Development of a pilot wetlands area to protect biodiversity in the southern basin of Prut river

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Abstract: - The issue of environmental protection and biodiversity conservation in the catchment of Prut river has both environmental and geopolitical implications due to the geographic position. This paper summarizes a large amount of information which constitutes the basis of documenting a report aimed at arranging a pilot wetlands area to protect biodiversity in the southern basin of Prut river. Premises are represented by the natural elements that support the development of sub-basin Horincea as pilot wetland basin in the Lower Prut sector (the conditions of relief, climate and hydrological features, flora and fauna composition, focusing on ichtyofauna). The advantages and threats regarding the development of these wetlands are presented based on legislative criteria as well as from the point of view of the exploitation of natural resources in this basin.There are presented both tehnical and institutional solutions. The institutional decision makers are identified as the two relevant ministries (Ministry of Agriculture and Rural Development, Ministry of Environment and Forests), two national companies (Romanian Waters National Company and Romsilva National Company) and entities within the general jurisdiction of the local authorities. The responsibilities of each of the above and the types of action required to fulfil the objective are presented further in this paper.

Key-Words: - environmental protection, biodiversity, wetland, Prut river, Horincea river, natural park, development.

1 Introduction

By nature protection we understand preserving representative natural entities (species, natural environments) of special scientific and landscape value whose existence is in danger. Preserving nature is a complementary action to the one of protecting the environment thus facilitating to the next generations a patrimony that otherwise might be lost.

Analyzing the system and the competencies of public local and central there can be identified the bodies and institutions which are bound to prepare priority programmes of reclaiming, using, protecting and developing these areas. Two ministries are involved directly in this process: (Ministry of Agriculture and Rural Development, Ministry of Environment and Forests), two national companies (Romanian Waters National Company and Romsilva National Company) and entities within the general jurisdiction of the local authorities.

2 Problem Formulation

2.1 Background of developing the sub-basin Horincea as the pilot wetland area in the Lower Prut River Basin

Horincea hydrographical basin, in the county of Galati, is included in the geomorphologic unit of the Moldavian Plateau, with its sector Covurlui Plateau, which is broken down into Covurluiului hills and Covurluiului plain. The hydrographical basin crosses two major structural units: Barladului Platform and Covurlui Platform [1].

Horincea river, an affluent of Prut river, is located in the south and has a total length of 35 km and the surface of the basin area of 253 square kilometres (Fig. 1).

