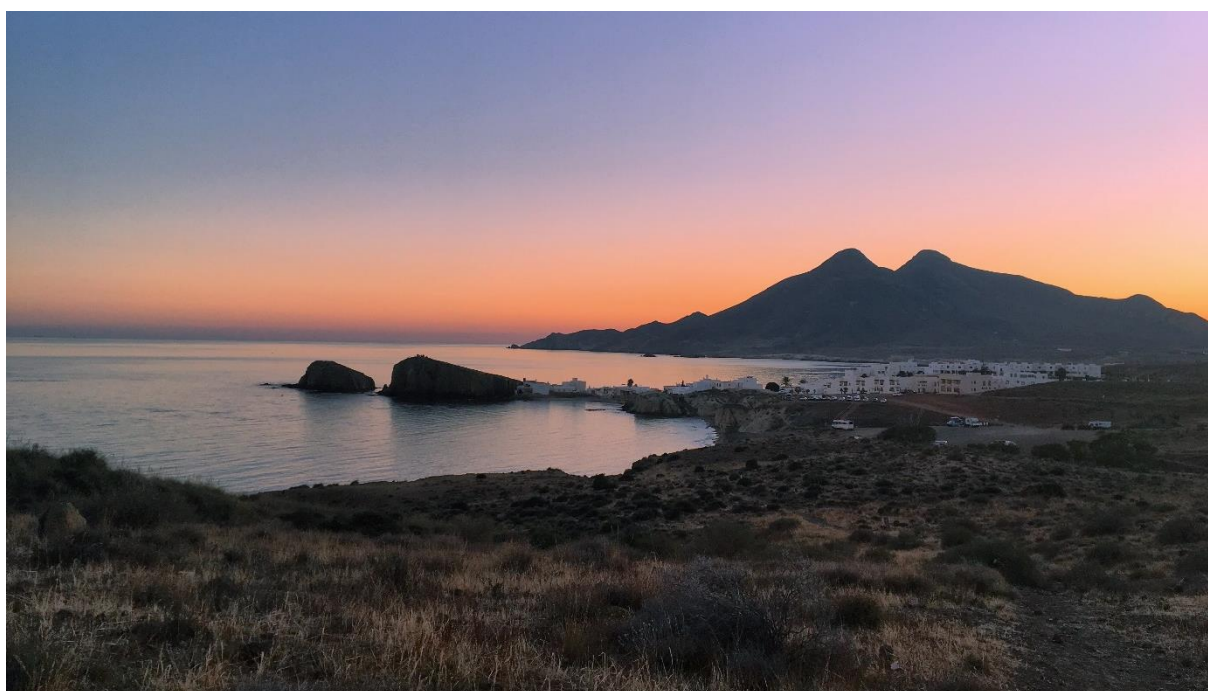


The Ecological Footprint and biocapacity Balance of DestiMED PLUS Destinations

Analysis of the Sustainability Baselines for Ecotourism
Packages (Preliminary Version)



DestiMED PLUS Project

Ecotourism in Mediterranean Destinations: From
Monitoring and Planning to Promotion and Policy Support

Developed by:
IUCN Med



With support from:
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Executive Summary

The Mediterranean Region is one of the world's richest regions in terms of ecosystems and species diversity. This region is also one of the top tourist destinations in the world, thus the tourism sector is fundamental for the region's economy. Developing tourism while protecting ecosystems and biodiversity is a unique opportunity, as highlighted in the DestiMED Plus Project. This report - "The Ecological Footprint and biocapacity balance of DestiMED Plus destinations: analysis of the sustainability baseline for ecotourism package" – provides an assessment of the Ecological Footprint and biocapacity of the countries and local administrative regions where DestiMED Plus's pilot Protected Areas (PAs) are located, and discusses the implications of current resource supply and use in these regions for the development of tourist offers.

Method

Ecological Footprint and biocapacity accounting, a methodology developed by Global Footprint Network, is used here to track competing demands on the planet's regenerative capacity by comparing human demand for and ecosystems' supply of ecological assets. A Multi Regional Input-Output (MRIO) assessment is also used in this report to translate the land-based Ecological Footprint results into activity-based Ecological Footprint results, thus indicating the human activities responsible for demands on our planet's ecological assets.

Results and Recommendations

The full report details biocapacity and Ecological Footprint results for the 6 countries, 9 NUTS II regions and PAs involved in the DestiMED Plus Project. Here the main outcomes of the analysis are listed:

- All countries in the DestiMED Plus Project run a situation of ecological deficit, implying a human pressure beyond the local ecosystems' limits and a dependence on resources and services from ecosystems outside the national borders to satisfy the demands of residents and tourists.
- Six regions including Albania South (Albania), South Aegean (Greece), Crete (Greece), Lazio (Italy), Catalonia (Spain), and Andalusia (Spain) show a situation of ecological deficit. These regions should pay careful attention in the management of future tourism inflow to their areas as their ecosystems are already under pressure from the overconsumption of resources by their own residents.
- Three regions including Corsica (France), Jadranska Hrvatska (Croatia), and Sardinia (Italy) show a situation of ecological reserve, in which local ecological assets are providing more resources and services than those actually demanded by the local residents. According to the biocapacity analysis, forests and fishing grounds are the fundamental "ecological assets" of these regions (i.e., biocapacity hotspot) and their preservation should be prioritized. As such, tourism offerings should be developed with special attention to safeguarding forest ecosystems and fishing grounds.
- Food, transportation, and housing are the main drivers of the Ecological Footprint in all regions. A dedicated effort to manage these drivers through ecotourism best practices should be considered.
- Reshaping the tourism offerings in all PA regions – e.g., by developing ecotourism - has the potential to reduce the environmental pressure on the local territories thanks to an increased awareness between local stakeholders and service providers, and the spreading of environmentally friendly best practices across the territory.
- As seen with the service providers involved in the DestiMED Plus project, involving local tourism stakeholders in the development and monitoring of sustainable tourism alternatives can constitute a way to increase their environmental awareness and influence their daily practices, thus triggering positive cascade effects throughout territories.

Conclusion

From a destination point of view, this situation of an existing unbalance between resource consumption and supply creates a vicious circle when tourism is considered: the inflow of tourists in the region is likely to worsen the pressure on ecosystems and increase the consumption of resources; in turn, the overconsumption of natural resources and deterioration of the natural capital compromise the local tourism offer. Ecological balances results presented in this report thus support the DestiMED Plus Project objective of developing and promoting carefully managed and monitored ecotourism offers as a viable alternative to mass tourism in Protected Areas.

1 Introduction and aim of this report

This document represents deliverable 3.3.3 “Environment and biocapacity baseline” of the DestiMED Plus Project, aiming at defining ecological baselines for sustainable tourism at Mediterranean Region level. To this end, this document provides an assessment of the Ecological Footprint and biocapacity of the whole region (the Mediterranean basin) and of the territories (countries and local administrative regions) where the DestiMED Plus pilot Protected Areas are located. The scope of this analysis is to assess *ecological balances* (i.e., a situation of deficit or reserve of natural resources) for the selected 9 destinations to shed light on those areas that, being eventually characterized by negative ecological balances (i.e., ecological deficits), are most in need of including a sustainability perspective in their ongoing actions, such as the development of tourism products.

Behind this approach is the realization that managing sustainability ultimately implies dealing with the planet’s capacity to support human societies. Living within the means of the only planet we have is the starting point to creating a future society where all people can thrive. *One Planet* is not a goal, but a reality which we must acknowledge and manage: how can policy makers guide our transition into the future considering humanity is already demanding more than Earth’s ecosystems can renew? How do we serve an expanding global population with legitimate growth aspirations (as put forth in the Sustainable Development Goals) while phasing out fossil fuels within a few decades (as promised in the Paris Agreement developed at COP21)? How to reconcile human development and aspirations with the protection of the planet’s ecosystems and its biodiversity (as intended through the Aichi Biodiversity Targets and the coming post-2020 biodiversity strategy)?

The Ecological Footprint is one of the most widely used and recognized integrated sustainability indicators for human pressure on ecosystems. It measures the renewable natural resources and ecological services demanded because of a population’s consumption activities and compares that to what ecosystems can provide, namely biocapacity. It provides a unique framework to compare different consumption activities and sectors within an economy, in terms of the pressure they generate on the environment.

The aim of this report is thus to first describe the Ecological Footprint methodology applied at national and local level, based on the standard methodology deployed by Global Footprint Network (Chapter 2). We then provide simple guidelines on how to interpret Ecological Footprint and biocapacity analysis (Chapter 3). Results are shown in chapter 4 for the Mediterranean region as well as the 6 countries and 9 administrative territories involved in the project. Ecological Footprint assessment is given at national and NUTS 2 (i.e., province) level, while biocapacity assessment is provided at national, NUTS 2 and Protected Area (PA) level.

2 Methodology

2.1 Overview: Ecological Footprint Accounting

Human socio-economic activities fundamentally depend on the capacity of the planet's ecosystems to provide primary resources (e.g., food and fibers) and life-supporting services (e.g., sequestering carbon emissions). As such, Ecological Footprint accounting measures humanity's appropriation of key ecosystems' services (Mancini et al., 2018a) by answering a simple research question: *How much of the planet's (or a region's) regenerative capacity does a specific activity (or a set of activities) require from nature?*

To measure and map human dependence on biocapacity, Ecological Footprint accounting relies on two principles: additivity and equivalence.

Additivity: given that human life competes for biologically productive surfaces, these surface areas can be summed. The Ecological Footprint (EF) adds up all human demands on nature that compete for biologically productive space, such as providing natural resources, accommodating urban infrastructure, or absorbing excess carbon from burning fossil fuels. The Ecological Footprint then becomes comparable to the available biologically productive space, or biocapacity (BC).

Equivalence: biologically productive areas vary in their ability to produce ecosystem services (i.e., biological resources and services used by people). Therefore, areas are scaled proportionally to their biological productivity. As such, the unit of measurement for Ecological Footprint accounting, the **global hectare (gha)**, represents a rate of biological regeneration equal to that of a world-average biologically productive hectare (see also Box 2.1). This regenerative productivity can be used for resource production, waste sequestration, or physical occupation, which are mutually exclusive (e.g., urban infrastructure can occupy productive areas).

BOX 2.1 - What is a global hectare?

A global hectare (gha) is an area-equivalent unit representing the capacity of a hectare of land with world-average productivity. Dividing the total biocapacity of Earth by the total number of bioproductive hectares yields the value of an average "global hectare". A gha is a measure of the inherent capacity of the biosphere to produce useful biomass that is harvested by humans.

A parallel with the unit CO₂eq can further clarify the nature of this unit. The release of 1 ton of CO₂eq does not mean that this amount has actually been released. Rather, it means that various greenhouse gases with the equivalent global warming potential of 1 ton of CO₂ have been released. Similarly, having an Ecological Footprint of 2.8 gha does not mean that 2.8 ha of physical land are used. It rather means that the equivalent capacity of 2.8 ha of land with world average productivity is needed to produce (via photosynthesis) the resources and services one demands – this biocapacity could be anywhere in the world and could be originating from an actual land area smaller or larger than 2.8 hectares.

The most widely used application of Ecological Footprint accounting is the National Footprint Accounts (NFAs), a framework annually published by Global Footprint Network, which provides annual accounts of biocapacity and Ecological Footprint for the world and nearly 200 countries, with historical data reaching back to 1961¹ (Lin et al., 2018); each NFAs edition provides updated results for the entire accounting timeline.

Describing Ecological Footprint Accounting at a glance goes as follow: for each country included in the NFAs, data on the amount of natural resources (e.g., food, fibers, timber, etc.) demanded (or carbon dioxide released) is first divided by the yield (or average carbon sequestration) of the ecological assets (i.e., land type) providing such resource (or sequestration services). The values obtained are then multiplied by equivalence factors and summed together to generate final national Ecological Footprint values in terms of hectare-

¹ National Footprint Accounts (NFA) data for all countries of the world is freely available at: <http://data.footprintnetwork.org/#/>. This continuously updated framework is based on United Nations (UN) data sets of over 15,000 data points per country and year.

equivalent units (i.e., global hectares, gha), according to the additivity and equivalence principles mentioned above.

The resources and services considered in the analysis – and the associated land-types (Figure 2.1) – includes plant-based food and fibre products, livestock and fish products, timber and other forest products, waste absorption (CO₂ from burning fossil fuels), and space for urban infrastructure (Borucke et al., 2013).

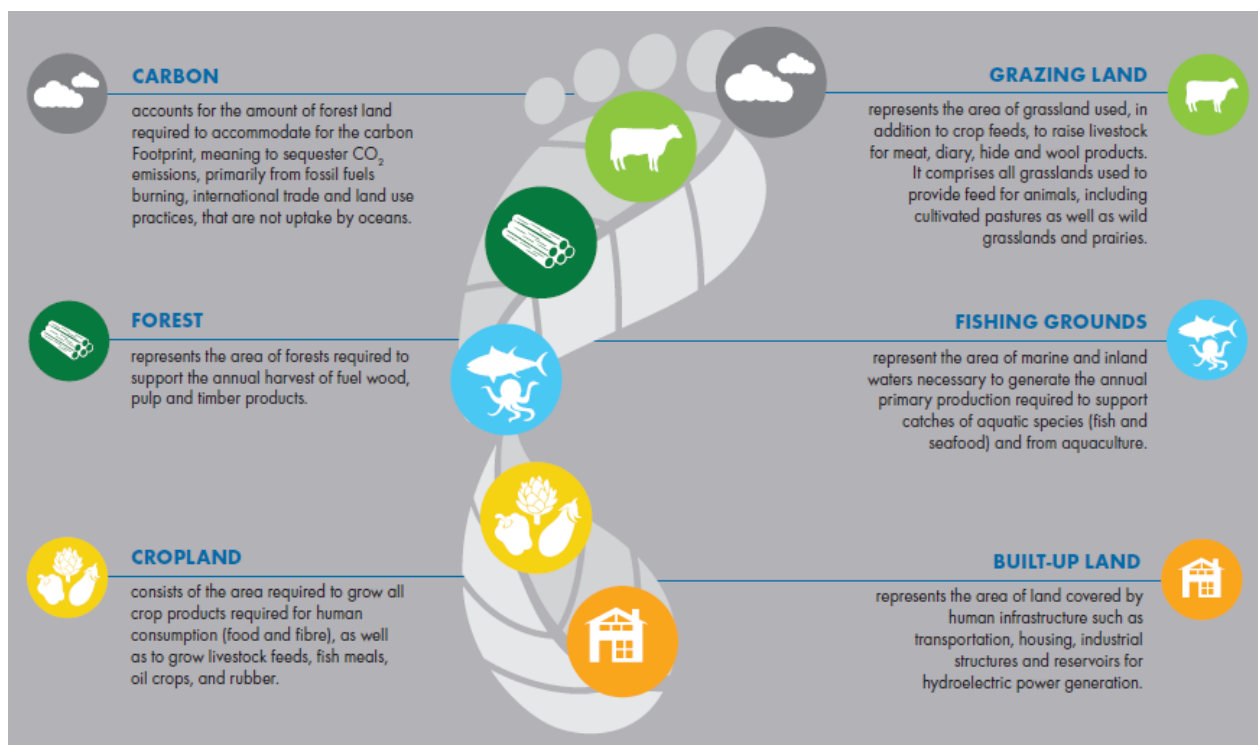


Figure 2.1 Major categories in Ecological Footprint and biocapacity accounting

Based on a consumer perspective (see Box 2.2), the Ecological Footprint of a country is estimated by calculating the Ecological Footprint of all what is produced within that country and then adding the Ecological Footprint embedded in imports and subtracting that embedded in exports (see Figure 2.2). The Ecological Footprint (EF) is then compared to the biocapacity (BC) of that country, which is a measure of the ecological assets available within the national borders (including forest lands, grazing lands, cropland, fishing grounds and built-up land) and their capacity to produce renewable resources and ecological services sustained under current technology and management schemes (Mancini et al., 2018a).

BOX 2.2 – The consumer approach in Ecological Footprint accounting

In a highly globalized world in which goods and services are traded internationally, the place of goods production and related use of resources is usually different from where final products are consumed. Consequently, associated environmental impacts are manifesting far away from where their drivers occur.

The **consumer** approach deployed by Footprint indicators aims at assigning responsibility for human's impact based on where the final demand takes place (Galli, 2015b). This is opposed to the more common **producer** approach in which the impact of a given product is assigned to the place in which the production activity takes place, irrespective of where that product ends up being consumed – see for instance the IPCC method for the GHGs inventory (Bastianoni et al., 2004; Peters, 2008).

The Ecological Footprint methodology applies a consumer approach according to which the resources' consumption of any given product/activity is assigned to the end consumer of that product/activity, irrespective of where the product/activity is produced.

Ecological Footprint and biocapacity are both expressed in global hectares (gha), a unit representing area of world-average productivity (Galli et al., 2007; Box 2.1). Further details on the Ecological Footprint and biocapacity calculations are provided in Annex 1.

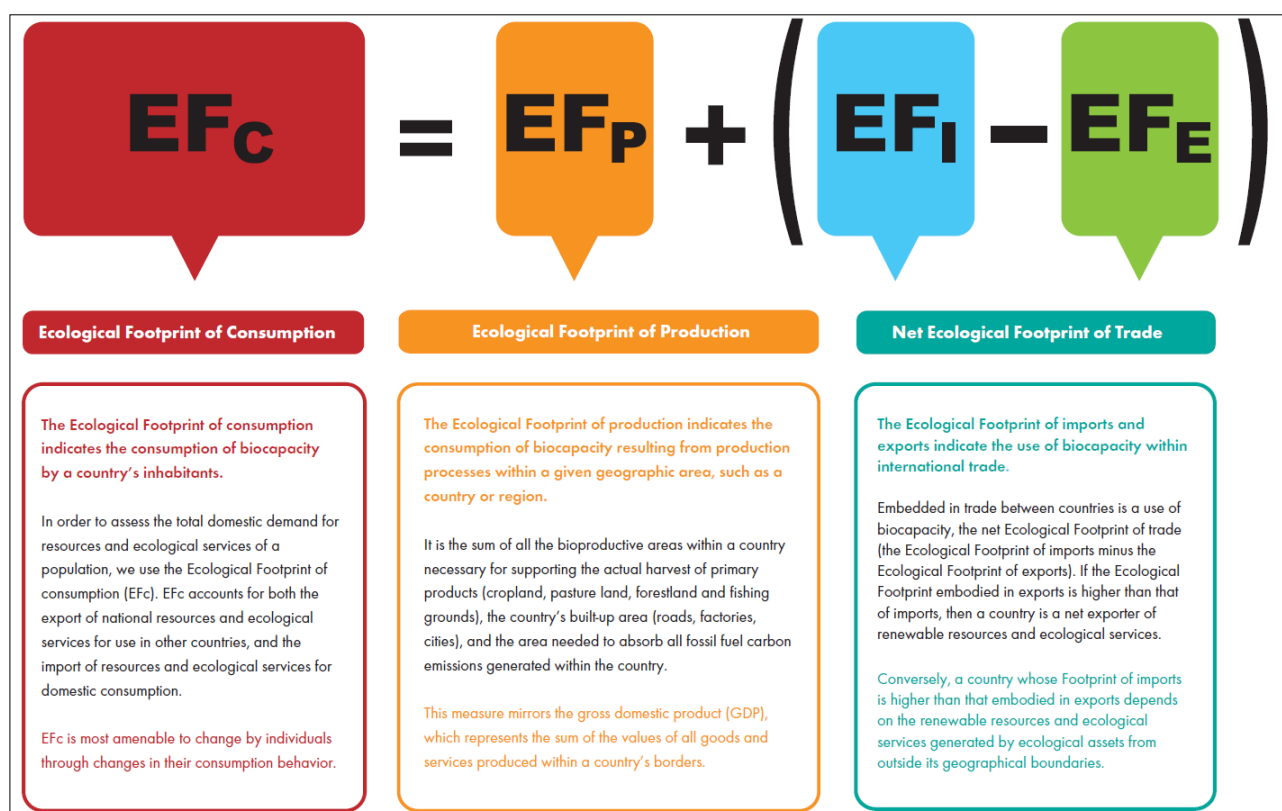


Figure 2.2 Tracking production, consumption, and net trade with the Ecological Footprint.

2.2 Nowcasting methodology: Ecological Footprint and biocapacity results for the 2016-2019 period.

The latest edition of the NFAs (2019) reports national Ecological Footprint and biocapacity results based on data until 2016, the latest year for which comprehensive data is available for all the countries analyzed within the NFAs. As such, to limit the time-lag in results, both Ecological Footprint and biocapacity values for the most recent years (2017, 2018 and 2019) can be estimated using a nowcasting methodology.

To estimate Ecological Footprint land-type components (cropland, grazing land, forest products, fishing grounds, built-up land, and carbon) beyond the latest year of accounting-based data, we use a combination of time-series forecasting models determined to have the lowest prediction error, averaged across all countries, compared to a multitude of other techniques. To forecast biocapacity land-type components, we use an ordinary least squares regression model based on per-capita biocapacity on the most recent 10 years of data (including the dataset assembled for nowcasting). For biocapacity estimates, we use OLS model forecasts to establish confidence intervals. Further details on the nowcasting method are provided in Annex 1.

2.3 Consumption Land Use Matrix

Within the NFAs, Footprint results do not usually show which economic activities are posing a demand on resources but rather the consequences, in terms of land appropriation, of demanding the outputs of economic activities (Mancini et al., 2018a). Still, attributing the overall demand on nature to particular human activities is essential to then be able to understand our behavior and act for a more sustainable lifestyle. This requires an additional analytical step beyond basic Ecological Footprint accounting (Galli, 2015a) and such step is primarily represented by Environmentally Extended Multi Regional Input-Output Analyses (EE-MRIO) (Wiedmann et al., 2006).

