



# **Flood protection Expert Group**

## **Flood Action Programme Delta-Liman**

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# 1 Introduction

In response to the damages provoked by disastrous flood events that have occurred in the Danube River basin, the **International Commission for the Protection of the Danube River (ICPDR)** decided to establish the long-term Action Programme for Sustainable Flood Prevention in the Danube River Basin.

The overall goal of the Action Programme is to achieve a long term and sustainable approach for managing the risks of floods to protect human life and property, while encouraging conservation and improvement of water related ecosystems.

The **four major basin-wide targets** of the Action Programme are:

- Improvement of flood forecasting and early flood warning systems; interlinking national or regional Systems;
- Support for the preparation of and coordination between sub-basin-wide flood action plans;
- Creating forums for exchange of expert knowledge;
- Recommendation for a common approach in assessment of flood-prone areas and evaluation of flood risk.

At the **sub-basin level**, six targets have been identified in the Action Programme:

- To reduce the adverse impact and the likelihood of floods in each sub-basin through the development and implementation of a long-term flood protection and retention strategy based on the enhancement of natural retention as far as possible;
- To improve flood forecasting and warning suited to local and regional needs as necessary.
- To increase the capacity building and raise the level of preparedness of the organizations responsible for flood mitigation;
- To develop flood risk maps;
- To harmonize design criteria and safety regulations along and across border sections;
- To prevent and mitigate pollution of water caused by floods.

This action plan for the Delta-Liman sub-basin reviews the current situation in flood protection in Romania and Ukraine and sets the targets and the measures for reduction of damage risks and flood levels, increasing the awareness of flooding and for improvement of flood forecasting. The targets and measures are based on the regulation of land use and spatial planning, increase of retention and detention capacities, technical flood defences, preventive actions, capacity building, awareness & preparedness raising and prevention and mitigation of water pollution due to floods.

## ROMANIA

The high torrentially degree of watercourses, due to the climate conditions, physical and geographical factors conduct to a frequent phenomenon of flooding on Romanian territory.

In last years the occurrence of flooding was higher. In 2005, 2006 and 2008, dangerous, atypical hydrological and meteorological phenomena took place with human lives and huge material losses.

The registered high-flood on Romanian sector of the Danube in April 2006 was the highest since 1898. The consequences were that dikes failed on many sectors.

According to the Water Law, the strategy and national politics in water management field are tasks for the Ministry of Environment and for the application and control of activities is responsible “Romanian Waters” National Administration through its water directorates.

**The National Plan for Prevention and Flood Protection** is part of national politics and constitutes a necessary tool for national coordination and basin correlation of investments in water management domain.

The National Strategy for Flood Risk Management on short term adopted in December 2005 takes into consideration the following aspects and priorities:

- preliminary estimation;
- critical analysis of existing flood defences;
- basic principles for national strategy for flood risk management on medium and long term;
- risk reduction means both vulnerability and objective factors mitigation;
- both structural and non-structural measures are necessary;
- we should take into consideration all local and regional conditions;
- European context: directives, funds.

The existing legislative framework offer to the central authorities and public local administration the legal support for the prevention, protection and preparation activities in flood risk management (Regulations regarding flood adopted in 2005)

It is necessary a strong coordination of these activities based on regulations regarding strategies and politics for flood risk mitigation, cost-benefit analysis, economic, social and environment impact assessment, programmes and plans for spatial planning.

### **National Strategy for Flood Disaster Prevention and the Flood Action Plan**

The short-term strategy for flood protection has the following principles:

- Sustainable development;
- Economic, social and ecological acceptability;
- Strategic assessment for a period of time;
- Simplicity and transparent aspects;
- Basin approach of the flood problem;
- Interdisciplinary approach;
- Solidarity;
- Equilibrium maintenance among preventive, response and post-factum measures, using the national territory plans, structural and non-structural measures, as intervention plans for emergency situations.

Applications of best practices proposed by EU and UN Economic Commission for Europe regarding flooding preventive measures, protection and effects mitigation are under implementation.

Flood Action Plan for the short term strategy implementation started in 2005 by integrated actions for 5 years (2010):

- development of the hydrological information system and modernization of the early warning system – DESWAT Project
- rehabilitation of the old flood defence hydraulic infrastructure and building new ones in areas of high risk,
- Flood hazard mapping and flood management plans. The first pilot basin was Siret. Nowadays, interdisciplinary studies in eight river basins are under implementation

(Siret, Mureş, Crişuri, Banat, Jiu, Olt, Someş-Tisa, Ialomiţa-Buzău) and will be finalized during 2009, beginning of 2010.

The National Plan will be finished in the frame of the River Basin Management Plans – Flood management Section first draft, till December 2009 and is planned to be adopted till mid 2010.

In mean time, during 2009 will be finalized mid and long term National Strategy for Flood Risk management, which will take into account the need for Flood Directive implementation.

## **UKRAINE**

Floods as natural phenomenon occur at 27% of the territory of Ukraine (165,000 km<sup>2</sup>), where one third of the population lives. The flood prone regions include Carpathians, Polissya, Lower Danube and Donbass.

