
Landscape Changes in the Valley of the Danube as a Result of Human Activities Impact

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Danube's floodplain is one of the regions in Romania that have undergone some of the most dramatic changes in the last 100 years, as it was transformed for agricultural purposes only to be later restored to its natural state, as the losses proved to be greater than the benefits. This region is considered one of the world's most important ecoregions. However, in the XX-th century Danube's natural system was affected by human activities. Great resources meant great opportunities for exploitation. Dams were built and large areas were drained for agricultural purposes and flood protection. Thus, much of Danube's wetlands, floodplains and floodplain forests were destroyed. The increasing pressure of human activities and unsustainable agricultural practices didn't prove to be cost-effective, and benefits were outrun by losses. Economical and environmental costs showed that action had to be taken. Therefore, in 2000, it was signed the declaration that created the Lower Danube Green Corridor, Europe's largest cross border wetlands protection and restoration area.

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Romanian Plain

Romanian Plain, the largest plain of Romania, is located in the south of the country, is bordered to the west, south and east by the Danube river, and to the north by the higher plateaus and Subcarpathians. The slope of the landform descends slightly from the north to the south and from the west to the east, towards the valley of the Danube.

The relief has a relatively plane surface, with a thick layer of loess (which reaches an extension of 10 to 45 meters), developed terraces and rivers with wide

floodplains. The slight declivity is also reflected by the large meanders of the rivers. The evolution of the loess layer determined the formation of V-shaped valleys or even gorges, and it also determined the great depth of the water tables location, a reason for which most of settlements are located in the valleys, along the contact line with the floodplains or the terraces base.

The existing geomorphologic processes, specific for a plain, are those characteristic for loess formation. The lack of effective drainage has usually caused significant damage to the crops.

As a particular landform, Danube's floodplain stands out, as a low alluvial plain, with an extension of 1 to 6 km, even up to 25 km in the Large Island of Braila. Much of this floodplain has been transformed for agriculture, by dam construction and drainage.

Natural lakes, especially floodplain lakes, numerous in the past, had consequently disappeared. Only a few remained. Among them, some lakes can be mentioned: Bugeac Lake, Oltina Lake, Vederoasa Lake, Baciul Lake, Hazarlic Lake, Turcoaia Lake, Jijila Lake, Suhaia Lake, Fistoveanca Lake, Radulea Lake, Chircanu Lake.

Valley of the Lower Danube

The Danube basin covers 817,000 km² and is the most international river basin in the world, extending over all or part of the territories of 18 countries. The Danube River flows across ten countries and four capitals and is Europe's second longest river after the Volga, flowing over 2,857 km from Germany's Black Forest to the Romanian Danube Delta on the shores of the Black Sea. The Danube is also Europe's only major river that flows west to east. It has played a vital role in the economic and cultural development of the continent. The European Commission recognizes the Danube as the "single most important non-oceanic body of water in Europe" and a "future central axis for the European Union".

Danube is the most important axis of naval transport in Europe. As result of the completion of Danube – Main – Rhein channel, it was created a waterway which links the Black Sea to the North Sea.

Danube has played an important role in Romania's history, culture and economy. 38 percents of its length and half of its navigable part including its mouths are situated on the territory of Romania.

Its resources and its economical, political and social importance made it a densely populated area from ancient times. Along its length there are 220 localities, out of which 22 are towns. The archaeological proofs show that some of the present towns are known from the times of Roman Empire, that is 2000 years ago. Orsova (Dierna), Drobeta Turnu-Severin (Drobeta), Turnu Magurele (Turrus), Cernavoda (Axiopolis), Harsova (Carsium), Isaccea (Noviodunum), Tulcea (Aegysus). The population growth and the appearance of new towns continued through the Middle Ages to the present day. Nowadays, Romanians towns located on the banks of the Danube according to its flowing direction are: Moldova Noua, Orsova, Drobeta-Turnu Severin, Calafat, Corabia, Turnu Magurele, Zimnicea, Giurgiu, Oltenita, Calarasi, Fetesti, Cernavoda, Harsova, Macin, Braila, Galati, Isaccea, Tulcea, Sulina. There are bridges across the Danube at: Giurgiu, Fetesti- Cernavoda, and Giurgeni – Vadu Oii. These towns and cities play a major role as fluvial ports.

