Current Situation and New Strategies for the Sustainable Development of the Danube Delta in Romania, Ukraine and Moldova

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Danube Delta and its importance for global natural heritage

The Danube Delta is Europe's greatest wetland, stretching over a vast aria of more than 5,000 square kilometers and channeling the water of the whole Danube Basin into the Black Sea (Figure 1). Thus, Danube Delta is a vital center for biodiversity in Eurasia, a natural genetic bank with incalculable value for the global natural heritage but also an economic resource for Romania and for the adjacent countries (Ukraine and Moldavia).

Figure 1. Danube River Basin.

For these considerations, the Romanian territory of Danube Delta has been declared a Biosphere Reserve in 1990.

The Program Man and Biosphere of UNESCO recognized the universal value of the reserve in 1990 through its inclusion in the international network of

biosphere reserves. It was recognized with this occasion that Danube Delta possesses unique and valuable features:

- it conserve examples of characteristic ecosystems of one of the world's natural areas;
- it is a land and coastal / marine area which people are an integral component, and which must be managed for objectives ranging from complete protection to intensive yet sustainable production;
- it is a regional center for monitoring, research, education and training on natural and managed ecosystems;
- it's a place where government decision-makers, scientists, managers and local people must cooperate in developing a model program for managing land and water to meet human needs while conserving natural processes and biological resources;
- it may serve as a symbol of voluntary cooperation to conserve and use resources for the well-being of people everywhere.

Development and physical characteristics of the Danube Delta

The Danube is the largest river in Europe; it runs through ten countries and with a catchments area of 805,300 km^2 it has by far the greatest impact on the Black Sea.

The Danube Delta can be divided into a number of discrete geographic units based on their morphological and biological characteristics. These are:

- delta itself (including the three main river branches of the Chilia, Sulina and Sfantu Gheorghe channels);
- the secondary delta of Chilia channel in Ukraine;
- the lakes from the North of Chilia channel, also in Ukraine;
- the Razim – Sinoe lagoon complex;
- the Black Sea coast out to 20m depth;
- the undivided Danube River East to Cotul Pisicii;
- the Isaccea – Tulcea floodplain;
- the Murighiol – Plopul saline plains.

Local history and cultural heritage

Owing to its mild climate, natural richness and geographic location, people have been attracted to the Danube Delta and it has possessed economic, political and strategic importance since ancient times. The access to the river and sea made the region a major trading center and crossroad for human migration, even from the prehistoric period (Neolithic and Iron Age), then in the succeeding Dacian, Greek and Roman civilizations periods, in the Byzantine period.

As a result of wars with Russia and Turkey during the18^{th} and 19^{th} centuries, which meant that the delta region was under Russian administration until 1856 and then under Turkish rule until 1878, almost all evidence of preceding settlements was destroyed. Sulina town enjoyed a revival of economic and

cultural importance between 1856 and 1940 that gave it a unique character among towns on the Danube; it born from the arrival and settlement of substantial Romanian, Russian, Ukrainian, Turkish, Greek and German ethnic groups, each of them with its own customs and religious practices. This diversity of culture is similarly reflected in all the smaller towns and villages in and around the delta at present time, in Romania, Ukraine and Moldavia.

Land use, production and zonation of the Danube Delta in Romania and Ukraine

The heterogeneous soils, landscape, climatic and hydrological conditions in the delta have played a major role in the land use of the Danube Delta (Figure 2). In Romania, local enterprises within the delta produce wide range of goods and services with a value of over USD 16 million per year (excluding shipping and industry). This same heterogeneity underlies the basis for the natural diversity, which led to the declaration of the biosphere reserve. The most extensive and important forms of natural resource use in the Danube Delta are fishing and reed harvesting, occurring over 3,306 km^2 (57%) of the reserve where there is a natural flooding regime. In Romania these areas are state – owned and controlled by the state, but the exploitation is carried out under license by both state – owned and private companies.

