Greece on a sustainable future: reviewing constraints and practices regarding forest and water resources management, flora and fauna biodiversity

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Abstract: The forest policy in Greece and the current regulatory framework is not efficient in supporting the implementation of sustainability at a satisfactory level. The main scope of this study is to review and present constrains and practices across the sectors of forest and water resources management, flora and fauna biodiversity. The hypothesis is that common practices in the forest field combined with inefficient and obsolete legislation are responsible for delays in the implementation of a national forest policy, which will promote sustainability. A systematic reviewing methodology was applied so to ensure a rigorous and repeatable method of sustainability constraints identification and evaluation. The identification of the constraints can promote the improvement of legislation, the revision of common practices concerning the forest sector and finally can help the forest managers to better understand how to work effectively within legal, regulatory and operational environments deriving from forest policy.

Keywords: forest management; biodiversity; constraints; sustainability; SDGs; Greece.

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1 Introduction

Sustainable development goals (SDGs) were set by the United Nations (UN) in 2015, when 193 countries adopted an agenda, comprising of 17 Goals and 169 Targets, which are "integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental" (UN, 2015). The Goals and Targets encourage global, national and local level actions to be taken over 2030, affecting all critical areas of humanity. They entail challenges regarding coordination, responsibility, planning, arrangement, expertise and commitment (Allen et al., 2018). Forests and biodiversity are vital for achieving the SDGs, as they are significantly interlinked with food, energy production, health, water, economy, climate, etc. In the SDGs, forests are mentioned in specific targets of Goal 6 (clean water and sanitation) and Goal 15 (life on land). More precisely, SDG 6 mentions the protection of forests in Target 6.6, which focuses at "protecting and restoring water-related ecosystems, including mountains, forests, etc." (UN, 2015). SDG 15 focuses on "*the protection, restoration and promotion of sustainable use of terrestrial ecosystems and sustainable forest management as well as halting and reversing the loss of biodiversity and land degradation*". To accomplish Goal 15, UN members have to achieve 12 targets, from which three refer directly to forests (15.1, 15.2 and 15.B) and seven to biodiversity (15.1, 15.4, 15.5, 15.7, 15.8, 15.9, 15.A, 15C) (Table 1). The progress of the targets achievement may be measured through the use of pertinent indicators (UN, 2017; 2020).

According to the Sustainable Development Goals Report 2019 (UN, 2019), biodiversity loss is critical, with approximately one million species facing extinction. Concerning the implementation of the Agenda, the report depicts an unavailability of implementation means and financing (UN, 2019). Concerning forests and biodiversity in Goal 15, globally, there are some promising trends, portraying the increase of terrestrial ecosystems and biodiversity protection (plus financial assistance) and the decrease of

forest loss. On the other hand, biodiversity loss continues, and efforts for protection and restoration of ecosystems and species, are frustrated due to invasive species and poaching and trafficking of wildlife. A beating alarm, clearly portrayed in the Report (UN, 2019), is the deterioration of the Red List Index (risk of extinction), from 0.82 in 1993 to 0.73 globally in 2019 (a value of 1 indicates no threat, and a value of 0 indicates that all species are extinct).

The significance of mountain ecosystems is underlined in the Sustainable Development Goals Report 2019 (UN, 2019), where it is stated that healthy mountain ecosystems ensure the provision of ecosystem services to local communities. In the 2030 Agenda for the sustainable development (UN, 2015) the conservation of mountains is highlighted in the Declaration of Transforming our world, while their role is mentioned in Target 6.6 of SDG 6 (clean water and sanitation) and in targets of SDG 15 (life on land). In Goal 15 Target 15.1 maintains that 'By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements', and Target 15.4 'By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development'. According to article 18 of European Union's regulation 1257/99, mountains are defined as areas characterised by significant limitations of land use (EC, 1999). The criteria for less favoured mountainous areas that were established by the European Commission (EC, 1999) brought out the difficulties that these areas face (Nastis and Papanagiotou, 2009).

