2011) given the existence of trees with Antiquarian value (1933) while Buskett Gardens and Verdala Palace, and Girgenti are both designated Bird Sanctuaries (2006). In fact, this site has also been declared as an important bird area by Birdlife International, particularly due to its international importance for raptor migration, including species like Marsh Harriers, Honey Buzzards, Hobbies, Eleonora's Falcons amongst others (Epsilon-Adi, 2013). It is also a resting and feeding area for a wide variety of migrants in both spring and autumn (Epsilon-Adi, 2013).

2.2 The Socio-Economic Importance of the Site

The existence of a well-preserved natural environment can guarantee the conservation of essential ecosystem services. Ecosystem services are defined as '*multiple benefits that people derive from*' the natural environment (Everard and Walters, 2013).

The Millennium Ecosystem Assessment allows for an assessment of the consequences of ecosystem changes for human well-being and the scientific basis for action needed to enhance the conservation and sustainable use of those systems and their contribution to human well-being. The system developed by the United Nations in 2001 provides a state-of-the-art scientific appraisal of the condition and trends in the world's ecosystems and the services they provide and the options to restore, conserve or enhance the sustainable use of ecosystems.

Figure 2. 3: The Ecosystem services



Source: Everard, M., Walters, R. (2013). 'Ecosystem services assessment: How to do one in practice'.

Figure 2.3 provides an overview of the services provided by ecosystems taking into account the environmental, economic and social implications. The services are divided into four categories; **the provisioning services** incorporating food and freshwater, **the cultural services** including all recreational activities both for locals and tourists, **regulatory services** referring to environmental self-balance regulating disasters like floods and climate change and **supporting services** referring to services that are necessary for the production of the other ecosystem services such as soil formation and habitat for wildlife as well as providing nutrient cycling and photosynthesis. All the ecosystem services are linked through a process to enhance human well-being (Gantioler et al., 2010). Despite the importance of ecosystem services, the socio-economic benefits of Natura 2000 sites remain poorly understood and appreciated (Kettunen et al., 2009).

The EC (2009) provides a toolkit to assess the socio-economic benefits of Natura 2000 sites. The toolkit seeks to provide an overview in terms of identifying and valuing various ecosystem services, particularly the ones which cannot be easily quantified. The table below follows the Millennium Ecosystem Assessment which is also utilised in the EC Toolkit. The table outlines different services that can be provided by a Natura 2000 site and provides an overview of the extent to which the Buskett and Girgenti area allows for the provision of these services. This table represents a high level assessment providing the basis upon which further detailed assessment is provided in Section 5 of this report.

Table 2. 1: The Ecosystem services in Buskett

ECOSYSTEM SERVICES		Is this service likely to be associated with Buskett and Girgent Area?
Provisioning Services		
Biodiversity Resources	Food (Crops, Fruit, fungi, wild berries and others)	👍
	Fibre/material (plant fibre, timbre, cork and others)	👎
	Fuel (Biomass and firewood)	👎
	Herbs for natural Medicines	👎
	Ornamental Resources (Wild plants and wood for Handcraft)	👎
Biochemical and Pharmaceuticals		👎👎
Water		👍👍
Cultural and Social Services		
Ecotourism and recreation		👍👍
Cultural values and inspirational services (Education, Research, art)		👍👍
Landscape and amenity values		👍👍
Regulating Services		
Climate and climate change regulation		👍
Water regulation (flood prevention, aquifer recharge)		👍👍
Water purification and waste management		👍
Air quality regulation		👍
Erosion control		👍👍
Storm Damage control		👍👍
Avalanche control		👎👎
Wild fire mitigation		👎
Biological control		👍👍
Pollination		👎
Regulation of Human Health		👎
Genetic/species diversity maintenance (Protection of local and endemic species)		👍👍
Supporting Services		
Primary Production		**These ecosystem processes form the basis for all the services above.**
Nutrient cycling and decomposition		
Water cycling		
Weathering/Erosion		
Ecological interaction		
Evolutionary Process		

Legend:

Very likely 👍👍 likely 👍 some potential 👎 unlikely 👎👎

Source: Based on Natura 2000 Toolkit (2009) and 'l-inħawi tal-Buskett u l-Girgenti: Natura 2000 management plan' (2013)

Buskett provides a variety of direct and indirect services to individuals, supports the ecosystem and regulates essential ecological processes. Buskett is a rich area of biodiversity. According to the Natura 2000 management plan for Buskett (2013), 66 per cent of the Natura 2000 area that is around 146ha is government owned. The rest, around 77ha (34 %) is privately owned. Most of this land is used for agricultural purposes providing crops and fruit. This land is a source of food for locals. The area is also considered important from the provision of services point of view in terms of water due to the fact that the site is located within the confines of a perched aquifer and the mean sea level aquifer.

Buskett is one of the few semi-natural wooded areas in Malta. It is one of the few areas in the Maltese islands where people can retire to relax, appreciate nature, carry out outdoor activities and breathe clean air. Based on a visitor's assessment study (Cassar and Conrad, 2012) the majority of respondents that is over 70%, visit Buskett as a means of relaxing and for walking followed by visits to Buskett for picnic (Cassar and Conrad, 2012) and other activities.

Buskett is enjoyed by society at large as families and social groups seek the area to get together, relax and enjoy group activities. Nevertheless, Buskett is also visited by individuals who want to jog, cycle, take photographs or escape somewhere quiet to think and relax. As depicted in table 2.1, Buskett is also a site of specific scientific interest. It is visited by scientific researchers and even by school groups for biology/environmental projects.

The environment has the ability to balance itself and control natural catastrophes such as flood and climate change as trees and plants absorb carbon dioxide (CO_2). Deforestation and human disturbance can eradicate these regulating services. Protecting the environment will provide regulating services such as contribution towards mitigation of climate change. Towards this end, climate change is recognised as a major environmental challenge and features prominently across EU agenda in a bid to attain smart, sustainable and inclusive growth. Excessive CO_2 and other GHG emissions can have negative impact on human health. Natural environmental protection can regulate such occurrences and reduce negative impact on human well-being while enhancing standard of living.

Buskett also supports habitat of wildlife providing shelter for animals, birds and insects. For example, Buskett has been designated as a bird sanctuary. Other supporting services include nutrient cycling and decomposition, as well as water cycling and photosynthesis. The latter is a chemical process where plants use the solar energy, carbon dioxide and water and convert them into food (glucose) (Gust, 2013). It is also considered one of the 'most important biological process on earth' (Gust, 2013) given that it involves the process of releasing energy and consuming carbon dioxide and therefore it is important in the process of climate change mitigation. Therefore, it supports a regulating service.

The last category of ecosystem services identified for Natura 2000 is the supporting service category. This forms the basis for all other services under any of the above categories. For example, soil formation greatly influences soil fertility (CTAHR, 2014). As soils form, nutrients are being continually removed from and added to the soil with time. The conditions that are present during soil formation ultimately determine how much and what kind of nutrients the soil can naturally supply and hold (CTAHR, 2014). This determines the growth of plants, trees, crops and fruit.

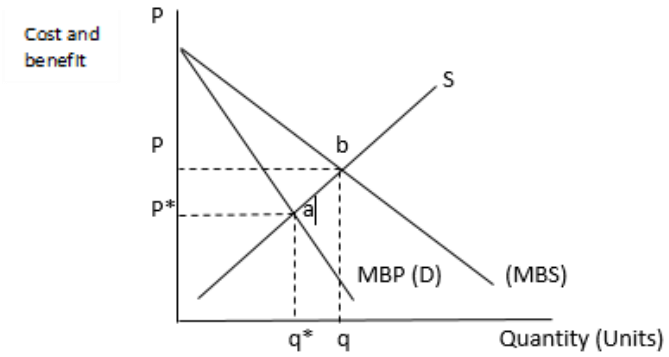
This means that conservation of the natural environment at Buskett and its surrounding area goes beyond the conservation of landscape for scenery purposes as by conserving the natural environment individuals will be safeguarding their well-being and their future. The Buskett visitors' survey (2012) also analysed the visitors' knowledge on different aspects and characteristics of Buskett such as nature, cultural heritage and protection status. It resulted that visitors are informed with an overall average of three out of five with five representing most knowledgeable. Kettunen et al. (2009) hints that although interest on the Natura 2000 benefits is increasing, availability of existing information on ecosystem services is still very low. This implies that more attention should be given to this area of study. Also the general public should be educated in a more thorough manner on the socio-economic, ecological and environmental value of the area.

3. Literature on the Economic valuation of the Ecosystem services of Natura 2000 sites

3.1 Positive Externalities of Natura 2000

Despite the importance of natural sites, their value is more than often underestimated. Siebert (2005) argues that natural resources have always been considered prototypes of free goods, with no price attached to their use and available in unrestrained quantities. The idea has always been that the environment belongs to everyone and everyone could dispose of it in any way without bearing consequences as it carries no price, ignoring the damage caused to social welfare. This is a clear case where the market fails and intervention is thus required to protect natural sites. The positive externalities, or the benefits, associated with the good, while giving satisfaction to users, are not associated with a price.

Figure 3. 1: Positive Externalities



Source: Tietenberg, 2006

A positive externality refers to an activity with a positive impact on an unrelated third party (Mansfield and Yohe, 2004). In this case, the ecosystem services generated by Buskett and the Girgenti environment are benefits for individuals or visitors to Buskett. Here, Buskett and Girgenti can be compared to producers of the ecosystem services giving rise to positive social implications. Figure 3.1 refers to the underestimation of positive externalities in a market setting. Curve D represents the marginal benefits to the private sector (MBP) and society (MBS).

Point 'a' represents the market equilibrium while point 'b' represents the social optimum point. If the production of these ecosystem services had to be put in a price mechanism framework the quantity produced will be at 'q*'. However, the benefits on society are much higher than those captured by the market. Consequently, given that not all the benefits can be captured by the price mechanism, the private marginal benefits will be lower than the social marginal benefits and hence the market fails. Even if an entry price is to be applied to such sites, the benefits to be gained in terms of accessibility to peace and tranquillity are most likely to be underestimated given the positive benefits on human physical and mental health. Therefore, social benefits (Point b) will be much greater than that determined by the market, since some of these benefits cannot be easily accounted for. Nevertheless,

the ecosystem benefits produced by the Natura 2000 site carry no direct price. Accessibility to Buskett is not restricted, is free of charge and its overutilization can pose a risk. It is on account of this reason that natural sites like the Buskett and the Girgenti area need protection since the area generates a number of positive economic, social and environmental benefits which may be overused and jeopardise without sufficient protection.

> "Nature is sometimes taken for granted and undervalued. But people cannot flourish without the benefits and services our natural environment provides. Nature is a complex, interconnected system. A healthy, properly functioning natural environment is the foundation of sustained economic growth, prospering communities and personal wellbeing."
>
> (HM Government, 2011)

The threats faced by Buskett and the Girgenti area represent costs imposed on the system by individuals as there is no price allocated to the imposition of these threats. The deterioration of the natural environment as a result of negative human impact on the environment will cause damage and consequently eliminate part or the entire ecosystem benefits described previously. For example, a picnic in Buskett results in the generation of waste which may be disposed of in an irresponsible manner posing a threat to the environment. Similarly, in the process of enjoying the recreational value of Buskett, users might not internalise the environmental benefits and thus cause damage or harm to trees unknowingly also affecting species.

All of these threats emanate from the fact that the external benefits derived from the natural site and the costs imposed on it are not internalised in a sufficient manner to the parties who enjoy the resources derived from the natural site. Users tend to underestimate the total economic value of Buskett. As such due to this asymmetric information, this natural site requires protection and specific intervention by authorities. Economic theory suggests that authorities can choose between two approaches (Tietenberg, 2006):

1. **Command and Control (CAC):** This approach refers to the imposition of legal restrictions or fines. This system is likely to be effective but requires enforcement and can be considered to be "unnecessarily bureaucratic" (Turner et al., 1994: 181).

2. **Market Based Incentives (MBI):** These include charges or permits. These are more commonly used as they are more cost efficient even when information is unavailable (Tietenberg, 2006).

However, these are not effective unless awareness of the importance of the site is emphasised. There is the need for dissemination of information and publicity on the socio-economic importance of the site. An understanding of the socio-economic benefits provided by protected natural areas is important for a number of reasons. It is not only important for policy makers to make the right investment and design the right management practices but also for users like farmers and visitors who interact with the sites from day to day and whose decisions ultimately determine the status of the site (Gantioler et al., 2010 & Kettunen et al., 2009). Awareness on benefits and implications of negative

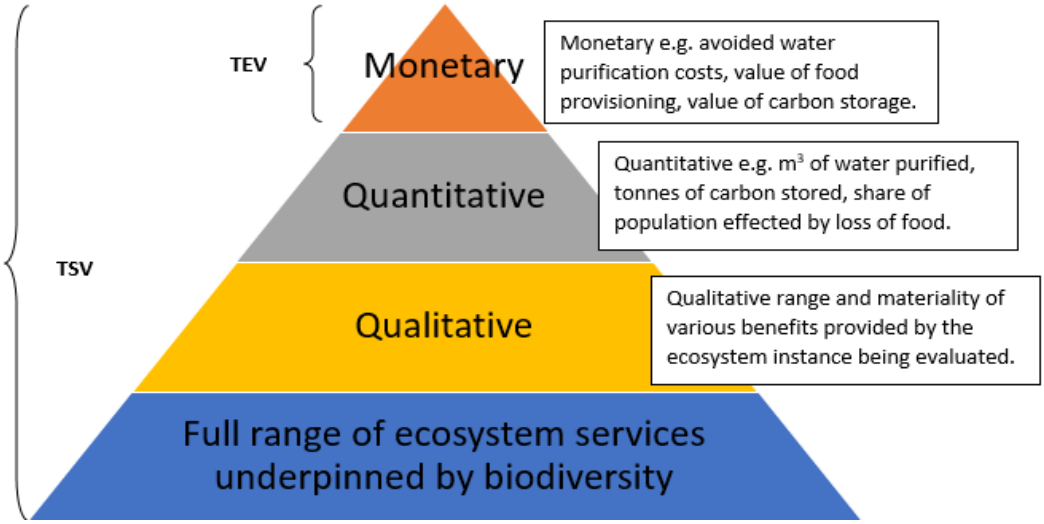
actions can instil responsibility in visitors who will understand that the future of the services depends on how they interact with the natural environment. The relationship is interdependent. Visitors depend on the ecosystem to provide these services whilst the status of these services depend on the impact of human action on the site.

3.2 Ecosystem service valuation

Given that the ecosystem services or benefits provided by Buskett and the Girgenti area, referred to in Section 2, are mostly free goods and are available for the gratification of everyone they do not have a market value and therefore little is known on their quantitative and monetary value. Thus indirect methods of quantifying the value of the area through an assessment of external costs imposed on it and external benefits derived from it, must be engaged. This can be done through a number of different methods which are explained in this section of the report.

The studies available that try to assess the net benefits of Natura 2000 are still very much limited and the existing ones' focus on a handful of ecosystem services mainly eco-tourism and recreation (Brink et al., 2011). As depicted by Figure 3.2, the ecosystem services are assessed on three levels; qualitative, quantitative and monetary. However, estimating the total value of the total range of ecosystem services is often impeded by the lack of quantitative and monetary information available.

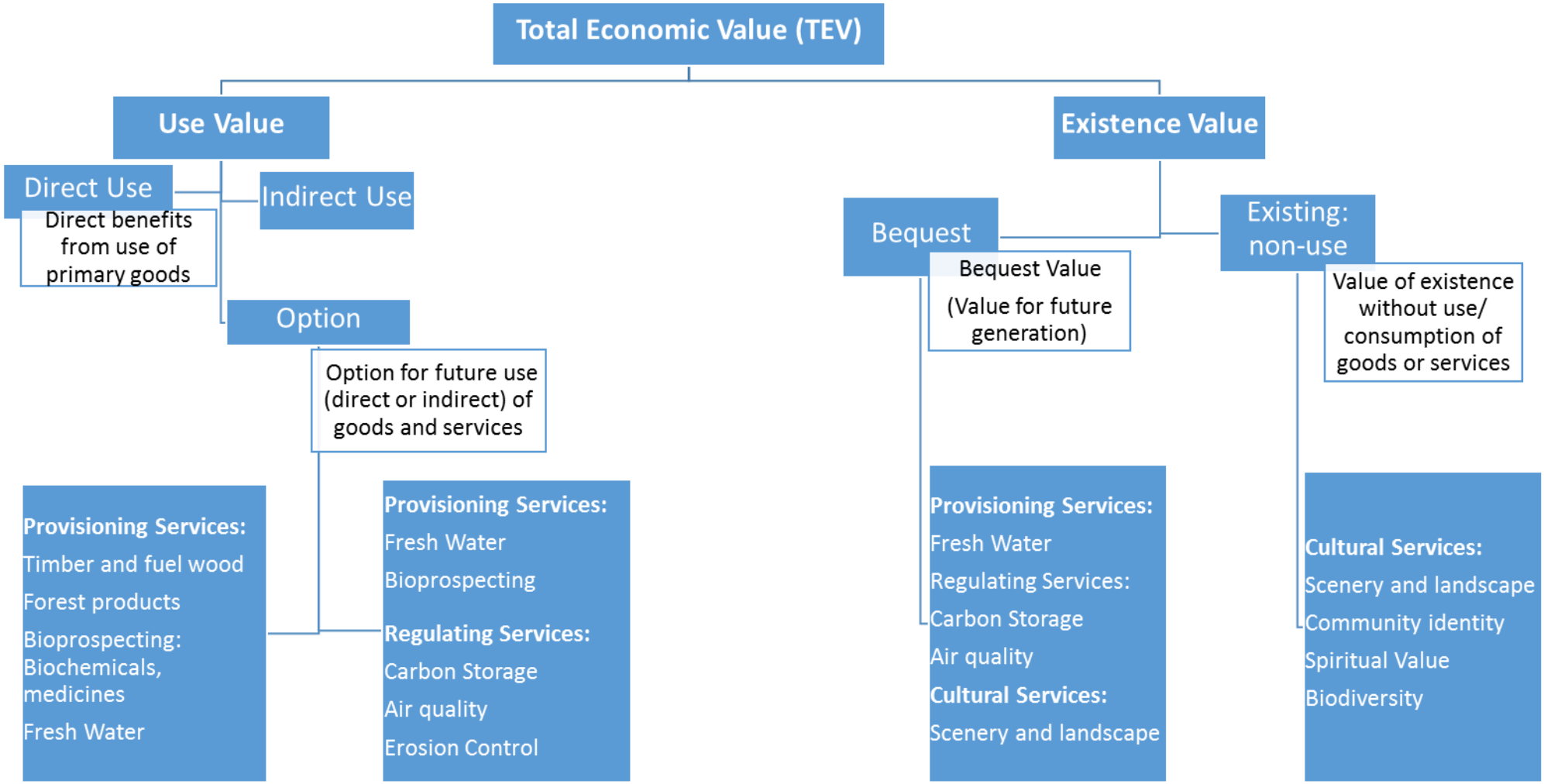
Figure 3. 2: Total system value



Source: Brink et al., 2011

The Institute for European Environmental Policy indicates that the valuation of socio-economic benefits can be valued using different valuation frameworks which depend on the scale of the study and its objectives for policy making. The most widely used approach is the Total Economic Value (TEV). One particular study carried out using this approach was the analysis of Natura 2000 sites in Scotland by the Scottish Executive Environmental and Rural Affairs Department (SEERAD). The TEV estimates the value of ecosystem services based on the way the services are used. Figure 3.3 illustrates the composition of the TEV which is composed of the use value that makes reference to the value gained through usage (e.g. wood used for furniture) and existence value that is the value we get through serenity and scenery (Kettunen et al., (2009) and Gantioler et al., (2010)).

Figure 3. 3: Total Economic Value of ecosystem services



Source: Estimating the Overall Economic Value of the Benefits provided by the Natura 2000 Network, 2011

The 'Use Value' as stated above is a value obtained through market transactions. This refers to items that can be either sold directly like food (e.g. Citrus fruit collected from the trees can be directly sold on the market) or find its way in the production of another commodity and therefore act as an intermediate good. However, both can be used directly or indirectly.

On the other hand, the 'Existence Value' or the non-use values refer to the value given to something simply for existing. It is also known as 'Conservative value' (CV). The value attached to these services is more of a qualitative and quantitative value rather than monetary. The 'Bequest value' is a value attached to services like air quality, freshwater, cultural heritage and scenery. Their importance makes their conservation necessary for future generations. There are also services with existence value but which have no use value like spiritual benefits.

Estimating a monetary value can be undertaken if the value of the related benefit is apparent through a market transaction. However, others are more difficult to assess as the benefits cannot be captured through market transactions (Kettunen et al., 2009). In other words, it is easier to assess the value of food or plants for natural medicine than to give a value to the natural ability of a site to purify water or its ability to reduce CO_2 (even though carbon dioxide does have a potential market value) and consequently its contribution to the reduction in respiratory diseases. It is also difficult to quantify the ability of a site to reduce natural hazards (Kettunen et al., 2009).

Table 3. 1: Methodological Valuation methods

Approach		Method
Market valuation	Price-based	Market prices
	Cost-based	Avoided cost
		Replacement cost
		Damage cost avoided
	Production-based	Production Function approach
		Factor Income
Revealed preference		Travel cost method
		Hedonic pricing
Stated preference		Contingent valuation
		Choice modelling/conjoint analysis

Source: (Gantioler et al., 2010)

Table 3.1 includes different types of methodologies which can be applied for the estimation of 'use' and 'non-use' values. The rest of this chapter discusses in further detail the different valuation methodologies that can be applied to estimate the benefits of a Natura 2000 site.

3.2.1 Market Valuations

1) **Price-based (Market prices):**
   This method estimates the economic value of ecosystem commodities as if they are bought and sold in commercial markets. It uses standard economic techniques for measuring the economic benefits from marketed goods, based on the quantity people purchase at different prices, and the quantity supplied at different prices.

2) **Cost-based**
   a) Avoided cost:
      Value of costs avoided by ecosystem services that would have been incurred in the absence of those services. For example, storm damage avoided by densiy of trees in a woodland.

   b) Replacement Cost:
      Cost of replacing ecosystem services with man-made systems. For example natural water cycling replaced with irrigation systems.

   c) Damage Cost avoided:
      This method uses either the value of assets protected, or the cost of actions taken to avoid damages, as a measure of the benefits provided by an ecosystem.

3) **Production-based**
   a) Production Function approach:
      This is estimated by taking the net value of an ecosystem service by deducting the gross revenue generated from the ecosystem service minus production costs.

   b) Factor income:
      The enhancement of income by ecosystem service provision. For example, water quality improvements increase the quality of fruit produced and agricultural products using natural water for irrigation.

3.2.2 Revealed Preferences

a) Travel Cost Method:
   It is built on the premise that the time and travel cost incurred to visit a site represent the "price" of access to the site. Thus, peoples' willingness to pay to visit the site can be estimated based on the number of trips that they make at different travel costs.

b) Hedonic pricing:
   It is based on the assumption that people value the characteristics of a good, or the services it provides (e.g. environmental characteristics), rather than the good itself. Thus, prices reflect the value of these characteristics.

3.2.3 Stated Preferences

a) Contingent valuation (The Willingness to pay concept)

Services without an exchange value are challenging to evaluate especially in monetary terms since they are free goods. Benefits like water purification, landscape and amenity values do not have an exchange value. They refer to 'the normative and moral frameworks' individuals attach to their beliefs and actions (Farber et al., 2002). The value given to these services is very personal as it depends on what one is looking for. The Buskett and Girgenti area has an intrinsic value to individuals which varies from individual to another. For some it is a place to go and relax with family and friends. Presence within the site renders a personal value, while for others it has a historical and cultural value. The value differs by individual and depends on the satisfaction each one attains from utilising the resources offered by the site. Given that there is no market to gauge this benefit it is not possible to directly quantify this benefit. Therefore, money becomes a unit to measure utility (Satisfaction).

One possible way of quantifying these values is through a survey known as the WTP survey. Individual's willingness to pay represents a utility-based value (Farber et al., 2010) which is indicative of the value for a service demand elicited by posing hypothetical scenarios that involve some valuation of land use alternatives. For example, people would be willing to pay for increased preservation of woodlands.

Given the nature of the services analysed in this report in connection to Natura 2000, market-based methodologies are somewhat infeasible given that some of the ecosystem services cannot be observed through market transactions. To estimate the value of ecosystem services, stated preference methods, surveys based techniques, might be more suitable and more feasible.

A WTP survey helps to identify the importance visitors attach to the non-market services by asking beneficiaries directly through interviews. It will reveal the satisfaction or utility they obtain from visiting area Natura 2000 location. Before asking individuals to place a value it is important to make sure they are aware of the services they are getting for free. Since no price is attached to visiting and carrying activities in this place, often these services are taken for granted and not even considered as services provided by nature.

Some people may enjoy it knowing that is free but than they are not willing to pay for it while others are. Given that there are individuals willing to pay than that means that ecosystem services do have a price and therefore can be classified as an economic good. That price or value attached to that commodity will reflect the satisfaction given to that individual as these *'measures of economic value are designed to reflect the difference that something makes to the satisfaction of human preferences'* (Farber et al. 2002). Therefore, one will question:

1. How will people's utility change if they ceases to exist?
2. How much will they be willing to pay for this service to remain available for their own satisfaction?

The WTP approach is recommended given that it allows for the coverage of a wider range of ecosystem services. For example, the WTP survey for Galicia increased coverage from 36,000 ha to 280,000 ha that is 15 per cent increase in the level of protection (Gantioler et al., 2010).

When carrying out a survey, a field study, it is impossible to interview the whole population, however it is important to collect a representative sample otherwise it would not be feasible. A sample is a proportion of the population selected for analysis. Once the survey data is collected it is analysed and grossed up to represent the entire population.

The WTP survey has been used for other natural sites listed under Natura 2000 like Pico da Vara in the Azores Island in Portugal and Bialowieza Forest in Poland for which the WTP for the existence value and value of cultural services amounted to €4 billion/ year (Mudgal et al., 2011). According Cruz and Royuela, 2009) the WTP survey should be carried out for all ecosystem services simultaneously given that services are interlinked and if separated could result in double counting.

