Flood protection Expert Group

Flood Action Programme
Prut-Siret Sub-basin

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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 Prut-Siret sub-basin reviews the current situation in flood protection in Romania, Ukraine and Moldova 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.

In 2005 the total value of material damages, due to the flooding in Timiş, Olt, Siret and Ialomița hydrographical basins was app. 1.66 bn. euro, representing 0.6 % of national GDP

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.

In July 2008, historical values of water discharge and levels have been registered in Tisa, Siret and Prut basins.

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 an 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 end 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 5years (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 the 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 km2), 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 several national programs covering Prut-Siret sub-basin, including:

- Complex program of prevention of hazardous impact of floods on agriculture and rural settlements for the years 2006-2010 and the Prognosis until 2020
- Complex Flood Protection Programme for Dnister, Prut and Siret river basins for the period 2009-2015 and the Prognosis until 2025.

For the last 10 years catastrophic floods in the Carpathian Region of Ukraine had caused extreme loss to the national economy. Only flood in July 2008 caused the loss with total amount about 6 billion UAH.

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.

MOLDOVA

This Document covers the Prut River Basin area on territory of the Republic of Moldova. It is based on the Action Programme for Sustainable Flood Protection in the Danube River Basin (ICPDR, 2004). Its content is in accordance with the recommended structure of the Danube Sub Basin Action Plans.
The highest level water management document is the GOVERNMENT RESOLUTION NO. 1030 of 26.10.2000, on the PROTECTION SCHEME OF THE REPBLIC OF MOLDOVA LOCALITIES AGAINST FLOODS, valid until 2010. This Plan is valid until 2010 and contains data on present state and future developments in water management, including the flood protection issues. The warning system on the dangerous and risk hydrological phenomena of Moldova is planned to be developed in the future.

2 Characterisation of Current Situation

ROMANIA

Natural conditions

The Siret's relief decreases on whole basin's length from West to East, the big units being: Carpații Orientali, Subcarpații Moldovei şi de Curbură, Podişul Central Moldovenesc and Câmpia Siretului Inferior.
The Prut's relief belong to the Podişul Moldovei and to the North-Eastern part of Câmpia Română.

Hydrography

Siret hydrographic basin has a total surface of 44,520 km^2, from which in Romania 42,890 km^2. Siret hydrographic space comprises almost integrally Suceava, Vrancea, Neamț and Bacău counties and in a smaller proportion Galați, Harghita, Iaşi, Botoşani, Buzău, Brăila, Covasna, Bistrița and Maramureş counties.

The hydrographic network has a total length of the cadastral water courses of 15,157 km, from which Siret has 559 km and an average density 0.35 km/ km^2.

The multi-annual flows volume (5800 $mn.m^3$) is distributed unevenly on seasons and month, so that during the vegetation time (April-September) the flow is maximum (70% from the annually total), and the minimum flow is registered during the winter time.

The minimum flow is produced in Siret h.b. during the Winter when the supply of the rivers comes exclusively from the underground waters, and during Summer - Autumn when the high temperatures favorite intense water evaporations.

Characteristic for Siret hydrographic space is that the maximum discharges are three times more the maximum discharges from Spring. The maximum historic flows in Siret hydrographic space is due to some powerful cyclones, while the maximum usual discharges are generated by local heavy rains.

The biggest floods in Siret hydrographic basin have been in 1969, 1975,1991, 2004, 2005 and 2008.

Prut hydrographic space is situated in North-Eastern part of Romania, neighbouring at west and south Siret basin, comprises integrally: Botoşani (90 %), Iaşi (83 %) and Vaslui (100 %) counties and partially: Neamț, Bacău, Vrancea and Galați. Prut h.s. with a surface of 18,320 km^2 is made of Prut basin of a surface of 10,990 km^2 and Bârlad basin with a surface of 7,330 km^2.

The hydrographic network has a total length of the cadastral waters from Prut hydrographic basin of 4,183 km, of an average density 0.38 km/km^2 and those from Bârlad hydrographic basin of 2,639 km, with an average density of 0.323 km/km^2.

Prut's main tributaries are: Başeul, Jijia, Chineja and Elanul and of Bârlad: Sacovăț, Rebricea, Racova, Vaslui, Tutova and Berheci.

The multiannual average discharge of Prut growth from 78.1 m^3/s (2,462 $mn.m^3$) in Rădăuți section, at 86.7 m^3/s (2,736 $mn.km^3$) in Ungheni section and 105 m^3/s (3314 $mn.m^3$) at the confluence with Danube. The main tributary of Prut, Jijia, brings in 10 m^3/s (316 $mn.m^3$).

For Bârlad, the average discharge varies from 9.48 m^3/s (300 $mn.m^3$) in Bârlad section to 11 m^3/s (347 $mn.m^3$) at the confluence with Siret.

Except for Prut and Bârlad River, the specific of this hydrographic area is heavy rains, with big variations from a period to another, from an year to another; the permanent flow is registered only on the main tributaries of Prut (Bahlui and Jijia), the other river mostly having a temporary/semi-permanent flow.

The biggest floods registered in Prut hydrographic basin have been in l969 and 2008. In Bârlad hydrographic basin, the biggest values were in 1979, 1985 and 2007.

The minimum flow of the Prut hydrographic basin tributaries is reduced, the most part of them have a temporary character. Draughts are also present in Bârlad hydrographic basin. The minimum monthly average discharges of 95% and the minimum average daily of 95 % is registered between 0 and 0.5 cu.m/s on the majority of Prut tributaries.

Climate

The climate in Prut-Siret hydrographic space is temperate with strong continental influences. In the Western part are present the mountain influences and in the South-East the steppe influences.

Anthropogenic influence. Flood defences

The main hydraulic works affecting the flow regime of the rivers are: reservoirs, deviations and water transfers from neighborough basin into a reservoir and dykes. 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.

SIRET

The Siret hydrographic basin has a total surface of 44,811 km^2, from which in Romania 42,890 km^2. Siret hydrographic space comprises almost integrally Suceava, Vrancea, Neamț and Bacău counties and in a smaller proportion Galați, Harghita, Iaşi, Botoşani, Buzău, Brăila, Covasna, Bistrița and Maramureş counties.

The hydrographic network has a total length of 15,157 km, from which Siret has 559 km and an average density of 0.35 km/km^2.

The multi-annual flows volume (5,800 $mn.m^3$) is distributed unevenly on seasons and month, so that during the vegetation time (April - September) the flow is maxim (70% from the total), and the minimum flow is registered during Winter.

The minimum flow is produced in Siret watershed during winter when the supply of the rivers comes exclusively from the underground waters, and during summer-autumn when the high temperatures favorite intense water evaporations.

The maximum historic discharges in Siret hydrographic space is due to some powerful cyclones, while the maximum usual flows are generated by local heavy rains.

The biggest floods in Siret hydrographic basin have been in 1969, 1975, 1991, 2004 and 2005.

Reservoirs

In Siret basin are 30 reservoirs (from which 20 with the surface > 50 ha) with complex use (energetic, water supply, flood mitigation, irrigation and fishery), having a total volume of 1847.632 $mn.m^3$ and an utile volume of 1206.121 $mn.m^3$.
In Siret exist also 104 reservoirs for fishery.
From the most important reservoirs with complex uses there are:

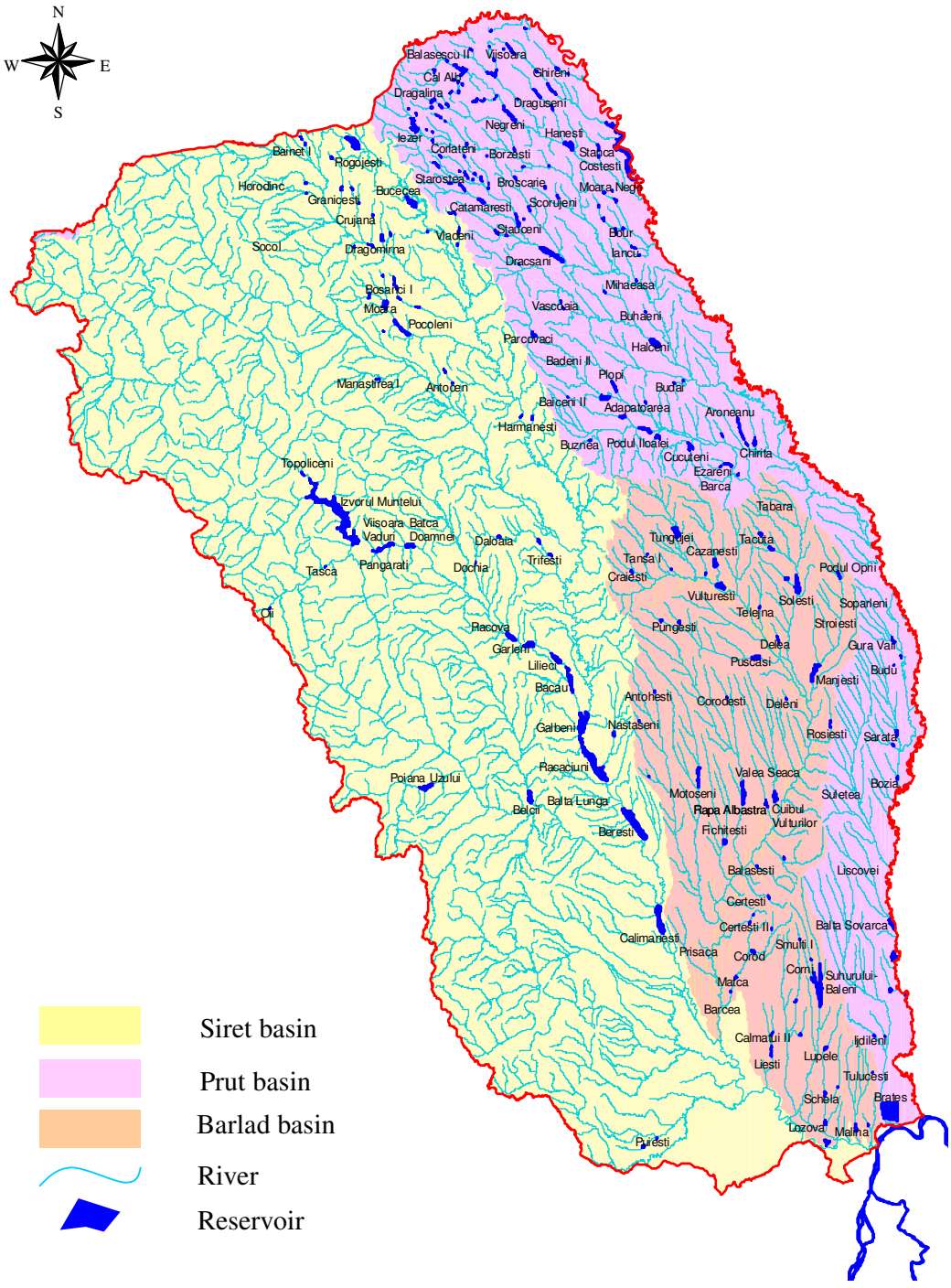
- **Izvorul Muntelui** on Bistrița River, used main for energetic purposes, is also used for the irrigation of 300,000 ha, water supply and floods mitigation;
- **Galbeni**, **Răcăciuni** and **Bereşti** on Siret, which are main used at present also for energetic purposes;
- **Rogojeşti** and **Bucecea** on Siret, which supply water for the area, the supplementary flows for the supply with potable water of Botoşani and Dorohoi towns and also cover the irrigation deficit;
- **Poiana Uzului** on Trotuş River which supply water for the consumers on Valea Trotuşului and of Bacău city and the production of electric power.

