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The Role of the Hungarian National Forest Inventory in Meeting Sustainability Goals

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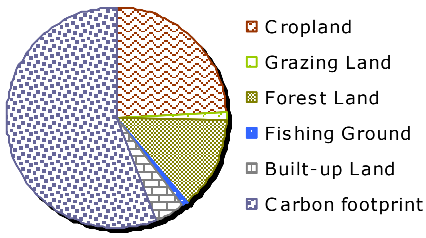
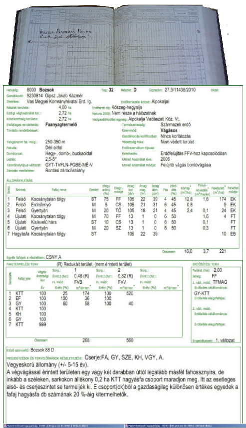
In the 1980s, the World Meteorological Organization (WMO) published a study on the risks of the climate change and global warming. In 1988, the Intergovernmental Panel on Climate Change (IPCC) was set up by WMO to coordinate the research activities related to climate change all over the world. The United Nations Conference on Environment and Development held in 1992 in Rio de Janeiro was also of great importance in the process of meeting the global challenges. The member states signing the Earth Summit Agreements have committed to reduce their net emissions of carbon dioxide.

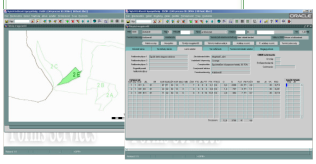
When investigating the changes of the ecological footprint we can detect an obvious fact. While most of the components haven't changed during the last 50 years, one of the components has grown nearly fivefold. This component is the carbon footprint resulting from energy consumption. According to data of the Global Footprint Network, none of the components (cropland, grazing land, forest land, fishing ground) of Hungary's ecological footprint has exceeded its biocapacity: 1.18 gha vs. 2.09 gha.

The deficit of 0.8 gha in the final account (EF vs. BC = 3.0 gha vs. 2,2 gha) results from our carbon footprint of nearly 1.5 gha. If we can reduce this component, we will get closer to sustainability. If we switch to technologies causing less carbon-dioxide emission (gross reduction), and to technologies taking up and storing carbon-dioxide (net reduction), we can reduce our ecological footprint.

Ecological Footprint of Hungary (3.0 gha)





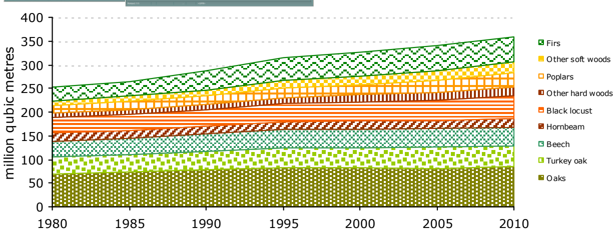


The National Forest Inventory (NFI) has a long tradition in Hungary. The first order, to sur-vey and map Hungary's forests, was decreed by Maria Teresa and came into force in 1769. The first forest act was issued in 1879. Treatment of the majority of forests had to be based on forest management plans. Sustainability was ensured based on existing age classes as it was ordered in 1920.

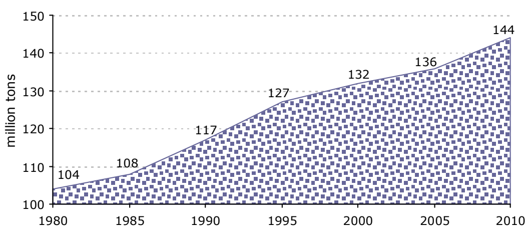
Forest management planning, as well as forest inspection is quite intensive in the country. In addition, there is a continuous forest inventory in the country. The units of the planning (the so called sub compartments, which are also referred to here as stands), as well as the inventory are stands of about four ha of size on average. During planning, practically all forest stands are surveyed once in every 10 years, which makes it possible to track the fate of all stands, and thus that of all forest land. The survey produces detailed maps, as well as a detailed description of the forest stands (e.g. species, mean breast height diameter, mean height, stock volume, number of trees, basal area, crown closure, volume increment etc.).