Nevertheless, although the WTP survey is recommended it is not always possible to carry out this survey given that it is a large scale exercise which is often costly. An alternative to the WTP is the ***Transfer benefit method***. This consists of transfer benefit values from a particular study to the benefits of the Natura 2000 site being studied. Nevertheless, given that the sites are never exactly the same, with the same characteristics, values need to be scaled so as to represent the current site under study.

Table 3. 2: Scaling up approaches

Unit value transfer	Involves the multiplication of the mean unit values estimated by a particular study by the quantity of that commodity on site.
Adjusted unit transfer	Involves adjusting the value being transferred to reflect the characteristics of the site. Adjustments usually reflect household income, policy sites and price levels.
Value or demand function transfer	Use function estimated through the application of methods like hedonic pricing, contingent valuation and choice modelling on other sites but using parameters of the site being studied.
Meta-analytic function transfer	Uses a value function estimated from different studies but using information on parameter values for the policy site to estimate values.

Source: Gantioler et al. (2010)

The fourth approach (Table 3.2) is considered as the most recommended approach. However, this is also the approach which is the most demanding in terms of data quality. Indeed, it is usually applied on large scale sites. The most commonly used approach is the unit value transfer approach.

The methodology used depends on the characteristics of the site, data availability, literature and the size of the site under consideration. Although there are a number of methods available, the usage of one method does not exclude the application of another. Indeed, it is possible to use a mix of different approaches (Gantioler et al., 2010).

b) Choice modelling/conjoint analysis

This is an indirect survey where individuals are presented with a list of products and prices and are asked to rate or order their preferences based on the product characteristics. In case of the conjoint

analysis individuals are asked to rank products according to their preference while in the case of choice modelling participants are asked to choose rather than rank between products with different characteristics profile.

3.3 Challenges associated with Ecosystem services valuation

The Natura 2000 toolkit (Kettunen et al., 2009) emphasises assessors to be cautious in avoiding double counting of the benefits. Ecosystem services tend to be interlinked meaning that one service provides support to another. Adding the value of the supporting service to the final value of the other services which indirectly make use of supporting service will result in double counting. For example, water purification is linked to the provisioning of water service and water regulation. Purification of water enables provision of high quality water which is added to the value of water provision. Therefore, if while adding the final value of water provision, the value of water purification is also added, the TEV will be overestimated since the value of water purification is included in water provisioning.

It is also important to note that any assessment and economic value derived from an ecosystem services may be clouded with 'uncertainties'. As a result, the valuation should be used as evidence to support decisions based on other information gathered alongside the economic valuation (Everard and Walters (2013) and Kettunen et al. (2009)).

3.4 Wider Socio-Economic Benefits

In order to protect 'l-inħawi tal-Buskett u tal-Girgenti' and other Natura 2000 sites investment is required and employees need to be employed so as to carry out the actions developed to counteract the threats. These projects result in direct economic benefits such as the generation of jobs (Rubble wall builders, tree planters and other subcontracting) and income further stimulating multiplier effects. Multiplier effect is defined as the effect on national income or consumption as a result of an initial spending. Such activities can contribute to enhance market activity and therefore indirectly contribute to economic growth (Epsilon-Adi, 2013). Table 3.3 depicts some of the wider socio-economic benefits which will also be considered in the ex-post evaluation report considering the benefits of the respective interventions to be carried out through the Life + project.

Table 3. 3: Wider socio-economic benefits

Wider Socio-Economic Benefits	
Benefits	**Quantitative Basis**
Direct Employment	• Number of jobs and salaries (Full-time equivalent) off and on-site
Indirect Employment	• Number of jobs and salaries (Full-time equivalent) off and on-site x multiplier
Support to the local economy through direct spending of the reserve	• Spending on local and regional services
Support to the local economy through spending generated by direct employment and volunteers	• Spending on local products and services by site employees and volunteers as percentage of local turnover.
Supporting rural and regional development e.g. contributing to rural/regional economic development and bringing in EU, national and/or regional financial support.	• Contribution of site/network related economic activities to total rural/ regional economy • Financial support received for the protection of a habitat of species.

Source: Kettunen et al., 2010

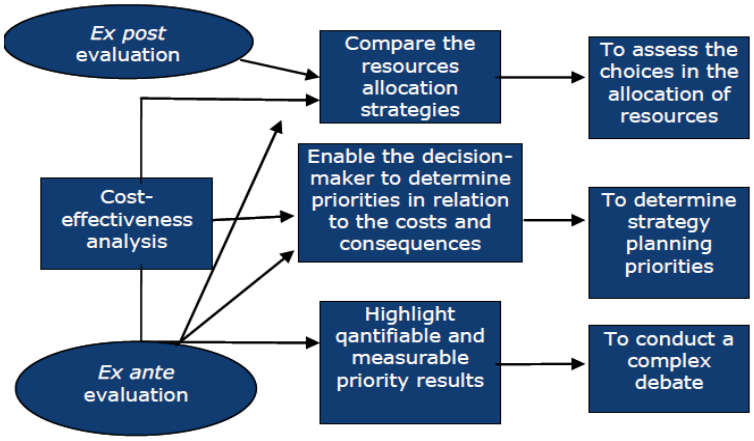
This approach has been adopted for some Natura 2000 sites in France and the United Kingdom. Based on a study on the economic and institutional evaluation of the Natura 2000 programme in France, using a cost-benefit analysis, taking into account direct and opportunity costs as well as direct and social benefits estimated that an economic net benefit of €146.68 ha/year has been produced (Gantioler, 2010). On the other hand, in a study for a Natura 2000 in the United Kingdom, 1,000 jobs were created (Full time equivalent) as a direct impact of reserves by the Royal Society for the Protection of Birds (Shiel et al., 2001).

3.5 Cost Effectiveness

Assessing and deriving an economic value for ecosystem services identified in the previous section emphasises the importance of the benefits derived from this Natura 2000 site and as mentioned above given these benefits these services needs to be safeguarded. This often requires investment in order to repair/restore/maintain a site of ecological importance. Investment can result in economic benefits as discussed in Section 3.4. But, is it worth investing in? Do the benefits derived exceed the cost? *'Cost effectiveness analysis is a decision making tool which allows for an assessment of the benefits derived from interventions in comparison to the cost determining whether interventions should or should not be undertaken. The method allows for the identification of the most economically efficient way to fulfil an objective.'* (EC, 2014). This approach entails an evaluation of the total cost of the programme and measures the impact of the programme at each level of output allowing for the establishment of a cost to effectiveness ratio.

In order to highlight the economic benefits of the project envisaged at Buskett as part of Life+, an assessment of the socio-economic benefits of Buskett and its surrounding area is considered in this report providing the basis upon which the respective measures and investment will be assessed

Figure 3. 4: Cost effectiveness Analysis



Source: European Commission, 2014

The cost effectiveness analysis is divided into three sections (EC, 2014). The first is an ex-ante evaluation which in this case entails an estimate of the ecosystem benefits derived from the Buskett and Girgenti area and which is undertaken in this report. The second and third sections focus on the determining priorities and finally assessing the choices in the allocation of the resources which will feature in the ex-post evaluation.

4. Methodology to Determine the Socio-Economic Benefits of Buskett

This section of the report presents an outline of the methodology to be adopted in deriving the socio-economic benefits of Buskett prior to the adoption of the LIFE+ project as well as the methodology for the post-project assessment which to an extent are intertwined. The methodology for each of the ecosystem services is based on the Toolkit Guidelines provided by the Institute for European Environmental Policy on Estimating the Socio-Economic Benefits of Natura 2000.

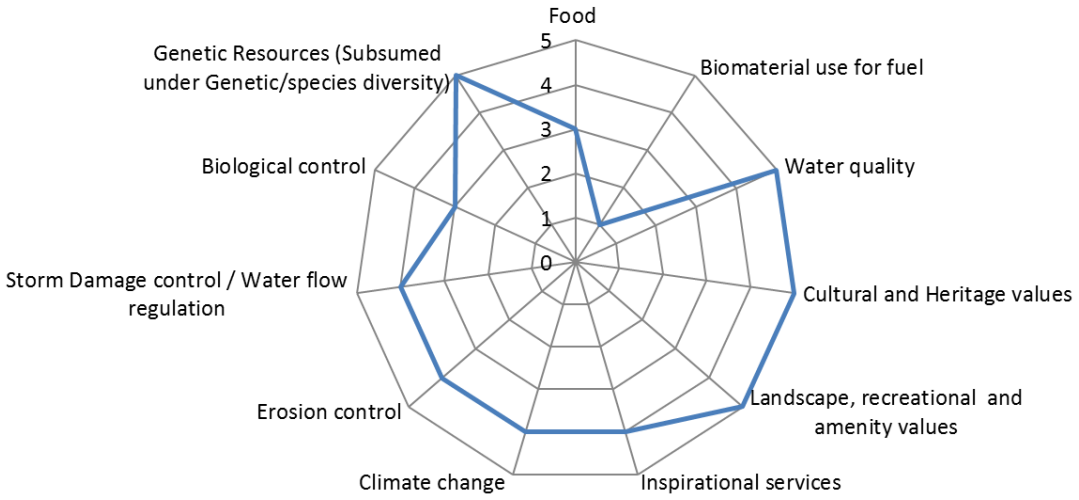
The methodology adopted for each variable, is presented in the methodology matrix as shown in the Tables 4.1-4.3 below. In essence, the matrix provides an overview of the methodology to be applied for each and every ecosystem services deemed of relative importance to Buskett which have been identified following Natura 2000 guidelines suggested question to identify which ecosystem services are available in the Natura 2000 site and their importance in terms of valuation:

1. **Does the Natura site provide this service?** This is a simple yes or no question. There are various ecosystem benefits in general but not all of them are provided by all Natura 2000 sites.
2. **Who benefits from this service?** It is important to identify the beneficiaries of these services (Locals, farmers, habitants, global etc…). The importance mostly relies in tracking the 'benefit flows' from the site to the point of usage by the beneficiary. This helps to identify the potential of these services.
3. **What is the significance / potential of this service?** Response can range from 1 to 5, 1 being not relevant to the site to 5 being of very high significance. This ranks services from the most trivial to the most important, identifying the services that needs to be calculated meticulously from those that can be evaluated with just a quick assessment.
4. **How easily it is to obtain a type of valuation? Is it or is not sold on the market?** In other words is it possible to obtain a qualitative, quantitative and monetary value for the services identified? The answer to this question depends on the type of service and whether or not it can be identified through a market transaction.

Not all ecosystem services can be valued in the same manner as not all have a market value. However, this quick assessment enables the screening of the likely impact across the ecosystem services because ultimately what matters is the value of those with an impact ranked as highly significant (Everard and Walters, 2013).

This assessment has been undertaken following discussions with the Contracting Authority, PARKS, as well as an environmental expert. The relevant variables and the extent of the importance of these ecosystem variables are summarised in the Figure 4.1 below.

Figure 4. 1: Ecosystem services offered at Buskett/Girgenti (Natura 2000)



1: Least Important
5: Most Important

The matrix also presents the methodology to be applied for each variable distinguishing between:

- Qualitative: An assessment based on non-quantifiable information;
- Quantitative: An assessment based on information or data to determine the absolute or relative abundance. It is a quantifiable measurement process;
- Monetary: An assessment based on identifying the worth of something by establishing or attaching a monetary value based on actual market data or on the application of shadow prices.

Other issues which are considered in the matrix are the beneficiaries, the current status of the service as well as the extent to which the importance of the service is likely to increase in the future. In addition, the extent to which the service is likely to increase in importance following the specific interventions is also considered in the analysis and serves as useful information for the post-project assessment.

The identification of the methodology presented in the following tables, is based on a review of international literature. In particular, the following publications have been utilised:

- Assessing Socio-Economic Benefits of Natura 2000 (Kettunen et al., 2009)
- Assessing Socio-economic Benefits of Natura 2000 – a Case Study on the ecosystem service provided by SPA PICO DA VARA / RIBEIRA DO GUILHERME. (Cruz, A de la, Benedicto, J., 2009)
- Assessing Socio-economic Benefits of Natura 2000 – a Case Study on the ecosystem service provided by the Natural Park of Vale do Guadiana (Portugal). (Bugalho, M. 2009).
- Assessing Socio-economic Benefits of Natura 2000 – a Case Study on the ecosystem services provided by Oaş-Gutâi Plateau and Igniş site, Maramures, Romania. (Kazakova, Y., Pop, E. 2009)

- Modello dimostrativo di valutazione qualitativa e quantitativa dei servizi ecosistemici nei siti pilota. Parte1: Metodi di valutazione. (Schirpke, U., Scolozzi, R. & De Marco, C., 2014)
- Natura 2000 Management Plan (SAC/SPA): L-Inħawi tal- Buskett u tal-Girgenti, 2013
- The Natural Capital Value of Native Woodland in Ireland (Bullock, C. &Hawe, J., 2013)

One of the main elements of this study is boundary identification. This is to be considered in light of the fact that Buskett, which has a total area of circa 47 ha, is located within a Natura 2000 site which in turn has an area of 226 hectares. Buskett in itself is an area of special importance as it is a site of ecological and nature conservation owing to it being the only example of a semi-natural woodland in the Maltese Islands possessing a variety of endemic and rare species needing protection. The interventions which are covered by the LIFE+ project are entirely based in Buskett but the socio-economic value of certain variables cannot be assessed solely for Buskett but must consider the wider area of the Natura 2000 site.

As a result, the methodology adopted identifies the boundary of assessment which may vary by the ecosystem variable. This implies that the benefits, particularly those which are quantified are not necessarily summable but will pertain to the specific variable being analysed. Furthermore, not all variables can be quantified. In such cases, a qualitative assessment of these variables is undertaken.

Table 4. 1: Provisioning Services

Ecosystem Services	Score: 1 to 5*	Short description on the service	Methodology			Who are the beneficiaries of the service?	What is the current status of the service?	Is the importance of this service likely to increase in the future?	Is the importance of this service likely to increase in the future on account of the interventions?
			Qualitative	Quantitative	Monetary				
Provisioning Services									
Food	**3**	This site includes fruit bearing trees and 149 hectares of mostly irrigated agricultural land, i.e. 61% of the entire SAC including livestock farms.		Area of agricultural land within the Natura 2000 site and agricultural produce with value based on published NSO data. Buskett - Number of fruit trees, produce in kgs/agricultural output	Kg of output produced x Market price	Local community	Agricultural activity within the SAC is historically considered to be important from a socio-economic perspective and is a main land use of the SAC.	Potentially through the rehabilitation of land in the SAC which will be reconverted back to agricultural land but its importance its not expected increase in terms of the Buskett area.	No
Biomaterial	**1**	Reeds which is available due to its harvesting in the past.		Area of Reeds		local population, farmers	Not currently extensively exploited. Harvesting of reeds was more prevalent historically locally, it is no longer a widespread practice, contributing to one of the reasons why this species has increased in dominance in the riparian habitats at this site.	No	No
Water quality	**5**	The Natura 2000 site includes three permanent watercourses running through it. The source of water used for irrigation of agricultural land is almost entirely from local sources being extracted either directly from the groundwater or channelled from the watercourses.	Ensuring water abstraction methods are regularised and sustainable. Ensuring water channelling is sustainable and does not disrupt downstream habitats and/or needs of farmers located downstream.	Rainfall, volume of reservoirs and m3 of water (annual); volume of water abstracted from groundwater	Consider the relative reliance of rainwater harvested to groundwater abstracted.	Farmers	Threats to groundwater quality, watercourse contamination, siltation of the watercourses due to soil erosion, obstruction of the watercourse from large boulders and stones.	The importance of this service is likely to remain high.	The importance of this service remains high. The interventions are likely to assist improved management of this ecosystem service.

Table 4. 2: Cultural and recreational services

Ecosystem Services	Score: 1 to 5*	Short description on the service	Methodology			Who are the beneficiaries of the service?	What is the current status of the service?	Is the importance of this service likely to increase in the future?	Is the importance of this service likely to increase in the future on account of the interventions?
			Qualitative	Quantitative	Monetary				
Cultural and Social Services									
Recreation for locals and foreign visitors	5	Buskett is a popular recreational site which contributes to well-being and improved quality of life. Also, Buskett is one of the few remaining woodlands in Malta attracting local visitors and tourists interested in spending time in and observing this relatively rare environment in the Maltese Islands. The site is also important for migratory birds, most notably birds of prey that can be observed roosting in large numbers during the migratory season at this site.	Unique woodland site	No. of persons visiting Buskett	Transferable value from WTP of other studies (A study for woodland in Ireland estimates a WTP between € 4 and € 10 per person)	Local community, and also the population on a national level, visitors , tourists, local business/markets	A popular recreational site, Buskett is well known for its recreational value. Buskett is associated with traditional celebrations such as Imnarja.	Yes. Sustainable development of Buskett could increase its recreational value.	Yes. The scope of these actions is to enhance the vegetation and the beauty of Buskett, increasing its importance in the future.
Cultural and Heritage values	5	Buskett is rich in cultural heritage including a number of archaeological features as well as scheduled monuments. Cultural events are also held at the gardens including the Imnarja Festival organised by the Malta Agrarian Society and the Verdala and Girgenti palaces are occasionally opened for public viewing.	Unique cultural and heritage assets with varied levels of scheduling	No. of heritage sites	Transferable values from WTP surveys	Local community and also national population, visitors , tourists, local business/markets	Buskett is particularly known for the Verdala Palace amongst others which are well preserved.	The importance is this service is likely to remain high	The project interventions should be carried out in such a way that respects the cultural context of this site including ensuring that rubble walls are re-built using traditional methodologies. Interventions on any other structures of cultural heritage features such as along the watercourse should also be rehabilitated in such a way that respects the cultural context.
Landscape and amenity values	5	The Natura 2000 site is a designated Area of High Landscape Value and includes the semi-natural woodland and agricultural land that dominate and contribute to the amenity of the area.	Landscape character	Area of woodland/Total woodland in Malta. Agricultural land.		Community and local and national level, visitors , tourists, local business/markets	The area is designated for its landscape value.	The importance of this service is likely to remain high.	The project interventions can enhance the visual amenity of the area.
Inspirational services (Educational Value, scientific value, artistic value, existence value)	4	Buskett can also offer inspiration. The tranquillity the place offers can be inspiration to art and research. The site has a great educational role for students to learn on Malta's nature and biodiversity and also learn on its importance for Malta's ecosystem and how to respect the environment .	-	Number of students benefiting from educational services provided at Buskett		Local community, visitors , tourists, local business/markets, researchers	This value is not very important and should be encouraged further.	Yes. This it is one f the few places in Malta with rich nature and biodiversity for students to enjoy, to carry research and to get inspired.	Yes. The scope of these actions is to enhance the value of the area.

Table 4. 3: Regulating Services

Ecosystem Services	Score: 1 to 5*	Short description on the service	Methodology			Who are the beneficiaries of the service?	What is the current status of the service?	Is the importance of this service likely to increase in the future?	Is the importance of this service likely to increase in the future on account of the interventions?
			Qualitative	Quantitative	Monetary				
Regulating Services									
Climate change	4	**Mitigation**: Carbon sequestration by the semi-natural woodland (as a result of photosynthesis). As trees grow they store carbon in their leaves, twigs and trunk (in the form of sugars) and in the soil around them, absorbing carbon dioxide from the atmosphere and releasing oxygen in the process. **Adaptation:** Safeguarding the habitat reduces soil erosion and contributes to reducing flood risk as well as providing diffuse pollution control. Trees influence the microclimate as they may buffer against extremes in temperatures.	Extent of the woodland; species grown; age / size of trees .	% land cover. Density.	Buskett as a % of the total area of woodland in Malta , GHG emissions of LLUCF (MRA database), shadow Price of CO2	All stakeholders affected by climate change (global public)	A number of Annex I habitats dominated by trees are present within this SAC, however, the total the percentage cover of these tree habitats occupies approximately 12% of the entire SAC. Some of these habitats including the watercourse galleries (dominated by willow and poplar, 92A0, occupying 1.2% of the SAC and consisting of 3 fragmented communities), olive and carob forests (9320, occupying 1.5% of the total SAC area and consisting of 6 fragmented communities, and the oak forests (9340, one of the rarest habitats at a national level, occupying just one area within the SAC, covering about 0.26% of its total area) have been assessed as having an unfavourable range within this SAC.	Yes. The importance of service is likely to increase due to climate change pressures.	Yes, planting of around 3300 trees will contribute to climate change regulating services
Water filtration	5	Water is slowed as it seeps into the woodland / forest soil where microorganisms break down waste and pollution.	An assessment on the importance of Water quality.			National / local	Limited to the extent of woodland cover in relation to the entire SAC.	Yes, water quality is important to ensure maintenance and improvement of Annex I habitats; also legal requirements including those under the Water Framework Directive and other relevant directives (e.g. Groundwater Directive).	Yes. Actions are target to regulate the watercourse and water quality.
Air quality regulation	3	Trees help to reduce pollution. Plants filter air when they absorb it into their leaves for photosynthesis or respiration. In addition, some airborne pollution particles may stick to leaves and subsequently wash off in the rain.	-	Tonnes of particulate matters sequestrated. Particle-removal estimates for individual trees is between 1.5 to 4.4 kg/day (McPherson, 1997).	Nowak et al. (2008) estimates the monetary value of air quality through the negative impact on society. Externalities are estimated at €4,828.22 per tonne of PM10 emitted in the atmosphere.	all stakeholders (global public)	Limited to the extent of tree cover throughout the SAC. It is also noted that this SAC is located within a rural, as opposed to urban environment.	It is not anticipated to change given the location in a rural environment	An increase in the number of trees could enhance the contribution of this service.

Ecosystem Services	Score: 1 to 5*	Short description on the service	Methodology			Who are the beneficiaries of the service?	What is the current status of the service?	Is the importance of this service likely to increase in the future?	Is the importance of this service likely to increase in the future on account of the interventions?
			Qualitative	Quantitative	Monetary				
Erosion control	4	Tree leaves catch and hold raindrops, reducing the speed at which the drops hit the soil surface and dislodge soil particles. Roots hold soil in place. Roots and stems slow down surface water, reducing the likelihood of carrying away soil particles. Rhizomes stabilise stream banks. Rubble walls and other retaining walls also play an important role in erosion control, acting as retaining structures that avoid loss of topsoil.	Protection of soil	metres of rubble walls, m3 of soil protected by rubble walls		local community,	A number of rubble walls are in need or repair, loss of Annex I riparian habitat can also negatively affect stream bank stability.	Yes. In particular as a result of increased extreme events such as floods.	Yes. Restoration of rubble walls along the water course as well as other walls in need of repair in other areas, should improve this service for this section of Buskett.
Storm Damage control / Water flow regulation	4	Forest areas intercept storm water and release this water over time thus water levels rise and fall less rapidly. This moderating effect on storm water runoff depends on tree density, ground flora, topography, soil and geological condition.	Damages from storm water runoff	m3 of Rubble Walls + Density of trees; surface water flow rate		local community	Restricted to the forest cover of the area	Potentially, as extreme events become more frequent as a result of climate change.	Potentially
Biological control	3	Provision of habitats for biological control agents, e.g. Bats - two Annex II species are known to roost and forage in this area.	Conservation status of biological control agents; farmscaping and farming practices that encourage biological control agent populations.	Populations of bats beneficial to cultivation	Reduced cost from avoiding or reducing the use of pesticides	Local community; natural environment	Current land management practices suggest that this service is not given much importance, as attested by the fact that artificial pesticides are used within this SAC, despite not being compatible with good	Yes, if management plan actions are successfully introduced	No
Pollination (Subsumed under Genetic/species diversity)		Provision of habitats for pollinators and seed dispersal agents (e.g. birds, mammals and insects).	Agricultural practices that encourage biodiversity such as the maintenance of field margins.	Number of agricultural management measures adopted to enhance biodiversity		local community, nature and biodiversity	Current land management practices traditionally do not include specific measures to enhance biodiversity, however, rubble walls do provide important habitat and encourage	No	No

5. Assessment of Ecosystem Services

This section provides an in-depth review of the ecosystem services provided by Buskett and its surrounding area. Where possible, an estimate of the benefits has been derived based on a review of literature of the respective ecosystem service and on the methodology which has been identified in the previous section of this report. The benefits attributed to Buskett will be assessed separately as the methodology varies for each and every ecosystem service depending on data availability and the characteristics of the service itself.

5.1 Provision Services

The Natura 2000 site plays an important role in contributing to the provisioning of resources to local communities. This section focuses on the provisioning services provided by Buskett and the surrounding area mainly in terms of food, water and biomaterial. The focal point in this section is on the contribution or role of "real" nature and natural ecosystems in supplying goods.

The analysis mainly focuses on the following elements:

- The extent to which Buskett supplies resources to the visitors and to the local community;
- Types of provisioning goods that are available and can be supplied by Buskett; and
- Consideration to the fact that elements of provisioning could be restricted by its protection status.

This section seeks to highlight the value of Buskett mainly from a qualitative perspective and where possible even from a quantitative and monetary perspective. Where relevant, using transferable values from other studies to provide a quantifiable estimate of the economic value of the area has also been undertaken.

5.1.1 Food

The Natura 2000 site of 'L-Inħawi tal- Buskett u tal-Girgenti' has a total surface area of 226 ha of which 149 ha is agricultural land. The agricultural land represents approximately 61% of the entire SAC and the rest is semi-natural woodland. The agricultural land within the area of Buskett is much more limited. The Management Plan for the Natura 2000 site indicates that agriculture is a main land use in the Natura 2000 area. The valleys include terraced fields and there is also a limited number of animal farms located within the site housing bovine, swine, rabbits and poultry.

The economic value of the agricultural land based within the boundary can be determined by considering the productivity of the national agricultural sector in Malta. Data published by the National Statistics Office in the Census of Agriculture (2010) indicates that 88.5% of agricultural land in Malta is utilised. Of these, about 49% of the land is used for forage, 6% is used for potatoes and 44% is used for other crops. The application of these proportions to the area of Buskett and the surrounding area

would imply that about 131.9 ha of agricultural land in Buskett is utilised. The value of output of crops can likewise be applied to the utilised agricultural land within Buskett and the surrounding area to determine a value of the agricultural activity. It is assumed that the type and amount of agricultural products produced in Buskett is similar to national proportions. There are no reason to assume that the agricultural products produced within Buskett is different from the national agricultural produce. Based on these assumptions it is estimated that the agricultural value of output occurring within Buskett and the surrounding area is about €593,000 per annum.