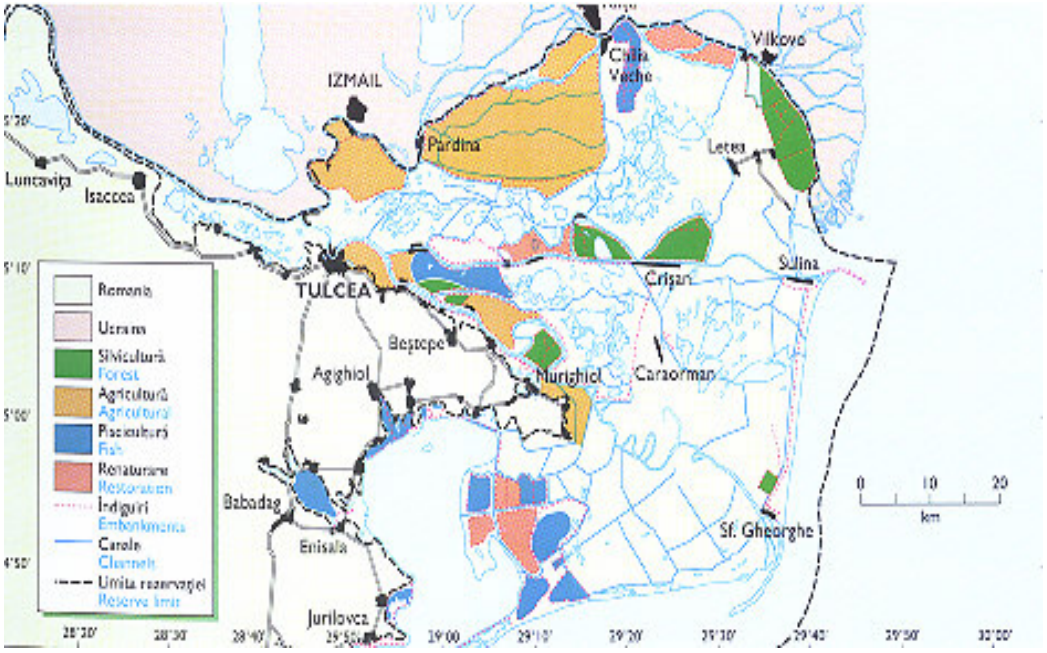

Figure 2. Land use, production and zonation of the Danube Delta.

Fish farming takes place in custom – built polders, which occupy about 406 km^2 (7%) of the delta. They are operated by ten states – owned or joint venture companies (some of which also fish and harvest reeds outside the polders). The polders are state – owned and controlled by the regional council of Tulcea.

Agricultural land cover about 696 km^2 (12%) of the delta, comprising arable land (about 42%) that occur on the higher sandy soils and dry summer pastures. Of this land, 63% is state – owned under the control of regional council of Tulcea and use by six states – owned companies and several small companies and bodies operated by the regional council itself. A further 29% of the land is the regional council under the control of local councils represented by the mayors, and the remainder (8% is privately owned by the inhabitants, who generally raise livestock, grow vegetables and plant orchards and vineyards.

Among the land uses in the Romania's delta forestry is one of the more stable components in terms of land use. Forests occupy some 227 km^2 of which 187 km^2 are actually wooded (chiefly with poplars) and the rest are used for the other purpose or are not in productive use. Most of the planted forest (73%) has a protective function: to reduce erosion of levees and soils, to form windbreaks, and to provide shade and shelter for livestock.

Game hunting is an important activity for local people. It is carried out across 14 designated hunting zones occupying 1,435 km^2 of which 7% is in forestry land, 37% in agricultural land and 55% in the area used for fishing and reed harvesting. The local authorities are responsible for organizing and monitoring the hunting system.

Although the delta is an area with a high reputation in Europe and elsewhere in the world, the number of foreign visitors is very limited and use of accommodation is low. However, there is a great potential for developing environmental tourism if sufficient investment can be found for renovating and upgrading existing facilities to more modern standards.

The social and physical infrastructure in the delta is poorly developed due to the difficulty of transport and communications. Until1970, the population grew (reaching a peak of 21,657) but since then the trend has reversed and by 1992, the population has declined to less than 15,000. The majority of the population (61%) is of Romanian origin. The rest come from many different countries, of which the Russian Lipovans (13%) and Ukrainians (24%) are the most numerous. The 28 settlements in the Romanian delta are divided into seven communes and one town (Sulina). The largest village in each commune serves as the center for social services. Not all of the villages have school, and in some schools two or more classes are combined; only Tulcea and Sulina have secondary schools. All villages have a phone connection (through an operator) and most have electricity except four of them. In most villages there is a church. In six of them there are partial drinking water supply systems; none exist elsewhere.

Biodiversity and ecological dynamics in the Danube Delta

The Danube Delta is Europe's largest delta and holds wetland areas that are among the least spoilt in the continent. It is internationally reputed for its bird populations, both in terms of sheer numbers using the area and in terms of

rare species, including white pelican *Pelecanus onocrotalus*, pygmy cormorant *Phalacrocorax pygmaeus,* squacco heron *Ardeolla ralloides*, glossy ibis *Plegadis falcinellus* and red - breasted goose *Branta ruficollis*. Its mosaic of habitats is the richest in Romania Ukraine and Moldavia and supports a wide variety of interesting communities of plants and animals (so far numbering over 5,200 types), including many species that are important at regional and even global level. Fish biodiversity is very high with over 70 species (including several types of sturgeon). The majority of these (40) are specific to fresh water species, the others are migratory: they live both in the Black Sea and in the delta / Danube River for reproduction.