The settlements located along the Danube have a well developed industrial role, some of them being among the leading industrial centres of the country

Danube's Sectors:

On the Romanian territory, Danube's course can be divided in four sectors: Bazias – Drobeta Turnu-Severin sector, Drobeta Turnu-Severin – Calarasi sec-

tor, Calarasi – Braila sector, Braila – The Black Sea sector (the maritime sector).

Bazias – Drobeta Turnu-Severin sector, is also known as Danube Gorge (the longest transversal valley in Europe, with a total length of 144 km). This sector varies in width from a few hundred meters to 5 km.

Before the construction of the Iron Gates hydroelectric and navigation system (between 1970 and 1972), this sector was characterized by a steep slope, high speed of water, whirlpools and rocks on the river bed, some of them visible at low water level.

The construction of the Iron Gates Hydroelectric plant and navigation system (the second largest plant in Europe, with an installed power of 2100 MW), lead to a rise of the water level and consequently for some of the settlements a new location had to be found, as it was the case of the town of Orsova.

Drobeta Turnu-Severin – Calarasi sector, is Danube's sector which is situated in the south of Romanian Plain. This sector is characterized by low banks and a wide floodplain. Due to Danube's great width, the waterspeed slows, and favours the formation of the alluvium deposits and islands.

In the past, in Danube's floodplain there were large lakes linked to the river by secondary arms; these floodplain lakes have been dammed and drained, as it was the case of Lake Greaca, the largest, while some of them have also undergone a planning program (for example Lake Bistret and Lake Suhaia).

Unlike the northern bank, which is low and has a well-developed floodplain, the southern Bulgarian bank of Danube is high and has no floodplain.

Calarasi – Braila sector (known in the past as Danube's ponds), is the third sector from upstream to downstream. The Danube divides two times into two arms, which form a giant island up to 25 km wide, which represent the widest sector of Danube's floodplain. These regions, formerly flooded, covered with ponds, marshes, lakes and forests are nowadays dammed, drained, and transformed into agricultural land (Braila's Great Island, Ialomita's Pond).

Due to the mild climate, the largest sector of Romanian Danube's floodplain was used in the past by the shepherds who climbed down the Carpathian Mountains as a place to spend the winter.

Braila – The Black Sea sector is also known as the „Maritime Danube”, as its depth allows access for sea-going ships and ocean liners, along the rectified and dredged Sulina arm. Between Braila and Ceatal Izmail, the Danube flows through a single arm, and beyond that point the river divides into three arms: Chilia, Sulina and St. George which enclose the Danube Delta.

Danube Delta

The Danube basin is home to a wide variety of natural habitats. Among these are the Lower Danube floodplains and islands and the large lakes, reed beds and marshes of the Danube Delta. These habitats are home to a rich and in many cases unique biodiversity, which includes more than 100 different species of fish, and among them six endangered species of sturgeon.

The 600,000 ha Danube Delta has been designated as a World Heritage Site,

UNESCO Biosphere Reserve and Ramsar Site. It is the habitat of more than 280 bird species, including 70 per cent of the world's population of white pelicans and 50 percent of the pygmy cormorant population.

Danube Delta is the largest compact reed bed in the world, with a total surface of 115.000 ha covered by reed. Between its three arms, there is a unique mixture of canals, reed beds, marshes, lakes and ponds.

Climate

The Romanian Plain and the Danube Valley are situated in terms of latitude at mid-way between the Equator and the North Pole and are characterized by a temperate climate, with four distinct seasons. The western part of the Romanian Plain has a continental temperate climate with sub Mediterranean climatic influences, characterized by rainy autumns and mild winters. Romanian Plain central part has a climate of transition from the oceanic and sub Mediterranean influences of the west to the more arid climate in the east. The quantity of precipitation also decreases from west to east. Baragan has a drier temperate climate, with east-European aridity influences, with very cold winters and hot summers, with frequent droughts. As concerns the Danube Floodplain, the evaporation along the river and the watershed level – close to the soil surface, causes a high level of humidity that determines moderate temperatures and fewer tropical days.