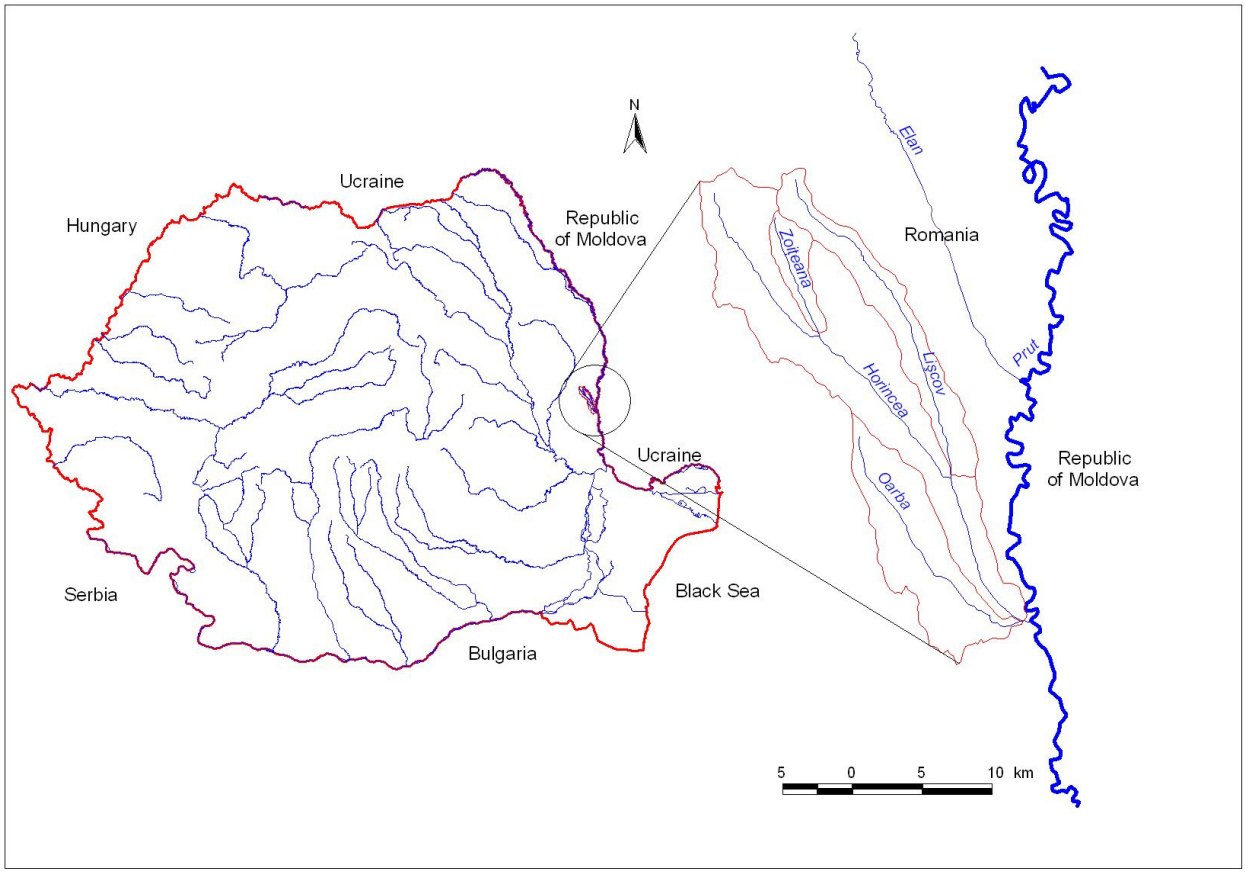

Fig. 1 The geographic position of Horincea sub-basin

The morphometric elements of the river system and basin surfaces are presented in Table 1. Thus, the main parameters of the river system (river Horincea collector and its affluents: Zoiţeana, Lişcov and Blind - column 1) are calculated in column 2 and the parameters of the main river basin and the three affluents are summarized in column 3. In addition, there have been calculated the form coefficients of the basins (in column 4) form factor (FF), the form report (Rf), circularity ratio (Rc) and the sinuosity coefficient of the watershed (Ks) [2].

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Tabel 1 The morphometric elements of the river system and basin surfaces

River **(1)**	Morphometric parameters of the hydrographical network **(2)**			Morphometric parameters of the hydrographical basin **(3)**				Form coffiecinets of river basins **(4)**			
	Length (km)	Slope (‰)	Ks	Surface (sqm)	Average altitude (m)	Perimeter (km)	Length (km)	Ff	Rf	Rc	Ks
Horincea	**35,0**	**6,0**	**1,1**	**253,0**	**150,0**	**93,5**	**29,8**	**0,3**	**0,5**	**0,6**	**1,7**
Zoiţeana	8,0	27,0	1,2	10,0	176,0	21,4	6,8	0,2	0,4	0,8	1,9
Lişcov	21,0	10,0	1,1	37,0	155,0	56,1	17,9	0,1	0,2	1,5	2,6
Oarba	17,0	12,0	1,1	48,0	149,0	45,4	14,5	0,2	0,4	0,7	1,8

Form factor ($F_f = F/L^2$) report form); raportul de formă ($Rf=F/(P/4)^2$) circularity ratio ($R\ c = F / Fc$), rate of development of water shed ($K_s=P/L_c=0,282P/\sqrt{F}$), where F represents the area of the hydrographical basin (km^2) and P is the perimeter of the hydrographical basin.

F_f and R_c are subunit coefficients, with values becoming smaller as the degree of elongation of the basin increases. According to the form report (Rf) there are three categories of basins: elongated ($R_r <$ 1), square ($R_r = 1$) and round ($1< R_r < 1,274$). Between this report and the circularity report (RC) there is the relation $R_f = 1,274R_c$ [3].

The main types of relief within the basin are plateaus, valleys and meadows at the confluence with the Prut River [4].

The average annual temperature is 10 °C at the meteorological station Galati and 9.8 °C at the meteorological station Barlad. Lowest temperatures are recorded in January: -3.1 °C and the highest temperatures are recorded in July: 22.6 °C. The continental character is expressed by the amplitude of monthly average temperature that is of 25.7 °C, fact explained that the whole territory is under the influence of air masses from the North East [5]. Across the basin, the average daily maxima, the frequency of days with maximum temperatures and average daily temperature of the air are within normal limits for fishing and agriculture. Their variation affects the water temperature regime and intensity of ice phenomena on rivers in the basin [6].

The average amount of precipitation is 512 mm in the north and 462 mm in the south. The study of average seasonal rainfall distribution during the year indicates that the maximum is recorded during the spring and summer, which justifies the need for water accumulation in these seasons and its redistribution depending on the requirements.

Due to the complex local factors such as relief, slope, exposure, there appear different climatic nuances in this area that differ from one area to another outlining certain topoclimates namely interfluves and large watersheds, areas exposed to atmospheric circulation maximum sun light; sunny sheltered in SE-SSW, broad valleys (Prut, Elan, Horincea), which direct the cold winter air masses [7].

