Montenegro Ecological Footprint Study

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Report prepared by Global Footprint Network for the

Ministry of Sustainable Development and Tourism of Montenegro

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1 Background to this study

In response to the changing resource metabolism of a transition economy, in February 2015, the Ministry of Sustainable Development and Tourism of Montenegro requested support from Global Footprint Network to assess current data and historical trends of demand and availability of ecological assets.

This collaboration is intended to contribute to the revision of Montenegro's National Strategy for Sustainable Development (NSSD), which the Government will complete in December 2015. In particular, the NSSD seeks to establish indicators to monitor sustainability progress and to identify the sectors of the economy that drive environmental pressure to help guide national policy and actions.

UNDP's 2014 Human Development Report for Montenegro (UNDP, 2014), for instance, outlined a number of actions deemed necessary to achieve the shift to a more resource-efficient and competitive economy that would be fully harmonized with EU key priorities and promote human development. However, optimizing material consumption ought to be coupled with ensuring that humanity's resource consumption rates stay within the Earth's carrying capacity, to limit pressures on fragile ecosystems while favoring economic prosperity.

Ecological Footprint accounting can help assess the current situation of resource demand (by the Montenegrin economy) and supply (by the Montenegrin ecosystems) as well as the historical evolution of these parameters. Moreover, by combining the information derived from Ecological Footprint accounting with UNDP's Human Development Index, this report attempts at assessing Montenegro's progress towards minimum conditions for sustainable human development.

The aim of this report is thus to assess the role of the Ecological Footprint as a monitoring tool for sustainability and in complementing other already identified indicators, to inform the NSSD process. This report also provides an insight into Montenegro's resource metabolism to 1) ensure socio-economic development stays within the country's carrying capacity, 2) limit pressures on fragile ecosystems while favoring economic prosperity.

2 Introduction to the Ecological Footprint rationale

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; Daly and Farley, 2004). Evidence of the tenuous relationship between humans and the planet is all 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., 2014a; Kubiszewski et al., 2013). Understanding those limits is crucial for the adoption of sound policies to manage ecological assets and ensure that all people live well, within the means of one planet.

The Ecological Footprint answers a specific research question core to sustainability: ***How much of the biosphere's regenerative capacity (also known as 'biocapacity') does humanity (or any human activity) demand?*** It measures the biocapacity that is required to make human activities possible, including providing food, shelter, mobility (or passenger transportation), and goods and services. The Ecological Footprint of a population encompasses all the biologically productive land and water area that is demanded to produce all the resources a population consumes and to absorb the waste the population produces, under prevailing technology (Wackernagel et al., 2002).

Similar to financial balance sheets, Footprint accounts include both "expenditure" and "income" flows, which compare demand on biocapacity (Ecological Footprint) against availability of biocapacity. The Ecological Footprint is able to quantify human demand, while biocapacity quantifies nature's supply in terms of

Box 1: Ecological Footprint in Brief

Just as a bank statement tracks income against expenditures, Ecological Footprint Accounting measures a population's demand for and ecosystems' supply of ecological assets.

On the supply side, a city, state, or nation's biocapacity represents the productivity of its ecological assets (including forest lands, grazing lands, cropland, fishing grounds, and built-up land).

On the demand side, the Ecological Footprint measures the ecological assets that a given population requires to produce the natural resources and services it consumes (that is plant-based food and fiber products, livestock and fish products, timber and other forest products, space for urban infrastructure, and forest to absorb its carbon dioxide emissions from fossil fuels) (see Figure 1). Both measures are expressed in global hectares—globally comparable, standardized hectares with world average productivity.

Each city, state, or nation's Ecological Footprint can be compared to its biocapacity. If a population's Ecological Footprint exceeds the region's biocapacity, that region runs a *biocapacity deficit*. A region in biocapacity deficit meets demand by importing, liquidating its own ecological assets (such as overfishing), and/or emitting carbon dioxide into the atmosphere.

resource production, built areas, and waste absorption[1]. By comparing the Footprint to biocapacity, it is possible to assess to what extent human demand stays within nature's budget. When a population is consuming more, or has a greater Ecological Footprint, than its domestically available biocapacity, it is said to be in 'biocapacity deficit'. Conversely, it is said to be in 'biocapacity reserve'.

In 2011, the global population demanded 55 percent more of the planet than could be provided that year and many countries were characterized by a biocapacity deficit (Galli et al. 2014).

2.1 National Footprint Accounts

Global Footprint Network calculates Ecological Footprint and biocapacity for over 200 countries and territories annually in the so called National Footprint Accounts - NFAs. The NFA 2015 Edition includes results from 1961 to 2011, including global totals, in order to provide scientifically robust and transparent calculations to facilitate the incorporation of ecological limits in decision making. National Footprint Accounts are calculated primarily using datasets from UN agencies and affiliated organizations such as the Food and Agriculture Organization of the United Nations, the UN Statistics Division, and the International Energy Agency, and are supplemented by studies from peer-reviewed journals (see Annex 1 for the full list of input data). NFAs incorporate over 7,000 data points per country and year, but can be reported as a single number, by land use type, or by product category (Borucke et al., 2013).

The National Footprint Accounts (NFA) measure one key aspect of sustainability: how much biocapacity in global hectares is used by humans compared to how much is available. While there are various other aspects of sustainability and environmental health, the comparison of Ecological Footprint to biocapacity provides necessary (though not sufficient) minimum criteria for sustainability (Bastianoni et al., 2013).

2.2 Ecological Footprint: Accounting Methodology

The system of measuring Ecological Footprint and biocapacity known as National Footprint Accounts allows for the monitoring of human demand on and supply of natural capital in a systematic manner. Through this accounting system, the production and consumption of resources can be tracked with a combination of production and trade data, providing valuable information for decision makers.

[1] Waste absorption of the presented analysis is limited to carbon sequestration.

The Ecological Footprint depicts a population's demand on the Earth for food and other primary renewable resources, services as well as waste absorption. These activities occur on five major land use types: Cropland, Grazing land, Forest land, Fishing grounds, and Built-up land (see Figure 1).

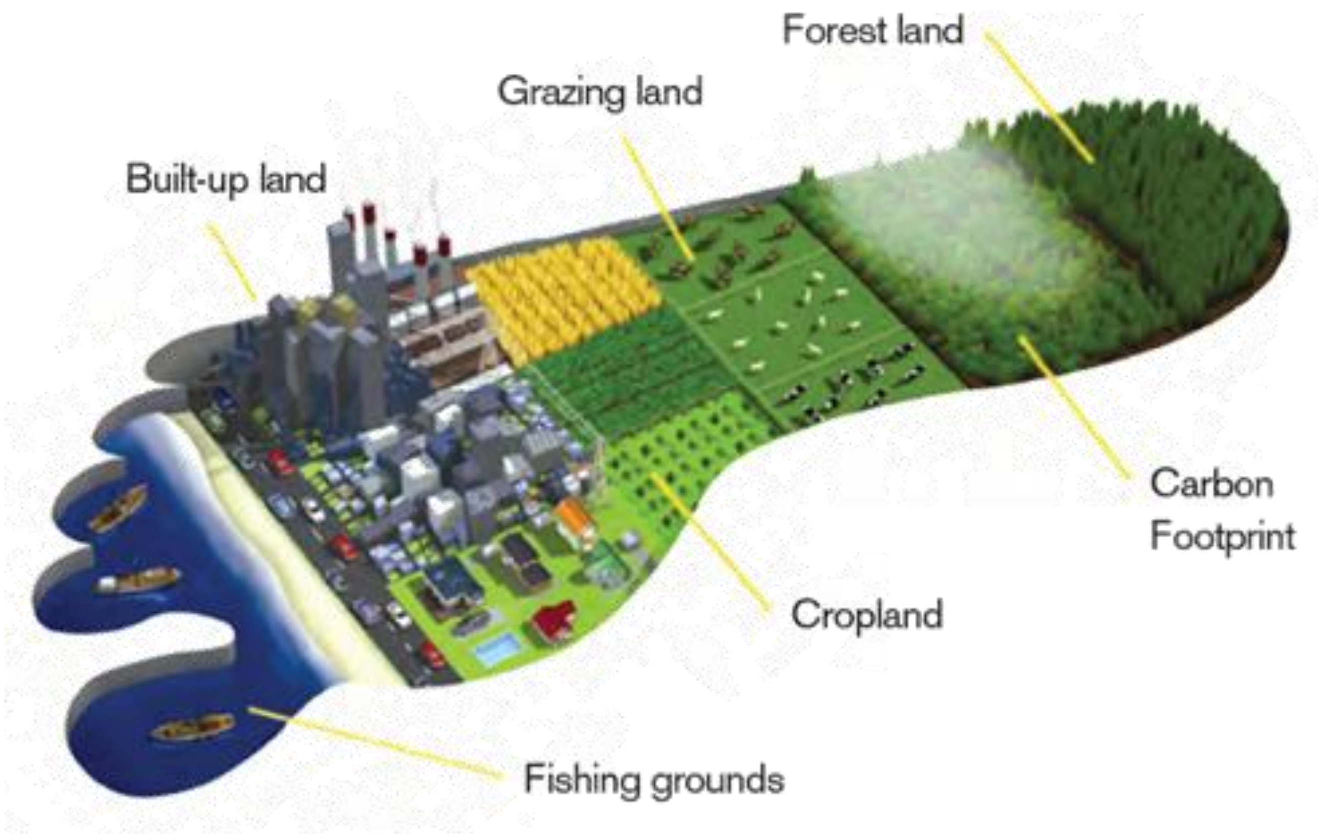
- Cropland is the area required to grow all crop products, including livestock feed, fish meal, oil crop, and all food and fiber required for human consumption.
- Grazing land is grassland used to raise livestock for meat, dairy, hide and wool products. It also includes wild and cultivated pastures required to provide feed.
- Forest land is the forested area required to support annual harvest fuel wood, pulp and timber products.
- Fishing grounds are the areas of marine and inland waters required to support catches of fish, seafood and aquaculture.
- Built-up land is the area covered by human construction, including housing, industrial structures, transportation infrastructure and dams.

A sixth demand category, carbon, refers to the land needed to sequester carbon dioxide (CO_2) emissions: this component of the Ecological Footprint is expressed as the forest area required to sequester the CO_2 released by the residents of a country or associated with a given activity[2]; it thus competes with forest products such as fuel wood, pulp and timber for the same producing land area (Borucke et al., 2013).

In order to account for the different abilities of these land-types to produce goods, the production from each different land type is modified to weight their overall contribution to the Ecological Footprint. Using two factors, yield factor (YF) and equivalence factor (EQF), we can express Ecological Footprint and biocapacity in global hectares (Galli, 2015), in order to compare across land uses and aggregate contributions (Borucke et al. 2013).

[2] Please note that the term 'carbon footprint' commonly refers to CO_2 emissions from fossil fuel use and is often expressed in tonnes of carbon. See Box 1 - "What's the difference between the carbon component of the Ecological Footprint (gha) and what is commonly called 'Carbon Footprint'?" - for additional explanation. See also Galli et al., 2012.

ECOLOGICAL FOOTPRINT COMPONENTS



CARBON
CO_2 emissions associated with use of fossil fuels, electricity and energy intensive commodities, converted into biologically productive areas (such as forest land) necessary for their sequestration.

GRAZING LAND
The area of grasslands used to raise livestock for meat, diary, hide and wool products. It includes all grasslands used to provide feed for animals, including cultivated pastures, wild grasslands and prairies.

FOREST PRODUCTS
The area of forests required to support the annual harvest of fuel wood, pulp and timber products.

FISHING GROUNDS
The area of marine and inland waters required to support annual catches of aquatic species (fish and seafood).