1.1 Forest and less favored areas (LFAs) management

Based on Table 1, more concern is given by the SDGs in conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, particularly forest ecosystems, aiming to promote the implementation of sustainable management, halt deforestation, restore degraded forests and increase afforestation and reforestation. Target 15B underlines the crucial need for stable financial support to sustainable forest management. According to Spanos et al. (2015), the main forest management approaches in Greece are wood and non-wood production, like resin, honey, wild plants, livestock, etc. Additionally, attention is given to the social uses like wildlife, recreation and hunting. Greece, as other Mediterranean countries, is a net importer of wood and wood products (Koulelis, 2019). The geographical and the climate conditions in Greece are not allowing important production of wood and wood products (Koulelis, 2016). Most of the forest area is located at high mountains and slopes and the production is limited. Although, Mediterranean forest products and services have represented a fundamental factor in the life of local inhabitants for centuries. Traditionally, the forest sector, including all economic activities that mostly depend on the production of goods and services from forests, makes a significant contribution to necessary social changes and sustainable economic development of the rural community (Koulelis, 2019). Considered that more than 63.5% of the forests are state-owned, 12% are owned by local communities and the rest 22.5% are privately-owned (by monasteries or individuals, etc.), the major stakeholder of the Greek forests is the state (FAO/FRA, 2015). Thus, Greek authorities are responsible for the long-term implementation of SDGs and for the implementation and the updating of the legislation and practices that are common in the forest sector. Even with the management of private owned forests, the

final management plan must be authorised by the local forest service, considering that same laws are applied in public and in private forests. This type of administration seems to be very state-centered, followed by weaknesses like bureaucracy or slow decision-making. On the other hand, this administration offers a relative security in terms of strict law enforcement and the protection of the forests. Many propose that the forest owner association of Greece, even that at national level represents a small private forestry sector, must play a more active role in policy and decision making. Even though, Greek construction industry has been severely struck by the recent financial crisis (Koulelis, 2016), the more effective promotion of domestic tree species and the competitive and certified timber production should be adopted, as tools that can facilitate the implementation of the latter scope.

Under the climate change concept, regional and global climate simulations, project (medium confidence) an increase in duration and intensity of droughts in Central and Southern Europe and the Mediterranean up until the UK for different definitions of drought (Feyen et al., 2012; Gao and Giorgi, 2008; Koutroulis et al., 2010; Tsanis et al., 2011; Vidal and Wade, 2009). Even in regions where summer precipitation is expected to increase, soil moisture and hydrological droughts may become more severe as a result of increasing evapotranspiration (Wong et al., 2011). Projected changes in the length of meteorological dry spells show that the increase is large in Southern Europe (Kovats et al., 2014) an increasing risk of wildfires over next decades. It's well known in Greece that the past large wildfires had both socio-economic (including loss of human lives, properties and other infrastructures) and ecological (degradation of forest cover and loss of biodiversity) consequences. The future of forest ecosystems, under the changes of climate and the characterisation of the Mediterranean basin as a climate change 'hotspot' demands important deep changes and redefinition of the institutional balance between state and private initiatives.

Concerning less favoured areas (LFAs), their development is a top priority for the European Union (Eliasson, 2010). For Greece in particular, LFAs are of great importance, since many regions of the Greek countryside can be classified as such. Greece follows the legal framework of the European Union regarding Less favoured areas, determined by Council Directive No 1698/2005 (EC 2005) which replaced the previous Council Directive No 1257/1999 (EC 1999). The criteria for LFA designation were first established in European legislation in 1975 (Directive 75/268 EEC and accompanying measures). The vast majority of less favoured areas (LFAs) in Greece is situated in mountainous areas, since Greece is a mountainous country, almost 80% of the country is covered with more than 300 mountains. Post 2020 common agricultural policy (CAP) of the European Union plans to support LFAs only with funding that directly targets environmental gains, excluding compensation for farming in areas with natural disadvantages (EC, 2019). Oxouzi et al. (2012) proved that compensatory allowances promote the profitability in mountainous less favoured areas; however, the production of more competitive and better quality goods is suggested as a way forward for LFAs in the absence of adequate financial support. Moreover, mountainous agricultural food products, such as olives and olive oil, wine, cherries, etc., are an additional income source for the residents of LFAs (Nastis and Papanagiotou, 2009).