The average annual temperature reaches 10-11°C, while in the Danube Floodplain the average annual temperature

has the highest values in the country, that is >11°C. July average temperature reaches 22-23°C, while in January the temperature drops to -3°C. Average annual precipitation reaches 500-600 mm in the western and central part of Romanian Plain, 400-500 mm in the Baragan, and at the mouths of Olt and Jiu rivers. Danube Delta reaches less than 400 mm of precipitation annually. The largest quantity of precipitation falls from May to July in form of showers.

The wind which blows from South and Southeast, also known as the „Austru”, affects the crops in the fields, because is a very hot and dry wind, which causes drought. During the winter, the dominant wind is the „Crivat”. The effects of the winds are moderated by the Danube's floodplain shelter role.

The large variations recorded by the atmospheric circulation determine strong fluctuations of the average annual precipitation quantity and pattern. As a consequence, droughts occur at irregular intervals in Romania, and affect mostly the South-East and Danube floodplain regions.

Romania's drought affected regions, Dobrogea and the eastern half of Romanian Plain, represent at the same time the main Romanian agricultural region. The soils in this territory are affected by different processes of degradation. As inappropriate agricultural techniques are still being used, much of this zone's soils are affected by a decrease in the contents of humus and nutrients and by degradation because of compactness and crust formation.

In the last few years, in the southern region of Romania has been observed a substantial reduction of the soil's water re-

serves due to prolonged droughts. The main problem that occurs in the drought affected regions is that of adopting managerial policy adapted to the drought scenarios, in order to make sure that measures are being taken: short-term measures (compensation of humidity deficit through irrigations, culture rotation, fertilization, adaptative agricultural techniques) and medium and long term measures (assuring water levels in reservoirs, creating tree lines for protection).

Droughts usually occur in September, March, April, and sometimes in June. Yet, the humidity deficit in the soil's and plants' water necessity reaches a maximum point during summer months when the high temperature increases the evaporation process.

All these characteristics prove the need for irrigation. For this purpose, Danube's water is used for the Sadova-Corabia, Giurgiu-Razmiresti, Galatui-Calarasi, Pietroiu-Stefan cel Mare, Terasa Brailei and Carasu irrigation systems.

From a total of 14.8 million hectares of agricultural land, in Romania the drought occurs on approximately 7,1 million hectares, which also include most of the 3,2 million hectares planned for irrigation.

According to the data provided by the ministry of Water, Agriculture and Forest and The Romanian Statistics Yearbook, from 1980 there has been an increase of irrigated land surface, while between 1990 and 1999, the irrigated land surface decreased from 62.5 % to 9.4 % of the entire irrigation planned surface. In 2001, 400.000 ha were irrigated, while in 2002, only 200.000 ha (6.2 %) were still irrigated.

At present, there is a government plan which stipulates that the irrigation system must be rehabilitated by the year 2010.

Soil salinization occurs on approximately 0.6 million ha, with some intensifying tendency on the irrigated or inappropriately used lands, or in areas with a salinization potential, which total another 0.6 million ha.

Direct economic losses to the crops because of the mentioned restrictions are estimated at 20 percents per year.

Flora

In the past, most of this region was covered by forests, a thing which is also revealed by the toponymy of some places. Thus, the name of "Teleorman" county comes from the Turkish words "deli"-crazy and "orman"- forest/woods, which indicates the former great expansion of the forested areas in this region.

The eastern part of the Romanian plain has natural steppe vegetation, while for the central and western part, the characteristic is given by a blend of steppe and forest.

Among the different species found in this area, there are: oak, lime, ash, elm, hornbeam. The shrub includes numerous species: may, sloe, wild rose, privet, common elder, cornel, hazel.

The high impact of human activities reduced the original natural vegetation to some islands, much of it being replaced by agricultural land.

The same phenomenon is found in the Danube Delta whose natural vegetation is represented by water plants and large surfaces covered with reed, and by

the characteristic floodplain vegetation, with forests of willows, alder and poplar.

Fauna

On the low altitude plain region live a wide variety of rodents (hare, ground squirrel, field mouse) and birds (lark, quail, partridge). In the forested areas live wild boars, deer, wolves, and foxes. This region is also known for its high-density of pheasants, most of them brought here by colonization, and also for the sporadic presence of protected species, such as two species of bustard.

