STATE OF ENVIRONMENT IN HUNGARY 2016

Extract
from the State of Environment in Hungary 2016

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1. Soil – Environmental remediation – Rehabilitation of brownfield sites

1.1. Soil

Soil formation is an extremely slow process, so soil is basically not considered as a renewable or a conditionally renewable resource. The soil provides us with food, biomass and raw materials. It serves as a field of human activity, as landscape, as a repository of natural heritage. As a habitat, it plays a central role in the survival of the biosphere, human cultural values and the gene pool. It stores, filters and transforms many substances such as water, nutrients and carbon. It is a decisive element in the earthly cycles of atmospheric gases, therefore the binding and emission of climate-influencing compounds. These functions need to be protected because of their socio-economic and environmental significance.

In Hungary, the proportion of artificial surfaces increases year by year while the area of cultivated arable land decreased by nearly 9% between 1990 and 2016 (A fenntartható fejlődés indikátorai Magyarországon, 2016 _ KSH 2017).

International outlook: In 2015, in the framework of LUCAS (Land Use / Cover Area Frame Statistical Survey), the cover and land use of the Earth has been repeatedly surveyed in the 28 member states of the European Union. The results show that nearly 40% of EU territory is covered by forests and other wooded areas. The proportion of built-in and other artificial areas is the highest in Malta (23.7%), and the lowest (1.4%) in Latvia. In Hungary, based on the LUCAS survey, this indicator is 4.1% which is close to the EU-28 average (4.0%). (A fenntartható fejlődés indikátorai Magyarországon, 2016 _ KSH 2017)

1.2. Soil quality

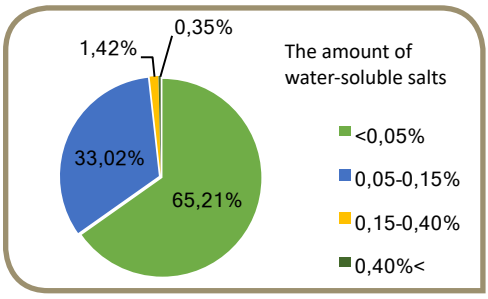

Figure 1.2.: Salt accumulation in the 0-30 cm soil layer at TIM sampling points (2015)
(Source: NÉBIH)

Among the factors that threaten soil functions, the most recent data are available on saline accumulation (salinisation) based on the 2016 measurements. Salinisation is the accumulation of water-soluble salts (potassium, magnesium, calcium, chlorine, sulphate, carbonate, bicarbonate, sodium) in the soil. From these, the most harmful is soda (sodium carbonate) because the most crops have a significant decrease in yield in case of even 0.05% soda content. Salinity can be also created as a result of a natural process such as a result of near-surface, high-salinity ground water and the evaporatory water balance of the soil (e.g. salt of our saline deserts). However, salinisation due to human activity is dangerous that results from inadequate irrigation water and / or irrigation techniques, inadequate water drainage practices or inadequate slurry application. The soluble total salt content of soils in Hungary is predominantly in the range of 0.02-0.03% (Figure 1.2.).

For about 65% of TIM sampling points, total salt solubility in the 0-30 cm soil layer remains below 0.05% (Figure 1.2.) of which crops are not yet susceptible. At 33% of the measurement points, salinity was measured to be between 0.05 and 0.15% (Figure 1.2.), to which the salt-sensitive plants reacted with yield reduction. Values above the critical threshold

of 0.15% were found at about 1.8% of the sampling sites with saline soils among them where high salinity is a consequence of natural soil development (Figure 1.2.). Soda content was detectable in 10.9% of the samples (typically 0.02-0.03% for each main soil type), 0.05% was exceeded by 2% of the samples predominantly in the case of saline, meadow and forest soils. In the case of the latter, it is possible to deduce secondary salinization by human activity.

Regarding of the heavy metal content of the soil, soil quality in Hungary can be considered to be excellent, heavy metal content exceeding the limit can only be found in the localized area of some former heavy industry centres (mostly non-agricultural).

In our country, nearly 2.3 million hectares of land are endangered by water and wind erosion.

1.3. Environmental remediation

Environmental damage that is been left behind in the soil and in groundwater is hidden from the human eye and its damaging effect usually appears when it poses a direct threat to human health and the wildlife.

Remediation is a remedial action aimed at alleviating groundwater and geological damage, restoring the original or near-original status and restoring services provided by groundwater or providing an equivalent service. It involves technical, economic and administrative activities aimed at exploring vulnerable, polluted, degraded groundwater, geological media, and reducing, eliminating and monitoring contamination, damage and risk (219/2004.(VII. 21.) Korm. rendelet a felszín alatti vizek védelméről).

Figure 1.3. shows a national overview of the settlements where objects can be found about which data sheets to the FAVI-KÁRINFO subsystem of the OKIR system have been have submitted. The data sheets can be categorized as: pre-factfinding data sheets (B1), post-factfinding data sheets (B2) and data sheets after technical intervention (B3). The size of the symbols displayed on the map refers to 1-3 objects depending on the size in 2016.

Figure 1.3.: FAVI-KÁRINFO datasheets locations (2016)

1.4. Rehabilitation of brownfield sites

The majority of cities in the European Union – due to their intensive industrial history – have brownfields that are important factors in the long-term success of cities (URBACT III OP 2014). In order to protect human health and the environment and to reduce urban expansion, the EU supports structural rehabilitation and re-utilization of brownfield sites (EURÓPAI SZÁMVEVŐSZÉK 2012).

1.4.1. Brownfield sites in Hungary

Brownfield site occur in a relatively higher rate Hungary due to the economic transformation that has been concentrated to the last decades and the structural change of brownfield areas. Rapid ownership changes have contributed to the formation brownfield areas. Out-of-use military areas – that are mostly contaminated – caused a large volume increase of brownfield areas.

Brownfield areas are scattered throughout the whole area of Budapest. Their appearance, more dense occurense as bigger, contiguous units is typical in the transition zone, mainly in the areas bordering railways as well as in Csepel and South Buda. In the historical nucleus of the city, unued properties mostly takes forms of vacant buildings, vacant lots (BARNAMEZŐS TERÜLETEK FEJLESZTÉSE TEMATIKUS FEJLESZTÉSI PROGRAM 2014).

The main objectives of the "Rehabilitation of Brownfields Areas" programmes (TOP-2.1.1 and TOP-6.3.1) are to create an attractive and environmentally sustainable urban environment for enterprises and investors as well as to the public.

During the rehabilitation of brownfield sites, it is necessary to strive for the function-changing renewal of the area that is to say that the development should accomplish the aim of the measure: to create as many new green and recreational, sustainable urban areas enriched with community and cultural functions as possible by rehabilitating the brownfield while employing innovative methods from the perspective of urban development and maintenance (SZÉCHENYI 2020).

Nowadays, the process and effectiveness of brownfield investments can be studied in such wonderful cases as the Grassalkovich Castle in Gödöllő, the Monostori Fortress Museum in Komárom or the Sármellék Regional Civilian Airport. It is less well-known that thousands visit the Óbuda Grand Bazaar that was built on the industrial area of the former Ganz works or the recreational area and shopping centre established on the premises of the former Hungarian Optical Works as successful brownfield investments (CÉGVEZETÉS 2005).

2. Surface waters and ground waters in Hungary

The hydrology of Hungary is mainly determined by the location of the country. Hungary is lying in the Carpathian basin, the areas around our border are typically situated higher, so rivers are flowing into the middle of the country, towards lower regions. There are 9 800 surface watercourses in the country, most of them are artificial canals. Our bigger rivers are: Danube, Tisza, Körös, Drava, Maros. Danube gathers most of the surface watercourses from the country and delivers their water to the Danube Delta at the Black Sea. The Danube is the second largest river in Europe. The area of its drainage basin is 801 463 km^2 which is

also the second largest in our continent. The length of the Danube is 2 860 km, of which 417 km is the Hungarian part. The river streams through 10 countries, its drainage basin extends to 19 countries. The whole area of Hungary is in its drainage basin.

The amount of water entering the country is 114 billion m^3/year while the amount of water leaving the country is 120 billion m^3/year. These figures shows that the Hungarian water balance is negative. More water flows away from the country than arrives. It also shows that the quantity and quality of our watercourses are primarily determined by waters coming from abroad, to which anthropogenic activities and natural processes inside the country also contribute.

There are around 4 000 still waters on the surface in Hungary, 75% of them are artificial lakes. Our biggest lake is Lake Balaton which is the largest lake in Middle-Europe. Its surface covers 594 km^2. Lake Balaton is one of the most important tourist destinations in Hungary, its water quality is excellent thanks to cleaning efforts in recent years. Our other major natural lakes are Lake Velence and Lake Neusiedl/Fertő, and our biggest artificial lake is Lake Tisza, also known as Kisköre Reservoir.

Hungary has 185 groundwater bodies that can be divided into three main hydrogeological types from a geological point of view: porous, karst and mountainous. 95 of our groundwater-bodies are bordering at least one neighbouring country. Another important hydrological feature of groundwater bodies is the type of their connection with surface water, wet habitats. 115 groundwater bodies have significant ecosystem connection depending on water.

In Hungary, the protection and sustainable use of water resources is one of the state responsibilities related to water management. The common water policy strategy (called 2000/60/EC Water Framework Directive, hereinafter referred to as WFD) adopted in July 2000, was a major step forward in water-related European Union regulations. Its main objective was to establish sustainable water policy. The Directive requires member states sharing the same drainage basins to harmonise their water management activities

The general goal of the WFD is to achieve good water quality both above and under the ground by 2015 (in justified cases, 2027) and to sustain this good status on the long term.

According to the rules of the WFD, member states have to develop Drainage Basin Management Plans (hereinafter referred to as DBMP) for the protection and sustainable use of water. In Hungary, the first drainage basin management plans were developed in 2009 by the Central Directorate of Water Management and Environment Protection as well as the locally competent Directorates of Water Management and Environment Protection.

Since drainage basin management plans have to be reviewed every six years according to the provisions of the WFD, the second DBMP has been made by the end of 2015 and it was adopted by the government in 2016. Compared to the first plan, it is fair to say that no significant improvement has taken place in the states of our water. 77% of water bodies need some intervention to reach the targeted good condition. The physical-chemical state of our water bodies shows a much better picture than the biological state. 46% of the examined water bodies achieves good condition. One of the main reasons of this difference is that aquatic organisms respond sensitively not only for chemical loads, but for changes in land use, morphology and hydrology, too.

Water pollution from agricultural activities is one of the most serious environmental problems. Our country, fulfilling its obligations towards the European Union, revised and re-designated the nitrate vulnerable zones. According to new regulations, 69% of Hungarian territory belongs to the nitrate vulnerable zone category.

Figure 2.1.: the river basin of the Danube, on the map of the International Commission for the Protection of River Danube (ICPDR), *source: http://www.icpdr.org/geochemical_maps/?country=DRB*

3. Improving and preserving air quality

High-quality air is a basic element of a healthy environment. The harmful effect of contaminated air on human health, vegetation and built environment has long been known. The need for treatment of diseases caused by air pollution, the loss of crops, damage to the built environment and the cost of other environmental damage are a major burden on society as a whole, and therefore measures to improve air quality have a real economic benefit at social level. Reducing air pollution is also a decisive task for the lives of our grandchildren, which must be labeled as a priority for our generation. The quality of the ambient air depends on the amount of pollutants emitted, the meteorological conditions, the terrain of the area, the degree of contamination from the built-in and the large distance. The most effective measure is prevention, therefore all activities should be designed and implemented in a way to minimize airborne emissions and pollutants.

Nowadays, solid fires have become an increasingly important source of air pollution, partly because of the increase of fuel prices, especially of natural gas. Wood and coal use have started to grow again in the population, and in the case of coal, basically lignite use. Large amounts of air pollutant, small dust / particulate matter (PM), carbon monoxide, nitrogen oxides, sulfur dioxide are generated when domestic combustion is used in the household if the fuel, combustion technology or combustion equipment is inadequate. Heating with wet firewood, coal, sometimes unfortunately waste is a serious health and environmental damage, and its adverse

air quality effects can be detected in airborne measurement results. When selecting such a household furnace, it is recommended to heat only with dry firewood, wood pellets or wood.

The Ministry of Agriculture, the OKTF's National Waste Management Directorate and the Herman Ottó Institute – part. Continuing the campaign launched in 2015 – launched a new, more extensive, comprehensive information campaign named "Heat Cleverly!" in 2017.

A complex awareness-raising campaign aims to raise the public's attention to the dangers and adverse effects of the use of certain solid fuels at the beginning of the heating season, as well as to make available any alternative information that provides and assists the proper heating technique.

Figure 3.1. Heat Cleverly! campaign *(Source: HOI)*

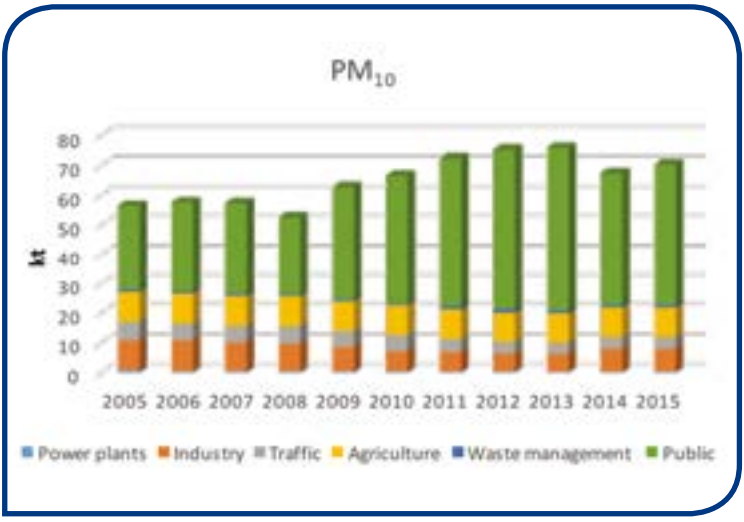

Figure 3.2. PM_{10} emissions from 2005 to 2015 *(Source:OMSZ)*

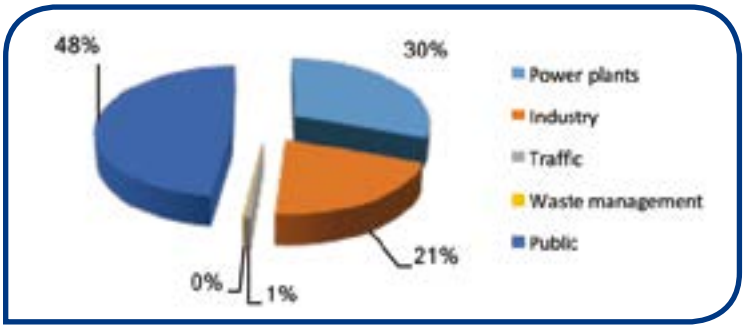

Figure 3.3: Sulfur dioxide emission data by sector by 2015 *(Source: OMSZ)*

Figure 3.4.: Evolution of nitrogen oxides emissions in 2005-2015 *(Source: OMSZ)*

4. Wildlife

The conservation status of natural values – species and habitats – in Hungary is not favourable in general, which reflects global trends. Human activities affect conservation status in direct and indirect ways. While it is relatively simple to manage direct impacts, it is difficult to handle indirect effects e.g. the expansion of alien species or climate change. Besides, species in many cases respond to environmental changes differently: there are "winners" and "losers" depending on the nature of changes and environmental preferences of the given species.

Fortunately, there are a number of methods to conserve our natural values. The most important one is the designation of protected areas. The primary function of those areas is providing safe haven for habitats and related species. As most habitats – including valuable ones for conservation – are secondary habitats formed by human activities (centuries ago in some cases), they can only be maintained by human activities. At the same time, it is essential to consider conservation needs when implementing those activities. It is not easy in a profit-oriented world that presumes infinite economic growth and refuses to consider the finite nature of natural resources.

Yet, wildlife conservation work of National Park Directorates, designation of new protected areas and locally protected conservation values, successful conservation of priority species give hope for stopping and reversing negative trends. For efficient conservation however, recognizing changes is essential. Identifying and following changes in biodiversity, understanding and quantifying the direction and speed of changes requires an established wildlife-monitoring scheme. Indicators used by the monitoring scheme must clearly show changes and help to draw appropriate conclusions.

In Hungary there are several ongoing wildlife monitoring programmes:

– *National Biodiversity Monitoring Scheme* (in Hungarian: Nemzeti Biodiverzitás-monitorozó Rendszer or NBmR) aims to monitor populations of various taxa in regular intervals, across the country, using the same methodology.

– As a part of NBmR, the programme "Vadonleső" ("Peeking Wilderness") started in 2009

and it aims not only to collect biotic data, but also to raise public awareness of environmentally conscious thinking.

– The *monitoring programme of strictly protected and colonial nesting bird species* started in 2012 also as a part of NBmR and it partly overlaps of the similar programme of MME/Birdlife Hungary. The programme's aim is to assess regional and national population trends of rare, endangered and colonial breeding bird species in Hungary, as well as learning about the factors threatening their successful breeding. Mostly the stuff of National Park Directorates (rangers and zoological coordinators) monitor the certain species in some cases involving external assistance.

– MME/Birdlife Hungary's Monitoring Centre started the *Common Bird Monitoring Scheme* (Mindennapi Madaraink Monitoringja – MMM). The scheme follows the long-term changes in the populations of common, well-known breeding bird species.

– A similar programme is the *Landscape Ecological Vegetation Database & Map of Hungary* (Magyarországi Élőhelytérképezési Adatbázis – MÉTA), which is the national vegetation mapping programme of the Centre of Ecological Research, Hungarian Academy of Sciences. Results enable researchers to draw conclusions on inter alia the deterioration, disappearance or regeneration of natural habitats.

Information compiled through various monitoring schemes makes conservation decisions well-grounded and makes it possible to implement focused conservation measures. It also helps to distribute resources in a more efficient and targeted way.

4.1. Flora

4.1.1. Vanishing grasslands, their deteriorating conservation status

The latest (2015) issue of Environmental Status of Hungary discussed in detail to what extent natural and semi-natural habitats have disappeared in Hungary since the 18th century. The significant decrease of grassland areas in the last centuries is especially alarming. That trend can be observed throughout Europe and even on global scale.