Table 5. 1: Value of output Agriculture

Natura 2000				
Type of crops	**value of output per ha (€)**	**National Proportions**	**Hectares (ha)**	**value of output (€)**
Forage	876	49%	65	56,563
Potatoes	9,826	6%	8	82,653
Other crops	7,825	44%	58	453,861
Total*	**18,526**	**100%**	**131**	**593,077**

Source: NSO

Although agriculture is important as it contributes towards '*shaping & managing landscape, supporting the effective capture & use of rainwater, protecting biodiversity & contributing to landscape quality & cultural heritage on the islands*.'[4], it is also a form of human intervention which if not adequately regulated can lead to disruption of the environment and the habitat of the Natura 2000 site.

Indeed, the Natura 2000 Management Plan indicates that agriculture also creates pressure on the site including, for example, loss of Annex I habitats (in particular the riparian community of *Salix alba* and *Populus alba*), contamination of the watercourses, introduction of alien species and also sewage outfall. As highlighted in the Management Plan, there is the need to control agricultural activities, through agri-environmental legislation targeting farmers to provide information on the environmental impact of their agricultural activities, so as to avoid negative repercussions from this important land use, especially if agricultural activities continue to intensify.

Specific to Buskett, and hence the woodland, the provisioning of food is much more limited. In essence the woodland is a habitat for a number of fruit-bearing trees, in particular citrus trees. In order to provide a quantitative assessment of the latter, an estimate of the amount of kilograms (Kgs) of citrus fruit produced within Buskett has been undertaken following discussion with the Environmental Landscape Consortium (ELC) which is a Public-Private Partnership (PPP) formed in 2003 and is responsible for the cleaning and management of part of Buskett including the orchards.

The ELC collects around 3 tonnes of citrus fruit per annum from Buskett of which only a very small proportion is sold. The rest of the oranges collected from Buskett are donated to charity. As a matter

[4] Rural Development Plan 2007-2013

of fact around 2 tonnes of what is collected goes to the Community Chest Fund, the President's charity foundation[5]. The exact quantification of the amount of fruit collected from Buskett and its monetary value is not available. However, an estimate can be undertaken through the application of the market price of citrus fruit as published by the NSO which amounts to about € 1.40 per kilogram resulting in a market value of about €4,221 per annum. It is interesting to note that the Visitor Assessment study carried out in 2012, indicated that 69% of visitors dislike the idea that fruit grown within Buskett is not sold within Buskett. Indeed, visitors have remarked that fruit produced in Buskett should instead be collected and sold on site. This highlights the presence and the potential of this feature. Other food resources within Buskett include pecan nuts and bay laurel as a herb. A quantification is however not possible due to the lack of available information.

5.1.2 Biomaterial

Ecosystems typically provide a diversity of raw materials such as wood used for fuel, biofuels, fibres and plant oils that are directly derived from wild and cultivated plant species. This ecosystem service is trivial in case of Buskett and the Girgenti area due to legal restrictions on the collection of biomaterials. Any attempt at directly estimating this service is thus limited.

According to L.N. 200 of 2011 Trees and Woodland Protection Regulations, '*no person shall fell or attempt to fell, cut or attempt to cut, strip off or attempt to strip off the bark or leaves……or attempt to remove timber…. or damage any tree….*'. Thus as the law clearly indicates logging is prohibited and no wood or any other biomaterial is allowed to be collected from Buskett for firewood unless permission is provided by the regulator. These actions are clearly restricted by the Malta Environment and Planning Authority (MEPA). The only wood collected, is the limited wood removed when pruning of fruit trees which is then used as 'mulch' in roundabouts for weed from control[6]. Other tree pruning activities are undertaken in exceptional cases when trees and branches are felled or damaged by inclement weather may lead to further damage to the same or other adjacent trees, or else pose a health and safety risk to visitors. However, it remains that one of the major concerns in Buskett is the improper practice of removing dead and rotting wood. Such actions will alter the natural habitat of Buskett endangering species.

The only action permitted is reed harvesting. Historically this activity used to be more important for the production of cane blinds, wicker baskets, fishing traps and various other artisanal products, but is now a dying trade. The Great reed in Buskett, more specifically the *Arundo donax*., is considered to be an invasive, alien species and has grown uncontrolled to significant amounts with a total coverage of 4,407.12m^2.

Furthermore, it has been noted recently that ivy branches, palm leaves and bay laurel branches are sometimes collected from Buskett as an ornamental resource in flower arrangements. However, such activity is not significant and individuals are only allowed to collect dead branches and leaves. Otherwise it is considered illegal to collect this material.

---

[5] http://president.gov.mt/mccf/

[6] Interview with Dr.Ronald Cuschieri – ELC: http://www.elcmalta.com/

5.1.3 Water Quantity

This section of the report focuses on water regulating services at Buskett and the wider confines in terms of the SAC. Water regulation is considered in light of the fact that certain ecosystems, such as wetlands can influence the timing and magnitude of water runoff, regulate and mitigate floods and provide support to recharging of groundwater resources (Epilson-Adi, 2013). An additional element considered in the methodology to assess the socio-economic impact of a Natura 2000 site is water purification due to the fact that ecosystems play a vital role in providing clean water, as they ensure the flow, storage and purification of water. Although water quantity and water filtration fall under different categories, one under provisioning and the other under regulating services for the purpose of valuation they are considered under the same heading.

Water filtration otherwise known as water purification allows microorganisms to break down pollutants such as metals, viruses, oils, excess nutrients, and sediment. These are processed and filtered out as water moves through wetland areas, forests, and riparian zones. This purification process provides clean water for irrigation and for industrial uses. The woodland habitat's role in water filtration can also contribute to a reduction in the spreading of disease. Biodiversity supported in woodland habitats can provide organisms counteracting disease by reducing the likelihood that disease vectors move to human or domestic animal hosts. For example, bats and frogs contribute to the control of mosquitoes.

As far as water quality is concerned, as shown in the methodology matrix, a qualitative assessment is undertaken to explain the role of this ecosystem service within the context of the entire Natura 2000 site. In order to quantify the quality of water, detailed hydrological studies are required to assess water quality filtration in Buskett. These are currently unavailable and thus the assessment will focus on the qualitative value. Notwithstanding, where water quantity is considered, an attempt will be made to monetise it given that water is such a scarce and expensive resource.

The SAC is located within the confines of a perched aquifer and the mean seawater aquifer. Based on MRA published data, the perched aquifer (Figure 5.1) which is based on the Rabat-Dingli plateau and part of which falls within the site of the Management Plan, ranges in height from 150m to 250m above mean sea level. It covers an area of 22.6km^2 with a mean aquifer thickness of 18.7m.[7] The main recharge source is precipitation and the aquifer has a mean annual recharge of 4.6hm^3 while demand is registered at 4.62hm^3 rendering an overall balance of 0.02hm^3.

Up to the late 19th century, the springs of the Rabat-Dingli plateau were the major resource of potable water for the whole island. For example, in 1884, water from the aquifer was distributed to around 60% of the population via the Wignacourt Fawwara aqueducts (MRA, 2005). The Rabat-Dingli groundwater has, however, been decommissioned from the municipal water supply and is now mainly used for agricultural irrigation purposes. Indeed, the main pressures on the aquifer emanate from the agricultural area within the vicinity as well as sclerophyllous vegetation (MRA, 2005).

A number of valleys are also sustained from this aquifer including valleys located within the SAC such as Wied tal-Isqof, Wied il-Buskett, Wied il-Luq, Wied x-Xagħri and Wied tal-Girgenti. Two specific

[7] http://mra.org.mt/wp-content/uploads/2012/08/MT002.pdf

watercourses have been identified as being directly dependent on springs flowing from the Rabat-Dingli groundwater body, one of which is Wied il-Luq.

Wied il-Luq is identified as an inland surface water body in accordance with the EU Water Framework Directive. The watercourse sustains distinctive types of flora and fauna, which have a limited distribution since their existence depends on a year round supply of freshwater[8]. Indeed, Wied il-Luq includes a riparian woodland with White Poplar (Luq), Narrow-leaved Ash (Fraxxnu), Hoary Elm and the English Oak (Balluta Ingliża). Furthermore, this area is the only known location in the wild for native female White Poplar trees in the Maltese Islands. In fact, the watercourse is also declared as an Area of Ecological and Scientific Importance via GN 403 of 1996.

The SAC is also located on the Malta Main Mean Sea Level Groundwater Body which covers an area of 217km^2.The mean groundwater thickness of the sea level aquifer is that of 67.5m and the mean annual recharge 34.3hm^3. The Management Plan indicates that a public borehole is located within the area and its use is mainly for agricultural activity. However, this public borehole cannot contribute significantly to agricultural activity given that it is not sustainable. Wied il-Luq only carries water during the wet season where it drains runoff from the highlands at its head and from the land surrounding its course (AIS, 2014). This means that although this watercourse ecosystem is very important, it is limited during the majority of the months since the stream is dry providing no source of water.

The maintenance of the site to ensure the quality of the water in the aquifers is however important. Most of the existing agricultural land in the SAC is irrigated. The source of water for irrigation is extracted directly from groundwater or channelled from the watercourse. According to the Management Plan, this creates conflict between local land users and hydrophilic flora. Moreover, there is little land available for watercourse vegetation as farmland is maximised by extending the cultivated land to the edge of the watercourse. Indeed, Wied il-Luq, has been susceptible to a change in flow due to abstraction for agricultural purposes.[9]

One of the factors that affects the watercourse is soil erosion as the watercourse in the valley bed silts up leading to occlusion of the watercourse. It is on account of this fact that the Life+ project has commissioned a study on the 'Silt/Debris Flow Monitoring at Buskett' in order to monitor the effects of the repair, rebuilding and restoration of retaining walls on soil erosion and the accumulation of silt and debris from the watercourse at Wied il-Luq.

Other sources of water supply include reservoirs which are filled with rainwater and used for irrigation. Within Buskett there are eight reservoirs which vary in size. According to information provided by PARKS, the following are the dimensions of the existing reservoirs:

1. Open Reservoir 4400mm*3280mm*2500 (good condition – retaining water)
2. Open Reservoir 12700mm*18310mm*3000 (good condition – retaining water)
3. Roofed Reservoir 7500mm*7100mm*Depth unknown (good condition – retaining water)

[8] http://mra.org.mt/wp-content/uploads/2012/08/MT002_C1.pdf

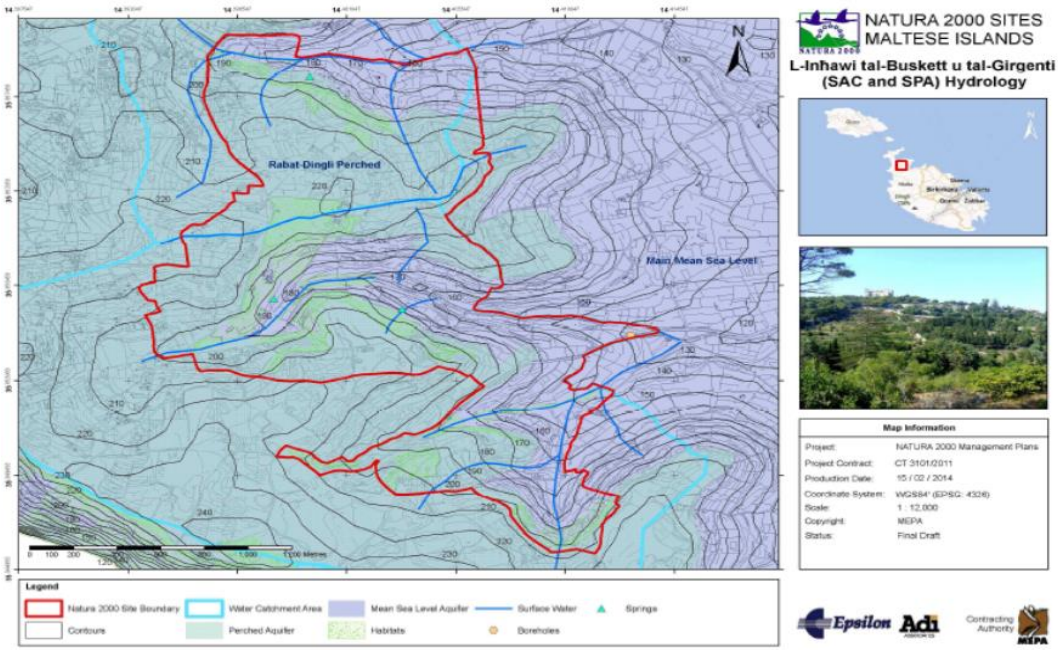
[9] The Water Catchment Management Plan for the Maltese Islands, 2011.

4. Open Reservoir 3800mm*2500mm*2400 mm (good condition – retaining water)
5. Open Reservoir 10550mm*6230mm*2550 (cracked - in need of repair)
6. Roofed Round Reservoir 5600mm diameter (good conditioning – retaining water)
7. Open Reservoir 5660mm*3170mm*1800 (cracked - in need of repair)
8. Open Reservoir 5700mm*3905mm*1670mm (cracked - in need of repair)

It is important to note that with respect to the volume and quality of water, the Management Plan includes a specific objective to ensure that the water requirements of important wetland habitats are satisfied. Another operational objective is to monitor the quantity and quality of water. It is on account of this objective that the Management Plan calls for the elaboration of a baseline hydrological study of the Buskett-Girgenti catchment area. The intention of the study would be to clarify whether water extraction control is needed for surface and groundwater extraction, identify mitigation mechanisms for the agricultural activities that have significant impacts on the riparian habitats and hydrophilous species and facilitate decision making with respect to the allocation and use of reservoirs, cisterns and other alternative sources of water supply in the area.

The availability of this study would furthermore allow for a detailed assessment of the economic value of water at the SAC including the area of Buskett. Due to the lack of detailed information, a high level estimate of the economic value of water is undertaken based on a review of economic literature and the application of a shadow price of groundwater in Malta.

Figure 5. 1: Rabat- Dingli Perched Aquifer



Source: Management Plan Natura 2000

Economic Value of Groundwater

An assessment of this variable is undertaken through an overview of the quantity of rainfall, volume of reservoirs and volume of water abstracted from groundwater following discussions with relevant authorities. In order to derive a monetary estimate of the economic value of groundwater, a shadow price is utilised. This in turn allows for a value of saved groundwater resources due to the lack of abstraction that occurs on account of the volume of reservoirs.

Data published by the NSO indicates that groundwater constitutes a significant source of water provision in the Maltese Islands amounting to 44 million m^3 in 2014 and accounting for over 50% of public consumption. As can be seen from Table 5.2 below, the use of groundwater at a national level is by far highest by the agricultural sector which in 2014 accounted for 62% of the water consumed from groundwater.

Table 5. 2: Water Resources type and exploitation (Year 2014)

Water resources and exploitation	*Volume (thousand m^3)*
Precipitation	159,371
Actual evapotranspiration	69,870
Total freshwater resources	89,501
LTAA total freshwater resources	95,460
Total groundwater abstraction	44,393
Public water supply	13,963
Agriculture (for irrigation)	27,526
Manufacturing industries	1,092
Services	746
Households	1,065

Source: NSO 20115/055

Approaches to Estimating the Value of Groundwater

The economic price of groundwater can be considered by taking into account the environmental cost of groundwater depletion which can be considered as the cost that would result with the degradation or depletion of ecosystems and biodiversity. Surface water systems receive a continuous discharge of inflowing groundwater and the level of its quality will ultimately be reflected in the quality of surface waters. Therefore, the quality of the groundwater will affect directly the quality of the associated ecosystems particularly if reactions like biodegradation are not sufficient to contain the contaminants (European Commission, 2011).

One possible approach to derive a value of the loss of the groundwater resource is to estimate the damage inflicted on the environment in the case that the use of the groundwater resource is constrained either through depletion (or regulatory interventions to prevent such depletion), thus resulting in a higher financial and economic costs of providing water through desalination plants.

Another approach is to determine the intrinsic value which is the value which would manifest itself in the loss of springs and as a result, the loss of rare biodiversity inhabiting these springs. The most widely used approach to measuring the economic value of environmental services is the Contingent Valuation Method (CVM). This method relies on direct consultation with beneficiaries regarding their preferences for paying and allows a sample of people to tell researchers, through surveys, what they are willing to pay for some improvement in environmental quality. (Saleh et al., 2010). This method is able to capture both use value (e.g. irrigation water use) and non-use values (e.g. protection of species biodiversity). It also asks respondents what compensation they are willing to accept (WTA) to give up specific environmental services (Martinez and Prantilla, 2007).

Press and Soderqvist (1998) offer an estimate of willingness to pay for groundwater protection in an aquifer underlying the city of Milan. Based on different calculation methods, the mean annual willingness to pay was estimated at between €215 and €231 per household. At the time, this represented 1.2% of household income or 166% of the annual expenditure on bottled drinking water. Strenger and Willinger (1998) present a contingent valuation exercise of the willingness to pay for the preservation of the Alsationa aquifer which is located in the Northeast of France. Their estimate is set at €94 per household. It is to be noted that in both cases the willingness to pay reflects the value of money at that particular point in time and the application of the price today would require an estimate of the inflationary effects.

The approach adopted in valuing groundwater in this report is estimated on the basis of the additional financial costs involved in replacing groundwater with other sources of water production. Costs incurred in mitigating the effects of reduced environmental quality represents a minimum value for the environmental function. It is, however, to be noted that this produces only a lower bound for the possible range of estimates that may be considered to value the groundwater resource in Malta. Notwithstanding, this constitutes an important and least controversial, component of total economic value. The underlying assumption is that the costs of replacement equal the benefits that society derives from the asset.

The marginal cost of abstraction from groundwater for the purposes of potable water production in Malta is, estimated on average at €0.21/m^3, which reflects the costs of the pumping technology used as well as an element of water polishing which is undertaken. Taking into account a sustainable restriction on groundwater use in m^3 per annum would result in a marginal financial cost of about €0.66/ m^3 of water produced. It is to be further commented that this financial cost can be in part extended to reflect an economic cost by taking into account the costs of emissions of carbon associated with reverse osmosis water production. This increases the costs further to €0.736/ m^3.

The application of this shadow price to the three sources of water in the SAC renders the economic value of water. The estimate of the Rabat-Dingli Perched Aquifer is based on the outflow of water which as explained above is mainly used for irrigation purposes. Towards this end, it is assumed that the entire outflow is considered for the purpose of deriving the economic value on account of the fact that a significant amount of activity within the SAC depends on the aquifer and the sustainability of the aquifer. As a result, the economic value, based on the abovementioned shadow price is estimated at €3.2 million as shown in Table 5.3.

Given that the Main Sea level groundwater also lies underneath the SAC, an economic value based on the proportion of the aquifer which lies within the SAC is also determined. In this case, the total size of the aquifer is 217km^2 but the SAC consists of an area of about 2km^2. As a result, it is assumed that only this proportion is relevant for the estimate of the economic value rendering an estimate of €0.3 million per year.

The third element is based on the number of reservoirs which are located within Buskett as explained above. In this case, only reservoirs which are in a good condition are taken into account. The volume of the rainwater harvested in the reservoirs is based on an assumed rate of five times the effective capacity rate. This volume is in turn considered in light of the saved groundwater costs which would accrue for irrigation in the absence of the reservoirs, rendering an economic value of approximately €3,300 per annum. It is to be noted in this regard only the reservoirs which are located in Buskett have been taken into consideration.

Table 5. 3: Economic Value of Water

Economic Value of Groundwater abstraction	**Inflow (hm3)**	**Outflow (hm3)**	**Shadow Price (€/m3)**	**Value (€)**
Rabat-Dingli Perched Aquifer	4.64	4.320	0.736	3,179,520
Malta Main Sea Level Groundwater		0.386		283,859
Open reservoirs in good condition[10]		0.005		3,372

Source: Author's Estimates

Another notable importance of water within the confines of the site is that the watercourse plays an important role in directly conserving the site's habitats and species of importance. Indeed, the

[10] This considers specifically the open reservoirs within the Buskett area.

Management Plan includes an objective to ensure that the water requirements of important wetland habitats are satisfied. Of particular importance is the freshwater snail, *Pseudamnicola melitensis*, which is limited to a few valleys with abundant freshwater and which is listed as endemic, endangered and with a restricted distribution in the Maltese Islands. Other fauna identified at Wied il-Luq is the *Argiope bruennichi* which is a large spider associated with watercourses which is rare and has only been recorded at Wied il-Luq. The caddis fly *Tinodes maclachnim* is only known from Buskett and is dependent on a source of freshwater in which to pass its larval stages. This is listed as very rare in the Red Databook of the Maltese Islands. There is also the damselfly, *Ischnura genei*, which is also restricted to wares with freshwater and is listed as vulnerable with a restricted distribution in the Mediterranean region. The provision of water is also important as it serves as an important source of water for birds during the summer months.

Pressures exerted on the watercourse

Maintaining this economic value water and the regulating functions of water within the site requires an identification and mitigation of pressures exerted on the ecology of the site. The Management Plan notes that one of the pressures exerted on the watercourse is soil erosion which is considered an important factor that affects the watercourse in the valley bed. This is due to the fact that without effective retaining walls to keep the soil in its place, the watercourse in the valley bed silts up leading to occlusion of the watercourse where important habitats are found. Without effective retaining walls to keep the soil in its place, the watercourse in the valley bed would silt up leading to occlusion of the watercourse where the Annex I priority habitat *Arborescent matorral with *Laurus nobilis* and Annex I habitat *Populus alba* and *Salix alba* galleries occur.

It is due to these factors that the Management Plan identifies various objectives which are targeted at the watercourse including the restoration of the watercourse and its riparian zone supporting various important habitats as well as the monitoring of the quantity and quality of water. The Management plan also calls for the removal of silt and boulders from the watercourse.

Alien species of trees particularly eucalypts are being planted throughout the SAC. The problem is particularly severe at Wied l-Isqof where Eucalyptus trees are being planted along the watercourse, in some cases instead of *Populus alba*. The population at Buskett remains one of the most important communities of this habitat in Malta due to the presence of the oldest population of *Fraxinus angustifolia* in Malta.

5.2 Cultural and Recreational Ecosystem Services

Natura 2000 sites are great destinations for nature tourism and provide numerous recreational and educational opportunities for local communities. This section subsumes regulation of human health ecosystem services. Recreation, amenity values and landscape create serenity, tranquillity and helps individuals to disconnect from the daily stressful routine. The presence of trees has been linked to reduce stress and enhance mental health. It also allows opportunity for exercise and increased physical mobility. As such services under cultural and recreational ecosystem services contribute to the regulation of both physical and human health. This section of the report therefore focuses intently on the cultural and social services offered by Buskett distinguishing between the heritage and cultural value of Buskett, the inspirational services in particular through the provision of educational services as well as the recreational value of the area. The analysis presented in this section seeks to highlight the value of Buskett mainly from a qualitative perspective. The qualitative analysis focuses on the following elements:

- Distinguishing landscape and amenity values that are an important source of recreation for visitors;
- The extent to which Buskett provides important learning opportunities;
- Protection of cultural heritage noting in particular the summer residence of the President of Malta located within the site;
- Inspirational activities offered by Buskett.

5.2.1 Recreation, Landscape and Amenity Values

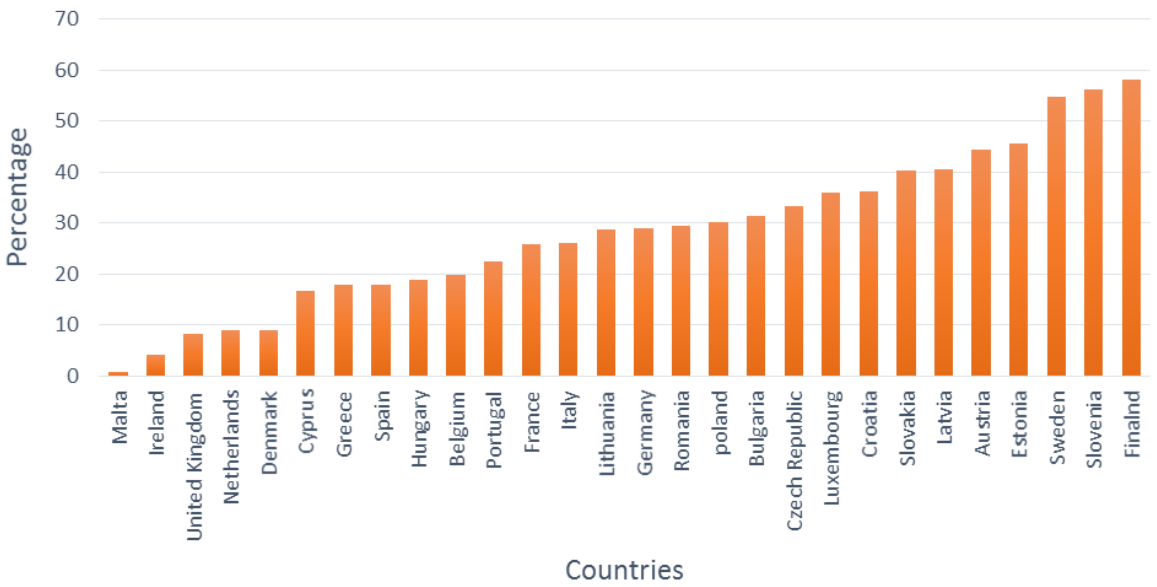
Malta is a small country by size with a high population density. Indeed, with a population density ratio of 1,336 per km^2, Malta is considered as one of the most densely populated countries with limited space available for recreational purposes[11]. Locations for outdoor activities and relaxation amongst nature are highly limited. It has been estimated that as at 2001, the total area available for recreational purposes comprised of 499,524 m^2 of public gardens, 133,068m^2 of playing fields and a mere 161,261m^2 of open spaces (MEPA, 2001)[12]. To this end Buskett provides a unique recreational and aesthetic experience.