Tsiaras and Spanos (2017) found that forestation (either for timber, production of fruits and nuts or environmental services) through tree planting that takes into consideration the special characteristics of each area can contribute to the sustainable development of mountainous less favoured areas of Greece. The role of local conditions

to the development of LFAs in Greece was also pinpointed by Kizos et al. (2011), while the role of local stakeholders in pursuit of sustainable development in less favoured areas of Greece was also well documented (Koutsouris, 2009; Tsiaras and Andreopoulou, 2015).

Table 1 Targets aiming to forests and biodiversity conservation, derived from Goal 6 and Goal 15

Goal 6. Ensure availability and sustainable management of water and sanitation for all
6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.
Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
15.1 Ensure conservation, restoration and sustainable use.
15.2 Promote the implementation of sustainable management of all types of forests.
15.4 Ensure the conservation of mountain ecosystems, including their biodiversity.
15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity.
15.7 Take urgent action to end poaching and trafficking of protected species of flora and fauna.
15.8 Introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species.
15.9 Integrate ecosystem and biodiversity values into national and local planning, development processes.
15.A Mobilise and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems.
15.B Mobilise significant resources from all sources and at all levels to finance sustainable forest management.
15.C Enhance global support for efforts to combat poaching and trafficking of protected species, including by increasing the capacity of local communities to pursue sustainable livelihood opportunities.

Source: UN General Assembly (2015)

1.2 Flora and fauna biodiversity

The Greek constitution (Article 24) defines that the protection of the natural and cultural environment is a state obligation and a citizen's right. There are also various legislation initiatives, covering various environmental aspects, some of which are: Forest management (forest code of Greece), species protection, conservation of indigenous farm animal breeds, structural environment and protected areas.

Greece is considered as a 'hot spot' concerning biodiversity, because more than 7,000 native plant taxa established there, with 20% being endemic. The vascular flora of Greece comprises 5,885 species and 2,000 subspecies (native and naturalised), representing 6,760 taxa, belonging to 1,087 genera and 184 families. The flora of Greece is unique in Europe for its richness and its large analogy of endemic species in relation to its size (Dimopoulos et al., 2013; 2016; Solomou and Sfougaris, 2021). A large number of plants has found their ideal habitats due to the large diversity of biotopes and ecosystems, responsible for this phenomenon. The geographical setting of Greece as a

"meeting point" of three continents (Europe, Asia, Africa), its mild Mediterranean climate, intense relief, vast lacy beaches, its numerous islands and of course its rich palaeogeographical history, have resulted in key and unique habitats for Europe and the planet (CBD 2010, EC 2019).

Greek fauna embrace 23,130 species of land and freshwater animals, of which 3,956 are endemic and 3,500 marine species (Fauna Europaea Web Service, 2004; Legakis and Maragkou, 2009). The large diversity of the Greek flora is justified by an equally large diversity of its fauna. In the first place, during the Ice Ages the Hellenic territory posed as a refuge for the animals from N. Europe. Another important issue is the large variety of biomes found even in relatively small areas where several habitats can be observed. This fact has contributed to the formation and development of different isolated populations of wildlife, which accordingly have evolved into new species/subspecies, creating endemism (CBD 2010, EC 2019).

In summary, in terms of biodiversity and its conservation, Law 3937 has existed since 2011 (Greek OJ number 60/A of 31.3.2011) and its status is constantly monitored by the Ministry of Environment, Energy and Climate Change. In 2014 a National Strategy for biodiversity was approved to be implemented until 2029 (Greek OJ number 2383 of 8.11.2014), (Ministry of Environment, Energy and Climate Change, 2014), energy and climate change (Ministry of Environment, Energy and Climate Change, 2014). In 2017, Law 4495/2017 was approved for the Control and Protection of the Structured Environment (Greek OJ number 167/A of 3.11.2017), and JMD 50743/2017 for the Revision of the national catalog of areas falling under the European Ecological Network Natura 2000 (Joint Ministerial Decision number 4432/B of 15.12.2017).