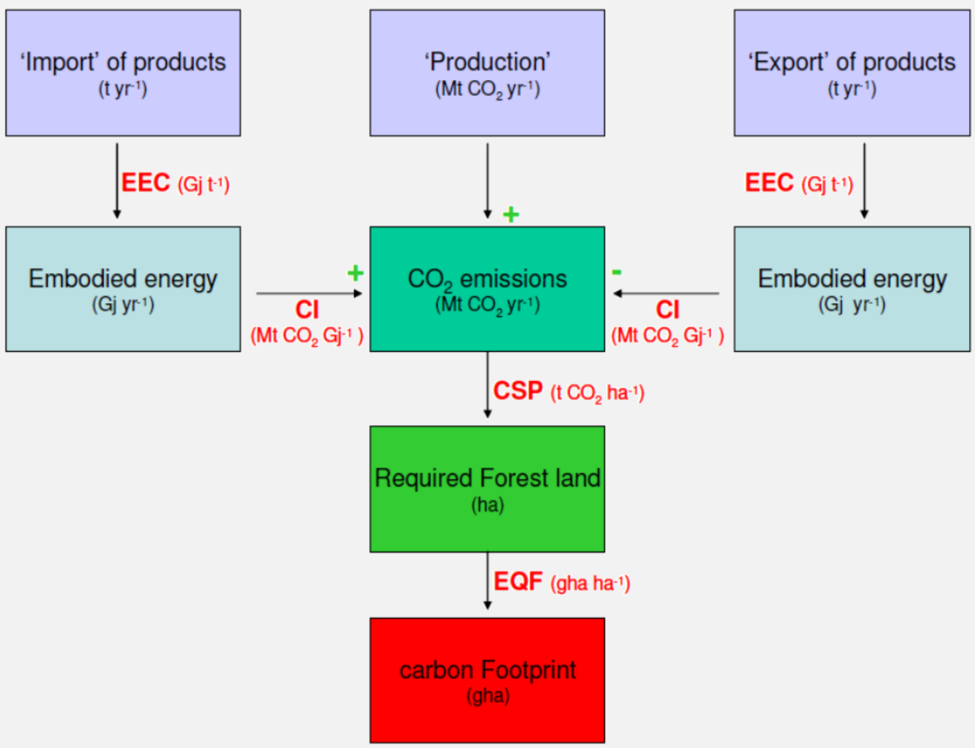
CROPLAND
The area required to grow all crop products required for human consumption (food and fiber) and for livestock feeds, fish meals, oil crops and rubber.

BUILT-UP LAND
The area of land covered by human infrastructure such as roads, housing, industrial structures and reservoirs for hydroelectric power generation.

Figure 1: Ecological Footprint components and descriptions

Box 2: *What's the difference between the carbon component of the Ecological Footprint and what is commonly called 'Carbon Footprint'?*

Although the Ecological Footprint was developed before the concept of Carbon Footprint became popular, there is a common misconception that the two have the same meaning. In popular debates, carbon footprint is used to refer to metric tonnes of CO_2 released into the atmosphere. By contrast, the carbon Footprint we refer to is one of the six demands that comprise the Ecological Footprint and is measured in global hectares (gha). It is calculated by first estimating the total amount of CO_2 emissions (in tonnes), including production and imports (but not including exports), that are associated with a country's life-style. Then, the total area of world-average forest land required sequestering that much CO_2 is calculated by dividing the tons of CO_2 by the world-average carbon sequestration potential of forest, in tonnes of CO_2 per hectare. Finally, the carbon Footprint is converted into global hectares using the forest equivalence factor (EQF).



Light purple boxes on the top level contain raw primary data. Boxes in the following levels represent the necessary steps to calculate the total amount of CO_2 the nation is responsible for ('CO2 emissions' box) and boxes in the last two levels (in green and red) are used to convert CO_2 values into carbon Footprint (gha).

The basic equation for calculating the Ecological Footprint is

$$EF_P = \sum_{i=1}^{n} \frac{P_i}{Y_{N,i}} \cdot YF_{N,i} \cdot EQF_i$$

where P is the quantity of each product i harvested (or carbon dioxide emitted); $Y_{N,i}$ is the annual national average yield for the production of each product i (or its carbon uptake capacity in cases where P is CO_2); $YF_{N,i}$ is the national yield factor for the land producing the given product i; and EQF_i is the equivalence factor for the land use type associated with each product i.

Yield factors are country-specific and reflect natural differences among countries in land productivity due to variation in soil quality or precipitation, as well as variation of management practices. Equivalence factors are used to weight different land areas by their inherent capacity to produce biological resources that are useful to humans. Together, yield and equivalence factors allow us to compare different land types by converting area in actual hectares into global hectares: a hectare of land or sea area with world average bioproductivity for a given year (Borucke et al. 2013; Galli, 2015).

In addition to using production data, Ecological Footprint accounting also uses international trade information to calculate the Footprint of consumption for each land use type. All commodities require material inputs from primary sources. The process of converting raw materials into goods has an embedded Footprint because renewable resources and ecological services are used as inputs to produce such goods. The basic equation for the Ecological Footprint associated with each country's final consumption is thus calculated by summing the Ecological Footprint of its production (EF_P) and its imports (EF_I), and subtracting the Ecological Footprint of its exports (EF_E):

$$EF_C = EF_P + (EF_I - EF_E)$$

This means that the resource use and emissions associated with producing a car that is manufactured in Russia, but sold and used in China, will contribute to China's rather than Russia's Ecological Footprint of consumption. (See Figure 2 for additional details about the relationship between the Ecological Footprint of consumption and the influence of trade.)

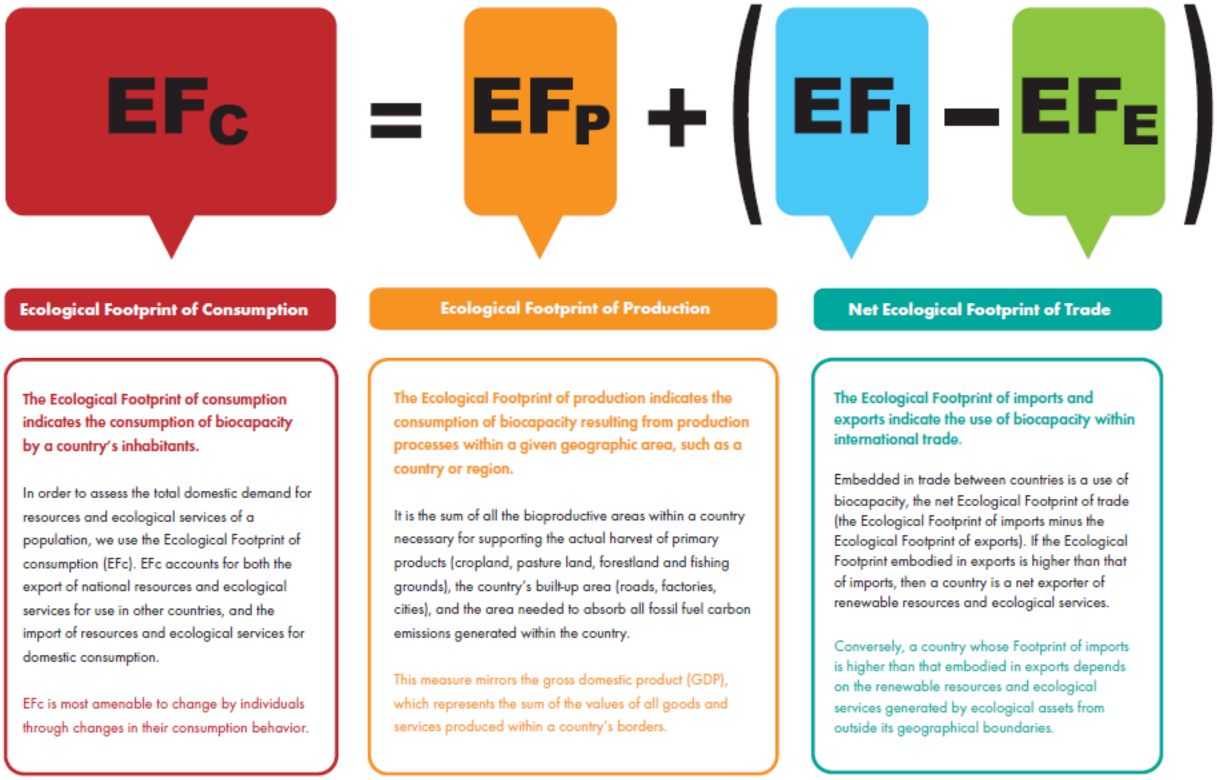


Figure 2: Tracking production, consumption and net trade with the Ecological Footprint.

The basic equation for calculating a country's biocapacity is

$$BC = \sum_{i=1}^{n} A_{N,i} \cdot YF_{N,i} \cdot EQF_i$$

Where $A_{N,i}$ is the bioproductive area that is available for the production of each product *i* in the country, $YF_{N,i}$ is the country-specific yield factor for the land producing that product and EQF_i is the equivalence factor for the land use type producing each product *i*.

Biocapacity reflects prevailing technologies and resource management practices and it thus tracks the current, actual productivity of ecosystems within a country.

3 Background context on the global and Mediterranean region

3.1 Global

In classic Ecology, the term *overshoot*, is commonly used to indicate the state in which a population's demands exceed its environment's ability to support those demands (i.e., its carrying capacity) (Catton et al., 1980). Similarly, in Ecological Footprint terms, *ecological overshoot* is used to indicate the state in which mankind's demand on the Earth's ecosystems exceeds the capacity of those ecosystems to regenerate resource provisioning and regulatory services, leading to liquidation of natural capital stocks (Lin et al., 2015).

According to the 2015 Edition of the National Footprint Accounts, such threshold was passed by humanity in the early 1970s: biocapacity deficits, once only accrued by cities and a few countries, became a global reality and humanity's aggregate demand on nature started exceeding what our biosphere could renew (see Figure 3). In 1961, 131 of the 182 countries tracked by the National Footprint Accounts had more ecological assets available to produce the resources and services, on aggregate, than their residents consumed. All other countries consumed more than their domestic ecosystems produced.

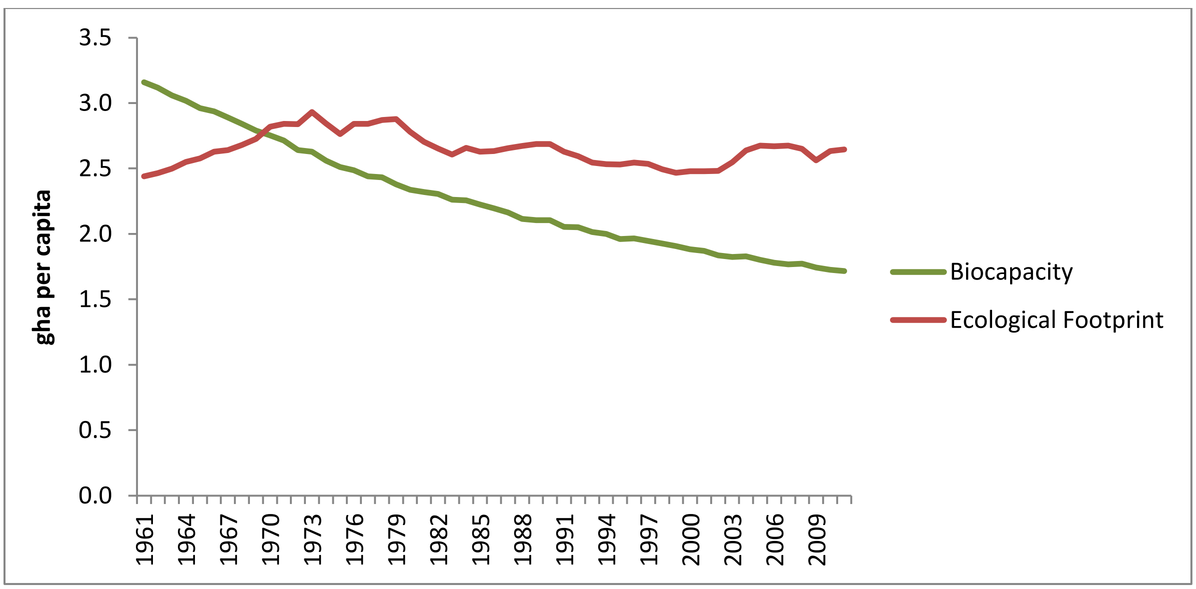


Figure 3: Humanity's Ecological Footprint compared to global biocapacity, 1961-2011.

Forty years later, in 2011, most countries are running biocapacity deficits (only about 80 countries out of the 219 covered by the NFA had not fallen into deficit), and countries that do still have biocapacity reserves are diminishing them (Galli et al., 2014, 2015). Meanwhile, populations and resource demands continue to grow. According to Global Footprint Network's most recent National Footprint Accounts (see Figure 3), in 2011 humanity's per capita Footprint and biocapacity were 2.6 gha and 1.7 gha respectively. As such humans demanded 1.55 times more from the planet than Earth could replenish[3] — a doubling from 1961, when people used approximately three-quarters of the planet's biocapacity. According to Moore et al., (2012), if trends follow even the moderate projections of UN agencies, humanity will likely use the equivalent resources of nearly three Earths by the middle of this century.

The current global appetite for natural resources and ecological services is unsustainable and a prolonged overshoot is likely to lead to the depletion of natural capital stocks (Kitzes et al., 2008). According to Barnosky et al., (2012), a planetary-scale critical transition might be approaching. We can already recognize many of the signs of global ecological overshoot: drought and climate change, depleted fisheries, deforestation and soil degradation (Butchart et al., 2010; Tittensor et al., 2014; SCBD, 2014; UNEP, 2012). Moreover, weaker natural capital stocks possibly erode economic opportunities and increase social pressures (Kubiszewski et al., 2013).