Due to the intensive forest monitoring as described above, all forest stands are continuously accounted for. This also means that all changes in the biomass carbon stocks of the forests due to any causes from growth through harvests, natural disturbances and deforestation are captured by the forestry statistics of each stand at least on a decade scale, and those of the whole forest area even on an annual basis. However, because the total forest cover has been growing for decades, and there have not been any major deforestations for decades (their total annual area being around five hundred ha), no separate and detailed statistics for conversions from forest to other land use were recorded until recently. Nevertheless, the forest inventory statistics include, and always included, all losses of volume stocks due to all deforestations.

In 1935 the forest act meant that forest owners had to manage their forest using forest management plans. Development of forest management plans has been supported by comput-erised data processing since 1970. The information collected by the NFI is stored in the National Forest Database. This database is used for reporting national and international annual statistics on Hungarian forests too. Detailed surveying and the comprehensive database containing statistics for the last 40 years help to observe the principle of practicability.



This figure shows changes of stand volume and species composition over the last thirty years



From the data shown on figure above we have calculated the amount of carbon sequestered in Hungarian forests over the past three decades using equation 1.

There are different ways to meet commitments. The most crucial factor in choosing which technology to use is cost efficiency. It has to be weighed up how much the sequestration of a carbon dioxide unit/credit cost. One of the possibilities is forest management which is capable of managing carbon to a great extent or even completely. Woods play a crucial role in the carbon cycle.

$$C_b = V_b \cdot \gamma \cdot (1+\rho) \cdot \varphi \quad (1)$$

where

C_b: carbon stock of biomass (tones C)
V_b: growing stock (m^3)
γ: wood density (t/m^3)
ρ: root-to-shoot ratio (dimensionless)
φ: carbon fraction of biomass (dimensionless)

$$V = (p_1 + p_2 \cdot d_{1.3} \cdot h + p_3 \cdot d_{1.3} + p_4 \cdot h) \cdot \left(\frac{h}{h-1.3}\right)^k \cdot \left(\frac{d_{1.3}^2 \cdot h}{10^8}\right)$$

where

V: growing stock (m^3)
$d_{1.3}$: breast height diameter (cm) – from the National Forestry Database
h: height (m) – from the National Forestry Database
p_1, p_2, p_3, p_4, k: parameters – depends on a tree species

When using this equation, we get the total aboveground volume of trees, so we don't need the biomass expansion factor.

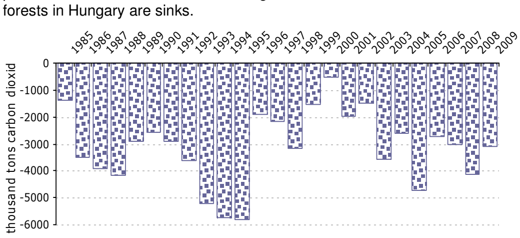
We have data on base density available for different tree species and groups of tree species. In 2008, investigations on base density were run in the Hungarian Forest Research Institute in order to eliminate doubts about overestimating its values in the first years of annual reports. Results indicate that real values are on average by 17% lower than those published in earlier references (SOMOGYI 2008). In accordance with statistical properties of the new investigations, corrected parameters were calculated for all tree species in the NFD.

For estimations of the underground biomass, the dimensionless root-to-shoot ratio of 0.25 is used for all tree species in general. (IPCC has recommended the use of a higher value, but having relatively young forests, we have chosen the conservative estimation method and use this low value.) The measurements recorded in Hungary are between 20% and 37%, but these values can not be considered reliable due to the low number of samplings.

According to IPCC recommendations, the value of 0.5 is used for estimating tree biomass carbon content. It coincides with measurements recorded in Hungary revealing values between 50.1% and 52.3%.

By 1970, all forests in Hungary had valid forest management plans. From this year onwards, computerized storage of forest management data has been prescribed by the Manual for Forest Inventory and Management Planning issued by the CAO Forestry Directorate or its predessedors. Computerization has allowed updating of data recorded at different times that is their projection for a given time-period. The availability of the complete digital database covering up the whole country since 1980 makes investigation of forest stand characteristics and species diversity possible.

The total amount of net sequestration by calendar year is reported in the chart below for years 1985-2009. In statistics like this, emissions are usually positive numbers, thus, the below negative numbers demonstrate that the forests in Hungary are sinks.



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