Multi Regional Input-Output (MRIO) tables from the Global Trade Analysis Project (GTAP) database² are thus used to translate land-based Ecological Footprint results into activity-based Ecological Footprint results (see Weinzettel et al., 2014 for further details), thus shifting the debate from where human pressure is being placed to the human activities responsible for such pressures (Galli et al., 2017). The outcome of this additional calculation step is called the Consumption Land-Use Matrix (CLUM); CLUM Tables for the 6 countries involved in DestiMED Plus were calculated by Global Footprint Network and are shown in Annex 3.

According to the COICOP³ classification, expenditures are due to 1) the household consumption; 2) government; 3) Gross Fixed Capital Formation (GFCF). The household consumption component refers to consumables paid for by households and can be also disaggregated into 12 consumption categories and related Footprint values. Government refers to the consumables paid for by government, such as school supplies in public schools, police equipment, and paper for public administration. Gross Fixed Capital Formation refers to lasting goods and assets, such as construction of buildings, roads, factories, and associated equipment.

² Global Trade Analysis Project (GTAP 9 Data Base) consists of 57 sectors – 12 of which are agricultural – and includes 140 countries and regions (Narayanan and McDougall, 2015).

³ The Classification Of Individual Consumption According to Purpose (COICOP) is the internationally agreed classification system for reporting household consumption expenditures. It is published by the United Nations Statistics Division for use in expenditures classification, National Accounts, Household Budget Survey and the Consumer Price Index.

2.4 Sub-National Ecological Footprint and biocapacity Accounts

Calculation of sub-national Ecological Footprints can refer to any sub-national territory, such as a region, state, or municipality. The feasibility and accuracy of sub-national calculations are generally limited by the availability of data, and therefore they either require extensive data collection efforts at the sub-national level (Moore et al., 2013) or a top-down approach based on national data, such as that implemented by Global Footprint Network (Baabou et al., 2017; Isman et al., 2018).

Within such framework, national CLUMs – Consumption Land-Use Matrixes – serve as the starting point, providing per-capita national average Ecological Footprint values for each consumption category⁴. Supplemental household-related data is then used to calculate the difference in consumption between the sub-national and the national populations and derive scaling factors for the appropriate consumption sub-category. For example, housing statistics may indicate that residents of a specific municipality live in 15% smaller buildings than the national average, and that the CO₂ intensity of municipal electricity generation is 10% greater than national average. This supplemental data would then be used to calculate scaling factors for the carbon and built-up Footprint associated with housing in the municipality. Such a methodology allows the calculation of specific sub-national consumption Footprints where data is available and assumes a national average consumption where detailed supplementary data is unavailable.

Biocapacity assessment is conducted both at national and sub-national level for the six countries involved in DestiMED Plus project. The sub-national level includes the NUTS 2⁵ as well as the Protected Area (PA) level, as reported in Table 2.1. Consistently with the biocapacity assessment in the NFA (see Annex 1, equation 3), biocapacity is calculated as the area of each land type multiplied by the yield factor (YF) and equivalence factor (EQF) for each land type.

⁴ The number of consumption categories ranges from five categories (Food, Transportation, Housing, Goods, Services) in the most aggregate form, to more than 40 (see Classification of Individual Consumption According to Purpose (COICOP) <https://unstats.un.org/unsd/classifications/>). The amount of disaggregation depends on the availability of consumer expenditure data for each country.

⁵ NUTS is the Nomenclature of Territorial Units for Statistics provided by the European Statistics. Level 2 indicates regions. For further details see: <https://ec.europa.eu/eurostat/web/nuts/background>

Table 2.1 Overview of the countries, administrative territories within which the 9 Protected Areas of DestiMED Plus project are located. Green cells are areas for which expenditure data is provided by Oxford Economics (dark green those chosen for the analysis).

NATIONS	PILOT ACTION PROTECTED AREAS of DestiMED Plus Project	ADMINISTRATIVE TERRITORIES	
		Region	Province
		NUTS 2 (code)	NUTS 3 (code)
Albania	National Park Divjake - Karavasta	Albania South (AL03)	Fier County (AL 032)
Croatia	Losinj Island	Jadranska Hrvatska (HR 03)	Primorsko-goranska županija (HR 031)
France	Natural reserve of the Mouths of Bonifacio	Corsica (FRM0)	South Corsica (FRM 01)
Greece	Karpathos	South Aegean (EL 42)	Kalymnos, Karpathos, Kos, Rodos (EL 421)
	West Asterousia Mountain	Crete (EL43)	Irakleio (EL431)
Italy	Pontine Islands	Lazio (IT14)	Latina (IT144)
	Porto Conte	Sardinia (ITG2)	Sassari (ITG25)
Spain	Zona Volcànica de la Garrotxa Natural Park	Catalonia (ES51)	Girona (ES 512)
	Cabo de Gata-Nijar	Andalusia (ES61)	Almeria (ES611)

Consistently with the NFA, Ecological Footprint and biocapacity assessments at national and sub-national level are both expressed in global hectares (gha), so that they can be compared to derive “ecological balances” between the supply of natural resources and services within a territory’s administrative borders and the demand on such resources and services of the residents of such territory. When the Ecological Footprint value is greater than the biocapacity (Footprint > biocapacity), the territory is in a situation of ecological deficit pointing out an unsustainability situation due to an overconsumption of natural resources and services compared with the capacity of local ecosystems to supply them. Conversely, when a territory's availability of natural resources and services is greater than the residents' demand (biocapacity > Ecological Footprint), the territory is in a “ecological reserve” situation.

Such ecological balance analysis is increasingly more critical at lower scales of reference because of the greater reliance on natural resources and services outside of the local administrative borders.

Finally, in this study the biocapacity of Protected Areas (PAs) is also assessed to have an ecological benchmark value of the local area's natural resources endowment, useful to measure the PA's biocapacity density (i.e., the ability of one physical hectare to provide ecosystem services: BC/area), and to evaluate the extent to which local PA contributes to the regional (NUTS 2) and national biocapacities (see section 3.2).

2.5 Data sources for the 9 destinations of DestiMED Plus

Given the absence of data at a smaller scale, the local level chosen for the Ecological Footprint analysis of the 9 destinations is the NUTS 2 regional classification in which each Protected Area and its surrounding communities are located (see Table 2.1). To calculate the Ecological Footprint at this scale, each national CLUM is scaled through household expenditure survey data of NUTS 2 regions (provided at Purchasing Power Parity by Oxford Economics 2015⁶) to derive CLUMs at NUTS 2 level (see Annex 3). All data is reported in per capita values, and the population size of all territories is taken from Eurostat 2020⁷ (for Croatia, France, Greece, Italy and Spain) and INSTAT 2020⁸ (for Albania). This top-down method allows consistent comparisons among the Ecological Footprint values of the multiple territories investigated within the DestiMED Plus project (Baabou et al., 2017).

The biocapacity is calculated at national, NUTS 2 and PA level as per equation 3 in Annex 1. To calculate the YFs for each NUTS 2 and PA level, a spatially explicit assessment of the bio-productivity is performed in ArcGIS ver. 8.3 on the basis of the average Net Primary Productivity (NPP) for Cropland, Grazing land, and Forest land types (see Annex 2 for detailed methodology and data sources). The calculation of YF for remaining biocapacity categories (Built-up, Inland Water, Marine Areas) and that of EQF values adhere to standard sub-national methodology (GFN, 2009) to maintain consistency and comparability to global hectare values for Ecological Footprint and biocapacity in the NFA. As such, built-up land YF is set equal to Cropland, Inland Water is given a YF of 1.00, and Marine Area YF is given respectively each country's YF value. Finally, EQF values are consistent with those calculated in the NFA 2019 Edition.

For each land type - except for Marine Area – area size was calculated using the 2019 CORINE land-cover dataset. The Marine Area was the only land type for which the area was calculated through the costal line length of each region and scaled with the total marine area of each related nation from the NFA.

⁶ HHE data are obtained from surveys and published in international dollars (Purchasing Power Parities, US\$ PPP). HHE databases are given by national statistical data or are drawn from Oxford Economics (2015). Global Footprint Network uses categories classified following the Classification of Individual Consumption According to Purpose (COICOP).

⁷ See <https://ec.europa.eu/eurostat/web/population-demography-migration-projections/population-data/database>

⁸ <http://www.instat.gov.al/en/themes/demography-and-social-indicators/population>

3 Ecological Footprint: instructions for use

3.1 How the Ecological Footprint can inform territory management and planning

Ecological Footprint accounting is driven by a simple, measurable question: *How much of the biosphere's (or any territory's) regenerative capacity does a human activity* – being it the entire consumption metabolism of an economy, the consumption of a given population, a sector (e.g., tourism) or a single process (e.g., a tourism product) – *demand*? In answering this question through Footprint and biocapacity numbers, Ecological Footprint Accounting incorporates and quantifies two key sustainability principles identified by Herman Daly (1990), according to which: (1) harvest rates of renewable resources should not exceed their regeneration rates, and (2) waste production rates should not exceed the natural assimilative capacities of the ecosystem into which the wastes are released.

The rationale behind these principles is that every facet of human activity requires resources obtained from the planet to sustain human life, societal well-being, and economic prosperity (Costanza and Daly, 1992). Evidence of the tenuous relationship between humans and the planet is around us: global environmental change puts a strain on forests, fisheries and cropland as growing economies and improved standards of living increase pressure on resources and ecosystem services (MEA, 2005). Ensuring that development occurs in a way that is sustainable for humanity requires the adoption of policies and practices that take planetary limits into account (Costanza et al., 2014; Kubiszewski et al., 2013). Understanding those limits is therefore crucial for the adoption of sound policies to manage ecological assets and ensure that all people live well, within the means of the sole planet we have.

Within this context, Ecological Footprint Accounting analyzes the human-environment relationship under the assumption that the Earth's capacity to renew resources and dispose waste will likely be a key limiting factor for the human economy if human demand continues to overuse beyond what the biosphere can renew. This approach is therefore highly relevant for a sector such as tourism – and a practice such as eco-tourism in particular – in which the presence of a healthy natural capital constitutes a key asset of the tourist offer. Managing tourism in any area thus requires both a quantitative understanding of the overall pressure exerted in that area and a quantification of the pressure placed by the tourists' inflow and behavior.

3.2 How to use and interpret Ecological Footprint results

The Ecological Footprint vs. biocapacity balances presented in this report can be informative in multiple ways:

- The top-down approach to calculate the Ecological Footprint of sub-national territories within DestiMED Plus project sheds light on the extent to which specific consumption activities of the inhabitants exert pressure on specific ecological assets. Per each national and NUTS 2 territory included in the project, results are given in per-capita average Ecological Footprint values (measured in global hectares) for each consumption category (household consumption, Government and Gross Fixed Capital Formation), as well as per Footprint land types (see nation specific sections and also Annex 3).
- Biocapacity results, on the other side, allow administrators to understand the core natural endowment of their territories, both at NUTS 2 level and PA level. This need to be safeguarded and maintained to ensure a long-term supply of key resources and ecosystem services, as well as the destination appeal and attractiveness, which is crucial to the long-term viability of tourism in the territory.
- Used together, these two sets of results can help local administrators, tour operators, protected area managers, ITOs and service providers identify sustainability hotspots and resource-use pressure

points. These can help them respond rapidly and tangibly to mitigate unsustainable demand from the tourism sector and thus lower the pressure from the tourist offer. The intent here is not just to help conceive ecotourism packages with a low Footprint on the environment, but also to understand, among the 9 Protected Areas analyzed in the DestiMED Plus project, in which area the need of shifting from mass tourism towards ecotourism is more urgent, due to the presence of already ongoing negative ecological balances.

- The ecological balance analysis (i.e., the Ecological Footprint vs. biocapacity comparison) for a given geographic destination (e.g., a region hosting a Protected Area of the DestiMED Plus project) can be used as a benchmark to determine whether the minimum conditions for sustainability — Daly's core principles — are met within the analyzed socioeconomic system or rather the area is running an ecological deficit due to an excessive resource demand of its residents (Patterson et al., 2007; Wang et al., 2017). This information provides insight on the demand for resources placed by the population living in the areas where the tourists are having their vacation and which they likely exacerbate through their behavior. As such, the ecological balance analysis can be used, among other scopes, to identify the destinations in which more sustainable intervention should be prioritized: the higher the ecological deficit of a territory, the higher the necessity to incentivize alternative, low-Footprint tourism propositions within it.

3.3 Ecological Footprint for governance and policy

Alongside informing decisions of PA managers and ITOs, the Ecological Footprint results can also ease municipal-level governance practices, at various stages of the policy-making process: to ease the application of Footprint accounting in guiding decisions of policy makers, it is first helpful to identify the steps of the policy-making process that are best informed by Footprint results. Galli (2015a) has identified five key steps in policy formulation and how Ecological Footprint can inform each of them (Figure 3.1).

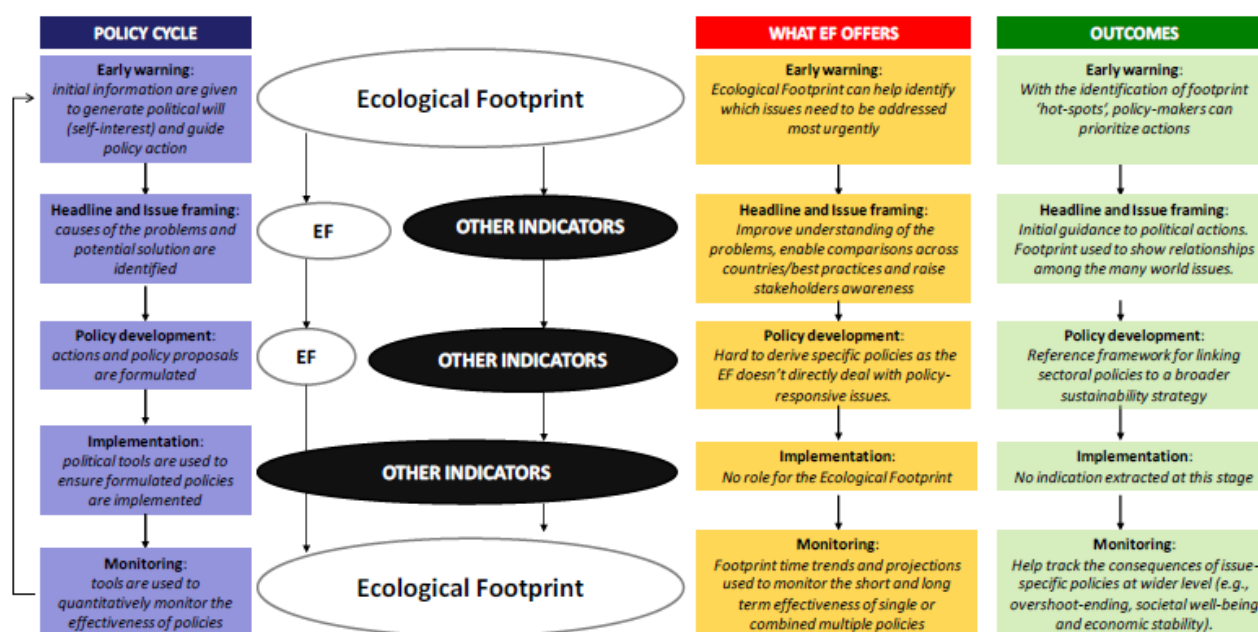


Figure 3.1 Role and usefulness of the Ecological Footprint in the policy cycle. Source: Galli, 2015a

As an “early warning” within the so-called “policy cycle”, Footprint results can foster holistic and long-term thinking among politicians and stakeholders around resource use and overuse. In fact, Footprint results,

especially those by consumption activities, help identify issues or “hot spots” that need to be addressed and guide the subsequent development of potential interventions and goal setting. As policies are implemented within the policy cycle, short-term and issue-specific indicators that relate to specific elements of a given intervention – as well as SDG indicators – constitute fundamental supplements to the Footprint. Subsequently, Footprint and biocapacity accounting are effective monitoring tools, assessing medium- and long-term outcomes for overall progress toward sustainable development.

An indicator such as the Ecological Footprint, if duly considered, can thus ease powerful processes that can change and steer governance contexts towards sustainable development within certain conditions. The Ecological Footprint has the potential to bring new stakeholders to sustainability debates. Because it yields tangible data that supports shared decision-making across common agendas, it can favor diverse multi-stakeholder gatherings, trigger new institutional arrangements, and support the creation of new networks as well as that of new communication channels that facilitate learning (for both residents and administrators) while steering policy integration horizontally and vertically (Moreno Pires and Fidélis, 2014).

Ecological Footprint Accounting is therefore useful for providing multiple stakeholder groups with a crosscutting viewpoint and for encouraging new “limits aware” thinking in the policy process and in societal debates (macro-level guidance). To this end, the Ecological Footprint has been listed as a potential Category A indicator by the Convention on Biological Diversity (CBD) to track global progresses against Aichi Target 4 for the period 2011-2020 (Galli et al., 2014; CBD, 2010). Moreover, in 2016 the Ecological Footprint has been included within the list of IPBES Core Indicators as an indicator of direct (anthropogenic) drivers of change in the state of biodiversity and ecosystems functioning (and their derived services) that affect the supply of nature’s benefit to people (Mancini et al., 2018a; Diaz et al., 2015). Finally, although proposed to the Inter-Agency Expert Group on SDG indicators (IEAG-SDGs) for inclusion as a potential indicator to track SDG 12, as of today the Ecological Footprint has not been selected as an official SDG indicator.

3.4 Ecological Footprint and Tourism

Accounting for the tourism sector within the National Footprint Accounts is currently partial, due to the lack of international and standardized dataset reporting detailed information about tourists’ consumption distinct from that of residents (Kitzes et al., 2009). To develop the research around this tourism issue, the DestiMED Plus project is contributing to improve the application of Ecological Footprint methodology to specific tourist products – the ecotourism packages – as well as to understand the ecological balance of the territories in which those packages are being developed (this report – see section 4).

As explained in Section 2 of this report, the ecological balance is the assessment of Ecological Footprint and biocapacity at local level based on the expenditure of local communities, which should reflect the levels of consumption in the various economic sectors, made by both residents and tourists. However, because of the current gaps in data, such distinction in the contribution of residents vs. tourists is not possible, although it would surely be of great usefulness for local policy makers and service providers to improve prediction and management of tourist impact in the territory (Patterson et al., 2007). Moreover, communicating and promoting tourism’s Ecological Footprint results in the target territories could help residents become more aware of the value of their protected area, and of the environmental consequences of their use of resources and of that of the tourists.

To fill this gap, Ecological Footprint assessment can contribute to work toward the establishment of a coherent and functional governance framework at local level for ensuring the sustainability, management and promotion of ecotourism, in order to build a viable alternative to mass tourism in the selected pilot areas of DestiMED Plus project.

The need for a comprehensive system to monitor and measure sustainable tourism has been acknowledged, highlighted, and recalled by the UNWTO conference held in Manila in 2017 (WTO, 2017). “*To better measure is to better manage*”, and thus a common and robust set of data is critical for governments and stakeholders to design, implement and monitor effective sustainable tourism policies. Development of Ecological Footprint in the tourism sector may thus contribute to the prosperity of tourist destinations.

4 Results

4.1 The Mediterranean context

The Mediterranean Region is one of the world’s richest regions in terms of ecosystem and species diversity, listed as a key biodiversity hotspot to invest on by the Critical Ecosystem Partnership Fund (CEPF)⁹. The region is also characterized by a unique geography where multiple cultures live and co-exist. With arrivals being 330 million tourists in 2016, the Mediterranean Region is the first destination in the world and tourism represents a fundamental sector for the economies of the region. Sea tourism represents the biggest attraction, with the summer season concentrating around 36-69% of the total international arrivals (Tovar-Sánchez et al., 2019; Plan Bleu, 2016; Mancini et al., 2018b). However, alongside the residents’ lifestyle and consumption patterns, tourism can pose a burden on ecosystems and biodiversity, especially when left un-managed. Such unsustainable consumption and development trends are threatening the ecological assets that are the Mediterranean Region’s most valuable sources of strength.

From 1961 to 2016, the Ecological Footprint of an average residents of the Mediterranean Region has increased by 45%, while per capita biocapacity in the region has decreased by 26%. As of 2016, with a population of more than 500 million people, an average Mediterranean resident had an Ecological Footprint of 3.17 global hectares (gha), more than double the 1.09 gha of biocapacity available per person in the region (see Figure 4.1). In slightly more than 50 years, the growing gap in supply and demand created a more than three-fold increase in the region’s ecological deficit (GFN, 2015).

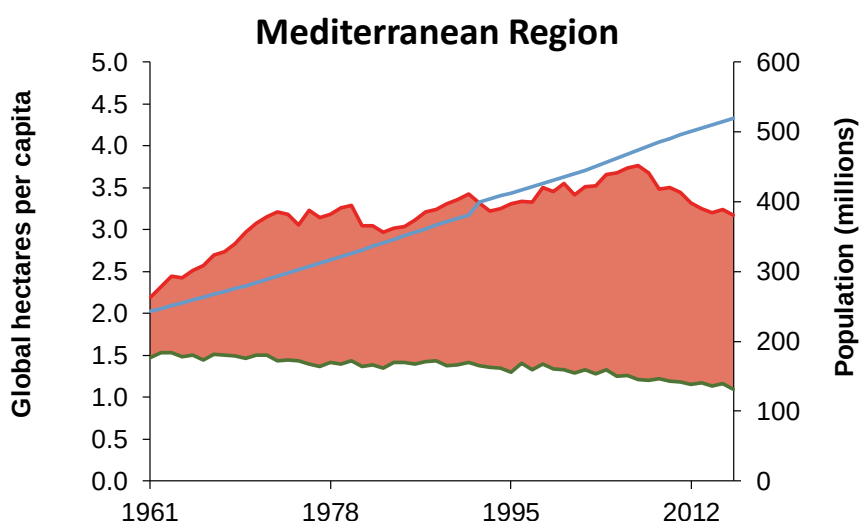


Figure 4.1 Mediterranean Ecological Footprint (red line), biocapacity (green line) and population (blue line) trends, 1961-2016. The shaded red area indicates the region’s ecological deficit that has been accumulating since before ‘1960s.