3.2 Mediterranean Region

The Mediterranean region[4] has been in biocapacity deficit since before 1961. By 2011, that deficit had increased by over 230% (Galli et al., 2012). Today, all countries in the region consume more than they can internally produce and the region as a whole uses approximately 2.5 times more natural resources and ecological services than their ecosystems can provide (Galli et al., 2015) (see Figures 4).

[3] In other words, it now takes the Earths approximately 18 months (1.55 years) to regenerate the resources our society uses in 12 months.

[4] The Mediterranean region is here defined as the sum of all countries characterized by Mediterranean-type of ecosystems: all countries that directly border the Mediterranean Sea plus Jordan, Macedonia and Portugal.

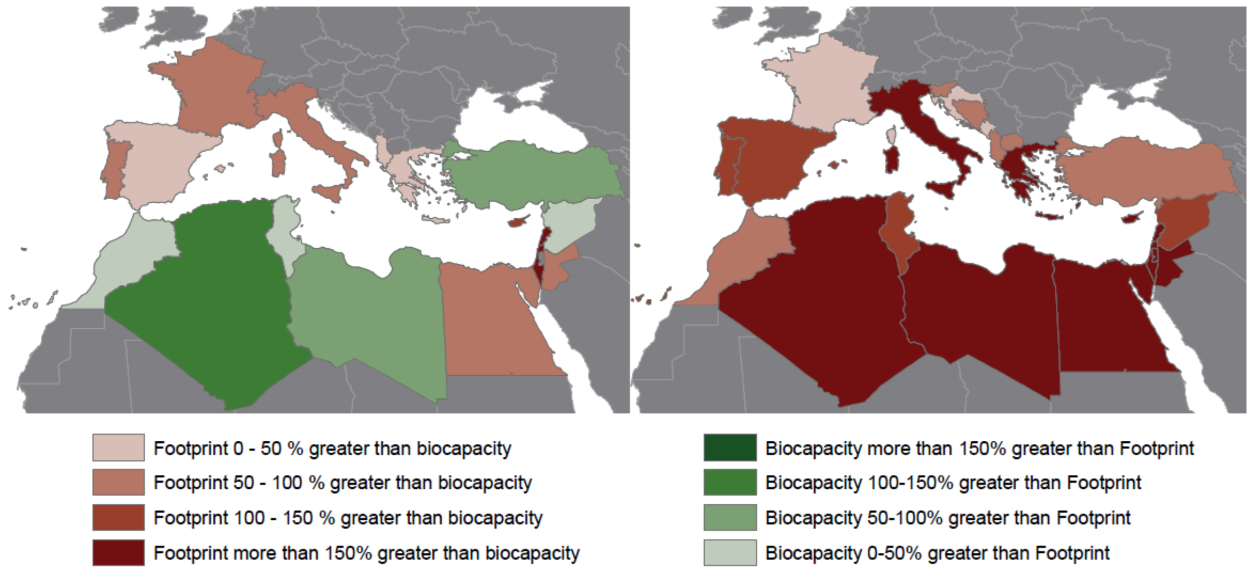


Figure 4: EF and Biocapacity in the Mediterranean 1961 left panel and 2011 right panel

The added demand on resources over the last few decades has been caused by economic growth increasing consumption levels compounded by the region's doubling population. The increasing consumption is most clearly seen in the rise of the region's carbon Footprint. Carbon is now the most significant component of the region's Ecological Footprint and is particularly significant for the region's highest per capita consuming countries (Israel, Slovenia, Italy, France and Greece), where it contributes at least 48% of each country's total (see Figure 5). Cropland is the second most significant contributor to the Ecological Footprint in the region, and this is still the single most important factor in middle-income nations such as Morocco.

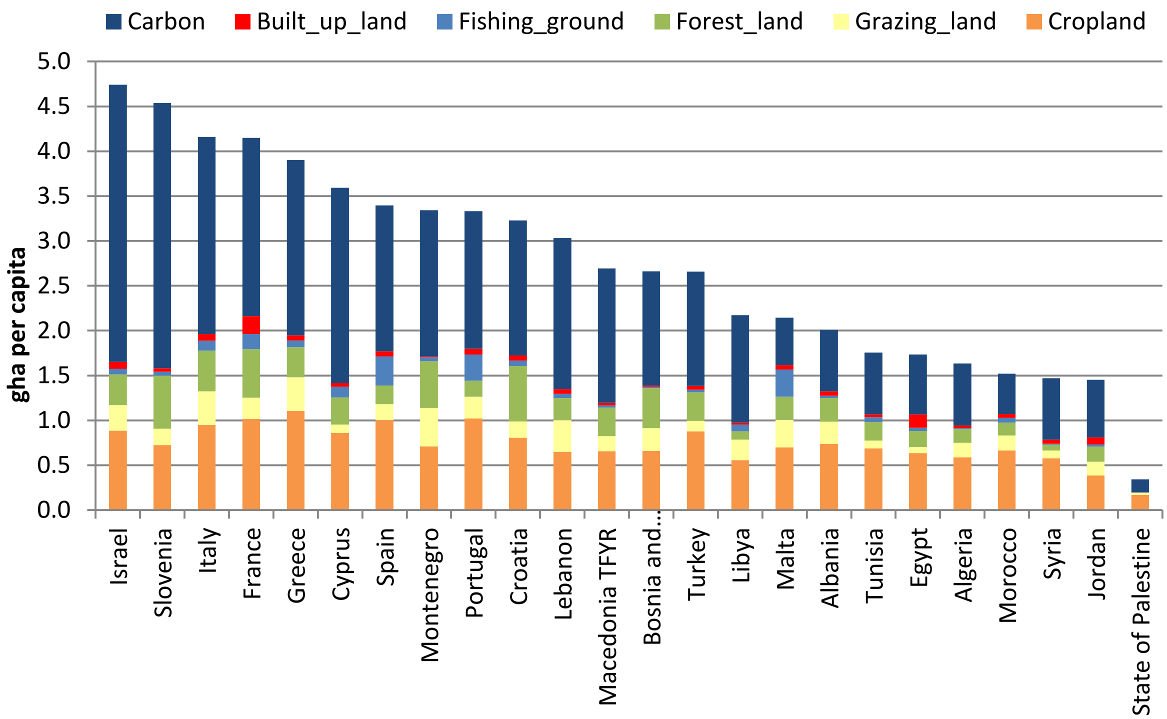


Figure 5: Per capita Ecological Footprint of Mediterranean countries, by land types, in 2011.

With economic turmoil in recent years there has been some disruption in the Ecological Footprint trends with overall consumption in the region decreasing between 2007 and 2009 (Galli et al., 2015). This is largely caused by a drop in carbon Footprint, but it is clear that an economic crisis is not a solution to the inherent and still present problems of overconsumption of resources. The effects in terms of reduced consumption tend to be short-lived and are accompanied by a high human cost through the loss of jobs and livelihoods. Recent political crises in the region cannot be fully explained by resource constraints but several authors have shown how drought, climate change and resource scarcity have helped create the underlying conditions for civil war in Syria or Egypt's failing economy and social unrest (Ahmed, 2013, 2015; Aly and Strazicich, 2011; Galli and Halle 2014; Werrell and Femia, 2013). The combination of ecological and economic deficits can have severe impacts on the long term health of the region's ecosystems. Some countries may turn to overharvesting and overexploitation to meet their resource needs, but in the short term countries are likely to be affected first with trade-related risks on their economy.

4 Montenegro's Ecological Footprint analysis

The Ecological Footprint analysis of Montenegro performed in this study differs from the traditional NFA analysis described above in two ways:

- First, we present results for Montenegro up to the year 2015, which includes estimated values for the period 2012-2015. These estimates are based on assumptions and derived by means of a methodology, which we call *now-casting*, described in details in section 4.1.1.
- Second, we analyze the drivers of the Ecological Footprint of consumption in more detail. The biggest share of biomass-based resources is consumed by households, for example daily needs such as food and clothing. This detailed analysis of the Ecological Footprint drivers is performed using environmentally-extended multi-regional input-output analysis (EE-MRIO) as it enables to connect consumer final demands with the environmental impacts of production activities these demands are driving. Our EE-MRIO model is based on the Global Trade Analysis Project (GTAP) database, which uses financial transactions to show the flow of goods and services between 129 world's regions in 57 sectors. As Montenegro-specific Input-Output data are absent in the GTAP database, we estimate such data based on the numbers for the neighboring countries Albania, Bulgaria and Croatia, which have a similar economy in terms of GDP and industrial structure. The methodology for this analysis is explained in details in section 4.1.2.

4.1 Methodology in details

4.1.1 Now-casting of Footprint and biocapacity values

The National Footprint Accounts are calculated primarily using datasets from UN agencies and affiliated organizations as mentioned in section 2.1. In performing such calculation, Global Footprint Network calculates the Ecological Footprint of the most recent year for which the complete set of input data is available for all the countries tracked in the National Footprint Accounts. As there is usually a three-to-four-year time lag between the current year (2015) and information in the most recently-published datasets, we have used a now-casting methodology to estimate the Ecological Footprint and biocapacity of Montenegro for the period 2012-2015. The process of now-casting involves projecting trend data from previous years.

For the carbon component of the Ecological Footprint we assume emissions (EF^{C}_{prod}) grow at the same annual rates as the GDP growth rate,[5] attenuated by a constant annual incremental improvement in carbon efficiency. We then assume the net trade (EF^{C}_{nt}) of embodied carbon Footprint to remain constant over the now-casted period. The final carbon Footprint of consumption is then calculated as the sum of the projected carbon Footprint of production and that of net trade:

$$EF^{C}_{cons} = EF^{C}_{prod} + EF^{C}_{nt}$$

For the non-carbon land components, including crops, grazing and fisheries, we assume the Footprint of production (EF^{*}_{prod}) continues to grow at the same average rate as it has over the past 40 years, as sampled by ordinary least-squares regression. We assume that embodied global hectares in the country's imports (EF^{*}_{i}) and exports (EF^{*}_{e}) change at the same rate each year as do the country's import and export trade values.[6] In some cases the projected growth in production is insufficient to satisfy projected growth in exports. In that case, we increase production to match the Footprint of consumption, rather than assume new exports will be supplied by reduced domestic consumption. The final Footprint of consumption is

$$EF^{*}_{cons} = EF^{*}_{prod} + EF^{*}_{i} - EF^{*}_{e}$$

Finally, biocapacity is assumed to continue growing at its 40-year historical rate, as sampled by ordinary least-squares regression. Total land area is assumed to have no change. Population growth estimates from the World Economic Outlook (WEO) are used to estimate per-capita Footprints values.

4.1.2 Environmentally-Extended, Multi-Regional Input-Output Analysis

Environmentally-extended input-output analysis (EE-IO) is applied to connect consumer final demands with the environmental impacts of the production activities these demands are driving (Leontief and Leontief 1986; Miller and Blair 1985). The most known application is in Carbon Footprint studies,[7] (e.g. Hertwich and Peters, 2009), which account for all the direct and indirect GHG emissions embodied in final consumption. This technique can be applied to identify the economic drivers of any environmental impact, including the appropriation of resources and ecosystem services. The main goals of this method

[5] As estimated by the World Economic Outlook (WEO) published by the International Monetary Fund (IMF).

[6] As reported by the World Economic Outlook (WEO).

[7] See Galli et al., (2012) for a detailed description of the differences between the Carbon Footprint methodology and the carbon component of the Ecological Footprint methodology.

are A) to account for the upstream embodied or indirect environmental impact from downstream (final) consumption, and B) to account for environmental impact of the consumption of internationally traded goods (Kitzes, 2013).

Input-output analysis accounts for the entire resource demand linked to producing a certain good or service at all the stages of production. To do so, an environmental extension table allocates total resource demand in physical units to each sector in the economy. The sectoral aggregation level is given through the input-output tables, which contain all the resource flows between economic sectors in order to produce all goods for final consumption. The GTAP 8 multi-regional input-output model used in this study consists of 57 sectors, of which 12 are agricultural. The model has trade data and input-output tables for 129 countries and regions (GTAP 2014), although a specific input-output table for Montenegro is missing (see below).

In order to estimate the Ecological Footprint of consumption, six environmental extension tables are required, which initially allocate the Ecological Footprint of production for crop-, grazing-, forest-, built-up and carbon-uptake land as well fishing grounds to the producing economic sectors.

Except for carbon-uptake- and built-up land, the Ecological Footprint of production as defined above is used to allocate the resource demand of each sector from the GTAP model. For the carbon-uptake land, the energy-environmental extension of GTAP is applied. Built-up land is assigned to each sector by the sector's value added to a country's GDP.