According to the European Commission (2014), only 0.7% of land cover in Malta consists of a forest area, of which 47 ha represent the Buskett area, the second largest woodland after 'Il-Miżieb'. The scarcity of forest land in Malta is conspicuous, clearly attributable to the size of the Island and to the unsustainable development over the years. As depicted in the figure below, at 0.7% of land cover, the proportion of forest area is by far the lowest in Malta followed by Ireland. This alone highlights the uniqueness and hence importance of Buskett.

[11] http://data.worldbank.org/indicator/EN.POP.DNST?order=wbapi_data_value_2014+wbapi_data_value+wbapi_data_value-last&sort=asc

[12] Leisure and Recreation Topic Paper, MEPA, 2001

Figure 5. 2: Forest Area

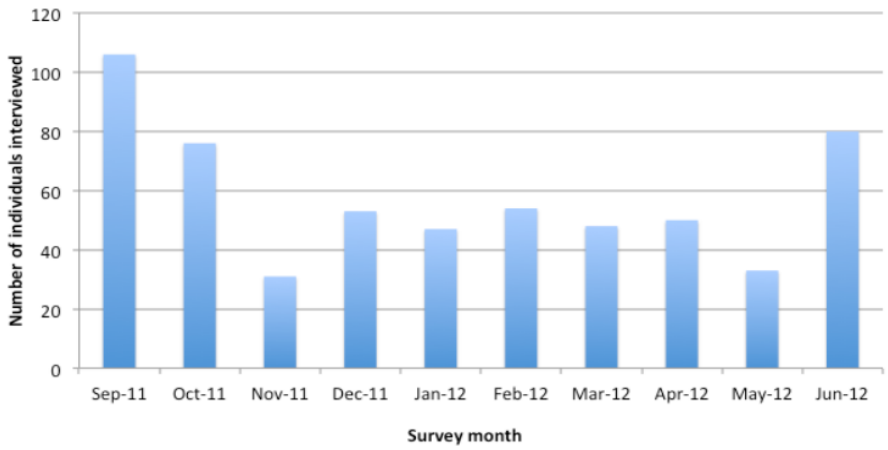


Source: European Commission, CAP context indicators, 2014-2020

Buskett is popular amongst citizens for picnics, long walks and relaxation. The Management Plan indicates that the Natura 2000 site serves as an important recreational area within the Maltese mainland and that its significance is amplified when considering the increased urbanization as well as the lack of green spaces of similar size to Buskett elsewhere in the Maltese Islands. Indeed, the function of Buskett as a key recreational area is established in the Northwest Local Plan, which designates the site as a Major Recreation Area. Within Buskett, there is a mobile kiosk and the Buskett Roadhouse complex which includes a restaurant, a wine bar and an entertainment facility.

The Buskett visitor assessment undertaken in 2012, reaffirms that the main activities undertaken in Buskett are related to recreation. Most visitors go to Buskett to relax, take long walks, engage in a picnic and spend quality time with friends or family members. The study shows that around 77% of total visitors visit Buskett for relaxation, 72% for long walks and 35% for picnics. 97% of these visitors were travelling with either family, friends or both. This study was carried out over a period of 10 months, from September 2011 to June 2012, between 08.00 and 17.00hrs, covering the most important months during which visitors seek Buskett as a source of recreation. During summer, the number of visitors is assumed to decline as the weather warms up and individuals seek alternative recreational sources such as beaches.

Figure 5. 3: Distribution of responses across the survey period



Source: Buskett visitor assessment study, 2012

The survey captured 578 respondents travelling either individually or in a group varying from a group size of 2 to over 10 individuals whereby the groups consisted of family, friend, clubs/organisations, school groups and business. A conservative estimate based on the data provided through this survey, indicates that around 1,600 individuals visit Buskett for the purpose of relaxing, observing nature, relaxing, picnicking, photography, sightseeing, scientific research, cycling, jogging and other adventurous activities. This value is however to be interpreted with caution as it does not necessarily capture the total amount of visitors visiting Buskett for recreational and other purposes. Indeed, the survey does not capture the number of visitors during specific cultural events such as 'Imnarja' which in 2015 attracted about 52,000 visitors.

A topic paper issued by the MEPA in 2001 estimates that Buskett given a radius of 5km has a population catchment area of 34,000 individuals. However, the Household Travel Survey revealed that Buskett attracts people beyond the assumed 5km radius catchment. This pin points the popularity of the site as a recreational area. It is also important to note that this was published more than 10 years ago and since then the importance of Buskett has escalated particularly through the promotion of various activities such as tours and bird watching.

Indeed, specific recreational activities also happen within Buskett given the uniqueness of the site. Nature Trust, a non-profit non-governmental environmental organization and a partner of World Wildlife Fund (WWF), organises pre-booked tours, usually consisting of half-day tours that can either be scheduled or on request, both for the general public and tourists. However, these tours are not organised frequently and no specific data is available on the number of participants[13].

Buskett is also a habitat which houses rich and diverse flora and fauna. It attracts local visitors and tourists interested in spending time in observing this relatively rare environment in the Maltese Islands. The site is also important for migratory birds, most notably birds of prey that can be observed roosting in large numbers during the migratory season. Months between August and October are considered

[13] Interview with Ms. Annalise Falzon, tour leader.

to be the best time to visit Buskett for the Autumn Raptor Migration. Buskett is an ideal site for bird watching as it is the largest wooded area and because of its high altitude (Birding in Malta, 2009). Buskett is in fact a protected bird sanctuary and is considered as the most important location for bird migration. Indeed, most migratory birds passing over Malta are likely to pass over Buskett and further to discussions with Birdlife, it appears that from 3pm onwards migrating birds are likely to descent in Buskett, due to the fact that it is the densest woodland offering a haven for these birds. Furthermore, on account of this fact, a number of bird watchers are attracted to Buskett to observe these birds. Birdlife also organises bird watching tours, usually on request. These include tours on endemic species and birdwatching especially in August and April. Birdlife is also engaged in Falco, a programme for students and young people which focuses on bird watching and often happens at Buskett. Table 5.4 outlines the main bird species which can be observed at Buskett.

Table 5. 4: Bird Watching at Buskett

Resident and Breeding Birds	Cetti's Warbler, Zitting Cisticola, Sardinian Warbler, Blue Rock Thrush, Spotted Flycatcher, Chaffinch, Tree Sparrow, Spanish Sparrow.
Summer Highlights	Eleonora's Falcon(Scarce), Turtle Dove, Woodchat Shrike, Spotted Flycatcher, Common Crossbill(Rare)
Winter Highlights	Woodcock, Song Thrush, Blackbird, Redwing (Scarce), Fieldfare(Scarce), Ring Ouzel(Rare), Goldcrest, Firecrest
Autumn Highlights	Night Heron, Grey Heron, Purple Heron, White Stork(Rare but seen yearly), Black Stork(Rare but seen yearly), Lesser Spotted Eagle(Rare but seen yearly), Short-toed Eagle(Rare but seen yearly), Black Kite, Marsh Harrier, Montagu's Harrier, Pallid Harrier(Scarce), Honey Buzzard, Common Buzzard(Scarce), Sparrowhawk, Kestrel, Lesser Kestrel, Hobby, Eleonora's Falcon, Merlin (Scarce), Nightjar, Scops Owl, Turtle Dove, Hoopoe, Bee-Eater, Roller(Rare), Red-rumped Swallow(Scarce), Tawny Pipit, Yellow-browed Warbler(Rare), Red-breasted Flycatcher(Rare)
Spring Highlights	Night Heron, Grey Heron, Purple Heron, Turtle Dove, Cuckoo, Nightjar, Hoopoe, Bee-eater, Roller(Rare), Wryneck, Subalpine Warbler, Icterine Warbler, Pied Flycatcher, Collared Flycatcher, Woodchat Shrike, Red-backed Shrike(Rare), Golden Oriole

Source: http://www.birdinginmalta.com/buskett.htm

In terms of sightseeing, the Visitor Survey (2012) estimated that around 25% of visitors go purposely for sightseeing. Thus there is scope for increasing the number of tours which are offered within Buskett with the following list identified as potential areas as highlighted during discussions held with stakeholders. These tours would contribute further towards highlighting the importance and uniqueness of Buskett. Proposed tours include:

1. Volunteering Tourism for conservation purposes;
2. Courses on Mammals involving a night walk; and
3. Astronomy related tours.

Although this assessment emphasises the importance of Buskett for recreational and amenity values purposes one has to closely monitor these activities to ensure that the natural environment is not disturbed. From a public attitude survey, it resulted that 1 in every 5 visitors interviewed mentioned the fact that Buskett should be protected from development. Outdoor sports and leisure activities, recreational activities and trampling, are recorded as threats by the Management Plan. It is important that Buskett is given the importance it deserves and allows locals as well as tourists to enjoy the site.

The Management Plan also outlines the potential of the area for attracting agri and eco-tourism. It is interesting to note that according to an operator travel agent survey the majority of their clients are attracted to Buskett/Dingli countryside. The Management Plan notes that rural tourism should be supported through small scale infrastructure to avoid excess development and make sure that ***'rural tourism and outdoor recreation are practiced in harmony with the site's conservation needs'*** to ensure that its authenticity is preserved and safeguarded. This can be achieved through close monitoring and investment in public awareness.

Estimation of Economic Value

For estimation purposes, recreation, landscape and amenity values of Buskett are analysed as a single ecosystem benefit. So far we have assessed this ecosystem service from a qualitative perspective based in part on the visitors' survey and discussions held with local experts.

There are various methods of quantifying the values of this service. As discussed in detail in section 3, one way of measuring this ecosystem service is the contingent valuation method (CVM) which can be used to estimate the income that people are prepared to forego to visit the woodlands. This is a non-market valuation of natural resources through a willingness-to-pay (WTP) survey which identifies how much visitors are willing to pay in order to continue enjoying trips to the woodlands. This method measures visitor's utility providing an indication of the economic welfare.

While this value cannot be ascertained for Malta on account of the lack of detailed information on the total number of visitors, studies which have derived a willingness to pay value for similar woodlands is worth a mention. A WTP survey carried out for a native woodland in Ireland (2014) estimates people's WTP for forest visits which varies between €4 and €10 per trip depending on the frequency of trips and the nature of the visit. Other studies have derived similar results with a Natura 2000 socio-economic

impact assessment for the Azores archipelago, Portugal (2009) estimating a mean WTP of €5.15 in the form of tax or a free donation of €10.41, concluding that people are more generous if they are free to decide their own amount of contribution rather than imposing a fee. The estimates found by WTP surveys in both studies are similar even though the Portuguese woodland is much more extensive, representing around 23% of land cover. Unfortunately, data on the number of visitors derived from the survey is likely to be underestimated and furthermore does not capture the frequency of visits. As a result, the transferable value cannot be applied to the number of visitors to determine the economic value. Any attempt to do so would result in an underestimation of the economic value of Buskett for recreational purposes. Furthermore, it is also to be noted that given the uniqueness of the site, even non-visitors are likely to place a value on the amenity value of Buskett.[14]

Another interesting aspect which can be applied to estimate the recreational value of Buskett would be based on the value of non-working time which is a time spent by individuals to relax and spend time with family and friends. If the total number of visitor's visiting Buskett is known as is the time spent, one may apply a shadow price of €5.44 per hour. This value is published in the Guidance Manual for Cost Benefit Analysis (CBA) Appraisal in Malta considered to reflect market price of non-working time and is based on gross employee earnings.

[14] A study is currently being conducted at the University of Malta as part of a doctoral dissertation on the individuals' connection to nature and participants in the study are being asked specifically about Buskett. The available of this information may allow for more plausible estimates of the use and non-use value of Buskett.

5.2.2 Cultural and Heritage values

5.2.2.1 Historical services

Ancient woodlands like Buskett often contain historical landscape value and other archaeological features as evidence of past agriculture and settlement. Buskett prides itself with historical landscape and buildings which add value to this semi-engineered woodland. Figure 5.4 below refers to the scheduled architecture and heritage sites located within the SAC. It is also interesting to note that further to discussions with an expert on the historical value of Buskett, there is the likelihood that other heritage assets have, as yet not been discovered.

Figure 5. 4: L-Inħawi tal-Buskett u tal-Girgenti Cultural Heritage Map

Source: L-Inħawi tal-Buskett u tal-Girgenti management plan

According to the operations manager of MSDEC-PARK, the historical importance of Buskett is evident from records which show that the origins of Buskett date back to the Knights of St. John when Grandmaster de Vallette (1557-1568) commissioned a small hunting lodge and some structures used as stables in Wied il-Luq. Over the years, as it passed from one Grandmaster to another, it continued to be developed with other important buildings being added to the site amongst which there is the imposing Verdala Palace which today falls under the President of the Republic of Malta and which is in fact the President's summer residence. Other interventions in this area entailed also the construction of game enclosures, complex irrigation works, fountains, fish tanks, engineered watercourse and water pools. As a matter of fact, Grand Master Alof de Wignacourt (1601-22) is recorded to have commissioned the construction of the aqueducts from which natural spring water situated in Rabat

and Dingli, where Buskett is located, was directed towards Valletta via arched aqueducts. These aqueducts were not constructed until the early 17th and represent one of the first major and more complex water systems[15] built during the Knights period which makes the aqueducts even more of historical importance. These were constructed with the purpose of bringing water down to Valletta given that it was constructed on an arid, rocky peninsula with just one natural spring causing a water shortage with an ever-increasing population that required a constant supply of water[16]. Furthermore, Buskett also includes a number of historical farmhouses as shown in Table 5.5 below which refers to a total of 6 farmhouses of which 4 have been restored.

Table 5. 5: The reinstated farmhouses

Name	Grand Master	Date
Ir-Razzett tal-Bosk	Lascaris	(1636-1657)
Ir-Razzett tal-Ispirtu	Lascaris	(1636-1657)
Ir-Razzett tal-Bagħal	Lascaris	(1636-1657)
Ir-Razzett tal-Għorof	Unkown	Unknown

Source: LIFE Saving Buskett presentation, 2015

The restoration of the first three farmhouses which was undertaken by 2013 (table 5.1) amounted to €611,240 funded in part through EAFRD funds while the restoration of the last farmhouse entailed an expenditure of €243,700 funded through the Italia-Malta cross-border Programme. The cost incurred for restoration gives an indication of the value attached to these historical assets representing the effort being made to conserve these structures. It is however to be stressed that this does not capture the overall historical importance of these farmhouses.

Estimating the total economic value for heritage poses a challenge. Any attempt to provide an economic estimate for historical assets present in Buskett is likely to be underestimated. The assets are not privately owned and are considered as public goods. Visits to these historical sites are not subject to payment thus making an estimation even the more so difficult.

Theoretically, there are methodologies that can be applied to derive an estimate such as cost-based methods like the replacement cost approach and the WTP to determine the economic value of heritage. The replacement cost method can be used to estimate the cost incurred for maintenance such as the cost of restoration as an attempt to derive the original value which to an extent has been referred to above. Yet, this only represents the value that government is willing to pay to maintain the asset. Another approach is asking visitors and non-visitors how much they are willing to pay to conserve such assets which in its own right can also be considered subjective as it reflects personal valuation which at time may be formulated without any prior knowledge on the site itself. It is however interesting to note that in a study by Y. Sanz et al. (2003) both visitors and Spanish residents are ready to pay a conservative value of €27 for the conservation of the national museum of Sculpture in Valladolid, Spain. Studies for other locations such as the conservation of Fez in Morocco estimated that

[15] Interview: Operational manager at MSDEC-PARKS, Mr. Emanuel Portelli.

[16] Din L-art Helwa: http://dinlarthelwa.org/uncategorized/dlh-news/our-heritage-saved-wignacourt-fountain-in-valletta-by-victor-j-rizzo/

visitors and non-visitors are willing to pay a mean value of approximately €50 for preservation of the archaeological sites (E. Beltran & M. Rojas, 1996). These estimates are close to the entrance fees of many prestigious historical sites reflecting the WTP of visitors. While these studies provide interesting results, the value derived from them will not be applied to the cultural assets located in Buskett given that the number of visitors is not known.

5.2.2.2 Cultural services

Buskett's cultural service is primarily associated with 'L-Imnarja', a national feast, which takes place on the 28th and 29th of June of every year. The link between culture and nature is highly evident during the celebration of the feast which commemorates two important saints in Maltese religious lore, St. Peter and St. Paul and dates back to before the Knights of Malta. This feast offers visitors to Buskett with a unique experience of various Maltese customs and traditions. Initially, the feast, used to be celebrated in the core town or village but then it moved to Buskett Gardens. The feast starts with a liturgical celebration and it involves a number of horse and donkey races, exhibition of animals and fruit and vegetables and Maltese food. This is one of the major events in Malta which is celebrated within Buskett, attracting over 52,000 in 2015.

The organisation of the Imnarja event falls under the remit of the MSDEC specifically the rural festive unit. The organisation of the event involves a number of stakeholders mostly co-operatives, the council for Maltese culture, Nature Trust and vendors selling Maltese traditional food which approximately add up to around 15 stalls. In total about 43 workers are involved for the 2-day festive celebration[17]. An overview of the expenditure associated with the setting up of the event as a proxy of its economic importance is presented hereunder.

The organisers of the event have indicated that the cost of organising the setting up of the event are approximated at about €40,000 while the revenue from organising the event established through the permits for the stalls, sales and sponsors amounts to about €45,000. This value does not take into consideration the value of sales made by the stalls which sell various local Maltese delicacies during the event but it does give an indication of the costs which organisers and stakeholders are willing to pay in order to maintain a tradition within Buskett which has been going on for over 500 years.

The Toolkit for assessing the socio-economic benefits of a Natura 2000 site refers to a study by Ruijgrok (2006) undertaken in the Netherlands to determine the recreation and bequest values related to cultural heritage in the Tieler and Culmborgerward area. The study through the application of a methodology which focuses on stated preference and willingness to pay, highlighted the value that households are willing to pay for recreation and as a bequest on an annual basis. While the two sites are not strictly comparable it is interesting to note that transferring the value of €11.88 per year per household in the study to the total number of households in Malta results in an annual value of about €1.3 million. The rate applied to Malta has been adjusted to take into account the different purchasing

[17] Interview with Mr. Mario Camilleri the events administrator and organiser from MSDEC

power parities between the two countries.[18] Furthermore an inflationary effect has also been applied to determine the rate in current prices.[19]

5.2.3 Inspirational services (Educational, Scientific and Existence Value)

An additional important service offered by Buskett is the provision of inspirational services most notably an educational experience. The site plays a great educational role for students to learn about Malta's nature and biodiversity and also the importance of Malta's ecosystem.

Eko-Skola[20] which is part of Nature Trust, a representative of the Foundation for Environmental Education (FEE) since 2002 is an important driver towards creating awareness and education on nature. It targets in particular school children so as to instil a sense of responsibility towards nature from a young age. One of the objectives of the Programme is to enhance ***'environmental awareness'.***

Other environmental education programmes include the Learning about forests (LEAF)[21] and the Young reporters for the environment (YRE)[22] programmes. These programmes are considered as main 'vectors' of Education for Sustainable Development. All three programmes are created to complement each other and ***'empower students to adopt an active role in environmental decision-making and action in their school community'***.

LEAF tries to transmit knowledge on the role forests play in sustaining life and understand what and how to reduce activities compromising this life. The scope of this programme is to make youngsters aware of the beauty of the forest and its inhabitants and at the same time use this opportunity to instil the appreciation and sensibility towards woodlands and forests and thus be able to make responsible decisions so as not to compromise this life by wrongful daily choices. This is done through various activities that are organised from drawing competitions to planting of trees. On the other hand, YRE is a programme designed specifically for secondary and post-secondary students with the aim of carrying out investigations on ***'local environmental issues and propose solutions through investigative reporting and photojournalism'***. ***The goal of YRE is to engage youth in resolving environmental problems and issues***'. All these programmes are run locally by Nature Trust Malta as FEE representatives and were at some point all integrated with the LIFE Saving Buskett Project. Some students, as part of their LEAF and YRE projects, actually went on site to report about the progress of the project.

There are approximately 31 schools which have participated in LEAF and YRE whereby students have been informed about the project and material on Buskett has been distributed to schools. About 500 to 600 students visit Buskett on an annual basis. A breakdown of these students is shown in the figure

---

[18] GDP per capita in PPS in the Netherlands in 2014 amounted to 130% of the EU average the rate in Malta amounted to 85%.

[19] An inflationary rate of 2% per annum.

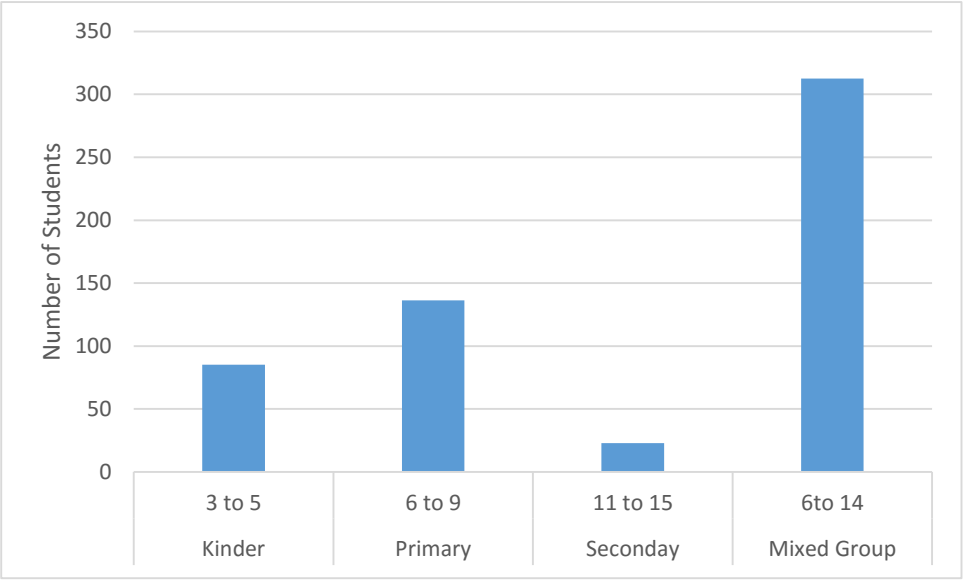
[20] http://www.ekoskola.org.mt/

[21] http://www.leafmalta.org/

[22] http://www.yremalta.org/

below. There is approximately one school visit per month with a maximum of about 25 students in each group.

Figure 5. 5: Number of Students visiting Buskett (2014)



Source: Interview with LEAF (Learning About Forests) National Coordinator

In addition, other educational activities which are not registered under the abovementioned programmes include visits by schools including post-secondary and university students for onsite learning such as biology and geography projects. Data on the number of these students is not formally captured. It is however important to note that the Buskett visitor assessment study undertaken in 2012 highlights the educational potential of Buskett as the survey indicates that 0.4% of visitors were visiting Buskett for scientific research.

As already highlighted in the section on recreation, Buskett is a protected bird sanctuary which attracts a variety of bird species during the autumn migratory period. Discussions have been held with Birdlife which have stressed the importance of the site in terms of the research and training which is undertaken on site within Buskett. Training provided by Birdlife is mostly related to bird ringing and bird watching. Bird ringing is an activity carried out to be able to study the pattern and paths of migration. Training on bird ringing is carried out within Buskett on account of the importance of the site for birds. Informal training on bird watching is also usually carried out on site as amateurs are usually accompanied by professionals who can usually identify different bird species from a far distance.

Such training can only be provided at Buskett given the number of birds passing through Buskett during the migratory period. Between August and October daily observations are made by local birdwatchers who monitor the Autumn Raptor Migration as Buskett is the largest wooded area and because of its high altitude, it is also considered the best place in Malta to watch birds of prey. Spring time is also good because the berries and fruit in Buskett's trees attract a lot of fruit-eating birds, such as Golden

Oriole and Subalpine Warbler. It is interesting to note that Birdlife collect relevant data which is stored in an international database on birds and their migratory patterns. This data is in turn used for various scientific and environmental studies.

It is also important to highlight that the importance and uniqueness of Buskett for birds has been recognised by Government as a rehabilitation and education centre located within Buskett has been provided to Birdlife. The fact that Buskett is a protected area where no hunting is allowed creates an ideal location for the setup of an observation system.

Birdlife also provides educational programmes and awareness campaigns including 'Dinja waħda' which is an environmental awareness campaign currently targeting primary schools but is expected to expand further and cater for secondary schools. Other educational activities include World Bird Watch day organised by Birdlife at Buskett.

From an artistic inspirational perspective, the serene atmosphere awarded by Buskett also serves as an inspiration for art. Sculptor Charles Sammut draws inspiration from Buskett and uses a number of elements such as untreated sandstone, sun dried seed, flowers, roots and wood in his creative arts. Some of his works are displayed in Buskett and at the Presidential Palace.[23]

5.3 Regulating Ecosystem Services

Nature is designed to control the environment in a way to safeguard itself. These are known as regulating services. The environment is able to self balance. This is a very useful trait for the protection of the Natura 2000 site. The environment is able to regulate floods, soil erosion, maintain biodiversity, regulate storm damage and absorb GHG amongst others. This section attempts to estimate an economic value for the regulating services identified for the Buskett and Girgenti area as a measure of the usefulness and benefits stemming from the presence of these services. As in the previous section, the aim is to try and provide a qualitative, quantitative and monetary assessment. However, these services are perhaps the most difficult to assess from a quantitative and monetary aspect. This is the result of unavailable information useful for a quantitative and monetary valuation. Thus this assessment of services within this category is mostly qualitative and it tries to address the following:

- To what extent is the regulating service available in this Natura 2000 site? Is the site a significant producer of this service?
- What is its function?
- To what extent does it contribute to the ecosystem? How does it help to safeguard its environment and its biodiversity?
- Is the effect of the regulation service local or nationally?

These represent some of the questions that the following assessment tries to answer and analyse for each and every regulating service indicated in section 2 and 4.