⁹ For further details see: <https://www.cepf.net/>

Such a situation of *ecological deficit* can occur through three different modes and/or combinations of them: 1) the region can import the natural renewable resources that it consumes but does not produce; 2) it can overharvest its own resources for a time through unsustainable agricultural practices, overgrazing, overfishing, or deforestation, and 3) it can emit more CO₂ in the atmosphere than it has the capacity to sequester.

As Figure 4.2 shows, some countries in the region were still in an ecological reserve situation in the 1960s, although they all entered in an ecological deficit situation by the beginning of the 1980; as of 2014, no country in the Mediterranean Region could provide all the natural resources and services that its population demands by solely relying on its own biocapacity. To some extent they all depended on net biocapacity imports, although this dependence varies considerably between countries – from under 3% in Bosnia and Herzegovina to over 60% in Malta – and exposes countries to potential socio-economic risks (see Galli et al., 2015).

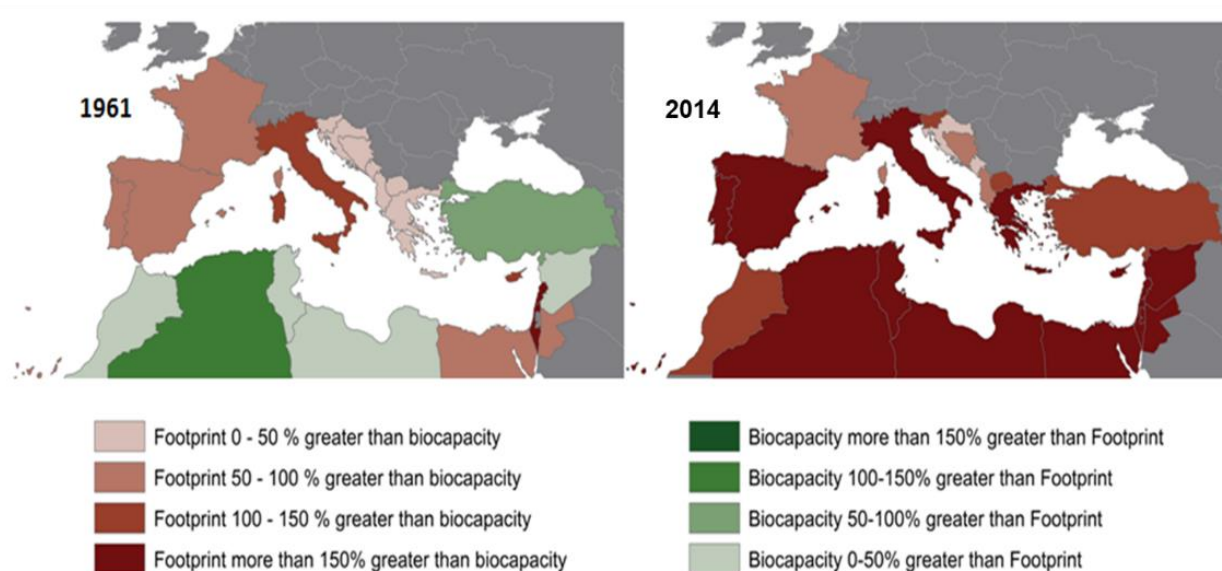


Figure 4.2 Ecological balance situation of Mediterranean countries in 1961 and 2014. Green countries are those in a situation of ecological reserve, while red countries are running an ecological deficit.

According to latest analyses (GFN, 2015; Galli et al., 2017), about 50% of the Mediterranean’s Ecological Footprint is made of two key daily activities: food consumption (28% of the total Ecological Footprint value of Mediterranean) and transportation (22%). These categories are highly influenced by the tourism flows and behaviors taking place in each country.

4.2 Ecological Footprint vs. biocapacity: eco-balances at destination level

This section shows the *ecological balance* results for the 9 destinations involved in the DestiMED Plus project. First, Ecological Footprint and biocapacity results are provided at national level for all six countries participating in the project. Then, for each country, sub-national Ecological Footprint and biocapacity assessments are calculated at NUTS 2 level – namely the “region” level (see Table 2.1 in section 2.4). Finally, biocapacity results are shown at PA level as explained in section 2.4. Biocapacity values are then divided by area values at national, regional and PA level, to assess the biocapacity density (i.e., the ability of one physical hectare to provide ecosystem services) of each area, thus providing an indication of each area’s (NUTS 2 and PA) contribution to the national biocapacity.

4.2.1 Albania

4.2.1.1 National and sub-national Ecological Balances

In Albania, Divjake-Krvarsta National Park was chosen as the pilot action Protected Area involved in the development of the ecotourism package in the DestiMED Plus Project. This PA is located within the Albania South NUTS 2 Region. As such, Ecological Footprint assessments were conducted for this NUTS 2 Region and the whole country, while biocapacity was analyzed at National, NUTS 2 and PA level. Results of the ecological balance are as follow:

- In 2019, the **Ecological Footprint** of an average Albanian resident was **2.02 global hectares (gha)** per person, whereas per capita biocapacity was **1.08 global hectares (gha)**. This indicates a situation of ecological deficit, in which residents' demand for resources was about 87% higher than the nationally available biocapacity budget per person (see Figure 4.3).

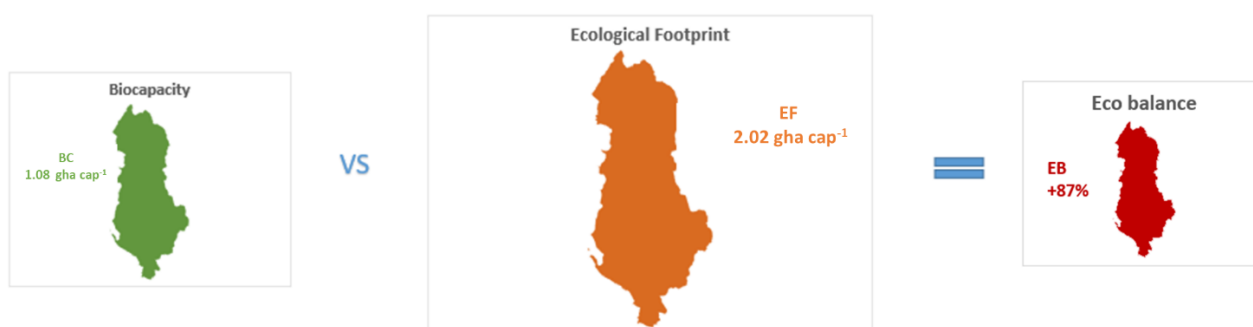


Figure 4.3 Eco balance representation of Albania: Ecological Footprint is compared to the national biocapacity, revealing a situation of ecological deficit. The assessment refers to 2019-year data.

- At the NUTS 2 level, the Ecological Footprint of an average resident of the Albania South region was 2.01 gha per capita, thus in line with the national average (-0.4%). Although higher (+55%) than the national value, Albania South regional biocapacity of 1.68 gha per capita was still lower than the regional Footprint thus determining a situation of ecological deficit, in which residents from the region of Albania South demand 20% more renewable resources and ecological services than those available within the region (see Figure 4.4).

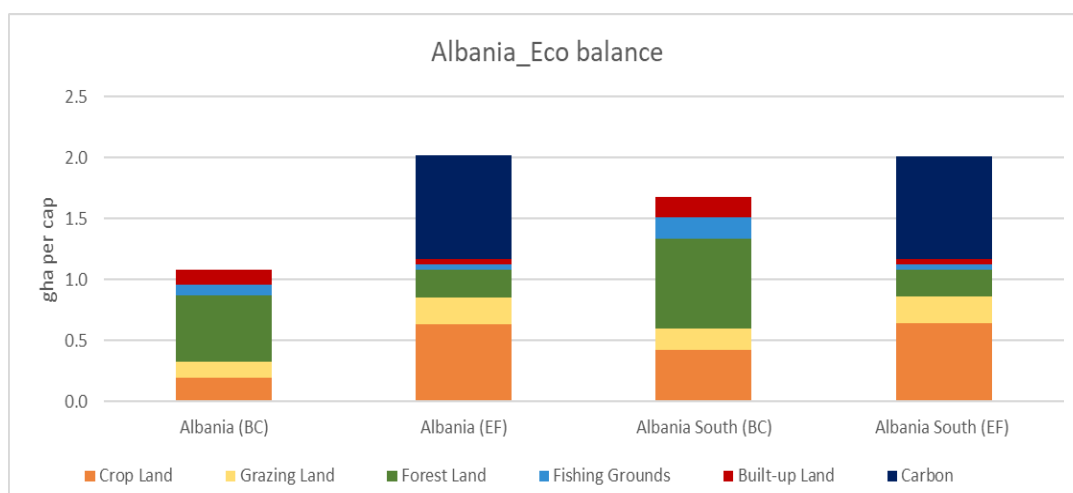


Figure 4.4 Comparison of Ecological Footprint and biocapacity results at national (Albania) and NUTS 2 regional (Albania South) level in 2019, by land types.

When looking at the breakdowns of the Ecological Footprint by consumption categories we found that:

- In 2019, Ecological Footprint in Albania was mainly driven by household consumption, representing 82% of the total value, followed by Gross Fixed Capital Formation (GFCF – see section 2.3) (15%) and government expenditures (2%). Within the household consumption, food represented the major driver of the total Ecological Footprint of Albania (44% of the total value), followed by transportation (14% of the total) and housing, water, electricity, gas and other fuels (10% of the total). Each of the other categories contributed to less than 5% of the total Footprint value, with a peak in miscellaneous goods and services (4%) (see Figure 4.5).

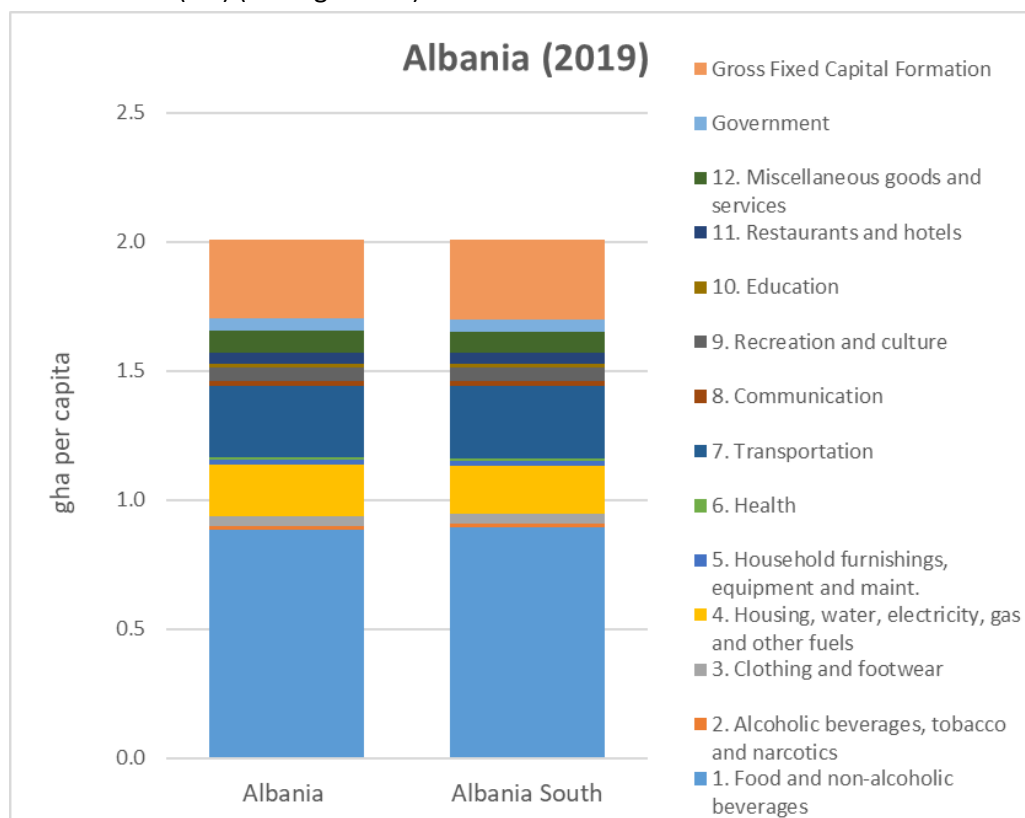


Figure 4.5 Ecological Footprint of Albania and its NUTS 2, Albania South, by COICOP consumption categories in 2019

- The Ecological Footprint of Albania South NUTS 2 region was characterized by a pattern similar to the national value: households responsible for 82% of the total NUTS 2 Footprint value, followed by Gross Fixed Capital (16%) and government (2% of the total). Within the household component, food represented 45% and transportation 14% of the total Ecological Footprint, with pressures mainly placed on carbon sequestration (42% of the total Footprint of Albania South), Cropland (32%), Grazing land and Forest land (both 11% of the total); Fishing grounds and Built-up land had a lower contribution (both 2% of the total). A complete breakdown of Albania South Ecological Footprint by both land types and consumption categories is provided in Figure 4.6.

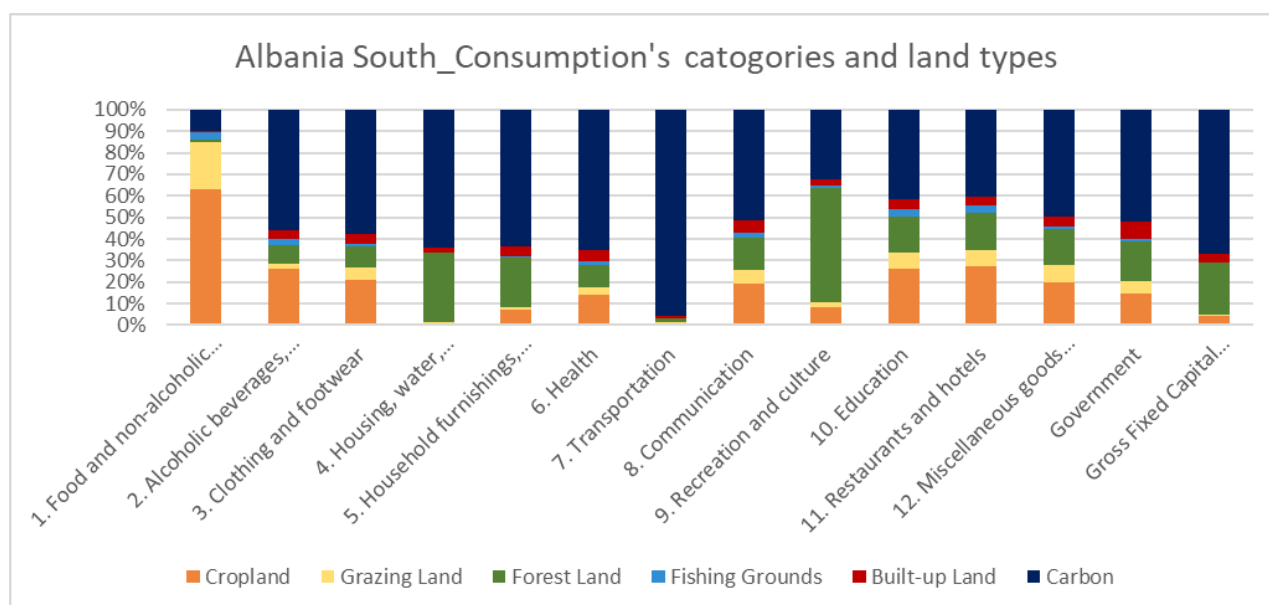


Figure 4.6 Percentage contribution of consumption categories and land types to the Ecological Footprint of the NUTS 2 Albania South region, in 2019

Analyzing in more details the national, regional and PA biocapacity values, it was found that:

- In 2019, the total biocapacity of Albania was 3,090,828 gha, composed by 51% of Forest land, 18% of Cropland, 12% of Grazing land, 11% of Built-up land and 8% of Fishing grounds.
- The total biocapacity of Albania South was 1,472,155 gha, representing about 48% of the whole national biocapacity. The regional biocapacity was mainly composed by Forest land (44%) and Cropland (25%), followed by Grazing land, Built up land and Fishing grounds (each of them respectively 10% of the total).
- Finally, the biocapacity of the local protected area, Divjake-Krvarsta National Park, makes up about 2% of the biocapacity of Albania South, and it is mainly constituted by Cropland (52%) and Forest land (19%), followed by Built up land (15%), Fishing grounds (9%) and Grazing land (6%) (see Figure 4.7).

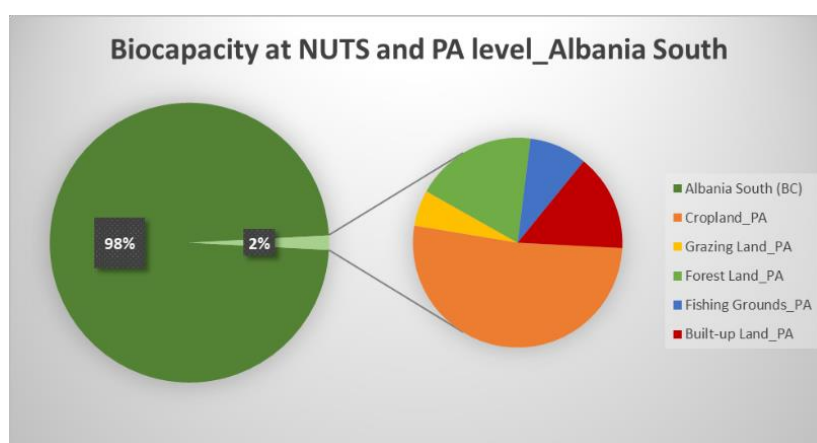


Figure 4.7 Biocapacity at PA level, Divjake-Krvarsta National Park, is compared with the biocapacity at NUTS 2 (Albania South) level, showing the breakdown by land types for year 2019.

- Considering the biocapacity density of the three geographical areas analyzed, i.e., the ability of one physical hectare to provide ecosystems services, the local protected area has the highest value at 1.24 gha ha⁻¹, followed by the national average 0.90 gha ha⁻¹, while the region is slightly less productive, showing a biocapacity density of 0.88 gha ha⁻¹ (see Figure 4.8). This indicates that, through its safeguarded ecosystems, the territory of the protected area is able to produce 38% and 40% more renewable resources and ecological services (i.e., more biocapacity) per hectare of land than the national-average and regional-average hectare of land, respectively.

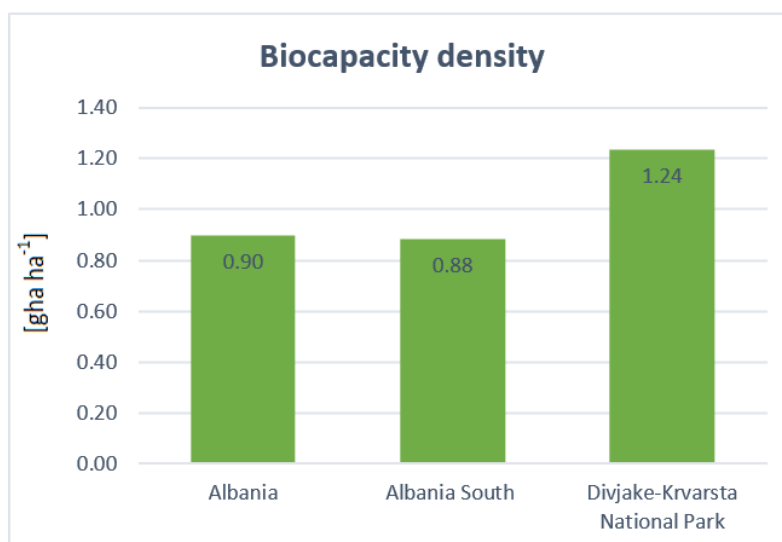


Figure 4.8 Biocapacity density at national, regional and PA level for the year 2019.

4.2.2 Croatia

4.2.2.1 National and sub-national Ecological Balances

In Croatia, Losinj Island was chosen as the pilot action Protect Area involved in the development of the ecotourism package in the DestiMED Plus project. This PA is located within the Jadranska Hrvatska NUTS 2 region. As such, Ecological Footprint assessments were conducted for this NUTS 2 Region and the whole country, while biocapacity was analyzed at National, NUTS 2 and PA level. Results of the ecological balance are as follow:

- In 2019, the **Ecological Footprint** of an average Croatian resident was **4.22 global hectares (gha)** per person, whereas biocapacity per capita was **3.23 global hectares (gha)**. This indicates a situation of ecological deficit, in which residents' demand for resources was about 31% higher than the nationally available biocapacity budget per person (see Figure 4.9).