At present there is no flood action plan, covering the territory of the whole country as well as no one joint legislative act concerning flood issues. Nevertheless, there are national and regional programs covering Ukrainian part of the Lower Danube sub-basin, including:

- National Complex program of prevention of hazardous impact of floods on agriculture and rural settlements for the years 2006-2010 and the Prognosis until 2020
- Regional Complex Programme for Protection of Rural Settlements and Agricultural Lands of the Odessa Region from Damages Caused by Waters for the years 2001-2005 and the Prognosis until 2010.

As it is seen from the previous experience, passive flood protection with dams constructed in different years and for different water levels in the rivers (different probability level), can not always guarantee protective functions even after its further reconstruction.

It is impossible to solve the problem of flood protection only by using engineering facilities. Costs for eliminating harmful effects of floods increase greatly, if natural factors are not considered, if money is spared on preventive actions providing the ecosystem sustainability.

There is a need for introducing comprehensive system of risk management and coordination in emergencies and flood warning on a transboundary level.

Due to a number of projects supported by European Commission and better financing from the Ukrainian state the flood forecasting and warning in the Ukrainian Danube Region gradually improving.

Nevertheless of progress there is still a lack of cross-border and transnational cooperation and poor technical capacities for hydrological monitoring, emergency planning and warning in the Lower Danube Area. One of the main gaps is absence of modern digital river water level forecast model based on the flow redistribution in the Danube Delta.

## **2 Characterisation of Current Situation**

### *Natural conditions*

#### **ROMANIA**

##### *Hydrography*

*The Danube basin* is situated in Central Europe, comprises 17 countries and covers 10 % from the Europe's surface. The river crosses 8 countries and 4 capital-cities, is oriented from V-NV to E-SE and represents an essential component of the trans-European water navigation

way known as "Rhein-Main-Danube System". The total surface of the catchments basin is 805,300 km<sup>2</sup>, with a length of 2,860 km, from which 1075 km on the Romanian territory.

From the total catchments area of the Danube hydrographic basin, 29 % pertains to our country, the Romanian territory being drained by 97.4 % by this river.

This hydrographic space is situated in southern Romania and goes administratively on the following counties: Caraș-Severin, Mehedinți, Dolj, Olt, Teleorman, Giurgiu, Călărași, Ialomița, Brăila, Constanța (Cernavodă and Hârșova towns) and Tulcea (Danube Delta).

The multi-annual stock of the Danube, at the entrance to Romania (Baziaș) is of 175.6 mn.m<sup>3</sup>/yr going up to 204 mn.m<sup>3</sup>/yr at the entry to the Danube Delta (Ceatal Izmail).

The maximum flow is achieved Spring-Summer. At the entrance to Romania the highest values are registered in April, because of the hydrological regime of the Drava, Sava, Tisa and Velika-Morava rivers. In Romania, at Zimnicea and Ceatal Izmail, the maximum flow is achieved in May-June, due to the hydrological regime of the Romanian tributaries.

Among the floods of big discharges, in the last 60 years, there have been: 1940, 1942, 1955, 1970, 1975, 1981 and 2006.

The highest registered values during floods on the Danube there have been at Orșova in 1940 and in 1981 and at Ceatal-Izmail in 1897.

It is to be mentioned that, for the Danube, floods regime means flows which go higher than 8000-9000 m<sup>3</sup>/s, as it is the transport capacity of the minor streambed downstream Porțile de Fier II (Iron Gates II).

The periods of small waters on the Danube are during Winter and especially in Autumn. The daily minimum flow values vary as it follows: the smallest values have been of 1060 m<sup>3</sup>/s at Orșova in 1985 and of 1350 m<sup>3</sup>/s at Ceatal Izmail in 1921. These are situated below the level of the minimum daily flows with the probability of 95%.

From administrative point of view, the Danube Delta belongs to the Tulcea county. The people's density is very low, only 5 inh./km<sup>2</sup> and is concentrated along the Danube's arms (ex. Crișan) or on the grinds (ex. Letea, Caraorman, Sfântu Gheorghe, Chilia Veche).

The Danube Delta is the youngest geographical unit in Romania and the second big deltaic unit in Europe (the first one is Volga), being an unique complex of echo-systems.

In the Delta are both positive and negative relief forms. The positive ones are the Bugeac, fluvial grinds and accumulation littoral forms and the negative are covered by water forming the hydrographical Delta network.

Approximately 20.5 % from the total area of the Danube Delta is under the medium sea level. The rest of the delta is between 0 and 1 m on 54.5 % and between 1 and 2 m on 18 %, the average altitude being 0.52 m.

The Danube Delta and the adjacent complexes have been declared Biosphere Reservation in 1990 for the Romanian part and in 1998 for the Ukrainian part.

The Reservation has on our country a surface of 5,800 km<sup>2</sup> and on Ukraine 465 km<sup>2</sup>.

On our territory the Reservation's components are:

- 3,510 km<sup>2</sup> the own delta;
- 1,145 km<sup>2</sup> the complex Razelm-Sinoe;
- 1,030 km<sup>2</sup> marine water (until 20 m line having Midia Cape as extremity);
- 13 km<sup>2</sup> Danube riverbed between Cotul Pisicii and Isaccea (on Romanian territory);
- 102 km<sup>2</sup> the Danube floodplain between Isaccea and Tulcea.

In the Danube Delta Biosphere Reservation have been delineated the following:

- 18 strictly protected zones with an area of 50,600 ha;
- 13 tampon zones with an area of 223,300 ha;
- Economic zones with an area of 306,100 ha.