Danube's floodplain's fauna is represented mostly by the great number of species of birds, especially water birds, along with a rich variety of species of fish, most of them with economic value. The most valuable in this respect are the sturgeons, well-known for their caviar.

Socio-Economic Importance

The main economic uses of the Danube are:

- navigation/transport
- hydro-electric potential
- domestic/drinking water supply
- water supply for industry
- water supply for agriculture
- fish resources, including sturgeons (best known for caviar production)
- agricultural land and pastures in Danube's floodplains and in the Danube Delta
- tourism and recreation
- waste disposal
- reed used in paper industry
- sand and gravel for construction

- In addition, the Danube's remaining floodplains provide a range of economically important 'ecological services', such as water quality regulation and flood control.

Danube's Floodplain

Lower Danube River and its floodplains and wetlands are a unique natural area whose economical, ecological and scientific significance is of international importance.

The floodplains of the Lower Danube are areas with outstanding biodiversity, providing multiple functions and benefits such as: biodiversity conservation, water purification, pollution reduction, flood protection and support for socio-economic opportunities such as fishery and tourism.

Floodplains and wetlands have a great importance in the maintenance of water quality and environmental health in the Danube River and Black Sea and offer a basis for creating economic development opportunities for local populations (fish harvesting, tourism etc).

Until the end of the 19th century, the Danube was a largely natural system with an extensive network of channels, oxbows, backwaters, marshland, floodplain forests and meadows. The river was characterized by constant changes in its course and dynamic natural exchanges with its floodplains. Since then, human interventions in the way of flood protection, agriculture, electricity production and navigation have destroyed over 80 percents of the Danube's wetlands, floodplains and floodplain forests. That led to great losses in terms of habitats and wildlife. One ex-

ample is the considerable reduction of nursery areas for spawning fish and the blocking of migratory pathways for commercially important species such as sturgeon, which now survive only as small remnant populations. Changes in discharge volume and speed, water quality, and alluvium volume as a result of river regulation and pollution have also had negative impacts on biodiversity. Such developments have altered the river, affecting wildlife and the food, water and raw materials resources.

The fertility of the lands of the Danube's floodplain determined seasonal cultivation, once the water retreated. The good crops which were obtained encouraged the expansion of the cultivated land. On the other hand, the annual rainfall creates an irregular water level pattern in time and space. Therefore, at the beginning of the XX-th century, the authorities decided that these fertile floodplain regions should be drained and cultivated permanently, by building dams and draining the land.

Starting from 1904, M. Roco (who had been hired in 1893 to work at the construction of the Fetesti-Cernavoda railway, and worked under the supervision of engineer Anghel Saligny until 1895, when the famous bridge over the Danube was finished) drew up the first projects and realized the first dams and drainage systems in the Danube's floodplain, being a forerunner of land improvement and planning, fields which, at those times, were looked at with scepticism. In 1906 he finished a part of Spantov-Oltenita dam, which was considered a great success and represented the base for the first Land Amelioration Law, in 1906. The construction of dams continued in Oltenita region, as it had positive results

on fishing, and, at the same time, the expansion of agricultural land lead to an increase, in real terms, in the total surface of agricultural land in Romania. The first dams were built between Oltenita and Giurgiu, but in 1930, the works came to a stop. After World War II, the works were resumed in an ever faster rhythm and at an ever larger scale, which lead to the drainage of over 80% of Danube's wetland.

These works actually continued the extended deforestation process undergone by the Romanian Plain in the XIX-th century, when, as a consequence of the peace treaty signed in Adrianopol in 1829, the commerce and navigation along the Danube was liberalized. Thus, it occurred a sudden upsurge in grain demand on Western European market, which determined big projects involving the expansion of agricultural land in Romania.

Grain production pushed forward the commerce, and thus, Romania became one of the most important European exporters.