In all these reservoirs there are important volumes for floods attenuation.

From the reservoirs for the water supply there is **Dragomirna** reservoir on Dragomirna brook for water supply of Suceava municipality.

Except the big complex reservoirs, which are for the production of electric power, there are to be mentioned the hydro energetic works on Bistrița downstream to Izvorul Muntelui: **Pângărați – Piatra Neamț** and **Racova – Bacău.**

Derivations and intakes



In the Siret hydrographic basin, are as most important **4** derivations of total length of **223.3** km and with an installed discharge **203.5** m^3/s. From the water uses view point, **3** are for the supply with potable and industrial water, and **1** for irrigation and the supply with potable and industrial water. These are:

- **Poiana Uzului** intake, Bacău county which draws off water from Poiana Uzului reservoir for the water supply of Bacău ;
- **Timişeşti** intake, Iaşi county, which gravitationally transports water from the Timişeşti intake (Moldova River) to Iaşi treatment station, for the supply with water of this municipality and also for the supply of the localities from Târgu Frumos area;
- **Siret–Bărăgan** Canal, Galaţi, Buzău and Ialomiţa counties, which draws off water from Călimăneşti (Siret River) and transits it in Dridu-Hagieşti canal for irrigation and the supply with potable and industrial water in the Siret–Ialomiţa hydrographic space;
- **Poiana Uzului micro-regional System**, Bacău county, which has as source Poiana Uzului and supplies with potable water: Moineşti, Comăneşti and Oneşti towns.

Dikes and river regulations

In the Siret hydrographic basin, there have been made and are functional 48 regulations of river beds of a total length of 450 km and 172 dikes of 512 km length.

These works protect against floods: 82 localities from which 12 municipalities, 162 industrial units, 8643 houses and residences, 90,300 ha agricultural areas, railways and roads and other objectives.

From the works in the Siret hydrographic basin, are most important **23** works with **602.3** km regulation of river beds and **454.9** km dikes.

These works protect against floods localities, agricultural areas and industrial units, as well as bridges, roads, railways and others. From the protected localities there are to be mentioned: Suceava, Piatra Neamţ, Bacău and Roman.

From the works there are to be mentioned:

- Regulations and dikes on Suceava River, Suceava county (Lreg = 55.4 km, Ldike = 25.0 km);
- Regulations and dikes on Moldova River, Suceava county (Lreg = 46.4 km, Ldike = 25.5 km);
- Dike and regulation on Siret River, Iaşi county (Lreg = 3.6 km, Ldike = 30.3 km);
- Regulations and dikes on Siret River, Neamţ county (Lreg = 11.7 km, Ldike = 21.3 km);
- Regulations and dikes on Moldova River, Neamţ county (Lreg = 15.7 km, Ldike = 16.6 km);
- Regulations and dikes on Bistriţa River, Neamţ county (Lreg = 30.9 km, Ldike = 8.5 km);
- Regulations and dikes on Trotuş River, Bacău county (Lreg = 50.3 km, Ldike = 40.0 km);
- Dike and regulation on Siret River, Vrancea county (Lreg = 3.6 km, Ldike = 37.5 km);
- Regulations and dikes on Putna River, Vrancea county (Lreg = 104.5 km, Ldike = 26.9 km);
- Regulations and dikes on Siret River, Galaţi county (Lreg = 27.2 km, Ldike = 94.4 km);
- Regulations and dikes on Siret River, Brăila county (Lreg = 30.8 km, Ldike = 40.7 km);

The areas of risks to flooding are related to the works of cca. 30 years old, which will need rehabilitation: localities on Suceava River on Izvorul Sucevei-Frătăuţii Vechi sector; on Moldova River, on Sulița-Vama and Cornu Luncii-Baia, Gura Humorului–Păltinoasa sectors, Răcătău River on Parincea–Horgeşt sector; Bistriţa River on Ţibău- Iacobeni and Borca- Poiana Teiului, Buhuşi–Hemeiuşi sectors; Bicaz River on Telec-Bicazu Ardelean sector; Cracău River on Bodeşti–Roznov sector; Tazlău River on Frumoasa–Belci sector.

The areas of risks to flooding in Siret watershed are especially on the sectors with banks erosions, putting in danger both the river banks and the pier.

PRUT – BÂRLAD

The Prut-Bârlad hydrographic space, is situated in North-Eastern Romania, neighbouring at West and South Siret watershed and comprises: Botoşani (90%), Iaşi (83%) and Vaslui (100%) counties and partially: Neamț, Bacău, Vrancea and Galați counties. Prut-Bârlad having a surface of 18,320 km^2 is made of Prut basin (10,990 km^2) and Bârlad basin (7,330 km^2).

The hydrographic network has a total length of the cadastral waters in Prut hydrographic basin of 4,183 km, with an average density of 0.4 km/km^2 and in Bârlad hydrographical basin 2,639 km with an average density of 0.3 km/km^2.

The Prut main tributaries are: Başeul, Jijia, Chineja and Elanul. The main tributaries of Bârlad are: Sacovăț, Rebricea, Racova, Vaslui, Tutova and Berheci.

The multi-annual average discharge of Prut River increases from 78.1 m^3/s (2,462 $mn.m^3$) in Rădăuți section at 86.7 m^3/s (2,736 $mn.m^3$) in Ungheni section and of 105 m^3/s (3314 $mn.m^3$) at the confluence with the Danube. Jijia, as the main tributary of Prut, brings in 10 m^3/s (316 $mn.m^3$).

For Bârlad, the average discharge varies from 9.48 m^3/s (300 $mn.m^3$) in Bârlad section to 11m^3/s (347 $mn.m^3$) at the confluence with Siret. The contributions of the main tributaries are of: 1 m^3/s (31 $mn.m^3$) Vaslui River in Moara Domnească section, 1 m^3/s (31 $mn.m^3$) Tutova River in Cuibul Vulturilor reservoir section.

Except for Prut and Bârlad River, the specific of this hydrographic area is of heavy rains, with big variations from a period to another, from an year to another; the permanent flow is registered only on the main tributaries of Prut (Bahlui and Jijia), the other river mostly having a temporary /semi-permanent flow.

The biggest floods registered in Prut hydrographic basin have been in 2008. In Bârlad hydrographic basin, the biggest values were in 1979, 1985 and 2007; there have been situated between 5% and 1%.

The minimum flow of the Prut hydrographic basin tributaries is much reduced, the most part of them have a non-permanent character. Draughts are also present in Bârlad hydrographic basin. The minimum monthly average discharges of 95% and the minimum average daily of 95% is registered between 0 and 0.5 m^3/s on the majority of Prut tributaries.

Reservoirs

In Prut-Bârlad area are 75 reservoirs from which 49 are complex and have as main purpose flood protection. In Prut basin are 26 reservoirs, the most important being Stânca-Costeşti with a total volume of 1400 $mn.m^3$. In Bârlad basin the main reservoirs are Soleşti on Vasluieț river, Râpa Albastră on Simila and Puşcaşi on Racova river.
Also in Prut-Bârlad area are 262 reservoirs for fishery.

The most important complex reservoirs are:

- **Stânca-Costeşti**, the most important complex reservoir, on Prut River, which provides potable and industrial water for Iaşi and Vaslui cities and for irrigation and the production of electric power;
- **Cal Alb** and **Negreni** both on Başeu River for irrigation, water supply for Săveni town and fishery;

- **Cătămăreşti** and **Hălceni** on Sitna River and Miletin, for irrigation, water supply for Vlădeni locality and fishery;
- **Pârcovaci**, **Podul Iloaiei** and **Tansa-Belceşti** on Bahlui River and tributaries for irrigation, water supply and fishery;
- **Soleşti** on Vaslui River and **Puşcaşi** on Racova River from Bârlad h.b. which provides potable and industrial water for Vaslui town and for irrigation;
- **Cuibul Vulturilor** on Tutova River and **Râpa Albastră** on Simila River which provides potable and industrial water for Bârlad town and for irrigation;
- **Tungujei** on Sacovăț River for the water supply of Tibana and Tibăneşti cities and for irrigation;
- **Căzăneşti** on Durduc River for water supply of Negreşti locality and for irrigation;
- **Mânjeşti** on Crasna River and **Pereschiv** on Pereschiv River for irrigation and fishery.