Considering conservation and socio-economic importance combined, grasslands are maybe the most important habitat types with a considerable capability for providing ecosystem services. At the same time, grasslands are also among the most vulnerable habitats. A common feature of most grasslands is that they have been being formed and maintained through human activities. Thus they are listed as semi-natural grasslands – even so that their plant associations are natural – because their conservation is strongly related to human activities like hay-making or pasturing. Grasslands have a special importance in Hungary. They provide significant ecosystem services for farming, nature conservation as well as they offer socio-economic benefits. According to the World Resources Institute grasslands store 34% of captured carbon in terrestrial ecosystems. Forests and agricultural areas store 39% and 17%, respectively. In addition, grasslands support fighting erosion and desertification and also play recreational role.

The extent of grassland areas in Hungary has gradually decreased in the past one hundred-and-fifty to two-hundred years, mostly due to their transformation to arable land. The increasing human population needed to be fed. Later, as industrialization proceed, infrastructure and cities required more and more land. Those demands were fulfilled not on the expense of the valuable arable land, but of the less valuable grasslands. The process was boosted by the formation of intensive husbandry, which further decreased the economic value of grasslands. In addition, lineal infrastructures did not only require land, but also fragmented remaining grasslands.

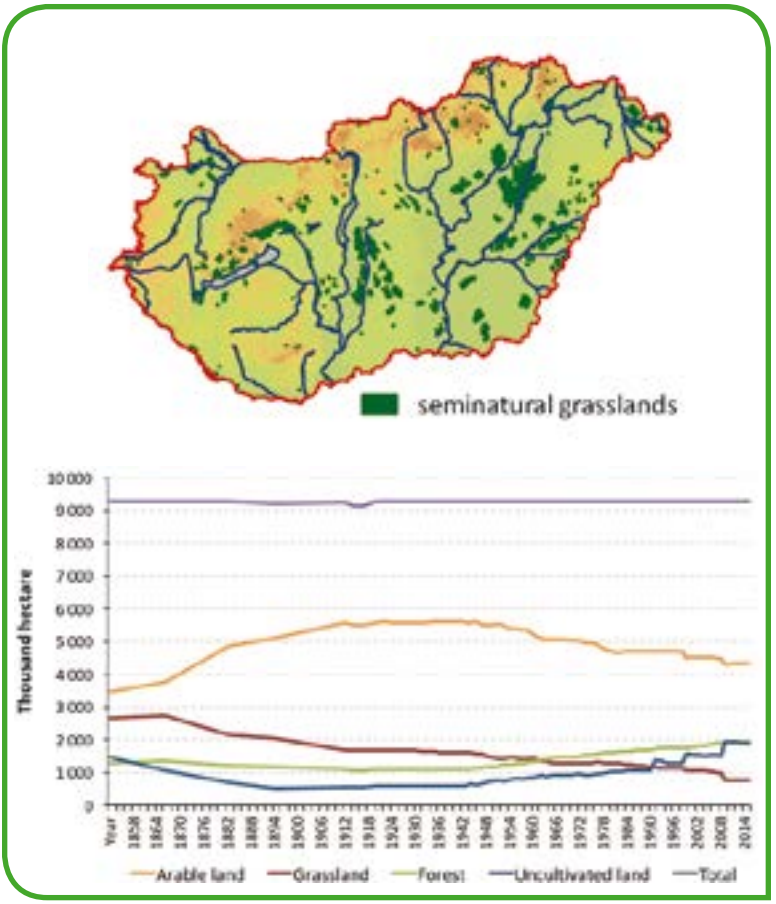

Figure 4.1.Grassland areas in Hungary *(Source: CORINE Landcover 2012)* **and changes in land use between 1853 and 2016** *(Source: Hungarian Central Statistical Office)*

Based on the data of the Hungarian Central Statistical Office (Központi Statisztikai Hivatal – KSH), the extent of grasslands decreased from 2 681 600 hectares (1853) to 784 200 hectares (2016) considering only the recent area of Hungary. It is more than a 70% loss in 163 years. Even if we consider nomenclatural changes in 2010 for classifying land use types – when KSH re-classified 240 000 hectares of non-actively used grassland (no hay-making or grazing) to "uncultivated land" –, the loss of grasslands is still significant. Grassland areas continued to decrease after 2010 and that affected all types of grasslands. For example in central Hungary, between the Danube and Tisza rivers, 21 000 hectares grassland – consisting of 60% fen, 25% alkali grassland, 8% sand grassland, 5% loess steppe and 1% marsh meadow – vanished in the past ten years. Since 2013 however, grassland area has been slightly increasing from the lowest level in 2011-2012 (758 900 hectares) to 784 200 hectares in 2016. The changing trend is probably due to the availability of agri-environmental subsidies (Figure 4.1.).

As the forest is the climax vegetation type in Hungary, scrub encroachment and afforestation starts with the abandonment of regular grazing or hay-making. From a conservational point of view, the unfavourable use of grasslands does not necessarily end with the grassland ceasing to exist, but it may change its flora and fauna significantly. It also affects the soil and microclimatic parameters. Moreover, unfavourable changes may invite invasive species. It was at the end of 20th century when the expansion of alien invasive species like Canadian

goldenrod (*Solidago canadensis*) or common milkweed (*Asclepias syriaca*) in grasslands became well-visible. Their range expansion strongly correlates to the poor management of grasslands, which generally means the abandonment of grazing or hay-making. Those species change fundamentally native grassland plant associations and subsequently the related fauna as well as environmental factors closely connected to vegetation like soil and microclimate.

In Hungary, 27% of the Special Protection Areas (SPA) and 33% of the Sites of Community Importance (SCI) are grasslands. In addition, 30% of the species of community importance occurring in Hungary are related to grassland habitats. According to the conservation country report (2013) based on Article 17 of the Habitat Directive of the European Union and covering the period 2007-2012, the conservation status of one-third of Hungarian grasslands is "unfavourable-bad" and "unfavourable-inadequate" for the remaining two-third. It is a good indication that there is still a lot to do for the appropriate conservation of Hungarian grasslands.

The European Union supports the conservation programmes of priority species related to grasslands through its LIFE funds. The programmes aim to conserve priority species and habitats, improving their conservation status in co-operation with various stakeholders as well as to raise public awareness. Other important conservation tools are the various agri-environmental measures under the Common Agricultural Policy (CAP) for supporting nature-friendly grassland management that also contribute to maintain grasslands. The measures make nature-friendly grassland management competitive for farmers compared to intensive grassland management methods.

4.1.2. Population dynamics of ladybells

The lily-leaf ladybell [*Adenophora liliifolia* (L.) Bess.] is a Eurasian-continental plant with drastically decreasing populations all-over Europe. It is listed as critically endangered species in Hungary which is in the red list. It is strictly protected by law and its conservation value is 250 000 HUF.

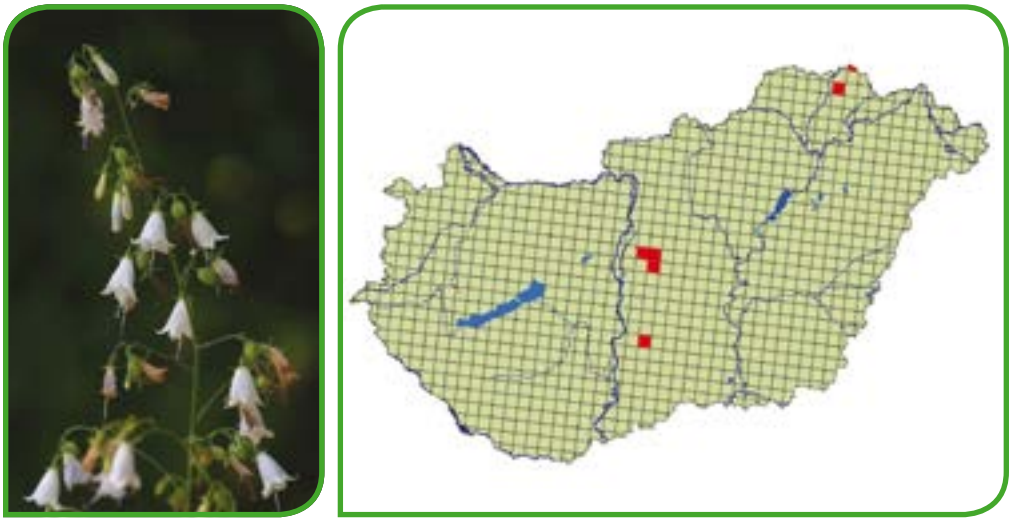

Figure 4.2. Lily-leaf ladybells (Photo: Eszter Aradi) and its presence in Hungary (shown in 10x10 km ETRS grid)

The lily-leaf ladybell was known to be present at some thirty locations in Hungary until the 1950s. However, the species probably disappeared from about ¾ of those sites and nowadays, it occurs only in Zemplén Hills, Aggtelek Karst and in the area between the Danube and Tisza rivers (Figure 4.2.).

The two most stable populations of the species in Hungary – in a total of 115 individual plants – can be found in Zemplén Hills on *Molinia* meadows afforested with birch. They grow both in the middle and at the edges of meadows. The presence of the species was recorded in the Aggtelek Karst first in 1952 and it was confirmed later several times. In 2012, three flowering plants were present. The habitat, however, has transformed significantly and the species has not been recorded since then. It is likely that the species has become extinct at that site. In the area of Kiskunság National Park Directorate, the species can be found in swamp woods, which make mosaics with fen and hay-making meadows. The Directorate carried out a detailed survey in 2010 and recorded 94 plants. They started artificial propagation to create a breeding stock of 60-80 plants to restocking original population later from the growth. In the Danube-Ipoly National Park, the species lives at the edge of oak-ash-elm riparian forests and in alder swamp forests. First, it was discovered in a swamp forest and its opened-up edge in 2004. Scrub encroachment decreased the open area causing the withdrawal of ladybells to the forest floor. The population shrank significantly, thus the National Park Directorate cleared the shrub to support the population.

Hungarian populations of the lily-leaf ladybell have seriously decreased and based on the surveys since 2004, the total population has varied between 163 and 259 plants. The number of plants on the various sites varied greatly between years (Figure 4.3.). On one hand it is partly because not all the plants shoot every year – they smoulder under unfavourable conditions. On the other hand, it is difficult to find unflowering shoots in the high grass, thus difficulties of monitoring may cause deviation in data. The unpredictable presence of the species, its low flowering and seeding rate can also be in correlation with the grazing of game.

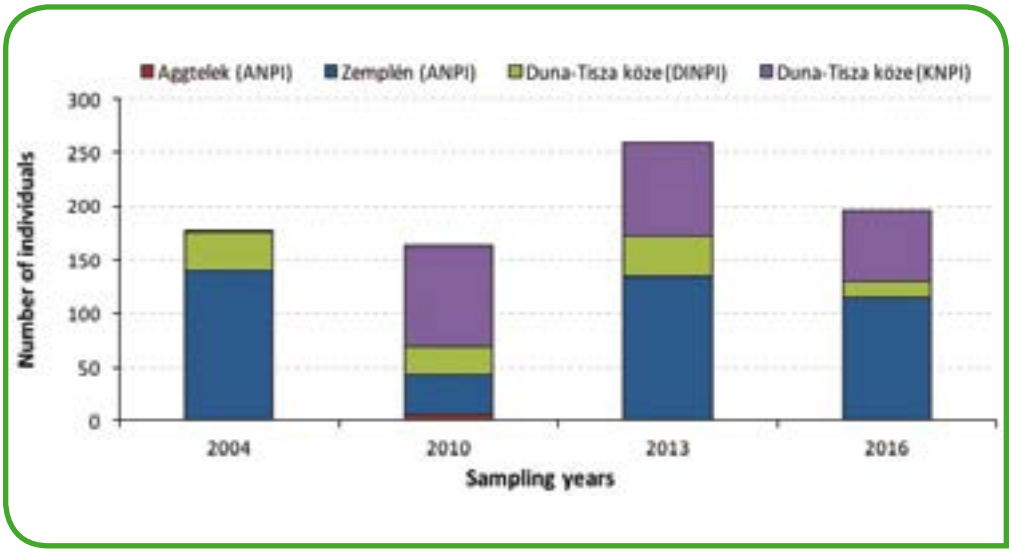

Figure 4.3. Changes of lily-leaf ladybell numbers based on the NBmR surveys (ANPI: Aggtelek National Park Directorate, DINPI: Danube-Ipoly National Park Directorate, KNPI: Kiskunság National Park Directorate)

All known places where the species occurs are situated in protected areas, where protection of the populations and habitats, as well as targeted conservation management measures can be provided. The disappearance of the species from its former habitats is due to the transformation of habitats – mostly scrub encroachment and closure of woody vegetation – resulting from changing land use. Low flowering and seeding rate as well as sensitivity to changes in precipitation and grazing game also played a role in the withdrawal of populations. Adequate conservation management is essential to conserve the species. Sustaining undisturbed habitats increases the life expectancy of individual plants and supports higher shoot and flower production rates.

4.2. Fauna

4.2.1. Occurrence of clubtail dragonflies

Clubtails constitute a distinct family (*Gomphidae*) within the order of dragonflies. The family is represented in Hungary with four species: river clubtail (*Gomphus flavipes*), common clubtail (*Gomphus vulgatissimus*), small pincertail (*Onychogomphus forcipatus* – Picture 4.1.) and green snaketail (*Ophiogomphus cecilia*). Their larvae prefer flowing water, hence they occur mostly in small and larger watercourses, but they can be rarely found also in still waters. They can reach a high abundance in their habitats, thus they play an important role in aquatic food network and nutrient traffic. Larvae move on the bottom, where they usually burrow in the sediment.

Picture 4.1. Small Pincertail

Dragonflies are broadly used for conservation-monitoring and for assessing the status of aquatic habitats as they are excellent indicators showing the changes in their environment well. Gomphid species are sensitive mainly to the pollution characterized by increased organic material level (e.g. sewage that is not treated at all or properly and released into the water or depositing waste) that decreases the oxygen level in their immediate environment (mostly in the sediment).

In the second half of last century, the withdrawal of populations of all four gomphid species of Hungary was reported all-over Europe which is likely due to the deterioration of water quality. It was especially typical in the case of river clubtail and green snaketail, of which populations are extremely fragmented in most parts of Europe. Due to their conservation status, these two species are included in the Annex of the Habitat Directive of the European Union, as well as in the Hungarian NBM Scheme. In addition, all four species are under legal protection in Hungary.

In the 1990s, the conservation status of the four species changed to a favourable direction in Europe: they recolonized many formerly abandoned habitats and they were found in watercourses from where they had not been reported earlier. This positive trend can be at least partly attributed to the favourable changes in the water quality of watercourses. Along with that trend, all four species – not only the more common river and common clubtail, but also small pincertail and green snaketail which are less common in Hungary – were found in several new locations in Hungary, according to the monitoring data of the last ten years (Figure 4.4.).

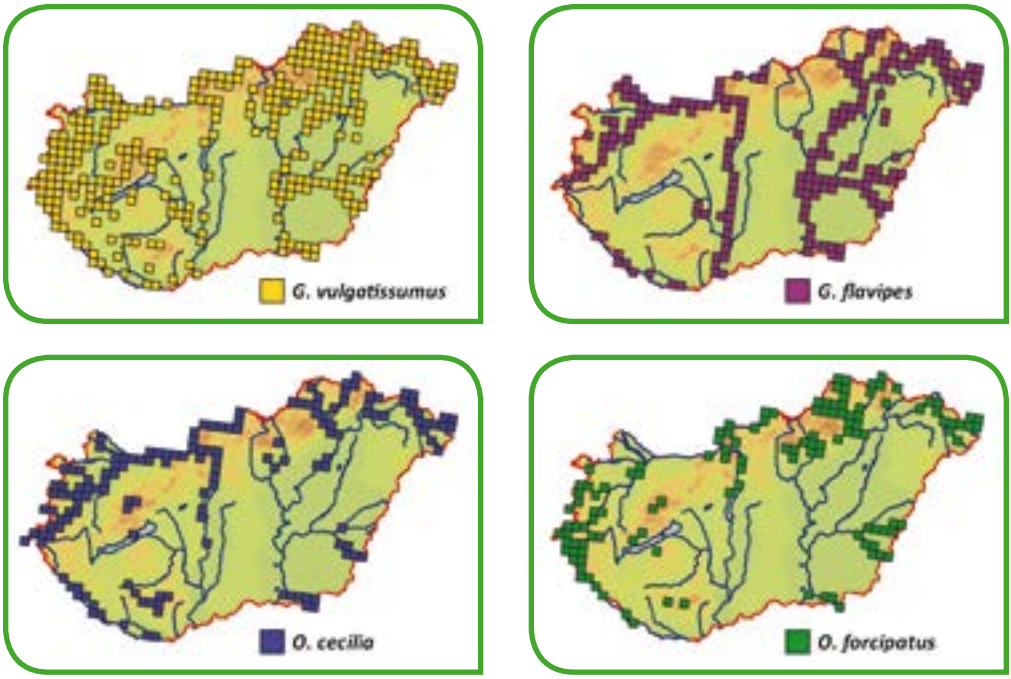

Figure 4.4. Occurrence of gomphid species in Hungary until 2016, based on larvae and exuviae which show the exact location of development (exuviae = cast skins of larvae left after emergence)
[Source: A. Ambrus, T. Danyik, T. Kovács, P. Olajos: Handbook of dragonflies of Hungary (working document) and the biotic database of BioAqua Pro Ltd.]

4.2.2. Status assessment and perspectives of strictly protected snake species in Hungary

Similarly to the situation of wildlife in general, the conservation status of reptiles is worsening on a global scale. A significant number of species have lost their habitats, populations are fragmented, isolated and they are victims of ignorance fuelled persecution or targeted by illegal wildlife-trafficking. The habitats of many species are being transformed by invasive alien plant species; others are threatened by invasive competitors or their parasites. In addition, a fungus – similar to the one desolate amphibians – emerged in the U.S. and reached Europe by this time. Global trends prevail also in the case of the Hungarian herpetofauna, pushing at least three reptile species out of eighteen to the brink of extinction and leaving dim perspectives to the others.