The basic equation of the multi-regional input-output analysis is:

$$EF_N = F(I - A)^{-1} y_M$$

Where:

- EF_N is a [6, 1] vector representing the country's Ecological Footprint embodied in total national final demand for goods and services represented by the [57, 1] vector y_M.
- F is the [6, 57] environmental extension matrix derived from the Ecological Footprint of production or from the energy environmental extension from GTAP for the carbon Footprint. This matrix is composed by f_{ij} coefficients (expressed in gha per dollar) representing the Footprint intensity i of one dollar generated by each economic sector j. The lower these coefficients are, the higher the bio-mass-based resource efficiency of a country's economy.
- I is the identity matrix and A is the technical coefficients matrix, which reflects the monetary exchange between each sector in order to produce one currency unit of output for a specific

sector. Together $(I\text{-}A)^{-1}$ represents the Leontief inverse [57, 57] matrix, which gives the total output from each sector for one unit of final demand from a specific sector. Therewith, the above equation accounts for upstream (indirect) resource requirements to produce goods of final demand.

The main difference between the Ecological Footprint of consumption from the NFA and the MRIO is the treatment of trade flows and indirect resource requirements (see Weinzettel et al., 2014). MRIO has three main advantages. First, it accounts for trade in intermediate goods and services and considers the structure (technology) of the country of origin when accounting for the embodied resource requirements of imports. Second, it treats total trade in goods and accounts for upstream (indirect) resource demands along the production chain. Third, it allows differentiating between final demand for resources by households, governments and investments. The Footprint of production is the same in both methods.

Although using MRIO is not the classical way of computing the Ecological Footprint, this approach has been used in this study to effectively analyze the demand for goods and services due to final demand[8]. Consistency in the results for the Footprint of consumption is ensured through adjusting the results from the MRIO model to the NFA results by means of a correction factor, in line with the methodology proposed by Wiedmann et al., (2006).

Initially, the EF-MRIO model provides the resource requirements of each one of the 57 GTAP sectors in the economy and, subsequently, households' resource requirements are calculated by analyzing the composition of household final demand for goods and services by COICOP[9] consumption categories such as food or transport. Different goods and services are produced with varying inputs from the different economic sectors in the economy. The household demand matrix (concordance table) assigns to each consumption category the respective amount of resource requirements by sector (Wiedmann et al. 2006). We refer to the household resource requirements by consumption category as Consumption Land-Use Matrix (CLUM), which displays the biomass requirements by land type for each consumption category (see Figure 11 below). Due to a lack of an input-output table for Montenegro within the GTAP model, the Montenegro CLUM was generated by referring to the CLUMs from neighboring countries

[8] Further details on the comparison between the two models can be found in Weinzettel et al. (2014).

[9] COICOP stands for *Classification Of Individual Consumption According to Purpose* and is the internationally agreed classification system for reporting household consumption expenditures. It is published by the United Nation Statistics Division for use in Expenditures Classification, National Accounts, Household Budget Survey and the Consumer Price Index.

with similar levels of economic activity in terms of GDP and a similar industrial structure of the economy. As such, the Montenegro CLUM is a population weighted combination of the CLUMs of Albania, Bulgaria and Croatia.

4.2 Results: Ecological Footprint and biocapacity of Montenegro

The rather young Montenegro country does not allow for a long run analysis of its Ecological Footprint of consumption and biocapacity trends. As such, Montenegro's trends for the period 2006-2015 have been compared with those of the *Socialist Federal Republic of Yugoslavia* (SFRY) for the period 1961-1991 and that of *Serbia and Montenegro* for the period 1992-2005. The analysis, reported in Figure 6, shows that A) Montenegro has been in biocapacity deficit since the foundation of the country in 2006; B) a biocapacity reserve characterized the *Socialist Federal Republic of Yugoslavia* (SFRY) back in the early 1960s; and C) Montenegro's Footprint and biocapacity values in the post-2005 period are higher than those of both the *Socialist Federal Republic of Yugoslavia* (SFRY) and *Serbia and Montenegro*. As it is shown in the reminder of this chapter, the higher per capita Ecological Footprint of Montenegro is likely due to the country's economic catch-up, especially in consumption patterns, of the last years. Conversely, the higher per capita biocapacity is likely due to the natural endowment of Montenegro (e.g., forest ecosystems) coupled with a low population density.

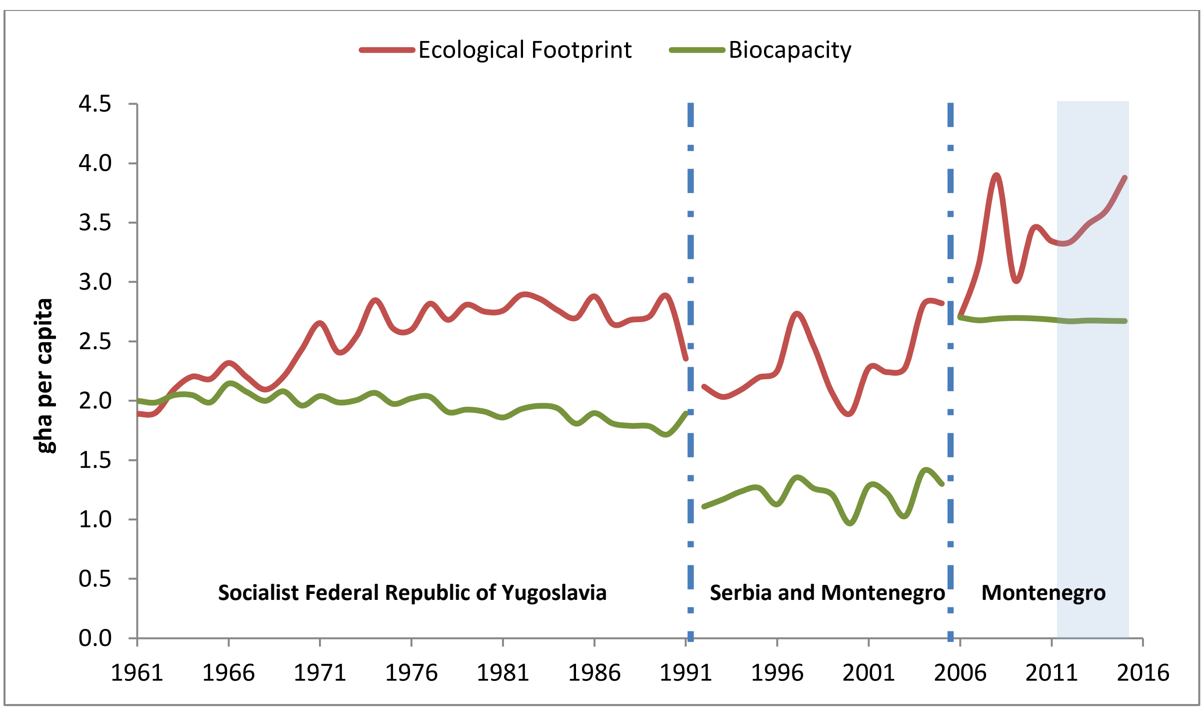


Figure 6: Per capita Ecological Footprint and biocapacity in Yugoslavia (1961-1991), Serbia and Montenegro (1992-2005), and Montenegro (2006-2015).

Detailed breakdowns of Montenegro's Ecological Footprint and biocapacity are provided in Figures 7 and 8. Figure 7 shows a steady increase in Montenegro's Ecological Footprint during the period 2006-2015, which is partially due to the higher economic activity - in terms of rising GDP and increasing consumption by households due to higher wages - in the post independence period. The economic crisis of 2008, however, has affected Montenegro as indicated by the noticeable drop in the Carbon Footprint around 2008 (World Bank, 2015); a similar drop has been found in several other countries (see for instance Peters et al., 2011, 2012). Biomass demands from Crop- and Grazing Land are increasing only slightly since they mostly provide natural resources for the consumption of food, which reflects to some extent an income inelastic demand. The forest land Footprint has been increasing strongly since 2006, which implies higher demand for wood products in Montenegro, which are commonly demanded by the construction sector.

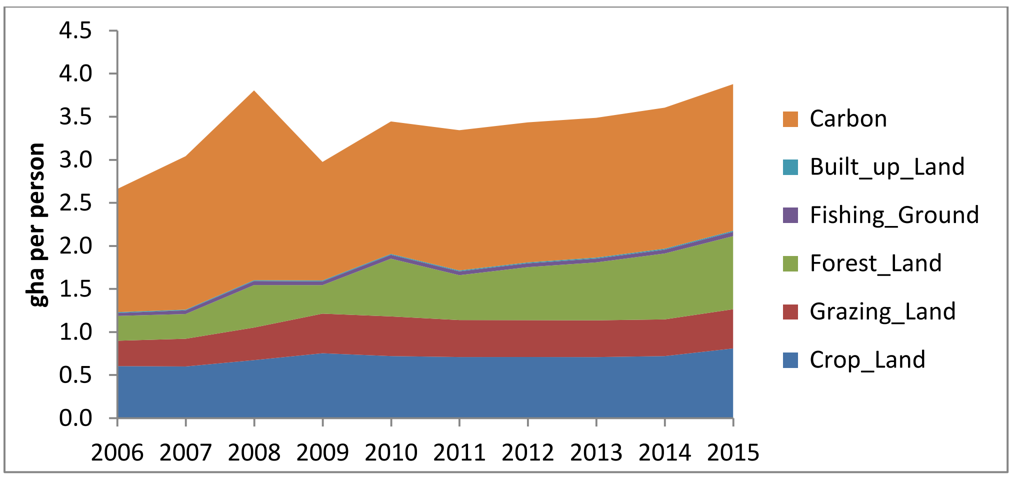


Figure 7: Montenegro Ecological Footprint by land-use type: actual trends for 2006-2011 and estimated projections for 2012-2015.

As of 2011, Montenegro's per capita Ecological Footprint was 3.3 gha (it is 3.9 gha per person in 2015) while per capita biocapacity was 2.7 gha per person (same in 2015). Both Footprint and biocapacity of an average resident of Montenegro are higher than the per capita Footprint and biocapacity of an average Mediterranean resident (2.8 gha and 1.3 gha, respectively – no data for the year 2015 is available for the Mediterranean region).

Figure 8 shows the key role that forested areas have for Montenegro's biocapacity: up to 40% of Montenegro's country area is indeed covered with forests and biocapacity from forest land constitutes 75% of Montenegro's total biocapacity. Population growth in Montenegro has been +0.01% over the last decade and therefore biocapacity per capita does not show any significant changes over the last six years.

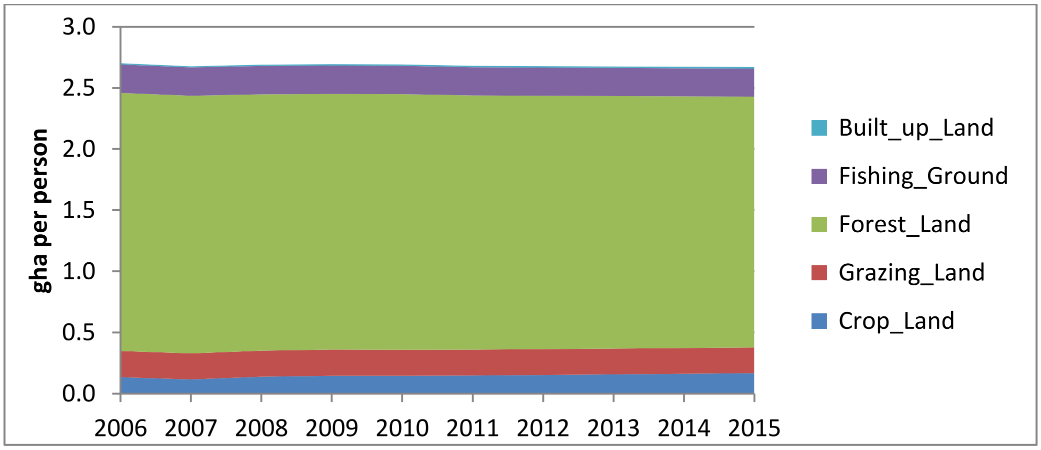


Figure 8: Montenegro biocapacity by land-use type: actual trends for 2006-2011 and estimated projections for 2012-2015.

Finally, trends in Figure 9 indicate that Montenegro's per capita Ecological Footprint of production has remained below the biocapacity budget during the period 2006-2015, indicating that the current biocapacity deficit is financed through net imports (see also Figures 12 and 13). Important to note is that the Ecological Footprint of consumption is steadily rising while the biocapacity remains constant. Therewith the gap between supply and demand is rising and the dependence on biocapacity imported from abroad increasing (see also chapter 4.4).