Derivations and intakes

In the Prut-Bârlad hydrographic space, are as most important **5** derivations with a total length of **53.3** km and having a total installed discharge of **17.0** m^3/s. From the water uses view point, **3** are for the supply with potable and industrial water and **2** for the supply with potable and industrial water and for irrigation.

These are:

- **Cuibul Vulturilor** intake, Vaslui county, which draws off water from Cuibul Vulturilor reservoir (Tutova River) and brings it to the treatment station of Bârlad city for water supply;
- **Prut** intake (**Țuțora-Iaşi**), Iaşi county, which draws off water from Țuțora intake - Prut River and brings it to the treatment station of Iaşi municipality for the supply with potable and industrial water;
- **Bârlad - Râpa Albastră** derivation, Vaslui county, which ensures the filling flows for the Râpa Albastră reservoir from Bârlad River (Captare Zorleni) for the water supply of Bârlad city;
- **Prut – Bârlad** derivation, Iaşi county, which fills in the Soleşti reservoir (Vasluet River) from Prut (Captare Oprişeni) for the water supply of Vaslui town and for irrigation (1500 ha).
- **Siret–Sitna** derivation, Botoşani county, which draws off water from Bucecea reservoir (Siret River) for the water supply of the localities from Botoşani-Dorohoi area and for irrigation in Cătămărăşti system.

Dikes and river regulations

In the Prut–Bârlad hydrographic space there have been made and are in function 182 regulations of river beds with a total length of 900 km and 124 dikes with a total length of 1088 km.

The protected objectives by these works are: 120 localities, 12 urban areas (7 municipalities), 146 industrial units, 150,000 ha agricultural areas, roads, railways and other objectives.

From the regulation and dike works on the Prut–Bârlad hydrographic space there have been retained as most important **15** works with a total of **183.8** km riverbank regulation and **726.6** km of dikes.

These works protect localities, agricultural areas and industrial units, as well as bridges, roads, railways and others. From the protected localities there are Iaşi, Galați, Vaslui and Tecuci towns.

From the main works:

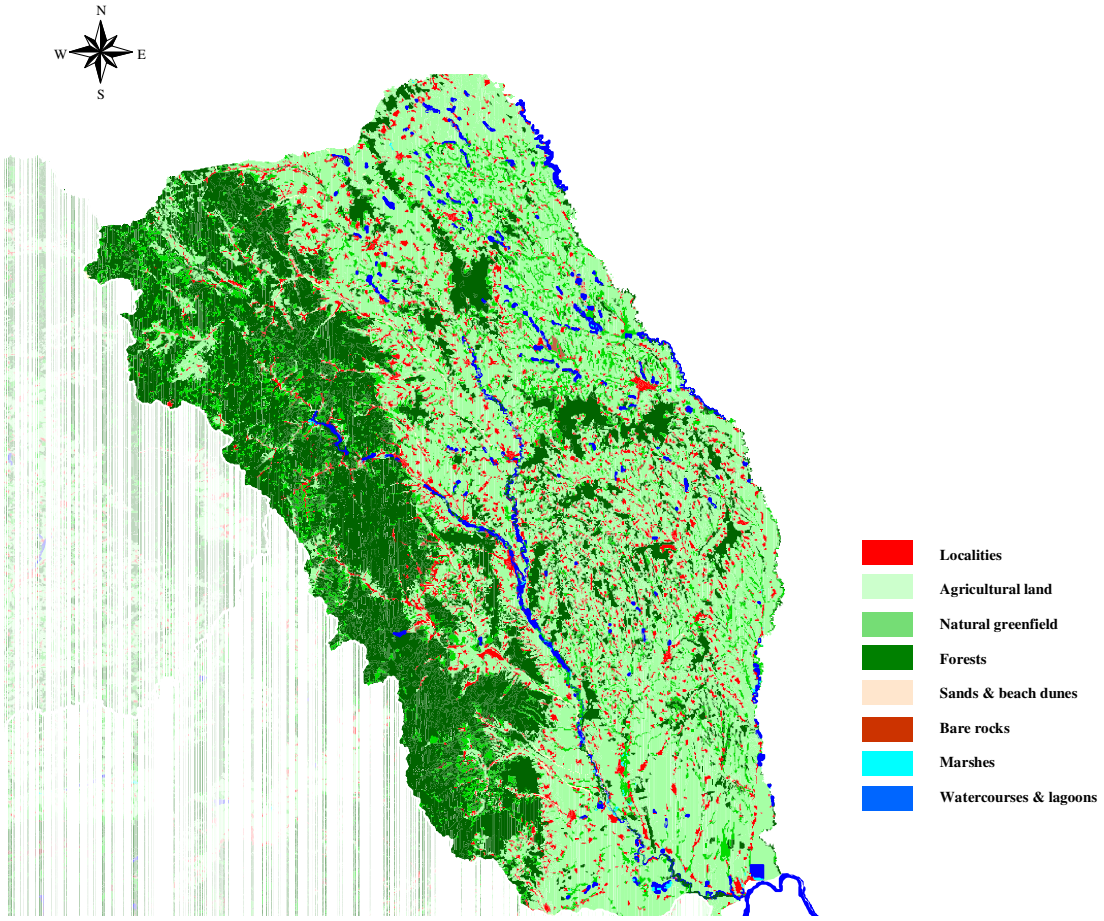
- Regulations and dikes on Bahlui River in Iaşi, Iaşi county (Lreg = 13.8 km, Ldike = 22.4 km);
- Dikes on Prut River on Trifeşti-Suculeni-Țuțora-Gorban sector, Iaşi county (Ldike = 105.7 km);
- Dikes on Prut River on Albița–Fălciu sector, Vaslui county (Ldike = 67.8 km);
- Dikes on Prut River on Brateşu de Sus-Vlădeşti–Şivița sector, Galați county (Ldike = 49.5 km);
- Dikes on Prut River on Brateşu de Jos-Sivița–Galați sector, Galați county (Ldike = 31.8 km);
- Dikes on Jijia River on Bosia-Oprişeni, Tuțora – Sivița sector, Galați county (Ldike = 3.8 km);
- Dike and regulation on Chineja River at Brateşul de Jos-Sivița - Galați, Galați county (Lreg = 18.2 km, Ldike = 12.2 km);
- Regulations and dikes on Bârlad River on Negreşti–Tutova sector, Vaslui county (Lreg= 115.3 km, Ldike = 225.0 km);
- Regulations and dikes on Vaslueț River on Soleşti – Vaslui sector, Vaslui sector (Lreg = 17.7 km, Ldike = 41.4 km);
- Dikes on Bârlad River on Ghidigeni-Munteni sector, Galați county (Ldike = 68.8 km);
- Dikes on Bârlad River, on Albeşti–Crasna sector, Vaslui county (Ldike = 27.0 km).

An important characteristic of the river basins/ hydrographic areas is the construction of fish ponds since historical times, especially in the Başeu, Jijia, Bârlad river basins.

Landuse

The area occupied by forests in Siret basin is about 58% usual situated in the high land (mountains). The perennial cultures are on 12% and the arable land is 23% along the Siret floodplain.
The agricultural land is prevalent in Prut basin (55%) as in Bârlad basin (46%), the forests being in Prut on about 21% from the total surface and in Bârlad basin on 27 %.

The perennial cultures are on 13 % Prut and on 16% in Bârlad basin.



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 Hydrographical Basin level (Governmental Decision 1309 from 2005);
- The Water Law 107 from 1996 modified and completed according to 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.

Between Romania and Ukraine is there an Agreement signed in 1997 regarding cooperation in water management field focusing on cross border watercourses.

The objectives and principles of this Agreement are:

- total cooperation, taking all kind of measures in order to maintain and improve the actual state of water;
- efficient flood protection and rational use of water for users;
- prevention of water pollution;
- information each-other about any kind of hydraulic structures that change run-off conditions or water quality;
- "polluter pays" and precaution principles are the basis of all measures for water quality protection.

A governmental agreement between Romania and Moldova for water management of transboundary rivers does not exist.

Operation of the Stânca-Costeşti reservoir on Prut River is made through the „Common Rules" Romanian and Moldavian, rules which have been signed in 1985 and approved by two governments, according to the Intergovernmental Agreement from 1971, the base for the construction of the Hydrotechnical Knot Stânca-Costeşti (including reservoir).

UKRAINE

The upper part of the Prut and Siret sub-basin located at Precarpathian Region of Ukraine (Chernivtsi and Ivano-Frankivsk Region) (see Fig.1).

The area is situated in the high storm activity area, that causes high risk of flooding and its harmful effects, which cause flooding of a different scale, including catastrophic floods, underflooding and overwetting of territories, destruction of engineering constructions and communications. Flood forming here is an effect of fast water level raising in the rivers. This causes flooding of settlements, industrial facilities and major economic loses. The same problem is in Transcarpathian Region and other countries in the Northern part of the Danube River basin.

It has been discovered that, that destroying floods in the region are caused by a number of natural and human factors. The main factor is excessive atmosphere precipitations (up to 100–300 mm per day) against a background of previous floods, frozen soils, rapid snow melting, deforestation and sand and gravel extraction etc.