Two of our three strictly protected snake species, the Hungarian meadow viper (*Vipera ursinii rakosiensis*) and the Caspian whipsnake (*Dolichophis caspius*) are on the brink of extinction – the former can be found almost exclusively in Hungary. Nature conservation in Hungary considered the Hungarian meadow viper as a priority species and it seems now that at last – in the last minute – we have managed to save that Pannonian endemic species. The Caspian whipsnake is still common south of Hungary, but the shrinking distribution range of the Hungarian population indicates well the disappearance of their unique, once extensive habitats. Populations of the third strictly protected snake species, the common European adder (*Vipera berus*) seem to be stable, although the number of recent observations is alarmingly low in their southwestern Hungarian range where fast expansions of invasive plant species are conspicuous (Figure 4.5.).

Figure 4.5. A) Present distribution of the three strictly protected snake species *(Source: Hungarian meadow viper programme of MME/Birdlife Hungary; Database of National Mapping Programme for Amphibians and Reptiles);* **B) Caspian whipsnake ; C) Hungarian meadow viper; D) Common European adder**

The conservation of these strictly protected snake species depends strongly on direct human activities, but climate change may also heavily affect the success of conservation efforts. Based on the forecasts of climate change models, one could think that milder winters will have positive impact on the populations and distribution of the Mediterranean Caspian whipsnake. In case of populations in Buda and Budaörs however, there is simply no room for the populations to expand. The distribution of populations therefore can probably be expanded by habitat restoration. Opposite to the Caspian whipsnake, warming climate affects the two viper species negatively in particular as they prefer cooler microclimate. In their case stopping or slowing down the drying-up of habitats by changing the water management regimes is a priority. Considering the predictions of climate change models, that would not only be in the interest of vipers as lowering water tables will also be a problem for forestry and agriculture.

The demanded structure of grassland habitats for the Hungarian meadow viper can be achieved and conserved best by using non-intensive, low grazing-pressure grassland management methods. That certain type of habitat structure is needed to enable Hungarian meadow vipers for hiding – and thus surviving. Managing scrub encroachment is a key for Caspian whipsnake populations. In the case of the common European adder, maintaining natural glades and bushy forest edges is essential, but in many cases it is hardly compatible with recent forest management principles. Invasive plant species threaten the habitats of all three snake species. Managing those plant species cannot be postponed. As other examples suggest, the sooner we intervene, the more likely the success is and the lower the costs are.

4.2.3. The conservation status and population dynamics of the corncrake in the last 20 years

The corncrake (*Crex crex*) is a strictly protected species in Hungary, inducing the designation of a number of Natura 2000 sites in Hungary. Recent studies suggest that populations in Central and Eastern Europe, including Hungary play an important role in maintaining the Western European populations. The conservation of corncrakes in Hungary was highlighted again when MME/Birdlife Hungary awarded the species the "*Bird of the Year*" title in 2016: a national census was carried out, the population trend was analysed and the locations of protected and High Nature Value (HNV) sites were compared to the distribution of corncrake populations.

Figure 4.6. Corncrake (Photo: Ádám Faragó) and its distribution in Hungary between 1997 and 2016

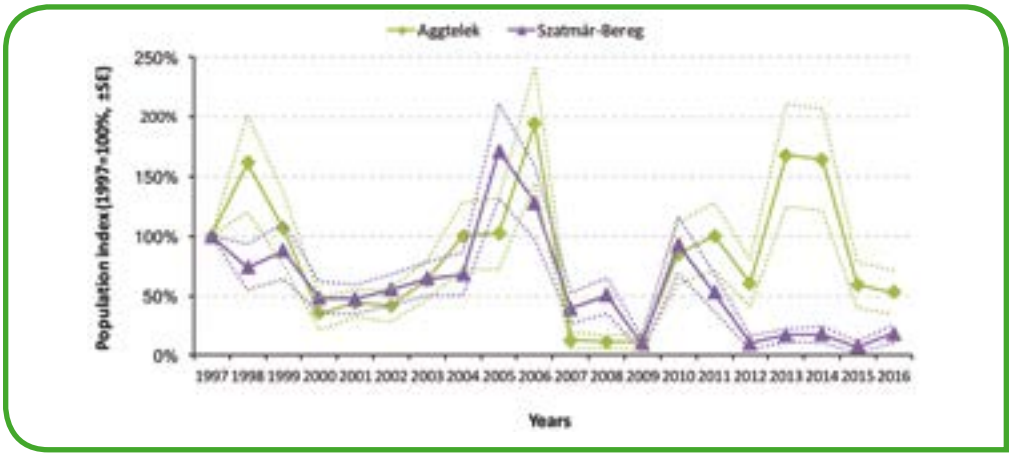

Figure 4.7. Population dynamics of corncrake in Aggtelek National Park and Szatmár-Bereg plain between 1997 and 2016 (SE = standard error)

Corncrake used to be common in Hungary until the 1970s, but the population declined sharply after this year. Recently, it is considered as a rare breeding species with a population of 500-2000 displaying males. The most important breeding areas can be found in northeast Hungary, in Aggtelek National Park, in the Zemplén Hills area, in the floodplains of Tisza and Bodrog rivers and on Bereg-Szatmár plain (Figure 4.6.). Based on the analysis of data

from the two most important breeding areas – Aggtelek National Park and the Szatmár-Bereg plain that belongs to Hortobágy National Park Directorate – between 1997 and 2016, the populations varied between 15-260 and 53-286 pairs, respectively. While in Aggtelek National Park, population size did not change significantly during that period, the other population decreased by 86% (Figure 4.7.). All together, the two populations showed a declining trend and decreased by 55% in the last twenty years. The result suggests that corncrake populations across Hungary are likely declining.

The Natura 2000 network including SPAs and SCIs covers 41% of corncrakes' breeding areas resulting in about 69% of the population breeding on Natura 2000 sites. At the same time, protected conservation areas – national parks, landscape protection areas and conservation sites – cover only 18% of the breeding area and thus only 33% of the population breeds on protected sites.

Agri-environmental measures targeting corncrake that are available for farmers in the entire area of Hungary together with measures that are available for HNV sites cover 40% of the corncrake breeding area. Due to that, 67% of the population breed in an area where favourable agri-environmental management is in place.

The most important negative factor for the species is inadequately timed mowing that occurs in 83% of the breeding area. Less frequent problems are grazing in the breeding period (13%), scrub encroachment and aridification of grasslands (10%). It must be noted that although long-lasting flooding and spring burnings occurs on a few sites only, yet they have a great importance, because a large proportion of the population can be found in the affected areas: Bodrogzug and the northern edge of the distribution range in Hungary.

Conservation measures reflect the major threats on the species and most of the applied management practices are appropriate as well. On protected areas (not owned by National Parks) limiting the agricultural activities is the mostly and wildly used protection measure. On lands owned by National Park Directorates habitat-reconstruciton is also possible. Outside of the protected areas, significant restrictions can only be applied in areas where agri-environmental measures are available. The most common conservation measure is the postponed mowing (hay-making). In most areas mowing is postponed to after 15th of August (74%), in other areas hay-making is delayed only to until 1st of August (23%). Postponing of grazing occurs mainly in Kiskunság National Park where grazing is allowed on corncrake breeding sites only after 15th of July.

Available scientific literature and the latest research results suggest that mowing should be restricted at preferably the entire breeding site but at least on 2 hectares buffer zone until 1-15 of August in order to maintain a stable population. Non-mowed strips left during hay-making in the breeding season must be at least ten metres wide to prevent corncrakes leaving the site and using them later as "proper" habitats. Nature conservation practices on protected sites must be standardized and requirements of agri-environmental measures applied outside of protected areas must be adjusted accordingly. In addition more farmers must get involved in the agri-environmental programmes in order to expand conservation measures to a larger part of corncrake population. It is highly necessary for nature conservation to deal with such threats as flooding and aridification affecting the most important habitats.

4.2.4. Range expansion and ecological role of golden jackal

In the last centuries, the golden jackal (*Canis aureus*) was present in Hungary only in small numbers. By the second half of the 20th century, the distribution range of the species

was limited to certain areas of the Balkans, likely due to significant changes in habitats and farming in Central Eastern Europe and the Balkans as well as to intensive persecution. The Hungarian Red Book published in 1989 listed it as extinct from Hungary. It was about the time when spontaneous recolonization from the Balkans started. The expansion of the species accelerated in the last decade thus they can occur almost anywhere in Hungary by now and they have already also reached the far northern and western parts of Europe (Figure 4.8.). Their occurrence is rare only in the distribution range of wolves. Limits to population growth have not been revealed in details.

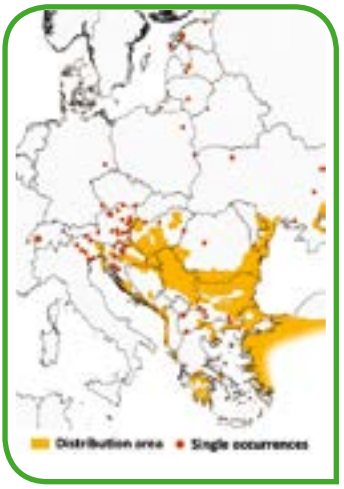

Figure 4.8. Golden jackal (Photo: Zoltán Horváth) and its distribution in Europe

(Source: Trouwborst et al. 2015)

The domestic population trend can be identified indirectly from hunting data (number of shot specimens). The dataset is appropriate to identify population trends because golden jackals can be hunted in Hungary in open season for the whole year since 1997 and without any restrictions since 2012. The number of hunted jackals has been increasing each year and it reached 4225 individuals in the season 2016/2017. Opinions on its impact on conservation, game management and non-intensive animal farming vary greatly.

Golden jackals live a secretive life. They prefer thick bushes, riparian forests. They dig their own dens or occupy the ones of other carnivores. Sometimes they make only simple lairs. Fenced afforestation areas and abandoned fallow lands offer favourable conditions – e.g. high abundance of rodents and lack of disturbance – for them. They can be found more often in areas with considerable populations of big game.

As an opportunistic species, golden jackals use food sources most easy available in the given period and they can switch food sources as well as hunting strategy very quickly. Juveniles of the increasing wild boar population are the favourite preys of jackals. Thus they can somewhat limit the growth of wild boar population. Wild boars are predating on animals available on the ground including even newborn red deer. Small game predation of the golden jackal is significantly lower than expected and lower than the predation of the red fox. Its diet, besides rodents and carcasses of large games consists of May bugs at swarming, wild fruits and berries in summer and autumn, fish at harvesting time, and viscera of large games in their hunting season (Figure 4.9.). They play an important role in eliminating carcasses.

Understanding its ecological role better gives further tasks to researchers and gamekeepers need to work on prevention or moderation of wild game loss caused by jackals as well.

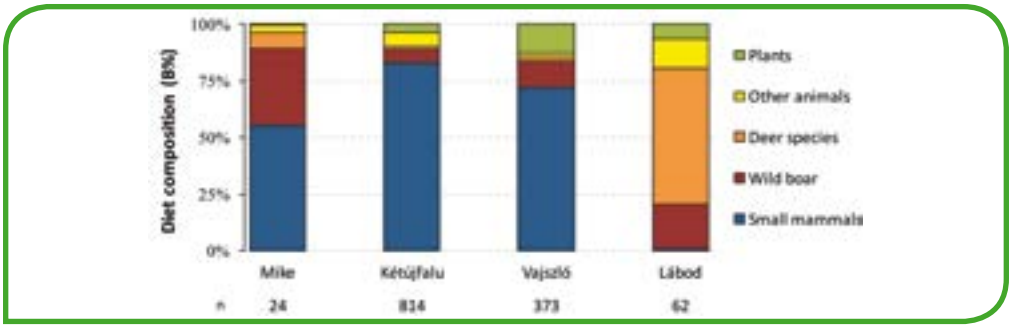

Figure 4.9. Diet composition of golden jackal in south-Transdanubian areas in Hungary (B% = percentage of consumed biomass, n = sample size)
(Source: Lanszki and Heltai 2002, Lanszki et al. 2006, 2015, 2016, respectively)

4.3. Alien species in Hungary

4.3.1. The invasive oak lace bug

Some of the unwelcome non-native "alien" species introduced as a side effect of global trade can pose a serious risk on biodiversity, the conservation status of habitats and biomes as well as on agriculture and forestry at the same time. Therefore following their expansion and population dynamics, learning their migration routes and biology as well as developing protection measures against them are important tasks.

The oak lace bug [*Corythucha arcuata* (Say, 1832) – Hemiptera: Tingidae] that arrived a few years ago to Hungary is an excellent example for those risks listed above. This North American species feeds mostly on oak species. It was first recorded in Europe in Italy in 2000 and it was also found in Turkey two years later. There was little to be heard about it in the next ten years but the species started to expand its range very quickly after 2010. In some places it turned up in extremely large numbers. The oak lace bug was first recorded in Hungary in May 2013 in the Arboretum of Szarvas. A few days later it was also found in the National Botanical Garden, Vácrátót. Records suggest that the species colonized Hungary starting not from the Italian but the Turkish population. New occurrences recorded in 2014 and 2015 indicated clear and continuous expansion towards West and East. The expansion accelerated in 2016 and by autumn, new locations West from the Danube have already been registered. In 2017, the oak lace bug colonized the Southern part of Transdanubia spreading from South and East at the same time (Figure 4.10).

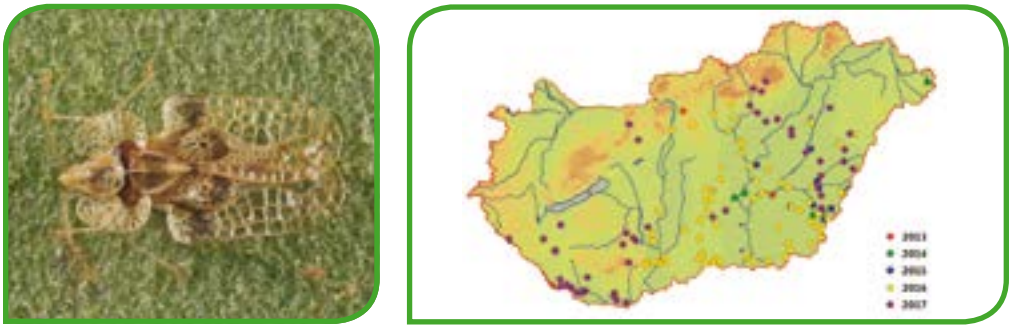

Figure 4.10. Occurrences of oak lace bug in Hungary between 2013 and 2017

Although the imago can fly, the expansion happens mostly passively: e.g. the small bugs can hide in the corners of a car parking under an infected oak tree and that way they can travel long distances in short time. As a consequence, there is little chance to stop their expansion. No climatic limitation is known so far that could stop oak lace bug's expansion. In fact, even the relatively cold winter of 2016/2017 did not cause high mortality in the wintering population. Increasingly frequent mild winters and hot, dry summers can facilitate the spreading of the species and also its mass reproduction. It is likely that the acceleration of the species' expansion in the period 2011-2013 is to be attributed to the mild, almost frostless winters and hot, dry summers in those years.

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Larvae's sucking on the back of the leaves results typical, unmistakeable symptoms (Picture 4.2.) causing well-visible changes in foliage colour (Picture 4.2). The phenomenon can already occur in early or mid-July. That type of foliage discolouration is very distinctive from that of caused by drought or changing colours in the autumn; and it can exacerbate the negative effects of droughts. Our native oak species are the primary hosts for the oak lace bug, hence it must be considered as a potential threat for oak forests in Hungary (about 500 thousand hectares) as well as in Europe (about 30 million hectares). On the locations of mass reproduction, symptoms of sucking are not uncommon on other food plants (e.g. linden, maple, rowans, hawthorns and sweet chestnut) either.

A number of generalist predators were identified as natural enemies of the oak lace bug in Europe, but none of them has seemed to be able to control oak lace bug populations so far. Therefore, massive presence of the species in a “chronic” form and for a longer time can be foreseen.

Picture 4.2. Typical symptoms of larvae's sucking on the back of an oak leaf and strong discolouration of pedunculate (common) oaks' foliage on the edge of a mixed forest (none of the green trees are oak)

There are more and more unanswered questions than scientifically based knowledge in relation to the oak lace bug. It is very likely though that the bugs will have negative impact on the infected trees' resilience, health status and acorn productivity, which makes natural regeneration of oak forests very difficult. As a consequence, repeated and massive infections by oak lace bugs may result in the withdrawal or local extinction of native insects specialized on oaks, including a number of rare and protected species.

4.3.2. Presence and range expansion of non-native fish species

Extensive and multipurpose use of natural habitats in Hungary has changed aquatic ecosystems significantly. Conditions for many native species have worsened due to the deterioration or transformation of natural habitats even causing local extinctions and opening the way for non-native species. Aquatic ecosystems are especially vulnerable to impacts of human activities. Unintentional or deliberate trafficking and intentional introduction (for economic use) of non-native species stands out of those activities and they can be considered as the major threat on the native fish fauna in Hungary.

Taxonomically, the non-native fish species and hybrids described from natural watercourses in Hungary belong to seventeen families of eight orders. Data on the presence of 60 non-native fish species and hybrids has been published so far. Most species (twenty-one plus one hybrid) belong to the order of Perciformes followed by Cypriniformes, Siluriformes and Cyprinodontiformes with ten (plus one hybrid), seven and six species, respectively. Most species (27) originate from the Americas (twelve from North America, nine from Central America and six from South America). Twenty-two species are native to Eurasia – seven have a Ponto-Caspian distribution range and further six live in the Far East. According to the Sály-classification scheme (2007), most species and hybrids (44) were introduced deliberately. The introduction of eight species happened indirectly, while two species were directly assisted in their colonization process. Two more species appeared in Hungary likely without any human intervention. The first record of a non-native fish species in Hungarian watercourses is dated back to 1872: it was the western tubenose goby [*Proterorhinus semilunaris* (Heckel, 1837)]. This species was followed by four more until the 1900s and the arrival of further five species was documented until the 1950s. The number of non-native fish species grew sharply – with thirty-six species – in the second half of the century. Further twenty-four species arrived after the millennium according to publications. Non-native fish species colonise natural watercourses in Hungary by using the Danube and Tisza rivers and their tributaries, as well as through fish ponds, garden and public ponds inundated by floods and thermal ponds connected to natural watercourses (Figure 4.11.). Figure 4.11a shows the number of non-native species on a time scale, while Figure 4.11.b depicts means of their introduction in the different periods.