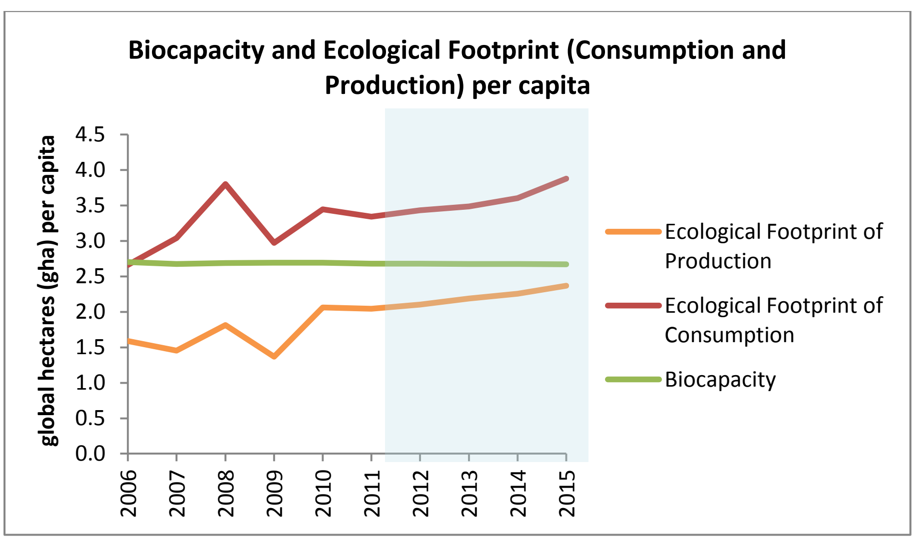
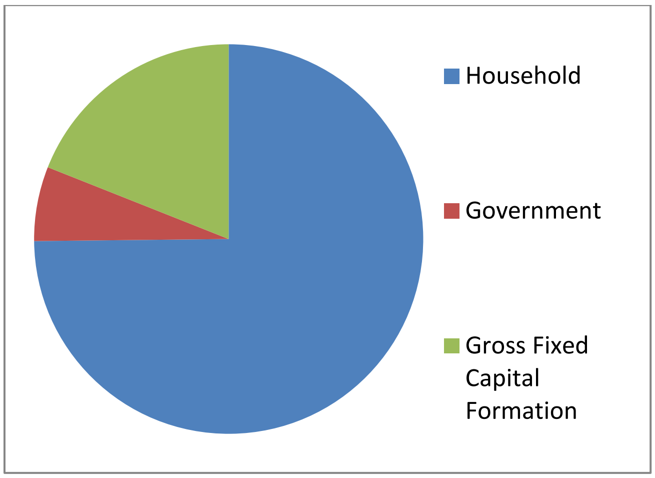


Figure 9: Per capita Ecological Footprint of production and consumption, as well as biocapacity trends for Montenegro, during 2006-2015 period.

4.3 Montenegro's Ecological Footprint of Final Demand

Application of the EE-MRIO analysis to Montenegro indicates that most of the Ecological Footprint of the country is required for household consumption, which amounts to about 75% of the total Footprint (see Figure 10). Gross fixed capital formation refers to resource requirements by households (e.g. new houses), the government (e.g. social infrastructure), and firms (e.g. a firm expands a production facility and needs to build more manufacturing halls) for investments and accounts for 19% of the total. The third main player is the government (6% of the total Footprint), which also has resource requirements since the public sector does include resources for public services (schools, hospitals) and defense.



Household consumption is defined as the final demand by household for final goods and services consumed within one fiscal year.

Government consumption is defined as all expenditure to maintain government actions. Unlike household consumption, consumption by industrial sector is suitable to represent the allocation of a government's budget and the corresponding environmental impact.

Gross fixed capital can be defined as investment activities by households (e.g. new houses), a government (e.g. social infrastructure), and firm (e.g. new factory). Gross fixed capital supports future consumption and economic efficiency. Although a portion of gross fixed capital is household direct investment, we consider this to be a societal component since it corresponds to long-term investment and is less adaptable to rapid change.

Figure 10: Montenegro Ecological Footprint of Consumption, by Consumer Type, in 2011.

Upon a further disaggregation of Montenegro's Ecological Footprint by individual consumption categories (see Figure 11), it can be seen that Food and non-alcoholic beverages represent the biggest share of resource demand by households followed by resource requirements for transportation and housing. Figure 11 also shows which land types are required to provide the demanded biomass. *Food and beverages* are goods which are produced with mostly Crop- and Grazing Land resources meanwhile the use of goods and services under *Transport and Housing* is mostly energy intensive and therewith generates high Carbon Footprints.

Cropland Footprint due to the consumption of food and alcoholic beverages and carbon Footprint due to transportation are the two major contributors to Montenegro's Ecological Footprint as they represent nearly 20 percent and 12 percent of the overall country's Footprint, respectively.

Cropland requirement for food and oil for transportation thus constitute Montenegro's main Footprint hotspots; as such alternative policies targeting these two consumption-to-production chains should be prioritized as a first step towards sustainability through lower resource consumption.

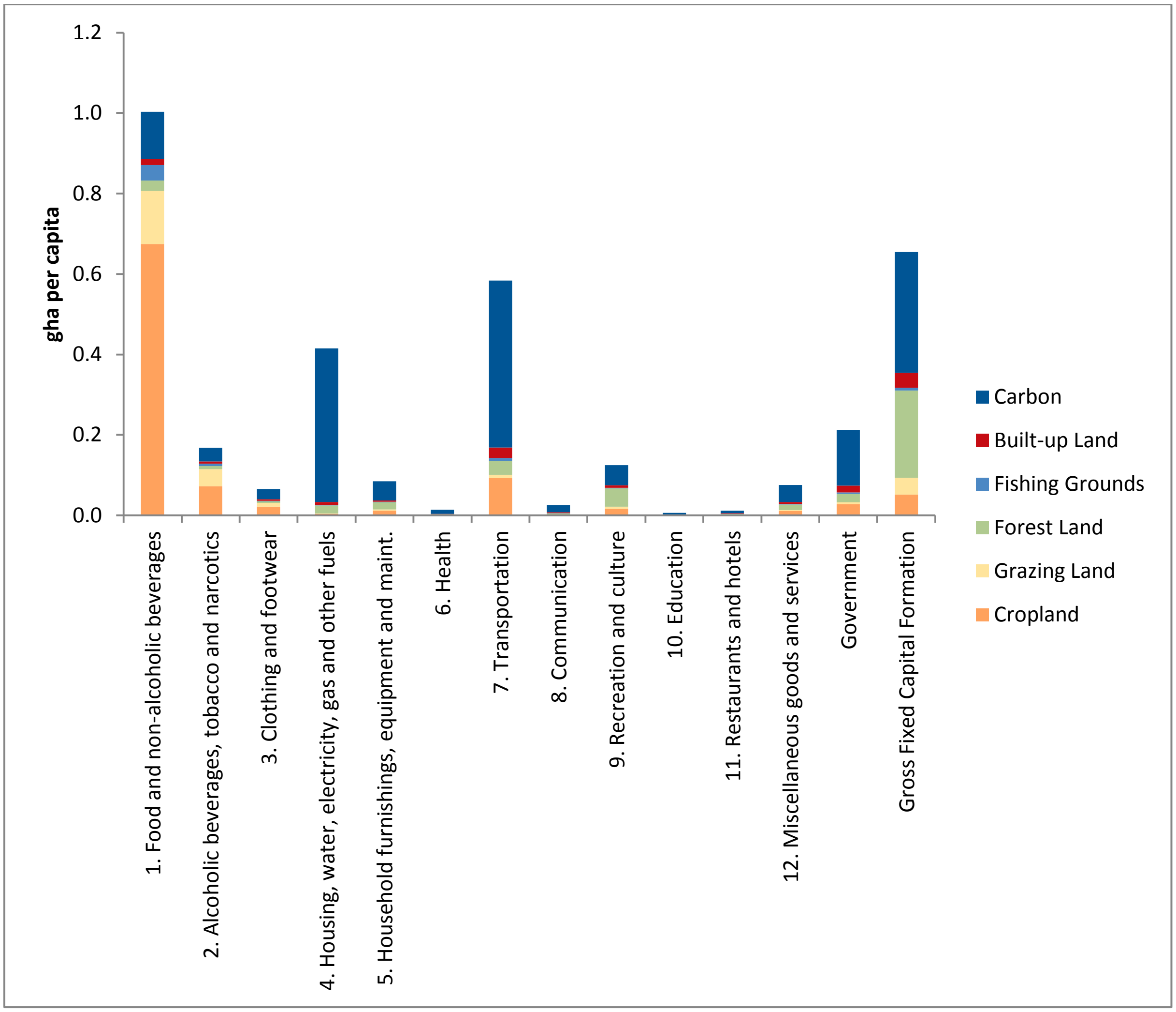


Figure 11: Montenegro's Consumption-Land-Use Matrix (CLUM), in 2011.

4.4 Montenegro trade Footprint analysis

Montenegro is trading mostly with its direct neighbors Serbia and Croatia: 35% of the total exports, which consist of 40% raw aluminum, are directed to those two countries. Imports (including mainly petroleum, cars or pig meat) come primarily from Serbia (28% of total imports) and Croatia (8%). This implies that Montenegro is not yet strongly integrated in intercontinental trade flows or that it is not importing directly from distant trading partners. (United Nations Statistics Division 2015)

Nonetheless, the share of Montenegro's Ecological Footprint of final consumption that is met through imports of biocapacity from abroad is growing over time, and the biocapacity embedded in exports increasing only moderately (see Figure 12). Montenegro's biocapacity trade balance is thereby slightly deteriorating.

Importing biomass from abroad - where it might be produced less resource-intensively - might make good ecological sense, but it comes at a price if this implies more import dependence for the country. A recent study by Galli et al., (2015), for instance, has found that a hypothetical 10% increase in natural resources' price, while keeping consumption levels unvaried, would cause a worsening of Montenegro's trade balance equivalent to 1.65% of the country's overall GDP due to an increased import bill.

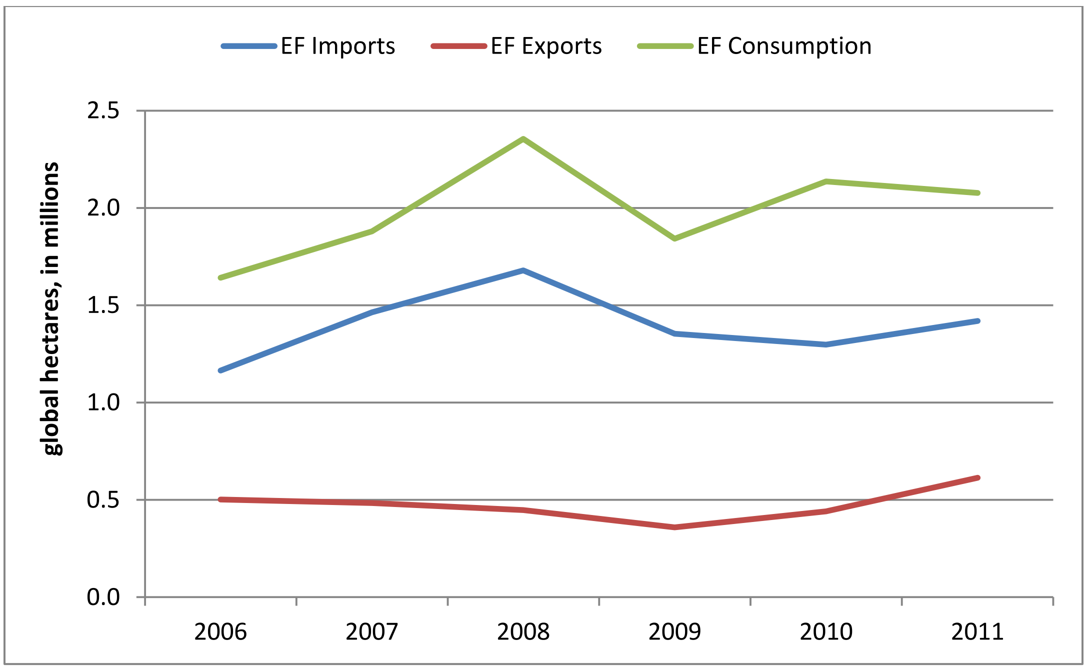


Figure 12: Montenegro's Ecological Footprint of consumption, import and export, in 2006-2011.

When looking at the type of imported resources and ecological services (see Figure 13), one can deduce that Montenegro is mostly importing energy intensive goods and services. Interestingly, the steeply increasing imports of biomass from Grazing Land suggest that more imported meat and dairy products have been consumed over this period.