The main reasons of very high floods in the region are:

- long rainstorms – 55%
- snow melt and rains – 40% %

- snow melt – 5%

Fig. 1. Ukrainian part of the Prut-Siret sub-basin

Among other reasonable natural factors are down-hill gradient, low water permeability of high subalpine meadows (mountain valleys), condition of vegetation and soil cover. Among prevailing human factors are weak flow regulation, lack of detention reservoirs, poor forestry activities, overploughing soil, haphazard building, blocking up channels by wood, littered lands etc.

Flood protection complex in the Prut and Siret river basins is created for their protection against harmful effect of flood waters, which may occur in any season of the year.

Today flood protection complex includes: protective dikes, bank protection, river regulation, main canals and feeding canals with constructions on them, water storages and ponds.

The flood protection system on the rivers of the Chernivtsi Region includes 70 km of protective dikes, 60 km of strengthened banks and 135 hydrotechnical objects.

They protect against flooding and damaging about 11 600 households in 60 settlements, more than 20 000 hectares of agricultural lands, 13,5 km engineering structures of the state border with Romania and other objects.

According to current regulations today water protective dikes, constructed in different time using different technologies with different probability level can not serve as a safe flood protective complex.

Dikes are usually made of local soils, with slopes planted with grass, sometimes strengthened with stone paving and reinforced concrete plates. Width of the dikes surface is between 2-4 meters, slopes are usually from 1:2 to 1:2,5 m. The surface and slopes of dikes are often deformed by precipitations and vehicles. The surface elevations mostly do not provide elevation over the assessed flood levels with probability of 1%, as a result of dike subsidence and for other reasons,.

Bank protective structures and alignment structures constructed mainly as back walls built of rubble concrete, stone paving, wire-wrapped dams etc. After a series of severe floods, bank protection structures suffer serious damage and need to be reconstructed and fortified.

Existing complex of the protective constructions on the rivers and basins are insufficient and need to be reconstructed. This is stipulated with the fact that most of them were constructed for solving local problems and these constructions do not form integrated complex for safe protection against catastrophic flooding.

As it was mentioned above for the last 10 years catastrophic floods in the Carpathian Region of Ukraine had caused extreme loss to the national economy. Historical flood occurred 23-27 July 2008 caused the loss with total amount about 6 billion UAH. Negative effects of the flood in the Chernivtsi Region:

- total loss – 1,6 billion UAH (damaging of more than 60 flood protection facilities – in total over 170 million UAH);
- 256 km of pavement is damaged;
- 123 small and big bridges are partly damaged and destroyed;
- over 10 thousand houses, 22 thousand hectares farmlands, 20 thousand hectares agricultural lands are underflooded;
- more than 50 transmission facilities and 790 transformer substations are damaged, 28 thousand houses are de-energized.

The main causes of increasing flood losses:

- Causes Chosen by(%)
- Clearance of forest – 40 %
- Building permits issued in high flood-risk areas – 24 %
- Weakened water management – 14 %
- Unsufficient warning system – 12 %
- Global climate changes – 4 %
- River regulation – 3 %
- Others – 3 %

In August 2008 the Government of Ukraine took the decision to develop Complex Flood Protection Scheme and Programme for Dnister, Prut and Siret river basins. The implementation of Programme is started from 2009. The total budget of the programme is about 4,5 bln. Euro.

The program envisaged implementation of flood protection of 223 settlements in Prut basin and 24 in Siret basin.

The Scheme and Programme based on the principle of cooperation between governmental and non-governmental organisations from all levels for solving the problem of the protection against harmful effect of flood based on the basin principle by taking concrete measures, which include the following:

- creation of the system of hydrotechnical constructions for flood protection of territories along the Prut and Siret rivers;
- river basin management of water resources;
- implementation measures for negative flood effect minimization;
- improving flood protection service, including exploitation of flood protection facilities;
- creation of the favourable conditions for development of the settlements infrastructure;
- creation of the automatic information and flood forecasting system;

- coordinated activities of the water management complex actors and measures on prevention of harmful effect of flood waters on territorial level through basin water management departments.

Taking into account modern tendency in flood protection development, which is directed on flood flow management, the Scheme sets the complex approach as a mainstream for solving the flood control problem: flood flow regulation by constructing special detention reservoirs, polders, constructing regulating hydrotechnical constructions, which reduce water flow speed on the major rivers tributaries as well as regulate the river bed, strengthening of a system of flood protective dikes, forest-protection, erosion-preventive and anti-mudflow measures in the mountains, and also protection against harmful effect of flood waters while town planning, organisation of land exploitation, creation of a road net and building of engineering structures. At the same time possibilities of local variants of the protection of separate communities and offers concerning resettlement are analysed in the Scheme.

According to the stated above the main directions in elaboration of the Scheme are the following conceptual statements:

- analysis of the factors and characterising of the losses from floods (natural and anthropogenic);
- elaboration of measures on liquidation of these factors in the catchment area;
- elaboration of measures on the communities and land protection with the use of regulating and protective constructions;
- river bed processes study, bank protection, control of streams and creation of automated information and measuring flood management system (AIMS -Prykarpatya);
- elaboration of measures for eliminating inevitable destruction;
- implementing exploitation measures on the existing constructions;
- monitoring improvement.

The task of the Scheme is to find optimum relationship of these methods for separate river, as well as for each basin in whole.

Global climate changes are observed during the last decades which directly influences the hydrometeorological conditions, flood activity etc. Creation of an effective mechanism for water emergency response, intending all actors (water management and emergency management organisations, local authorities, residents) to take effective and immediate measures for flood preparedness and liquidation of its consequences is extremely needed.

MOLDOVA

Natural conditions

The Prut River originates from the Forest Carpaţi Cernogora (Ucraina) and is flowing into the Danube River from the left bank at a distance of 164 km from the mouth of the river, at a distance of 0,5 km from Giurgiuleşti. At the beginning the course river passes the Cernăuţi region (Ukraine) that is represents a natural boundary between Romania and Republic of Moldova.

The river Prut is 967 km long, the catchment area is 27540 km^2. The river fall is 1577 m, the average slope is v1,63‰, the river tortuosity coefficient reaches the value of 2,1 (fig. 1).

The main right tributaries are: Liucika (56 km), Ceremoş (80 km), Derelui (24 km), Başeu, Jijia, Elanului; the main left tributaries – Turka (41 km), Cerneava (63 km), Beleluia (30 km), Sovitsa (39 km), Staraia Graniţa (33 km), Ryngaci (42 km), Cerlena (36 km), Vilia (50 km), Lopatnic (57 km), Racovăţ (67 km), Ciuhur (90 km), Camenca (93 km), Gîrla Mare (40 km), Delia (30 km), Nîrnova (49 km), Lăpuşna (70 km), Sărata (59 km), Tigheci (43 km).

High waters normally occur in spring caused by snowmelt and in summer caused by heavy rains. The autumn season is characterized lower and more stable waters, nevertheless sometimes floods may occur.

The high waters are registered during the floods caused by rains that are formed in the mountain part of the river basin, where cca. 1000 mm of precipitations/year fall. The average height of the middle high level above the average level constitutes 1,2 - 5,7 m. The most significant floods may be considered those that occurred in 1911, 1913, 1932, 1941, 1948, 1949, 1955, 1969, 1973, 1991, 1994, 2006 (only in the inferior course, due to the Danube river afflux) and the catastrophic flood from July-August 2008.

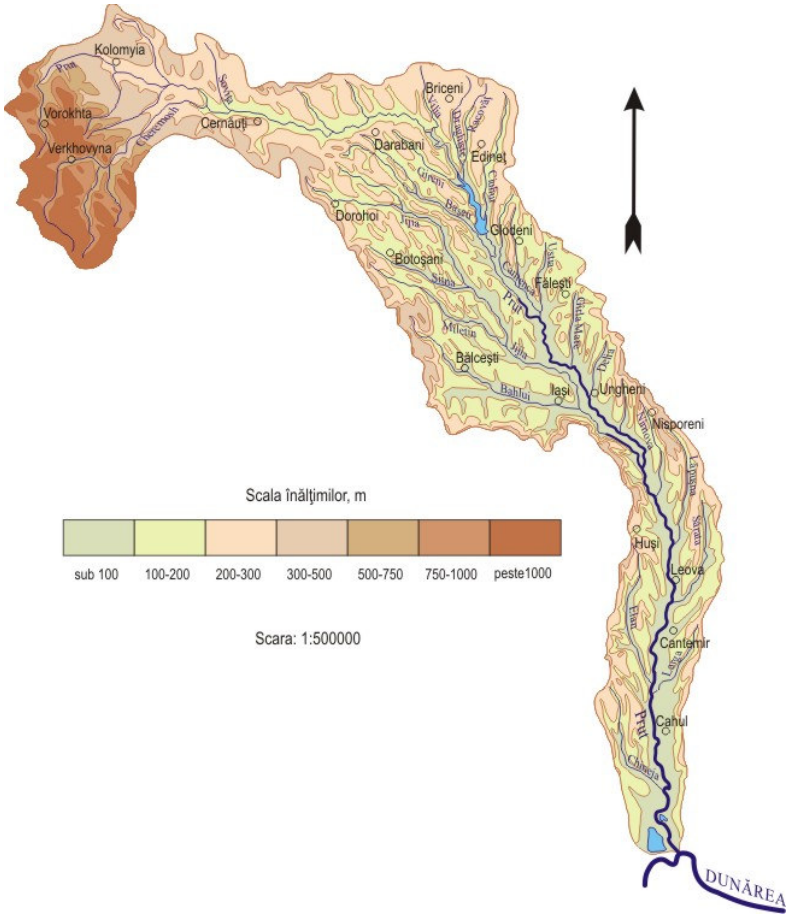


Fig. 1. The map of the Prut River basin

The research of the hydrologic regime of the Prut River – the second river in the Republic of Moldova according to its size and importance, in carried out in three countries: Ukraine (9 posts), Romania (8 posts) and Republic of Moldova (12 posts), fig. 2.