Publications about non-native fish species suggest that the colonizing species found in Hungary arrived from four different directions. Species of subalpine origin (e.g. marena species) colonized Hungary from the Upper Danube's tributaries, while Ponto-Caspian goby species arrived from the direction of the Lower Danube. Amur sleeper and Caucasian dwarf goby expanded their distribution range to the Tisza River and its tributaries from the transboundary section of Tisza River's tributaries. Typically, species native to other continents (Africa, America, Asia) brought to Hungary for economic purposes. They escaped from fish ponds or they were introduced deliberately (for fisheries, angling, aquaristic purposes) to domestic waters. In many cases isolated populations of otherwise naturally arrived species were formed due to fish transports between unconnected tributaries and subsequently colonized natural habitats (e.g. the appearance of the Amur sleeper in Lake Balaton's tributaries).

The impact of non-native species on native fish associations and habitats can be very diverse. From a functional ecological aspect, the massive occurrence of any non-native species can impact native fish associations negatively. It is important to add, however, that invasion of certain fish species may locally favour native predator fish species by becoming important food sources. Considering their diet, most of the non-native fish species in Hungary are omnivore. Thus they can affect ecosystems negatively on multiple levels and it is a well-known fact that a high number of omnivores destabilize the affected ecosystem. Hybrids of silver and bighead carp (*Hypophthalmichthys molitrix x H. nobilis*) and American paddlefish are filter-feeding species live on zooplankton, which is also important for

fries of native fish species; therefore the presence of those non-native species substantially decreases the survival chances of fry populations of other native species. A number of invasive fish species, especially Ponto-Caspian gobies feed largely on macroscopic aquatic invertebrates; in extreme cases, that can fundamentally transform the benthic fauna of riverbank ripraps.

All those examples above suggest that the impact of non-native fish species discovered in natural watercourses of Hungary is diverse and significant due to the number of species and sizes of populations. In the future, a further increase of the number of non-native fish species is expected. They can spread actively or passively in the domestic section of the Danube using the Danube-Rhine-Main shipping route. Besides, it is not possible to predict changes in the number of exotic fish species introduced to artificial or semi-natural thermal water habitats. Although those species can only form local populations, they can still make a considerable impact due to the factors described above.

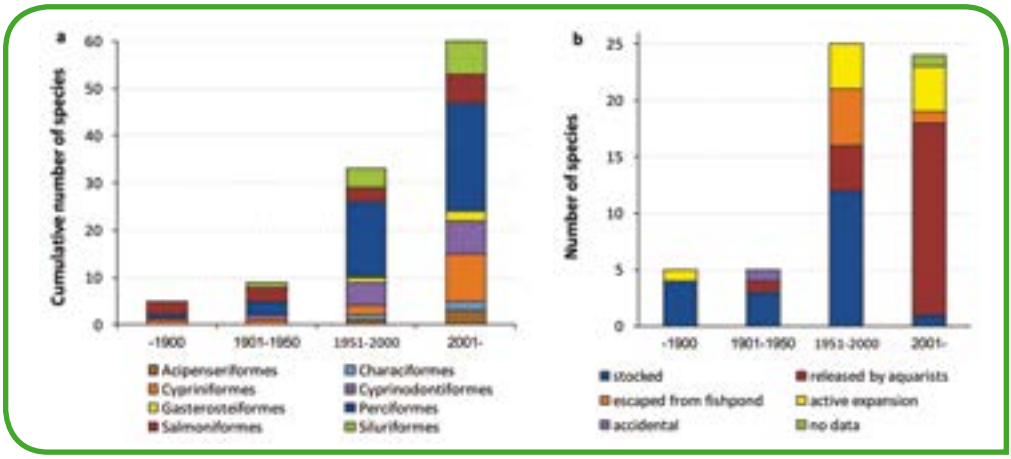


Figure 4.11. Temporal changes of numbers of non-native fish species recorded in natural waters of Hungary (a); temporal changes of means of colonization (b)*(Source: Takács et al. 2017b)*

5. Built environment

Considering the population characteristics of the settlement network, it can be seen that there are seven large cities in Hungary that have a population of over 100,000. In Budapest, with 1.7 million inhabitants, there are five districts with a population of over 100,000. On October 1, 2016, at the time of the microcensus, 9 million 804,000 people lived in Hungary. With the exception of Central Hungary, the population of all regions has decreased since 2011. The loss of the population was the most intense in Northern Hungary with 59000 fewer people than five years ago. Excluding Budapest, the population of Pest and Győr-Moson-Sopron increased while there was a varying population decline in other counties. Based on the 2011 census data, Figure 5.2. shows housing stock of Hungary by age-related distribution. As the map shows, Hungary's housing stock is ageing: an average dwelling has been built nearly fifty years ago. There is a wide discrepancy among certain regions of the country. The housing stock is the youngest in the counties of Győr-Moson-Sopron, Hajdú-Bihar and Szabolcs-Szatmár-Bereg county and in Budapest's agglomeration with an average of forty years. Tolna, Békés and Nógrád counties have the oldest housing stocks: on average over 50 years.The excessive building density has numerous negative features that have to be reckoned with as well. For instance, the heat-island effect or floods caused by the overload of the drainage system which is the side effect of the sudden, flood-like rainfalls and the high flow rate of the cladding.

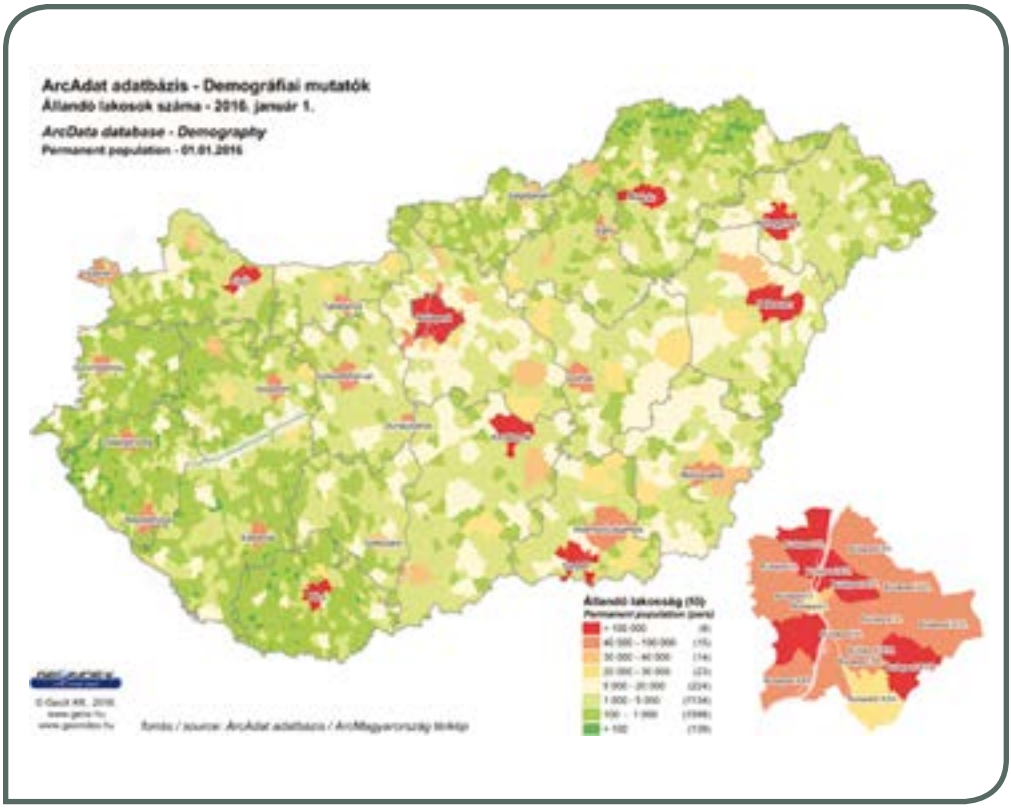


Figure 5.1. *Source: http://www.geoindex.hu/adatbazisok/arcadat/magyar-telepulesek-nepessege-2016-01-01/*

Figure 5.2. Average age of housing stock in Hungary (2011) *Source: MNO*

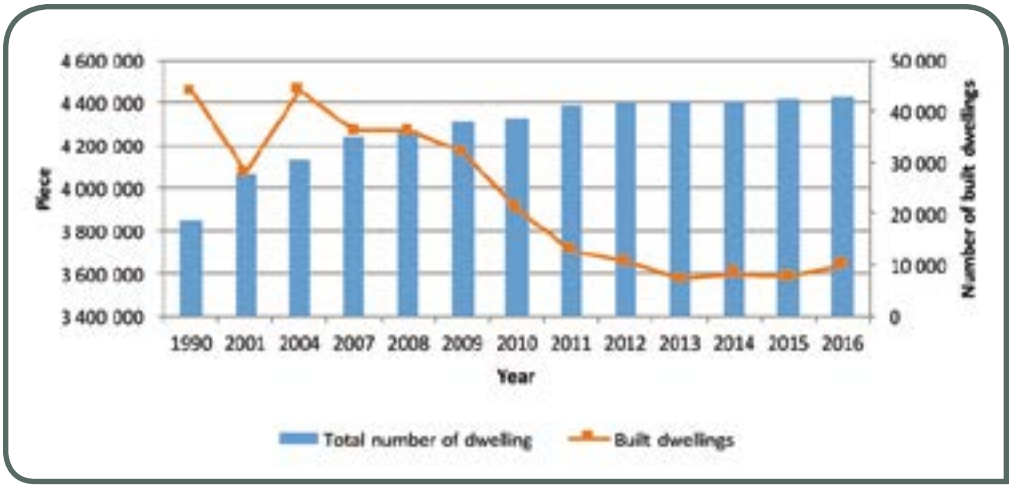


Figure 5.3. Changes in the number of dwellings in Hungary and the number of built dwellings in the 1990-2006 period *(Source: KSH)*

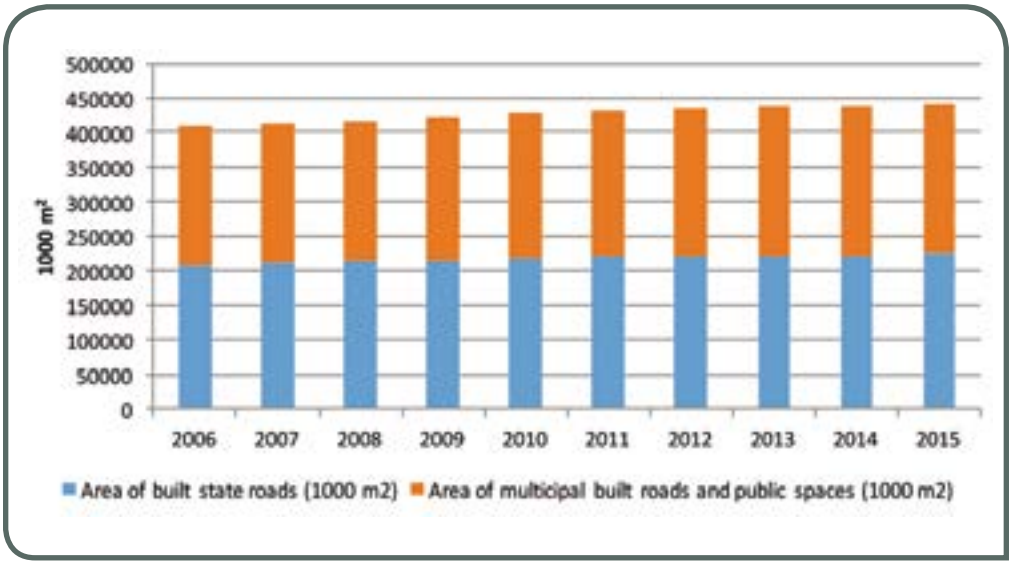


Figure 5.4. The area of built roads and public spaces, and their distribution *(Source: KSH)*

5.1. Urban Climate

Due to concentrated human activity in settlements, local climatic conditions can change significantly.

This will lead, among other things, to the emergence of the city's heat-island effect.

Large temperature inertia structures such as buildings, traffic road networks, cooling and heating of buildings, industrial heat loads and narrow streets make a significant rise in temperature from outer areas to inner parts of the city.

This results in a higher air temperature of less than 3-5 ° C in inner-city urban areas compared to the natural environment.

5.2. Green facades

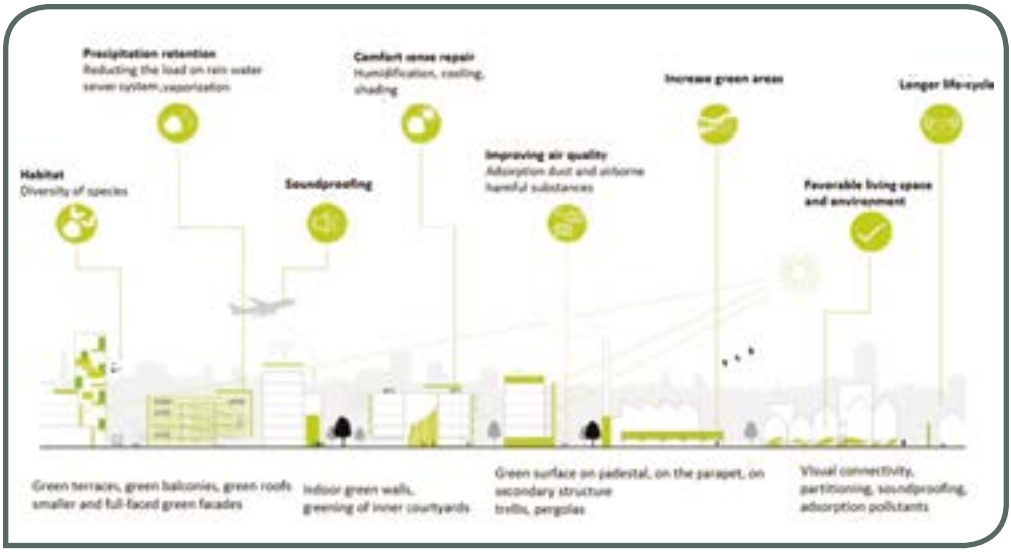


Figure 5.5. Benefits of green areas on buildings
(Source: Zöldinfrastruktúra füzetek 2.: Zöldhomlokzatok)

5.3. Water-permeable surfaces

Because of the high degree of urban surfaces being covered, the flow of rainwater is very rapid increasing peak precipitation further.

Therefore the application of water-permeable coatings is instrumental in the reduction of the amount of rainwater which flows into the canals and streams.

The spread of integrated urban rainwater management approach is currently the world's leading driver for green infrastructure development.

Vegetation-covered ditches, raingardens, water permeable cover systems, green roofs and facades also get an increasingly important role as elements of a new type of rainwater management beside well-known technical infrastructure elements and traditional urban green spaces.

6. Protection against environmental noise

6.1. Evaluation and management of environmental noise

Noise is invisible pollution, we do not perceive it like we do in the case of a smoking chimney or a hill of waste, contaminated water surfaces. We may not even notice it – but health effects increasingly occur and noise damages our whole body and effects its functions.

Noise pollution of cities over 100,000 citizens are shown by noise maps. (http://www.kormany.hu/hu/foldmuvelesugyi-miniszterium).

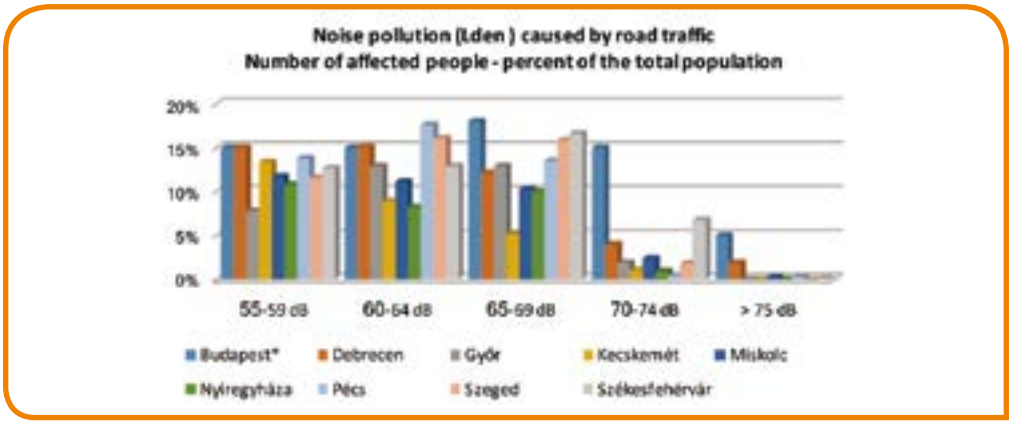
Noise maps of main roads and main railways as well as of cities under 100,000 citizens can be found in the Electronic Air and Noise Protection Database (ELZA). Homepage: http://www.elza-altalanos.kti.hu/

We get detailed information about the noise pollution of about 3 million Hungarian citizens from noise maps and data obtained from them.

6.2. The noise pollution of large Hungarian cities

Out of the data about the environmental noise situation of our big cities, the extent of the problem may be shown by residential noise load the best. Load indicators per capita in each city makes it possible to make a certain comparison between the environmental status of our cities.

The following diagrams show the exposure indicators of citizens in the cities – compared to the total population of the cities, as percentages of their ratio. (It expresses how many percent of the population is affected by the given noise level band.)



6.1. figure: Noise pollution caused by road traffic *Source: Population exposure to noise from different sources in Europe (European Environmental Agency – 2016.) Remark: Budapest* - Data from 2006.*

6.3. Noise control – options, results, examples

Intervention on the propagation path

The efficiency of the noise barrier can be increased by a „tube-like" absorbent on the top of the wall.

The effect is the same as if the noise barrier would be significantly higher without changing the height.

6.2. figure: Increasing the effectiveness of noise barriers – noise barrier tube (M0 Highway)
[Source: Herman Ottó Intézet Nonprofit Kft.]

Intervention at the source

We can achieve noise reduction at the source when tram tracks are reconstructed or laid down

An aesthetic and „noise-friendly" design is shown here: a grass-covered tram track. We can see more and more of these solutions in Hungary.

6.3. figure: Vibration insulation of a tram track (Budapest, Kossuth tér)
[Source: Herman Ottó Intézet Nonprofit Kft.]

6.4. figure: Grass covered tram track in Budapest (Kőrösi Csoma út)
[Source: Herman Ottó Intézet Nonprofit Kft.]