In the context of climate change and fauna, forest health and adaptation of forest management are closely linked. Forest trees are increasingly affected by a multitude of factors directly related to climate change. The recent increase of the international trade is expected to increase or facilitate the invasions of numerous insects and other arthropods, vertebrates, and pathogens (fungi, bacteria, viruses). The invaded ecosystem, comprises plants and animals not equipped with the proper defense mechanisms to confront the invading taxa (Ramsfield et al., 2016; Trumbore et al., 2015). In effect, the climate change is expected to cause an issue more noticeable in the animal biodiversity of the landscapes but the outcome is not simple (Jactel et al., 2019). For instance, while most of the responses of insects to climate change effects are beneficial (shorter generation times, more food for herbivores, higher fecundity, higher survival, which allows pest species to cause greater damage during the growing season) there are other hostile factors like the increase in number and efficiency of natural enemies, phenological mismatch between an insect and its plant or insect food (Ramsfield et al., 2016). All these phenomena will be accelerated because of the geographic expansion of many insects and other animal pests.

1.3 Water resources management as concerned to forests and biodiversity

Sustainable development goals are intertwined as, for example, forests and biodiversity are directly connected to water. Access to safe water, sanitation and hygiene are still lacking in many places in the world and this challenge becomes an urgency in cases as COVID-19 pandemic. Ensuring access to water has been a priority for a long time, but nowadays it is more than essential that all countries sustainably manage their water (UN, 2015). In this regard, by 2030, sustainable development goals on water resources management require the achievement of access to safe water, sanitation and hygiene,

improvement of water quality, reuse and recycling, water resources management integration at all levels and finally international cooperation and support (UN, 2015). Water resources management of a country highly affects its forests and biodiversity, as droughts or floods may directly result in related irreversible impacts. For example, droughts are responsible for increased tree mortality (Colangelo et al., 2018; Schuldt et al., 2020) or species migration (Dale et al., 2001; Hanson and Weltzin, 2000). Significant progress has been made towards the set targets, but still there is a lot to accomplish to reach the set goals worldwide.

The water framework directive 2000/60/EC of the European Parliament (WFD - 2000/60/EC) and of the European Council of 23 October 2000 are establishing a framework for Community action in the field of water policy, is incorporated into the Greek national legislation through the enforcement of Law 3199/9-12-2003 (Greek OJ number 280A of 9.12.2003) on "water protection and the sustainable management of the water resources". River basin water management and water pricing are set into force to protect and restore deteriorated water resources, to reduce groundwater pollution and to prevent its further deterioration. Furthermore, Law 3199/03 encompasses actions towards the mitigation of flood and drought impacts and enforces for all water resources the 'polluter pays principle' and the aim of a 'good ecological status'. Concerning transboundary water Law 3199/03 introduces transnational cooperation approaches as well. Concerning drinking water, EU Directive 98/83/EC sets drinking water quality standards and as reported by Karavoltsos et al. (2008) Greece and especially Athens and Thessaloniki, where more than half of the Greek population lives, present very good water quality. In other Greek areas, problems in water quality arise and they are mainly caused by the very old or poorly maintained distribution systems (Karavoltsos et al, 2008). Another problem to deal with in water resources management in Greece is the high freshwater abstraction for public water supply, where Greece, among the EU Member States, over-abstracts water (with 157 m^3 of water per inhabitant in Greece, to a low of 30 m^3 per inhabitant in Malta) (EUROSTAT, 2021). Finally, according to the voluntary national review on the implementation of the 2030 agenda for sustainable development, which was reported to EU in July 2018 (UN, 2018), by the Greek government, there is some progress achieved towards SDG 6, target 6.6 (related to protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes). More precisely, policy and legislative frameworks were developed at national and European level towards the sustainable management of ecosystems, forest land and natural resources (water). Greece's natural vegetation and wild species are very rich, thus measures to combat desertification and conventions on climate change and biological diversity are made to promote conservation and biodiversity. In addition, in order to improve forest sustainability, restoration and maintenance, actions are taken to boost investments in the development of forest areas.