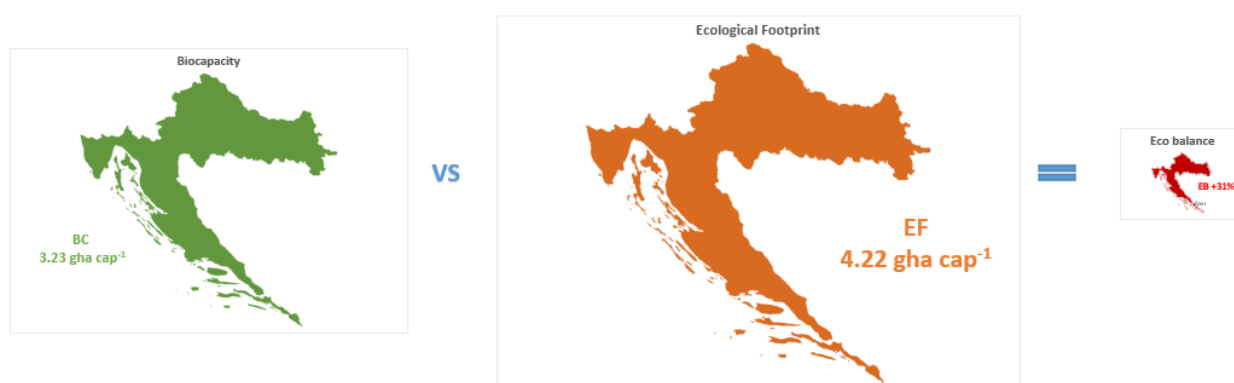


Figure 4.9 Eco balance representation of Croatia: the Ecological Footprint is compared to the national biocapacity, revealing a situation of ecological deficit. The assessment refers to 2019-year data.

- At the NUTS 2 level, the Ecological Footprint of an average resident of the Jadranska Hrvatska region was 4.26 gha per capita, thus in line with the national average (+1.1%). On the other hand, the regional biocapacity was 5.20 gha per capita, thus 61% higher than the national biocapacity value, and also higher than the regional Footprint. This determined a situation of ecological reserve in which residents from the region of Jadranska Hrvatska demand 18% less renewable resources and ecological services than those available within the region (see Figure 4.10).

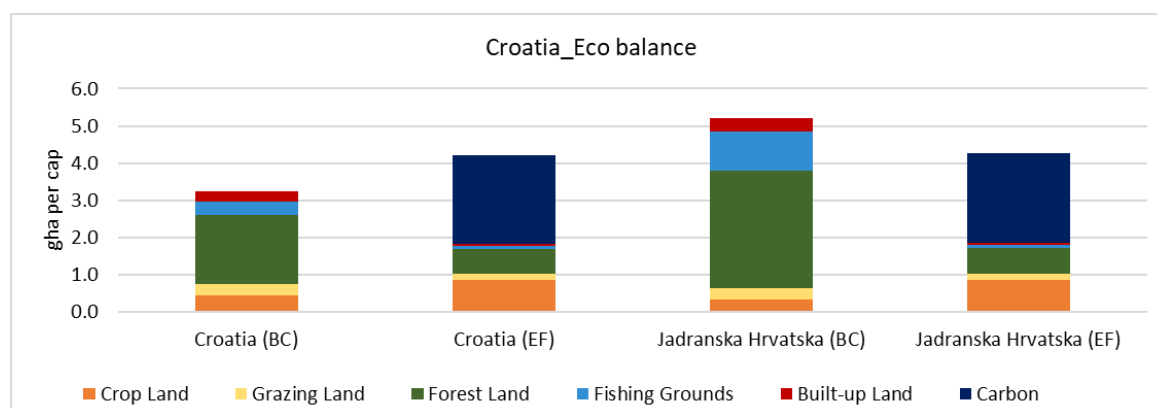


Figure 4.10 Comparison of Ecological Footprint and biocapacity results at national (Croatia) and NUTS 2 regional (Jadranska Hrvatska) level in 2019, by land types.

When looking at the breakdowns of the Ecological Footprint by consumption categories we found that:

- In 2019, Ecological Footprint in Croatia was mainly driven by household consumption, representing 75% of the total value, followed by Gross Fixed Capital Formation (16%) and government expenditures (9%) (see section 2.3). Within the household consumption, food represented the major driver of the total Ecological Footprint of Croatia (24% of the total value), followed by housing and the associated energy use (water, gas, electricity) being 16% of the total value, and transportation (14% of the total value). Each of the other categories contributed less than 5% of the total value, with a peak in miscellaneous goods and services and clothing (both 4% of the total value) (see Figure 4.11).

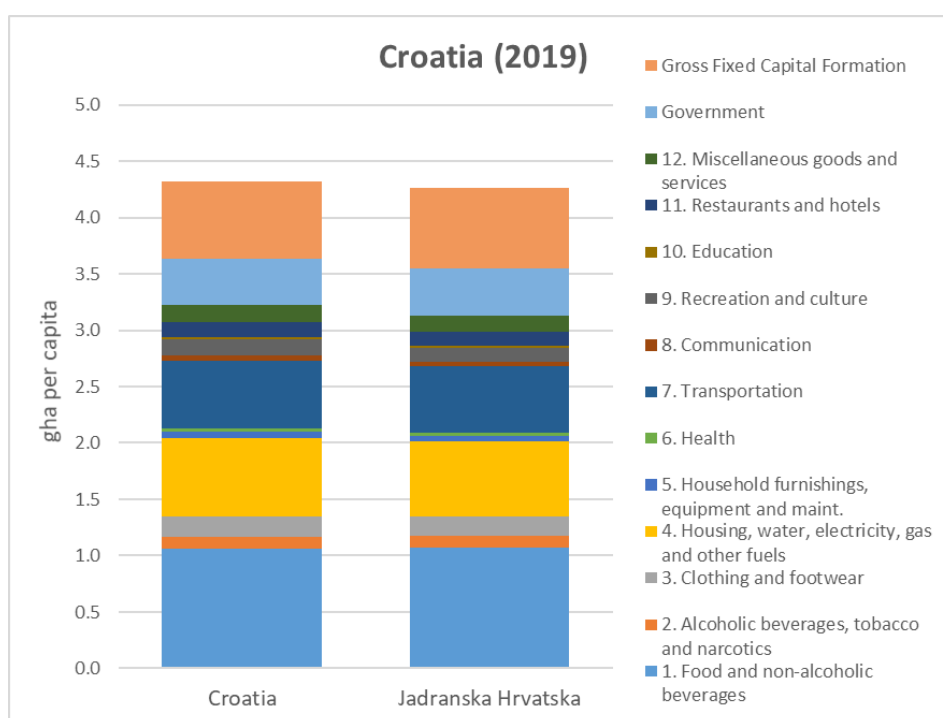


Figure 4.11 Ecological Footprint of Croatia and its NUTS 2 Jadranska Hrvatska, by consumption categories (COICOP) in 2019

- The Ecological Footprint of the Jadranska Hrvatska NUTS 2 region was characterized by a pattern similar to the national value: household consumption was the major driver of the region's Footprint (73% of the total), Gross Fixed Capital represented 17% and government expenditure 10 % of the total. Within the household component of Jadranska Hrvatska region, food represented approximately 25%, housing about 16% and transportation 14% of total Footprint value. Such activities placed a pressure mainly on carbon sequestration (57% of the total), Cropland (20%) and Forest land (16%); Grazing land, Fishing land and Built-up land had a lower contribution (all below 5% of the total). A complete breakdown of Jadranska Hrvatska Ecological Footprint by both land types and consumption categories is provided in Figure 4.12.

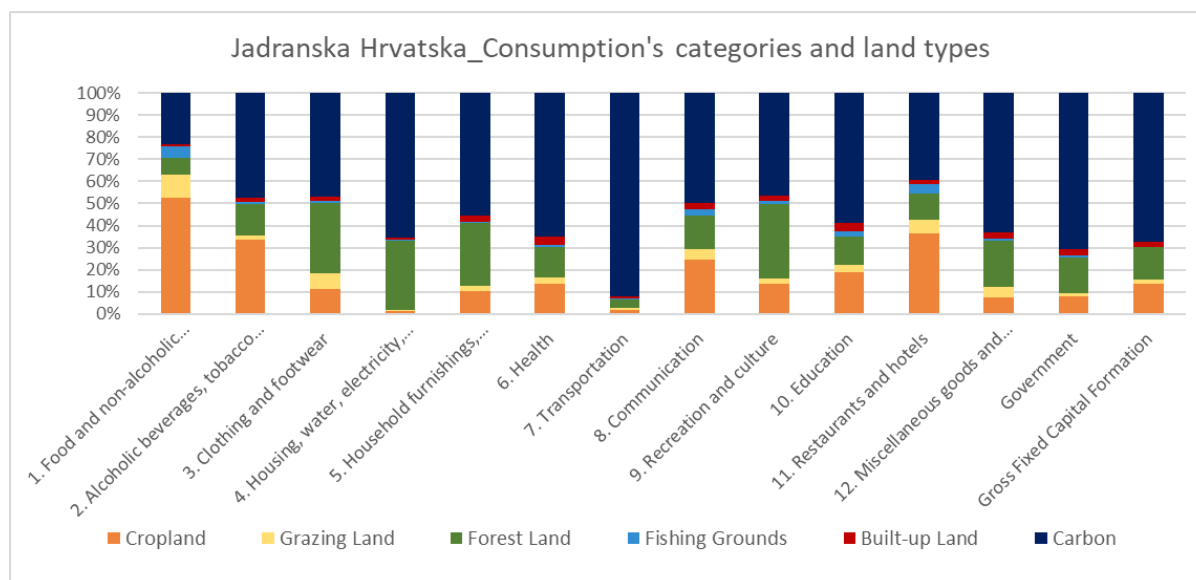


Figure 4.12 Percentage contribution of consumption categories and land types to the Ecological Footprint of the NUTS 2 Jadranska Hrvatska region, in 2019.

Analyzing in more details the national, regional and PA biocapacity values, it was found that:

- In 2019, the total biocapacity of Croatia was 13,168,260 gha, composed by 58% Forest land, 14% Cropland, 11% Fishing grounds, 9% Grazing land and 8% Built-up land.
- The total biocapacity of Jadranska Hrvatska Region was 7,143,946 gha, representing 54% of the whole national biocapacity. The biocapacity of Jadranska Hrvatska NUTS 2 was mainly composed by Forest land (61%) and Fishing grounds (20%), followed by Built up land (7%), Cropland and Grazing land (both 6%).
- Finally, the biocapacity of the local protected area, Losinj Island, makes up about 0.3% of its region biocapacity; being a Marine Protected Area, it is mainly constituted by Fishing grounds (96%), and Forest land (4%) (see Figure 4.13).

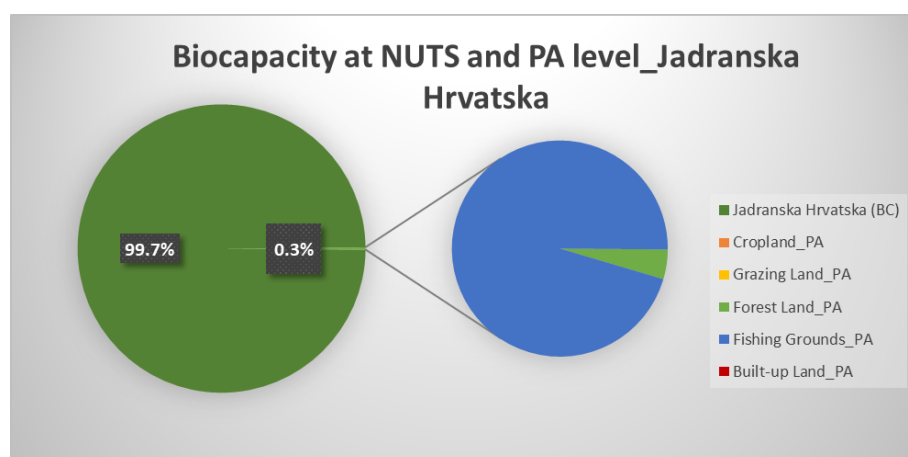


Figure 4.13 Biocapacity at PA level, Losinj Island Marine Protected Area, is compared with the biocapacity at NUTS 2, Jadranska Hrvatska, showing the division by land types for year 2019.

- In terms of biocapacity density, i.e., the ability of one physical hectare to provide ecosystems services, the local protected area has the lowest value 0.35 gha ha^{-1} , followed by regional average 1.07 gha ha^{-1} , while the nation is the most productive, showing a biocapacity density of 1.34 gha ha^{-1} . This indicates that the protected area's territory produces 74% and 67% less renewable resources and ecological services (i.e., less biocapacity) per hectare of land than a national-average and the regional-average hectare of land, respectively. The low biocapacity density of the Losinj Island Marine Protected Area is due to the fact that the PA territory is mainly composed of Fishing grounds that, in the Footprint methodology, have a lower biocapacity density than other land types (see Figure 4.14).

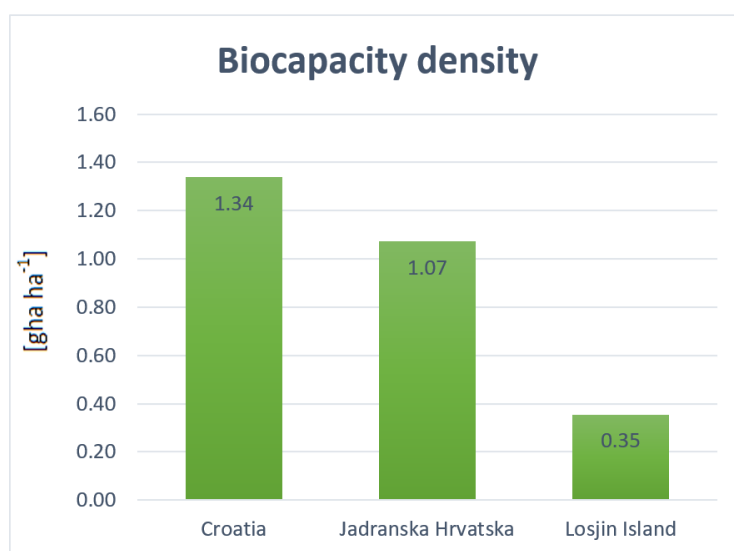


Figure 4.14 Biocapacity density of Croatia, at national, regional and PA level for the year 2019

4.2.3 France

4.2.3.1 National and sub-national Ecological Balances

In France, the Natural reserve of the Mouths of Bonifacio was chosen as the pilot action Protected Area involved in the development of the ecotourism package in the DestiMED Plus Project. This PA is located within the Corsica NUTS 2 Region. As such, Ecological Footprint assessments were conducted for the NUTS 2 Region and the whole country, while biocapacity was analyzed at National, NUTS 2 and PA level. Results of the ecological balance are as follow:

- In 2019, the **Ecological Footprint** of an average French resident was **4.81 global hectares (gha)** per person, whereas the per capita biocapacity was **2.55 global hectares (gha)**. This indicates a situation of ecological deficit, in which residents' demand for resources was about 89% higher than the nationally available biocapacity budget per person (see figure 4.15).

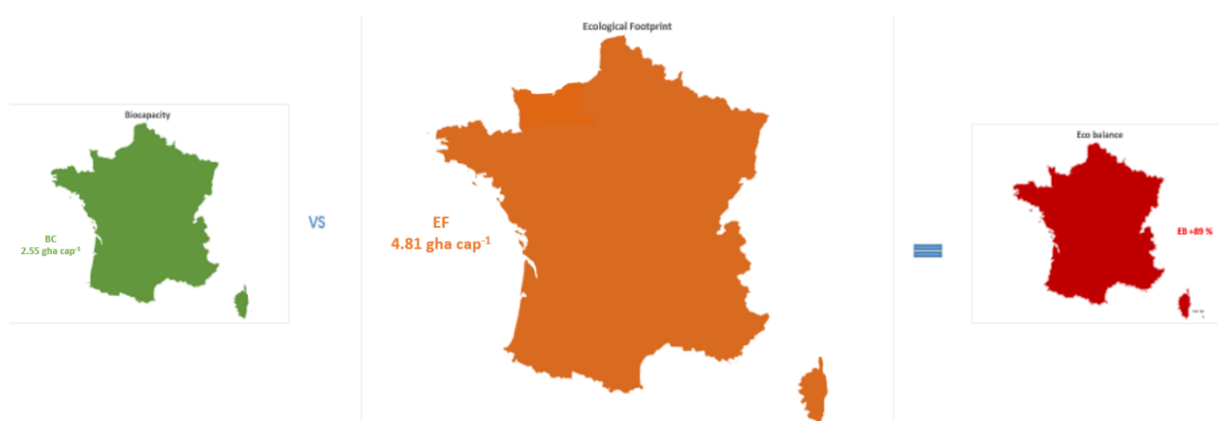


Figure 4.15 Eco balance representation of France: Ecological Footprint is compared to the national biocapacity, revealing a situation of ecological deficit. The assessment refers to 2019-year data.

- At the NUTS 2 level, the Ecological Footprint of an average resident of Corsica was 4.83 gha per capita, thus in line with the national average (+0.4%). On the other hand, Corsica per capita biocapacity is considerably higher (about + 600%) than the national biocapacity value, due to lower population density¹⁰ (38.7 p/km², that is a third of the national average of 105.6 p/km²), and also higher than the regional Ecological Footprint thus determining a situation of ecological reserve, in which residents of Corsica demand 73% less renewable resources and ecological services than those available within the region (see Figure 4.16).

¹⁰ <https://ec.europa.eu/>

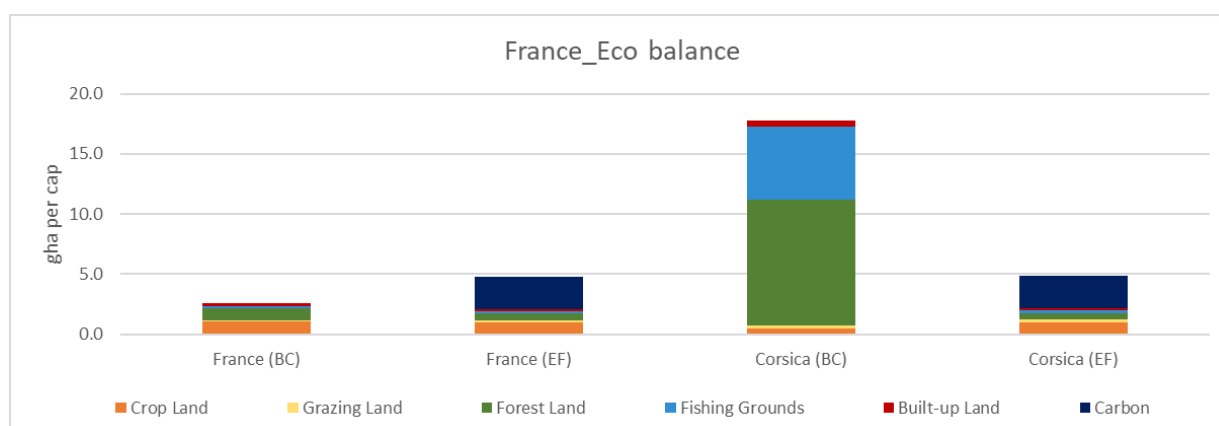


Figure 4.16 Comparison of Ecological Footprint and biocapacity results at national (France) and NUTS 2 regional (Corsica) level in 2019, by land types.

When looking at the breakdowns of the Ecological Footprint by consumption categories we found that:

- In 2019, Ecological Footprint of France was mainly driven by household consumption, representing 71% of the total value, followed by Gross Fixed Capital Formation (GFCF) (19%) and government expenditures (10%) (see section 2.4). Within the household consumption, food consumption represented the major driver of the total Ecological Footprint value of France (22% of the total value), followed by transportation (18% of the total value). Housing and associated energy use (water, gas, electricity) had also a noticeable contribution (11% of the total value). Each of the other categories contributed to less than 5% of the total value (see Figure 4.17).

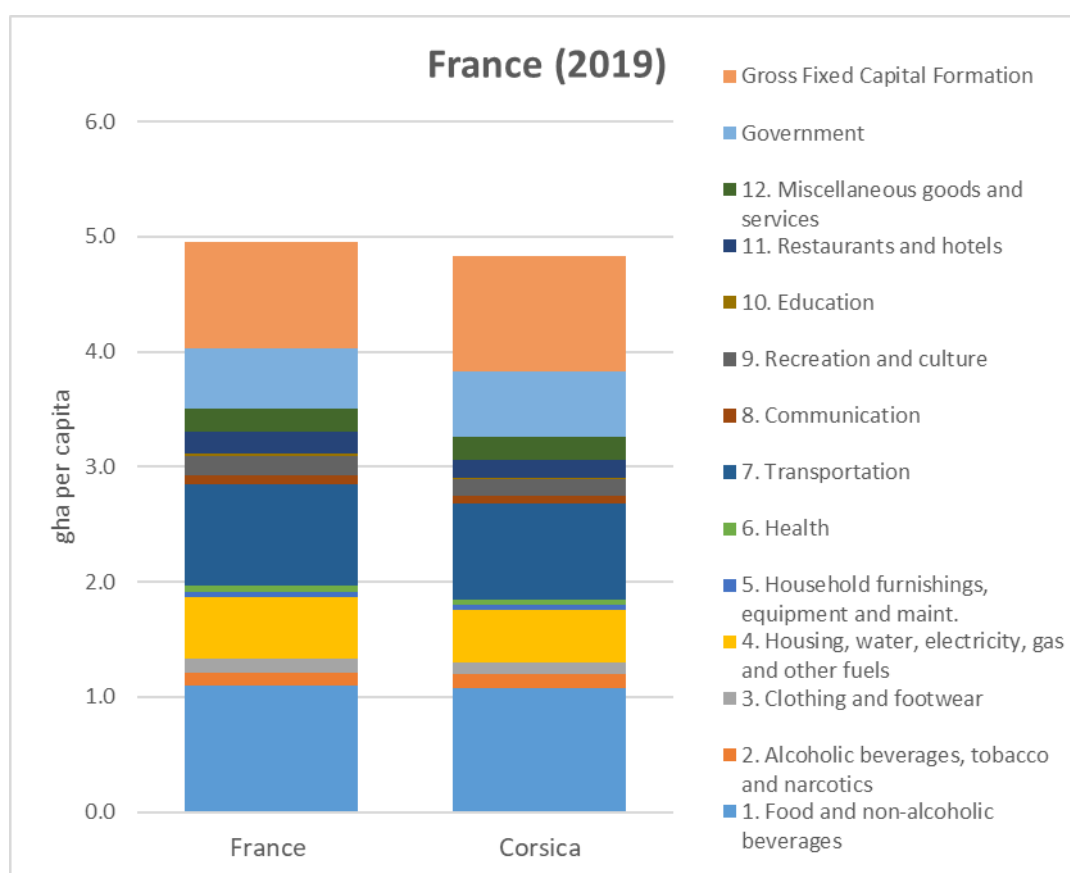


Figure 4.17 Ecological Footprint of France and its NUTS 2 Corsica, by consumption categories (COICOP) in 2019.