7. Status of landscapes and the protection of landscape heritage

7.1. Changes and status of landscapes

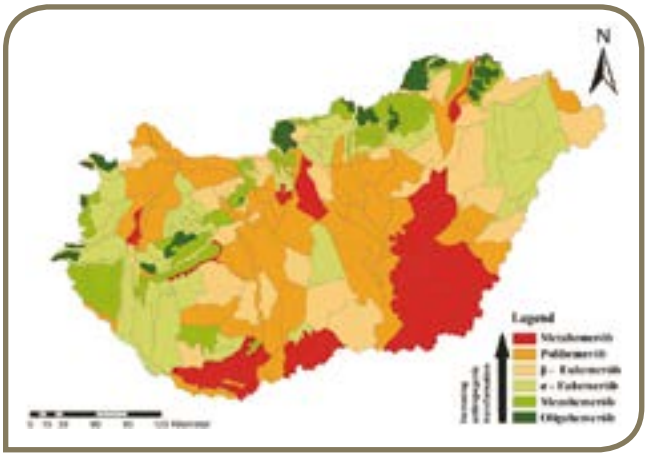


Figure 7.1. The anthropogenic transformation of Hungary's micro regions (Péter Szilassi 2016)

There are re no country-level monitoring surveys currently underway for tracking changes related to the status of Hungarian landscapes, we can guess the changes based on the results of surveys conducted in various research institutes. These studies in the last one and a half decades indicate a significant decrease in the naturalness of landscapes and a strong increase in the fragmentation of landscapes due to the increase of the proportion of built-up areas, especially in the Budapest agglomeration and in the major part of Transdanubia. At the same time, there are certain areas (e.g. in the Danube-Tisza plains), – on a much smaller area nationally – where the naturalness index has increased due to the habitat restoration and development interventions. In total, the transformation degree of Hungary's landscapes is higher than average, most of our microregions belong to the heavily transformed (metahemerob and polyhemerob) categories (Figure 7.1).

7.2. Protection, management and planning of landscapes

Legislation on landscape protection is based on Act 53rd of 1996 on Nature Conservation (hereinafter referred to as: ANC). According to the ANC, the purpose of landscape protection is to maintain the natural and semi-natural status of landscapes while using them and their natural values and to ensure the survival of aesthetic features of landscapes, the characteristic natural values of natural systems and unique landscape values that determine the nature of landscapes.

The provisions of landscape protection legislation are partially implemented by the authorities in the course of examining the landscape protection issue and partly within the framework of spatial planning. The delineation and regulation of the landscape scenery protection belt can be regarded as a landscape protection tool for spatial planning which creates the opportunity mainly for local authorities to define local landscape protection rules. Other pillars of the landscape protection toolkit are those standards that provide a professional background for the integration of buildings, structures, roads, railways, overhead power lines and pipelines into the landscape.

The National Landscape Strategy, which was completed in 2016 as a result of extensive professional and inter-ministerial consultations, could serve as basis for preserving our landscape heritage on the long term. The strategic document defines the goals and tasks that help to preserve our landscape heritage by applying the three-tiered tool system of protection, management and planning. As a comprehensive goal of the landscape strategy, the document sets out the development of responsible land use based on local conditions.

7.2.1. Local and international initiatives to protect the landscape heritage

An important component of the state of landscapes is the attitude and landscape awareness of people and farmers living in the landscape. Hungarian nature parks, geoparks and greenways are good examples of community-based initiatives on a landscape scale to preserve the landscape heritage.

An important, joint feature of *nature parks* is that within their framework, the members of local communities in the region consider it to be a joint task to strengthen the affiliation to the homeland and to utilize the natural and landscape heritage in such a way as to provide a healthy environment for the next generations. They should on to assure a rich, living and liveable landscape, the survival and consolidation of rural communities. At present, there are nine nature parks recognized by the minister responsible for nature conservation in the country. Nature Parks with a name usage title cover 6.5% of the country's land area as well as of settlements (Figure 7.2).

In Hungary, g*reenways* are functioning in the same spirit but without the obligations prescribed by law, established as a result of the conscious interconnection of individuals and communities, in response to the natural needs of local communities to acquaint themselves with the inner values of the area and the community.

Geoparks work in partnership with local communities to preserve the geoheritage of the area concerned and, in particular through "soft" geotourism, to support a locally sustainable economy. The two Hungarian members of the European and the Global Geopark Network, Bakony–Balaton and Novohrad–Nógrád Geoparks, operate as UNESCO Global Geoparks since 2015.

In 2009 the Galloway Park in Scotland and the Zselic National Landscape Protection Area were the first ones in Europe to get the *International Dark Sky Park* title founded by the Interna-

tional Dark-Sky Association. In 2011, the Hortobágy National Park got the right to use this title as second internationally recognized dark sky park in Hungary. The management organizations of these parks and their co-operative partners keep the sight of the undisturbed night sky with initiatives to reduce unnecessary light emissions and the features of the high-quality skies of the concerned areas are presented to the public on a regular basis, within the framework of organised programmes.

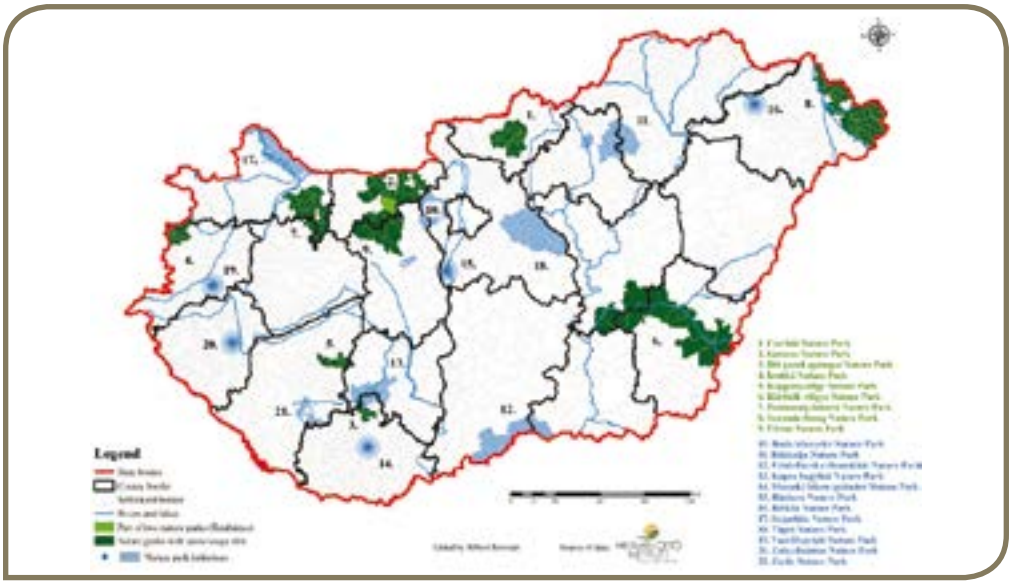


Figure 7.2. Nature Parks and nature park initiatives in Hungary

7.2.2. Protection of the valuable elements of the landscape

The identification and registration of the valuable elements of the Hungarian landscapes, the so-called *unique landscape features*, is the responsibility of National Park Directorates. Spatial planning plans should include the list of unique landscape features of the target area. The cadastre of unique landscape features was completed in 1025 settlements by the end of 2016, i.e. approximately one third of the country's settlements.

The community-based survey, assessment and sustainable utilization of our valuable landscape elements can not only progress the protection of Hungarian landscapes but it can also help to strengthen the bond to the landscape and the to the homeland as well as being more susceptible to the landscape. Thereby it may improve the landscape diversity of Hungary and the state of our lands, too. These initiatives promoted the publications of the methodology for *community-based survey of valuable landscape elements* by the Herman Ottó Institute Nonprofit Ltd., the predecessor of the Herman Ottó Institute (Zsófia Monspart-Molnár - Zsófia Pécsi - Zoltán Vágány 2015, Gábor Kiss 2016).

In 2010, Hungary introduced the cross-compliance regulations of European Union for the preservation of landscape characters. The number of protected landscape elements registered in the Agricultural Parcel Identification System on a national level was as follows: kurgans/tumuli – 981 pieces, well-poles – 3110 pieces, wood and bush groups – 27627 pieces, solitary trees – 11871 pieces, small ponds – 1081 pieces. Cross-compliance regulations are designed to keep agricultural

areas in favourable agricultural and ecological conditions by defining minimum prescriptions both for agricultural and environmental standards and to decrease negative environmental effects generated by climate change. The supervising authority shall examine whether the farmers concerned are complying with the requirements set in the Ministerial Order on their entire farming territory.

7.3. The international professional framework: the European Landscape Convention

In Hungary, the European Landscape Convention – defining the professional framework for landscape protection at international level – entered into force on 1 February 2008 after establishing the legal foundation. The minister responsible for nature conservation (currently the Minister of Agriculture) is responsible for the implementation of relevant measures in agreement with the minister responsible for the protection of cultural heritage and in cooperation with the minister responsible for regional development and spatial planning.

One of the most important tools of the implementation of the convention is the Landscape Award of the Council of Europe. In the year preceding the donation of the landscape award on a European level, some countries, including Hungary, are enlisting a national tender for local or regional authorities or non-governmental organizations. In the 4th Session 2014-2015, the Landscape Award of the Council of Europe was awarded to Hungary for the landscape preservation and development programme using greenway methodology implemented in Hetés. One of the aims of the award-winning pilot programme was to create the motivation and raise the interest of local communities in preserving landscape values, especially through the presentation and interpretation of these landscape-related values to the interested ones.

An important milestone in the implementation of the landscape convention agreement is that in 2016, a research programme was started aiming to identify, evaluate Hungarian landscapes based on landscape characteristics and define qualitative objectives and management guidelines for landscapes. The landscape character system created as the output of the project can be a basis for commonly used landscape protection within the Hungarian regulatory system which has until now lacked a unified methodological basis and databases.

8. Resource and waste management

8.1. Hungary's environmental policy in the light of legal requirements concerning waste management

We highlight the most important feature from the reorganisation of public administration from the environmental legislation procedure, but also the appearance of the National Coordination of Waste Management and Asset Management Plc. (hereinafter NHKV Zrt.) as a coordinating body.

Due to the dissolution of the National Inspectorate for Environment and Nature (hereinafter OKTF), national authority tasks such as the nationwide treatment and waste export-import permits (including: secondary-level authority tasks) were transferred to the Department for Environment and Nature of Pest County Government Agency as the new national authority for environment and nature. From now on, the landfill charge has to be paid quarterly to the central government account named „income originating from the landfill charge of the Hungarian Treasury" which is in the ownership of the Treasury and the National Tax and Customs Administration and managed by

Pest County Government Agency. The examination of the fulfillment of obligations laid down in act 2012/CLXXXV. about waste (hereinafter Ht.) and its implementing regulation (government decree 318/2013. (VIII. 28.) concerning the landfill charge) is carried out by the Division of Landfill Charge Control within the Department for Environment and Nature of Pest County Government Agency.

After OKTF ceased its operation, the tasks of OKTF-NHI (National Waste Management Directorate) which were related to for example the product charge the compilation of the National Collection and Recovery Plan), ordering services, the management of public purchase procedures and the control of proceedings were taken over by the Ministry of Agriculture.

Over the whole country, all the counties' first instance environmental authorities were incorporated into the district level authorities of the counties' government agenciesoperating under the Prime minister's Office. Consequently, the first-instance administrative competences of nature conservation and environmental protection are carried out by them in all counties with the professional guidance of the Ministry of Agriculture as the ministry responsible for environmental protection. The only exception is Pest county and the capital where this duty belongs to Érd district level office of Pest County Government Agency.

From now on, this regional environmental authority is acting in the second instance in the environmental protection and nature conservation cases of the municipalities. The environmental laboratories are operating in the appointed eight government agencies under the professional governance of the Ministry of Interior as the ministry responsible for water protection by carrying out regional tasks as well.

Implementing regulations in several successive waves had been issued by the new organisation, NHKV Zrt. established on 1 April 2016 that was appointed to carry out public waste management tasks. These denote the important and highlighted position of this area within waste management. The legislative acts incorporate details about the function of NHKV Zrt., identify its operation, introduce new definitions in this context, define data requests and the method to prepare the National Waste Management Public Service Plan.

8.2. Material consumption

The reduction of material consumption shows how the economy is moving towards a resource-efficient direction and a reduced use of natural resources. Circular-based, resource-efficient strategic thinking is still not yet widespread within the Hungarian economy although there are some initiatives for it (e.g. National Prevention Plan).

Figure 8.1.: Annual material consumption in the EU and Hungary between 2004 and 2016
(Source: Eurostat, 2017)

Figure 8.1. shows the tendency of material use which is characteristic of the EU and Hungary (Domestic Material Consumption, DMC). DMC marks all the materials used (extracted, imported) with the exception of indirect streams, e.g. export.[1] On the figure, it is visible that material use within the EU per capita has been steadily decreasing since the 2008 world economic crisis. This tendency was followed by Hungary, too with the exception of the years 2012-2014.

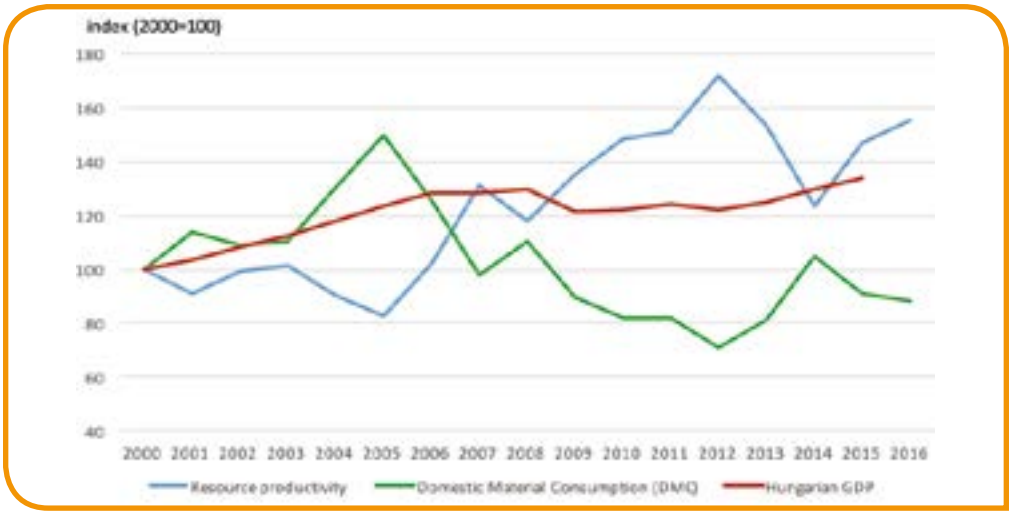


Figure 8.2.: Annual material consumption in the EU and Hungary between 2004 and 2016
(Source: Eurostat, 2017)

The indicator shown on figure 8.2. is resource productivity, the ratio of GDP and national material use. By using this indicator, it can be defined that what is the extent of the consumption of natural resources concurrently with economic growth. The increase of its value demonstrates the increase of available resource productivity which makes it possible to have an economic increase with less environmental load.

The decoupling of environmental degradation and economic growth occurs when in a certain period, the growth of an environmentally significant input is smaller than the GDP. Concerning Hungarian data, a strong decoupling can be observed since 2005 when – apart from one-two exceptions – the continuous rise of GDP went hand-in-hand with the decrease of the national material use.[2]

According to Figure 8.3, the use of one kilogram resource was enough to produce a gross national product in the value of EUR 0.59 in 2000, 0.8 in 2009 and 1.05 in 2016 in Hungary. This tendency is mainly a result of the reduction of specific material use, but Hungary is still below the EU average of 2.23 EUR/kg.

Eco-innovation is the key to Europe's and also Hungary's future competitiveness. This innovation – be it a new technology, product, process or service – facilitates the protection of the environment, and the effective use of resources. Economic and regulatory barriers must be eliminated in order to achieve a widespread acceptance of environmental technologies, research, investment and new solutions must be supported. Research is essential to fully unlock the potential in the fast growing ecoindustry, thus launch a wave of innovation and job creation.[3]

1 http://www.tankonyvtar.hu/hu/tartalom/tamop425/0021_Kornyezetmenedzsment_rendszerek/ch05s04.html
2 KSH, Statisztikai szemle 2013, augusztus-szeptember
3 http://ec.europa.eu/environment/pubs/pdf/factsheets/eco_innovation/hu.pdf

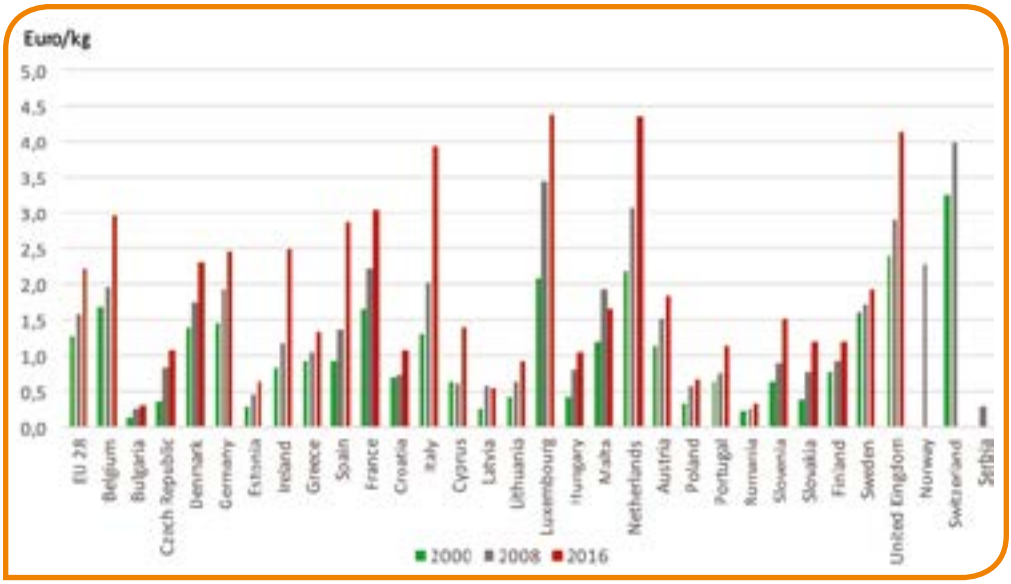


Figure 8.3. Resource productivity in the 28 EU and EEA Member States in the years 2000, 2008 and 2016 *(Source: Eurostat, 2017)*

Hungary takes the 18th place at the eco-innovation scoreboard which is still below the EU average but shows a significant progress considering the 23rd place in 2013.[4]

To achieve resource efficiency and circular economy, the European Union recommended several measures to Hungary in the 2017 country report (Brussels, 2017.2.3. SWD(2017) 46 final):

– Develop an overarching circular economy policy framework, create economic instruments to support the transition towards it and raise awareness within the general public and private sector on circular economy principles and products.
– Adopt circular economy principles within the SME sector, improve their access to finance, promote full-time green jobs and support the increase of their innovation rates.
– Incentivise investments in green products and services.
– The use of environmental management and audit schemes suitable to monitor, report and improve the environmental performance of companies and organisations in Hungary should be more frequent,
– a more widespread use of product ecolabelling should be facilitated by applying various measures.