2 Materials and methods

Aiming to a systematic research to discover the necessary knowledge through describing the sustainability context at national level -across the mentioned sectors – a document-reviewing analysis was adopted. Document analysis is a systematic procedure for reviewing or evaluating documents–both printed and electronic (computer-based and Internet-transmitted) material, which requires that data are examined and interpreted to

elicit meaning, gain understanding, and develop empirical knowledge (Corbin and Strauss, 2008; Rapley, 2007). As Bowen (2009) reported, documents that may be used for systematic evaluation as part of a study, take a variety of forms. The approach of this study mostly follows public records of legislation, papers, books and journals which are related to forest and water management and biodiversity. Following that, the study employs literature reviewing, personal practical knowledge and statements of the authors as well, to achieve convergence and corroboration.

3 Results and discussion

SDG Target 15.B points towards financing sustainable forest management and mobilising significant resources. In contrast, Spanos et al. (2015) reported the issue of the weak financing in forestry in general and the lack of investment in the exploitation of the potential of forest resources. The issue of poor financing seems to be listed also at the national forestry strategic plan (2018) (from now on NFS) (Article 7). In addition, Kazana et al. (2015) included the lack of funds in forest management plan studies and Koulelis (2011) referred that the motives offered for private investments in the timber sector are deficient. Targets 15.1 and 15.2. promote the implementation of sustainable forest management of all types of forests. Spanos et al. (2015) mentioned that in Greece the logging system is problematic, with deficiencies in the organisation of wood harvesting in forests, and significant negative effects, both on forestry working operations and the forest. They claimed that practices like substantial supervision by foresters play their negative role. Furthermore, inefficient and outdated management practices make it difficult to continue logging operations and forest production especially in environmentally sensitive areas (Natura 2000 Network, National Parks, Aesthetic Forests). The high cost and the outdated methods of harvesting and production, the highland terrain of the Greek mountains and the low level of automation in harvesting increase production and transportation costs (Koulelis, 2016). Kazana et al. (2015) also added the exploitation system of public forest and the outdated forest management plans standards in the weaknesses factors of a SWOT analysis for sustainable forest management and monitoring in Northern Greece. Moreover, deficiencies in the information system and statistical forestry, an administration system of forestry services not performing well and incomplete support for forestry research are reported by Spanos et al. (2015). The lack of know-how (new technologies and tools) and inefficient forestry legislation are referred by Kazana et al. (2015), while complicated forest legislation is reported by Solomou et al. (2015). Incomplete support for forestry research is also underlined by Spanos et al. (2015). The authors' view on this issue converges. Forest research enhances the protection and exploitation of the national forest resources at the same time. Inadequate standardisation of forest products, problematic exploitation of timber and other forest products, lack of modern systems in quality certification of wood and forest management, are some expressions of the common observed constraint of the lack of a national forest products certification system (Georgiadis and Cooper, 2007; Kazana et al., 2015; Koulelis, 2011; Spanos et al., 2015).

At the same time, Tsiaras (2018) underlined the lack of a common forest policy framework within the European Union as a major constraint for the forest sector in Greece and therefore for the sustainability of mountainous less favoured areas. Furthermore, the absence of a strategic plan at national level for less favoured areas in

Greece is also an obstacle for the sustainable development of LFAs (Tsiaras and Andreopoulou, 2015). Micha et al. (2015) designated that people living in Less Favoured Areas of Greece perceive as corrupted the implementation of policies regarding rural development. The same study indicated that psychological constraints are also important to local population of LFAs and have as a result a cautious attitude towards governmental policies.