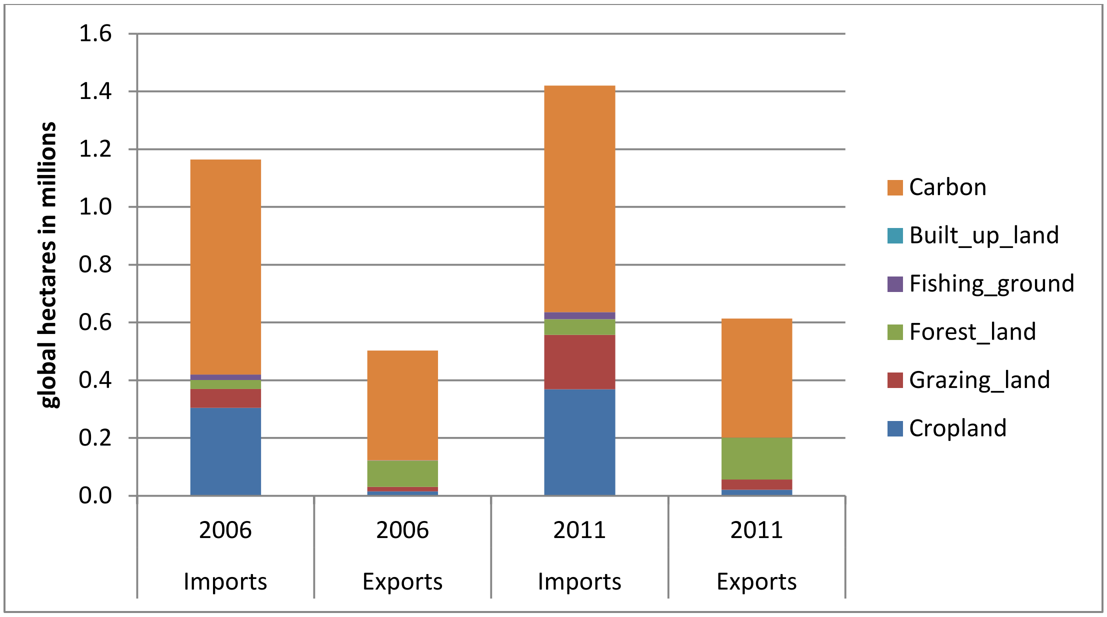


Figure 13: Montenegro's Ecological Footprint of imports and exports, by land-type, in 2006 and 2011.

The Ecological Footprint of exports has also increased over the period 2006-2011, and the Forest Footprint markedly so. This indicates that pressure on Montenegro's forests has been recently increasing, driven by consumption outside the national borders. These results suggest that sustainable harvesting regulations for timber, alongside with a timber-friendly building code, become critical for Montenegro since the economic pressure on Montenegrin forest ecosystems is mounting.

4.5 Assessment of Montenegro's path towards sustainable human development

Sustainable development seeks to improve human well-being while maintaining the natural resource and ecosystem service base for use by future generations. Sustainable development also recognizes the human entitlement to a long-term, secure access to ecological assets. The environmental bottom-line condition for sustainability, in other words living within the means of nature, can be assessed with the Ecological Footprint.

At the same time, human well-being, including welfare, can be approximated using the United Nation's widely recognized Human Development Index (HDI). This index was created by Pakistani economist Mahbub ul Haq in 1994 to provide an alternative to national income as a standard metrics of development (Moran et al. 2008). A country's HDI is composed of three different components: longevity index, education index, and income index. According to UNDP, an HDI of 0.71 or higher is considered "high human development."

Combining both the Human Development Index and the Ecological Footprint, the EF-HDI framework provides a macro-level, comparative assessment of nations' progress towards the two main sustainability goals of living well within the limits of the planet. Only two countries in the Mediterranean region meet the two minimum requirements for globally replicable sustainable development (depicted in the shaded blue area in the bottom-right corner of Figure 14): a per capita Footprint lower than world biocapacity of 1.8 gha and an HDI of at least 0.71. At the planetary level, humanity also exceeds these minimum requirements for sustainable development.

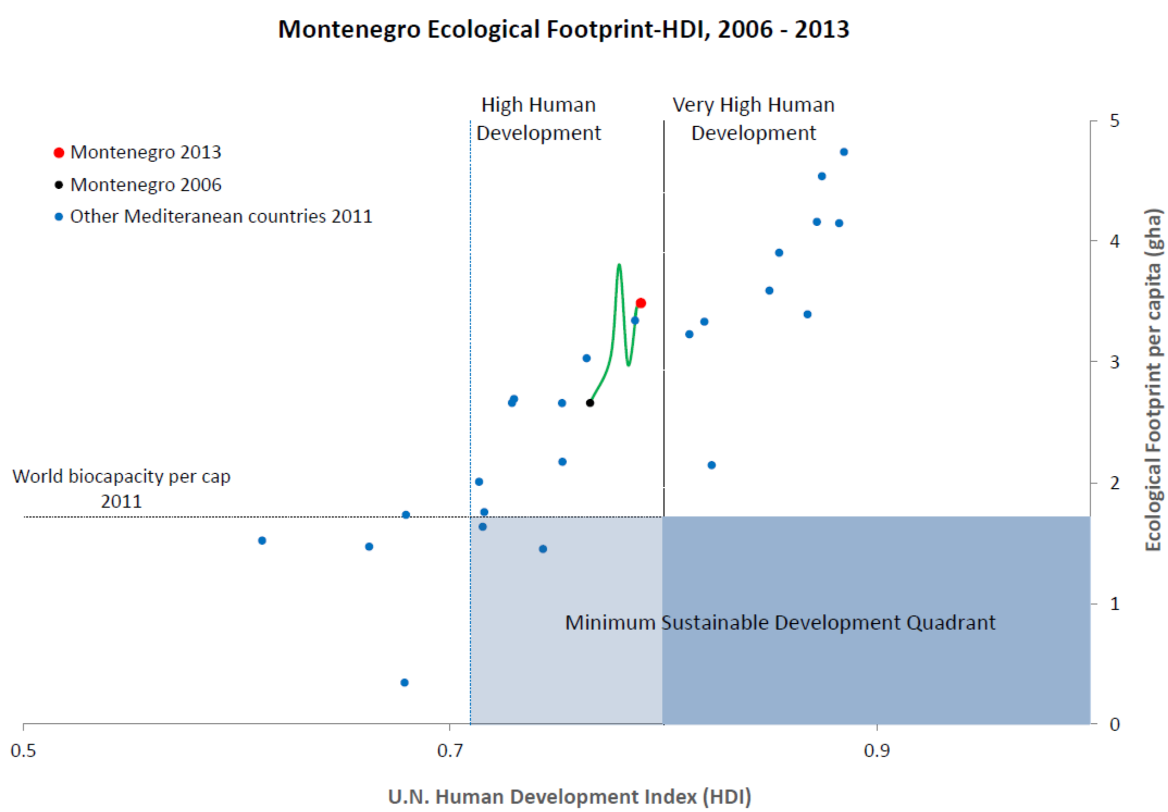


Figure 14: Montenegro Ecological Footprint and HDI path over the period 2006-2013. Blue dots represent other Mediterranean countries in the year 2011.

Figure 14 depicts Montenegro's development path between 2006 and 2013[10], along with the 2011 position of various other countries in the Mediterranean region. The pattern, whereby countries with higher HDI values generally also have high Ecological Footprints per capita, is consistent with global trends. It manifests that any country's Ecological Footprint is not yet decoupled from its income, the dominant driver of HDI. For all countries so far, development has been – and still is - a resource-intensive journey, improved welfare being fuelled by resource extraction at ever increasing scales (Moran et al., 2008). In many cases, small increases in HDI are accompanied by much larger increases in Ecological Footprint.

HDI has increased across the Mediterranean basin at the cost of growing biocapacity deficits region-wide. Although it is still the case most of the time, an increased HDI needs not inherently imply a larger biocapacity deficit. Sustainable development means less reliance on fossil fuels and the proliferation of resource efficient practices in infrastructures and institutions (Myers and Kent, 2001), which can help decouple human well-being from resource use, as well as, resource use from environmental impacts.

Montenegro has experienced a minor increase in HDI (+3%) over the time period under review, from 0.77 to 0.79, contrasting with a sizeable increase in the Ecological Footprint (+30%), from 2.7 gha per person to 3.5 gha per person. Since small increases in HDI seem to be continuously obtained at the cost of far larger increases in Ecological Footprint, this could signal a huge potential for a more resource-sober development in Montenegro. Moreover, dependence on imported food and fuel could put Montenegro's long-term welfare at risk, considering more frequent supply disruptions and price hikes in forthcoming decades.

5 Key differences and complementarities between Domestic Material Consumption (DMC) and Ecological Footprint (EF)

In the search for indicators to monitor progresses towards sustainability, Montenegro has identified the Domestic Material Consumption (DMC) as a potential indicator to be adopted in the revised NSSD. This section is thus intended to compare DMC with the Ecological Footprint to highlight whether, and eventually how, these two indicators could complement each other in the monitoring of sustainable development.

[10] Montenegro's EF-HDI analysis is limited to the 2006-2013 period due to the lack of more updated HDI results.

5.1 Methodological comparison

Domestic Material Consumption (DMC) analysis and Ecological Footprint (EF) accounting have broadly similar aim, which is to better understand a country's consumption patterns and how they relate to issues of environmental sustainability. Both approaches provide a means of aggregating a population's consumption of a large set of products to provide a macro-view at the country level.

DMC focuses on the consumption of physical goods, which it aggregates by weight. EF accounting, on the other hand, focuses on renewable natural resources and ecosystem services. The different goods and services tracked by the EF are aggregated by the biological productivity of surfaces needed to produce them (see Galli et al., 2014) rather than by weight. Although there is some overlap in the products covered by both accounting systems (see Box 3), they provide distinct information on consumption: DMC focuses on total mass of consumption while EF focuses on the appropriation of ecological assets that the consumption represents.

Box 3: product categories covered by DMC and EF

DMC (in tons):

- **Biomass**
- Metals and ores
- Non-metals
- Fossil fuels

EF (in global hectares):

- **Biomass**
- Built-up land
- Waste (emissions) from fossil fuel use

EF accounting therefore provides a means to compare a country's consumption to the capacity of its own ecological assets to supply goods and services or to express this consumption in terms of the share of the world's capacity. EF accounting thus make it possible to benchmark a country's consumption to nature's capacity to supply it unlike DMC analysis where benchmarking is only possible through cross-country comparison.

Another important distinction between the two approaches is the scope that they cover. DMC only accounts for the goods that are consumed in a given country. The materials used in the extraction, transformation, and transport of imported goods (that is along such good supply chain) are therefore not captured by this indicator. Given the growing importance of trade in provisioning the goods and services that countries consume, this can lead to misleading conclusions and a questionable focus on sole resource productivity indicators as argued by Wiedmann et al. (2013). Indeed, a country's apparent improvements in resource efficiency could simply reflect a shifting of impacts to other countries rather than a change in the production chain or in consumption patterns. EF accounting, on the other hand, does cover the upstream impacts of imported products (and conversely discounts the impacts that are associated with production for exports). It therefore provides a more precise picture of the impact that Montenegro's consumption may have domestically as well as internationally (see section 4.2), along the various supply chains that support Montenegro's consumption patterns. Similarly, EF accounting can show the impact on Montenegrin ecosystems caused by consumption in other countries (see section 4.4, for the case of forest products for instance).

5.2 Comparison of DMC and Ecological Footprint results

Results from the DMC analysis (MONSTAT, 2014) and from EF accounting for the years 2006-2013 – the sole period for which results from both analyses are available – share some features but also differ in crucial areas:

- Both measures show a rapid increase in their value between 2006 and 2008 followed by a decrease, possibly influenced by the global economic crisis.
- After 2008, however, the per capita DMC of Montenegro appears to decline until 2012 and rebounds only slightly in 2013, ending up far below the 2008 peak. Overall, the per capita DMC shows only a small increase (+7%) between 2006 and 2013.
- Conversely, the per capita Ecological Footprint of Montenegro declines between 2008 and 2009 before rebounding sharply and remaining at a level just below the 2008 peak until 2013. Overall, the per capita Footprint shows a substantial increase (+32%) between 2006 and 2013 See Figure 15).

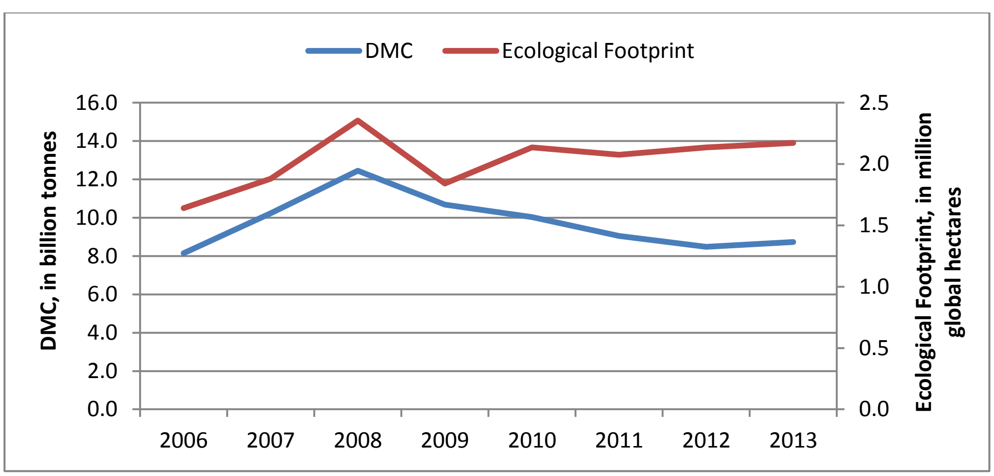


Figure 15: Montenegro's DMC vs. Ecological Footprint trends, 2006-2013.