Over the last four to five decades, however, the delta has suffered deterioration in habitats and loss of species caused by the impact of a range of related factors, including:

- construction of dams upstream which has subtly altered the flooding regime;
- creation of agricultural and fish polder in the delta which reduced the original natural area by over 20%;
- increased nutrient levels in the water (known as eutrophication) leading to dramatic losses of aquatic plants and changes in fish communities, due to the use of nutriments in agriculture in all the Europe;
- industrial pollution and effluents that accumulate in fish an then in the eggs of fish – eating birds like pelicans and cormorants, so reducing their breeding success (Figure3);
- extension of canals for navigation that carries polluted and sedimented water all over the delta and reduces the overall drainage time during the flood period, leading to great changes in lake hydrology and poorer water quality both in Romania and Ukraine;
- mis – management of fish and reed resources that has lead to the development of a black market in fisheries and a collapse of reed harvesting both in Romania and Ukraine.

Figure 3. Industrial pollution in the Danube Delta.

In Romania the best remaining natural areas have been protected within core zones where biodiversity can be studied and from which local genotypes of species can be collected for habitat restoration in future. But these protected areas must extend in the Ukrainian and Moldavian zones of the Danube Delta.

Main impacts on the natural ecosystems of the Danube Delta in the Danube Basin

Over the last fifty years there has been an increasing rate of economic development and resource use within and around the Danube Delta. This trend has lead to a situation where the natural ecosystems and their resources are now under severe threat of collapse, particularly as a result of air and water pollution. Recent research into environmental quality has shown many sources of such pollution and human impacts (factories, agricultural chemicals, human waste), which is actually greater around the Danube Delta than it is within it. For example, while the human population living in the Romanian delta is less than 15,000, the population living in the towns and villages around its borders in Romania is over 145,000 (about the same number live along the Ukrainian stretch of the river).

The use of the main river branches by commercial shipping is one of the principal sources of air and water pollution, not only from the boats (exhaust fumes generate noxious gases and introduce sulphur, lead and vanadium into the water) but also from associated docks and shipyards where wastes (oil, metal ores, garbage, sewage and hot water containing detergents) are often discharged. Other impacts of navigation include bank erosion from wash due to use of unsuitable craft and high speeds, which then causes high water turbidity from the suspended sediments; disturbance of feeding and nesting places for fish and birds (from wash, noise and vibration); and direct destruction of aquatic plants and animals from propulsion systems.

Very little industrial activity takes place within the Danube Delta, but several factories exist close-by, particularly in Tulcea as a deliberate attempt to generate economic growth and provide local employment. The most significant of these are two factories that manufacture alloys for use in steel production and which do not have smoke filters. Wastes from these factories mostly comprise combustion products (at least 30% of the solids and 80% of the gases) that are transported into the territory of the Danube Delta by air or by water. The smoke issuing from the factories contains ash, coal dust, hydrocarbons, sulphur dioxide, chlorides, fluorides and many other toxic compounds (Figure 4). Moreover, the smoke particles are very fine and persist in the atmosphere for long periods; these are generally washed out by rain so that they have highly acidic episodic impact rather than a consistent, less harmful deposition. In addition, the solid wastes comprise ash with a high concentration of heavy metals, silica and titanium, which are dumped on the edge of the Danube Delta, where it is subject to windblown and leaching by rainwater.

Figure 4. Smoke issuing from the factories in the Danube Delta.

There is another factory, which manufactures alumina, also causes a high degree of air and water pollution when its filters are not operating properly, or the processing of bauxite is not carried out correctly. The factory uses 12,960 m^3 of water per day, of which 10,366 m^3 is returned to the river with a high likelihood of chemical contamination. When the filters are not operating, very fine particles are released. RAACET Tulcea, which supplies the town hot water system, is the largest consumer of water in Tulcea, taking 73,440 m^3 per day, of which 51,840 m^3 is returned. It has no water treatment plant, so this effluent contains an increased level of dissolved materials.

