

## THE EVALUATION OF THE FUNCTIONAL AND ECOLOGICAL STATUS OF THE TIRASPOL SECTION OF THE DNIESTER PROTECTION EMBANKMENT

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**Abstract:** The article discusses the contemporary problems connected with the Dniester's embankment protection of the Tiraspol segment. A special attention is paid to the probable scenarios of the under-flooding of the city area. A set of measures is suggested for the prediction, protection and overcoming of the flooding consequences.

**Keywords:** anthropogenic impact, catastrophic flooding, embankment (dam), floodplain, hydrological mode, residential area, residential district

The magnitude and frequency of floods on the rivers of Europe is steadily increasing. This is due both to changes in climate, terrain, and inefficient exploitation of land and water resources. The specificity of the rivers consists in the extremely important cross-border function. The reduction of the capacity of river channels due to high anthropogenic pressure weakens this feature. The situation requires the development of an integrated concept of prevention of catastrophic flooding through preventive assessment of actual and potential risks (Hägl and Spenser 2004).

The anthropogenic impact on the mainstream of the Dniester River within the residential areas of cities is manifested in a

radical change in the river valley landscapes and in the creation of artificial forms of relief. Such a form of relief is a protective dam. Its construction began in 1930, and its modern form was built later in the 50-60s. It was created to protect the city (and surrounding villages) and the agricultural land located in the Dniester valley from catastrophic floods, as well as for the regulation (fixing the channel) of the Dniester river bed with a view to shipping activity during the second half of XIX century until the mid of the twentieth century. During the spring high floods water covered the entire Dniester floodplain up to the street Sadovaya (modern May 1 Street) in Tiraspol city. Later, the dam also began to perform recreational functions. Its construction has accelerated after the disastrous floods in 1969, which resulted in severely affected areas of the city of Tiraspol and the villages of Slobozia district in Moldavia. By the 1970s the construction of the dam was almost completed (Zaiat 2000; Rusev 2008).

Initially, the width of the dam foot ranged from 50 to 100 m, and the height -

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from 3 to 7 m. The dam was built of clay, sand and gravel rocks. The profile consists of three large artificial terraces with “pockets” to absorb the excess flood water. At the most high (5-7 m) the inner terrace is mounted by a dirt road. The top and slopes of the dam were planted with trees and shrubs with the aim of strengthening them, primarily willows, poplars and elms. The dam holds back floods with the rise of the water line up to 3-4 m. The very construction the dam had created a number of serious environmental problems in the valley of the Dniester River. The dam has broken the surface runoff in the river valley, which, combined with a selection of river water for melioration needs, has led to a reduction of the water input of the Dniester. The narrowing of the channel and the change of the water speed has altered the micro relief of river bottom. The dam not only defended the floodplain agricultural lands from spring and seasonal floods, but also deprived these areas of the river water rich in highly fertile silt. This violated the Dniester floodplain ecosystem and reduced the fertility of floodplain soils. The alluvial floodplain-meadow soils have a low humus layer and require additional irrigation and fertilizers. The construction of the dam and its erosion have resulted in increasing turbidity of river water up to 200-300 g/m<sup>3</sup>, which has affected the fish fauna extremely negatively, and has been especially fatal to young fish and benthos. Freshwater fish has lost the natural floodplain spawning grounds, which was annually created by the spring spillage of the river. Without provisional natural floodplain ponds the wading birds, amphibians, reptiles and mammals have remained without water and lost their places during breeding season and their habitats in the grasslands (Topciev 1996; Trombičkii 2008).

For half a century the dam has not been reconstructed. Considering the fact that the Dniester near Tiraspol meanders (the sinuosity coefficient 2.8), the bend of its bed was attempted to be consolidated as it was by the mid of the previous century. This has radically altered the hydrological regime and

the river bottom relief. The width of the river at Tiraspol section had narrowed to 100-150 m. As a result the river erosion, not only had slowed down, but in certain areas was intensified. A sort of “clots” was formed in the river, retaining its natural flow. The narrowing of the river bed has led to an increase in the flow velocity (up to 2 m/sec) and the flood level, which encourages the erosion of its banks. Thus, near the Tiraspol district “South”, the river erosion has led to a dangerous erosion of the dam and the destruction of its “body” up to 50 % (Atlas Pridnestrovskoi Moldavsko i 2000; Krivenko 2001; Sadikin and Kolivenko 2008).