8.3. Waste management

8.3.1. National waste management in the light of numbers

8.3.1.1. Waste generation

According to the data of indicators that are used to measure the efficiency of waste prevention (the quantity of waste generated or its ratio to GDP), there has been significant positive changes (Figure 8.4.) recently. This is visible in the almost continuous increase of the GDP (apart from

4 http://ec.europa.eu/environment/eir/pdf/report_hu_hu.pdf

the period of the economic crisis) and the decrease of the total amount of waste generated. The year 2014 is somewhat different since the quantity of waste increased, but it decreased after 2015. The following years will show whether this will be a tendency in waste generation.

According to Figure 8.4, the amount of waste generated was 25.4 million tonnes in 2004, it decreased to 15.5 million tonnes by 2015. Compared to the early 2000s' waste generation, Hungary produced 10 million tonnes less waste in 2015.

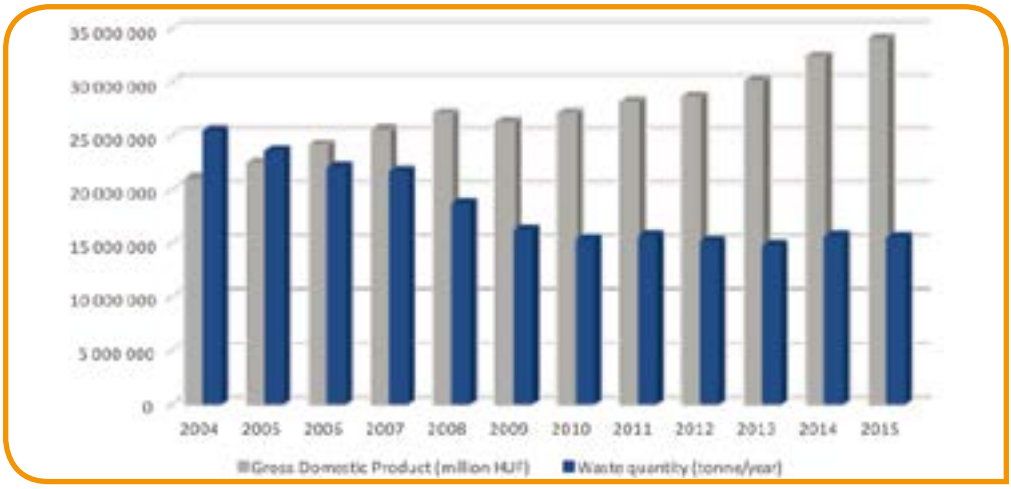


Figure 8.4 Changes in waste quantity and GDP *(Source: KSH, 2017)*

8.3.1.2. Waste treatment

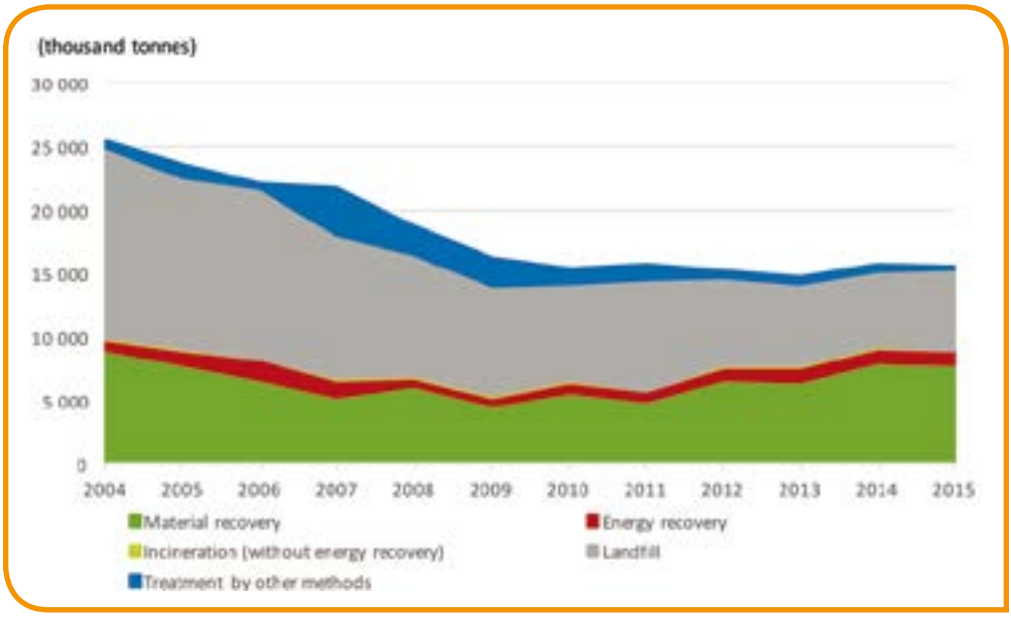


Figure 8.5. Development of waste treatment between 2004 and 2015 *(Source: KSH, 2017)*

Looking at the development of waste treatment, a beneficial effect can be observed as the total amount of disposal by landfill decreased constantly after 2011. Beside this, it is unfavourable that in 2015, figures of material recovery (50 %) and energy recovery (7.8 %) are not increasing further. At the same time, the ratio of landfill compared to total waste generated is 40 %, which is still unfavourably high.

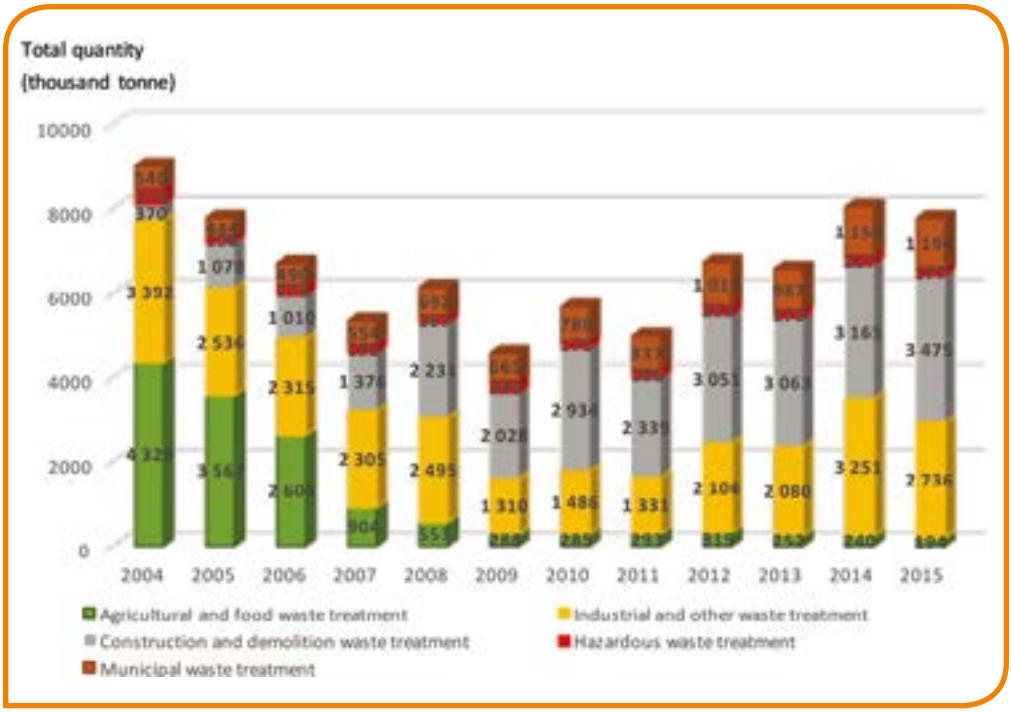


Figure 8.6. Development of materially recovered waste quantity *(Source: KSH, 2017)*

One of the indicators to measure the efficiency of national waste management is the increase in the amount of materially recovered waste. Figure 8.6. shows that the increase in the quantity of materially recovered waste is stalled in 2015. There was 22% decrease in recovery for hazardous waste, 15.8% for industrial and other waste and 19.1% for agricultural and food waste a . An increase in recovery could be observed in the case of municipal waste by 3 % and by 9.8% in the case of construction and demolition waste.

According to the values of Figure 8.7., recent years didn't show significant changes in the total amount of waste disposed by energy recovery and incineration. Among the total amount of waste, agricultural and food waste has been decreasing clearly from the year 2013 while the amount of municipal waste shows an increase. Industrial and other waste but also hazardous waste have stayed on the same level since 2013. The planned capacity extension of national municipal waste incineration such as HUHA II. and regional incinerators will increase the ratio of municipal waste disposed of by energy recovery further.

According to Figure 8.8., an increase in the amount of landfilled waste could be observed between 2004 and 2014, landfill waste has increased in total amount from 2015. The examined waste streams could differ as the landfill of municipal waste decreased but the amount of construction and demolition waste has increased between 2013 and 2015 and the amount of agriculture waste has stagnated in recent years.

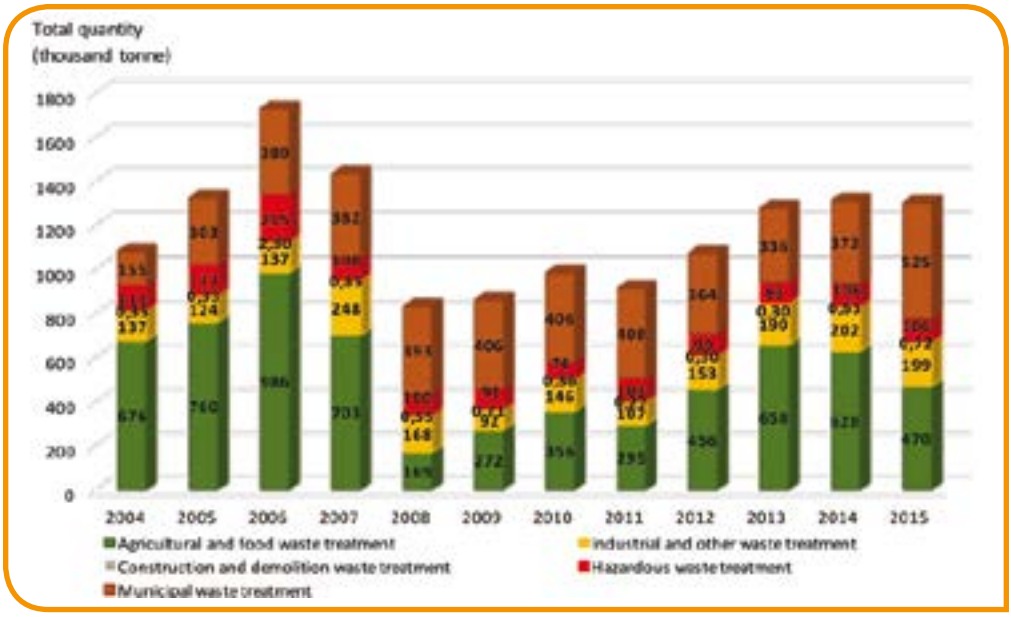


Figure 8.7. Development of the amount of waste disposed by energy recovery and incineration *(Source: KSH, 2017)*

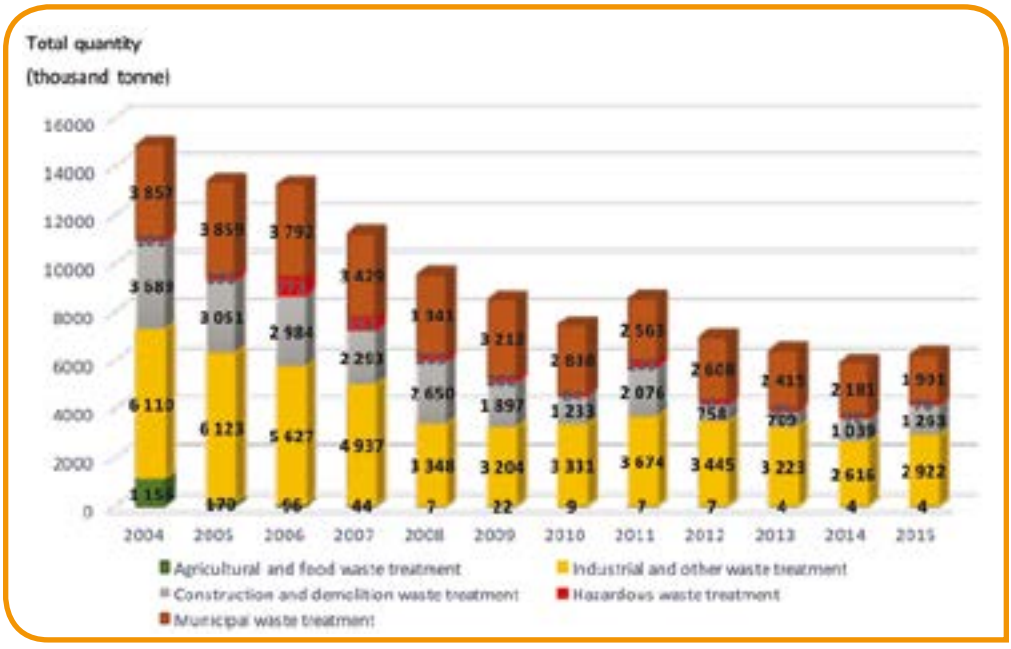


Figure 8. 8. Development of the amount of waste disposed by landfilling *(Source: KSH, 2017)*

8.3.2. Priority waste stream: municipal wastes

According to Figure 8.9., the ratio of selective waste collection has nearly doubled between 2004-2015. This suggest a significant improvement in itself but if we look at the ratio of

selective and conventional waste collection, the picture is somewhat more ambiguous. Another problem can be seen in the tendency of stagnation since unfortunately no significant move towards selective collection can be observed. From the year 2015, it is required by law that paper, plastic, metal and mixed municipal waste should be collected door-to-door. Hopefully this will be shown as an increase in next years' collection data.

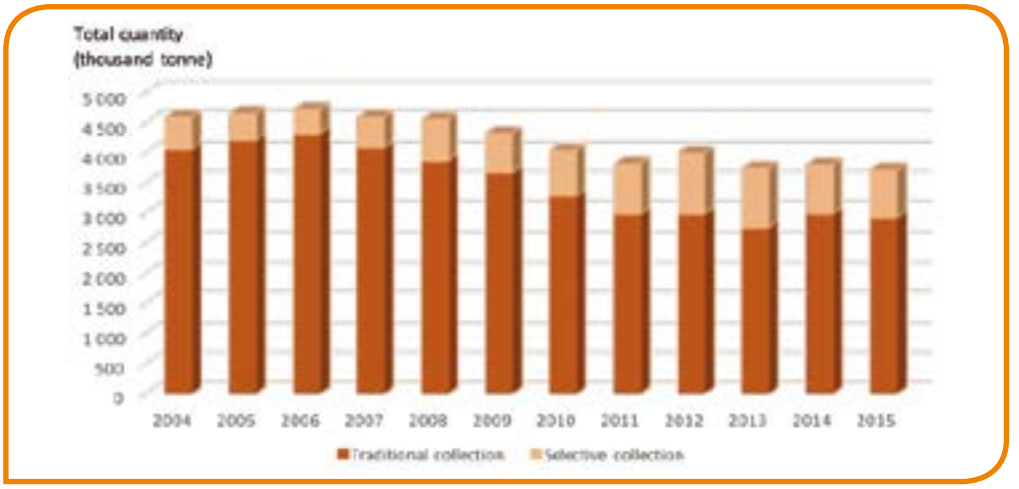


Figure 8.9. Development of the amount of municipal waste according to waste collection method *(Source: KSH, 2017)*

Looking at the treatment ratio of municipal waste, a clear positive change can be seen in the change of the ratios. On the one hand ,the total amount of waste generated and the disposal is decreasing, on the other, the ratio of material and energy recovery increased. (Figure 8.10.) However, the majority of municipal waste in Hungary is still ending up on a landfill- according to 2015 data, it is 54 % – and the value of material recovery is only 32%.