The main sources of pollution arise from the overuse of chemicals, especially pesticides that persist in the soil and accumulate in the food chain. For example, in 1992 levels of the chlorinated hydrocarbon ppDDE found in the eggs of pygmy cormorant *Phalacrocorax pygmaeus* (up to 57mg/g dry weight) and white pelican *Pelecanus onocrotalus* (up to 15 mg/g dry weight) are among the highest found anywhere. Such concentrations cause thin eggshells and embryo defects that greatly reduce breeding success. Today, the pesticides used in the Romanian Danube Delta Biosphere Reserve are biodegradable with low persistence. However, recent research shows that levels of persistent organochlorine pesticide residues derived from DDT and HCH remain high ten years after they were prohibited. In fact, these residues are also present in the river water entering the Danube Delta, indicating transport from other sources.

The heavy use of fertilizers, especially in upper reaches of the Danube catchments, combined with a lake of sewage treatment facilities, has lead to very high concentrations of nitrogen and phosphorus in the waters entering the delta. These nutriments encourage the growth of algae, which displace other plant species and, through de-oxygenation of water, cause the death of aquatic invertebrates and fish.

Arable farming in the Danube Delta involves pumping water for irrigation, which is another impact (Figure 5). Around the Lake Razim – Sinoe complex, for example, fish screens are not installed at the pump-house intakes so there

is heavy mortality of fingerlings. Elsewhere, the pig - rearing units can cause serious damage from the discharge of untreated slurry.

Figure 5. Arable farming in the Danube Delta.

Legislation for conservation and development in the Danube Delta

In Romania laws, government decisions, decrees and order of the Ministry of Water, Forests and Environmental Protection regulate the activities carried out within the Danube Delta. This regulatory framework was established before and after the government reform of 1989 and largely covers the range of problems concerned with nature conservation and human development within the Danube Delta.

The most important act is the Low No. 82 of 1993, which confirmed the establishment of the biosphere reserve promulgated by Government Decision from 1990. It also sets out the arrangements for administering the reserve and managing human activities within it, mainly by the creation of the Danube Delta Biosphere Reserve Authority itself as a regional environmental agency. The low is delineating the boundaries and internal zones of the reserve and authorizing the statutes of the Authority.

The Romanian legislation relating to nature conservation and natural resources use in the Danube Delta have the next scopes:

- designation of the Danube Delta Biosphere Reserve (DDBR);
- establishment of DDBR Authority;
- delimited borders and zones in DDBR;
- created statutes for the DDBRA and appointed Scientific Councilors;
- provisions for environmental protection in developments projects;

– establishes penalties for environmental damage;
– protection of waters;
– establishes penalties for polluting navigation waters by shipping;
– concerning fisheries and fish farming;
– hunting regulations;
– forest conservation and use;
– return of arable land to private owners;
– protection of crops and forest using chemicals.

In addition, Romania is a Party to five international conventions that are applicable to the management of the Danube Delta:

– Biodiversity Convention (Rio de Janeiro, 1992);
– Convention for the Conservation of European Wildlife and Natural Habitats (Berne);
– Convention on the Prevention of Marine Pollution (London, 1973);
– Convention of the Protection of World Cultural and Natural Heritage (Paris,1972);
– Convention on Wetlands of International Importance Especially as Habitat for Waterfowl (Ramsar, 1971).

Administration and management of the Danube Delta

I consider that the administration and management in the Danube Delta is a complex process, which must be separate from but linked to the local government structure both in Romania, Ukraine and Moldavia. There must be lands under national control, lands under local government control, and land with a privately owned. The local district councils must take the lead for all decisions relating to land under their control, including development planning and control, public works, conserving historic monuments, and providing recreation facilities and protection and improvement of the environment to enhance the quality of life.

The superior level of government must coordinate various services on behalf of the district councils, as well as taking responsibility for land under its own control, town planning and maintaining and improving infrastructure such as roads and water supply. The district councils must control in these areas land comprising fish, agriculture and forestry polders, which may be use by companies in which the state has the majority ownership.

Also, must be establish in each country special administrative regimes for the conservation and protection of biological diversity in the natural ecosystems of the zones, to develop human settlements and to organize economic activities in accordance with the carrying capacities of those ecosystems. These special administrative regimes must have a range of duties, for examples:

– to assess that ecological status of natural resources, organize scientific research, elaborate a strategy for conservation and improvement and protection of the genofund and biodiversity;

– identify, delimit and propose the designation of functional zones of each area and mark them with signs and notices to avoid deleterious impact;

– act as a regional environmental agency and must issue licenses and permits for economic and social activities;

– to establish and apply measures for restoring damaged delta's ecosystems;

– to collaborate with local public authorities in order to protect the interests of the local population, to conserve their cultural heritage and to improve the quality of life and living standards;