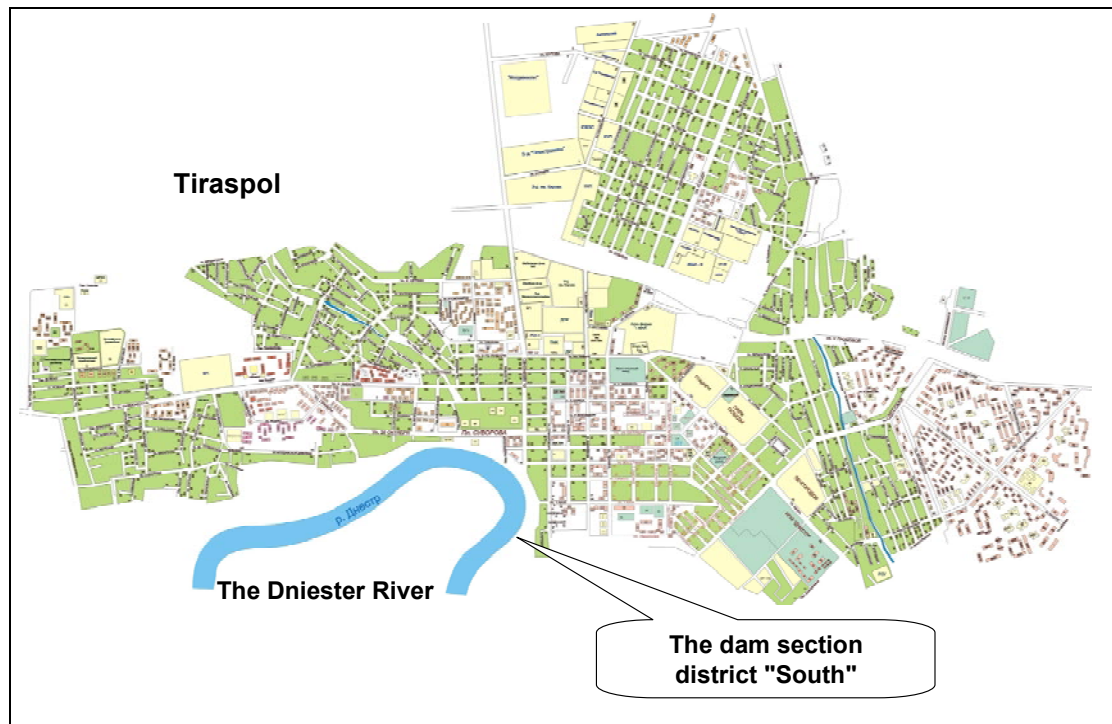
In addition to these negative factors, it should be noted that the Dniester mainstream has not been cleaned and profiled for the past twenty years. This has led to its siltation, which in turn became an obstacle for the pass through its cross-section of large volumes of water during the floods. In July-August 2008, the above causes, as well as the forced discharge of large amounts of water at Novodnestrovskaya PSP (pumped storage power plants) (Ukraine) led to a catastrophic rise in water level in the river - by 7-9 m, and in the vicinity of Tiraspol - up to more than 12 m. As a result the bank protection structures have been partially breached and the water flooded the floodplain fields and gardens and directly approached the high rise apartment buildings of Tiraspol district “South” up to the town maternity hospital, which created a threat of flooding (Fondovaie materialŭ Tiraspoliskogo gorodskogo Sovietsa narodnah deputatov 2008) (Fig. 1).

The current situation on dam section of Tiraspol district “South” can be assessed as critical. By May 2008, after a spring flood, the 40 meters stretch of the dam had been destroyed by more than one third of its width. If the downstream of the river from the opposite bank sediments form shallows, then the erosion vulnerable area forms/ will form a deep whirlpool of 8-10 m deep. The situation was aggravated by the lack of vegetation which strengthened the dam on this site. Sheet erosion leads to washouts,

washing down and bank slips. The monitoring of the state of the dam is carried out by the Ministry of Agriculture and the Natural Resources Division of TMR and the Section of Architecture and Urban Planning

of the Tiraspol City Council (Fondovaie materialî Tiraspoliskogo gorodskogo Sovietsa narodnah deputatov 2008; <http://tiraspol.ru/content/view/55/1/>).

**Figure no. 1** The map of Tiraspol



In addition to the mechanical erosion of the dam on hydrological reasons, it is still under the influence of the degradation of a number of factors. Today this area is experiencing a significant recreational dam overload. In this case there has been no organized recreational infrastructure. Mass recreation on the river bank is accompanied by the cutting of trees and bush plantations, by the violation of the soil and grassland cover, pollution of the dam surface and of the waters with solid waste, as well as chemical contamination and mechanical destruction of the dam under the influence of vehicles. Biocenoses of the dam were formed resulting from human activities. Significant damage to grass and tree and shrub cover causes an unauthorized grazing of cattle and

small ruminants. Biocenoses of the dam are violated by the unauthorized fishing, hunting, collecting herbs and mushrooms, as well as pet-ranging (Hägl and Spenser 2004; Topciev 1996; Trombițkii 2008).