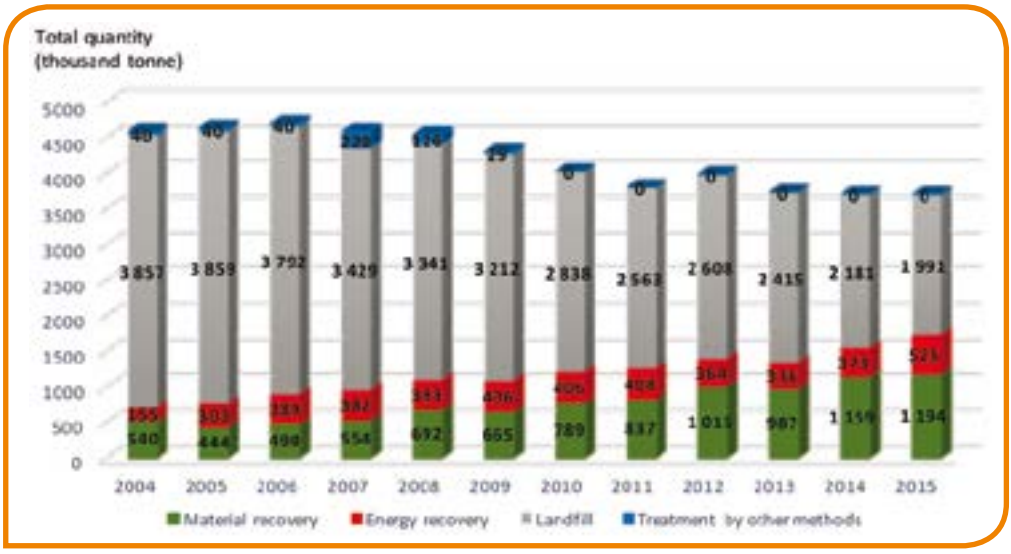


Figure 8.10. Development of the treatment of municipal wastes *(Source: KSH, 2017)*

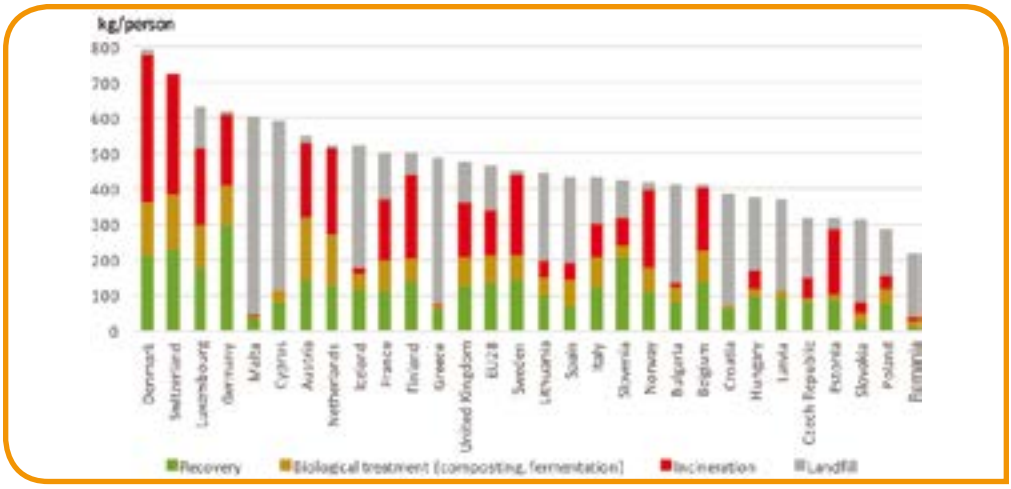


Figure 8.11. Distribution of treatment of municipal waste (kg/person) in the EU in 2015
(Source: Eurostat, 2017)

A wide discrepancy can be found when looking at diversion from landfill across the waste management performance of EU member states .(Figure 8.11.) Hungary doesn't reach the average of the average of EU-28 in waste recovery, composting and treatment of incineration but it exceeds it in waste landfilling. Overall, it can be said that Hungary is in the midfield of member states catching up to countries with a developed waste management system.

8.3.2.1. Biologically degradable part of municipal waste

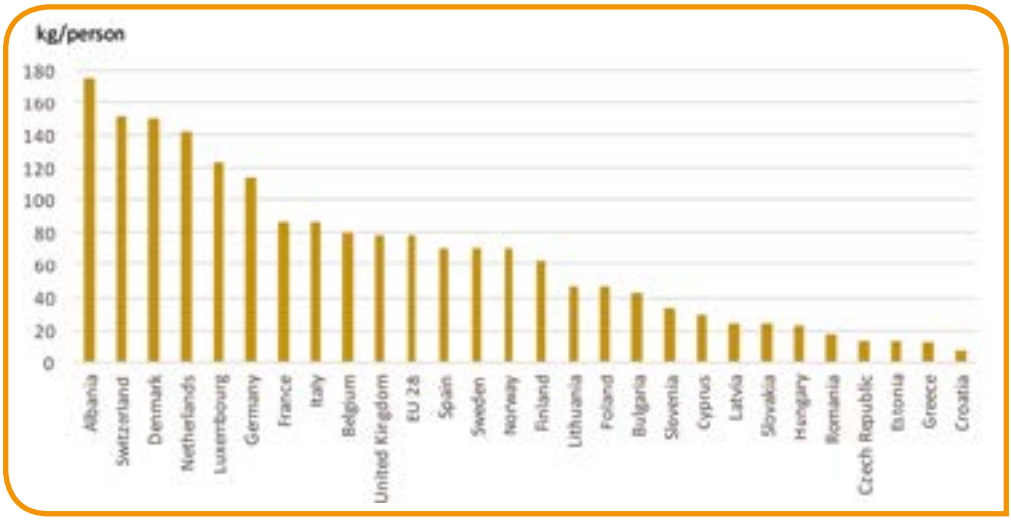


Figure 8.12. Distribution of treatment of municipal waste (kg/person) in the EU in 2015 *(Source: Eurostat, 2017)*

According to data of Figure 8.12., Hungary is below the average of the the EU-28 regarding the use of composting and this gap gets even wider when comparing with advanced countries. An important concern in EU waste management is the separate treatment of biologically degradable waste which accounts for almost one fourth of municipal waste and also its diversion from landfills and incinerators.

8.3.3. Directions of development in Hungarian waste management

According to the latest legislative proposal of the EU on waste management, the ratio of landfill waste has to reduced to less than 10%. Therefore it is by all means needed to decrease the rate of landfilling in Hungary which is unfavourably high:
– Building HUHA II. and regional incineration plants for handling municipal waste will mean a significant step forward in this process.
– The increase of price per ton for waste transported to landfills effectively facilitates the diversion of waste from landfills, to direct waste streams towards higher steps of waste hierarchy. It is recommended to increase the price further to enhance the effectiveness of this tool.
– Transporting any organic or biodegradable waste to landfills should be clearly forbidden if it is partly or fully reusable, recyclable or has a high heating value to decrease its disposal at landfills.

Mandatory quality criteria should be set for public service providers in the case of compost made from biological waste and fermentation residues to divert them from landfills. This would strengthen the situation of composting and biogas handling for municipal waste further.

The methods of collecting selective waste transported from households and its utilisation should be improved nationally to the direction of taking it according to its measured weight. As a part of this, e.g. the (high) rate of food waste should be pointed out. Collected data should be made public to people. Thereby the amount of selectively collected food waste and its utilisation as biogas and compost would be able to be increased.

Further efforts should be made to direct the attention of citizens to the significance of local home and community composting in environmental protection waste management by developing and employing a proper system of interest for acknowledging local composting to expand it further.

8.4. Conclusion

In an international comparison, the performance of national waste management (e.g. the ratio of diversion from landfilling, the value of material recovery) does not reach the average of the European Union in several cases. Hopefully the developments, investments realized with the help of current EU funds will induce positive processes and thus our rate of catching up will speed up.

The compulsory implementation of door-to-door selective waste collection, the spreading of household and community composting, the favourable figures of recovered waste in recent years, the extended use of the landfill fee and the new national awareness raising programmes will make the diversion of more and more waste possible from landfilling.

A wider use of the principles of waste hierarchy in waste management will facilitate its modernisation and to bring society

9. Climate change in Hungary and abroad

Climate change is one of the major challenges of our times (if not even the biggest one): a change with a direct impact on our environment, economic and social circumstances and on our daily lives which cannot be handled without global co-operation. We are already experiencing the signs of it but in the second half of the century, the adverse impact will be much more significant.

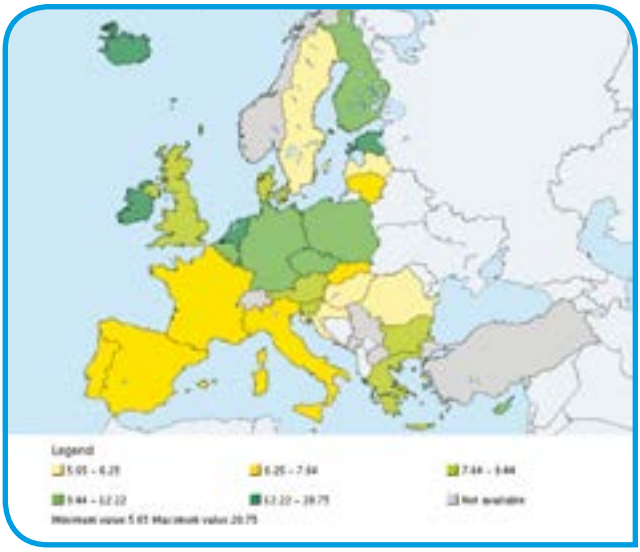
9.1. Greenhouse effect – the causes of climate change

For climate change, greenhouse gases (GHGs) emitted by humans into the atmosphere are

primary responsible. When global temperature change is compared with the atmospheric CO2 concentration change, it can be seen that the temperature rise is in parallel with the increase of GHG concentration. Figure 9.1. shows the breakdown between sectors and total emission from 1990 to 2015 in Hungary. The percentage of individual industries has been similar in the past 25 years, total emission is declining considerably compared to 1990 but the negative trend after the economic crisis seems to have been changing, growth can be observed since 2014 for the second year in a row. In 2015, emissions from the energy industry, energy production, industry, agriculture and transportation were the most significant.

9.1. Figure: Greenhouse gas emissions per sector in Hungary 1990-2015 *(Source: CSO 2017)*

Figure 9.2. shows the evolution of anthropogenic emissions of greenhouse gases in the European Union. Emissions per capita show differences between specific emissions in the member states even though emission targets for countries are not reflected in per capita emissions. In this respect, Hungary has the sixth most favourable data for the Union: 6.25 t/capita/year.



9.2. Figure: Greenhouse gas emissions per capita in the European Union in 2015 [t CO2 eq / cap]
(Source: EUROSTAT 2016)

9.2. Climate change observed in Hungary

Starting in the 2000s, the tendency of the past hundred years seems to be accelerating both in terms of warming and precipitation with extreme weather events.

On Earth, the year 2016 had record warmth from a thermal point of view, the global surface temperature was about 0.07 ° C warmer than in 2015. The year 2016 was also warmer than the average in Hungary, but it was almost one degree behind the hottest year (2014), and since 1901 it has been the eleventh hottest. The linear trend adjusted to annual average temperature data shows a clear increase, annual average temperature change for the last 116 years is +1.10 ° C and +1.38 ° C for the last 30 years.

The year 2016 is worse than average in the dataset starting from 1901 regarding precipitation. Especially in February and July, a record amount of precipitation was recorded. The annual average rainfall was 699 mm which is 117% of the multi-annual average. Adjusting the exponential trend to the data of the past 116 years, a moderate decrease of 3.6% was observed, while the last 30 years saw a 14.6% increase in annual rainfall.

9.3. National and EU goals and commitments – the Paris Agreement

The most significant climate policy agreement of 2016 was the United Nations Framework Convention on Climate Change, the Paris Agreement adopted on 12 December 2016 and entered into force on 4 November 2016, posing numerous new commitments to signees like regular reporting commitments on own contribution in order to mitigate the ever-growing effects of global warming.

10. Drinking water supply and sewerage in Hungary

Residential water supply went through a significant development in the last few decades. Before 1990, only less than 80 percent of Hungarian settlements had public piped drinking water network. This number had grown fast during the 1990s, and by 2007 it reached 100 percent. Today, public piped drinking water is available in any Hungarian settlement, but that doesn't mean that it has been installed in every single household, too. The length of the public piped drinking network is about 65.9 thousand km.

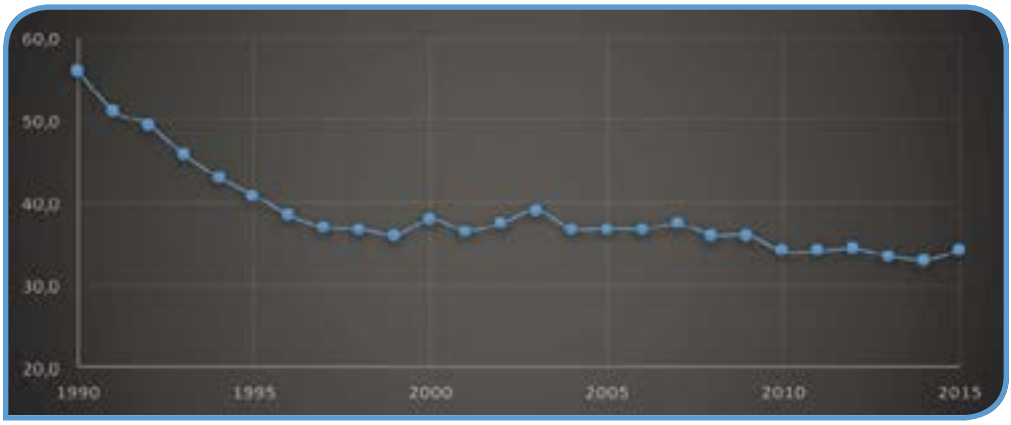


Figure 10.1. The changes in per capita water consumption in Hungary (m^3)

The following figure demonstrates the change of the use of drinking water by the Hungarian population. In 1990, per capita annual water consumption was 55,8 m^3 which decreased about 38 m^3 at the end of the 2000s. During the next years, water consumption stagnated with small fluctuations. Towards the end of the decade, it started decreasing again, and in 2010 it reached 34 m^3 which is the actual annual value today. To put it more clearly, an average Hungarian person uses 93 litres of drinking water during a usual day, including drinking, cooking, washing and personal hygiene.

However, water consumption varies by area: while an average person uses 150 litres of water per day in Budapest, this number is 120 litres in rural towns and 60 litres in villages. The quality of piped drinking water is regularly analysed by the suppliers and public health authorities so, drinking water is one of the most frequently investigated foods. The quality of piped drinking water is primarily determined by the quality of the source raw water and the used treatment technology. In our country, arsenic dissolved from rocks previously caused health risks, but the number of affected settlements significantly decreased in the last years due to efforts. Piped drinking water doesn't meet the quality standards of the European Union in every Hungarian settlement. In most places, the natural arsenic content of drinking water is higher than the 10 µg/l limit value but in some areas ammonia, nitrite, boride, fluoride pollution is a problem, too. The solution of water quality problems in the area of public piped drinking water network is provided by drinking water quality enhancement programmes financed by the European Union.

The increase of the length of sewage collecting canals was nearly continuous in the last few decades. In the last 20 years, the length of the established canals almost tripled, from 15.6 thousand km to 47.8 thousand km. From the perspective of the collection and cleaning of municipal wastewater, the settlement structure of Hungary is not favourable. The proportion of municipalities with less than 2 000 residents is high, but only 16.8 % percent of the population lives there. Beside Budapest, only five cities have more residents than 150 000. Supplying larger areas with public utilities where small communities are located is more expensive and less efficient as if it would have to be done in larger settlements.

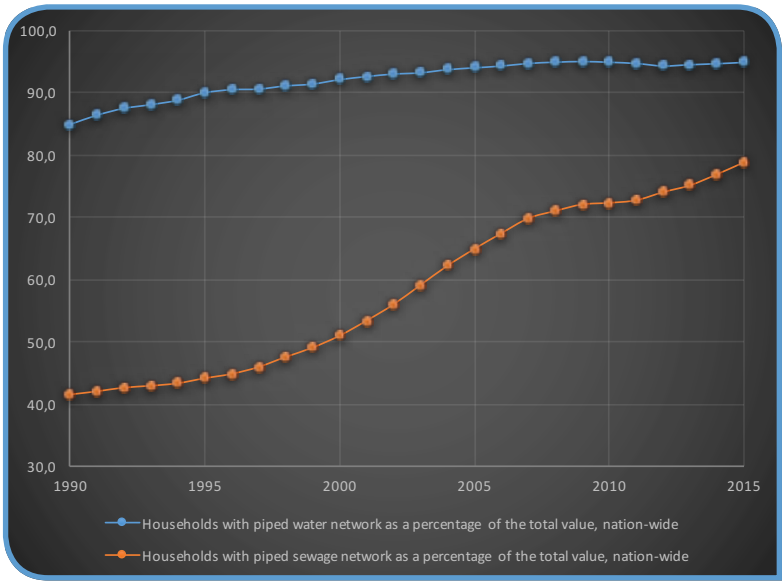


Figure 10.2.: The development of the "utility scissor" between 1990 and 2015 (%)

The difference between households with piped water network and households with piped sewerage network is usually called the "utility scissor". In Hungary in the early 2000s, only 51% of the sewage of households with piped water network went to the sewer and nearly half of the sewage went to the recipient uncleaned. However, municipality sewage drainage and cleaning is constantly evolving, in 2014, 77% of the Hungarian households were connected to the sewerage network.

11. Agriculture

11.1. Land use

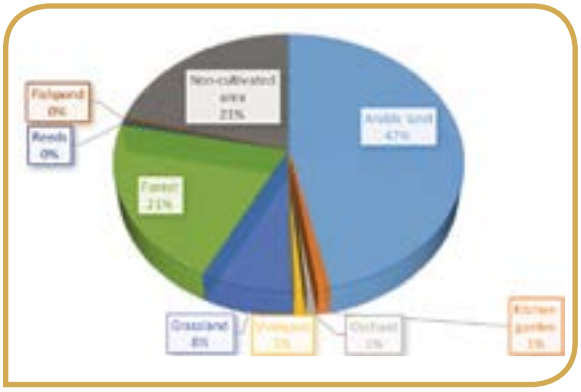


Chart 11.1.: Different types of land utilization (2016)

In 2016, the size of areas involved in agricultural production reached 5.4 million hectares in Hungary. Since 2010, the area of arable lands has remained almost the same, 4.3 million hectares. It is important to mention that according to the multi-annual trends, the extension of our forests (1.9 million hectares) has increased by 2016, too.

The 28 Member States of the European Union have a total of 178.5 million hectares of area utilized for agriculture. In the EU, nearly 60% of agricultural areas are arable lands, on which predominantly cereal crops are grown.

11.2. Economy indicators, employment, property sizes

According to 2016 data, agriculture contributes to the Gross Domestic Product (GDP) with 3.8%. The total gross output of agriculture was 2 619 billion HUF in current base price based on preliminary data which is 5.3% more than the price of last years. The number of people employed in agriculture exceeded 217 thousand which is 6.8% more than the last year.

In the European Union, the average farm property size is 16.1 hectares according to data from 2013. In contrast, farm property sizes in Hungary are smaller, 9.5 hectares in average. The Czech Republic (133 hectares) and the United Kingdom (92.3 hectares) has the highest farm property sizes. Among the countries with the lowest farm property sizes, Malta (1.2 hectares) and Cyprus (3.1 hectares) are worth to be highlighted.

11.3. Crop production

Hungary accounted for 2.4% of the total plant product output of the European Union. Considering the sowing structure, the proportion of cereals is 60% of the total cultivated arable land. The cultivated area of wheat and maize together provided almost half of cultivated arable land in the last year. It is also important to mention the increasingly significant oilseed plants, of which proportion was 24%. Rapeseed was 15% and sunflower was 5.9%.

The weather in 2016 was favourable for crop production, 16.7 million tons of grain were harvested on 2.6 million hectares, which was 18% more than last year and 22% more than the five-year average.