2.1.2. Floodplains and flood defenses

The flood along the Prut River on the Moldavian part is based on an existent system of dumps downstream of the hydrotechnic node Costeşti-Stânca. The dumps were built in 1978 and at present are kept only in some sectors.

In 1978 the hydrotechnic node Costeşti-Stînca was put in commission. The destination of the object is complex – mitigation of the flood high hydrograph point, hydro-energy, irrigation, water provision, etc.

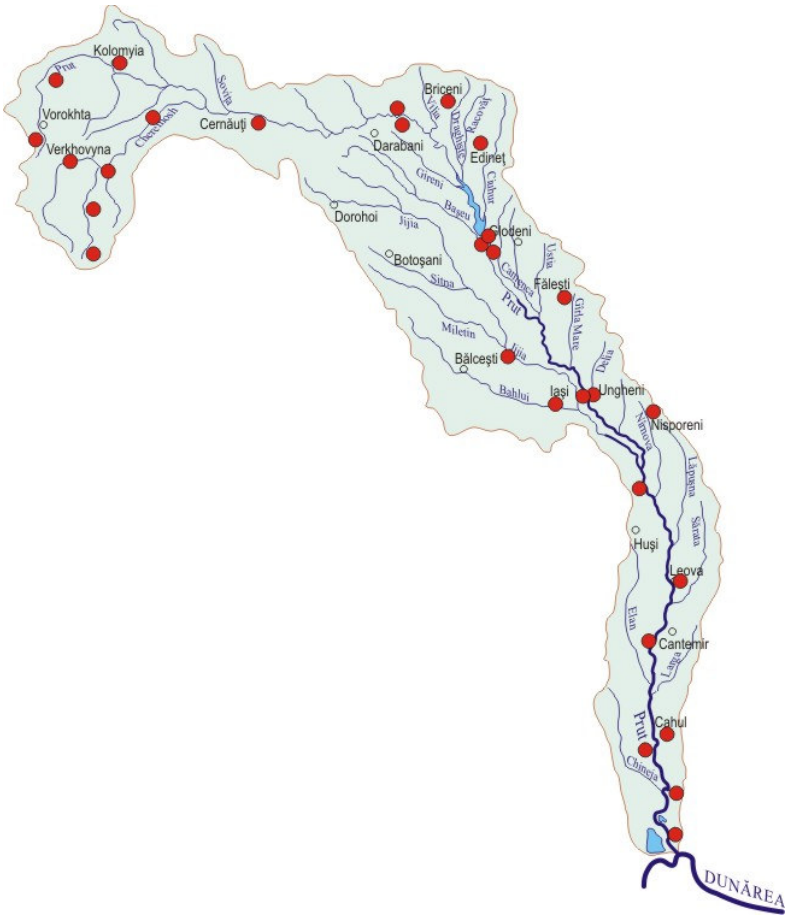


Figura 2. The network of the hydrometric posts distribution on the territory of the Republic of Moldova

The main water hydrologic and management characteristics offered by the State Agency „Apele Moldovei" are the following:

1. The surface of the catchment area – 12000 km^2.
2. The average multiannual flow – 2430 million m^3.
3. The minimal sanitary flow– 5 m^3.
4. Calculation levels:
    a. Normal Level of Afflux (NLA) – 90,80 m.
    b. Dead-Storage Capacity (DSC) – 99,50 m.
    c. Tail Water Level at maximum level discharge – 71,85 m.
    d. Tail Water Level at minimum sanitary level discharge – 62,30 m.
5. The specific pressure:
    a. Maximal static – 30 m.
    b. Minimal worked – 17 m.
6. The area of the water surface at NLA – 5,9 thousands ha.
7. The length of the bank line (the perimeter of the lake surface) – 140 km.
8. The area of the bank zone (depth up to 2 m) at NNR – 0,18 thousands ha.
9. The maximal calculated height of the wave – 2,65 m.
10. The term of silt – 100 years.
11. The total volume of the reservoir– 1285 million m^3.
12. The payload volume of the reservoir – 450 million m^3.
13. The volume of the lost water due to evaporation and infiltration – 104 million m^3.
14. Coefficient of flow usage– 0,8.

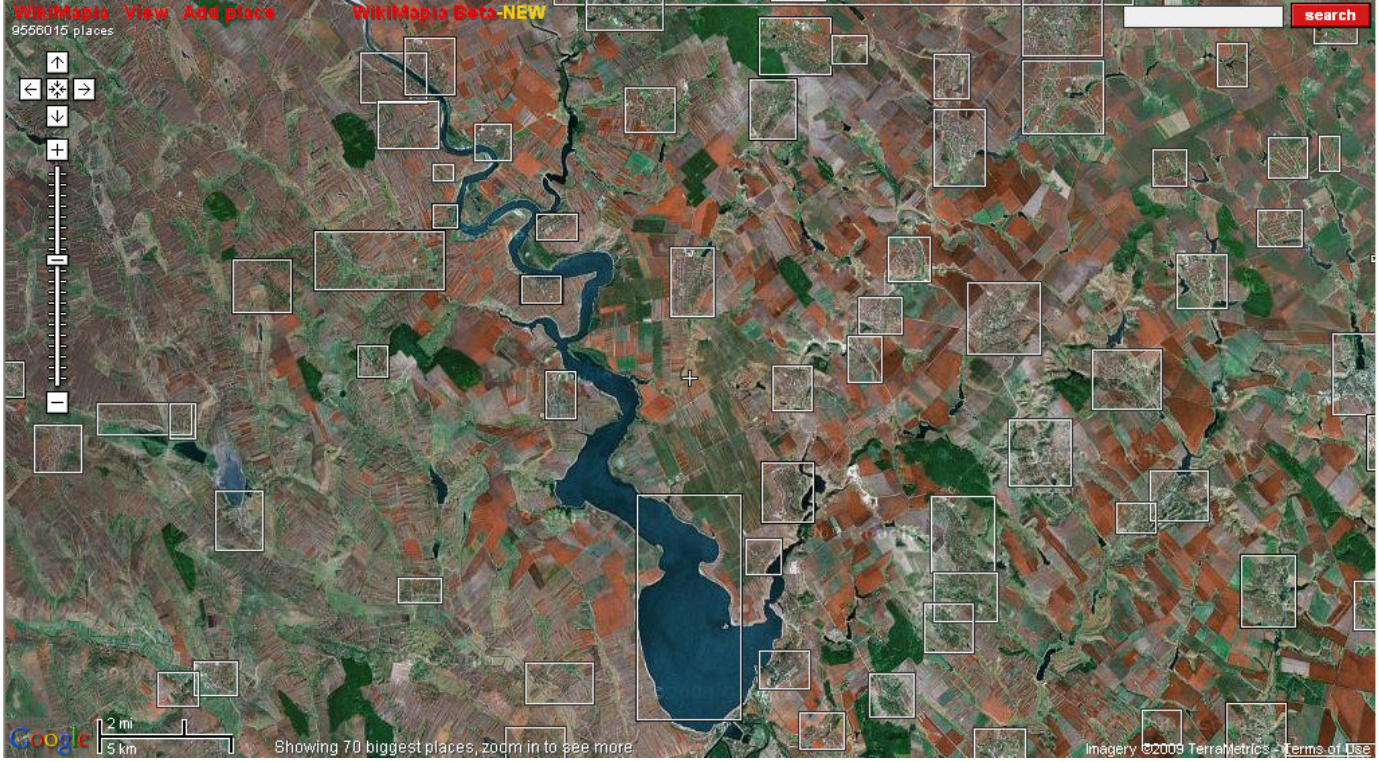


Fig 3. The Costeşti-Stînca reservoir with the respective hydrotechnic node

Characterization of land uses and known risks

The urban and rural localities are developing in the riverine lowlands along the Prut river. The catchment area is mainly used in agriculture.

The floodplain of the river is used mainly for grazing. In some sectors it is afforestated. (fig. 3).

Conditions of flood forecasting and warning

The State Hydrometeorological Service of the Republic of Moldova is responsible for monitoring, measurement, collection, process and storage of the hydrologic and meteorological data. The Service is also the provider of forecasts and relevant information from domestic and foreign territories to all the flood defense participants. The data are collected at 12 stations on the Moldavian part of the Prut river as well as at 17 foreign stations (Ukraine and Romania).

Institutional and legal framework

Protection against harmful water effects is regulated by the: Parliament of the Republic of Moldova Resolution No. 1515-XII; No. 1516- XII of 16.06.1993; No. 1533- XII of 22.06.1993; No. 619 of 16.08.1994; No. 1536- XIII of 25.02.1998. The Law arranges proceedings and measures for flood and ice protection, as well as protection from torrents and erosion.