Valuable agricultural flood plains, protected by a dam, are the most important reserve for the town. The dam has changed the hydrology of the floodplain - disturbed the drainage of the river valley and dropped groundwater levels. On the one hand, it has created favourable conditions for high-rise residential construction in the floodplain, on the other - has required additional melioration of the flooded farmlands. Gradually, both residential development and its infrastructure, together with the household areas, begin on the flood lands.

The lower terraces of the Dniester River are assigned for construction. To do this, urban construction companies build up layers of soil, preferably using rubble from other districts in Tiraspol. Thus there is an uneven subsidence of rocks of varying porosity, which complicates the further construction of the territory. In August 2008, the Tiraspol dam section did not suffer destruction. However, though the drainage pipes feed water into the Dniester floodplain irrigation canals, there was a sudden discharge of large masses water into irrigation channels of the floodplain. As a result, there were flooded boreholes and private cottages on the Transnistrian Institute of Agriculture and under the threat of flooding were the City Maternity Hospital and the high-rise residential buildings in “South” neighbourhood.

The lessons of the catastrophic floods of the summer of 2008 sum up the following conclusion: the savings on preventive measures of warning and protection against spring flooding and floods in the future will lead to greater costs many times to overcome their devastating effects (Trombičkii 2008). However during 2009-2012 no significant measures to strengthen and build the dam, to clean and deepen the riverbed were implemented.

The decision of the city council of People's Deputies of Tiraspol, the

Environmental Fund of a number of companies and organizations involved in activities to prevent and eliminate the effects of summer floods in 2008 have allocated funds to strengthen the dam.

From the Environmental Fund Tiraspol provided 100 thousand dollars. However, they have not been utilized for their intended purpose. Control over execution of decisions has been entrusted to the permanent commission of the City Council on Finance, budget, tax policy and economic development. About 5500 dollars of the total amount will be used to conduct exploration work that will determine the status of dams affected by the floods, as well as identify works that will be needed to strengthen or repair them (Fondovaie materialŭ Tiraspoliskogo gorodskogo Sovieta narodnah deputatov 2008).

On July 28, 2008 in Transnistria was declared an emergency due to flooding that occurred as a result of heavy rains and melting snow in the Carpathians. As a result, the Western Ukraine, Transnistria and Moldova suffered. In Transnistria, were flooded more than 800 homes, and about two thousand people were evacuated (Figs. 2 and 3).

**Figure no. 2** Flooding in 2008, the Central Square of Tiraspol



**Figure no. 3** Country house in one of the Transdnestrian villages in the flood zone, 2008

1200 members of rescue squads, militia and civil defense, 210 pieces of heavy equipment were involved in restoration works. Citizens who had lost their shelter in the floods, received 200 thousand rubles PMR (20 thousand dollars), and those whose homes were subject to recovery received 25 thousand rubles PMR (2500 dollars) (Fondovaie materialî Tiraspoliskogo gorodskogo Sovieta narodnah deputatov 2008; <http://tiraspol.ru/content/view/55/1/>).

### Conclusions:

According to expert engineering and construction estimates, the reconstruction of the dam section district "South" would require the following measures: the "sealing" of the erosion parts with two thousand m<sup>3</sup> of clay and sand and pebble mixture, creating a

reinforced concrete lining of most vulnerable areas, the restoration soil retaining belts, while the organization (the establishment of recreational infrastructure) and the regulation of public recreation, re-establishing the water protection zone.

Across the Dniester basin it is recommended to extend the areas of interstate cooperation between Ukraine, Moldova and Transdnestria through the creation of a specialized river commission. For this it is necessary to:

- carry out permanent monitoring of the river system;
- implement an electronic database of the Dniester River Basin;
- develop an electronic map of the potential flood areas;
- design a system of measures aimed at preventing catastrophic flood-situation development options;

- develop plans for areas adjacent to the Dniester river bed;
- a system of evaluation to justify the forecast environmental and economic consequences of possible floods;
- provide educational and social programs in environmental management in the basin of the Dniester.

### Rezumat:

#### EVALUAREA STĂRII FUNCȚIONALE ȘI ECOLOGICE A DIGULUI DE PROTECȚIE A NISTRULUI DIN SECȚIUNEA TIRASPOL

Articolul prezintă problemele contemporane referitoare la digul de protecție a Nistrului din secțiunea Tiraspol. Se acordă o atenție deosebită scenariilor posibile de inundare a zonei orașului. O serie de măsuri sunt recomandate pentru predicția, protecția și soluționarea problemelor legate de consecințele inundațiilor.

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