The extent of the harvested area was below recent years and also below the five-year averages.

In 2016, nearly 5.6 million tons of winter wheat were harvested with a harvest level of 5.3 tons/hectares which was 4.9% more than the last year. At the same time, 8.7 million tons of maize were harvested which was considered to be a record harvest. 13% of European Union maize production comes from Hungary.

11.4. Animal husbandry

In the last year, Hungary gave 2.1% of the agricultural output of the European Union, within this, our country gave 1.8% of the animal products. The livestock of cattle grew steadily in the last year while the number of swine and sheep decreased and the size of the poultry stock essentially did not change.

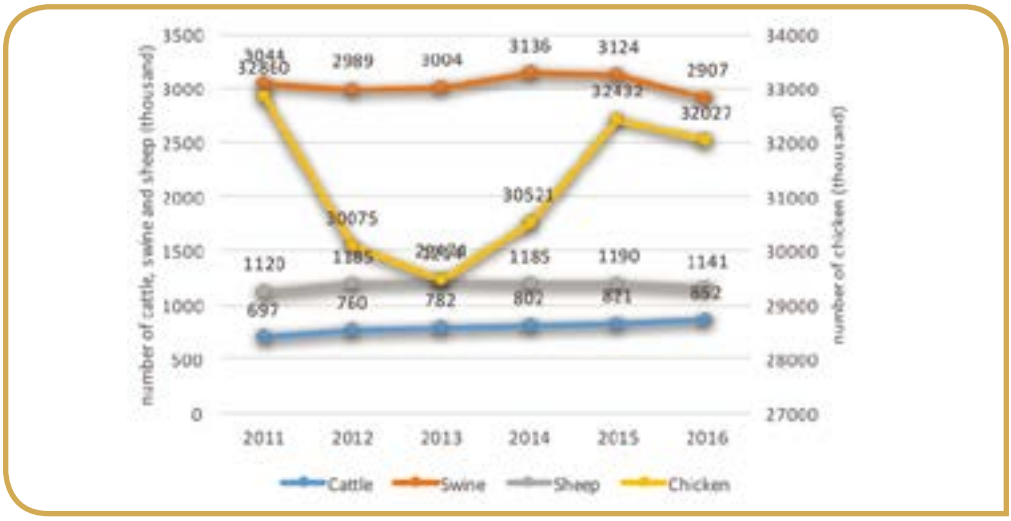


Chart 11.2.: Changes in livestock between 2011-2016

11.5. Nutrient management

Nearly 554 thousand tons of fertilizer (agent) was sold to the farmers by the distributors, of which 365 thousand contained nitrogen, 98 thousand contained potassium and 91 thousand contained phosphorous. Only 2.8 million hectares was the total fertilized area in 2016 which shows a little decrease compared to previous years. The amount of dispensed fertilizer per hectare was 398 kg in 2016. In recent years, the size of the areas treated by organic fertilizer decreased year by year in Hungary. In 2015, it was 254 thousand hectares.

11.6. Plant protection

According to most recent data, 29 769 tons of pesticides were distributed in 2015 in Hungary. 40% of the pesticides was weed-killer, 8% was insecticide, 24% was fungicide and 28% were other agents (seed dresser, soil disinfectant). The quantity of the marketed agents is collected and annually published by National Food Chain Safety Office (NFCSO). A substantial part of the weed-killers, fungicides and insecticides was applied for the four most important arable cultures. The Hungarian Central Statistical Office together with the Ministry of Agriculture and the NFCSO performed

data collection and based on that, the size of the area treated by pesticides reached 2.5 million hectares in 2014 which is more than half of our arable lands (4.3 million hectares).

11.7. Ecological farming

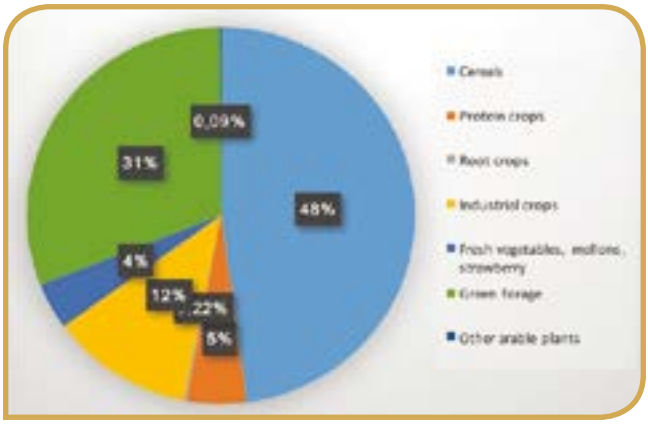


Chart 11.3.: Proportion of area (change-over and ecological) of arable plants involved in ecological farming (2016)

While there were 1 574 registered bio-farmers in 2010, their number had reached 3 414 by 2016. Compared to the year 2015, the number of bio-farmers had increased by nearly 1 500. The size of the area included in ecological farming reached 186 322 hectares. Out of this, 91 299 hectares are ecological areas and 95 023 hectares are areas under change-over.

On a significant part of the area involved in ecological farming, cereals (48%), green forage (31%) and industrial plants (12%) are cultivated. Vines are grown on 1 637 hectares (with change-over), which is a 23% increase compared to 2015. Ecological fruit is produced on 6 591 hectares while 104 869 hectares was subject to pasture management in 2016. The numbers of animals kept within the framework of ecological farming were the following in 2016:20 815 cattle, 8 945 swine, 8 138 sheep, 1 105 goats and 77 520 poultry.

12. Transportation and environment

12.1. The environmental impact of transportation

All transportation pollutants originate from an artificial, anthropogenic source. They are territorially concentrated, so the emissions can get into a limited airspace. The attenuation of the pollutants occurs out of the cities. The proportion of sources may change occasionally and it depends on the technical development of society and technical instruments.

Motorised transport is an important pollution source. Soot from the diesel engines as well as particulates which emerge during the wear and tear of tyres, brakes and clutches and also platinum from the catalyst can get into the air.

Public transport with a low emission of pollutants and non-motorised single transport modes should be a developed to reduce air pollution from transport. There are some examples below for air quality protection and improvement. (Without the need for completeness.)

– Restriction or banning of transit-traffic, designating bypass route(s)
– Temporary introduction of common (environmental) speed-limit
– Increase of parking opportunities
– Restriction of transport by environmental classification, vehicle registration number, etc.

12.2. Transport development programmes

In the 2014-2020 budgetary period of European Union, the Integrated Transport Operational Programme provides sources for the sustainable urban transport development. The programme supports the modernisation of rolling stock urban transport (tram, suburban railway train, metro, trolleybus, tram-train) and related awareness-raising actions.

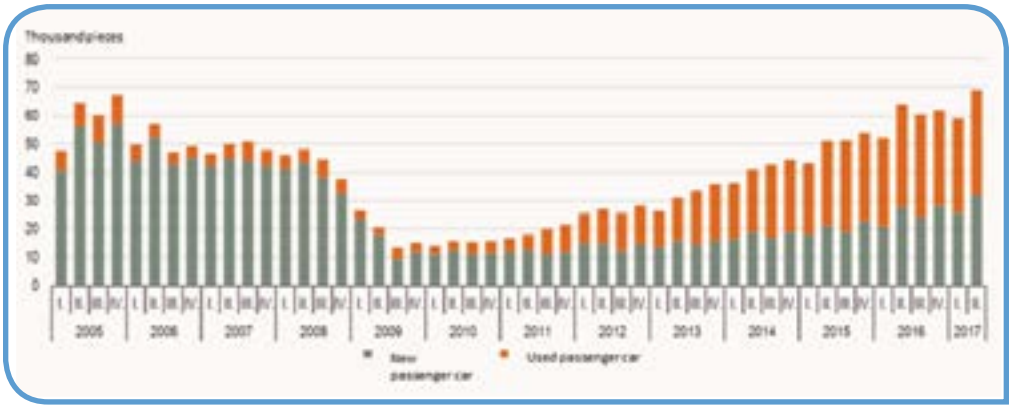


Figure 12.1.: The number of first-registered passenger cars in Hungary between 2005 and 2017 *(Source: KSH)*

As we can see on figure above (Figure 12.1.), the number of first registered passenger cars is increasing, specially the number of used passenger cars. It means more and more used passenger cars are registered in Hungary which are imported from abroad.

12.3. Development of electric mobility – Ányos Jedlik Plan

The share of renewable energy was 5.35 % in 2013. In the transport sector but this target number is 10 % by 2020 for all EU member states according to the EU directive on the support of energy produced from a renewing energy source. To achieve this target, the government of Hungary will use 25 % of income from the CO_2-quota sales to develop the electric mobility infrastructure.

The Ányos Jedlik Plan was approved in 2015. The plan's key aim is to spread electric vehicles. The plan is a part of Ányos Jedlik Cluster established under the control of the Ministry of National Economy and the National Innovation Office. The members of the Cluster are companies whose aim is the development of electric mobility in Hungary and that innovate in this field. In the near future, it is planned to have "electric quick service stations" every 80 km along the major roads. Moreover, local governments will get an opportunity for 100% non-refundable support to establish electric service stations. This contributes to implement the plan that our country should become fully traversable by an electric vehicle. Planned works are going to start as part of the Ányos Jedlik Plan.

As we can see on the figure above (Figure 12.2.), transport has an important share of energy demand which is increasing more and more. This growth rate, this large-scale oil dependence is not sustainable. The EU published a document in 2011 related to transport. It's the White Paper – "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system". According to this paper, member states should reduce their GHG emission from transport compared to 1990 levels by 60 % by 2050. Despite this, emission increased by 27% between 1990 and 2009, the EU has to achieve a 68% decrease in total until the designated date.

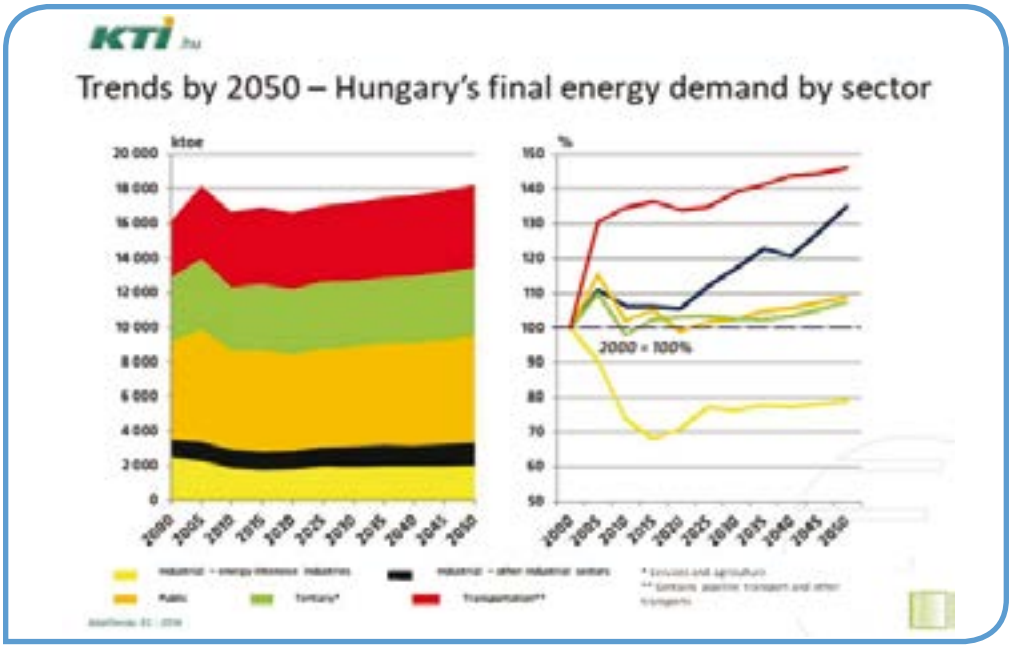


Figure 12.2.: Hungary's final energy demand by sector until 2050. *(Source: KTI)*

Transport is responsible for one third of energy consumption and one fifth of GHG emissions. Transport also generates urban air and noise pollution. In addition, transport has a significant effect on the landscape, fragmenting the natural territorial units and habitats which may have serious consequences for animals and plants. Further significant damage is caused by de-icing roads with salt as well as applying herbicides to the area immediately adjacent to railroad track but there is no room to detail these in this publication.

13. Development programmes

This chapter is about the most important programmes related to the environmental developments in the 2014-2020 budgetary period of the European Union. The Partnership Agreement is the definitive document of the 2014-2020 period. This agreement includes operational programmes (OP) and ensures the connection between the member states and the EU's territorial cooperation programmes. The main task of the Partnership Agreement is to outline the participation of member states in the Europe 2020 Strategy which aims for smart, sustainable and inclusive growth in the EU. Operative programmes that contain the development and investment opportunities have been made according to the goals of this strategy.

The main objective of the Environmental and Energy Efficiency OP is to maintain a balance between a good quality of human life and environment protection during economic growth. The programme highlights the importance of inhibiting and minimising the negative effects of climate change; enhancing the efficient use of energy sources; reducing pollution and environmental strain; and ensuring a healthy and sustainable milieu. The increased use of renewable energy sources and improved energy efficiency are two main priorities for the programme; due to this, substantial emphasis is placed on their development.

The Territorial and Settlement Development OP is for all Hungarian regions with the exception of Central-Hungary. Its aims are to increase territorial economic development and employment.

In settlement development priorities, we can find projects including environmental protection infrastructure improvement and strengthening sustainable, liveable urban environment that are directed towards investments improving environmental security. Another important aspect of the programme is to create a low CO_2 emission economy, for example by the transformation of the transport sector and the reduction of emissions. Supporting systems that use renewable energy sources is also highly significant in the programme so energy efficiency, energy modernisation and energy saving developments for buildings, properties, infrastructural establishments are prioritised. This OP also contributes to the making of Sustainable Energy Action Plans.

The Integrated Transport OP's primary goal is improving the transport network and infrastructure using environmentally friendly methods if possible. Related to the EU 2020 Strategy, the Integrated Transport OP aims to improve energy efficiency and reducing the CO_2 rate by improving public transport- and railways as well as by related attitude-shaping. In order to make road infrastructure sustainable environmentally and technically, the programme includes for example building noise protection walls and weigh stations, the modernisation of guard rails and drainage systems and deploying wildlife crossings. An important expectation is to reduce the PM10 and NO_x emission of urban public transport.

The Competitive Central-Hungary OP was created for the further developing the most developed region of Hungary and making it more competitive economically. This OP's priorities are mainly the same as the Environmental and Energy Efficiency OP' and the Economic Development and Innovation OP's priorities. In the programme, funds are available for tourism and nature conservation. These kinds of development include natural and cultural heritage preservation, biodiversity conservation and repair/restore. The support of energy efficiency and renewable energy are also of great significance in enterprises and infrastructures.

The Economic Development and Innovation OP was created for stimulating the economic growth of Hungary. The main aim is to raise our country's employment rate to 75%. It is important to support low CO_2 emission, environmental protection and preservation and the improvement of energy efficiency. A fundamental goal is to raise the competitiveness of entrepreneurs with cost effective energy production and usage. The scheme provides the opportunity to reduce the energy use and use renewable energy sources in public buildings and households.

The LIFE programme is a financial instrument for the European Union's environmental protection and climate action. It has two subprograms (Environment and Climate Action) that support the general aims of the programme. One of the general aims of LIFE is to switch to a low CO_2 emission, resource-efficient economy. The programme also supports environment quality protection, the prevention of biodiversity decline and reversion and the assistance of Natura2000. LIFE helps updating and developing EU environmental and climate policies and legislation by co-financing projects with a European benefit. The programme supports environmental and climate action cooperation with civil society, non-governmental organisations and local people.

INTERREG is the European Territorial Cooperation's more popular name. The programme's general overarching goal is to support harmonic economical, social and regional development in the whole EU. Now, INTERREG is in its 5th programming period. INTERREG is built on three strands of cooperation: cross-border (INTERREG A), transnational (INTERREG B) and interregional (INTERREG C). Hungary has cross-border cooperation programmes with Austria, Croatia, Romania, Slovakia and Slovenia. In all these examples of cooperation, development cases that support sustainable environmental protection, effective resource use and environment-friendly transportation are observable. The preservation and development of cultural inheritance, the improvement of the appeal of cross-border areas and sustainable tourism are also important goals of the programme.

HORIZON2020 is the largest research and innovation programme of the European Union. The most important goals are supporting innovative products and services, the simplification of administrative rules, handling social challenges and making the financing system clear. Beside strengthening the leading scientific position of the EU and investments in strategically important technologies, one of the priorities of HORIZON 2020 is to ease, solve social challenges. In the latter field, the programme is advocating sustainable energy and biological resource usage, and climate action projects. In HORIZON 2020, investments supporting environment-saving economical innovations are also significant.

14. Raising awareness

Environmentally responsible attitude and thinking are named to be strategic tools in the 4th National Environmental Protection Programme. The aim of this activity is that citizens should be more informed about the values, significance and condition of their environment, and lead their lives according to this attitude. During awareness raising – beside the knowledge transfer – attention must be drawn, possible risks must be shown and people should be oriented this way for environmentally responsible behaviour and acting. This is a continuous, work approached systematically in order to make citizens consider when they make under personal consumer decisions what their long-term effects are and to anchor an economical, environmentally friendly lifestyle and corresponding consumption habits in their minds. This idea goes through the actions and campaigns of the Ministry of Agriculture designed and executed to promote environmentally conscious thinking that are thereby trying to contribute achieving the goal formulated in the environmental programme of the European Union: "Living well, within the limits of our planet."

During its environmentally conscious educational and awareness-raising tasks, the Ministry of Agriculture implemented effective informative campaigns following the levels of the waste hierarchy and it also provided support with various tools, serving to reach the goal mentioned above:

- European Week for Waste Reduction (EWWR)
- YouGrabIt! – Voluntarily for a cleaner Hungary!
- BINculTOUR – Waste Management Open Day
- Green Keyboard
- National Waste Management Conference
- Green List Customer Program
- Earth Day
- Film Competition – 2016.
- Glass Collection in Department Stores
- BinLand
- Five-bin Games
- Public Awareness Raising Program
- Heat Smartly!
- IV PET Cup
- II International Nature Film Festival, Gödöllő
- Tour de Hongrie – 2016.
- XXVI National Meeting of Environmental and Nature Protection NGOs (Green OT)
- Not Hard!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