A close correlation between the annual average flow and average annual rainfall is observed, especially for the Horincea river, throughout the year. The correlation is quite tight in the case of Prut river as well and in particular between the years 1983-1988 and 1991-1998 [8]. The coefficient of variation of the flow for the Prut river basin presents a low variability, $C_v=0,3$ and in the sub-basin Horincea the C_v value is 0.8, supporting the unevenness of the leak [9]. The maximum average flow for the Horincea stream is recorded in July. Values close to those reported in this month are those of June, May and August. The minimum average flow is recorded in January. Monthly average flow has two maxima: in March, due to melting snow, and a summer maximum in June-July, caused by summer rains. Comparing the flow volume we note that the highest percentage is recorded in the spring. Prut river has a significant potential, the annual volume of water circulated is 3.079 thousands m^3. Sub-basins come with an intake of 6,79 thousands m^3, representing a rate of

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0.2% of its volume [10]. Seasonal flow regime is characterized by low variability, the coefficients of the flow ranging between 0.65 and 1.46 in the Prut river basin and between 0.05 and 0.26 in the Horincea sub-basin [11].

Volume flow ranges between 17 to 23.9% from the annual flow volume in autumn and winter and between 26.4 to 32.7% from the annual flow volume in spring and summer for the Prut River and between 11.9 to 19% of the annual flow volume in autumn and winter and 38 2 to 30.9% in spring and summer for Horincea stream [12]. Maximum river flows of the basins of 100-1000 ha are high, highlighting the torrential character of the flow and justifying flood mitigation works were carried out in the valleys. The volume of annual flow/debit of small basins justify the opportunity of building accumulations [13]. The average volume of sediments in the Prut river basins is 4770 m^3. The lowest value is recorded in Oancea valley and the highest in Oarba Valley [14]. The minimum flow is recorded during winter, in January for Prut river and for Horincea stream in January and August [15]. In the lower basin of the Prut River there have been identified several sources of water, namely: the Prut groundwater layer, layer of the terrace groundwater, springs arising from Prut river deposits, the neogene aquifer complex (Pontian, Dacian) [16].

In terms of flora and fauna the territory falls under the South-eastern forest steppe zone- the district of South-eastern Barlad Plateau has small forest of thermophilic essences, mainly grey oak. Prut floodplain vegetation is represented by natural vegetation formations and forest meadows, specific to alluvial which are periodically flooded and presenting excess groundwater moisture [17]. Aquatic species, more than other groups of birds have suffered from the improvement hydro-technical and hydrological works on both sides of the lower basin of the river) since 1970. Changing landscapes, habitats and favourable nesting refuge led to a marked decline in their numbers. Another limiting factor is human disturbance and the practice of uncontrolled bird hunting [18]. Ichthyofauna of the lower Prut river currently includes a variety of fish species. Assessments made showed that 77.2% of the investigated fish population is composed of non-prey species, out of which 46.7% are of economic value and 3.8% of prey species [19].

As a general feature, all systematic units in the Prut river meadow can not be gravitationally supplied operated during periods of technological maximum. The average quotes of 309 cm, 355 cm, 352 cm, 315.9 cm recorded in May, June, July, August for the past twenty years, no longer supply these units. Only values higher than 400 cm of the Prut level can provide a gravitational supply but only as a small percentage. This creates additional costs reflected in the price of fish production [20].

3 Solution

Based on the analysis of the premises and conclusions that have emerged there can be extracted a series of proposals to solve the problem. The most important aspects are the technical (technical works for effective exploitation of water resources and the role improvement works combined with fish farming biotechnology) and organizational ones (decision-makers involved and the specific tasks).

3.1 Technical Aspects

Rivers crossing the plain area as is it is the case of Prut river are not adequate for the partitioning of the river bed of their basins, because of the hydrologic regime with large flow variations. They may however be used as power sources for the system units created as a result of improvement works on the former marshes or for natural marshes as well as for economic and social utilities. Water use in these two cases requires the installation of pumping stations in the Giurgiulesti Oancea-area location, water and wastewater treatment. Their location will be dictated by the population exodus from town to village and the development of small rural industries.

The hydro potential of the sub-basins of this stream opens the door to elaborating an unified scheme in line with landscape features, hydrology and geology of the area. In this respect a complex arrangement of Horincea sub-basin, Oancea, Bisericii and Stoenesei valleys which are located in an area of moisture deficit becomes essential.

To complete the sub-basin planning, they should be viewed as indivisible natural units. Developing works on these basins should start from the watershed line and include all works required for combating and preserving soil erosion and the total elimination of the harmful effects of the flood water.

The accumulation of water thus created can store the flood waves and can also have a complex use: agro-fishery, water supply for livestock farms, for recreation. Regardless of the type of use, they must perform the following functions: to not allow the water flooding downstream, to ensure a guaranteed minimum flow during periods of low fluid potential and to ensure efficient use of water resources.