The participants involved in flood defense are:

- The Ministry of Ecology and Natural Resources
- State Hydrometeorological Service
- Academy of Sciences of the Republic of Moldova
- Institute of Ecology and Geography
- The Stat Agency „Apele Moldovei”
- The State Tiraspol University
- The Technical University

- The Agrarian University
- The Institute for Geodesy and Cadastre
- The Civil Protection Department

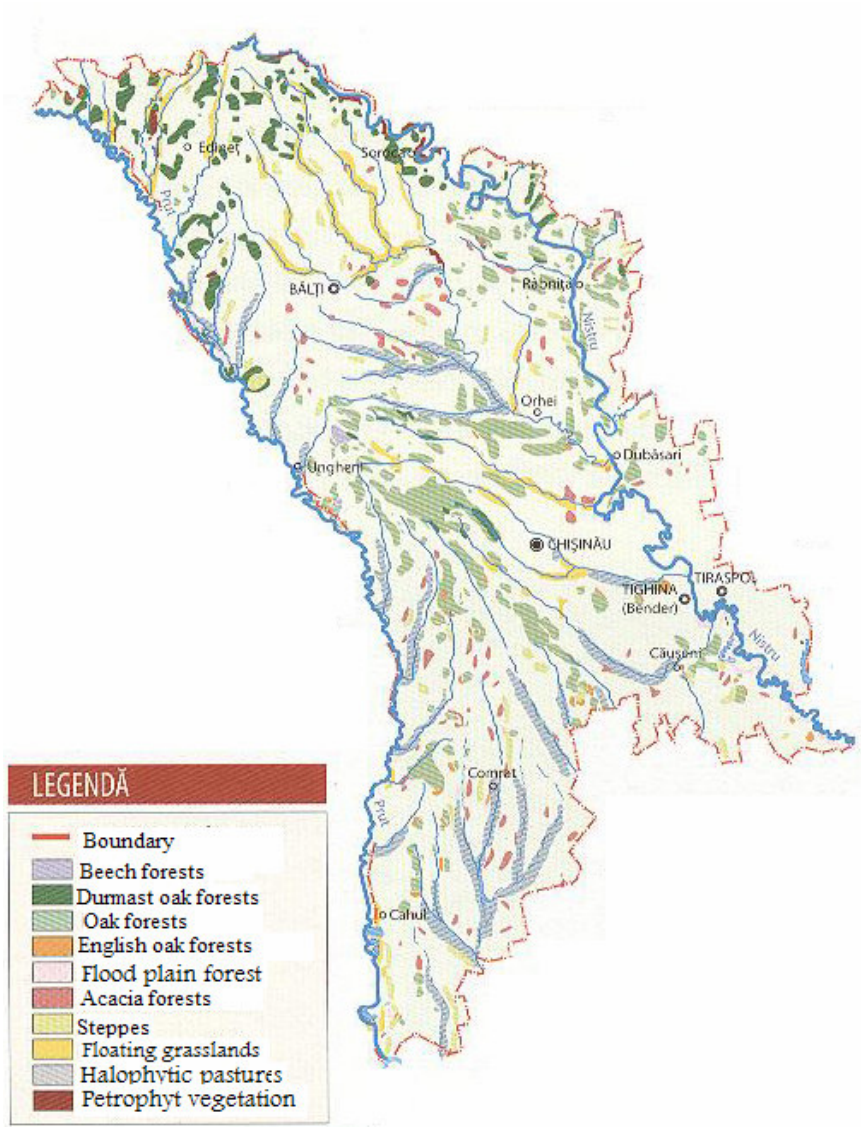


Fig 5. The vegetation of the Republic of Moldova (forests)

Responsibilities of participants are determined in the General Flood Defense Plan and the Annual Plan for Flood Defense. These plans are prepared only for watercourses with the existing flood protection structures. For other areas endangered by floods, local community appoints flood protection measures and proceedings. Also companies whose properties are endangered prepare special flood protection plans

The flood and ice control actions are organized and carried on in three phases, depending on the hazard degree: preparation, regular and emergency defense. Phases of defense are defined in the Annual Plan for Flood Defense, in relation to the river stage on the adjacent gauging station.

Spatial plans relevant for the Prut River Basin are the spatial plans of the mayoralties. Many municipalities within the Tisa River Basin don't have spatial plan adopted so far. Existing plans as a rule lack data on potential or actual flood areas.

Recent awareness of flooding

The high waters are registered during the floods caused by rains that are formed in the mountain part of the river basin, where cca. 1000 mm of precipitations/year fall. The average height of the middle high level above the average level constitutes 1,2 - 5,7 m. The most significant floods may be considered those that occurred in 1911, 1913, 1932, 1941, 1948, 1949, 1955, 1969, 1973, 1991, 1994, 2006 (only in the inferior course, due to the Danube river afflux).

From the list above the 1969 flood may be mentioned. On 8 and 9 June 1969 heavy rains has fallen in the river basin. The quantity of fallen precipitations on 8 June constituted : in Krementsy village – 151 mm, Buiarşki village – 170 mm, Dora village – 172 mm, Iaremcea town – 173 mm, Buhtovets village – 284 mm, Pojijevskaia village – 98,4 mm, Kolomiya town – 74 mm. the intensity of the level increase was 530 mm/day in Iaremcea town, 247 cm/day in Kolomiya. The height of the flood above the gauge zero reached in Krementsy 510 cm, in Iaremcea town – 760 cm, Cernăuți town – 638 cm, Lipcani district – 970 cm, Corpaci village – 996 cm, Ungheni town– 510 cm, Brînza village – 430 cm.

In 1969 the maximal instant record discharge was registered and in Corpaci village it reached the value of 3130 m^3/s.

In the lower part of the river, after the dam constructions in the bed of the river, the river levels increased and reached higher values. So, before the dam construction the high flood level constituted 490-500 cm in Ungheni town, 410-430 cm in Leova town, and after it was 500-530 cm and 400-520 cm respectively.

High levels are registered during spring floods. The increase of the level is very intensive (up to 4 m/day in 1901 in Iaremcea). As a rule, the increase of the water level during spring floods on the Prut River from the Moldovan part varies between 0,5-2,5 m above NAS.

As a rule, the maximal discharges of the pluvial flooding overcome the maximal level of the spring high waters. Thus, in Iaremcea the maximal discharge of the pluvial flooding from 8 June 1969 constituted 1530 m^3/day (module of the flow2560 l/s km^2), and the maximal discharge of the spring high waters registered on 2 April 1952 – 299 m^3/s (module of the flow 5200 l/s km^2). In Cernăuți, the maximal discharge of the pluvial flooding constituted 5200 m^3/s (module of the flow 750 l/s km^2) on 9 July 1969, and the maximal discharge of the spring high waters registered on 6 June 1932 – 1320 m^3/s (module of the flow 191 l/s km^2). In Corpaci village the maximal values are 3130 m^3/s (1969) and 661 m^3/s (1971) respectively.

Also, floods with a low frequency were registered in 1980 and 2008.

In summer 2008 the flood wave had formed in the mountain part of the Prut River basin and the maximal discharge constituted 3890m^3/sec (in Cernăuți on 27July at 8 p.m.). In the same hour the dispatcher service of the Costești-Stînca reservoir started to release water downstream at a rate of 620 m^3/s, increasing to 1 400 m^3/s on 30 July. The reason for the increase was the sudden rise of the water level in the reservoir up to 98.25 m (the maximum acceptable level being 99.5 m). In order to save the dam, several localities were inundated. The increase of water level in the neighboring areas continued until 5 August.

Review and assessment of the predictable long term developments

Possible impacts on a current flood protection level

The regime of Prut floods is determined in the Ukrainian part of the basin (Carpathian mountains). Therefore, the most
significant impacts on safety of flood defense system along the Prut River in Moldova are:

- ***Trend of flood level increase*** (due to natural or anthropogenic factors as disconnection of floodplains, heightening of levees, constructions in inundated areas, deforestation, etc.).

Under influence of new structures or works in the Prut River basin, characteristics of design flood could be changed, lessening the level of flood protection on Moldovan territory.

• ***Ill-timed coincidence*** of flood waves on the Prut River and Ceremoş. The utmost importance have possible changes within the catchment areas of those rivers, since both influence the development of flood waves on the Moldovan part of the Prut River flood waves development. Any river or floodplain engineering activities on the Prut river, contributing to ill-timed coincidence would imperil flood protection lines on Moldovan territory.
• ***Climate change.***

Summary of existing national plans and ongoing programs
• ***Ongoing structural flood protection projects***
1. Modernization of the hydrometeorological observations network in the Prut River Basin on the territory if the Republic of Moldova.
2. Development of a flood risk map in the Prut River Basin on the territory if the Republic of Moldova.

• ***Ongoing non-structural flood protection projects***
1. Pilot project for Răut River and Nistru River Basin „Surface water monitoring and flood protection in Răut River Basin".

3 Target Settings

ROMANIA

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 hydrographic 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.

UKRAINE

The main goal of the Scheme and Programme is the flood protection of communities, lands, roads, communications and other objects within the Prut and Siret sub-basin.

MOLDOVA

Implementing criteria from the Water Management Master Plan of the Republic of Moldova, and taking into account the actual flood protection conditions and problems (especially the size of flood prone areas and possible damages) the long term flood protection strategy **in the Prut River basin** in Moldova will comprise of:
• The existing layout of flood protection structures remains the same, while the following is planned:
- Regular maintenance of the flood protection structures, according to criteria, standards and norms;
- Reconstruction or/and construction of the flood protection structures to decrease flood hazard.
• Gradual and broad implementation of non-structural flood protection measures (as upgrade of the flood forecasting and warning procedures; introduction of flood maps into spatial plans, etc.).

• International cooperation in flood management on rivers which cross the state borders with Ukraine and Romania.

3.1 Regulation on Land Use and Spatial Planning

ROMANIA

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.

UKRAINE

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

1. establishment of protective strips along the banks of watercourses as required by Water Code (Art. 88) and the Land Code (Chapter 13);

2. resettlement of people from flood prone zones, which cannot be protected by technical flood defenses;

3. prohibition to construct houses and industrial sites in flood prone zones;

4. renaturalization of lands by means of reconnection of former floodplain;

5. development of flood risk maps based of modern methods such as aerial photography, flood simulation taking into account different hydrological situations;

6. introduction of environmentally friendly technologies of water and land use;

7. further development of amelioration channel work.