- The Ecological Footprint of the Corse NUTS 2 region was characterized by a pattern similar to the national value: household consumption was the major driver of the region's Footprint (68% of the total), Gross Fixed Capital Formation contributed 21% and government expenditure 12% of the total. Within the household component of the Corsica region, food represented approximately 22%, transportation 17%, and housing about 9% of total Footprint value. Such activities placed pressure mainly on carbon sequestration (56% of the total), Cropland (21%) and Forest land (11%); Grazing land, Fishing grounds and Built-up land had a lower contribution (all below 5% of the total). A complete breakdown of Corsica Footprint by both land types and consumption categories is provided in Figure 4.18.

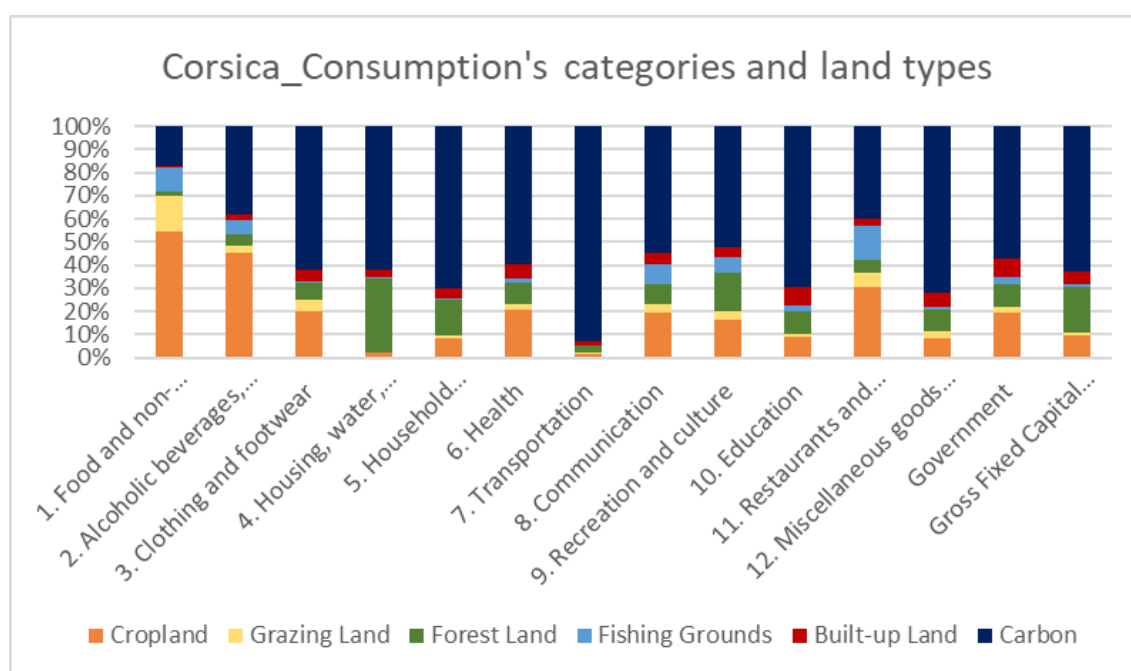


Figure 4.18 Percentage contribution of consumption categories and land types to the Ecological Footprint of the NUTS 2 Corsica region, in 2019.

Analyzing in more details the national, regional and PA biocapacity values, it was found that:

- In 2019, the total biocapacity of France was 170,735,748 gha, mainly composed by Forest land and Cropland, both representing 41% of the total, followed by Built up land (10%), Grazing land and Fishing grounds (both 4%).
- The total biocapacity of Corsica was 6,085,184 gha, representing about 4% of the whole national biocapacity. It was mainly composed by Forest land (59%) and Fishing grounds (34%), followed by Built up land and Cropland (both 3% of the total value) and Grazing land (1%).
- Finally, the biocapacity of the local protected area, the Natural reserve of the Mouths of Bonifacio, makes up about 0.4% of the biocapacity of Corsica, and being a Marine Protected Area, it is mainly constituted by Fishing grounds (92%), and Forest land (8%) (see Figure 4.19).

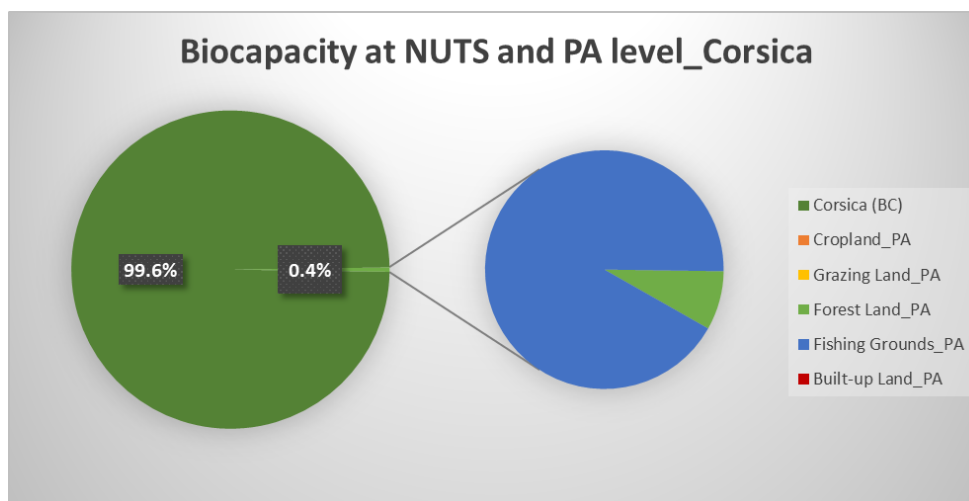


Figure 4.19 Biocapacity at PA level, the Natural reserve of the Mouths of Bonifacio, is compared with the biocapacity at NUTS 2, Corsica, showing the division by land types for year 2019

- Considering the biocapacity density, i.e., the ability of one physical hectare to provide ecosystems services, the local protected area has the lowest value 0.34 gha ha^{-1} , followed by the regional average 0.81 gha ha^{-1} , while the nation is more productive, showing a biocapacity density of 2.20 gha ha^{-1} . This indicates that, the territory of the protected area produces 85% and 58% less renewable resources and ecological services (i.e., less biocapacity) per hectare of land than the national-average and a regional-average hectare of land, respectively.
- Since the Natural reserve of the Mouths of Bonifacio is a Marine Protected Area, a lower biocapacity density is due to the main land type making up the biocapacity of protected area, that is Fishing grounds, characterized by a lower biocapacity intensity than other land types (see Figure 4.20).

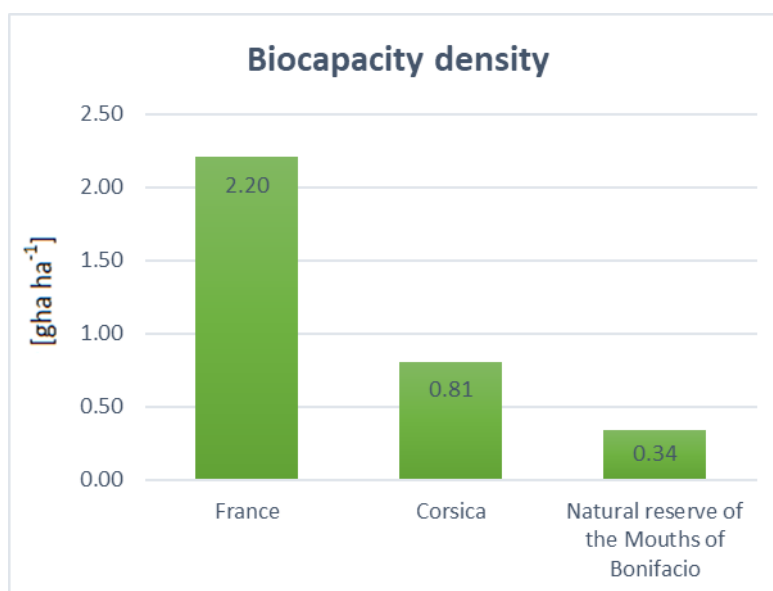


Figure 4.20 Biocapacity density at national, regional and PA level for the year 2019

4.2.4 Greece

4.2.4.1 National and sub-national Ecological Balances

In Greece, two Protected Areas have been chosen as the pilot actions involved in the development of the ecotourism packages in DestiMED Plus project: the Regional Marine Park of Northern Karpathos Saria and Astakidonision, in the South Aegean NUTS 2 region and the West Asterousia Mountain, pertaining to NUTS 2 Crete region. Results of the ecological balance are as follow:

- In 2019, the **Ecological Footprint** of an average Greek resident was **4.24 global hectares (gha)** per person, whereas the per capita biocapacity available was **1.57 global hectares (gha)**. This indicates a situation of ecological deficit, in which residents' demand for resources is nearly 2 times higher (+170%) than the nationally available biocapacity budget per person (see Figure 4.21).



Figure 4.21 Eco balance representation of Greece: Ecological Footprint is compared to the national biocapacity, revealing a situation of ecological deficit. The assessment refers to 2019-year data.

- At the NUTS 2 level in the South Aegean region, the Ecological Footprint of an average resident was 4.48 gha per capita (+6% than the national average), whereas the biocapacity of the region was 2.64 gha per capita (+68% than the national biocapacity average). This means that, although not severe as the national situation, the region was in a situation of ecological deficit in which residents demanded 70% more renewable resources and ecological services than those available within the region.
- At the NUTS 2 level in the Crete region, the Ecological Footprint of an average resident was 4.10 global hectares (gha) per person, meaning nearly 3% lower than the national average and 9% lower than the South Aegean region. On the supply side, the region of Crete was found to have a biocapacity of 2.42 gha per capita (+54% than the national biocapacity average) leading to a regional ecological deficit situation in which residents demanded 69% more renewable resources and ecological services than those available within the region (see Figure 4.22).

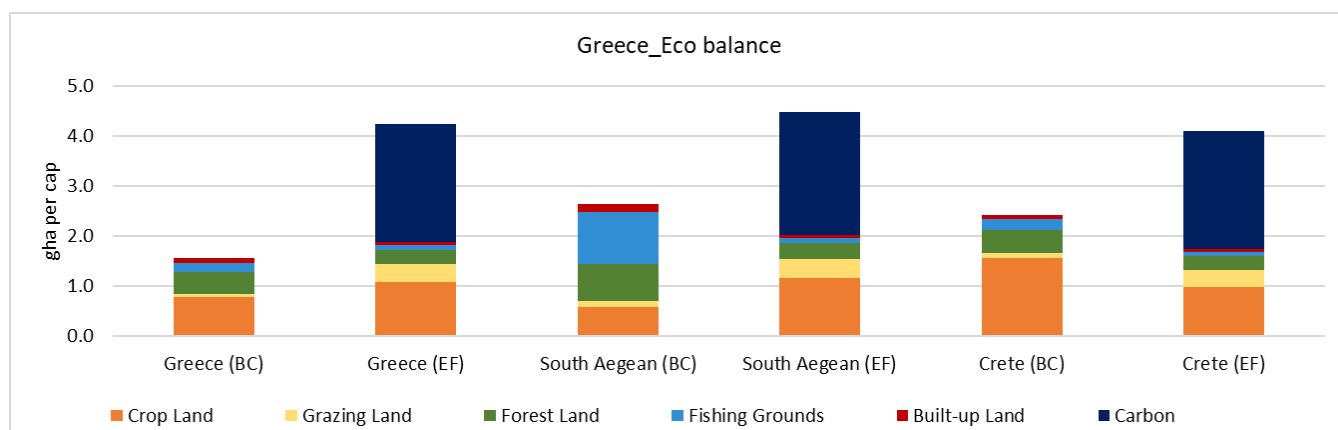


Figure 4.22 Comparison of Ecological Footprint and biocapacity results at national (Greece) and NUTS 2 regional (South Aegean and Crete) level in 2019, by land types.

When looking at the breakdowns of the Ecological Footprint by consumption categories we found that:

- In 2019, Ecological Footprint of Greece was mainly driven by household consumption, representing 84% of the total value, followed by Gross Fixed Capital Formation and government expenditures (both 8% of the total) (see section 2.4). Within the household consumption, food consumption represented the major driver of the total Ecological Footprint value of Greece (34% of the total value), followed by transportation (18% of the total value) and Housing and associated energy use (12%). Each of the other categories contributed less than 5% of the total value. (see Figure 4.23).

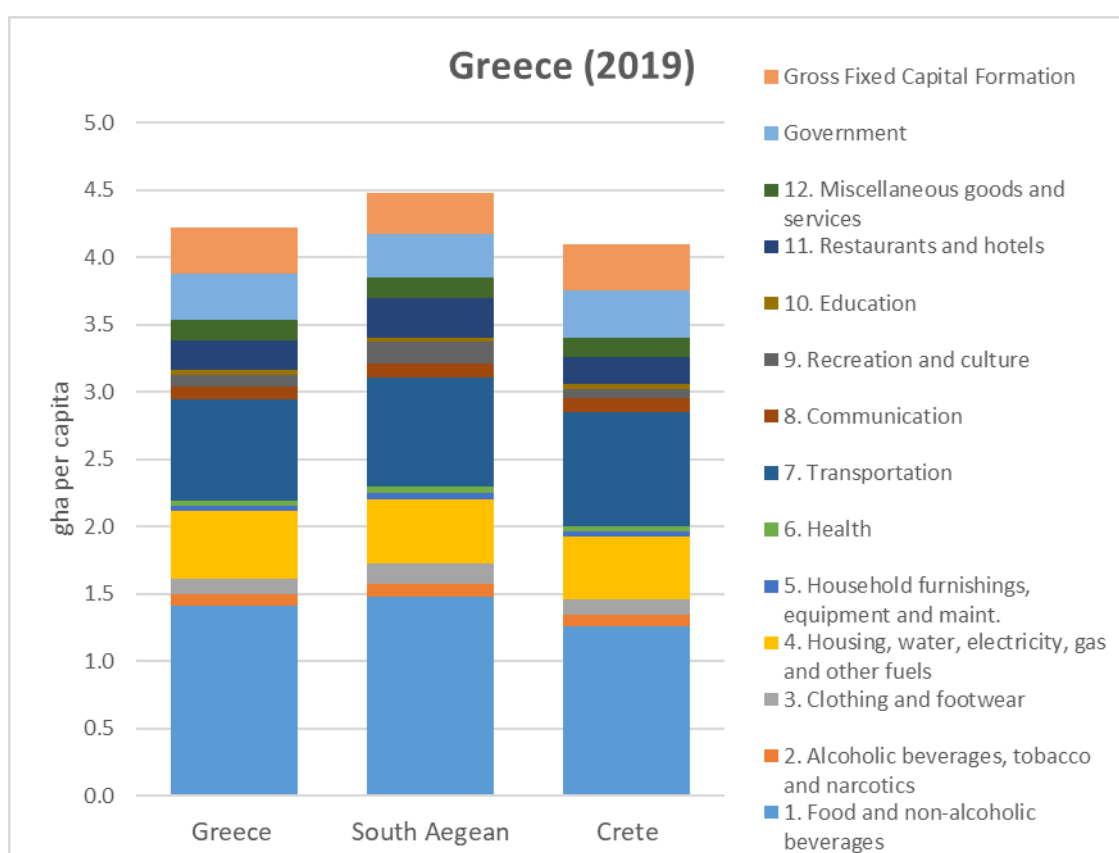


Figure 4.23 Ecological Footprint of Greece and its NUTS 2 regions of South Aegean and Crete, by consumption categories (COICOP) in 2019

- The Ecological Footprint of the South Aegean NUTS 2 region and Crete NUTS 2 region were characterized by a pattern similar to the national value: with household consumption being the major driver of both the regions' Footprints, 86% and 83% of the total respectively, followed by Gross Fixed Capital Formation and government expenditure (7% of the total both categories of South Aegean region) in the South Aegean NUTS 2 region and by government expenditure (9%) and Gross Fixed Capital Formation (8%) in the case of Crete. Within the household component of both South Aegean and Crete regions, food represented 33% and 31% respectively, transportation 18% and 21%, and housing about 11% in both regions of total Footprint value. For both regions, pressures of such consumption activities were mainly placed on the regions' carbon sequestration capacity, (being 55% in South Aegean and 57% in Crete of the total), Cropland (26% and 24% respectively), Grazing land (9% and 8% respectively) and Forest land (both 7%); Fishing grounds and Built-up land had a lower contribution (below 5% of the total) for both regions. A complete breakdown of South Aegean and Crete Footprint by both land types and consumption categories is provided in Figure 4.24a and Figure 4.24b.

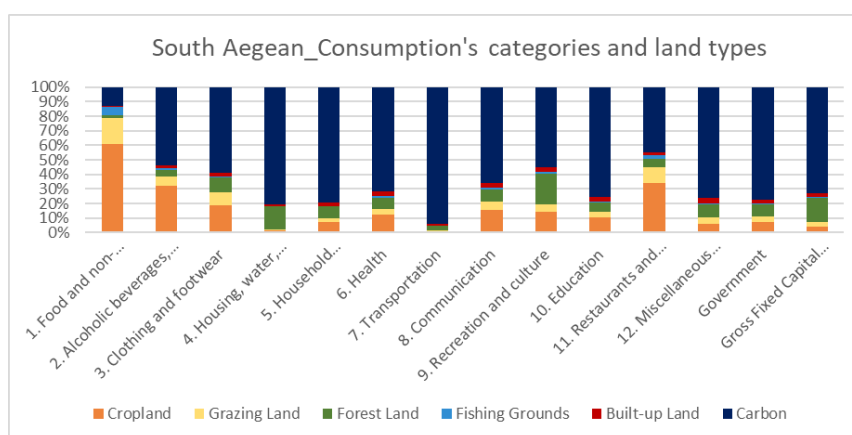


Figure 4.24a Percentage contribution of consumption categories and land types to the Ecological Footprint of the NUTS 2 South Aegean in 2019

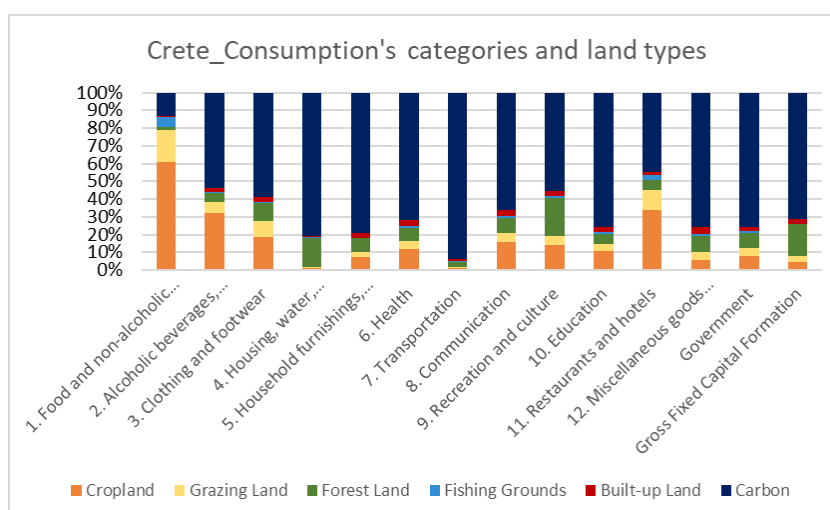


Figure 4.24b Percentage contribution of consumption categories and land types to the Ecological Footprint of the NUTS 2 Crete in 2019

Analyzing in more details the national, regional and PA biocapacity values, it was found that:

- In 2019, the total biocapacity of Greece was 16,830,330 gha, composed by 49% Cropland, 28% Forest land, 12% Fishing grounds, 6% of Built-up land and 5% of Grazing land. The total biocapacity of South Aegean was 908,709 gha, representing about 5% of the whole national biocapacity. The total biocapacity of Crete was 1,539,308 gha, being about 9% of the national value.
- The biocapacity of South Aegean NUTS 2 was mainly composed by Fishing grounds (39%) and Forest land (28%), followed by Cropland (22%), Built up land (6%) and Grazing land (5%). The biocapacity of the local protected area placed in South Aegean Region, the Regional Marine Park of Northern Karpathos Saria and Astakidonision, makes up about 1.4% of the biocapacity of South Aegean, and it mainly consists of Forest land (70%), Fishing grounds (13%) and Cropland (12%), followed by Grazing land (4%) and Built-up land (2%) (see Figure 4.25a).
- The biocapacity of Crete NUTS 2 region was mainly composed by Cropland (64%) and Forest land (19%), followed by Fishing grounds (9%), Built up land and Grazing land (both 4% of the total). West Asterousia Mountain, the protected area involved in the DestiMED Plus project, makes up about 0.1% of the biocapacity of Crete and it mainly consists of Forest land (83%) and Fishing grounds (9%), followed by Built up land (6%) and Grazing land (2%) (see Figure 4.25b).