The differing paths of DMC and EF in the post-2008 period might be due to multiple reasons, among which we have identified: A) the different set of products being tracked by the two indicators. More precisely, the decline in DMC is mainly due by a decrease in the use of non-metallic minerals[11], which are not tracked in the Ecological Footprint analysis; and B) the different coverage of the various steps of resources' supply chains tracked by the two indicators. More precisely, DMC analysis does not capture the materials used along the full supply chain of goods and services imported by Montenegro. Conversely, the Ecological Footprint analysis tracks the biocapacity embedded in the extraction and transformation of these goods and services in the country of origin as well as that embedded in their shipping to Montenegro. As Montenegro has increased its dependence on imports of resources from other countries, the environmental pressure/impact due to the use of such resources is being increasingly shifted to other countries: among the two indicators, this phenomenon is only tracked by the Ecological Footprint.

The cross-country comparison presented in the DMC study (MONSTAT, 2014) shows Montenegro to be roughly in the middle of the group of comparator countries. A comparison of Montenegro with the same comparator countries in terms of their per capita Ecological Footprints shows that Montenegro has a comparatively low per capita Footprint (Figure 16). This suggests that Montenegro's material consumption is associated with less pressure on renewable natural resources and ecological services than many of the other countries.

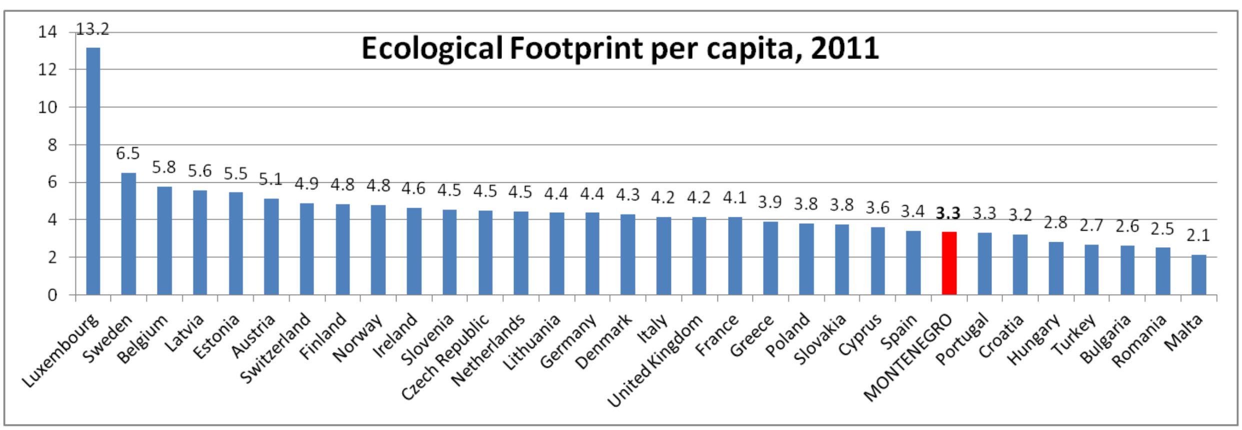


Figure 16: Per capita Ecological Footprint of Montenegro and selected countries, in 2011.

[11] Non metallic minerals – also referred to as "non-metals" – constitute between 53% and 72% (depending on the year) of Montenegro's DMC. See the report "Indikatori Materijalnih Tokova u Crnoj Gori 2006 – 2013".

The DMC study also presented a cross-country comparison of the resource efficiency of national production activities (in terms of GDP generated per ton of material used), indicating a lower value in Montenegro than in many of the other countries. This also appears to be the case when countries are compared in terms of the economic output that can be generated by each national economy per unit of Ecological Footprint (see Figure 17). Indeed, this comparison suggests that Montenegro is among the least efficient countries of the sample; however, it also indicate that Montenegro has considerable scope for improving the resource efficiency of national production activities (i.e., to generate more economic output from its use of renewable natural resources and ecosystem services). EF analysis, in combination with economic information on the structure of the economy, can help prioritize sectors to target policies by identifying economic sectors that are particularly resource intensive, either in absolute terms or in comparison to similar sectors in neighboring countries. Such sectoral analysis was not within the scope of the current report and it is suggested as a follow-up analysis to further inform the NSSD.

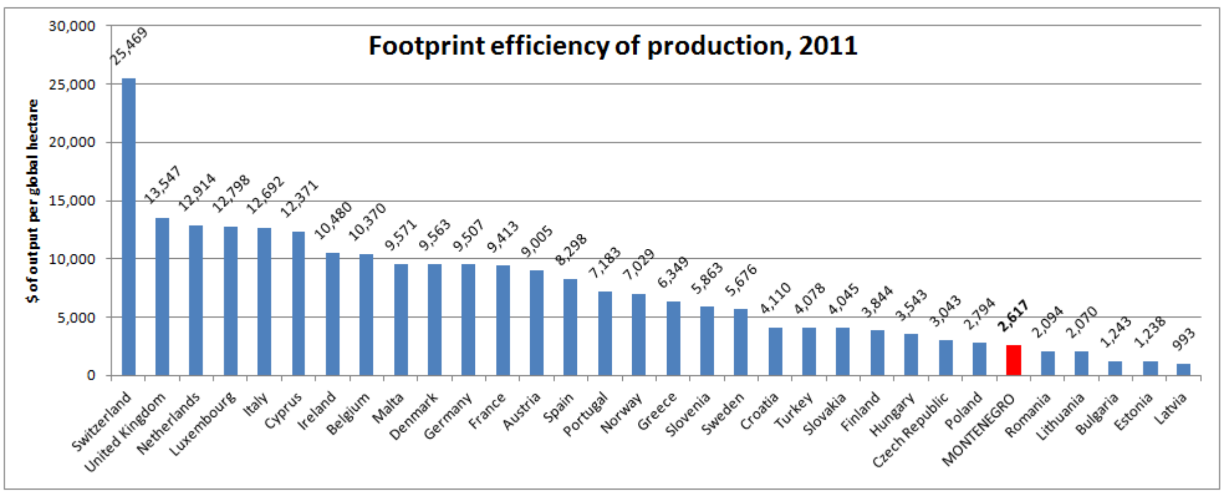


Figure 17: Footprint Efficiency of production (US$ of GDP per global hectare) of Montenegro and selected countries, in 2011.

As noted above, EF accounting uniquely allows to compare a country's Ecological Footprint not only to that of other countries but also to the capacity of its own ecosystems to sustain it. This provides an objective biophysical benchmark to compare countries consumption not only among each other but in relation to their own natural endowment.

It is interesting to note that, considering this measure, Montenegro's performance seems to be above the average of the sample of countries (see Figure 18) as the mismatch between Montenegro's

Ecological Footprint of consumption and its biocapacity is lower than that of most countries in the sample.

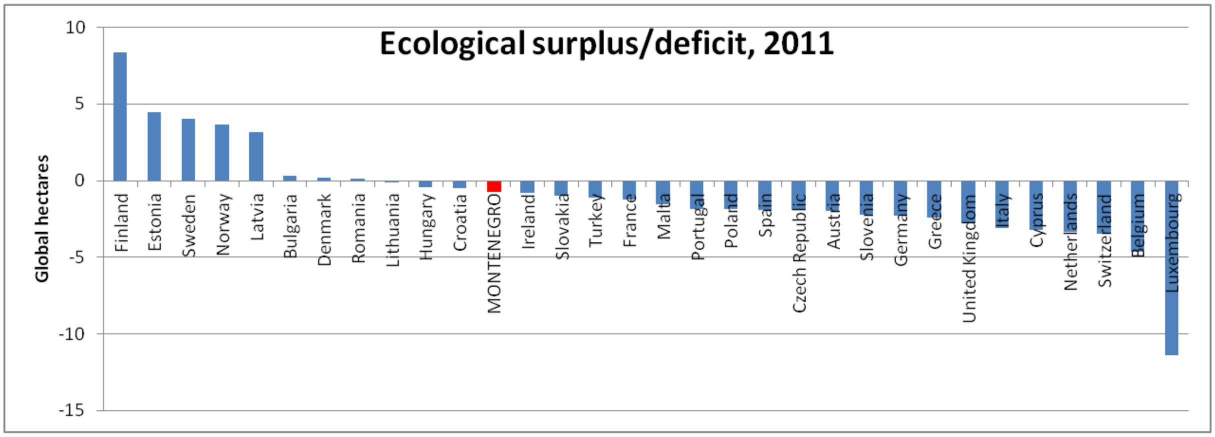


Figure 18: Biocapacity balance (Ecological Footprint minus biocapacity) of Montenegro and selected countries, in 2011.

Nonetheless, it is important to note that EF accounting only considers products and services that compete for biologically productive surfaces. What is shown here as the country's biocapacity deficit is therefore only a subset of the environmental pressures caused by the production and consumption activities of Montenegro. Still these results seem to indicate that a need exists to direct Montenegro's development towards a more sustainable path.

5.3 What can an Ecological Footprint study bring to complement the DMC analysis?

Three main conclusions can be drawn at this stage from the comparison between DMC and EF:

1. The **metrics measure fundamentally different things**. DMC analysis provides a measure of physical consumption while EF measures humans demand for and nature supply of renewable natural resources and ecosystem services.
2. DMC **analysis does not provide a clear means of measuring the environmental impacts** of consumption. For example, the two products that account for the largest share of DMC in Montenegro are Sand/Gravel and Lignite. The production and consumption of these two products have radically different environmental implications that a simple comparison of

consumption by weight cannot capture. By comparing consumption with ecosystems' capacity to supply goods and services, EF accounting provides a more precise estimate of the pressure that production and consumption create on the environment. However, products and services that do not compete for biologically productive surfaces such as Sand/Gravel and Lignite are not included in the EF calculation; the biocapacity deficit showed by Ecological Footprint Accounting thus represent an underestimate of countries' actual pressures on ecosystems.

3. EF accounting can be used to extend multi-regional input-output analysis in order to **identify the consumption drivers behind the country's Ecological Footprint**. Unlike the DMC analysis that looks at a limited number of production sectors, this analysis could show how final consumption by consumers is driving the demand for natural resources and services. This complementary information can be used to inform policies that are seeking to improve resource efficiency and reduce overall resource use.

6 Discussion: potential role of EFA in tracking and monitoring the Montenegro NSSD

According to the outcome document of the 26th session of the National Council for Sustainable Development and Climate Change (NSSD MNE 2015-2020), the 2015-2020 National Strategy of Sustainable Development of Montenegro sets out to *"…identify measures and actions in interdisciplinary and intersectoral priority topics of sustainable development in line with the UN requirements and EU policy, unlike the previous NSSD…*". Moreover, the *"…identification of key requirements set in the international framework […] should be transposed to the national sustainable development policy…".*

Similarly, the current draft revision of the Mediterranean Strategy for Sustainable Development (UNEP(DEPI)/MED WG.407/3) is built around the following vision "*a prosperous and peaceful Mediterranean region in which people enjoy a high quality of life and where sustainable development takes place within the carrying capacity of healthy ecosystems*".

Both documents seem to stress the need to look at sustainability in a systemic and multidisciplinary way, rather than reducing sustainability to the sole integration of environmental protection principles into the areas of social and economic development. The need to approach sustainability from a systemic point of view is also supported by many scientists (e.g., Daly and Farley, 2004; Pulselli et al., 2008; Steffen et al., 2015), including Robert Costanza and colleagues (Costanza et al., 2014b), who call for an overarching or 'ultimate' sustainability goal, possibly defined as "*a prosperous, high quality of life that is equitably shared and sustainable*".

According to Pulselli et al., (forthcoming), while a systemic/crosscutting view is essential in assessing and addressing sustainability and its multiple interacting processes (Knight, 2015; Steffen et al., 2015), decisions and policies are implemented at sub-global levels: national and local governments are ultimately responsible for taking action. A gap thus exists between the 'scientific need' for a systemic thinking and the 'governance need' for local actions and policy implementation. This implies that multiple and diverse indicators are needed to comprehensively track sustainability and to try and bridge the above gap. Systemic indicators are needed to verify any society's claims towards sustainability and monitor them over time: without such systemic perspective, solving one smaller issue at a time may ignore other related issues or create new problems elsewhere. On the other side, abundant, punctual issue-specific indicators are also needed to identify, draft and implement specific policies (Galli, 2015).

Understanding how the Ecological Footprint can inform Montenegro's National Strategy of Sustainable Development and monitor the country's progress towards sustainability thus requires pondering about the above elements.