According to Soulis et al. (2018) climate variability is another serious constraint for the sustainable development of LFAs in Greece and its importance increases taking into consideration the effects of climate change in forests in mountains of Greece (Zindros et al., 2020). However, Zindros et al. (2020) attributed the significant increase of forest cover in Olympus mountain in the last 60 years to climate change, asserting that warmer summers caused an upward shift to the tree line.

Finally, the above-mentioned constraints may be validated, as recently, in 2018, a National Strategy for Forests was established in Greece (NFS 2018–2038) to address them through respective actions.

Before the latest strategy, like other countries in Mediterranean region, Greece had engaged in a National Forest Programme process aiming to sustainable forest management, improve forest governance and develop more cross-sectoral and participatory approaches for the development, implementation and evaluation of the forest policy. The future seems more promising, due to that new forest strategy is more focused to objectives like:

a The forest management contribution to socio economic development and the promotion of forest goods and services.

b The promotion of resilience under global changes.

c The enhancement of capacities and the mobilisation of resources.

Regarding biodiversity constraints, Solomou (2013) reported that due to insufficient scientific data on the individual components of biodiversity and their characteristic trends, appropriate measures should be taken, such as optimising the boundaries of protected areas. Dimopoulos et al. (2006) indicated that as there is a lack of monitoring data, we cannot hope for a fruitful decision-making which is vital for the implementation of conservation strategies. Moreover, Solomou and Sfougaris (2011) have underlined the need for distinguishing spatial-temporal biodiversity changes, through monitoring for a better designation of conservation efforts and overall assessment of the progress towards the relevant targets. In addition, Ministry of Environment, Energy and Climate Change (2014) focused on the partial or non-partial implementation of the existing institutional framework, which so far, is unfortunately unable to prevent certain illegal activities (poaching, overfishing, arsons, etc.). Another serious drawback is the lack of environmental awareness in general and more specifically of those engaged in agro-productive activities, who do not always make environmentally friendly choices. Besides, there are some more impediments harming the biodiversity cause:

a the non-integration of sustainability principles in productive activities

b the lack of stable funding causing protected areas to be understaffed, without solid management structures

c the lack of specialised and adequately staffed services (both central and regional) (EKBY, 2020; Nature and biodiversity of Greece, 2020; Ministry of Environment, Energy and Climate Change, 2014; Solomou, 2013; Solomou and Sfougaris, 2011).

It is important to be mentioned that despite the provision of the contract for biodiversity and the fact that Greece has ratified the Convention since 1994 (Law 2204/1994), it took 20 years to complete and adopt the National strategy for biodiversity (Joint Ministerial Decision number 40332/2014). The national strategy has a duration of 15 years. The duration starts practically in the middle of the UN Decade on Biodiversity, and covers almost the entire UN Decade on Ecosystem Restoration, as it will be formally completed in 2029. Its structure follows the structure of the strategic framework of the Convention on Ecological Biodiversity and the EU 2020 Strategy. Also, it includes a long-term vision for 2050 and a general goal for fifteen years, with an intermediate milestone for 2026. It is noteworthy that the adoption of the first National Biodiversity Strategy is an important milestone in national biodiversity conservation policy precisely because it focused more to objectives such as the halting of biodiversity loss and the degradation of the ecosystem functions of Greece until 2026, their restoration, where necessary and possible, the promotion of biodiversity as a national asset, as well as the intensification of Greece contribution to preventing the biodiversity loss worldwide (The Green Tank, 2020).