Possible locations of accumulation for Horincea sub-basin can be completed in a subsequent step, with accumulations in its lower sector thereby ensuring effective control of the flow of the whole basin. The investment costs will be higher because of the fact that in this area Horincea stream has a riverbed requiring a dam of approximately 6 km. Another future possibility would be that of transferring water from Prut although it would involve higher costs.

This option would be justified in case the population in this area will grow up and small industry would develop.

The entire range of hydrotehnical works in the sub-basin Horincea of Oancea, Bisericii and Stoenesei valleys aimed at regulating the water stream in order to to avoid negative effects of flooding must nevertheless respect the principles of ecological planning in order to avoid failures occurring after the completion of this type of works respectively: the disappearance of flooded area which increases the speed of the water drainage because of the fact that the river beds, after the improvement works are performed, they become channels, thus the riparians can only use the water for a short time; increasing speed also leads to a gradual deepening of the river causing a general lowering of groundwater in the area leading to depletion of water from wells and land dryness.

When considering the environmental planning, one should start from the principle that the streams in the Prut basin represent simultaneously ways of circulation, tanks and complex ecological zones which are in strict interaction with the surrounding areas.

Based on the data presented so far, respectively the abiotic and biotic components of the climatic, hydrologic regime, soil structure, vegetation, the intensity of erosion processes, profiles, the first steps that are recommended are: cutting the steep banks, which immediately reduces erosion, creating low gradient banks, stabilization of river's bottom current by adding of rocks and boulders and planting both grass and shrub vegetation on the banks in order to stabilize the soil.

The restructuring of fisheries facilities take the following general technical aspects:

-Sensible dimensioning of fishery farms to focus on technological activity on small areas of, easier to control and more effective;

-Use of hydraulic pressurized systems for the water supply of the units;

- Mechanization of the main technological phases for fishing, nutrition, maintenance - using recirculation systems for intensive fish farming.

Regarding the natural marshes that can still be found in the Prut meadow the best solution would be that they preserve their current form and they should become natural reservations. Preserving these areas will lead to the conservation of the biological balance and biodiversity of the area. Moreover, under the present circumstances, opens the perspective towards a new approach: the Prut meadow would enter the international circuit of protection and development.

3.2 Organisational issues

The central authorities that have specific responsibilities in environmental protection are the Ministry of Agriculture and Rural Development, Ministry of Environment and Forests and the two national companies - Romanian Waters National Company and National Company Romsilva).

Ministry of Environment and Forests has major responsibility for environmental protection in Romania, its main tasks being related to water management of river basin planning for the reclaim of new water sources, coordinates the preparation of plans and frameworks for developing the hydrographical basins, approves the water-related works, establishes forecast and information activities in the field of water management and hydrology, etc.

Ministry of Agriculture and Rural Development has specific responsibilities the field of protection of soil, terrestrial and aquatic ecosystems. Also, it elaborates and sets up priority programs for improvement of works and financing, preventing and combating animal diseases, plant protection and phyto-sanitary quarantine, quality control of seeds and seedlings. This ministry approves land improvement, conservation and environmental protection programs and it elaborates regulations regarding agricultural systems, technologies of plant cultivation and animal husbandry, forest regeneration, harvesting, collection and transport, and soil quality standards in order to maintain and improve it, to remove the negative consequences on aquatic and terrestrial ecosystems to ensure conservation of specific functions, biodiversity and natural habitats, and communicates with the central environmental authorities.

Ministry of Agriculture and Rural Development keeps track of land rendered unfit for agricultural production and provides upon the request of their owners specialized technical assistance for land improvement works.

Romanian Waters National Company manages water resources (surface and groundwater) and prepares and monitors the implementation of programs for meeting the water demands of the population and economy, exploitation of new water sources, rational use and protection against depletion and pollution, complex planning of water in accordance with current and future requirements. It is also the Romanian Waters National Company that correlates the water works with land reclamation works.

National Forest Company Romsilva is required to perform all the works of ecological restoration, regeneration, plantation and maintenance.

From an institutional point of view, the present system is satisfactory, still the legislative framework needs improvement. The above mentioned authorities must promote regional development programs in agreement with the national strategy while the Government supports the legislative initiatives It is necessary to continue observing the aquatic ecosystem of the Prut River and its direct affluents as per the Regulation agreed between Romania and Moldova. Ministry of Environment and Forests Ministry of Environment has the task of requiring the Republic of Ukraine to join the existing Regulation.

There must be a correlation in terms of legislative measures between the riparian parties to Prut river regarding the zones of sanitary protection of water sources and locating these areas upstream from the water supply for the population.

4 Conclusion

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