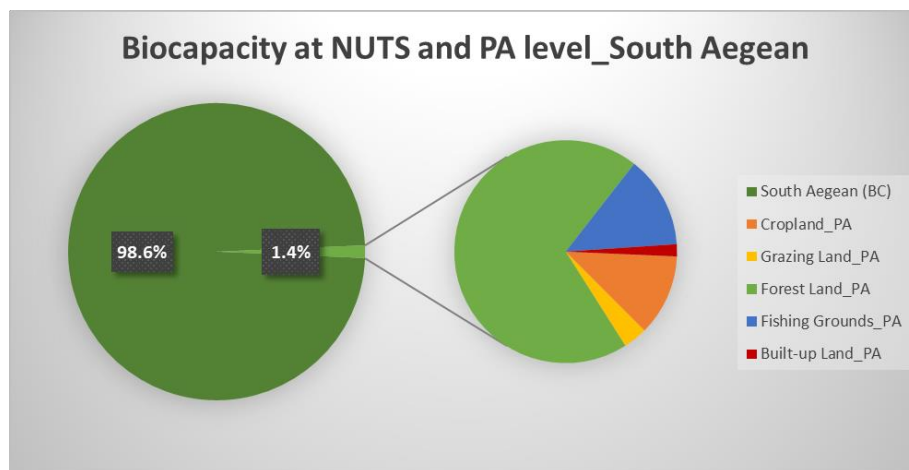


Figure 4.25a Biocapacity at PA level, the Regional Marine Park of Northern Karpathos Saria and Astakidonision, is compared with the biocapacity at NUTS 2, South Aegean, showing the division by land types for year 2019

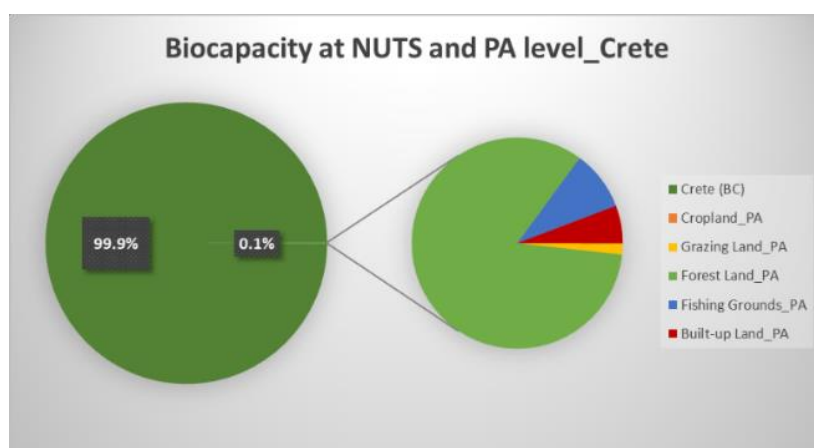


Figure 4.25b Biocapacity at PA level, the West Asterousia Mountain, is compared with the biocapacity at NUTS 2, Crete, showing the division by land types for year 2019.

- Considering the biocapacity density, the region of South Aegean has a lower value than the Regional Marine Park of Northern Karpathos Saria and Astakidonision (0.50 gha ha^{-1} vs. 0.60 gha ha^{-1} , respectively). The national level is instead more productive, showing a biocapacity density of 0.85 gha ha^{-1} . This indicates that, the territory of the protected area produces 20% more renewable resources and ecological services per hectare of land than the regional-average hectare of land, but it produces 29% less resources than the national average hectare (see Figure 4.26).
- The protected area of the West Asterousia Mountain has the lowest biocapacity density value 0.43 gha ha^{-1} among all geographical areas analyzed in Greece, while the region of Crete showed a biocapacity density of 1.18 gha ha^{-1} . This indicates that the territory of the protected area produces 50% and 64% less renewable resources and ecological services (i.e., less biocapacity) per hectare of land than the national-average and the regional-average hectare of land, respectively (see Figure 4.26).

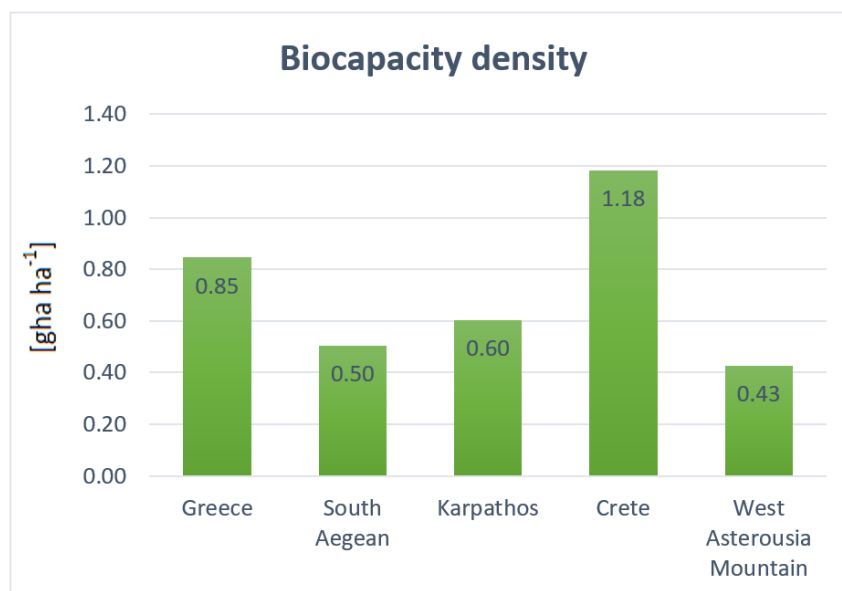


Figure 4.26 Biocapacity density of Greece, at national, regional and PA level for the year 2019

4.2.5 Italy

4.2.5.1 National and sub-national Ecological Balances

In Italy, two Protected Areas have been chosen as pilot actions involved in the development of the ecotourism packages in DestiMED Plus project: Pontine Islands in the Lazio NUTS 2 region and Porto Conte in the Sardinia NUTS 2 Region. Results of the ecological balance are as follow:

- In 2019, the **Ecological Footprint** of an average Italian resident was **4.34 global hectares (gha)** per person, whereas the per capita biocapacity available was **1.06 global hectares (gha)**. This indicates a situation of ecological deficit, in which residents' demand for resources is about 3 times higher (+310%) than the nationally available biocapacity budget per person (see Figure 4.27).

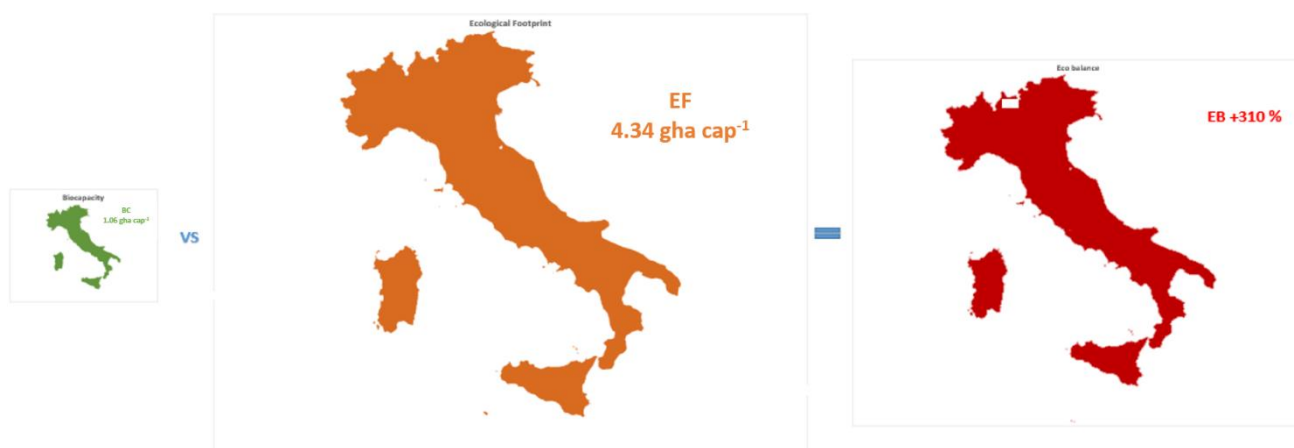


Figure 4.27 Eco balance representation of Italy: Ecological Footprint is compared to the national biocapacity, revealing a situation of ecological deficit. The assessment refers to 2019-year data.

- In the NUTS 2 territory of the Lazio region, the Ecological Footprint of an average resident was 4.42 gha per capita (2% higher than the national average), while biocapacity was 0.64 gha per capita (-40% than the national biocapacity value). As such, this determines a regional situation of ecological deficit more severe than the national balance, in which residents' demand for resources is nearly 6 times higher (+596%) than the regionally available biocapacity budget per person.
- In the NUTS 2 territory of the Sardinia region, the Ecological Footprint of an average resident was 4.00 global hectares (gha) per person (nearly - 8% than the national average), while biocapacity was 4.25 gha per capita, thus about 300% higher than the national biocapacity value. In this case, Sardinia region is in a situation of ecological reserve, in which residents demand 6% less renewable resources and ecological services than those available within the region (see Figure 4.28)

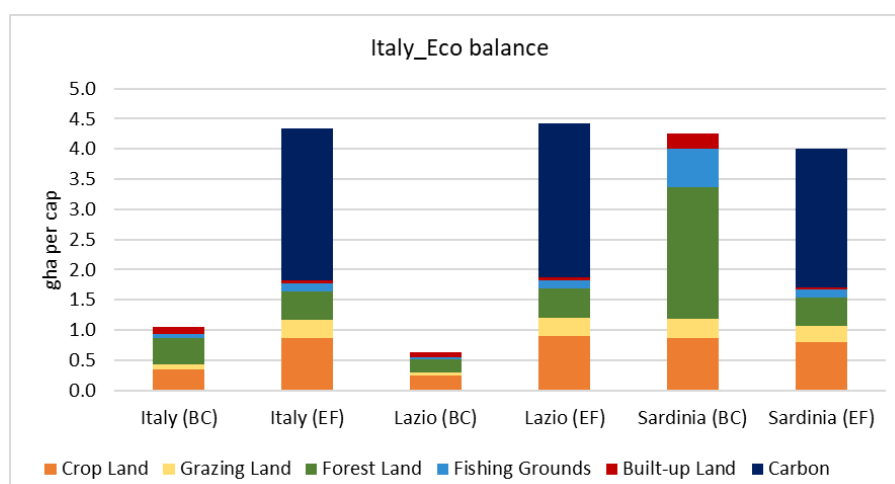


Figure 4.28 Comparison of Ecological Footprint and biocapacity results at national (Italy) and NUTS 2 regional (Lazio and Sardinia) level in 2019, by land types.

When looking at the breakdowns of the Ecological Footprint by consumption categories we found that:

- In 2019, the Ecological Footprint of Italy was mainly driven by household consumption, representing 79% of the total value, followed by Gross Fixed Capital Formation (13%) and government expenditures (8%). Within the household component, food consumption represented the major driver of the total Ecological Footprint value of Italy (25% of the total value), followed by transportation (18% of the total value), housing and associated energy use (12%) and restaurant and hotels (6%). Each of the other categories contributed less than 5% of the total value. (see Figure 4.29).

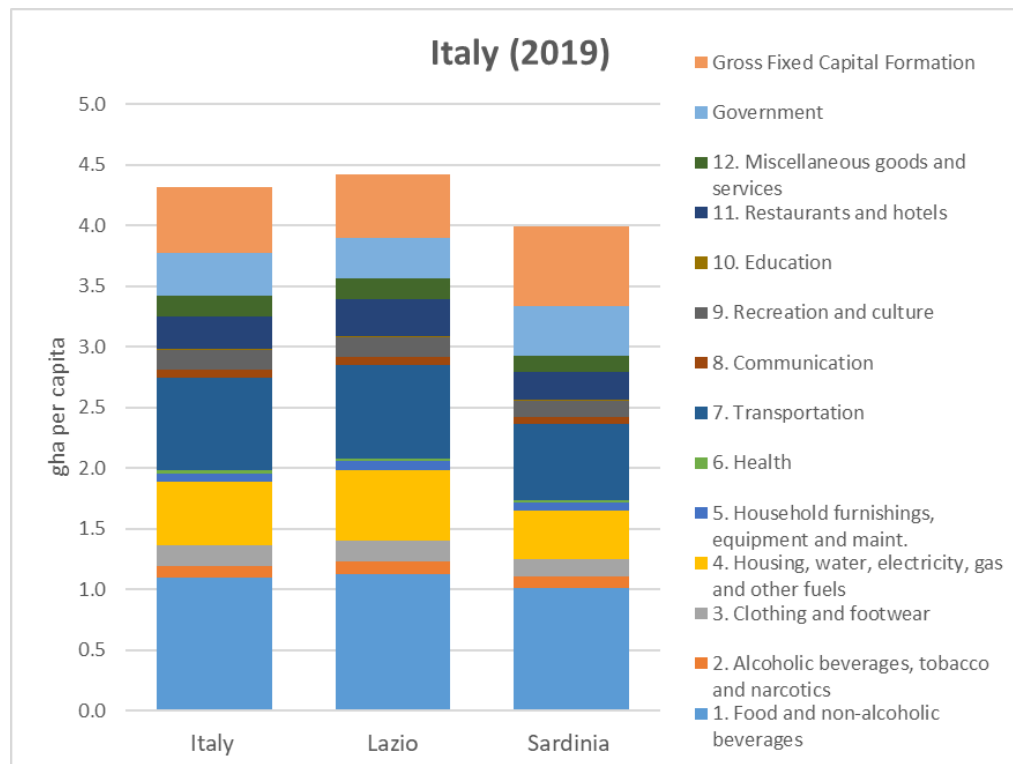


Figure 4.29 Ecological Footprint of Italy and NUTS 2 regions of Lazio and Sardinia, by consumption categories (COICOP) in 2019

- The Ecological Footprint of the Lazio and Sardinia NUTS 2 regions were characterized by a pattern similar to the national value: household consumption was the major driver of both the regions' Footprints (81% in Lazio and 73% of the total in Sardinia), followed by Gross Fixed Capital Formation (12% and 16%, respectively) and government expenditure (8% and 10%, respectively). Within the household component for both regions, food represented approximately 25% of the total, transportation 17% in Lazio and 16% in Sardinia, and housing about 13% and 10% respectively of the total Footprint value. Such activities placed pressures mainly on carbon sequestration (58% in Lazio and 57% in Sardinia of the total, respectively), Cropland (20% in both regions), Forest land (11% and 12% in Lazio and Sardinia respectively), and Grazing land (7% in both regions). Fishing grounds and Built-up land had a lower contribution (all below 5% of the total) for both regions. A complete breakdown of Lazio and Sardinia Footprint by both land types and consumption categories is provided in Figure 4.30a and Figure 4.30b, respectively.

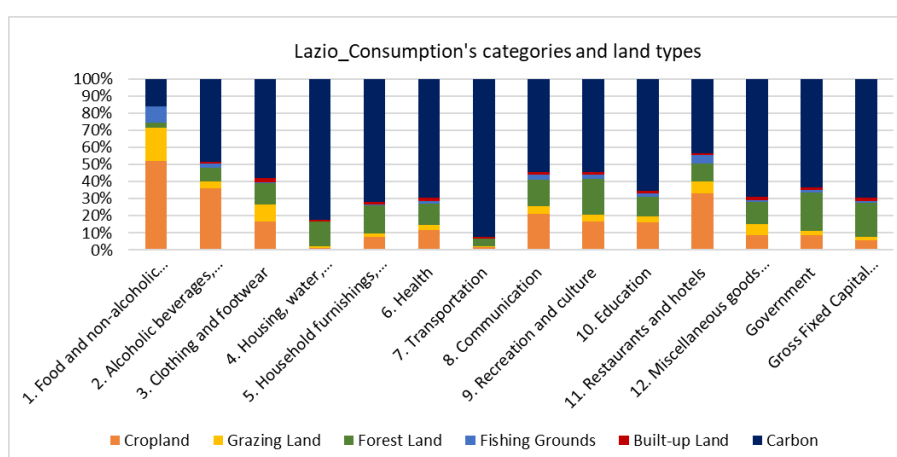


Figure 4.30a Percentage contribution of consumption categories and land types to the Ecological Footprint of the Lazio NUTS 2 Region in 2019

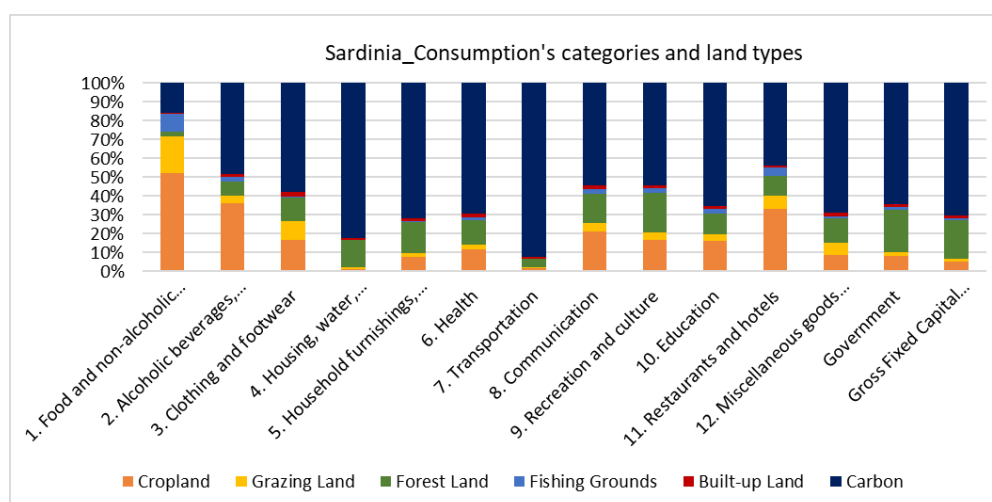


Figure 4.30b Percentage contribution of consumption categories and land types to the Ecological Footprint of the Sardinia NUTS 2 Region in 2019

Analyzing in more details the national, regional and PA biocapacity values, it was found that:

- In 2019, the total biocapacity of Italy was 63,940,108 gha, composed by 42% Forest land, 34% Cropland, 12% Built-up land, 6% of Fishing grounds and Grazing land. The total biocapacity of Lazio was 3,736,959 gha, around 6% of the whole national biocapacity. The total biocapacity of Sardinia was 6,971,619.03 gha, about 11% of the national value.
- The biocapacity of Lazio NUTS 2 was mainly composed by Cropland (38%) and Forest land (35%), followed by Built up land (14%), Grazing land (8%) and Fishing grounds (5%). The biocapacity of the local protected area placed in Lazio, Pontine Islands, makes up about 0.2% of the total biocapacity of Lazio region, and it is mainly constituted by Fishing grounds (63%), Forest land (23%), Built up land (9%), and Grazing land (5%) (see Figure 4.31a).
- The biocapacity of Sardinia NUTS 2 was mainly composed by Forest land (51%) and Cropland (20%), followed by Fishing grounds (15%), Grazing land (7%) and Built-up land (6%). Porto Conte Protected Area makes up about 0.3% of the total biocapacity of Sardinia and it is mainly constituted by Forest land (86%), Cropland (9%) and Fishing ground (5%) (see Figure 4.31b).

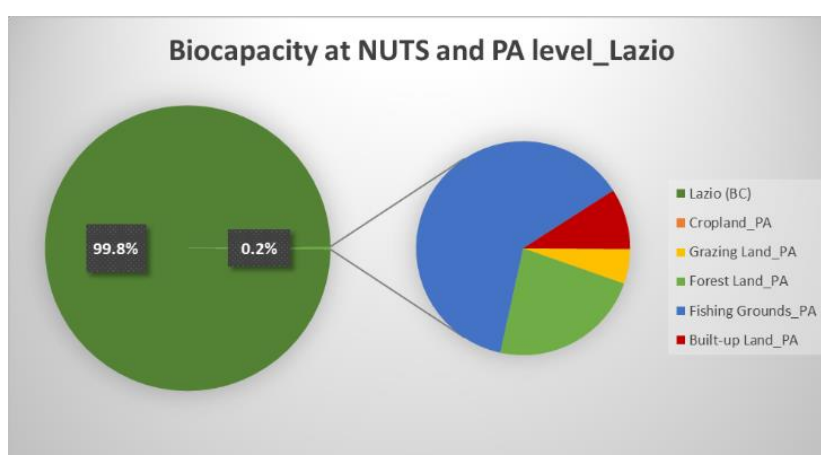


Figure 4.31a Biocapacity at PA level, Pontine Islands, is compared with the biocapacity at NUTS 2, Lazio, showing the division by land types for year 2019.

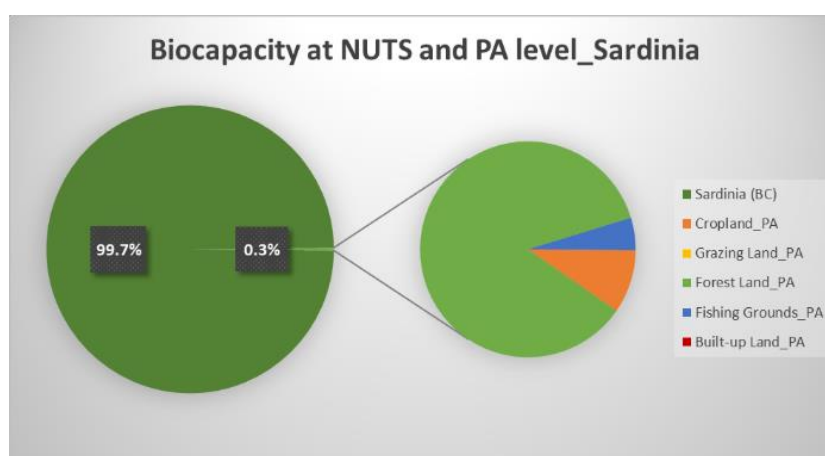


Figure 4.31b Biocapacity at PA level, Porto Conte, is compared with the biocapacity at NUTS 2, Sardinia, showing the division by land types for year 2019.