The strategy of the police makers to address forest health issues and potential dangers is controversial. While aerial spray of biocides and other substances is stopped, the treatment of arthropod pests with sprayed chemicals is a common practice in agricultural land parcels neighbouring forest areas. Even in urban forests the insecticide application is a common practice. The usual implementation of the pest control measures is the political decision for the "exception of the arthropod pest incidence from the exclusion of spray in urban areas". The case of Metcalfa pruinosa (Hemiptera, Auchenorrhyncha) in the urban trees of the city of Corfu is such a case. The problem is that the affected organisms in such 'exceptional' cases are the arthropods that collectively configure the high biodiversity of Greek landscapes. The lepidopteran insects on Mt Parnitha were a few years ago more or less 60 species. Among them Parnassius mnemocyne, Zerynthia polyxena, Iphiclides podalirius, and Aporia crataegi are IUCN listed as LC (Least Concern) (Van Swaay et al., 2010). These butterflies became locally extinct or extremely rare after the aerial sprayings (now abolished by law) and the introductions of the honey dew producing pine scale (Marchallina hellenica [Hemiptera, Sternorrhyncha, Coccoidea]) by bee keepers (Petrakis et al., 2010). The introduction of M. hellenica in previously unoccupied places caused an overall reduction in the biodiversity mainly due to the exploitation of food resources on the pine tree (mostly Pinus brutia and P. halepensis) and environmental factors. The sprayings with insecticides in urban places in order to stop the progression of the insect on pine trees in forests is now abolished by a decision of the Greek supreme court (Greek Supreme Court, 2006). The spread of the pine scale was previously financed by the Ministry of agriculture with ~2.5 M $ / 1997. The recipients of the funds were university departments, institutes and beekeeper cooperatives. After the aforementioned decision of the supreme court and the disapprovals of many citizens' associations Greek state stopped funding of the pine scale spread. However, the practice of introductions of the insect in many pine forests is continued by individual beekeepers (Petrakis et al., 2011). Finally, in the last decade the ecological associations and the increasing participation in the market of organic agroforestry products forced political authorities to manage forests in an ecologically

compatible way involving semiochemicals / infochemicals, release of beneficial insects reared from local genetic stock in insect farms and ecologically sound forest management.

Though the pertinent laws are in force, it seems that Greece still overexploits its limited groundwater reserves resulting in high contamination percentages and intrusion of seawater. Moreover, the lack of the required water infrastructure does not allow the usage of its extensive surface water potential (Karavitis, 2008). The latter makes the country highly dependent on the annual rainfall and temperature patterns, meaning that any water shortage or any unexpected temperature variation may initiate, major impacts on environment (forests, species, etc.) and society. Greece is characterised as drought prone, given that severe droughts have occurred in consequent time periods (e.g., 1989–90, 1993, 2000, 2003 and 2007) (Karavitis, 1998, 1999; Karavitis et al., 2014; Loukas et al., 2007; Livada and Assimakopoulos, 2007; Tsakiris and Vangelis, 2004; Tsesmelis et al., 2019; Vasiliades et al., 2009) affecting all kind of life (humans, animals, plants). Unfortunately, it is still not clear whether the impacts of these extreme events are intensified due to the extreme water deficiency or due to the lack of local or country level contingency planning and drought management (Karavitis 1992, 1998, 1999; Karavitis et al., 2012; Tsesmelis et al., 2019).

4 Conclusions

Constraints such as the lack of resources by the government, bureaucracy, lack of investments and a forest certification system, weak private forest sector and inefficient logging system were detected. Likewise, the lack of effective monitoring of biodiversity, lack of specialised and adequately staffed services, lack of stable funding, knowledge gaps, poorly performing system administration, lack of the required water infrastructure and the ineffective law enforcement simultaneously with the intermittent productive relationships between public administration, academia and other authorities were detected as the most common constraints across the examined sectors towards sustainability. One main vision of the national forest strategy (NFS) is to "Ensure sustainability and increase the contribution of forest ecosystems to the country's economy through multifunctionality, adaptability and strengthening their socio-economic role" (Article 2), a vision totally compatible with the SDG 15 and its targets. From now on, it must be proven in time that all these proposed actions will be implemented. The recent legislation of NFS, adopting the Mediterranean forestry model, could increase the contribution of forests in the country's GDP. Any new forestry-related legislation submitted for voting should consider both the SDGs and the national strategy vision.

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