Romania's wheat was listed on the Braila International Grain Stock Exchange. The price level fixed here became standard price for Western Europe and other regions as well. From the second half of the XIX-th century to the outbreak of World War II, Romania became a major grain supplier for both Western Europe, especially Germany and Scandinavia and Egypt, Syria and other East-Mediterranean regions. Between 1921 and 1932, the average grain-cultivated land surface in Romania was 11.1 million ha and an annual medium production of 1000 kg per ha was obtained. The best crop was collected in 1929, while in 1927 crop failure occurred. As regards wheat, an average land surface

of 3.2 million ha was cultivated between 1921 and 1938.

In the next period, during the communist regime, the figures in the statistics are not credible, as the statistics were often exaggerated or false, for propaganda purposes.

After a period of full exploitation of the agricultural land in Danube's floodplain, the crop began to fail. The new agricultural land was little by little affected by aridity, which resulted in loss of fertility and crop failure. Thus was discovered that the element left out during land planning was exactly the one which determined the very existence of Danube's floodplain, that is, its annual inundability. The fertility of this land proved to be temporary, due to the river's alluvium deposits, which were full of nutrients. Aridity also caused the need for irrigation.

After the revolution in December 1989, during Romania's prolonged economic transition period, the irrigation systems in Romanian Plain and Dobrogea were almost totally destroyed.

Taking all these into consideration, the best solution for most of this land is ecological reconstruction, which can be done in two ways: by removing the dams and flooding the land, or by controlled flooding, by maintaining the existing dams. Thus, in case of pollution, the lakes and ponds can be isolated from the river avoiding any spread.

Danube Green Corridor

The existing damage to the floodplain and wetlands of the lower Danube and the increasing pressure of human activities have adverse effects on the ecologi-

cal, biological and scientific values of the area.

Thus, Romania, Bulgaria, Moldova and Ukraine (four countries bordering the Danube River) have agreed in 2000 to create Europe's largest cross border wetlands protection and restoration area. This initiative will establish the Green Corridor for the Danube, a stretch of at least 600,000 hectares (1.5 million acres) of existing protected wetlands and new ones along the Danube River.

The objectives of the Danube Green Corridor project are:

- assess the current state of the natural protected area
- build new natural areas in the Danube Flood Plain
- create natural cross border reservations together with Bulgaria, Moldova and Ukraine
- designate the wetlands in the Danube Flood Plain
- ecologically reconstruct some areas of the Danube Flood Plain
- coordinate and indicate the socio-cultural and economical activities
- make a correct assessment of the environmental costs and long term environmental effects of the common actions of the Declaration signatory States

The accomplishment of this project was the result of a decade of action focused on this direction. Thus, in 1992 WWF Green Danube Program is established. Six years later, in 1998, WWF Danube-Carpathian Program is initiated, and two years later, in June 2000 the Lower Danube Green Corridor Agreement was signed. In 2003, WWF (World Wide Fund for Nature) completed the official "Danube River Basin Public Participation

Strategy” as a contribution towards implementing the EU Water Framework Directive in the basin.

The four countries have to establish programs and take all suitable measures to ensure the protection of the Lower Danube Green Corridor wetlands and floodplain habitat by:

- protecting and restoring the wetlands and floodplain habitat in the Danube river basin, taking into account the necessity of protecting some social economic objectives of great importance from floods;

- setting up a common standard system for water quality indicators allowing a clear evaluation of the state of the environment and certain human activities in buffer and economic zones;

- protecting and improving the quality of water and environmental conditions of the Danube river ecosystem.

The Lower Danube Green Corridor (which includes the Danube Delta) is composed of a minimum of 773.166 ha of existing protected areas, 160.626 ha of proposed new protected areas and 223.608 ha areas proposed to be restored to natural floodplain. The Lower Danube Green Corridor will comprise the following areas:

- areas with strict protection regime
- buffer zones with differentiated protection regime, in which human activities could be permitted and degraded areas restored

- areas where sustainable economic activities could be developed.

The Green Corridor for the Danube will include wetlands, lakes, flooded areas, flooded forests and meadows. In the last 100 years, more than 80 percent of the Danube River Basin's wetlands and floodplains have been destroyed. The floodplains have been disconnected and were affected by the impacts of development, dam construction, pollution and war. The aim of the agreement is to reconnect these lands to restore the essential wetland functions to the benefit of local people, nature and sustainable economy.

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