23 Times of Malta, An artist's 'up and down' world, February 3, 2005.

5.3.1 Climate change

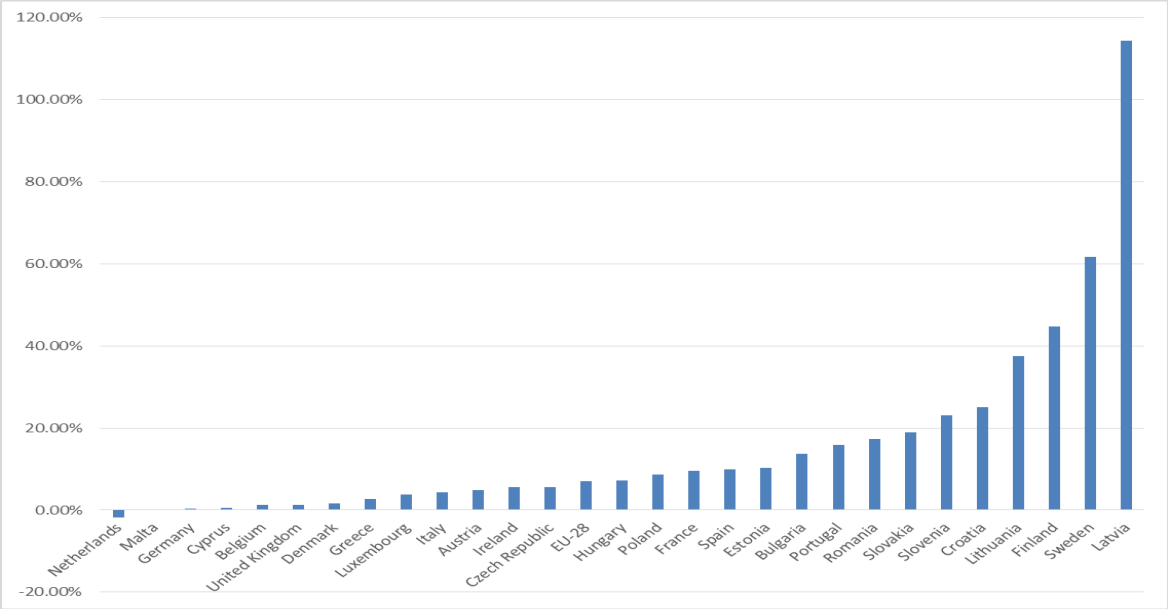
One of the major environmental challenges faced by the world is the issue of global warming. Today the world is facing consequences of years and years of uncontrolled greenhouse gas emissions (GHG). Climate change has become a major environmental issue which has negative economic, social and environmental implications. The natural remedy to GHG emissions is nature itself.

Forests and woodland are a significant resource in terms of the mitigation of climate change. The woodland in Buskett contributes to carbon sequestration. Given that Buskett is the second largest woodland with the highest density of trees highlights the importance of the site. As for adaptation, safeguarding the habitat reduces soil erosion and contributes to reducing flood risk as well as providing to diffuse pollution control. Buskett woodlands are small in comparison to large forests located within Europe, but Buskett is unique within the national context.

Trees remove carbon dioxide from the atmosphere through the natural process of photosynthesis and store the carbon in their leaves, branches, stems, bark and roots (Primefacts, 2010). The rate of carbon sequestration depends on the growth characteristics of the tree species, the conditions for growth which depend on where the tree is planted, and the density of the woodlands. It is greatest in the younger stages of tree growth, between 20 to 50 years. Trees in forests typically sequester carbon at a maximum rate between the age of 10 and 30 years. At the age of 30 years, trees typically sequester around 200 to 520 tonnes of CO_2 equivalent per ha (Primefacts, 2010). After this age, if the trees are not harvested, the sequestration rate slows down gradually until maturity at about 80 to 100+ years of age, and flattens out from then onwards as growth is balanced by decay.

For the purpose of analysis, the boundary to be considered for this variable is the area of Buskett woodland and not the entire SAC area. The rest of the SAC which includes the Girgenti area is mainly composed of bushes and shrubs, field edges, scrubland and marshes which do not contribute that much to the absorption of GHG emissions. Indeed, the focus is on the ability of the woodland to contribute positively to climate change pressures. Unfortunately, the main challenge in this regard is related to the lack of available data on the total, age and types of trees located within Buskett. The level of carbon sequestration varies with the type of tree species and the age as the biomass of large trees contains a relatively large amount of carbon. In contrast, young trees grow much faster, sequestering carbon at a much faster rate. Such analysis is limited as data on the type and size of trees at Buskett is not available. As a result, an estimate of carbon sequestration is considered based on the percentage of land cover by trees. As a proxy to determine a rough estimate of the contribution of Buskett to the mitigation of climate change, the use of Land use, land use change and forestry (LULUCF) data is used in CO_2 equivalent terms together with the shadow price of CO_2 based on the traded price of carbon on the European Emissions Trading Scheme (EU-ETS).

Figure 5. 6: LULUCF as a percentage of GHG emissions in CO2 equivalent



Source: UNFCC

The LULUCF represents the sequestration of CO_2 or the removals of greenhouse gases resulting from direct human-induced land use, land-use change and forestry activities. Malta's LULUCF has been increasing over the years. In 2012, it had increased by 38.6% when compared to 1990. In 2012 the LULUCF was of -7.22 Gg CO_2 equivalent. As is evident in the Figure above, at 0.23% of the total GHG emissions in CO_2 equivalent terms, Malta registers one of the lowest rates reflecting in part the small size of available woodland. This also highlights the importance of Buskett and the conservation and preservation of the woodland given that it is an important contributor towards this achievement. Indeed, the Buskett woodlands cover an area of 47ha equivalent to 30% of the total forest area in Malta. This implies that Buskett woodlands absorbs about -0.15362 Gg CO_2/ha.

An estimate of the benefits of this carbon sequestration can be undertaken through the application of a shadow price of CO_2 emissions at a price of €25/tonne CO_2e. [24]. The economic value of the carbon sequestration occurring on account of the Buskett woodlands amounts to about €3,917.

It is important to note that the Natura 2000 Management Plan stresses the importance of maintenance, seed collection and planting of saplings of characteristic trees within the SAC. The maintenance of trees allows for further absorption of CO_2. Furthermore, the plantation of saplings will result in an increase in LULUCF as the rate of sequestration of CO_2 by young trees is higher than older trees.

[24] The Handbook of Shadow Prices (Delft, 2010)

5.3.2 Air quality regulation

Air quality generally refers to the quantitative presence of particulates, biological molecules, or other harmful materials into Earth's atmosphere damaging the air we breathe and consequently threatening potential life and living organisms, as well as damaging the environment and the food chain through the creation of various diseases. The damage by air pollutants is evident and scientifically proven, to the extent that if not controlled and left to increase beyond what is deemed acceptable it will destroy any living organism including human life through the cause of various diseases which will destroy any form of life.

Lack of air quality causes a serious of consequences which can be fatal to life if not kept under control. The substances termed as pollutants include the following (MEPA, 2015):

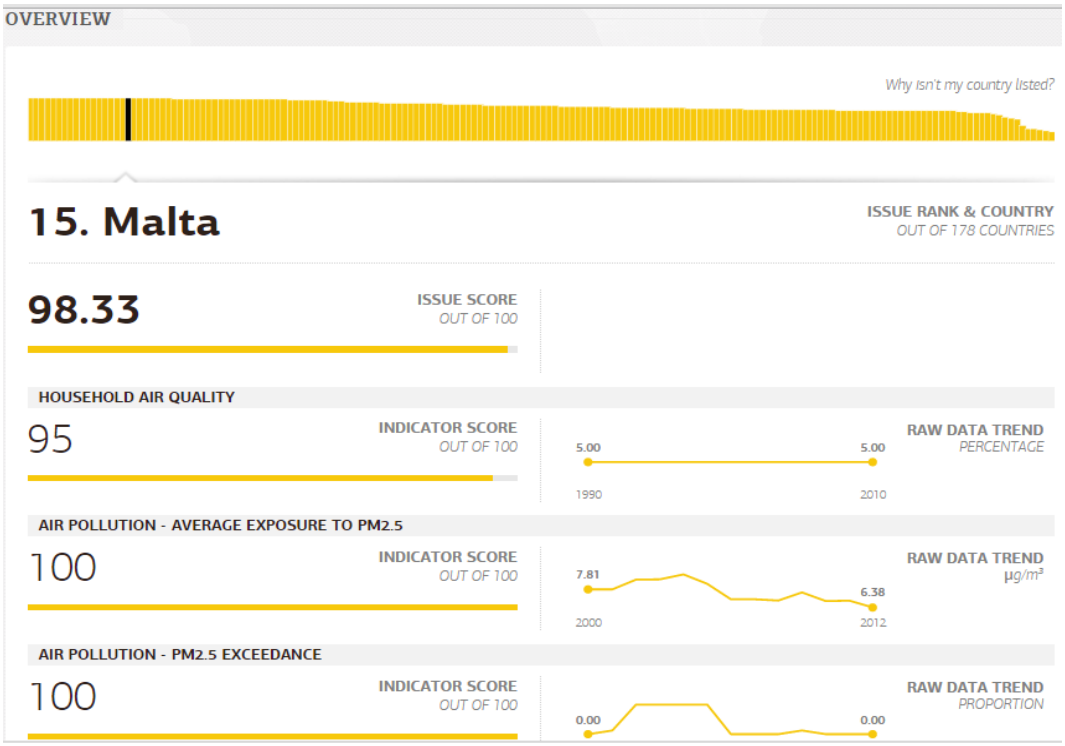
- Sulphur Dioxide (SO_2)
- Particulate Matter ($PM_{2.5}$, PM_{10})
- Carbon Monoxide (CO)
- Nitrogen Dioxide (NO_2) and Nitrogen Oxide (NO) - collectively known as Oxides of Nitrogen (NOx)
- Ozone (O_3)
- Volatile Organic Compounds (VOC) including Benzene
- Lead, mercury and other (heavy) metallic compounds
- Polycyclic aromatic hydrocarbons (PAH)

Most pollutants are the result of anthropogenic activity, with the principal sources of pollution in Malta generated from power generation, industry and transport which is mostly evident in urban areas (MEPA, 2015).

However, trees and plants can contribute in filtering the air when they absorb it into their leaves for photosynthesis or respiration. In addition, some airborne pollution particles may stick to leaves and subsequently wash off in the rain. The overall impact on air quality depends on species, location, temperature as well as other factors. Thus, although the area of woodland in Malta is not significant it still contributes to better air quality.

Evidence of the quality of air in Malta is evident from the Air Quality Index (AQI) which reports the air quality. As the AQI increases, the extent to which air is polluted becomes higher meaning that risks of health and environmental damage increase as well.

Figure 5. 7: Overview of Malta's Air quality



Source: Environmental Performance Index, 2014

An overview of Malta's performance is shown in Figure 5.7 above which indicates that Malta registers an overall index of 98 referring to moderate air quality. It is also ranked the 15th country out of 178 countries with the most serious issues when it comes to air quality. As is clearly evident from the chart above, Malta's exposure to PM2.5, which are tiny particles in the air that reduce visibility and cause the air to appear hazy when levels are elevated, is of 100. This is considered moderate according to the air quality index definitions.

A pilot study for Natura 2000 sites in Italy[25] refer to a paper by McPherson et al. (1997) which gives an estimate of the absorption rate of individual trees of particulate matters per day. McPherson (1997) estimate that individual trees are capable of particle removal between 1.5 to 4.4kg/day. This implies that on average one tree is capable of trapping 2.95kg of particulate matter per day. We know that in Malta in 2012, 796,420kg of PM10 and 495,140 kg of PM25 were registered. This implies that Malta would need around 437,817 trees to absorb the entire amount of particulate matter emitted. The total number of trees or the type of trees in Buskett is not known and therefore the contribution of this service to Buskett cannot be estimated. However, given the fact that the site is the second largest woodland and the densest one implies that Buskett as a site contributes significantly towards the removal of these emissions.

[25] http://www.lifemgn-serviziecosistemici.eu/IT/docu/Pages/documgn.aspx

5.3.3 Soil Protection and Erosion control

Soil is the foundation of all terrestrial ecosystems and agricultural and forestry provisioning services. It is also the structural medium for supporting the terrestrial biosphere and human infrastructure. Ecosystem services provided by soil to support human well-being are described through an understanding of its functions. Key functions provided by soil as reported by Finvers (2008) include:

- Production of biomass;
- Storage, filtration and transformation of nutrients, substances and water;
- Provision of habitat, species and genetic biodiversity;
- Provision of the physical and cultural environment for humans and their activities;
- Provision of raw materials;
- Carbon storage and cycling; and
- Protection of archaeological heritage.

Aggregate ecosystem services provided by soil are in fact largely reliant on the biotic community in the soil (Brussaard in Wall et al, 2013). Examples of functional groups of biota in the context of aggregate ecosystem functions include litter-transformers and the micro-food web, which affect carbon transformations and nutrient cycling; the root rhizosphere biota such as nitrogen-fixing bacteria, mycorrhizal fungi and root herbivores, affecting nutrient cycling and plant performance; ecosystem engineers, such as earthworms and plant roots, which affect soil structure maintenance, the soil as a habitat for other soil organisms and the greenhouse balance of the soil; and competitors of soil-borne diseases affecting biological population regulation. The balance and function of the biota in providing the ecosystem services is highly complex and derivation of meaningful quantitative indications can be difficult. In understanding the functions overall, it is pertinent to note that the system relies on two main process. This first is photosynthesis, resulting in carbon fixation and largely occurring above-ground and the second is respiration (carbon dissipation). With carbon being the common factor integrating function, the ecosystem function of the soil is necessarily also dependent, therefore, on the vegetative communities which it structurally (and functionally) supports.

As identified by Brussaard in Wall et al, 2013, the challenge to soil ecology is to obtain an improved understanding of the sorting of traits in natural communities (comprising plants, animals and microbes) and applying them in managed ecosystems. The type, range, and relative abundance of functional organismal and species traits in biotic communities exert control over different ecosystem functions in that there are multiple associations between traits and ecosystem services across different trophic levels.

Soil functions are also dependent on other factors other than biota, including soil porosity and associated water-holding capacity as important determinants for plant growth.

The ability of the soil to provide the above functions is dependent on soil condition and type. Soil degradation is exhibited through a decline in soil fertility, soil organic matter and organic carbon content, loss of biodiversity, loss of water retention capacity, disruption of water, nutrient and gas cycles, and reduced capacity to degrade contaminants (Toth et al, 2007 and cited in Finvers (2008)). Soil erosion is the weathering away of topsoil due to natural processes (wind, rain, etc.) and as a result of land management practices, including soil tillage. Topsoil is high in organic matter, fertility and soil biota.

As reported in the draft Management Plan[26], the topsoil in the area of Buskett has low organic carbon content (10 – 20 mg/kg) whilst the area to the west of the woodland has medium organic content (20 – 60 mg/kg). The area close to the quarries (see **Figure 5.8**) exhibits even lower organic carbon content (<10 mg/kg). There is a low probability that zinc exceeds its limit in this area (in the vicinity of the quarries) and the copper content in the southern and eastern parts of the site range between 10-20 mg/kg. Soil electrical conductivity provides an indirect measurement allowing inference of soil condition and correlates well with particle size and soil texture. Electrical conductivity can also define differences in organic matter content cation exchange capacity (electrical conductivity). The electrical conductivity in the Natura 2000 site is less than 500 uS/cm with the exception of the area between Wied Il-Luq and Wied tal-Girgenti where it ranges between 500-1000 uS/cm. These values indicate that the limitation to productivity is mainly medium. There is a high limitation along part of Triq il-Buskett and a low limitation in the Ta' Kardarun area.

Soil erosion at Buskett

Soil erosion involves soil detachment, movement and deposition elsewhere. When it occurs naturally, soil is displaced at a rate that is in relative synchrony with the rate of generation of additional soil. Land management practices often accelerate this natural process resulting in harmful effects both to the natural environment and the people dependent on it. To this end, implementation of erosion control measures is necessary to avoid such harmful effects which include an increase in stormwater runoff, reduced supply to groundwater, reduction in rate of low water flow during the dry season and siltation and reduced water quality in watercourses. Although erosion does result in negative effects on agricultural productivity in the areas affected, as reported by Roose (1996), it is the off-site damage that causes the more significant economic effects and requires the State to react i.e. invest in measures to control erosion.

At Buskett, soil erosion is considered an important factor that affects the watercourse in the valley bed because without effective retaining walls to keep the soil in its place, the watercourse in the valley bed silts up leading to obstruction of the watercourse where important habitats, dependent on a constant water-supply, are found. The Annex I priority habitat *Arborescent matorral with *Laurus nobilis* and Annex I habitat *Populus alba* and *Salix alba* galleries are specifically affected. The damaged/collapsed

[26] Epsilon International SA - Adi Associates Environmental Consultants Ltd Consortium. 2013. L-inħawi tal-Buskett u tal-Girgenti Natura 2000 [draft] Management Plan (SAC/SPA). MEPA.

rubble walls leading to loss of soil from the higher areas of the valley sides can also affect other Annex I habitats, that is, *Arborescent matorral with *Laurus nobilis,* Mediterranean pine forests with endemic Mesogean pines, *Olea* and *Ceratonia* forests, and *Quercus ilex* and *Quercus rotundifolia* forests as a result of the loss of the substratum and exposure of the roots of the defining dominant trees.

Erosion control

In the Natura 2000 Management Plan, various objectives are targeted at the watercourse and these are supported by the LIFE Saving Buskett project itself in terms of its objectives and planned actions. The conservation objectives, identified in the Management Plan, include (i) restoration of the watercourse and its riparian zone supporting various important habitats; (ii) removal of invasive alien species; (iii) monitoring the quantity and quality of water; (iv) planting saplings of the typical and characteristic tree species; and (v) planning and implementing a project for the restoration of rubble walls and to control soil erosion.

Erosion control can be achieved through a number of strategies, all of which will be applied as part of the Life+ project:

- Planting of vegetation/trees – plants establish root systems which stabilise the soil, thus preventing erosion. The vegetative cover also shelters soil from the force of rain. This is the most natural form of control.
- Use of geotextiles – another method used to stabilise soil, it is even more effective if used in conjunction with planting vegetation.
- Use of mulch/soil improvers – applying to the topsoil allows the soil to soak up water, protect against rain impact and restore pH levels.
- Retaining walls – built to prevent/reduce stormwater run-off; even more effective when used with other methods.

Rubble walls in the Buskett/Girgenti Natura 2000 site

As indicated previously soil erosion, in particular water-induced erosion, is a widespread problem which persists throughout Europe. Indeed, in 2003 it was estimated that about 12 million hectares of land in Europe, or approximately 10 per cent of the area, is strongly or extremely degraded by water erosion (as in Jones et al. 2003). Furthermore, the highest erosion rates are located in the central and southern Europe, including the Mediterranean region. In fact, (Jones et al. 2003) indicate that in parts of the Mediterranean erosion has reached a stage of irreversibility, leaving behind areas with no soil cover highlighting the fact that the ecosystems' ability to control soil erosion is of high value in Europe. The Mediterranean region is even more prone to soil erosion due to long dry periods followed by heavy bursts of erosive rain which falls on steep slopes with fragile soils, resulting in considerable amounts of erosion (Jones et al. 2003).

In terms of Buskett and the surrounding area, rubble walls play a key role in soil conservation. When constructed well they are highly efficient, however, they require regular maintenance. The rate of loss of soil accelerates when there are breaches in the rubble walls and their repair will directly contribute

to a reduction in the rate of soil erosion in the area. It is particularly important to ensure that load-bearing walls that serve to retain soil on terraced land are maintained in a good state as required through the GAEC (Good Agricultural and Environmental Conditions) Standard according to Annex II of Council Regulation 1306/2013.

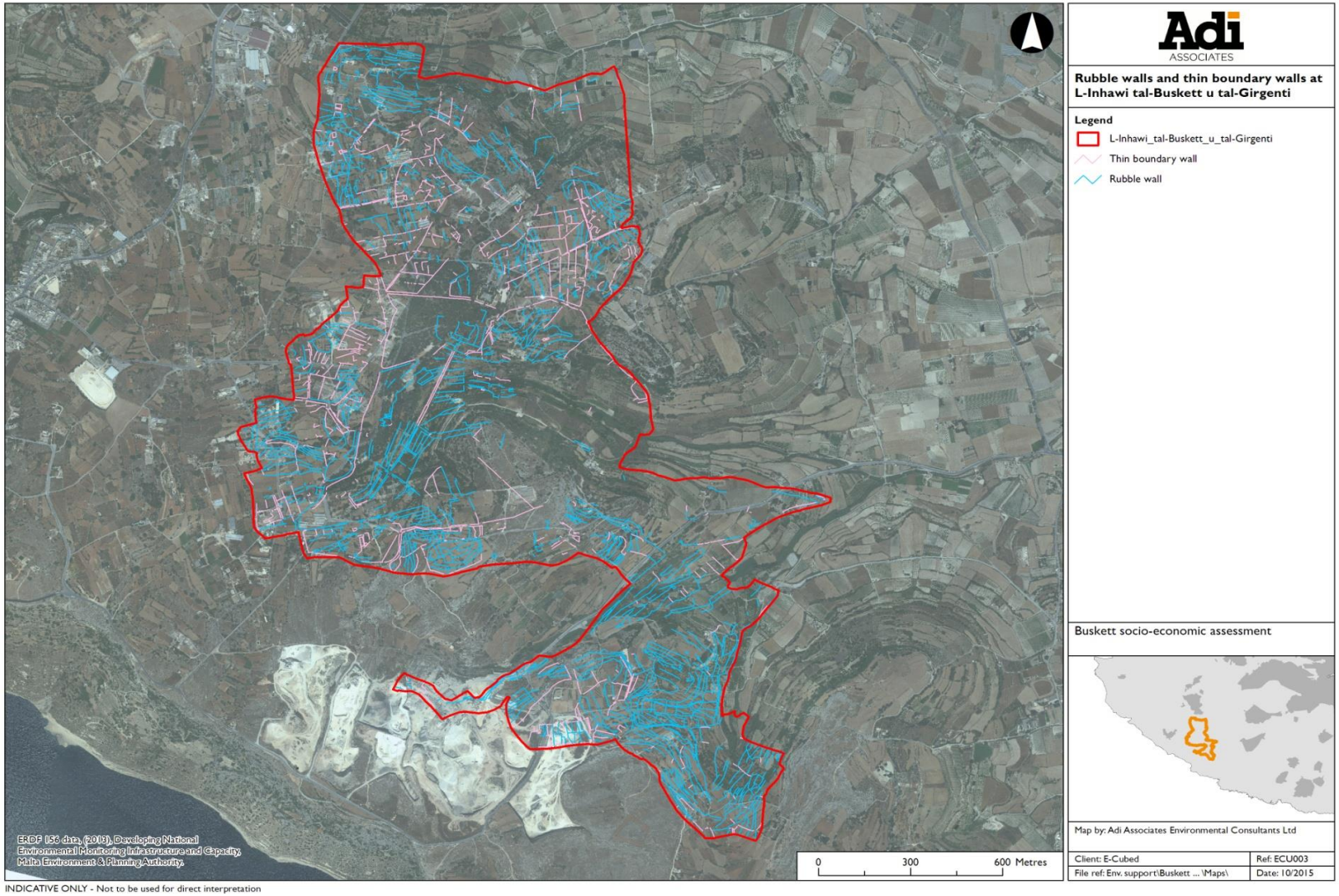
Figure 5.8 illustrates the extent of rubble and retaining walls within the Natura 2000 site following a desk study carried out during the preparation of the Management Plan. The total length of the rubble walls (as reported in the Management Plan) is 56.9km. Thin boundary walls are also identified in the figure which amounts to 28.5km.

Literature on the economic value of soil erosion is sparse. A study undertaken by Ruijgrok et al. (2008) estimated the value of erosion control in pristine scrubland areas in Europe and in Belgian grasslands at €44.5/ha, at 2008 prices. These values were estimated on the basis of the avoided cost method.

From an economic perspective, an estimate of the value of soil erosion control is undertaken based on the market price of restoring and building rubble walls as an estimate of the avoided cost of eroding soil. The market price for restoring and building rubble walls is based on the value derived from an open tendering process for the purpose of rebuilding rubble walls at Buskett. An average value of the prices is derived as an estimate of the market price which is determined at about €80/m^2. This price includes works for dismantling of unstable sections of walls, excavations to expose foundations, provision of foundations where they are absent and reconstruction.

The application of the market price identified above to the total length of rubble walls in Buskett and the confines of the area renders an estimate of the economic value of soil protection of about €8.2 million. It is to be highlighted that this value provides an underestimation of the true economic value of soil protection as a detailed environmental study would be required to determine the quality of the soil and the extent of soil erosion. In the absence of such data, the economic value is derived through an estimate of the avoided cost of soil erosion through the applied market price of building and restoring rubble walls.

Figure 5. 8: Rubble walls and boundary walls within the Buskett/Girgenti SAC



Source: Natura 2000 Management Plan

5.3.4 Storm Damage control and Water Regulation

The density of woodland plays an important role in storm damage control. The impact of storm damage, like for instance damages caused by collapsing walls, depends on the density of trees which act as a barrier to reduce the speed of impact. Forests also pay a crucial role in regulating water flow caused by heavy rain which could result in flooding. Forest areas intercept storm water and release water over time thus resulting in less flash flow of streams, i.e. water levels rise and fall less rapidly. This moderating effect on storm water runoff thus depends on tree density, ground flora, topography, soil and geological condition.

5.3.4.1 Storm Damage Control

Storm protection refers to the role of ecosystems in protecting society from storm damage. The impact from a storm can be lessened through maintenance and management of vegetation. This section is also linked to flood prevention which falls under water flow regulation. Native woodland does not remove the risk of flooding although it does have a moderating effect on run-off. Bullock et al (2014) report that peak flows are extended by 20-140 minutes reducing the risk of flash flooding.

The Toolkit indicates that the monetary value of this ecosystem service can be gauged through the avoided damage cost which is based on the actual losses due to storms that could have been avoided if the ecosystem service were in place. This, however, is not possible to undertake within the context of the SAC due to lack of local detailed technical studies which consider this specific variable. It is important to note that limitations associated with this approach include the assumption that expenditures to repair damages are valid measures of the benefits provided. However, costs may represent an undervaluation of the benefits.