The Delta is under continuously transformation under liquid and solid discharge impact.

The water circulation in the Danube Delta is very complex among those three delta units (Letea, Caraorman and Dranov).

The main water ways in the delta are the Danube's arms.

Chilia arm (120 km from Ceatal Chilia) is the most important, in last years the discharge proportion (58 %) is lower than '50-ies (63.8 %).

In the same period the proportion of the Tulcea arm (17 km between Ceatal Chilia and Ceatal Sf. Gheorghe) is growing from 28 % to 42.4 % due to the Sulina arm role (63 km length) from 7-8 % in the last century to 20 % in present.

The Sf. Gheorghe arm (70 km length) has 20% from the Danube discharge.

The difference between the discharge at Ceatal Chilia and at Ceatal Sf. Gheorghe is on Mila 35 Canal.

The channel network in the delta is represented by 45 watercourses with 1742 km length and 26 channels with 1753 km.

### ***Climate***

The influence of the Black Sea is very low but cumulated with the marshes and subaquatic areas, the influence is lower after 25 km from the littoral.

The average annual temperatures are rarely under 10<sup>0</sup> C and in some years over 12<sup>0</sup> C.

The average precipitation vary from 450 mm in the fluvial delta to 325 mm in the Razelm-Sinoe complex.

### ***Anthropic influence. Flood defences***

The main hydraulic works affecting the flow regime of the rivers are: reservoirs, deviations and water transfers from neighborhood basin into a reservoir and levees. These types of infrastructures are in fact the most useful instruments for water management, offering possibilities in getting regulation of different volumes during the seasons and sometimes during the year, to offer flood protection or dilution in case of accidental pollution.

In order to protect goods and human lives, on Romanian territory have been realised hydraulic structures which compose the National System for Flood Defence.

The works done in the Delta there have been aimed the following main goals:

- Take of from the floods influence of the areas from the Danube floodable wetlands;
- The supply with potable and industrial water of the important localities situated on the Danube bank;
- Prevention of the phenomena of atomization of the flow on Sf. Gheorghe arm;
- Ensure some water transfers from Sf. Gheorghe arm in Razelm and Sinoe lakes in view of preventing of their metrification;
- The prevention of the Delta littoral erosion phenomena and of the Littoral Belt;
- The restoration of the ecological balance of the Danube Delta Reservation.

### **Reservoirs**

In the Danube Delta – Liman sub-basin are not reservoirs

## Derivations and intakes

In the Delta-Liman sub-basin are **3** important derivations. Two are for ensuring irrigation and fishery and one is exclusively aimed for navigation.

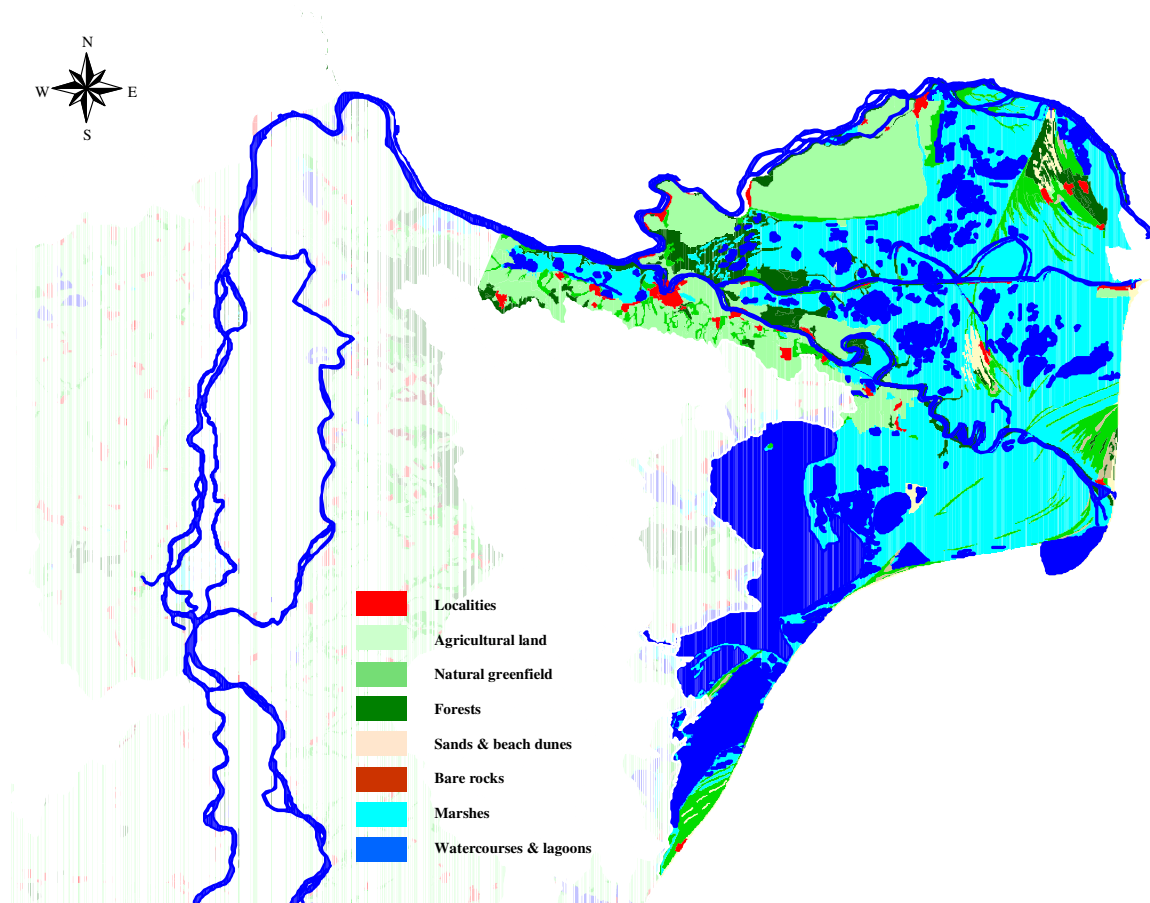
These are:

- **Dunavăț** Canal - Tulcea county, which links Sf. Gheorghe arm (km 54) from Danube Delta with Razelm lake and which is meant to supplement the water volume of Razelm lake, for irrigations and fishery;
- **Dranov** Canal - Tulcea county, which links Sf. Gheorghe arm (km 44) from Danube Delta with Razelm lake and which is meant for the supplementation of the water volume of the Razelm lake for irrigations and fishery;
- **Tulcea - Pardina** Canal - Tulcea county, which links Tulcea arm (Mm 34) from the Danube Delta to the Chilia arm (km 82.5) for cutting short the navigable way.

## c) Dikes and river regularizations

The Danube Delta includes more hydraulic structures: embankments and riverbanks protections made for water supply, flood protection and excess water fighting.

In the Danube Delta are 73 embankments with a total length of 988 km.





Three important distinct groups can be revealed:

- Dikes with complex functions from the Danube Delta with lengths of more than 20 km, up to 76 km (Pardina Enclosure);
- Dikes for the protection of some localities from the Danube Delta, like the dike of the Sulina arm, at Sulina town on both banks (Ldike = 13,4 km);
- Works for the Delta littoral protection against marine erosions, like the:
  - Sulina Sf. Gheorghe Pier (Ldike = 30.0 km);
  - Sinoe Pier for the littoral shore consolidation (Ldike = 19.0 km);
  - North - Portița Pier for the littoral protection (Ldike = 9.0 km).

### *Landuse*

In the **Delta-Liman subbasin** the repartition of the various fields is:

- Artificial field 6,060 ha;
- Arable land and permanent cultivated area 67,064 ha;
- Forests 22,220 ha;
- Bushes 3,636 ha;
- Pastures 33,128 ha;
- Field without vegetation 7,272 ha;
- Water and wetland 349,864 ha (the biggest part of the field is represented by water and wetland (71.5 %), wetland used for agriculture – 4,444 ha and land covered by water and wetland non-used -345,420 ha).

There is another zone, named maritime-tampon-zone with an area of 103,000 ha.

### *Flood forecasting and warning*

The National Institute for Hydrology and Water Management (NIHWM) has the responsibility in order to issue warnings regarding watercourses (including Danube) levels increase.

The methodology and procedures used in warning elaboration are based on well known hydrology law (precipitation transformation in base run-off, concentration, creating high flood waves and downstream attenuation).

For improving the information-decision flow and for the raising population awareness concerning the risk of flooding and the possibilities of decrease the damages and causalities, a new type of hydro meteorological warnings which is based on colour codes was approved in 2006, through a joint order of the Ministry of Interior and the Ministry of Environment.

The colours code (green, yellow, orange and red) depend of the intensity of the meteorological or hydrological phenomena which are forecasted.

### *Institutional and legal framework*

It has been issued or updated important regulations as follows:

- The National Strategy for Flood Risk Management on short term (Governmental Decision 1854 from 2005), which establish prevention and protection measures for flood effects mitigation for each of involved structures from central to local level;
- National Plan for Prevention and Flood Protection at Hydrographic Basin level (Governmental Decision 1309 from 2005);
- The Water Law 107 from 1996 modified and completed according tot the National Strategy;

- Emergency Order regarding safety operation of the reservoirs for fishery, recreation or local importance, establishing operating conditions;
- Regulations for management of emergency situations generated by flooding, dangerous meteorological phenomena and accidents at hydraulic structures adopted in May 2005.

Based on these regulations, taking into account the 2005 and 2006 floods, new flood protection plans at basin, county and local level have been approved in 2006. These plans comprise maps with level curves that bordered flooded zones by watercourses overflow and versant run-off corresponding to the maximum known discharges. In 2009 all flood protection plans will be updated.

## **UKRAINE**

Danube is the second river in length (2,860 km) and basin (805,300 km<sup>2</sup>) size in Europe (after the Volga), springing from the central-western part (the Black Forest Mountains – Schwarzwald).

Danube Delta is situated on the territory of two countries (Romania and Ukraine). The total area of Danube Delta is 4,178 km<sup>2</sup> from which 82% on Romanian territory and 18% on Ukrainian territory.

The name “Danube Delta” refers to the area downstream of the first bifurcation of the Danube river at Cheatal Chilia, bordered by the Black Sea to the east, the floodplain of the Danube river Chilia branch to the north and the Razim lagoon to the south. A second bifurcation, some 10 km south of Tulcea, results in 3 main branches of the Danube river (from north to south of Tulcea, results in 3 main branches of the Danube river (from north to south: the Chilia, Sulina and Sfântu Gheorghe branch).