First of all, it should be noted that Ecological Footprint Accounting conforms to neither traditional economic nor traditional environmental indicators, but rather stands at the problematic interface between economy and the environment (Galli, 2015). The rationale behind the Footprint is to provide as comprehensive a picture as possible[12] of national economies' demand for, and the Biosphere's supply of, finite renewable resources and ecosystem services. Its main added value is its capacity to highlight trade-offs between competing human activities (e.g., agriculture, forestry, fishery, urbanization, manufacturing) by assessing the relationships between a number of anthropogenic drivers of resource overuse. Moreover, many stakeholders have embraced the Footprint for its ability to communicate – in simple terms and visuals – the environmental consequences of human metabolism.

Secondly, in order to assess the role the Ecological Footprint may have in supporting a National Strategy for Sustainable Development (i.e., its policy usefulness), one needs to understand what steps are involved in designing and implementing policies, and what information decision-makers critically need

[12] While the theoretical approach of EFA leans towards comprehensiveness, its actual implementation is more limited in scope (Galli, 2015; Lin et al., 2015; Wiedmann and Barrett, 2010). EFA tracks resource provisioning services and only one regulatory service: climate stabilization via CO2 sequestration (Galli et al., 2014; Galli, 2015).

(contrasted with what a given measurement is actually capable of providing) at each step of the policy formulation process. Figure 19 breaks down the policy-making process into its five key steps and analyzes how the Ecological Footprint can inform each one of them.

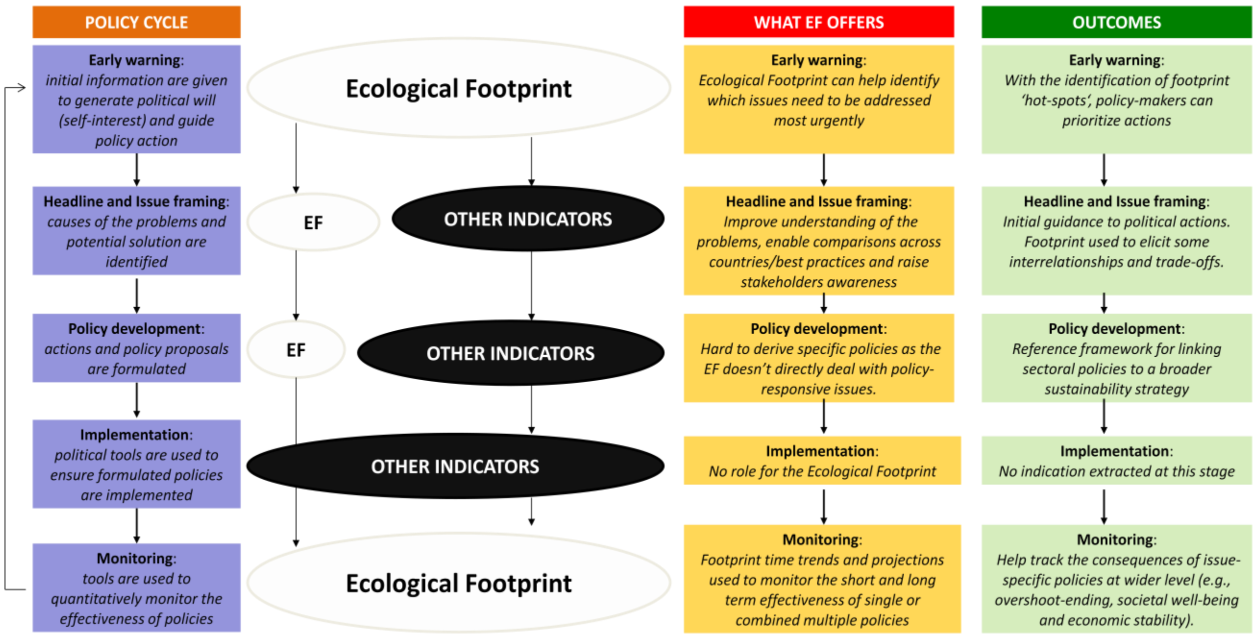


Figure 19: Policy usefulness of the Ecological Footprint in each step of the policy-making process. For ease in visualization, such 'policy cycle' has been represented here in linear fashion. Source: adjusted from Galli, 2015.

Ecological Footprint can offer guidance helping societies and leadership realize that there is finite supply of global resources, including ecosystem's services. Moreover, while it can help in identifying areas of potential intervention (Footprint hotspots) and in setting goals, it must be complemented with issue-specific indicators in the development and implementation of policies (see Figure 18). Once policies are implemented, ad-hoc indicators must be designed to monitor progress in the specific issues. Such a view as provided by Ecological Footprint Accounting is therefore needed to integrate the various issue-specific policies into a measurable, reportable and verifiable sustainability framework.

However, it must be kept in mind that, even with regards to the environmental pillar of sustainability, the current Ecological Footprint is unable to provide an exhaustive measure as it only tracks a limited set of resources and services: that is renewable resources and carbon sequestration capacity. Joint use of

Ecological Footprint and DMC analyses can thus ensure that a broader range of resources is monitored from the wider-angle.

It is in this capacity – as a macro-level framework to guide Montenegro's overall trajectory towards sustainability – that we expect the most promising contribution of the Ecological Footprint to the National Strategy for Sustainable Development of Montenegro. Furthermore, combining the Ecological Footprint with the United Nations Human Development Index (HDI) might provide a macro-level, comparative assessment framework of the Montenegro's progress towards the overarching goal of living well within the means of nature, globally and in the country.

7 Conclusion

This report has been prepared by Global Footprint Network for the Ministry of Sustainable Development and Tourism of Montenegro to inform the government's revision of its National Strategy for Sustainable Development (NSSD), particularly the selection of indicators to monitor national progresses towards sustainability.

Overall, we found that Montenegro's residents experienced a minor increase in well-being (as indicated by a 3% increase in their HDI) over the period 2006-2013, coupled with a dramatic increase in their use of renewable resources and ecological services (as indicated by a 30% increase in their Ecological Footprint per capita). The fact that small increases in HDI were achieved at the expenses of large increases in the Ecological Footprint might be a sign that Montenegro's economic development has entered a resource-inefficient path and that its residents' consumption levels might be unsustainable once the global picture is considered. Indeed, although the country's "*biocapacity deficit*" was found lower than that of many other European countries (see Figure 18), the assessment of the Montenegrin economy's production efficiency (indicated by the economic output – GDP – generated per global hectare of Footprint demanded) showed that Montenegro is among the least efficient countries of the analyzed sample (see Figure 17).

Nonetheless, our analysis also found that Montenegro has a considerable scope for improving the resource efficiency of economic activities and that alternative policies should be tailored for *Food*, *Transportation* and *Housing* with a view to reducing the consumption of resources. Dependence on imports of essential resources such as food and fuel was found to be increasing (see Figure 13); this could put Montenegro's long-term welfare at risk as supply disruptions or increased costs might undermine a sustainable growth of the economy. Improving the production efficiency of key sectors in the national economy and promoting import of commodities from countries with more eco-efficient production processes might be a way to lower risk exposure, reduce the country's dependency on *natural capital* outside its borders and move towards sustainability.

Finally, we would like to stress the fact that the Ecological Footprint analysis provided in this report is based on data from globally recognized databases, such as the Food and Agricultural Organization of the United Nations (UN FAO) and the International Energy Agency (IEA). However, an institutional ownership of this accounting tool within Montenegro's governance system critically depends on a deeper engagement of government bodies with the indicator production process.

- **Recommendation 1:** it is recommended that capacity building activities (such us technical trainings, workshops, and roundtables) for government institutions, technical experts, as well as university students are set-up and routinely improved in following-up to this report.
- **Recommendation 2:** it is recommended that Global Footprint Network and the Statistical Office of Montenegro (MONSTAT) initiate a dialogue to facilitate the acquisition and management of locally-sourced and reliable quality data and ensure the appropriate use and interpretation of information derived from the Footprint assessment.

In addition, the detailed EE-MRIO analysis used to identify Montenegro's main Footprint drivers was based on proxies for want of an Input-Output table for Montenegro (see section 4.1.2). However, during this project it was found that MONSTAT is working on producing the first ever Input-Output table for Montenegro.

- **Recommendation 3:** should the construction of a Montenegro's Input-Output table be confirmed, it is recommended that a proper and detailed environmentally-extended input-output analysis for Montenegro be performed. This would allow identifying the specific economic sectors that are responsible for the high Footprint intensity of the Montenegro's economy – either in absolute terms or in comparison to similar sectors in neighboring countries – and would thus benefit from targeted sectoral policies to increase production efficiency.

8 Annex 1 – Data needs for Footprint assessments.

The table below lists the full set of input data to the Ecological Footprint and biocapacity calculation. Approximately 61 million data points are used in the National Footprint Accounts 2015 Edition (6,000 data points per country and year). Source: Borucke et al. (2013).

DATASET	SOURCE	DESCRIPTION
Production of primary agricultural products	FAO ProdSTAT	Physical quantities (tonnes) of primary products produced in each of the considered countries
Production of crop-based feeds used to feed animals	Feed from general marketed crops data is directly drawn from the SUA/FBS from FAOSTAT Data on crops grown specifically for fodder is drawn directly from the FAO ProdSTAT	Physical quantities (tonnes) of feeds, by type of crops, available to feed livestock
Production of seeds	Data on crops used as seeds is calculated by Global Footprint Network based on data from the FAO ProdSTAT	Physical quantities (tonnes) of seed
Import and Export of primary and derived agricultural and livestock products	FAO TradeSTAT	Physical quantities (tonnes) of products imported and exported by each of the considered countries
Import and Export of non-agricultural commodities	COMTRADE	Physical quantities (kg) of products imported and exported by each of the considered countries
Livestock crop consumption	Calculated by Global Footprint Network based upon the following datasets: • FAO Production for primary Livestock • Haberl et al., 2007.	Data on crop-based feed for livestock (tonnes of dry matter per year), split into different crop categories
Production of primary forestry products as well as import and export of primary and derived forestry products	FAO ForeSTAT	Physical quantities (tonnes and m^3) of products (timber and wood fuel) produced, imported and exported by each country
Production of primary fishery products as well as import and export of primary and derived fishery products	FAO FishSTAT	Physical quantities (tonnes) of marine and inland fish species landed as well as import and export of fish commodities
Carbon dioxide emissions by sector	International Energy Agency (IEA)	Total amounts of CO_2 emitted by each sector of a country's economy

Built-up/infrastructure areas	A combination of data sources is used, in the following order of preference: 1. CORINE Land Cover 2. FAO ResourceSTAT 3. Global Agro-Ecological Zones (GAEZ) Model 4. Global Land Cover (GLC) 2000 5. Global Land Use Database, SAGE, University of Wisconsin	Built-up areas by infrastructure type and country. Except for data drawn from CORINE for European countries, all other data sources only provide total area values
Cropland yields	FAO ProdSTAT	World average yield for 164 primary crop products
National yield factors for cropland	Calculated by Global Footprint Network based on cropland yields and country specific unharvested percentages	Country specific yield factors for cropland
Grazing land yields	Monfreda, C., personal communication, 2008. SAGE, University of Wisconsin, Madison	World average yield for grass production. It represents the average above-ground edible net primary production for grassland available for consumption by ruminants.
Fish yields	Calculated by Global Footprint Network based on several data sources including: • Sustainable catch value (Gulland, 1971) • Trophic levels of fish species (Fishbase Database available at www.fishbase.org) • Data on discard factors, efficiency transfer, and carbon content of fish per tonne wet weight (Pauly and Christensen, 1995)	World-average yields for fish species. They are based on the annual marine primary production equivalent.
Forest yields	World average forest yield calculated by Global Footprint Network based on national Net Annual Increment (NAI) of biomass. NAI data is drawn from two sources: • Temperate and Boreal Forest Resource Assessment – TBFRA (UNECE and FAO 2000) • Global Fiber Supply Model – GFSM (FAO, 1998)	World average forest yield. It is based on the forests' Net Annual Increment of biomass. NAI is defined as the average annual volume over a given reference period of gross increment less that of neutral losses on all trees to a minimum diameter of 0 cm (d.b.h.).
Carbon Uptake land yield	Calculated by Global Footprint Network based on data on terrestrial carbon sequestration (IPCC 2006) and the ocean sequestration percentage (Khatiwala et al., 2009) Further details can be found in Borucke	World average carbon uptake capacity. Though different ecosystems have the capacity to sequester CO_2, carbon uptake land is currently assumed to be forest land only by the Ecological

	et al., (2013)	Footprint methodology.
Equivalence Factors (EQF)	Calculated by Global Footprint Network based on data on land cover and agricultural suitability. Data on agricultural suitability is obtained from the Global Agro-Ecological Zones (GAEZ) model (FAO and IIASA, 2000). Land cover data drawn from the FAO ResourceSTAT database.	EQF for crop, grazing, forest and marine land. Based upon the suitability of land as measured by the Global Agro-Ecological Zones model.

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