5.3.4.2 Water Regulation

Hydrological ecosystem services from forests are among the most difficult to measure and predict, due to a strong variability in time and space. Differences in precipitation and ambient temperatures result in fluctuations in service provision over time. Moreover, the complex interplay between vegetation cover and its management, soils and slopes is spatially highly heterogeneous. In addition, many targeted watershed services refer to the mitigation of serious risks such as floods or silting of water infrastructure, which are events that do not occur on a regular basis (Thorsen et al. (2014). Any improvements over a risk-mitigation baseline would only therefore be noted and accrued, potentially much later in terms of time. Progress towards improved services is therefore likely to be accrued through investing in land uses that will promote service provision.

Forest/ woodland habitat and its role in water flow regulation

In terms of water flow regulation, forests impact the timing and magnitude of water runoff and water

flows. Forest ecosystems intercept rainfall and absorb water through root systems. Water is stored in porous forest soils and debris and then is slowly released in surface waters and groundwater. Thus, forests recharge groundwater, maintain base flow watercourse levels, and lower peak flows during heavy rainfall or flood events.

Forests also typically result in lower surface flows to nearby waterways because of infiltration and the transpiration of water into the atmosphere through leaves. Therefore, reducing forest cover and density generally increases surface water yield from watersheds, although these changes can be short-lived and depend on climate, soil characteristics, and the percentage and type of vegetation removal. The ability of forests to absorb and store runoff can be approximately 20 times greater than that of an impervious parking lot and nearly six times greater than a residential lawn[27].

The water flow regulation services that forests provide can also yield economic benefits to communities. By reducing water runoff during rainstorms, forests reduce the volume of water that a municipal stormwater containment facility such as a reservoir or retention pond must store. Communities, therefore, do not need to invest as much in constructing stormwater control infrastructure. Based on this avoided cost of stormwater storage, one assessment estimated that forests near Atlanta, Georgia, saved the city $420 per acre per year[28].

Hydrology at Buskett/Girgenti SAC

As identified in the draft Management Plan, hydrological features at L-Inħawi tal-Buskett and tal-Girgenti SAC are closely related to the nature of the area's geology and geomorphology. The Rabat-Dingli Perched Groundwater Body underlies this SAC and gives rise to a number of springs including Għajn il-Kbira, two springs in Buskett woodland and three springs in the Wied tal-Isqof area.

The SAC includes a number of valleys that are sustained from this aquifer including Wied tal-Isqof, Wied il-Buskett, Wied Luq, Wied ix-Xagħri and Wied tal-Girgenti. As explained in the section on water quality, Wied il-Luq (MT302) has been identified as an inland surface water body of conservation value in accordance with the EU Water Framework Directive. Water bodies are protected areas under the WFD Registry for Protected Areas and thus the water related requirements of any protected species and the functioning of the protected water related habitats must be conserved.

The Management Plan area also includes the Malta Main Mean Sea Level Groundwater Body. Rainfall, albeit limited, is absorbed through root systems stored in porous forest soils and debris and then is slowly released in surface waters and groundwater. This economic benefit has been estimated in section 5.1 and any attempt at quantifying water flow regulation would likely result in double counting.

---

[27] American Forests. 2001. Urban Ecosystem Analysis Atlanta Metro Area: Calculating the Value of Nature. Washington, DC: American Forests. 2-5; Cappeilla, K. T. Schueler, and T. Wright. 2005. Urban Watershed Forestry Manual, Part 1: Methods for Increasing Forest Cover in a Watershed NA-TP-04-05. 94. Ellicott City, MD: USDA Forest Service; McGuire, Kevin. Water and Forest Cover Literature Review. Virginia Water Resources Research Centre & Dept. of Forest Resources & Environmental Conservation, Virginia Tech. Citation in literature review taken from: Swank. W.T., J.M. Vose and K.J. Elliott (2001). "Long-term hydrologic and water quality responses following commercial clearcutting of mixed hardwoods on a southern Appalachian catchment." Forest Ecology and Management 143 (1-3): 163-178.

[28] Ibid

It is however to be reiterated that the Management Plan calls for a hydrological study of the Buskett Girgenti catchment area in order to identify and delineate the water catchment area of Buskett and Girgenti in order to:

- Identify and delineate the watercourses including tributaries;
- Identify springs and their status;
- Identify location of boreholes and their legality (including an estimate of extraction);
- Identify possible surface abstraction and other surface flow redirection;
- Identify the amount of flow required to protect riparian habitats and hydrophilic species;
- Establish the degree of dependency of the protected habitats/species on groundwater quality and quantity;
- Investigate if water abstraction is currently a problem for riparian habitats and exploring the agricultural trends within the next 20 years, assess the future needs and draw a balance between the water requirements of the habitats and species and the needs of the agricultural community;
- Identify the impacts of channel modification present along the watercourses. Elements such as dumping of construction debris or large swathes of Giant reed may alter the hydromorphological characteristics of the watercourse, redesigning the path and extent of water flow and the degree of connectivity between the different stretches of the watercourse;
- Investigate the impact of *Arundo donax* (Giant Reed) as a factor competing for the limited water flows in the valley systems and as a siltation generating factor;
- Provide feedback for the improvement of legislative regulations regarding the extraction of water from surface water environments and valley environments; and
- Guide future management objectives as regards the conservation of riparian habitat and water dependent species.

Forest/woodland habitat at Buskett/Girgenti SAC

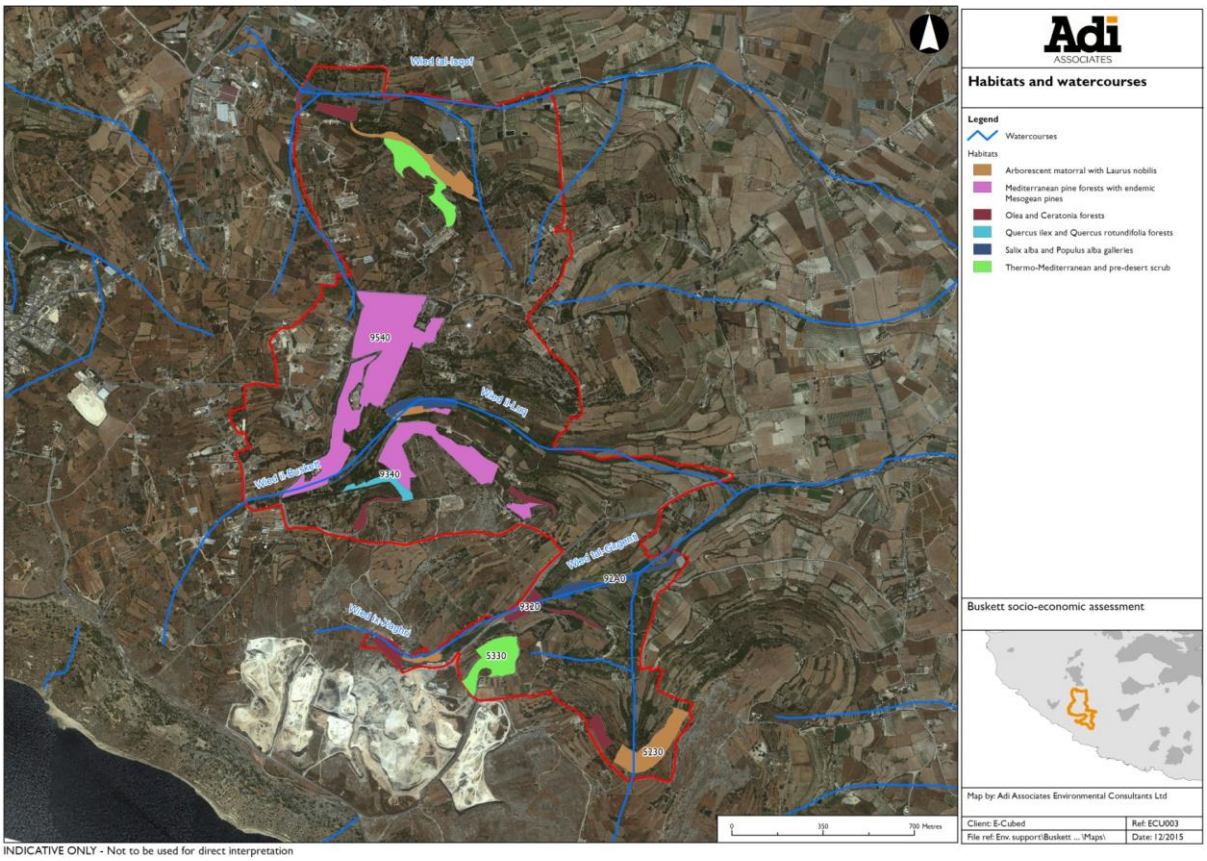
Finally, an assessment of the forest/woodland habitat at the SAC is undertaken in this section. Tree cover in the SAC in terms of Annex I habitats is represented as follows:

- *Arborescent matorral *Laurus nobilis* (Bay Laurel) – 4.8 Ha
- *Salix alba* and *Populus alba* galleries – 2.9 Ha
- *Olea* and *Ceratonia* forests – 3.7 Ha
- *Quercus ilex* and *Quercus rotundifolia* forests – 0.6 Ha
- Mediterranean pine forests with endemic Mesogean pines – 16.7 Ha.

The total coverage of Annex I woodland habitats thus amounts to approximately 29 Ha. In addition to the above recommended studies, the determination of surface water flow rates before and after the wooded habitats will contribute to the assessment of the effectiveness of the habitats in limiting storm water damage. Figure 5.9 illustrates the location of the habitats relative to the watercourses.

Data collection will assist in the monitoring of this ecosystem service by the woodland habitats and the contribution of the Life+ project to enhancing benefits through the planting of more trees in each of these habitats. In the meantime, records of specific damages to infrastructure as a result of stormwater runoff can be used to eventually estimate the economic value of this benefit.

Figure 5. 9: Watercourses and woodland habitats at Buskett



Source: Natura 2000 Management Plan

5.3.5 Biological Control

Biological control is the action of parasites, predators or pathogens in maintaining other organisms' population density at a lower average than would occur in their absence. Insects are also suppressed by natural predators and environmental factors. This is known as natural control. Natural predators of insect pests are known as biological control agents.

Biological control can be categorised into:

- Classical biological control – which involves the planned relocation of natural enemies of insect pests and weeds from one locality to another;
- Natural enemy augmentation – actions taken to increase the populations or beneficial effects of natural enemies; and
- Conservation of natural enemies (habitat management) – planned action for protecting and maintaining natural enemies. This is arguably the most important and readily available biological control practice available to growers and is also important in ecosystem management.

Traditionally, biological control was seen as one of many components of integrated pest management (IPM), although over recent decades its importance has been recognised as a key component in itself. On the strength of this, it has been further appreciated that biological control can be developed for use in complex ecological systems and is seen as a tool for ecosystem management. The control of potential pest species can be described as a stabilising process within ecosystem services.
According to (Balmford et al. 2008), proximity of crop fields to semi-natural habitats highly influences the abundance and diversity of available natural enemies to crop pests. As a result a Natura 2000 site such as Buskett, located in the vicinity of agricultural fields could play an important role in keeping crop pests in control.

The importance of biological control is highlighted in this section from a qualitative perspective in terms of the prevalence of biological agents such as bats which are found within Buskett, two species of which are listed in Annex II of the Habitats Directive. The role of bats in this regard is to control arthropod pests, which are often native. Bats also keep pest population in check thus assisting in agricultural pest management. The boundary of analysis in this respect is focused on the Natura 2000 site.

This section focuses mainly on the bats, as opposed to other species, on account of the fact that bats are Annex II species under the Habitats Directive. The Natura 2000 Management Plan calls for the collection of data on this species. While some data on bats is already available as published in the Management Plan, namely on the population of bats, data on other species such as the syrphid flies (hoverflies) and parasitoid wasps (e.g. braconids and ichneumonids) which prey on other insect pests like aphids, flies, beetles and lepidopterans is not available.

Biological Agents: Bats

Among the estimated 1,232 bat species in the world, over two-thirds are either obligate or facultative insectivorous mammals (Kasso & Balakrishnan, 2013). All the species that are found in the Maltese Islands are obligate insectivores. These insectivorous species largely feed on airborne insects and other arthropods thus suppressing both naturally occurring and anthropogenically-generated insect populations (such as agricultural pest species and insects that annoy or transmit specific pathogens to humans and other mammals) and contributing to the maintenance of ecosystem stability (Kunz et al, 2011). However, data on the economic value of bats to terrestrial ecosystems are limited.

Kunz et al (2011) note that insectivorous bat activity and diversity are strongly related with arthropod abundance that could suggest that bats seek out areas of concentrated prey sources. There is considerable variation in the relative proportions consumed by different species, however, most insectivorous bats eat large quantities of lepidopterans (moths), coleopterans (beetles), dipterans (flies), homopterans (cicadas, leaf hoppers) and hemipterans (true bags). The magnitude of arthropod consumption by a bat varies considerably depending on species, season and reproductive cycle. By way of example, lactating *Myotis lucifugus* is known to consume more than all its body mass during lactation, an energy consuming phase in the reproductive cycle and Kunz et. al (2011) report that an average maternity colony of one million Brazilian free-tailed bats weighing 12g each could consume up to 8.4 metric tons of insects in a single night.

Bat species in Buskett

Eleven species of microchiropteran bats have been recorded in the Maltese Islands covering three families. There are seven known resident bat species *Rhinolophus hipposideros* (Lesser Horseshoe Bat), *Myotis punicus* (Lesser Mouse-eared Bat or Maghreb Bat), *Pipistrellus pygmaeus* (Soprano Pipistrelle), *Pipistrellus kuhlii*, (Kuhl's Pipistrelle), *Pipistrellus pipistrellus* (Common Pipistrelle), *Hypsugo savi* (Savi's Pipistrelle) and *Plecotus austriacus* (Grey Long-eared Bat).

All the resident bats identified above, i.e. the Lesser Horseshoe Bat, Lesser Mouse-eared Bat, Pipistrelles and the Grey Long-eared Bat have all been recorded foraging at Buskett.

Two bat species that are found in the Maltese Islands, *Myotis punicus* and *Rhinolophus hipposideros*, are listed in Annex II of the Habitats Directive, which means that it is necessary to designate Special Areas of Conservation for their conservation. Both species are known to roost and forage in the Buskett-Girgenti SAC. The draft Management Plan for the Buskett-Girgenti Natura 2000 site (Adi-Epsilon, 2013) identified that the conservation status for these species is considered to be indeterminate because the full extent of potential roosting habitat has not yet been fully explored. There are a number of potentially suitable places where these species may roost including water tunnels, caves and hypogea. As identified in the Management Plan, data gathering and monitoring of these species is required in order to obtain a better understanding of their conservation status.

The importance of Buskett in this regard is evident by the ability of the site to provide a favourable foraging habitat (including woodland near running water) and therefore, if roosting habitats can be

conserved, it is likely that this site would be an ideal location for this population to improve in conservation status. It is also pertinent to note that the populations of these species should also be considered at a national level since bats can move around depending on circumstance. Thus, specific sites, such as the Buskett-Girgenti SAC would be described in terms of their importance for the national population. As already identified, the Buskett-Girgenti SAC could potentially be of particular importance in this regard.

All resident bat species listed above have been recorded at Buskett. The Greater horseshoe bat *Rhinolophus ferrumequinum* was also recorded from Buskett, however, this species is now considered to be extinct as a resident bat in the Maltese Islands (Baron, 2007; Baron & Borg, 2011). In a study on *Pipistrellus* sp., Falzon (1999) found that pipistrelles preferred foraging habitat was agricultural land followed by wooded areas with water availability such as wetlands or near watercourses, reflecting insect abundance and diversity, thus further supporting the potential importance on a national level of the Buskett-Girgenti SAC which is made up of both examples of preferred foraging habitat.

In terms of the role of the bats at Buskett-Girgenti their particular importance locally is their role in arthropod suppression. For instance, moth species that can have negative effects on woodlands constitute an important part of bats' diets (Falzon, 1999). Falzon's (1999) results confirmed the importance of lepidopterans in these species' diets, with this taxonomic order being the second highest represented in faecal analysis (following Diptera). Other orders constituting pipistrelle prey include Trichoptera and to a lesser extent Hemiptera, Coleoptera, Ephemoptera and Hymenoptera.

Borg and Sammut (2002) identified that *Plecotus austriacus* fed on at least 23 different moth species of which at least 8 are known pests. Pest species identified included *Autographa gamma*, *Chrysodeixis chalcites* and *Spodoptera exigua*, which feed on a variety of wild and cultivated plants. They were also recorded feeding on *Galleria mellonella*, a pest in apiculture.

Baron and Borg (2011) refer to Borg's (1998) study where he identified that the diet of *Myotis punicus* in the Maltese Islands is largely dependent on Orthoptera (65%) with Lepidoptera and Coleoptera (20% and 15%, respectively) making up the remainder.

Threats to the resident bat populations

A major threat to bats is loss of roosts. Other threats include disturbance to the bats in their roosts, including direct killing. Loss, fragmentation and modification of flight paths or foraging areas are also of concern. The indiscriminate use of chemical pesticides (insecticides) also adversely affects bats by reducing the abundance of prey species. Falzon (1999) also makes reference to accumulation of certain chemicals as a result of environmental pollution in industrialised areas that results in an increase in fat metabolism in hibernating bats or bats in torpor, resulting in the bats being unable to survive the winter.

Borg et al (1997) noted a decline of 50% of the local *Myotis punicus* population on a national level. Bats are particularly vulnerable to extinction due to their slow reproduction rate. Populations must also be above the minimum viable population (MVP) in order to ensure their sustainability in the long-term. Loss of individuals exerts pressure on remaining populations in terms of genetic impoverishment.

Pest control in the Maltese Islands

Studies have shown (Baron & Borg, 2011) that the use of pesticides on agricultural land has exerted control on the populations of insect groups to the extent that there has been a shortage in food resources for bats resulting in ecological changes to the bat populations including, for instance, intraspecific resource competition amongst *Myotis punicus*, requiring the species to exploit other vacant food niches or feed on prey at the boundary of those more traditionally exploited.

In terms of their consideration as biological agents for agriculture, Malta's National Guidance Document on Integrated Pest Management (IPM)[29] does not make reference to the use of bats. This may be a result of the lack of awareness of the importance of these species and their role in the ecosystem service they provide. Data collection and monitoring is thus necessary in order to provide an estimated valuation of the ecosystem services provided by bats in the Maltese Islands, in particular, in their role as biological agents.

Valuing biological control

A review of economic literature on biological control indicates that a monetary valuation can be undertaken based on the replacement cost method. This method estimates the value of biological control indirectly by estimating the value of ecosystem services as the cost of replacing them with alternative man-made goods and services. In other words, given that in the absence of natural biological control, human intervention is required, the cost represents the value of the natural biological control because its existence would save that cost. In order to derive an economic value from the biological control awarded by bats, detailed technical studies would be required. In the absence of these studies, the available literature indicates that monetisation of this variable is restricted.

As a result, the approach adopted in this section has been to highlight the important role of Buskett particularly in the provision of biological control in terms of the conservation status of bat species at this SAC. It is once again reiterated that as identified in the Management Plan, further data collection is nonetheless required in order to be able to assign conservation status as required under the Habitats Directive.

While consideration of bats as biological agents for agriculture is not considered in Malta's National Guidance Document on Integrated Pest Management (IPM)[30] it is interesting to highlight the value of IPM as identified in the Rural Development Programme for Malta for the funding period 2014-2020. The Programme has identified IPM as an agri-environmental climate change measure and the support rate for the implementation of an IPM has been set at €1495.92/ha/year. The value of the support rate has taken into account various elements such as inspection costs and monitoring expenses as well as saved fertiliser costs. The support rate can be considered as a proxy in terms of costs which are saved through the provision of biological control.

[29] Malta Competition and Consumer Affairs Authority. 2015. Guidance Document on Integrated Pest Management in the Maltese Islands.

[30] Malta Competition and Consumer Affairs Authority. 2015. Guidance Document on Integrated Pest Management in the Maltese Islands.

5.3.6 Genetic/species diversity maintenance

> *Millenium Ecosystem Assessment (UNEP, 2005):*
>
> ***Biodiversity refers to the number, abundance, and composition of the genotypes, populations, species, functional types, communities, and landscape units in a given system.***

Biodiversity and ecosystems are closely related concepts. As identified by Defra (2007) significant evidence suggests linkages between changes in biodiversity and the way ecosystems function. Biodiversity supports all ecosystem services, however, it can also be a service in itself such as the existence value of species in cultural services.

Biodiversity has a bearing on the following ecosystem processes which in turn provide ecosystem services:

- Production of plant and animal biomass;
- Nutrient cycling;
- Evapotranspiration;
- Movement of pollen and seeds by animals;
- Resistance; and
- Resilience.

Functional diversity considers the value, range, and relative abundance of organismal traits present in the community affecting ecosystem functioning.

Biodiversity affects regulating services including pollination, seed dispersal, climate regulation, carbon sequestration and pest and disease control. Biodiversity also provides supporting services that are necessary for the production of other ecosystem services. Diaz et al (2005) provide a classification of this contribution which has been used to provide the context for this section.

5.3.6.1 Biodiversity and supporting services

In terms of supporting services, functional composition and species richness of plant communities affect the amount of primary production in an ecosystem. Faster-growing, larger, more efficient, more locally adapted plants will produce more biomass. In low-diversity systems coexisting plants with different resource use strategies result in more resource take up. A larger species pool is more likely to contain groups of complementary species and individual species that are highly productive, both of which should lead to higher productivity of the community.

Stability of primary production is also dependent on biodiversity. Large genetic variability within a crop species buffers production against losses due to diseases and environmental change. Polycultures maintain production over a broader range of conditions. Life history, resource use strategy, and

regeneration strategy of dominant plants determine resistance and resilience of ecosystem functioning against any changes.

Habitat provision, its diversity and spatial distribution including connectivity, landscape heterogeneity and large areas are important for migrating species and species that require large foraging areas. Breeding and roosting species may require habitat complexity. Species richness also enhances habitat and ecosystem function through increasing the resource base at each trophic level (Diaz et al, 2005).

Resistance to alien species invasion

Invasive species threaten biodiversity, change ecosystem functioning and have economic costs. Higher species richness, traits of resident species and functional type richness can increase the resistance of a community against invasion. Also, some individual species may be particularly important in resistance.

Invading species may alter the local environment to favour themselves whilst making it less favourable to native species. Geomorphic processes such as soil erosion rates or sediment accretion may be altered. The Great reed, *Arundo donax*, an invasive species which is considered an archaeophyte in the Maltese Islands, may influence water movement in a watercourse, rendering the area prone to flooding (Spencer et al., 2013). Given that *Arundo donax* is not a new introduction, conservation biologists and ecologists call for its management rather than complete eradication. Its management is also required at Buskett as stipulated in the Management Plan.

At Buskett, alien species, in particular *Eucalyptus* are being introduced by farmers. Farmers are actively replacing the riparian woodland with these alien species which have contributed to an unfavourable conservation status of relevant habitat (see below). Invasive species may also alter biogeochemical cycling, hydrological cycles or fire or light regimes.

The arrangement of landscape units is an important consideration in terms of invasion resistance. Landscape corridors (e.g. roads, watercourses, and rubble wall networks) can facilitate the spread of aliens although they are also important in the maintenance of biodiversity to be maintained (see below). Corridor characteristics such as width, connectivity, breaks and nodes determine whether or not a particular corridor will provide a barrier to a particular species (Diaz et al, 2005).

Direct and indirect interactions between species

Important natural processes can be influenced by the interactions between plants and symbiotic microorganisms, such as mycorrhizal fungi, endophytic fungi, and nitrogen-fixing microorganisms resulting in impacts on the provision of ecosystem services.

Interactions between plants and animals are also important in providing ecosystem services. This is because animals interact with plants directly either by consuming them or by dispersing their pollen or seeds across the landscape resulting in both short-term consequences, as well as longer-term evolutionary consequences. Direct interaction between plants and animals results in the support of

major ecosystem services such as herbivory, pollination and seed dispersal. Animals and plants can also result in indirect effects by changing each other's habitat and resource availability.

The functional composition of the pollinator assemblage is important for pollination. The loss of specialised pollinators and a reduction in their species richness leads to a reduction of number and quality of fruits produced and plant genetic impoverishment. Connectivity between landscape units needs to be ensured in order to maintain the vegetation gene pool (Diaz et al, 2005).

As described below, Buskett is rich in biodiversity and supports a number of complex relationships. It supports pollinators, which in turn are important in ensuring maintenance of the various woodland, maquis, and garrigue habitats found within this SAC.

Biodiversity effects on climate regulation

The capacity of terrestrial ecosystems to sequester carbon and regulate climate at the local, regional and global scales is influenced by biodiversity components including dominant species characteristics and the distribution of landscape units, which influence the capacity of terrestrial ecosystems to sequester carbon and regulate climate at the local, regional and global scales. Vegetation height, structural diversity, architecture, and leaf seasonal patterns affect albedo, heat absorption, and mechanical turbulence thus affecting climate by influencing local atmospheric temperature, and air circulation patterns. Thus, any changes in land use will thus indirectly influence climate.

Carbon loss is higher at forest edges and as this habitat type declines in size, it results in a larger proportion of the total landscape losing carbon. The functional composition of vegetation is also important. Fast-growing, fast-decomposing, short-leaved, small-sized plants retain less carbon in their biomass than slow-growing, slow decomposing, long-leaved, large statured plants (Diaz et al, 2005).

Younger plants sequester more carbon that older plants and the planting of trees as part of the project is thus expected to contribute to some extent to enhanced carbon sequestration at Buskett.

Pest and disease control in agricultural systems

Ensuring genetic diversity of crops enhances pest resistance by reducing the density of hosts for specialist pests, thus limiting their ability to spread. Ensuring also a high richness of crop, weed, and invertebrate species also increases habitat for natural enemies of pest species. Biodiversity can reduce or eliminate the need biocides application and, hence, the selective pressure and rate at which resistance evolves. Thus, maintaining areas of natural vegetation at the fringes of agricultural land will support natural enemies against insect pests.

Reduction in the use of pesticides by farmers with land in and around the SAC would be integral in helping to reduce impacts from chemicals in the local environment. As described in a separate section, Buskett provides ideal roosting and foraging habitat for a number of bat species, which are biological

control agents. Ensuring a favourable conservation status for these species could be an important aspect of agricultural land management as well.