A length of the Ukrainian part of the Danube is 170 km between the border of the Republic of Moldova near the Prut River mouth and the Black Sea and is located in the south-western part of the Odessa Region. This part of the Danube makes a natural borderline between Ukraine and Romania. The Ukrainian part of the Danube delta and floodplain occupies about 124,000 hectares, including 75,000 hectares of land and 50,000 hectares of big lakes – Kahul, Kartal, Kugurlui-Yalpug, Katlabuh, Kitay and Stensovsko-Zshebriyansky Plavni (SZP). There are the Ramsar sites – the Lake Kugurlui, the Lake Kartal and the Kyliiske Mouth of the Danube Delta and the Danube Biosphere Reserve (Ukraine).

For several decades in the middle of the last century more than 50% of flooded lands along the Ukrainian section of the Danube were drained. Embankments and conversion of the left bank flooded territories and islands to agricultural lands, setting up water reservoirs on the basis of Danube lakes, pollution of Danube waters and runoff of small rivers, total ploughing of the steppe resulted in a drastic change of the environment. On the whole, many functions of wetlands and the Danube delta were essentially depleted.

The total dyking of the Ukrainian part of the Danube floodplain has been started in the middle of XX century. The total length of the system of flood protection hydrotechnical constructions, including the islands, is 255 km. The Ukrainian flood protection constructions were built much earlier than the Romanian ones without taking into account the following factors: increasing of water level during flood periods under the circumstances of two-sided dyking, a steam-channel erosion, impact of navigation, the structure of land use in the floodplain etc. Nowadays about 108 km of dykes along the Ukrainian part of the Danube are inadequate to the rated conditions of food event that has a probability to occur once every hundred years, 32 km of the dykes is in emergency situation. 8 sluices from 13 of the flood protection system are in a poor condition. Placing stakes on conventional methods of

hyrotechnical protection only (total embankment of flood plains) proved to be ineffective ( see Fig. 1).

Figure 1. Ukrainian part of the Danube delta region



During the flood 2006 under the threat of inundation was the area occupying more than 40,000 hectares may be flooded including settlements; the ports of Reni and Izmail; fishing farms, agricultural areas, drinking water inlets; highways of international importance; boundary check-points; 10 km of the transit gas pipeline Russia-Romania-Turkey; 10 km of the current supply line the Dubossary Hydroelectric plant (Moldova) – Romania – Bulgaria etc. In case if flooding some of these units are potentially dangerous for the environment of the Danube delta and the lakes.

Another problem is the lack of public awareness of what local people have to do when get a flood warning. In addition, the emergency warning system needs to be improved taking into consideration modern technical and communication opportunities such as mobile telephone connection, FM radio and TV programmes etc.

Higher intensity and frequency of floods, pollution of the Danube and its tributaries resulting from emergence discharges of pollutants necessitate development of a transboundary comprehensive system of risk management and coordination in emergencies and flood warning.

Responding to the risk of flooding on the regional level were adopted the *Complex Programme for Protection of Rural Settlements and Agricultural Lands of the Odessa Region from Damages Caused by Waters for the years 2001-2005 and the Prognosis until 2010 (Programme)*. The program was prolonged till 2020. The programme aims to provide the protection of people, rural settlement, agricultural lands from damages caused by waters and minimize economic losses.

The main program objectives are:

- improvement of the system of flood protection hydrotechnical constructions
- creation of condition for people security
- implementation of measures to prevent hazardous impacts of water through introducing of complex approach to flood protection
- improvement of the state of environment of water bodies
- environmental education, etc.

Unfortunately, a lack of state and local budget funds is an obstacle to implementation of the programmes.

The Danube River Basin Water Management Department (DRBWMD) is responsible for implementation of the Programme including maintenance and reconstruction of the flood protection system along the Ukrainian part of the Lower Danube.

The Danube River Basin Management Department was founded in April 2008 by the Decree of the State Committee of Ukraine for Water Management to create an institutional background for the implementation of the national policy in introducing a river basin management approach in the Ukrainian part of the Danube Region. The DRBMD is created on the basis of the Danube Flood Protection Department. The Danube Flood Protection Department was founded in 1966 in Izmail, the Ukrainian part of the Danube Region as a public authority responsible for flood protection in the area.

In 2006 the Centre for Analysis of Flood Situation in the Danube Area, Flood Warning and Information has been created on the Department's basis as an output from the project "Emergency Planning and Flood Protection in the Lower Danube EuroRegion" funded by the European Commission.

The Department is also directly responsible for developing cross-border cooperation in the field of water management and flood protection with Romania.

The Danube hydrometeorological observatory (DHMO) that is a part of the State Hydromet Service of Ukraine is the main authority in charge of the hydrometeorological monitoring in the Danube region of Ukraine. It is a state-funded organization managed by the Ministry of Emergencies.

Besides DHMO, levels and quality of water is monitored by the DRBWMD.