– to cooperate with international bodies and interested national and foreign institutions and promote cooperation in scientific research and exchange of information relating to the restoration of the Danube Basin, Danube Delta and Black Sea region;

– in accordance with the specific legislation and based on the results of scientific research, to set up concessions for the use of renewable natural resources;

– to propose for the approval of the district councils the fees for licenses for local people to use of renewable natural resources (farming, apiculture, grazing, hay – cutting etc.);

– to carry out actions for ecological education and public awareness;

– to monitor and control the disposal of waste, especially toxic and dangerous materials, the treatment and neutralization of waste, or its removal from the Danube Delta, as well as removal of disused terrestrial and marine machinery;

– to propose to the Governs the regulation for navigation and access for shipping and boats on the main river branches and on the smaller channels.

For carrying out these duties, a series of communication and cooperation mechanisms must be establish with the order local government bodies and agencies operating within the Danube Delta.

The transition of the socio-economic systems in Romania, Ukraine and Moldavia to the sustainable development model involves:

– protection of biodiversity;
– living within the framework of biodiversity;
– minimize of the collision with the ecosystems;
– creation and maintenance of the positive externalities;
– human society organization for a sustainable development;
– assessment of individuals needs.

International management objectives and projects for the sustainable development in the Danube Delta

Therefore, Romania, Ukraine and Moldavia must elaborate common political and environmental strategies for the sustainable development in this region,

materialized in common management objectives and projects, in the spirit of Agenda 21.

The general management objectives for these countries should focus on the improvement of the overall ecological status of the Danube Delta. It is therefore important to have good legislative framework and long perspectives plans for saving one of the world's most important wetland:

- Developing and implementing those measures required as a consequence of the international commitments assumed by Romania, Ukraine and Moldavia.
- Developing and maintaining an integrated database comprising information necessary for management of biodiversity conservation and use of resource within their carrying capacity.
- Protecting and maintaining populations of species and habitats with high ecological value on the whole the territory of the D.D.
- Identifying recently extinct and endangered species within the all D.D. and identifying suitable habitats in order to restore their populations.
- Ensuring the proper management of reed beds.
- Carrying out research on the natural operations and functions of the natural delta's ecosystems.
- Managing the circulation of water in the ensemble of D.D. in order to improve the ecological conditions in the lacustrine zones and adjacent areas.
- Carrying out ecological restoration works where the natural or semi-natural character of areas has been lost as a result of human activity.
- Improving the monitoring of the environment's quality in D.D. in each riparian country, its integrating with the each national monitoring system.
- Identifying critical areas and sources of pollution, which have an important impact on the D.D. and develop zonal controls.
- Formulating a regional action plan to deal with cases of accidental pollution.
- Encouraging economic activities but only as far as these do not cause damage to the delta's ecosystems or conflict with the objective of maintaining biological diversity.
- Improving the quantity and quality of data available on tourism activity in the D.D.
- Facilitating tourism activity that is in harmony with the ecological objectives of the D.D., in a particular to guide appropriate investments in the private sector.
- Promoting sustainable development of agriculture in D.D.
- Investigating the potential for extending the boundary of Romanian Danube Delta Biosphere Reserve in Ukraine and Moldavia.
- Cooperating with internationally organizations to generate support for the Danube Delta's preservation.

The management objectives for the sustainable economic use of the wetland should ensure that the development of the economic activities does not affect the ecological equilibrium of the zone. One the other hand, the identification of new economic activities with less impact in the environment is important:

- Protecting and conserving the morphology of the D.D. coastal zone.
- Institute a common system of management for the sustainable utilization of natural resources of the D.D. in Romania, Ukraine and Moldavia.
- Developing and improve fish farming on the basis of economic efficiency.
- Improving the marketing of products from the delta.
- Developing of ecological tourism, producing handicrafts, growing organic food and other similar activities in which the local people are directly involved.

For the buffer zones and strictly protected zones from the Danube Delta Biosphere Reserve (in Romania), special strategies should be designed in order to ensure the conservation of the existing natural heritage. In addition, habitat restoration measures are needed:

- Assess the effectiveness of existing buffer zones and, if necessary, recommend modifications to their management or their limits.
- Create an adequate legal frame in order to develop measures for conservation, protection and reconstruction of coastal / marine zone through establishing standards regarding the integrated management of coastal zone.
- Develop scientific methods for assuring the protection and conservation of the coastal morphology of the Danube Delta Biosphere Reserve.
- Strengthen the capacity for the control of the economic activities in the marine zone. Formulate criteria to stimulate mariculture in the marine zone, especially of organisms that have a role in bio-filtration of water.
- Ensure the ecological integrity of strictly protected areas.