Agribusiness relies on the diversity of genes among wild relatives of domesticated crops to ensure the health and resilience of major food crops that might be threatened by disease or pests and is thus important for food security. Some crop wild relatives present at Buskett and its surroundings may include Wild Artichoke (*Cynara cardunculus*), Wild Carrot (*Daucus carota*), Prickly Lettuce (*Lactuca serriola*), Squirting Cucumber (*Ecballium elaterium*), Wild Cabbage (*Brassica oleracea*), Wild Leek (*Allium commutatum*) and Barley Grass (*Hordeum murinum*), amongst others.

Buskett Girgenti SAC Biodiversity

The Buskett/Girgenti Natura 2000 site is one of the largest in the Maltese Islands with a high level of biodiversity and rich in indigenous and endemic species. The site is supported by three perennial valley systems, Wied il-Luq, Wied l-Isqof and Wied il-Girgenti. This is known as the Wied il-Kbir valley system and is the largest of the Maltese watercourse systems (Haslam & Borg, 1998). The site supports the largest example of woodland in the Maltese Islands including associated species of invertebrates and mycoflora.

The present woodland was largely planted during the rule of the Order of St John and the British to enhance a small natural woodland largely dominated by the Holm Oak (*Quercus ilex*) and the Aleppo Pine (*Pinus halepensis*). Other trees include the Bay laurel (*Laurus nobilis*), Buckthorn (*Rhamnus alaternus*), Olive (*Olea europaea*), and Hawthorn (*Crataegus monogyna*). A number of climbing shrubs are also typical including Ivy (*Hedera helix*), Spiny asparagus (*Asparagus aphyllus*), Common smilax (*Smilax aspera*), Wild madder (*Rubia peregrina*), Honeysuckle (*Lonicera implexa*), and Traveller's joy (*Clematis cirrhosa*). In the more rocky terrain, a maquis is dominant including species such as the Lentisk (*Pistacia lentiscus*), Carob (*Ceratonia siliqua*) and Fig (*Ficus carica*). Pollinators are abundant and species such as ivy attract diverse insects including flies (Order Diptera), wasps (Hymenoptera) and butterflies (Lepidoptera). Haslam & Borg (1998) cite the Painted lady as the most abundant butterfly species. White butterflies and the common blue butterfly are also present. The woodland is important for wood-associated species and species that are found in leaf-litter and for cryptofauna in general. These include a number of insects, woodlice and spiders that are only known from Buskett and a couple of other places in the Maltese Islands.

The site also supports the highest concentration of riparian woodland in the Maltese Islands. Three populations have been recorded in each of the valleys, resulting in a fragmented representation of this habitat type. Trees that grow at Wied il-Luq include White poplar (*Populus alba*), Ash (*Fraxinus angustifolia*), also only known from this site, Elm (*Ulmus minor*) and the Common oak (*Quercus robur*). A number of sedges (mainly *Carex divulsa*) grow along the watercourse, and less frequently, Gladdon (*Iris foetidissima*), which has only been recorded from this site. The watercourse supports a number of freshwater snails such as the Bladder snail (*Physa acuta*) and the River limpet (*Ancylus fluviatilis*). Flatworms and pondskaters are also common. It also supports the Mediterranean Painted frog (*Discoglossus pictus pictus*).

Rare species are found at the permanent freshwater spring at Għajn Il-Kbira, at least two of which have only been recorded from this site.

Caves are also present within this SAC that provide ideal roosting grounds for bat species including two Annex II species, the Lesser Horseshoe Bat (*Rhinolophus hipposideros*) and the Mouse-eared bat (*Myotis punicus*) as well as the Grey long-eared Bat (*Plecotus austriacus*) and a unique habitat for rare troglobiont and troglophilic species. Caves also provide habitat for a number of invertebrates which are largely endemic.

Mixed garrigue is also found in this SAC. That surveyed as part of the Management Plan was dominated by Mediterranean heath (*Erica multiflora*) and the Lentisk (*Pistacia lentiscus*). Other species include Olive-leaved buckthorn (*Rhanmus oleioides*), Shrubby kidney vetch (*Anthyllis hermanniae*), Sea squill (*Urginea pancration*), Honeysuckle (*Lonicera implexa*), White hedge nettle (*Prasium majus*), Wall rue (*Ruta chalepensis*) and Mediterranean buckthorn (*Rhamnus alaternus*). A number of orchid species are also found in this area including Brown orchid (*Ophrys fusca*) and Maltese blue orchid (*O. hospitalis*). This is the only site for the critically endangered Greek Oregano (*Salvia fruticosa*). Mediterranean temporary rock pools are also supported within this SAC.

A karstland area supports a rocky steppe dominated by Branched asphodel (*Asphodelus aestivus*) and Hispid beard-grass (*Hyparrhenia hirta*).

Buskett and the areas around it are a hotspot for migratory birds of prey as well as other migratory species, providing an ideal resting spot as explained under section 5.2 under recreation, landscape and amneity values. It is also important to reiterate that as highlighted in section 5.1, a large extent of this SAC comprises agricultural land.

Conservation Status

The Buskett Girgenti SAC supports eight types of Annex I habitats (habitats of community interest whose conservation requires the designation of Special Areas of Conservation under the Habitats Directive) and six Annex II species (species listed in the Habitats Directive whose conservation requires the designation of Special Areas of Conservation). Thirty-two bird species of conservation importance under the Birds Directive have also been recorded frequenting the area. Table 5.6 summarises the conservation status of the Annex I habitats, Annex II species and bird species of importance under the Habitats and Birds Directives as assigned in the Management Plan.

Table 5. 6: Conservation Status of Annex I habitats and Annex II species at Buskett Girgenti SAC

Code	Habitat	Conservation Status
3170	Mediterranean temporary ponds	B
5230	Arborescent matorral with *Laurus nobilis*	B
5330	Thermo-Mediterranean and pre-desert scrub	B
92A0	*Salix alba* and *Populus alba* galleries	C
9320	*Olea* and *Ceratonia* forests	B
9340	*Quercus ilex* and *Quercus rotundifolia* forests	C
9540	Mediterranean pine forests with endemic Mesogean pines	A
Code	**Species**	**Conservation Status**
4092	*Elatine gussonei*	Indeterminate
1395	*Petalophyllum ralfsii*	B
4051	*Myrmecophilus baronii*	Indeterminate
1293	*Zamenis situla*	Indeterminate
1303	*Rhinolophus hipposideros*	Indeterminate
1307	*Myotis punicus*	Indeterminate
	Birds	**Conservation Status**
	Raptors	B
	Breeding and wintering passerines	B

A - favourable status; B - unfavourable - inadequate; C - unfavourable - bad

Source: Natura 2000 management plan

Of the eight Annex I habitats, only one (Pine forests) has been assigned favourable conservation status[31] in the Management Plan. Four others were assigned an unfavourable – inadequate status and two (the Poplar galleries and Oak forests) were assigned the status unfavourable – bad.

For many of the Annex II species including two bat species, the amount of data available was considered inadequate to assign an overall conservation status[32]. Migratory raptors and breeding and wintering passerines were assigned an overall conservation status of unfavourable – inadequate.

Assigning an economic value to biodiversity

The value of this ecosystem service is based on qualitative and quantitative estimates. Qualitatively the importance of the site has been explained in the previous sections.

Theoretically, there are different methods to determine the value of biodiversity. Direct (related to direct consumption including tourism and cultural use), indirect (e.g. processes such as pollination, habitat for other species, climatic effects), unknown (e.g. possibility, not yet discovered plants and/or their extracts that may provide medicinal use), and non-use values (including option, bequest and

[31] In describing a habitat's conservation status, parameters considered include area, structure and function, and future prospects.

[32] The conservation status for species is described through the consideration of range, size of population, habitat, and future prospects.

existence values, which describes the benefit people feel from knowing that a particular species exists) can all be used to value biodiversity. It should be however, be noted that some aspects of biodiversity simply cannot be valued, such as unknown genetic material, global life support systems and religious values. In that case, the main aim should be to avoid species extinction and establish safe minimum standards to preserve ecosystems and biodiversity.[33] The conservation status of habitats and species of conservation interest are an indicator for monitoring of biodiversity conservation. Annex A consists of a list of Annex I habitats, Annex II species and bird species of importance under the Habitats and Birds Directives, some of which are considered to be very rare and with unfavourable conservation status emphasising the importance of Buskett for conservation purposes.

However, it is interesting to note that a study by Christie et al (2006) estimates that in the UK the value of biodiversity creation, using a WTP exercise, is esitmated at €55 per household per year. Taking this tranferable value and adjusting to reflect purchasing power parities and inflationay effects to 2015 while applying it to the number of households in Malta would result in an annual value for biodiversity creation of about €9.3 million per year.

5.4 Supporting Services

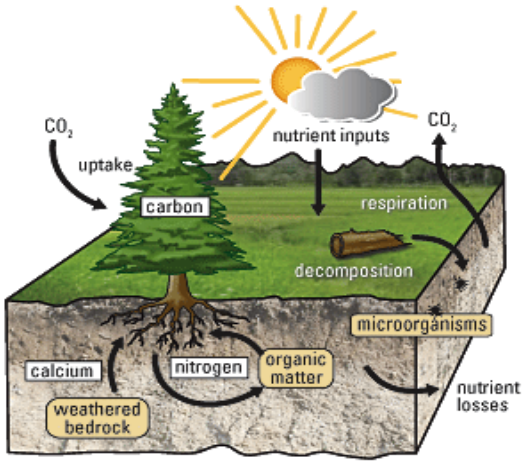
The final service considered in this secton is supporting ecosystem services which are the ecological qualities and functions that underpin the provisioning, regulating and cultural ecosystem services. These services are the fundamental ecosystem processes and they form the basis for all other services.

By way of example photosynthesis is the process used by plants, algae and certain bacteria to harness energy from sunlight into chemical energy. It takes in the carbon dioxide produced by all breathing organisms and reintroduces oxygen into the atmosphere (live science, 2015)[34]. Thus this contributes to the mitigation of climate change. Through photosynthesis, plants and organisms grow and reproduce providing an important element to sustain biodiversity. Also indirectly, it contributes to landscape and amneity values which only exist because of the beauty of the landscape and unique flora and fauna in Buskett. This also provides for better air quality and as such contributes to regulation of human health.

[33] Caspian EVE 2005/UNDP and WBI John A. Dixon, Valuing Biodiversity

[34] http://www.livescience.com/environment/

Figure 5. 10: The Nutrient Cycle



Source: http://biology.about.com/

Another example is the nutrient cycle or otherwise known as the ecological recycling. This involves the movement and exchange of organic and inorganic matter back into the production of living matter. The nutrient cycle describes the use, movement, and recycling of nutrients in the environment. It recycles valuable elements such as carbon, oxygen, hydrogen, phosphorus, and nitrogen which are essential to life for organisms to exist. This supports landscape to maintain its beauty, keeping production of fruit and thus contributes to the surviving of the natural habitat.

Biodiversity relies on supporting services through nutrient cycling, soil formation and water cycling to remain healthy. These will indirectly contribute to sustaining the provisioning and cultural ecosystem services. With no supporting services there will be no flora and fauna which will provide none of the services above including food, water of quality, recreation, amenity values, landscape and more. Other supporting services include weathering/erosion, ecological interaction and primary production.

Estimating specific quantitative and monetary values for these supporting services is difficult and it often leads to problems with double counting. As such these supporting services are not estimated in line with the recommendations of the Natura 2000 Guidelines which refer to the possibility of double counting as these variables are captured under other ecosystem services as highlighted in Table 5.8. The value of these variables is thus integrated in estimates for the provisioning, cultural and regulating services. Nevertheless, when discussing the value of ecosystems, it is important to highlight the role of these fundamental services. These services are essential for the existence of the above discussed ecosystem services without which the other ecosystem services will not function.

Supporting Services	Definition	Ecosystem services
Water cycling	Buskett has a number of reservoirs which are important in regulating the flow of water on the area. Thus, processes related to water cycling are of high significance.	Water quantity, Water quality
Nutrient cycling and decomposition	The site plays an important role in providing provisioning & regulating services closely dependent on ecosystem's ability and capacity to decompose organic material for water purification, waste management.	Food, Landscape, Water quality, Genetic maintenance
Ecological interaction	The site hosts a number of species and habitats resulting in a high rate of ecological interactions which are considered fundamental for the characteristic functioning of site's ecosystem, thus securing the provisioning of its services.	Landscape, Genetic maintenance
Evolutionary Process	This has an important role in creating variations within or among species and ecosystems, by, for example, functioning as an important refuge / stepping stone / corridor in fragmented landscape, thus helping to maintain a healthy gene flow within species.	Landscape, Genetic maintenance
Soil formation	Weathering describes the means by which soil, rocks and minerals are changed by physical and chemical processes into other soil components which us an integral part in soil formation. The natural environment of Buskett contributes to soil formation which is important for it habitats and the ecosystem.	Food, Landscape & amenity values
Primary production	The site is a significant source of sustainably produced / harvested biological resources or it has a high carbon sequestration capacity. Thus, production of biomass plays an important role at the site.	Food, Climate Change, Genetic maintenance

Source: Kettunen, M., Bassi, S., Gantioler, S. & ten Brink, P. 2009. Assessing Socio-Economic Benefits of Natura 2000; Toolkit for participants

6. Threats faced by Buskett

6.1 Threats identified in the Management Plan

Natural sites like those under the protection of Natura 2000 including the area of Buskett and Girgenti support a wide diversity of living species and various landscapes as highlighted throughout this report.

The scope of this report has been to highlight the importance of the Buskett and Girgenti Natura 2000 site. This has, in essence, been undertaken from a qualitative perspective as detailed technical studies from which data can be sourced tend to lack. This is also highlighted in the Natura 2000 Management Plan which calls for a number of technical studies on the site.

Notwithstanding, the importance of the site is clearly evident. It provides a unique recreational area, an educational experience and is the basis for rich cultural and historical heritage. Where possible a quantitative assessment of the benefits offered by the Natura 2000 has been undertaken. Of notable importance is the contribution of the site in maintaining the quality of water which has been determined through the application of a shadow price on groundwater. In addition, avoided costs such as those related to soil erosion through an estimate of the cost of rubble walls has also been undertaken.

It is however to be stressed that the socio-economic benefits of the site cannot be preserved and maintained unless the threats to the area are adequately identified and addressed. As a result, this section highlights the threats to Buskett as highlighted in the Natura 2000 Management Plan.

Buskett currently faces numerous threats that need to be addressed so as to safeguard the habitat, the flora and fauna within this natural site. One of the main threats faced by Buskett is that related to soil erosion. There are a number of retaining walls which are collapsing and need repair, restoration or rebuilding. If these walls collapse soil, rocks, living species, rubble, ruins and even litter will find its way down to the watercourse (Epsilon-Adi, 2013). This in turn causes sedimentation and can create a blockage of the watercourse. Furthermore, this will damage the flora and fauna found along the watercourse (Epsilon-Adi, 2013). If these walls separating earth from water collapse, trees close to the water can become clogged in water, choking mature trees and burying saplings at the detriment of the habitat's regeneration (Epsilon-Adi, 2013).

Example of retaining walls which have collapsed or are about to collapse are the arched buttresses over the watercourse. This is a threat to the flow of the watercourse. Altering the flow will have a negative impact on the surrounding habitat (Epsilon-Adi, 2013).

Other causes for collapsing retaining walls at Buskett and surrounding areas include human interventions such as outdoor sports and leisure activities undertaken within the area (Epsilon-Adi, 2013). Trampling and overuse contribute to the loss of protected species (Epsilon-Adi, 2013). Visitors over the years have dislodged stones from retaining walls so that they can use them as low football

goalposts. Such activities compromise the stability of such walls leading to their collapse or damage (Epsilon-Adi, 2013). This also results in rubble on the soil surface which ends up in the watercourse.

Another threat identified in the Management Plan is that habitats are being negatively affected by invasive species such as *Ailanthus altissima*, *Vitis* sp, *Agave* spp and *Ricinus communis.* According to the Management Plan, invasive species are spreading across the whole area of Buskett and Girgenti.

Another threat which is mentioned in the management plan refers to illegal logging and illegal hunting which occur in particularly around the Girgenti area and Wied l-Isqof which can exterminate rare and protected birds. Often this will result not only in the killing of rare and important species but also contributes in destroying and weakening their natural habitat.

Following a stakeholder workshop carried out in 2013 on the Buskett and Girgenti area a number of additional threats have been identified and observed and which constitute a threat to Buskett and Girgenti:

1. Cement is sometimes thrown into the watercourse;
2. Spring water is being used for agriculture and consequently the watercourse has dried out;
3. Locals and tourists prefer to walk on soil rather than pathways destroying young plants and living creatures;
4. Fires from BBQs (illegal);
5. Unauthorised cutting of fruit from Buskett trees; and
6. Waste from picnics, restaurants and other festive occasions occurring within the area.

All the above mentioned threats need to be addressed to maintain the value of the area. It is important to increase awareness as to make sure that individuals understand the consequences or the impact of their actions on the environment and ultimately on their well-being.

6.2 Actions against threats

The Management Plan also highlights a number of actions required to minimise the impact of threats to the area and to maintain its social, economic and environmental value.

Table 6.1 identifies the threats and the actions required to address these threats. It is to be noted that the actions which are identified in the Management Plan also form the basis of the Life+ project upon which the post-project assessment will be undertaken.

Table 6.2 lists other threats and required actions which are not directly addressed through the Life+ project.

Table 6. 1: Threats and Actions

THREATS	ACTIONS	CAUSES AND CONSEQUENCES
Soil erosion, Collapsing retaining/ Rubble walls	**Actions C1 and C2 (Ashlar and rubble walls):** These actions require monitoring of rebuilt/restored/repaired walls and frequent maintainance so as to avoid serious damage, application of geotextile, mulch and deadwood to control erosion of the soil). **Action C3:** The selective removal of silt from the watercourse is not expected to take place for many years as the aim of the project is to prevent further silt/boulders from being transported to the watercourse. **Action C5**: Planting of saplings of native trees to mitigate soil erosion, restore and recreate natural habitats and their growth progress will be monitored and necessary measures will be taken accordingly.	**CAUSES:** Outdoor sports and leisure activities, trampling and overuse. **CONSEQUENCES:** **1.** Debris finding its way in the watercourse which can cause blockage and consequently flooding. **2.** Flooding or wateroverflow can choke or bury trees/sapling. **3.** Damage to surrounding species. **4.** Loss of soil which will make trees and plants more vulnerable due to exposure of their roots.
Invasion of alien species	**Action C4:** Check on invasive species will be carried out and removed.	**CAUSES:** Introduction and invasion of new species, which are not compatible with the native environment. **CONSEQUENCES**: Can damage and replace other flora and fauna and cause the extinction of indigenous/ endemic species

Source: Based LIFE Saving Buskett Project Technical Description (2013) and on Natura 2000 management plan for 'l-inħawi tal-Buskett u tal-Girgenti' (2013)

Table 6. 2: Other Threats and Actions

THREATS	ACTIONS	COMMENT
Destruction of flora and fauna	Prepare and implement monitoring programmes for: Mediterranean temporary ponds (3170), Arborescent matorral with *Laurus nobilis* (5230), Thermo-Mediterranean and pre-desert scrub (5330), *Salix alba* and *Populus alba* galleries (92A0), *Olea* and *Ceratonia* forests (9320), *Quercus ilex* and *Quercus rotundifolia* forests (9340), Mediterranean pine forests with endemic Mesogean pines (9540), *Elatine gussonei*, *Petalophyllum ralfsii*, *Myrmecophilus baronii*, *Zamenis situla*, *Rhinolophus hipposideros* and *Myotis punicus*, and the protected migratory raptors and breeding passerines. Prepare and implement: 1. A water monitoring plan for *Populus alba* and *Salix alba* galleries 2. A pilot project for the expansion of Habitat 9320 3. An action plan for selected RDB species Enhance habitats 92A0, 9320 and 9340 through seed collection and the planting of saplings of characteristic trees. Apply access control measures at areas bearing habitats Arborescent matorral with *Laurus nobilis*, and *Salix alba* and *Populus alba* galleries.	**Causes:** Illegal hunting and trapping, trampling and other human activities **Consequences:** The killing of plants, trees, animals, insects and the overall natural environment.
Water quality	Prepare a baseline hydrological study of the Buskett - Girgenti catchment area	**Causes:** Collapsed retaining walls, agricultural waste and waste generated from human activities **Consequences:** Water quality deteriorates
Fire	Install an anti-fire system for the protection of the pine forest	**Causes:** Restaurants in the area catching fire, illegal BBQs, or a discarded cigarette can generate a fire, or even natural fire such as spontaneous combustion or lightning. **Consequences:** Large destructive fires.

THREATS	ACTIONS	COMMENT
Trampling	Restore the footpaths along the watercourse Monitor and control access	**Causes:** Human activities **Consequences:** Walking on soil and retaining walls collapsing causing environmental damage
Agricultural pollution	Implement and enforce the Maltese Code of Good Agricultural Practice (CoGAP) and Nitrates Action Programme in the agricultural land within the SAC	**Causes:** Dumping of agricultural waste, excessive application of fertilisers and pesticides. **Consequences:** Deterioration of the natural environment. It occurs at the detriment of the surrounding flora and fauna.
Human activities	Regulate tourist infrastructure development affecting the natural environment. Implement monitoring and patrolling schedule. Prepare a study for the design and technical specifications for visitors' amenities/ infrastructure, information/ interpretation/ warning signposting, and promotional material. Install the amenities/ infrastructure and signage and produce the promotional material; signage will take the form of: 1. Signs to direct visitors to designated paths 2. Directional signs to direct visitors 3. Signs to explain vulnerability of retaining walls	**Causes:** Lack of awareness and knowledge about the surroundings. Also no restrictions and regulations on human activities and development of infrastructure at the detriment of the environment **Consequences:** Environmental damage. 19% of those interviewed in the Visitors' assessment study of Buskett mentioned the need to establish an information centre, have signs with names and description of various areas in Buskett including history and cultural heritage and others with rules and restrictions as to conserve the area and a map with different areas of Buskett. Such initiatives can help in promoting the importance of Buskett and raise awareness amongst visitors to care for this natural site.

Source: Based LIFE Saving Buskett Project Technical Description (2013) and Stakeholders workshop (2013)

7. Post - Project Assessment

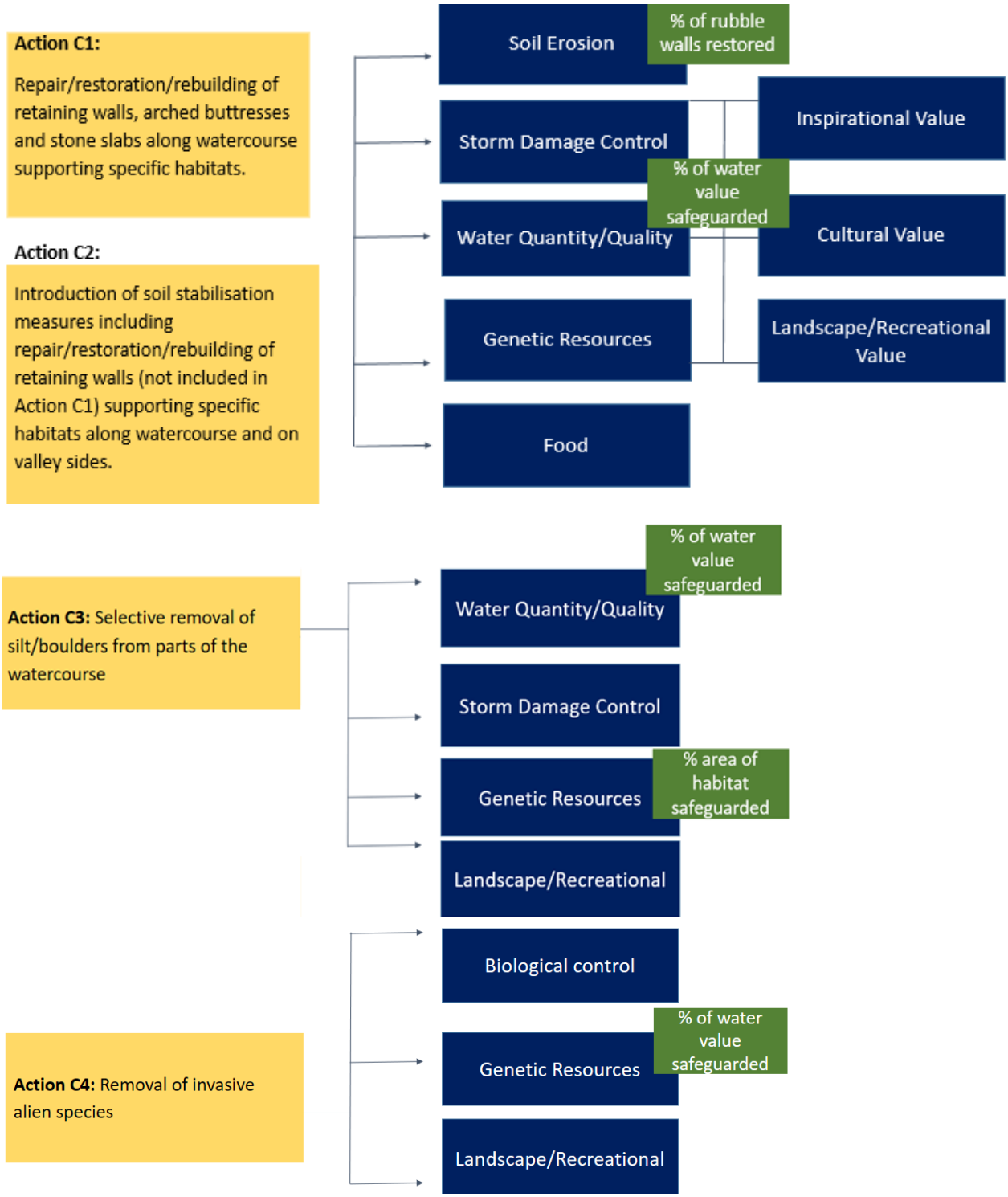
This report has focused specifically on an assessment of the Buskett area highlighting the challenges faced by the area, most notable of which are environmental in nature also as outlined in the Natura 2000 Management Plan. The report provides an intrinsic value to the site and the importance of preserving, protecting and where relevant restoring the value of the site serving as the basis for highlighting the need for specific intervention to safeguard and enhance the socio-economic value of the area. This report seeks to provide justification for the use of EU funds and National funds to preserve the value of the site

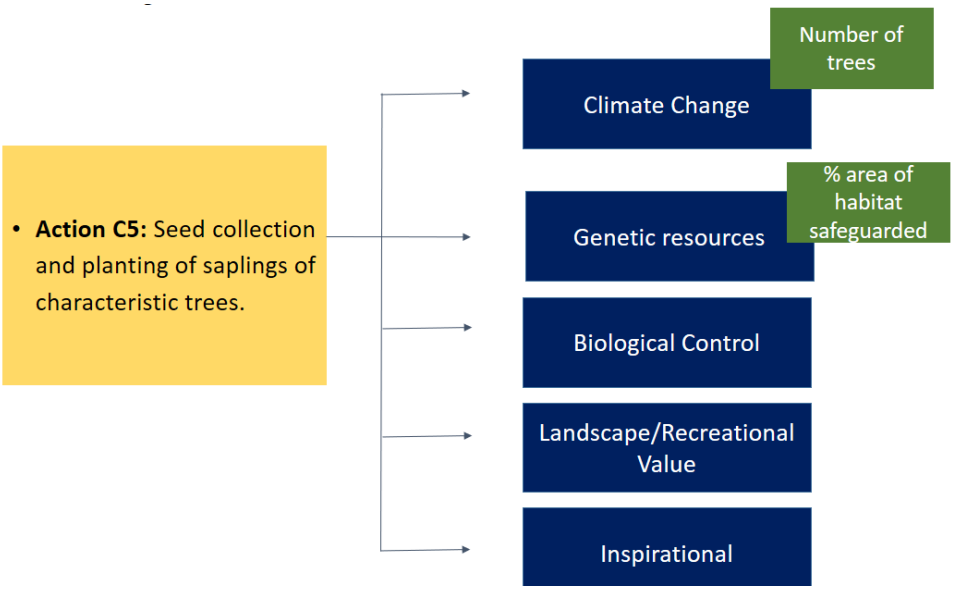
The aim of the post-project assessment will be to:

- Identify areas targeted and the scope of intervention
- Identify how actions address the threats highlighted in the pre-project assessment and thus safeguard and maintain the socio-economic benefit of Buskett
- Map interventions with the results and include an objective/subjective ratio of the specific interventions to the socio-economic value highlighted in the pre-project assessment including though not restricted, to key parameters such as land area protected, quality of soil, soil stabilisation, rubble wall area, quantity of alien species expected to be removed, number of saplings, new trees and so on. This will in part depend on the outcome of environmental studies currently being conducted.
- A prudential approach to be adopted on account of the risk of losing the socio-economic value of the area without adequate intervention

Figure 7.1 depicts all the specific interventions in Buskett. These are than mapped to the Ecosystem services that will be enhanced with these interventions. The green boxes represent the methodology that will be undertaken so as to estimate the change over the current state.