MOLDOVA

Target 1. Spatial plans of municipalities contain flood hazard maps (both for potentially and actually flooded areas) and flood risk maps.
Target 2. Limitations related to land use in flood prone areas are defined.

3.2 Reactivation of former, or creation of new, retention and detention capacities

ROMANIA

The most important polders in Prut-Bârlad basin are: **Bârca**, **Ciurea** and **Cornet** in Nicolina sub-basin - Bahlui basin with a role of flood protection for Iaşi city, **Câmpeni** on Miletin River for downstream area protection and of **Valea Seacă** on Valea Seacă for flood protection of Bârlad town.

One wetland was realised in 2007 on **Jijia river at Ciobârciu** (Prut basin).

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 Galați with this subject.

UKRAINE

1. Construction of the dry detention reservoirs of two types:
   - in the mountain upper rivers – flood protective cannel dam with temporary flooded bowls;
   - in the piedmont, lower part of the basins – temporary flooded polders or riverbed plain reservoir.
2. Construction of high-water dams and bank protective structures.
3. Modernization and construction of the multipurpose reservoir including detention reservoirs.

MOLDOVA

Target 1. Retention capacities along the Tisa are re-considered.

3.3 Technical Flood Defences

ROMANIA

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.

UKRAINE

1. Reconstruction and construction of the new dikes
2. River bank enforcement
3. Erosion, slides protection constructions and measures.
4. Development of water course regulation, cleaning silted cannels

MOLDOVA

Target 1. Provide protection for the adopted design 100-year flood along the Prut River. This is an adequate criterion for the protection of the Tisa riparian lands, considering the size of the potentially endangered areas, number of inhabitants
and infrastructure value.

Target 2. Provide permanent preparedness of the flood defense system.

3.4 Preventive Actions

ROMANIA

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.

UKRAINE

Flood risk management requires organisation of a constantly operating system of monitoring of the factors influencing the hydrological conditions, system of accumulation and processing the primary information. These systems as well as river-bed processes modelling should be a base for forecasting of probable hydrological situations on the concrete parts of the river as well as on the river basin in the whole.

1. It is planned to create a system of automatic meteorological and hydrological stations to provide collecting of objective information enough for giving reliable forecasts. These stations are intended to automatically measure meteorological characteristics, control

water levels and discharge on the specific cross-sections on the rivers, and to transmit the data to the centre of primary information processing through radio- and satellite communications. Forecasting will be conducted at the regional and basin centres and its results will be passed to Ukrainian, Moldavian and Romanian stakeholders.

2. Creation of an information and measuring system intends to install automatic hydrometeorological stations in Prut and Siret river basins, to create 2 centres for collecting information:

- Regional– at the Ivano-Frankivsk RWMD;
- Basin-wide – at the Dniester-Prut River Basin Management Department (Chernivtsy).

The departments for maintenance of meteo- and hydrological stations, communications, automatic systems and for information processing, forecasting and dissemination of its results should be created at the mentioned Centres.

The Centres will also develop forecasting method, software, management mathematical models etc.

The Centres should be equipped with the computers, specialised software and should have own transportation facilities.

3. To provide further development and proper functioning of the flood forecasting system AIVC «Prykarpatya» it is intended to:

- provide the centres with premises and communication facilities;
- construct necessary facilities and install 2 meteorological locators (near Chernivtsy and Gidachiv);
- install automatic meteorological stations for measuring precipitation and temperature at all representative altitude zones of the river basins;
- improve 6 existing stations of system of the Ukrainian Hydrometeorological Centre;
- install 3 automatic hydrological stations on the Prut river, 2 on the Siret river for measuring water discharges at the representative cross-sections;
- create a communication system: Ultra-short waves – from field stations and hydrological stations to the information collecting centres; Satellite – from the information collecting centres to the Crisis Centre of the State Committee of Ukraine for Water Management.

4. Concerning the analysis of currently operating AIVS systems in the border areas of Romania and Moldova as well as Transcarpathian region, the concept intends to coordinate the future system for flood warning and forecasting "AIVS-Precarpathians" with the similar systems of the neighbour countries.
5. Developing warning systems for the population and governing bodies at local, district and regional levels.
6. Protective afforestation, silt filters construction.
7. Meadow formation and afforestation on the bank protective zones on the riversides, slopes, gullys and ravines.
8. Contour melioration on the water catchment areas

MOLDOVA

The non-structural measures (encompassing institutional, preventive, corrective and other measures) should be given an appropriate role in flood control and mitigation. Main activities should be tied to:

• Preventive and operative tasks (setting up or improving the data base on natural events and protection system characteristics, modification of the existing plans for flood coping practices, adoption of reservoir operational rules, development/improvement of flood forecast and warning system);

• Regulative and institutional measures (zoning of floodplains, floodplain management policy, construction standards etc.);

• Managerial and technical education, as well as public awareness building.

3.5 Raising Awareness and Preparedness of General Public

ROMANIA

- 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.

UKRAINE

As observed during the flood in July 2008, lack of public awareness about the flood scale caused people to suffer from water while trying to save their property or acting in a unsafe way.

The Dniester-Prut RBMD and the water management institutions of the Dniester, Prut and Siret river basins plan to hold a training and work-shop aimed at practicing the proper actions in the case of emergency. The event is intended to involve representatives of the local authorities, emergency management departments and the residents of the districts which are at risk of flooding. It is also planned to distribute publications related to floods, flood protection structures, proper actions in the case of flood, including house protection, during the work-shop.

Similar events are planned to be held at least annually with obligatory involvement of the local authorities, emergency management departments etc.

3.6 Capacity building of professionals

ROMANIA

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.

UKRAINE

To provide functioning of the information and measuring system, including maintaining the automatic stations and operation of control service, professionals in multiple fields are needed

(engineers, programmers, hydrologists etc.). Creation of the information and analytical centre within the Dniester-Prut RBMD foresees staff increasing in compliance with the modern requirements to water management officers.

Improving professional level of the DPRBMD staff is intended to be conducted at the Training Institute of the State Committee of Ukraine for Water Management through participation in workshops and trainings, international activities etc.

3.7 Prevention and Mitigation of Water Pollution Due to Floods

ROMANIA

A characteristic is represented by the pollution with heavy metals, especially in Sasar, Crisul Negru, Crisul 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

Priority activities for elaborating the measures for decreasing water pollution during the high water levels are to:

- assess the rate of forestation of the river basins catchment areas;
- assess the state of tilled water protection zones and classification of the substances used in agriculture within the river basins;
- identify and set borders of the water protection zones (WPZ);
- implementing measures on forestation within the WPZ;
- assess and zone the places of dangerous waste storage, sedimentation tanks, solid municipal waste disposal places and enterprises potentially dangerous in the case of adverse hydrometeorological conditions;
- map river basins' underground water bodies, assess the pollution of water bodies which are the source of the river waters;
- modernise the existing waster treatment facilities and construct the new ones;
- equip the laboratory with necessary devices including equipment for bacteriological measurements;
- purchase a mobile laboratory for immediate response on water pollution;
- conduct the analytical calculation necessary for immediate response in the case of environmental emergency within the river basin (factor of pollutant dilution depending on the hydrological conditions, time of hazardous substance diffusion, etc.). Creation of the relevant software.

4 Measures to Achieve Targets

4.1 Regulation on Land Use and Spatial Planning

ROMANIA

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)

MOLDOVA

Targets	Measures	Costs (k€)	Deadline	Comments
Spatial plans of municipalities contain flood hazard maps and flood risk maps	Defining water estate		Continuous	
	Introduction of flood maps into spatial plans of municipalities		Continuous	
Limitations related to land use in flood prone areas are defined	Preparation of instructions for limitations on land use		Continuous	
	Land use limitations applied		Continuous	

4.2 Reactivation of former, or creation of new, retention and detention capacities

ROMANIA

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

MOLDOVA

Targets	Measures	Costs (k€)	Deadline	Comments
Retention capacities along the Prut are re-considered			Continuous	

4.3 Technical Flood Defences

ROMANIA

Measures	Type of intervention	Institution in charge	Costs (mn.USD)	Deadline	Comment
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	

Measures	Type of intervention	Institution in charge	Costs (mn.USD)	Deadline	Comment
Slănic river control on Slănic Moldova-Tg. Ocna sector, Bacău county	Technical	Romanian Waters	3.855	2010	Hazard Risk Mitigation & Emergency Preparedness Project – World Bank
Prut river control , downstream Petreşti locality, Iaşi county	Technical	Romanian Waters	1.290	2010	Hazard Risk Mitigation & Emergency Preparedness Project – World Bank
Increase of safety degree for Cătămărăşti dam, Botoşani county	Technical	Romanian Waters	0.969	2010	Hazard Risk Mitigation & Emergency Preparedness Project – World Bank