Negative consequences of the global climate change which are, practically, not accounted for in water management will become one of the main constraints for developing the water and land use management system in the nearest future. These consequences will manifest themselves in the Danube region of Ukraine by higher temperature, change of the quantity and regime of precipitation, increase of frequency and intensity of floods in the Danube as well as other extreme hydrometeorological events, reduction of the small river run-off, elevation of the Black Sea level followed by flooding of the coastal parts of the Danube delta, shrinking of wetlands and their degradation, underground water salinization, etc. There exists a strong necessity to assess future changes at the regional level and develop the approaches to transform and adapt the existing economic infrastructure and management of land and water ecosystems.

## ROMANIA

### 3. Target Settings

The Action Plan for flood protection on medium-term (2009-2012) launched and comprises new hydraulic structures in frequently affected zones, higher safety degree of existing works and finalization of ongoing ones.

The Action Plan foresees 1850 km river regulation 976 km of dikes, 810 km riverbank consolidation, finalization of two wetlands in Crişul Negru hydrographical basin and identification of new zones as wetlands and DESWAT and WATMAN Projects finalisation.

The prioritisation criteria for promoting investments for flood protection have been made following:

- Inclusion of the proposed works in the Strategy of Ministry of Environment;
- Actual safety degree of the flood protection structures;
- Amplitude of avoided damages as result of the projects;
- The elaboration status of technical and economic documents;
- Financing possibility
- Occupied field status.

#### *Regulation on Land Use and Spatial Planning*

The existing local urban plans for development should contain maps with actually flooded areas, based on historic and studies data.

These maps are from the Local Flood Protection Plans and are updated every 4 years.

#### *Reactivation of former, or creation of new, retention and detention capacities*

#### **The Ecologic and Economic Resizing Lower Danube Floodplain Programme**

During the last century, almost entire Danube floodplain was embanked (53 enclosures with a total area of 430,000 ha and 1200 km of dikes), which affected the hydro morphologic and local-regional climate.

In Spring 2006, Romania faced to biggest Danube's flows. Some dikes collapsed on 50-100 m length, flooded the riparian localities, over 15,000 people being evacuated.

In the following years this kind of event could be repeated and the need for a strategic and adequate approach for flood risk management on the Romanian sector of the Danube appeared.

A real analysis is more and more necessary for some alternate measures to remake wetlands, initially existing, in comparison with the classic defences.

The study regarding ecological and economic resizing on the Romanian sector of the Danube River will be a vital instrument for a strategic co-ordination on all Romanian Danube's sector of the investments for flood prevention and for the future economic development measures.

Elements and principles that we are taking account in the Danube's improvement are:

- changing of the hydrologic regime characteristics;
- realising of an adequate habitat in order to preserve the aquatic natural biodiversity;
- the improvement variants for the Danube take into account the following: riparian localities should be defended, proposed ecologic restored zones in various studies of the "National Institute for Research and Development Danube Delta" and World Wild Fund, controlled flooded zones and areas which the Danube created breaches in the longitudinal dikes.

Public debates have been realized in Bucharest, Giurgiu and Galati with this subject.

### ***Technical Flood Defences***

The structural flood defences are realized in order to make an effective protection for populated areas, to avoid human and material losses.

The Action Plan (2009-2012) foresees 1850 km river regulation 976 km of dikes, 810 km riverbank consolidation.

For all investments works are realized feasibility studies.

### ***Preventive Actions***

These actions are concentrated towards prevention/mitigation of potential damages generated by floods through:

- a) avoiding houses, social and cultural or/and economic objectives constructions in potentially flooded area;
- b) realisation of structural and non-structural measures for protection;
- c) geographical delimitation of natural flood risk zones and noting these in the general urban planning studies;
- d) modern forecast, warning and alarming systems implementation in case of floods;
- e) existing infrastructure for flood protection and riverbed maintenance;
- f) effective communication and people education regarding flood risk and the action ways in emergency situations.

A good system for people warning and preparation could save many lives. For this reason, in the last years was and are in development three projects: SIMIN (National Meteorological Integrated System), DESWAT (Destructive Water) and WATMAN (Water Management).

SIMIN integrates the provided data from existent systems in Romania with a high technology in meteorological radars field, stations with surface hydrologic sensors, data processing systems and forecast decision based on satellite transmission. System was released in September 2003.

The DESWAT project has in its first stage as objective, the modernisation of informational hydrological system, beginning with data acquisition through 600 automatic stations placed on rivers, 250 automatic gauging stations and 64 automatic quality stations, continuing with transmission support which will comprise the actual classic radio system, the GSM and satellite systems.

The programme package for hydrological forecast will be modernised, enlarged and will include semi-automatic procedures for elaboration of warnings, forecasts and information products for various decision makers, media and population.

WATMAN is a project through that the National Strategy for water management in case of disaster will be applied. It will integrate the output data from SIMIN and DESWAT, finally being carrying-out the Information-Decisional Integrated System. Those two projects, through modernised hydrologic and meteorological information systems will provide data and forecast in real-time, which represents input data for WATMAN infrastructure, optimising the integrated water management system.

### **Financial insurance for flood risk**

In 1 January 2010, a law referring to the obligatory insurance for houses against natural disasters such earthquakes, landslides and flooding will come into force.

### ***Capacity building of professionals***

It was planned an intensive programme for raising personnel capacity from the water management units of Romanian Waters responsible with flood defences maintenance and with means and equipments for interventions in case of flooding.

It is developing the training action of new elected mayors and public local administration.