Figure 7. 1: Post-Project Assessment





Source: Author's diagram

The analysis of the post-project assessment will include the mapping of softer interventions such as signage and publicity with results. Furthermore, the direct economic benefits of the project not related to the outcomes of the ecosystem restoration/protections, such as direct employment growth and income in producing the project deliverables will also be identified.

The focal point of the entire assessment is that the interventions will not necessarily increase the value of Buskett identified in the pre-project assessment but maintain and preserve the socio economic benefits.

8. Conclusion

The primary objective of this report has been to study the socio-economic benefits of Buskett, a unique wooded area in the Maltese Islands which is located within a Natura 2000 site. This serves as the basis of the pre-project assessment of a Life+ Nature project currently being undertaken within Buskett. The scope of this report has been to derive and where possible estimate the value of Buskett as well as the threats which jeopardise the conservation and protection of this value.

The assessment has been undertaken on the basis of the Toolkit developed by the Institute for European Environmental Policy focusing most notably on provisioning, cultural and social services, regulating services as well as supporting services offered by Natura 2000 sites.

By far, the most important services offered by Buskett and the surrounding area are provisioning, regulating services as well as a recreational, cultural and inspirational value. Table 6.1 below highlights the benefits which have been explained in the report and summarises the main quantitative indicators pertaining to Buskett and the surrounding area.

Of particular interest are the following elements:

- 149 ha of agricultural land within the Special Area of Conservation contribute to an output of about €600,000 per annum.
- The Natura 2000 site is located within the confines of a perched aquifer and the mean seawater acquifer. There are three permanent watercourses running through the Natura 2000 site and one of the watercourses has been identified as being directly dependent on springs flowing from the Rabat-Dingli groundwater body. The economic value of this which has been based on the shadow price of groundwater abstraction is estimated at about €3.5 million. The premise behind this economic valuation is based on the important role played by the SAC in maintaining the quality of water and in reducing the abstraction of groundwater particularly for agricultural use.
- The uniqueness of the site is evident by the fact that only 0.7% of the land area in Malta is considered to be a woodland (lowest in the EU) and Buskett constitutes the second largest woodland and the densest one.
- Visitor Survey estimated about 1,600 visitors to Buskett. This value however only captures the number of respondents. 52,000 visitors visit Buskett during the national feast of Mnarja. About 600 students visit Buskett on an annual basis for educational purposes.
- From a historical perspective, the Presidential Palace (summer residence) is located within Buskett and there are a number of scheduled architectural sites and heritage assets within the site.
- Total length of 56.9km of rubble walls aimed at minimising soil erosion. The replacement costs of the rubble walls is taken as an estimate of the avoided costs of soil erosion estimated at €8,200,000.
- Buskett woodlands covers about 30% of the forest area with the woodands absorbing an estimated value of about 150 tonnes of CO_2 equivalent to €4,000.
- Provision of habitats for biological control agents such as bats.

- This SAC is one of the most diverse and richest in biodiversity, supporting a variety of rare and endemic species. Indeed, and as such actions are necessary to safeguard or improve the conservation status.

Table 7. 1: Summary of Socio-Economic Importance of Natura 2000 Buskett and Girgenti

Ecosystem Services	Short description on the service	Relevant Quantitative Information	Quantitative value
Provisioning Services			
Food	This site includes fruit bearing trees and irrigated agricultural land	149 ha of agricultural land (61% of the SAC)	Value of Agricultural Activity within SAC (€ 600,000),Citrus Fruit in Buskett (€4,000)
Biomaterial	Reeds which is available due to its harvesting in the past.	Arundo Donax 4,407 m2	
Water quantity	The Natura 2000 site includes three permanent watercourses running through it. The source of water used for irrigation of agricultural land is almost entirely from local sources being extracted either directly from the groundwater or channelled from the watercourses.	The SAC is located within the confines of a perched aquifer and the mean seawater aquifer. A number of valleys are also sustained from the aquifer including valleys located within the SAC such as Wied tal-Isqof, Wied il-Buskett, Wied il-Luq, Wied x-Xaghri and Wied tal-Girgenti. Two specific watercourses have been identified as being directly dependent on springs flowing from the Rabat-Dingli groundwater body one of which is Wied il-Luq.	Applied shadow price of groundwater abstraction: 1- Rabat-Dingli Perched Aquifer (€3,200,000), 2 - Main Sea Level Aquifer (€290,000), 3 - Reservoirs (€3,000)
Cultural and Social Services			
Recreation for locals and foreign visitors, landscape and amenity	Buskett is a popular recreational site. Many visitors visit Buskett to relax, take long walks, picnics and other outside activities, contributing to well-being and improved quality of life. The site is important for migratory birds, most notably birds of prey that can be observed roosting in large numbers during the migratory season at this site.	Uniqueness of Buskett: 0.7% of land cover (lowest in EU), Buskett Visitor Assessment 1,600 individuals, Topic Paper MEPA 34,000 catchment area	
Cultural and Heritage values	Buskett is rich in cultural heritage including a number of archaeological features such as cart ruts and ancient quarries as well as scheduled monuments including the Verdala palace, the Knights' farmhouses, hunting lodge, and chapels.	Mnarja Feast: 52,000 visitors, Presidential Palace, Six farmhouses, numerous scheduled architecture and heritage assets	
Inspirational services (Educational Value, scientific value, artistic value, existence value)	The site has a great educational role for students to learn on Malta's nature and biodiversity and also learn on its importance for Malta's ecosystem.	About 500 to 600 students visit Buskett on an annual basis	

Regulating Services			
Climate change	Carbon sequestration by the semi-natural woodland	Buskett woodlands cover an area of 47ha equivalent to 30% of the total forest area in Malta	Buskett woodlands absorbs about -0.15362 Gg CO2/ha equivalent to (€4,000)
Air quality regulation	Plants filter air when they absorb it into their leaves for photosynthesis or respiration.	Malta would need around 437,817 of mature trees to absorb the entire amount of particulate matter emitted.	
Erosion control	Soil erosion involves soil detachment, movement and deposition elsewhere.	The total length of the rubble walls (as reported in the Management Plan) is 56.9km. Thin boundary walls are also identified in the figure which amounts to 28.5km.	Replacement cost of about €80/m2 results in a total value of (€8,200,000)
Storm Damage control / Water flow regulation	Forest areas intercept storm water and release this water over time thus water levels rise and fall less rapidly. This moderating effect on storm water runoff depends on tree density, ground flora, topography, soil and geological condition.		
Biological control	Provision of habitats for biological control agents,	Two bat species that are found in the Maltese Islands, Myotis punicus and Rhinolophus hipposideros, are listed in Annex II of the Habitats Directive forests – 0.6 Ha • Mediterranean pine forests with endemic Mesogean pines – 16.7 Ha.	
Genetic/species diversity maintenance	This SAC is one of the most diverse and richest in biodiversity, supporting a variety of rare and endemic species. It also hosts thea dense woodland which supports the largest concentration of woodland-associated species of invertebrates and mycoflora in Malta. Buskett, and the area around it, is also important as a concentration point for birds of prey, many of which are of international importance.	Conservation Status of Annex I habitats and Annex II species at Buskett Girgenti SAC	Transferable value of €55 per household per year results in an annual value for biodiversity creation of about (€9,300,000)

These benefits are however subject to threats as identified in the Management Plan. The most notable threats are related to the regulating services offered by Buskett and include collapsing rubble walls leading to soil erosion and to the build-up of silt in the watercourse, the invasive nature of alien species as well as the destruction of flora and fauna.

As a result, PARKS has embarked on a Life+ Nature project to specifically address these threats and to safeguard and maintain the socio-economic benefit of Buskett. This report has sought to provide the basis upon which the interventions of the project will be assessed in the post-project assessment.

Table 7. 2: Actions

Action C1: Repair/restoration/rebuilding of retaining walls, arched buttresses and stone slabs along watercourse supporting specific habitats. Action C2: Introduction of soil stabilisation measures including repair/restoration/rebuilding of retaining walls (not included in Action C1) supporting specific habitats along watercourse and on valley sides. Action C3: Selective removal of silt/boulders from parts of the watercourse Action C4: Removal of invasive alien species Action C5: Seed collection and planting of saplings of characteristic trees.

It is worth mentioning that the main interventions of the Life+ Nature project which are highlighted above have been specifically developed to address the threats to the site as highlighted in the Management Plan and thus will seek to maintain and where possible enhance the socio-economic value of Buskett.

References

AIS Environment Limited. 2014. *Baseline Surveys for inland surface and transitional waters-Hydromorphological, physicochemical and biological quality elements.*

Baron, B. 2007. A look at the Chiropteran Fauna of the Maltese Islands: Towards an effective Action Plan for their conservation. (12) Xjenza.

Baron, B. & Borg, J.J. 2011. Evidence of Niche Expansion in the Myotis punicus (Mammalia Chiroptera) of the Maltese Islands. S. IV. XXXV. Naturalista sicil.

E. Beltran, M. Rojas, Diversified funding in Mexican archaeology, Annals of Tourism Research 23 (1996) 463e478.

Borg, J.J., Violani, C., Zava, B. 1997. The Bat Fauna of the Maltese Islands. 35. Myotis.

Brussaard, L. Chapter 1.3 Ecosystem Services Provided by the Soil Biota in Wall, D.H., Bardgett, R.D., Behan-Pelletier, Herrick, J.E., Hefin Jones, T., Ritz, K, Six, J., Strong, D.R. & van der Putten, W.H. 2013. Soil Ecology and Ecosystem Services. Oxford Scholarship

Bugalho, M. 2009. Assessing Socio-economic Benefits of Natura 2000 – a Case Study on the ecosystem service provided by the Natural Park of Vale do Guadiana (Portugal). Output of the project Financing Natura 2000: Cost estimate and benefits of Natura 2000 (Contract No.: 070307/2007/484403/MAR/B2). 20 pp.

Bullock, C., Hawe, J., Little, D. 2014. Realising the ecosystem-service value of native woodland in Ireland. 44 (Suppl 1) 54. New Zealand Journal of Forestry Science.

Cassar, F.L. & Conrad, E. 2012. Buskett Visitor Assessment Study: September 2011 to June 2012.

Cruz, A de la, Benedicto, J. 2009. Assessing Socio-economic Benefits of Natura 2000 – a Case Study on the ecosystem service provided by SPA PICO DA VARA / RIBEIRA DO GUILHERME. Output of the project Financing Natura 2000: Cost estimate and benefits of Natura 2000 (Contract No.: 070307/2007/484403/MAR/B2). 43pp.

College of Tropical Agriculture and Human resources (CATHR). 2014. 'Soil formation'. [Online] Available from: http://www.ctahr.hawaii.edu/mauisoil/a_factor_form.aspx [Accessed December 2014].

Department for Environment, Food and Rural Affairs, UK. 2007. An introductory guide to valuing ecosystem services. Defra Publications

Díaz, S., Tilman, D., Fargione, J., Chapin, F.S. III, Dirzo, R., Ktzberber, T.et al. 2005. Biodiversity regulation of ecosystem services. In: Trends and Conditions (ed. MA). Island Press, Washington, DC

Epsilon International SA - Adi Associates Environmental Consultants Ltd Consortium. 2013. L-inħawi tal-Buskett u tal-Girgenti Natura 2000 [draft] Management Plan (SAC/SPA). MEPA.

European Commission. 2011. *Groundwater. About groundwater deterioration risks.* [Online]. Available:http://ec.europa.eu/environment/water/waterframework/groundwater/deterioration/index_en.htm

European Commission (EC). 2011. Proposal for a Regulation on the establishment of a Programme for the Environment and Climate Action (LIFE). Working paper

European Commission (EC). 2015. Environment. [Online] Available from: http://ec.europa.eu/environment/nature/natura2000/index_en.htm [Accessed 6th February 2015].

Everard M and Waters R. 2013. Ecosystem services assessment: How to do one in practice (Version 1, October 13). Institution of Environmental Sciences, London. www.ies-uk.org.uk/resources/ecosystem-services-assessment

Falzon, K. 1999. Biological Analyses of Pipistrelles (Pispistrellus sp.) for Conservation. Unpublished B.Sc. dissertation.

Farber, C. S., Costanza, R. & Wilson, A., W. 2002. Economic and ecological concepts for valuing ecosystem services. Ecological Economics 41 (2002) 375–392.

Finvers, M.A, 2008. Application of e2 DPSIR for analysis of soil protection issues and an assessment of British Columbia's soil protection legislation. M.Sc. Thesis. Cranfield University, UK.

Gantioler S., Rayment M., Bassi S., Kettunen M., McConville A., Landgrebe R., Gerdes H., ten Brink P. Costs and Socio-Economic Benefits associated with the Natura 2000 Network. Final report to the European Commission, DG Environment on Contract ENV.B.2/SER/2008/0038. Institute for European Environmental Policy / GHK / Ecologic, Brussels 2010

Glenville. P. & Cassar, E. 2015. Silt/Debris Flow Monitoring at Buskett Gardens - part of the EU LIFE Saving Buskett – Soil stabilisation measures to protect Annex I habitats in Buskett-Girgenti Natura 2000 site. DOCUMENT REF. NO: ENV332354/A/14. AIS Environment Limited, Fgura.
Haslam, S., Borg, J. 1998. The River Valleys of the Maltese Islands: environment and human impact. Valletta, E.I.S Univ. Of Malta) and CIHEAM.

Gust. D. "Why Study Photosynthesis?" Arizona State University, 25th June 2013. [Online] Available from: http://photoscience.la.asu.edu/photosyn/study.html [Accessed 6th February 2015].

Haslam, S., Borg, J. 1998. The River Valleys of the Maltese Islands: environment and human impact. Valletta, E.I.S Univ. Of Malta) and CIHEAM.

Jones. J.W., Hoogenboom. G., Porter. C.H., Boote. K.J., Batchelor. W.D., Hunt. L.A., Wilkens. P. W., Singh. U., Gijsman. A.J., & Ritchie. J.T. 2003. The DSSAT cropping system model. European Journal of Agronomy, Vol. 18 (2003) 235/265.

Kasso, M & Balakrishnan, M. 2013. Ecological and Economic Importance of Bats (Order Chiroptera). Hindawi Publishing Corporation.

Kazakova, Y., Pop, E. 2009. Assessing Socio-economic Benefits of Natura 2000 – a Case Study on the ecosystem services provided by Oaş-Gutâi Plateau and Igniş site, Maramures, Romania. Output of the project Financing Natura 2000: Cost estimate and benefits of Natura 2000 (Contract No: 070307/2007/484403/MAR/B2). 22 pp. + Annexes.

Kettunen, M., Bassi, S., Gantioler, S. & ten Brink, P. 2009. Assessing Socio-economic Benefits of Natura 2000 – a Toolkit for Practitioners (September 2009 Edition). Output of the European Commission Project Financing Natura 2000: Cost estimate and benefits of Natura 2000 (Contract No.: 070307/2007/484403/MAR/B2). Institute for European Environmental Policy (IEEP), Brussels, Belgium. 191 pp. + Annexes.

Kunz, T.H., Braun de Torrez, E., Bauer, D., Lobova, T., Fleming, T.H. 2011. Ecosystem services provided by bats. Annals of the New York Academy of Sciences.

Malta Competition and Consumer Affairs Authority. 2015. Guidance Document on Integrated Pest Management in the Maltese Islands.

Mansfield, E. & Yohe, E. 2004. Public goods, externalities and the Role of government. In: C. Granville, ed. 2004. *Microeconomics: theory/applications.* 11th Ed. New York: W.W. Norton and company, Inc. Ch.18.

Martinez, C.P. and Prantilla, E.B. 2007. 'Economic valuation of the groundwater in Dumoy aquifer'. 10th National Convention on statistics. October 1 – 2, 2007. [Online] Available: http://www.nscb.gov.ph/ncs/10thNCS/papers/contributed%20papers/cps-06/cps06-02.pdf

Medhurst, J., Slater. C., Pieterse, M. (GHK), Acoleyen, M. V. (ARCADIS), Zamparutti, T. (Milieu) & Gantioler, S. (IEEP). 2011. Combined Impact Assessment and Ex-ante Evaluation of the Review of the LIFE+ Regulation: Options Development – FINAL REPORT. Job Number 8300. Institute for European Environmental Policy (IEEP), Brussels, Belgium.

Malta Resources Authority (MRA). 2005. 'Initial Characterisation of the Groundwater Bodies within the Maltese Catchment District under the Water Policy Framework Regulations.

McPherson EG, Nowak D, Heisler G, Grimmond S, Souch C, Grant R, Rowntree R (1997) Quantifying urban forest structure, function, and value: The Chicago Urban Forest Climate Project 1083-8155 Urban Ecosystems. Kluwer Academic Publishers.

Malta Resource Authority (MRA). 2011. 'The Water Catchment Management Plan for the Maltese Islands'

Mudgal et al. 2001. *Estimating the Economic Value of the benefits provided by the tourism/recreation and employment supported by Natura 2000.* European Commission – DG Environment

Press, J. and Söderqvist, T. 1998 On Estimating the Benefits of Groundwater Protection: A Contingent Valuation Study in Milan, in: Timothy Swanson and Marco Vighi (eds) Regulating Chemical Accumulation in the Environment, 1998, Cambridge University Press, pp. 121-182.

Roose, E. 1996. Land husbandry components and strategy. Food and Agriculture Organisation of the United Nations.

Ruijgrok, E.M.C. 2006. The three economic values of cultural heritage. A case study in the Journal of Cultural Heritage.

J.A. Sanz, L.C. Herrero, A.M. Bedate, Contingent valuation and semiparametric methods: a case study of the National Museum of Sculpture in Valladolid, Spain, Journal of Cultural Economics 27 (2003) 241.

Saleh, W., Jayyoushi, A.N. and Almasri, N.M. (2010) '*Arab environment water. Sustainable management of a scarce resource. State of Freshwater Ecosystems, Chapter 3.'* 2010 Report of the Arab Forum for Environment and Development. [Online] Available. http://www.afedonline.org/Report2010/pdf/En/Chapter3.pdf

Siebert, H., 2005. *Economics of the environment: theory and policy*. 6th ed. New York: Springer Berlin Heidelberg.

Schirpke, U., Scolozzi, R. & De Marco, C., 2014. Modello dimostrativo di valutazione qualitativa e quantitativa dei servizi ecosistemici nei siti pilota. Parte1: Metodi di valutazione. [Online]. Available from: http://www.lifemgn-serviziecosistemici.eu/IT/docu/Pages/documgn.aspx [Accessed June 2015].

Saleh, W., Jayyoushi, A.N. and Almasri, N.M. (2010) '*Arab environment water. Sustainable management of a scarce resource. State of Freshwater Ecosystems, Chapter 3.'* 2010 Report of the Arab Forum for Environment and Development. [Online] Available. http://www.afedonline.org/Report2010/pdf/En/Chapter3.pdf

Spencer, D., Colby, L., Norris, G.R. 2013. An evaluation of flooding risks associated with Giant Reed (Arundo donax). 28 (3). Journal of Freshwater Ecology.

Shiel, A., Rayment, M., Burton, G. 2001. RSPB Reserves and Local Economies. Sandy, UK.

Stenger, A. and Willinger, M.: Preservation value for groundwater quality in a large aquifer: a 20 contingent-valuation study of the Alsatian aquifer, J. Environ. Manage., 53, 177–193, 1998.

Terracore. 2013. Service tender for a soil baseline survey. Project: ERDF 156. MEPA, Floriana.

Tietenberg, T., 2006. *Environmental economics and policy*. 5th ed. Boston: Pearson Education, Inc.

Turner, R.K. Pearce, D. & Bateman, I., 1994. *Environmental economics: an elementary introduction.* Cornwell: T.j. Press (Padstow) Ltd.

Thorsen, B.J., Mavsar, R., Tryvainen, L. 2014. The Provision of Forest Ecosystem Services. Volume II: Assessing cost of provision and designing economic instruments for ecosystem services. (5) What Science Can Tell Us.

ANNEX A

	ECOLOGICAL INFORMATION	
	Habitats Directive Annex I	
Code	**Habitat types**	**Conservation Status**
3170	Mediterranean temporary ponds	B
5230	Arborescent matorral with *Laurus nobilis*	B
5330	Thermo-Mediterranean and pre-desert scrub	B
8310	Caves not open to the public	B
92A0	*Salix alba* and *Populus alba* galleries	C
9320	*Olea* and *Ceratonia* forests	B
9340	*Quercus ilex* and *Quercus rotundifolia* forests	C
9540	Mediterranean pine forests with endemic Mesogean pines	A
	Birds Directive Annex I and Habitats Directive Annex II	
Code	**Species**	**Abundance Category in the site**
A086	*Accipiter nisus*	**V**
A294	*Acrocephalus paludicola*	**V**
A089	*Aquila pomarina*	**R**
A288	*Cettia cetti* (concentration)	**P**
A288	*Cettia cetti* (reproducing)	**P**
A081	*Circus aeruginosus*	**P**
A289	*Cisticola juncidis* (concentration)	**P**
A289	*Cisticola juncidis* (reproducing)	**P**
A122	*Crex crex*	**V**
1293	*Elaphe situla*	**R**
4092	*Elatine gussonei*	P
A101	*Falco biarmicus*	V
A100	*Falco eleonorae*	P
A095	*Falco naumanni*	P
A099	*Falco subbuteo*	P
A096	*Falco tinnunculus*	P
A359	*Fringilla coelebs* (wintering)	**R**
A359	*Fringilla coelebs* (reproducing)	**R**
A359	*Fringilla coelebs* (concentration)	C
A251	*Hirundo rustica* (concentration)	C
A251	*Hirundo rustica* (reproducing)	V
A341	*Lanius senator* (concentration)	C
A341	*Lanius senator* (reproducing)	V
A271	*Luscinia megarhynchos* (reproducing)	V
A271	*Luscinia megarhynchos* (concentration)	C
A319	*Muscicapa striata* (concentration)	C

A319	*Muscicapa striata* (reproducing)	R
1307	*Myotis blythii*	
4051	*Myrmecophilus baronii*	P
A072	*Pernis apivorus*	P
1395	*Petalophyllum ralfsii*	V
1303	*Rhinolophus hipposideros*	
A361	*Serinus serinus* (concentration)	C
A361	*Serinus serinus* (wintering)	R
A361	*Serinus serinus* (reproducing)	R
A305	*Sylvia melanocephala* (reproducing)	P
A305	*Sylvia melanocephala* (concentration)	P
A305	*Sylvia melanocephala* (permanent)	C

Abundance categories (Cat.): C = common, R = rare, V = very rare, P = present

SOURCE: NATURA 2000 - STANDARD DATA FORM

List of Interviews

Name	Ecosystem service	Company	Date/Time of Interview
Ms. Annalise Falzon	Recreation	Previously worked with Nature trust	14th September 2015
Dr. Ronald Cuschieri	Food	ELC	17th September 2015
Mr. Johann Gatt	Recreation (Education)	Eco-Skola	5th October 2015
Mr Eman Portelli	History/ Culture	Operations Manager Rural Development Department - Parks and Initiatives	12th October 2015
Mr. Mario Camilleri	History/ Culture	Events Administrator and Organiser Rural Development Department	14th October 2015
Mr. Nick Barbara	Conservation/ Ecosystem	Birdlife	5th November 2015