- As for the biocapacity density, Pontine Islands have a value of 0.50 gha ha^{-1} , the lowest among the national average (1.56 gha ha^{-1}) and the Lazio region (with a biocapacity density of 1.64 gha ha^{-1}). This indicates that, the territory of Pontine Islands protected area produces 68% and 70% less renewable resources and ecological services (i.e., less biocapacity) per hectare of land than a national-average (-68%) or a regional-average hectare of land (-70%) (see Figure 4.32).
- The local protected area of Porto Conte in Sardinia region has the highest biocapacity density value among all analyzed territories in Italy with a value of 2.46 gha ha^{-1} , while Sardinia region showed a biocapacity density of 1.26 gha ha^{-1} . This indicates that, through its safeguarded ecosystems, the territory of the protected area of Porto Conte is able to produce 58% and 96% more renewable resources and ecological services (i.e., more biocapacity) per hectare of land than a national-average or a regional-average hectare of land, respectively (see Figure 4.32).

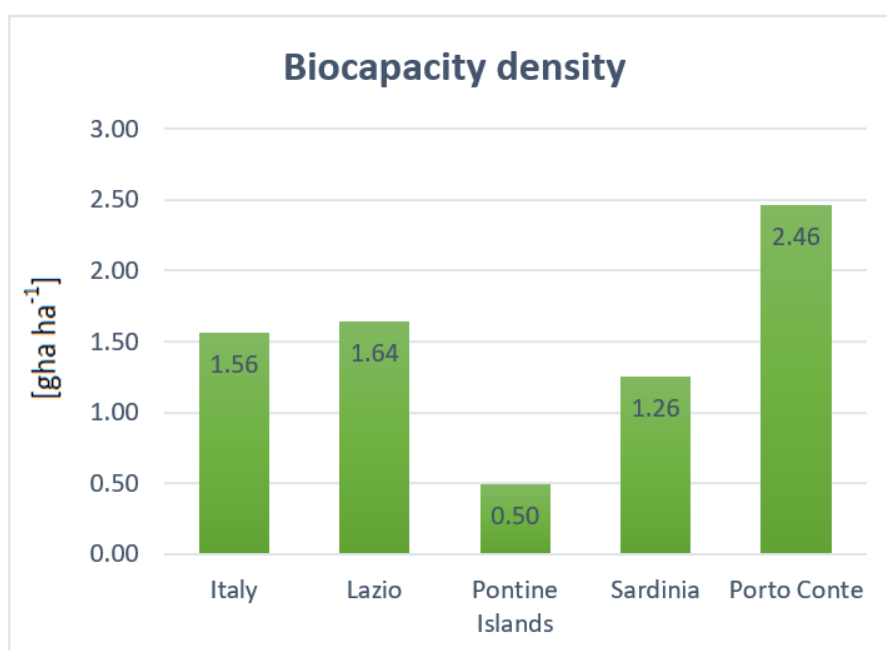


Figure 4.32 Biocapacity density at national, regional and PA level for the year 2019

4.2.6 Spain

4.2.6.1 National and sub-national Ecological Balances

In Spain, two Protected Areas have been chosen as pilot action for DestiMED Plus project: Zona Volcànica de la Garrotxa Natural Park in the NUTS 2 region of Catalonia and Cabo de Gata-Níjar National Park in the NUTS 2 region of Andalusia. Results of the ecological balance are as follows:

- In 2019, the **Ecological Footprint** of an average Spanish resident was **4.06 global hectares (gha)** per person, whereas the biocapacity per capita was **1.49 global hectares (gha)**, this indicates a situation of ecological deficit, in which residents' demand for resources is nearly 2 times higher (+173%) than the nationally available biocapacity budget per person (see Figure 4.33).



Figure 4.33 Eco balance representation of Spain: Ecological Footprint is compared to the national biocapacity, revealing a situation of ecological deficit. The assessment refers to 2019-year data.

- At the NUTS 2 level, the Ecological Footprint of an average resident of the Catalonia NUTS 2 region was 4.32 gha per capita, 7% higher than the national average, while the biocapacity per capita is 0.80 gha per capita, 46% lower than the national value. This stresses a situation of ecological deficit, in which Catalonia residents' demand for resources is 4 times higher (+438%) than the regionally available biocapacity budget per person.
- At NUTS 2 level of Andalusia region, the Ecological Footprint of an average resident was 3.88 global hectares (gha) per person, that is nearly 4% lower than the national average and 10% lower than Catalonia region). On the other hand, the regional biocapacity of Andalusia is 1.42 gha per capita, thus pointing to a situation of ecological deficit, in which residents of the region demanded 173% more renewable resources and ecological services than those available within the region (see Figure 4.34).

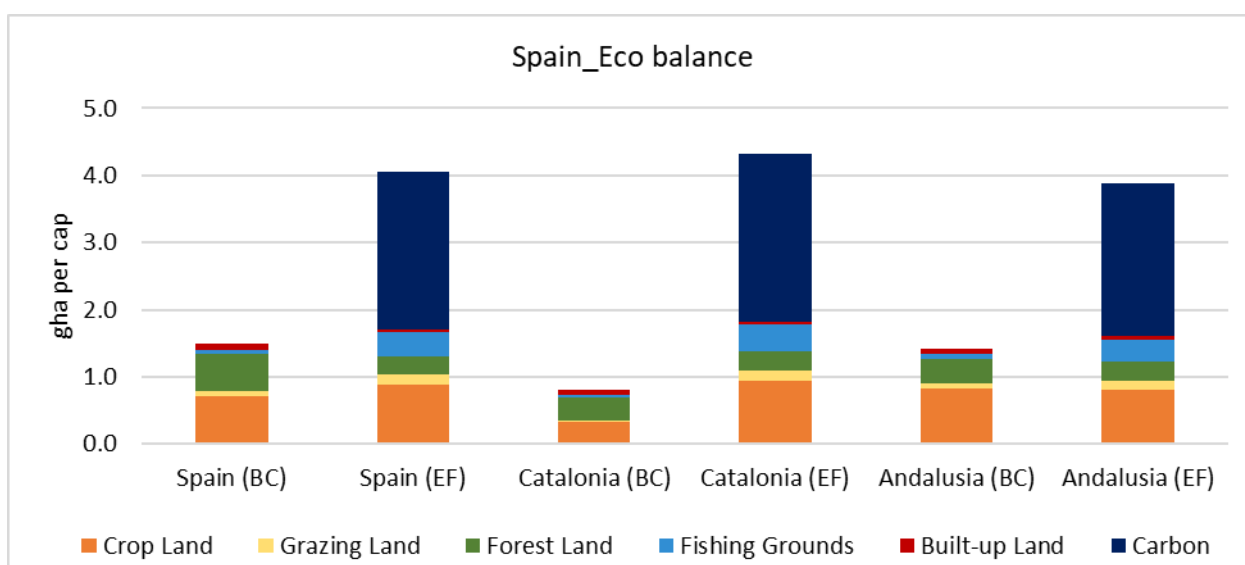


Figure 4.34 Comparison of Ecological Footprint and biocapacity results at national (Spain) and NUTS 2 regional (Catalonia and Andalusia) level in 2019, by land types.

When looking at the breakdowns of the Ecological Footprint by consumption categories we found that:

- In 2019, the Ecological Footprint of Spain was mainly driven by household consumption, representing 77% of the total value, then GFCF (14%) and government expenditures (9%) (see section 2.4). Within the household consumption, food represented the major driver of the total Ecological Footprint value of Spain (27% of the total value), followed by transportation (16% of the total value) and housing and the associated energy consumption (11% of the total value). Each of the other categories contributes to less than 10% of the total EF value, with a peak in restaurants and hotels (7%) (see Figure 4.35)

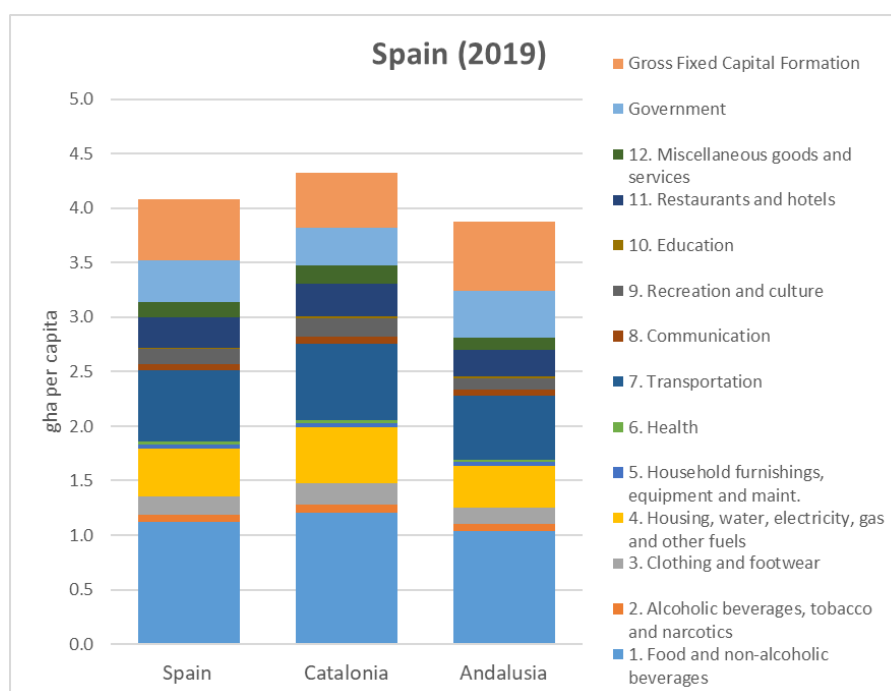


Figure 4.35 Ecological Footprint of Spain and the NUTS 2 regions of Catalonia and Andalusia, broken down by consumption categories (COICOP) in 2019.

- The Ecological Footprints of both Catalonia and Andalusia NUTS 2 regions were characterized by similar patterns to the national value, but with slightly different percentages: with household consumption being the major driver of both the regions' Footprints, 80% and 72%, respectively, followed by Gross Fixed Capital (12% and 16% respectively), and government (8% and 11% of the total value, respectively). Within the household component, of both regions, food was the first driver (28% of the total in Catalonia and 27% in Andalusia), followed by transportation (respectively 16% and 15%), and housing (12% and 10%), as for the national level; all the other categories contributed less than 10% of the total value for each region. Such activities posed pressures mainly on carbon sequestration (58% and 59% of the total in Catalonia and Andalusia, respectively), Cropland (22% and 21% respectively), Fishing grounds (both 9%), and Forest land (both 7%). Grazing land and Built-up land had a lower contribution (below 5% of the total) for both regions. A complete breakdown of Catalonia and Andalusia Footprint by both land types and consumption categories is provided in Figure 4.36a and Figure 4.36b.

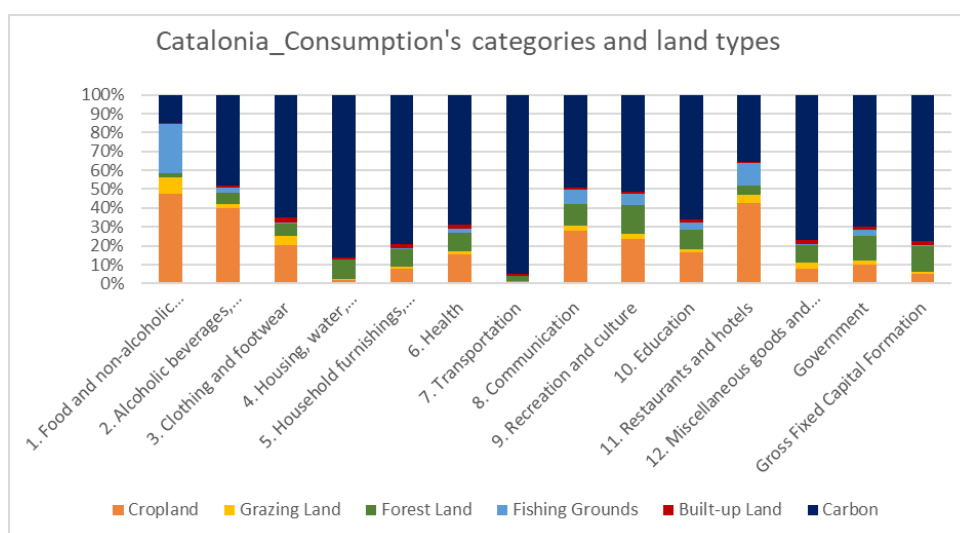


Figure 4.36a Percentage contribution of consumption categories and land types to the Ecological Footprint of Catalonia in 2019

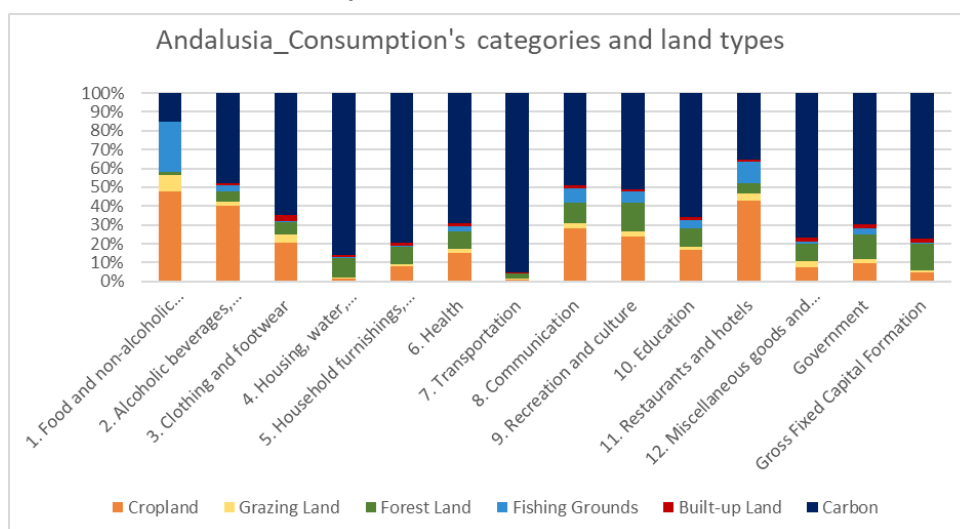


Figure 4.36b Percentage contribution of consumption categories and land-types to the Ecological Footprint of Andalusia in 2019

Analyzing in more details the national, regional and PA biocapacity values, it was found that:

- In 2019, the total biocapacity of Spain was 69,807,763gha, composed by 48% Cropland, 38% Forest land, 6% Built-up land, 5% Grazing land and 4% Fishing grounds. The total biocapacity of Catalonia was 6,078,248 gha, around 8.7% of the whole national biocapacity. While the total biocapacity of Andalusia was 11,975,332 gha, about 17.9% of the national value.
- The biocapacity of Catalonia NUTS 2 was mainly composed by Cropland and Forest land (both 42%), followed by Built up land (10%), Fishing grounds (4%) and Grazing land (2%). The biocapacity of the local protected area placed in Catalonia, Zona Volcànica de la Garrotxa Natural Park, makes up about 0.5% of the biocapacity of Catalonia region, and it is mainly constituted by Forest land (63%), Cropland (33%), Built up land and Grazing land (both 2%) (see Figure 4.37a).
- On the other side, the biocapacity of Andalusia NUTS 2 was mainly composed by Cropland (59%), Forest land (26%), followed by Fishing grounds and Built-up land (both 5%), Grazing land (4%). Cabo de Gata-Nijar National Park, makes up about 0.2% of the biocapacity of Andalusia and it is mainly constituted by Forest land (69%), Cropland (24%), Grazing land and Built-up land (both 3%) (see Figure 4.37b).

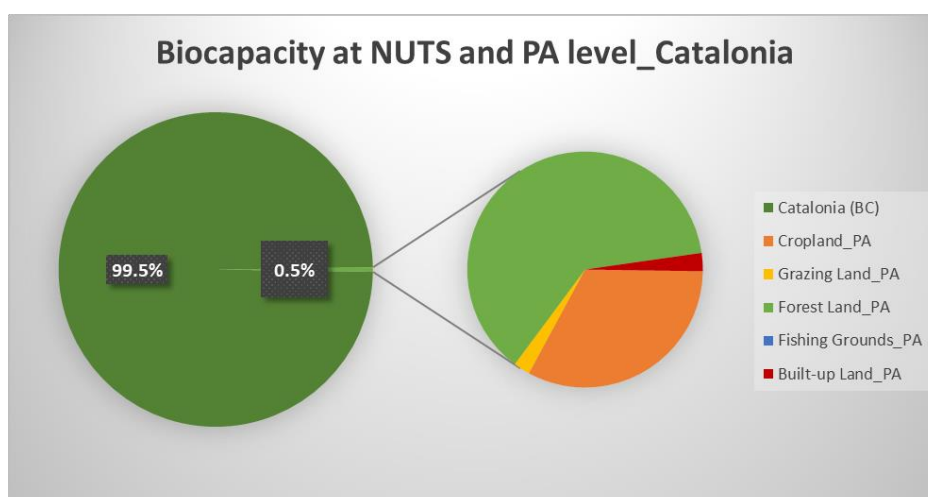


Figure 4.37a Biocapacity at PA level, Zona Volcànica de la Garrotxa Natural Park, is compared with the biocapacity at NUTS 2, Catalonia, showing the division by land types for year 2019.

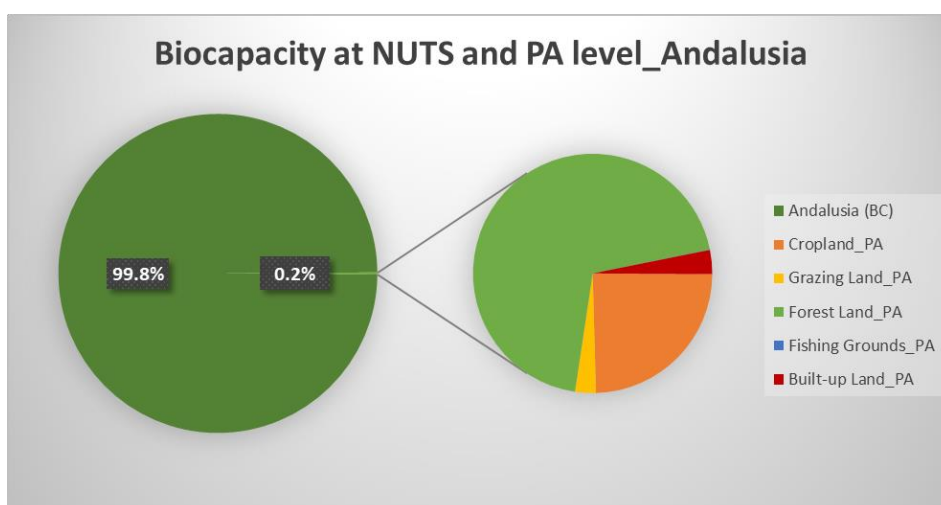


Figure 4.37b Biocapacity at PA level, Cabo de Gata-Nijar National Park, is compared with the biocapacity at NUTS 2, Andalusia, showing the division by land types for year 2019.

- As for the biocapacity density, the protected area of Zona Volcànica de la Garrotxa Natural Park has the highest biocapacity density value (1.84 gha ha^{-1}) among all geographical areas analyzed in Spain, followed by the regional average of Catalonia (1.56 gha ha^{-1}), and the national average (1.21 gha ha^{-1}). This indicates that, through its safeguarded ecosystems, the territory of the protected area is able to produce 52% and 18% more renewable resources and ecological services (i.e., more biocapacity) per hectare of land than the national-average and the regional-average hectare of land, respectively (see Figure 4.38).
- On the other hand, Cabo de Gata-Níjar National Park has the lowest biocapacity density value (0.67 gha ha^{-1}) among all the areas analyzed in Spain, whereas the region of Andalusia had a value of 1.16 gha ha^{-1} , thus a productivity lower than the national average. This indicates that, the territory of the protected area produces 45% and 43% less renewable resources and ecological services (i.e., less biocapacity) per hectare of land than the national-average and regional-average hectare of land, respectively (see Figure 4.38).

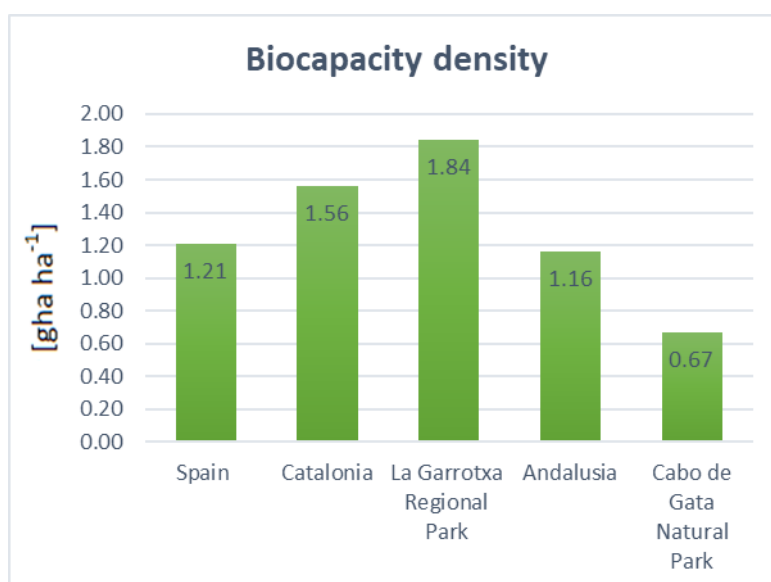


Figure 4.38 Biocapacity density of Spain, at national, regional and PA level for the year 2019

5 Discussions & Conclusions

Overall, the findings of this report indicate human demand for natural resources and ecological services across the Mediterranean Region to be greater than the capacity of the region's ecosystems to renew such resources and services. As such, countries in the Mediterranean run an ecological deficit situation that implies a dependence on resources and services from ecosystems outside their borders to satisfy the demands of residents and tourists.