Measures	Type of intervention	Institution in charge	Costs (mn. €)	Deadline	Comment
Vârful Câmpului control , Suceava and Botoşani counties	Technical	Romanian Waters	31.06	2010	External funds
Bistriţa river and tributaries on Iacobeni-Sabasa sector, Suceava and Neamţ counties.	Technical	Romanian Waters	22.75	2010	External funds
Ozana river bank protection in Târgu Neamţ town, Neamţ county	Technical	Romanian Waters	3.38	2010	External funds
Moldova river and tributaries control on Fundul Moldovei-Gura Humorului sector, Suceava county	Technical	Romanian Waters	45.33	2012	External funds
Bicaz river and tributaries control at Taşca, Neamţ county	Technical	Romanian Waters	2.05	2009	External funds
Trotuş river and tributaries control on Ghimeş-Urecheşti sector, Bacău county	Technical	Romanian Waters	144.57	2010	External funds
Moldova river control for intake protection at Baia (for Fălticeni town)	Technical	Romanian Waters	6.50	2010	External funds
Râmna river control on Târâtu-Dumbrăveni sector, Vrancea county	Tehnical	Romanian Waters	1.61	2009	External funds
Prut riverbank consolidation downstream Stânca-Costeşti dam, Botoşani county	Tehnical	Romanian Waters	4.37	2009	External funds
Increase of safety degree of Mileanca reservoiron Podriga river, Botoşani county	Tehnical	Romanian Waters	1.68	2009	External funds
Increase of safety degree of Negreni and Cal Alb, Botoşani county	Tehnical	Romanian Waters	3.02	2009	External funds
Increase of safety degree of Hydraulical Knot Munteni and of the flood defences, Galaţi county	Tehnical	Romanian Waters	3.22	2010	External funds
Increase of safety degree of Tansa Belceşti reservoir, Iaşi county	Tehnical	Romanian Waters	2.78	2009	External funds
Increase of safety degree of the reservoirs from Racova h.b., Vaslui county	Tehnical	Romanian Waters	4.94	2010	External funds

Measures	Type of intervention	Institution in charge	Costs (mn. €)	Deadline	Comment
Increase of safety degree of Râpa Albastră reservoir, Vaslui county	Tehnical	Romanian Waters	0.98	2010	External funds
Increase of safety degree of Pereschiv reservoir on Pereschiv river, Bacău county	Tehnical	Romanian Waters	0.65	2009	External funds
224 objectives (polders, riverbank regulations, dams) at national level	Technical	Romanian Waters	2000	2013	9 dams, 4 polders, 211 regulations works

UKRAINE

Measures	Type of intervention	Institution in charge	Costs (€)	Deadline	Comment
Major rivers (Prut and Cheremosh) bank protection with total length of 20 km		DPRBMD	25428571	2009-2015	
Small rivers bank protection with total length 15 km		DPRBMD	8880000	2009-2015	
Construction and restoration of dikes on major rivers (Prut and Cheremosh) with total length of 87 km		DPRBMD	90742857	2009-2015	
Construction and restoration of dikes on small rivers with total length of 8 km		DPRBMD	6914286	2009-2015	
Riverbed regulation with total length of 182 km		DPRBMD	24662857	2009-2015	
Cleaning silted water bodies		DPRBMD	5257143	2009-2015	
Construction of 10 detention reservoirs		DPRBMD	12000000	2009-2015	
Constructing of detour road, which will also serve as a protective dike with total length of 10 km		DPRBMD	30857143	2009-2015	
Construction of a dry mountain detention reservoirs		DPRBMD	114285714	2009-2015	
Construction of a dry plain detention reservoirs		DPRBMD	205714286	2009-2015	
Landslide and soil erosion prevention activities		DPRBMD	28571429	2009-2015	
Construction of 3 hydrological posts		DPRBMD	171429	2009-2015	
Recovery and construction of 2 small hydroelectric power stations		DPRBMD	2285714	2009-2015	
Modernization of the existing hydraulic facilities with total lenghth of 35 km		DPRBMD	20000000	2009-2015	
Total			**575771429**		

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Targets	Measures	Costs (k€)	Deadline	Comments
Provide protection for the adopted design 100-year flood along the Prut River	Reconstruction of levees on the left bank of Prut		Continuous	
Provide permanent preparedness of the flood defense system	Maintenance of flood protection structures		Continuous	According to specific standards and norms.
	Maintenance of dam on Prut and weirs on tributaries		Continuous	According to specific standards and norms
	Purchase and repair of machinery, tools, materials, equipment and communications		Continuous	According to specific standards and norms.
	Rehabilitation of weak points at levees		Continuous	

4.4. Preventive Actions

ROMANIA

Measures	Type of intervention	Institution in charge	Costs (mn.€)	Deadline	Comment
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 Asessment - Run-off control - Improvement of flow conditions in river beds - Improvement of the flood defence capacity - Reduction of flood vulnerability of infrastructures and agriculture	Administrative Technical	Ministry of Environment Ministry of Agriculture Ministry of Administration and Interior Romanian Waters		2020	

Measures	Type of intervention	Institution in charge	Costs (mn.€)	Deadline	Comment
- Reduction of flood vulnerability of the environment - Social vulnerablity to floods - Individual vulnerability mitigation - Funding & compensation - International Cooperation					
DESWAT – Carrying of a hydrologic information-decisional system for the management of emergency situations (204 automatic stations in Prut-Siret sub-basin)	Technical	Romanian Waters	45	2011	
Information System for Integrated Water Management (WATMAN)	Technical	Romanian Waters	138.4	2015	
DANUBE FLOODRISK flood risk reduction: risk assessment, risk mapping, involvement of stakeholders, risk reduction by adequate spatial planning.	Administrative Public	Romanian Waters	6.38	2012	
WIMS – Investment supporting the information system and database for water management (PHARE project) at national level	Technical	Romanian Waters	2.4	2009	
Trotuş and Tazlău river and tributaries improvement (PHARE project)	Technical	Romanian Waters	3	2009	
Contributions to the development of the flood risk management strategy – pilot basin Siret	Technical	Romanian Waters	1.7	2009	
High-flood forecasting and flood management in Romania – feasibility study - the analysis for implementing of the decision support system	Administrative Technical	Romanian Waters	0.1	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	

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Targets	Measures	Costs (k€)	Deadline	Comments
Reduce flood risk	Implementation of operative flood defense measures		Continuous	
Introduce principles of EU flood directive	Preparation and adoption of new Water Law		Continuous	
	Preparation of bylaws according to new Water Law		Continuous	
Build capacity of professionals and institutions responsible for flood management	Regular upgrade of General and Annual Flood Defense Plans for the Republic of Moldova		Continuous	State level – increased efficiency of operative flood defense.
	Preparation and regular upgrade of General and Annual Flood Defense Plans for municipalities		Continuous	Municipality level – increased efficiency of operative flood defense
	Characterization of current situation			
	Update/preparation of technical documentation for all existing flood protection structures (incl. data on water estate)		Continuous	
	Update/preparation of flood defense manual		Continuous	
	Preparation of bylaw for establishment and management of cadastre of water structures		Continuous	
	Preparation of cadastre of flood protection structures		Continuous	
Upgrade flood monitoring, forecast and warning	Improvement of the system of automated weather and gauging stations		Continuous	Measured data available to relevant services in real time.
	Improvement of the system of hydrological and weather forecasting		Continuous	Introduction of the latest technologies in forecasting. Forecasts available to relevant services
	Improvement of alarm systems and systems for issuing timely warning to population at risk		Continuous	
Introduce regulations for emergency situations response (natural disasters)	Preparation of strategic, tactical and operative disaster management plans for catastrophic flood		Continuous	- Criteria for declaration of an emergency; - Information routes; - Methods of public warning; - Evacuation routes; - Preparedness of public services.

Targets	Measures	Costs (k€)	Deadline	Comments
	Training exercises		Continuous	- Organizing operations of the police and fire fighting forces as during floods; - Organizing evacuation of population; - Organizing life (medical services, and emergency recovery).
Preparation of the Flood Risks Management Plan	Preliminary flood risk assessment		Continuous	Activities started. Required harmonization with neighboring countries.
	Preparation of methodology for flood risk mapping		Continuous	Standard hydrological and hydraulic models should be revised or new should be developed for computation of reference high water levels. Also, methodology for digital mapping should be developed according to standard specifications. The following results/conclusions will be used: - Common position on flood risk mapping (ICPDR); - Flood risk project; - Common approach of Danube/Prut countries.
	Adoption of bylaw on methodology for flood risk mapping		Continuous	
	Preparation of flood hazard maps		Continuous	Financing?
	Preparation of draft Flood risk management plan		Continuous	Tisa countries will prepare an integrated plan.
	Public information and consultation on draft Flood risk management plan for the Prut River basin in Moldova		Continuous	Flood risk management plan and Flood risk maps should be discussed in public. The results, benefits and consequences of preparation of the flood risk maps as a legal act should be presented to a broad public
	Bring into force Flood risk management plan for the Prut River basin in Moldova		Continuous	
Update/build scientific base for flood management	Preparation of studies and design		Continuous	
Improve international cooperation in flood management	Bring into force bilateral agreement with Ukraine and Romania		Continuous	
	The Prut River basin wide online flood related		Continuous	Improvement and formal agreement

Targets	Measures	Costs (k€)	Deadline	Comments
	meteorological and hydrological data exchange			
	The Prut River basin wide on line operative flood defense information exchange		Continuous	Improvement and formal agreement

4.5. Raising Awareness and Preparedness of General Public

ROMANIA

Measures	Type of intervention	Institution in charge	Costs (mn.€)	Deadline	Comment
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 Inspectorate for Emergency Operations	0.50	Continuous	
Flood Protection leaflets	Public participation	Ministry of Environment	0.01	Continuous	
Setting-up New Eco-centres	Administrative	Ministry of Environment	0.02	Continuous	

MOLDOVA

Targets	Measures	Costs (k€)	Deadline	Comments
Improve awareness of stakeholders on floods	Introduction of flood insurance			
	Introduction of water management issues into schools		Continuous	From elementary school to university.
	Preparation of flood leaflet, film, TV broadcasts etc.		Continuous	

4.6. Prevention and Mitigation of Water Pollution Due to Floods

ROMANIA

Measures	Type of intervention	Institution in charge	Costs (mn€)	Deadline	Comment
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