### ***Raising Awareness and Preparedness of General Public***

- Improvement reaction capacity, response and intervention;
- Information and awareness of the population regarding floods and its effects;
- Eco-centres setting-up in frequently affected zones;
- Public meeting presenting the local flood protection plans and the warning procedures based on colours code;

Exercises for flood simulation at basin and county level with the participation of population.

### ***Prevention and Mitigation of Water Pollution Due to Floods***

A characteristic is represented by the pollution with heavy metals, especially in Săsar, Crișul Negru, Crișul Alb and Aries river basins, where there are important mining perimeters with rocks which reach the surface and which are washed by the precipitation. Another significant pressure is represented by the suspended solid loads caused by coal mining activities, especially on Jiu River.

The Law 466 (regarding dam safety) covers the safety problems of dams and dikes of the mining waste deposits.

Now, according to the EU Directive 1999/31/CE and Governmental Decision 349 from 2005 the major part of the mining ponds with high risk stopped the activity.

The actual legislation foresees the continuity monitoring of the closed ponds.

## **UKRAINE**

### **3. Target Settings**

Based on the Programme the following targets for complex flood protection in the Delta-Liman sub-basins could be proposed:

#### ***Regulation on Land Use and Spatial Planning***

Regulations on land use and spatial planning include the following directions:

- improve conditions for wise spatial planning and land use in the Ukrainian part of the Danube floodplain especially taking into consideration the fact of high density of population on the territory and high biodiversity;
- establishment of protective strips along the banks of watercourses as required by Water Code (Art. 88) and the Land Code (Chapter 13);
- resettlement of people from flood prone zones, which cannot be protected by technical flood defences;
- prohibition to construct houses and industrial sites in flood prone zones;
- renaturalization of lands by means of reconnection of former floodplain;
- development of flood hazard and flood risk maps, as required by EU Flood Directive;
- introduction of environmentally friendly technologies of water and land use.

#### ***Reactivation of former, or creation of new, retention and detention capacities***

There are three main directions there:

- Reactivation of former floodplain by full or control removing of dikes along the Ukrainian strip of the Danube;

- Increasing of flood retention capacity of the big Lower Danube Lakes (Water Basins) - Kagul, Kartal, Kugurlui-Yalpug, Katlabuh and Kitay
- Increasing of discharge capacity of Danube branches during a flood by elimination of the dikes on the Islands of the first inner delta of the Kyliya Branche.

### ***Technical Flood Defences***

Traditionally technical flood defences planned by the Program include continuation of:

- Reconstruction and construction of the new dikes
- River bank enforcement
- Riverbed training

### ***Preventive Actions***

Prevention actions are aimed at improvement of the level of knowledge about flood events, their prognosis and regulations:

- Fundamental and applied researches of floods, torrents, erosion and other events, human impact at their development, preventative actions to be taken and adaptation measures;
- Scientific grounding of flood protection actions at regional and local levels;
- Use of the best available techniques for modeling, construction and maintenance of flood protection structures taking into account national and international experience;
- Development of new models of banks enforcement and dikes;
- Improvement methodological background for efficient flood risk management in the region;
- Development a methodology for assessment eventual loses, which may be caused by floods;
- Improvement flood warning system and coordination between flood protection and emergency management authorities, and local government when get a flood warning;

It also includes the measures related to:

- Improvement of monitoring networks and establishment of integrated environmental assessment
- Further metrological and hydrological researches;
- Establishment of databases based on GIS and space images;
- Improvement of weather forecast, water level and flood prone zones modeling, and further improvement of early warning system\$
- identification of flood zones of different probability based on modern technologies of hydrological investigations, geodesic and mathematical calculations, which goes in line with EU Flood Directive.

### ***Capacity Building of Professionals***

Capacity building of professionals includes the following actions:

- Proficiency courses for water management specialists, including intercalibration exercises;
- Further improvement of co-ordination between different authorities in case of floods;
- Improvement of technical capacities of the professionals, namely hardware and software purchasing.

### ***Raising Awareness and Preparedness of General Public***

Raising awareness and preparedness of the general public include:



- Dissemination of the information concerning actions during the floods among population in flood prone zones;
- Publications of informational materials;
- Development of Internet based real time sources;
- Development of storage places for goods and equipment.

***Prevention and Mitigation of Water Pollution Due to Floods***

Prevention and Mitigation of Water Pollution actions include:

- Inventory of industrial and agricultural objects on flood prone zones with potential impact of water quality
- Development of pollution prevention plan for industrial sites
- Water quality control in surface water bodies.

## 4. Measures to Achieve Targets

### ROMANIA

#### *Regulation on Land Use and Spatial Planning*

Measures	Type of intervention	Institution in charge	Costs (mn.€)	Deadline	Comment
Implementation of the medium- and long-term flood risk management strategy - Land-use control Relocation, land purchasing & cultural changes	Technical Administrative	Ministry of Environment Ministry of Agriculture Ministry of Administration and Interior Romanian Waters		2020	
Including the results of the study “Identification and delimitation of the natural hazards (earthquakes, landslides and floods). Hazards maps at county level” into local and regional developing plans	Administrative	Public Administration	120	2009	
Including the maps from Local Flood Protection Plan (Contingency Plans) into the Urban Development Plans	Administrative	Public Administration	20/year	continuous	This actions include flood risk evaluation (flooded areas maps and estimation of damages)