From a destination point of view, this situation creates a vicious circle as the presence of tourism in the region is likely to worsen the pressure on ecosystems and increase the consumption of resources; in turn, the overconsumption of natural resources and deterioration of the natural capital compromise the local tourism offer. Realizing this physical reality calls for the development of tourism monitoring and planning strategies that put sustainability and resource security issues at their core, and that favour the development of sustainable tourism and ecotourism alternatives.

Looking at the Footprint drivers, we found *food*, *transportation*, and *housing* to be the main components of the Ecological Footprint in the Mediterranean Region, all of which are key categories in the development of the tourism offer. In other words, failing to properly manage these three sectors might lead to an exacerbation of the Footprint values due to increasing tourism inflows, thus worsening an already delicate situation. Conversely, a dedicated effort to manage these categories (through a sustainable implementation of tourism) could help improve the present situation, lowering the pressure caused by these components on the regional territory and the local natural resources. Ecotourism might offer a way to contribute to natural conservation objectives, while also constituting a valid alternative to mass tourism in the region.

Upon a closer look at the country results, we found all countries involved in the DestiMED Plus project to run a situation of ecological deficit, as the Footprint values are greater than the biocapacity one. Croatia is the country having the smallest ecological deficit with a biocapacity 31% lower than the National Footprint. On the other hand, Italy has the largest gap as its Ecological Footprint is 3 times higher than the national biocapacity. Spain and Greece have an Ecological Footprint nearly 1.7 times higher than their national biocapacity, while national Footprint of Albania and France are about 87-89% higher than their biocapacity. Consistently with the Mediterranean regional situation described above, in all 6 countries involved in the DestiMED Plus project, the major Footprint drivers are food (an average 30% of the total Footprint among all countries), transportation (16%) and housing (12%).

At regional (NUTS 2) level, 3 areas out of the 9 participating in the project are in a situation of ecological reserve, as the regional biocapacity is greater than the regional Ecological Footprint. These three regions are Corsica (France) with a biocapacity 2.7 times higher than the regional Ecological Footprint; Jadranska Hrvatska (Croatia) with a biocapacity 22% higher than the regional Ecological Footprint; and Sardinia (Italy) with a regional biocapacity 6% higher than the regional's Ecological Footprint. In these three regions, forests represent the ecosystem type making up most of the natural assets (i.e., the biocapacity) of the regions: in Jadranska and Corsica, forests contribute to nearly 60% of the biocapacity, while in Sardinia they contribute to 50%. In all three regions, the second highest determinant of the regional biocapacity are fishing grounds, representing 34%, 20% and 15% of the total in Corsica, Jadranska Hrvatska and Sardinia, respectively. Forests and fishing grounds are thus fundamental "natural assets" of these regions (i.e., biocapacity hotspot) and as such their preservation should be prioritized. Moreover, from a tourism point of view, the presence of abundant forest ecosystem might constitute an alternative attraction to the more usual seaside destination, while the rich fishing grounds might support a local food system based on fish products.

The other 6 regions participating in the project (Albania South, South Aegean, Crete, Lazio, Catalonia, and Andalusia) show a situation of ecological deficit, with regional Ecological Footprints ranging from being 20% (in Albania) to 600% (Lazio) higher than the regional biocapacities. These regions should pay careful attention in the management of future tourism inflow to their areas as their ecosystems are already under pressure from the overconsumption of resources by their own residents and current tourists. Still, a reshaping of the tourist offer in these regions has the potentiality to contribute reducing the environmental pressure on the local territories thanks to an increased awareness in local stakeholders and service providers and the spreading of environmentally friendly best practices across the territory. As seen with the service providers involved in the DestiMED project, involving local tourism stakeholders in the development and monitoring of sustainable tourism alternatives can constitute a way to increase their environmental awareness and influence their daily practices, thus triggering positive cascade effects throughout territories.

Calculated at PA level, biocapacity represents a tiny share of the regional biocapacity in all the pilot actions involved in the DestiMED Plus project. However, the biocapacity density – a measure of the average biocapacity that can be produced out of a hectare of land – of 3 PAs is greater than the that of the regions and countries (Divjake-Krvarsta National Park in Albania South, Porto Conte in Sardinia and the Garrotxa Regional Park in Catalonia) hosting them. Also, the PA of Karpathos has a greater biocapacity density than its South Aegean region but lower than the BC density of Greece. These results indicate that the biological productive areas in these territories have a greater ability to provide natural resources and ecosystem services than the same areas at regional or national level. Being areas of particularly high biological productivity, they represent key biocapacity hotspots, and thus deserve continuous protection and preservation.

To conclude, and with all the necessary limitations due to the current lack of dedicated Footprint assessments for the tourism sector and the ecotourism packages of the pilot areas, initial guidance can be provided from the eco-balance assessment for the 9 regions involved in the project. Within **regions in ecological deficit**, such as Albania South, South Aegean, Crete, Lazio, Catalonia and Andalusia, tourism planning should pay careful attention not to further compromise the natural endowment of the local territories, especially considering the already high pressure at regional level. Moreover, while developing the tourism offer, particular attention should be put on food and mobility, being these the more resources demanding categories; also, tourist practices aiming at reducing carbon emissions should be prioritized (ECO licences, CO₂ compensation, etc) given that carbon uptake lands are the ecological assets under the highest pressure. Within **regions in ecological reserve**, such as Jadranska Hrvatska, Corsica and Sardenia, the tourism offer should be developed paying special attention to safeguarding forest ecosystems and fishing grounds as they represent, from a biocapacity viewpoint, the “natural assets” upon which the region rely for their territorial development.

6 Limitation of the analysis

The Ecological Footprint vs. biocapacity balance assessment at destination level constitutes a baseline for the sustainability context within which each package is promoted and implemented; to properly understand such context, it is important to acknowledge some of the limitations that affect the results and could compromise the representativeness of the analysis. The main limitations are as follow:

- **Area resolution.** According to the DestiMED Plus project, ecotourism packages are designed to be experienced in and around the related Protected Area. Therefore, a good resolution for the sustainability baseline of the Ecological Footprint vs. biocapacity balance would be the small scale of

municipalities in and around the PA. However, information on residents' expenditure – used to derive sub-national EF results (see sections 2.4 and 2.5) – at such small scale is hard to obtain and we thus opted for the broader regional level, which include all the municipalities and the PA itself. A biocapacity analysis has been also conducted at PA level to understand the natural endowment available on site and the contribution it makes to the regional level.

- **Biocapacity value.** According to the Ecological Footprint methodology, biocapacity considers single and mutually exclusive resources or services produced by each land type. Specifically, biocapacity is an anthropocentric measure of those services or resources that are useful to humans and that can be tracked in terms of biologically productive surfaces. For instance, *biocapacity of forests* captures the production of wood, timber and paper products but it does not track services like maintenance of soil quality and prevention of soil erosion, biodiversity habitat, climate regulation, flood control, recreational and cultural services etc.; similarly, the *biocapacity of fishing grounds* tracks the production of edible fish and seafood, but does not track all other ecosystem services, such as air temperature regulation (regulation services), wellness due to beauty and landscapes (cultural services) and life-cycle maintenance, habitat and gene pool protection (support services). More precisely, fishing grounds' biocapacity does not account for ecosystem services offered by the *Posidonia Oceanica* – the typical Mediterranean marine plant essential for the underwater life – like CO₂ sequestration, protection from seabed and coastal erosion, wave movement regulation, as well as habitat and nursery functions.
- **Comparison with the tourism sector.** In this report, Ecological Footprint and biocapacity values have been conducted based on expenditure data of the regions' residents (the EF) and GIS data about the land coverage of the considered territories (the BC). The scaling approach used to assess sub-national Footprint values, however, is limited by the difficulty to distinguish expenditure by residents from the expenditure made by tourists. As such, it is hard to derive indications for the tourism planning based on the sole ecological balance analysis. To address this issue, a future task of the DestiMED Plus project includes the development of a methodology to calculate the Ecological Footprint of the tourism sector within the countries and regions participating in the project. This analysis is ongoing and once ready, tourism sector results will be comparable with the ecological balance results.

7 References

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8 Annexes

8.1 Annex 1 – Ecological Footprint calculation methodology

The Ecological Footprint, in its most basic form, is calculated using the following equation:

$$EF = \frac{P}{Y} \quad \text{Equation 1}$$

Where P is the annual demand of a product and Y is the annual yield of the same product (Lin et al., 2018, Borucke et al, 2013). Yield is expressed in global hectares (see Box 2.1). In practice, global hectares are estimated with the help of two factors: the yield factors (YFs), which compare national average yield per hectare to world average yield in the same land category; and the equivalence factors (EQFs), which capture the relative productivity among the various land and sea area types.

Taking into account these factors, the formula of the Ecological Footprint becomes:

$$EF = \left(\frac{P}{Y_N} \right) \times YF \times EQF \quad \text{Equation 2}$$

Where P is the amount of a product harvested or waste emitted, Y_N is the national average yield for P, and YF and EQF are the respective yield factors and equivalence factors for the country and land use type in question. The yield factor is the ratio of national-to-world-average yields, which is calculated directly from FAO data as the annual availability of usable products and varies by country and year. Equivalence factors – calculated by means of the FAO GAEZ (Global Agro-Ecological Zones) model – translate the supply of or demand for an area of a specific land use type (e.g., world-average cropland or grazing land) into units of world-average biologically productive area expressed in global hectares. These factors can vary by land use type and year.

The calculation of a country's biocapacity begins with the total amount of bioproductive land and sea available in that country. "Bioproductive" refers to areas of land and water that support significant photosynthetic activity and accumulation of biomass. Barren areas of low or dispersed productivity are ignored. This is not to say that places such as the Sahara Desert, Antarctica, or the alpine environments of various countries do not support life; simply that their production is too widespread to be directly harvestable and is negligible in quantity.

Biocapacity is an aggregate measure of the amount of area available, weighted by the productivity of that area. It represents the ability of a biosphere to produce crops, livestock (pasture), timber products (forest) and seafood; it also measures how much of this regenerative capacity is occupied by infrastructure (built-up land). In short, it measures the ability of the available terrestrial and aquatic areas to provide ecological services. A country's biocapacity for any land use type is calculated as:

$$BC = A \times YF \times EQF \quad \text{Equation 3}$$

Where BC is the biocapacity, A is the available area of a given land use type, and YF and EQF are the yield factors and equivalence factors, respectively, for the land type in question in that country.

As explained in section 2.2, a nowcasting methodology is used to estimate Ecological Footprint and biocapacity for the most recent years and thus avoid gaps in between the year of publication of results and the year of the analysis. The nowcasting method used by Global Footprint Network applies an equally-weighted ensemble forecast for each land-type, consisting of non-seasonal exponential smoothing (ETS) and

an auto-regressive integrated moving average (ARIMA) with GDP per capita (in fixed USD) as an external regressor.

For the non-carbon Footprint components, we apply the ensemble model to per capita Ecological Footprint of consumption (EF). For the carbon component of the Ecological Footprint, we model production and trade separately because reported CO₂ production data is generally available for more recent data years compared to trade datasets. In the case where CO₂ emissions data exists as the only dataset available for a certain year, the carbon Footprint of production is first scaled, according to the annual change in CO₂ production emissions, to the latest year of reported data before applying the ensemble model. For both carbon and non-carbon land-use component Ecological Footprint forecasts, associated confidence intervals are calculated from individual model forecasts and combining them with the root of a weighted sum of squares. The weights in this calculation are the square of the maximum likelihood estimates associated with each model¹¹.

¹¹ For internal quality check, nowcasted values from previous NFAs editions have been compared with actual values from the latest NFA edition, finding nowcasted values to be well aligned with calculated values for all the Footprint components except fishing grounds. Additional research is ongoing on this topic.

8.2 Annex 2 – Yield Factors and data sources

8.2.1 Yield Factor of Cropland, Forest land and Grazing land

The YFs for Cropland, Forest land and Grazing land of all the regions assessed in this project (together indicated as $YF_{\text{Sub-national}}$ in equation 4 below) have been calculated by scaling YF data from the NFA 2018 edition for year 2016 (nowcasted value) for each nation involved in the project. Net Primary Productivity (NPP) specific for each year was used for calculating average productivity of each land type. NPP is the net amount of energy a plant accumulates during a certain period of time. NPP can also be understood as the amount of mass a plant gains (or how much it grows) over specific period of time. NPP is calculated by subtracting the plant's respiration (the total amount of energy/mass lost by the plant as it breathes) from the gross primary productivity (the total amount of energy/mass taken in by the plant) (Foley et al., 1996; Kucharik et al., 2000).

$$YF_{\text{Sub-national}} = \frac{\text{Mean NPP Region}}{\text{Mean NPP Nation}} \times YF_{\text{Nation}} \quad \text{Equation 4}$$

The annual NPP data with global spatial extent and spatial resolution of 500 m is from Terra MODIS (Moderate Resolution Imaging Spectroradiometer) dataset. The raster NPP data of each year has been overlaid separately with CORINE land cover (2012) for calculating average NPP of each land type.

8.2.2 Yield Factor of Built-up land or Infrastructure

The built-up or Infrastructure yield is set equal to cropland yield: according to Global Footprint Network's National Accounts Methodology (Borucke et al., 2013), built-up land is assumed to be the same as that for cropland because urban areas have typically been built on or near the most productive agricultural lands.

8.2.3 Yield Factor for Inland water and Marine area

Consistent with the NFA standards, Inland water and all other areas classified as inland water, were given a yield factor of 1.00 [wha nha⁻¹]. Marine Area YF is given respectively each country's YF value.

8.2.4 Area

For each land type - except for Marine Area – area size was calculated using the 2019 CORINE land-cover dataset. The Marine Area was the only land type for which the area was calculated through the costal line length of each region and scaled with the total marine area of each related nation from the NFA.

8.2.5 Equivalence Factors

Equivalence Factor (EQF) is a scaling factor for converting actual areas in hectares for each land type to their global hectares' equivalence. To have consistent and comparable measures, EQF is applied both to Footprint and biocapacity. For this report, all EQF values were set equal to national data (more local data would allow us to adjust the EQFs to the local conditions).

8.3 Annex 3 – CLUM tables of the 6 countries involved in DestiMED Plus project

ALBANIA	2015	2016	2017	2018	2019
1. Food and non-alcoholic beverages	0.88	0.87	0.89	0.88	0.88
2. Alcoholic beverages, tobacco and narcotics	0.01	0.01	0.01	0.01	0.01
3. Clothing and footwear	0.04	0.04	0.04	0.04	0.04
4. Housing, water, electricity, gas and other fuel	0.21	0.21	0.20	0.20	0.20
5. Household furnishings, equipment and main	0.02	0.02	0.02	0.02	0.02
6. Health	0.01	0.01	0.01	0.01	0.01
7. Transportation	0.29	0.27	0.27	0.27	0.27
8. Communication	0.02	0.02	0.02	0.02	0.02
9. Recreation and culture	0.06	0.06	0.06	0.06	0.05
10. Education	0.01	0.01	0.01	0.01	0.01
11. Restaurants and hotels	0.04	0.04	0.04	0.04	0.04
12. Miscellaneous goods and services	0.09	0.09	0.09	0.09	0.09
Sub Total	1.70	1.64	1.67	1.65	1.66
Government	0.05	0.05	0.05	0.05	0.05
Gross Fixed Capital Formation	0.33	0.32	0.32	0.31	0.30
Total	2.08	2.01	2.03	2.00	2.01

CROATIA	2015	2016	2017	2018	2019
1. Food and non-alcoholic beverages	0.95	1.01	1.03	1.05	1.06
2. Alcoholic beverages, tobacco and narcotics	0.10	0.11	0.11	0.11	0.11
3. Clothing and footwear	0.16	0.16	0.17	0.17	0.17
4. Housing, water, electricity, gas and other fuel	0.63	0.64	0.68	0.69	0.70
5. Household furnishings, equipment and main	0.05	0.05	0.05	0.05	0.05
6. Health	0.03	0.03	0.03	0.03	0.03
7. Transportation	0.54	0.56	0.58	0.60	0.60
8. Communication	0.04	0.04	0.04	0.04	0.04
9. Recreation and culture	0.13	0.13	0.14	0.14	0.14
10. Education	0.02	0.02	0.02	0.02	0.02
11. Restaurants and hotels	0.12	0.12	0.13	0.13	0.13
12. Miscellaneous goods and services	0.14	0.15	0.15	0.16	0.16
Sub Total	2.90	3.01	3.14	3.18	3.23
Government	0.33	0.34	0.36	0.38	0.41
Gross Fixed Capital Formation	0.56	0.58	0.61	0.64	0.69
Total	3.79	3.94	4.10	4.20	4.32

FRANCE	2015	2016	2017	2018	2019
1. Food and non-alcoholic beverages	1.09	0.95	1.10	1.10	1.10
2. Alcoholic beverages, tobacco and narcotics	0.11	0.10	0.11	0.11	0.11
3. Clothing and footwear	0.12	0.12	0.12	0.13	0.13
4. Housing, water, electricity, gas and other fuel	0.51	0.50	0.51	0.52	0.53
5. Household furnishings, equipment and maintenance	0.05	0.05	0.05	0.05	0.05
6. Health	0.04	0.04	0.04	0.04	0.05
7. Transportation	0.86	0.85	0.86	0.87	0.89
8. Communication	0.08	0.07	0.08	0.08	0.08
9. Recreation and culture	0.16	0.16	0.16	0.17	0.17
10. Education	0.01	0.01	0.01	0.02	0.02
11. Restaurants and hotels	0.19	0.17	0.19	0.19	0.19
12. Miscellaneous goods and services	0.20	0.20	0.20	0.21	0.21
Sub Total	3.43	3.22	3.45	3.48	3.51
Government	0.44	0.42	0.44	0.47	0.52
Gross Fixed Capital Formation	0.83	0.80	0.83	0.87	0.93
Total	4.70	4.45	4.72	4.82	4.96

GREECE	2015	2016	2017	2018	2019
1. Food and non-alcoholic beverages	1.28	1.38	1.38	1.41	1.42
2. Alcoholic beverages, tobacco and narcotics	0.08	0.09	0.09	0.09	0.09
3. Clothing and footwear	0.11	0.11	0.11	0.11	0.11
4. Housing, water, electricity, gas and other fuel	0.51	0.52	0.51	0.51	0.51
5. Household furnishings, equipment and maintenance	0.04	0.04	0.04	0.04	0.04
6. Health	0.04	0.04	0.04	0.04	0.04
7. Transportation	0.77	0.78	0.76	0.76	0.75
8. Communication	0.10	0.10	0.10	0.10	0.10
9. Recreation and culture	0.09	0.09	0.09	0.09	0.09
10. Education	0.03	0.03	0.03	0.03	0.03
11. Restaurants and hotels	0.21	0.22	0.22	0.22	0.22
12. Miscellaneous goods and services	0.15	0.15	0.15	0.15	0.15
Sub Total	3.41	3.55	3.52	3.53	3.54
Government	0.36	0.37	0.36	0.36	0.35
Gross Fixed Capital Formation	0.35	0.35	0.35	0.34	0.34
Total	4.13	4.27	4.23	4.23	4.22

ITALY	2015	2016	2017	2018	2019
1. Food and non-alcoholic beverages	1.11	1.11	1.11	1.10	1.10
2. Alcoholic beverages, tobacco and narcotics	0.10	0.10	0.10	0.10	0.10
3. Clothing and footwear	0.17	0.17	0.17	0.17	0.17
4. Housing, water, electricity, gas and other fuel	0.55	0.54	0.54	0.53	0.53
5. Household furnishings, equipment and main appliances	0.07	0.07	0.07	0.06	0.06
6. Health	0.03	0.03	0.03	0.03	0.02
7. Transportation	0.80	0.80	0.79	0.78	0.77
8. Communication	0.07	0.07	0.07	0.07	0.07
9. Recreation and culture	0.16	0.16	0.16	0.16	0.16
10. Education	0.02	0.02	0.02	0.02	0.02
11. Restaurants and hotels	0.26	0.26	0.26	0.26	0.26
12. Miscellaneous goods and services	0.18	0.18	0.18	0.18	0.18
Sub Total	3.51	3.50	3.48	3.45	3.42
Government	0.36	0.36	0.36	0.36	0.35
Gross Fixed Capital Formation	0.58	0.57	0.57	0.56	0.55
Total	4.45	4.44	4.41	4.37	4.32

SPAIN	2015	2016	2017	2018	2019
1. Food and non-alcoholic beverages	1.13	1.17	1.11	1.12	1.12
2. Alcoholic beverages, tobacco and narcotics	0.07	0.07	0.07	0.07	0.07
3. Clothing and footwear	0.16	0.17	0.16	0.17	0.17
4. Housing, water, electricity, gas and other fuel	0.42	0.42	0.43	0.43	0.44
5. Household furnishings, equipment and main appliances	0.03	0.03	0.03	0.04	0.04
6. Health	0.03	0.03	0.03	0.03	0.03
7. Transportation	0.62	0.63	0.63	0.65	0.65
8. Communication	0.06	0.06	0.06	0.06	0.06
9. Recreation and culture	0.14	0.14	0.14	0.14	0.14
10. Education	0.02	0.02	0.02	0.02	0.02
11. Restaurants and hotels	0.28	0.28	0.27	0.28	0.28
12. Miscellaneous goods and services	0.14	0.14	0.14	0.14	0.14
Sub Total	3.10	3.15	3.09	3.13	3.14
Government	0.36	0.36	0.36	0.37	0.38
Gross Fixed Capital Formation	0.52	0.52	0.53	0.54	0.56
Total	3.98	4.04	3.98	4.04	4.09