#### *Reactivation of former, or creation of new, retention and detention capacities*

Measures	Type of intervention	Institution in charge	Costs (mn.€)	Deadline	Comment
Implementation of the study “Ecologic and economic resizing of the Lower Danube floodplain”	Administrative and technical	Ministry of Environment	2.5	2010	Including contributions for Romania in the Danube Floodrisk Project

### *Technical Flood Defences*

<b>Measures</b>	<b>Type of intervention</b>	<b>Institution in charge</b>	<b>Costs (mn. €)</b>	<b>Deadline</b>	<b>Comment</b>
Implementation of the medium- and long-term flood risk management strategy- Improvement & maintenance of defence structures	Technical Administrative	Ministry of Environment Ministry of Agriculture Ministry of Administration and Interior Romanian Waters		2020	
Flood protection works for Tudor Vladimirescu locality, Tulcea county	Technical	Romanian Waters	5.56	2008	External funds
Flood protection works for Pătlăgeanca locality, Tulcea county	Technical	Romanian Waters	6.74	2010	External funds
224 objectives (polders, riverbank regularizations, dams) at national level	Technical	Romanian Waters	2,000	2013	9 dams, 4 polders, 211 regularizations works

### *Preventive Actions*

<b>Measures</b>	<b>Type of intervention</b>	<b>Institution in charge</b>	<b>Costs (mn.€)</b>	<b>Deadline</b>	<b>Comment</b>
Implementation of the medium- and long-term flood risk management strategy - Elaboration & implementation of Flood Risk Management Plans - Forecasting, monitoring & warning - Emergency plan & management - Flood Risk Assessment - Run-off control - Improvement of flow conditions in river beds - Improvement of the flood defence capacity	Administrative Technical	Ministry of Environment Ministry of Agriculture Ministry of Administration and Interior Romanian Waters		2020	

<ul style="list-style-type: none"> <li>- Reduction of flood vulnerability of infrastructures and agriculture</li> <li>- Reduction of flood vulnerability of the environment</li> <li>- Social vulnerability to floods</li> <li>- Individual vulnerability mitigation</li> <li>- Funding &amp; compensation</li> <li>- International Cooperation</li> </ul>					
DESWAT – Carrying of a hydrologic information-decisional system for the management of emergency situations (10 automatic stations in Tulcea county where the Delta is included)	Technical	Romanian Waters	45	2011	
WIMS – Investment supporting the information system and database for water management (PHARE project) at national level	Technical	Romanian Waters	2.4	2009	
Information system for integrated water management (WATMAN)	Technical	Romanian Waters	138.4	2015	
<b>DANUBE FLOODRISK</b> - flood risk reduction: risk assessment, risk mapping, involvement of stakeholders, risk reduction by adequate spatial planning.	Administrative Public	Romanian Waters	6.38	2012	
Contributions to the development of the flood risk management strategy	Technical	Romanian Waters	1.7	2009	
Climate changes impact in the Danube Delta	Administrative	National Institute for Research and Development “Danube Delta”		2010	
High-flood forecasting and flood management in Romania – feasibility	Administrative Technical	Romanian Waters	0.1	2009	

study - the analysis for implementing of the decision support system					
Cross-border cooperation showing multiple benefits and uses of the wetlands recovery (Zagen and Stensovko Plavni) in the Danube Delta Reservation Romania-Ukraine	Administrative Technical	NIHWM	0.23	2009	
Cross-border cooperation improving regarding the integrated management of the water resources in the Lower Danube Euroregion - TACIS	Administrative Technical	Romanian Waters	0.48	2009	
Update the Water Law	Administrative	Ministry of Environment			
Update the Flood Protection Plans at basin, county and local level	Administrative	Romanian Waters		Every 4 years	
Update the Plan for warning-alarming for downstream localities in case of accidents at dams	Administrative	Romanian Waters		Every 10 years	

***Raising Awareness and Preparedness of General Public***

<b>Measures</b>	<b>Type of intervention</b>	<b>Institution in charge</b>	<b>Costs (mn.€)</b>	<b>Deadline</b>	<b>Comment</b>
Implementation of the medium- and long-term flood risk management strategy - Population preparedness & feedback - Individual vulnerability mitigation	Technical Administrative	Ministry of Environment Ministry of Agriculture Ministry of Administration and Interior Romanian Waters		2020	
Exercises for general public preparedness for flood simulation	Public participation	Romanian Waters, General	0.50	Continuous	

<b>Measures</b>	<b>Type of intervention</b>	<b>Institution in charge</b>	<b>Costs (mn.€)</b>	<b>Deadline</b>	<b>Comment</b>
		Inspectorate for Emergency Operations			
Flood Protection leaflets	Public participation	Ministry of Environment	0.01	Continuous	
Setting-up New Ecocentres	Administrative	Ministry of Environment	0.02	Continuous	

*Prevention and Mitigation of Water Pollution Due to Floods*

<b>Measures</b>	<b>Type of intervention</b>	<b>Institution in charge</b>	<b>Costs (mn.€)</b>	<b>Deadline</b>	<b>Comment</b>
Monitoring the closed ponds and waste deposits	Administrative, Technical	Ministry of Industry	5.00	2012	USTDA estimation of the minimum needed equipment for monitoring and communication