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The Morphological Evolution and Sediment Transport in the River Bed Barlad Following to the Effects of Human Activities

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Abstract- The sedimentary processes and morphological changes in the rivers are among the most complex and least understood phenomena in nature. To determine the causes of these morphological processes in these rivers it have been made numerous studies and research, which involved collecting data through field measurements, data modelling and simulation with modern software and developing theoretical analysis and experimental laboratory.

In this paper the author shows the influence of anthropogenic activities on the morphological evolution and sediment transport in river bed Barlad.

Keyword- sedimentary processes, morphological evolution, solid flow, multiannual average, anthropogenic intervention.

1. INTRODUCTION

The sedimentary processes and morphological changes in the rivers are among the most complex and least understood phenomena in nature.

To determine the causes of these morphological processes in these rivers it have been made numerous studies and research, which involved collecting data through field measurements, data modelling and simulation with modern software and developing theoretical analysis and experimental laboratory. The main data that must be followed when carrying out studies and modelling, to provide a comprehensive picture of the morphological changes occurring in the river, are: flat geometry of the river, the relationship between fluid flow and solid flow, the identification of stable channel conditions, the longitudinal profile of the river, geometrical and physical characteristics of alluvial, alluvial bed stability and development, morph metric relationships of stable riverbed, erosions and accumulations along riverbeds , morph metric processes in the beds by planning dams (upstream clogging, downstream erosion).

The intake and sediment transport on a river (which may be dust, clay, sand, gravel, rocks, etc..) depend on the nature of the sediments (size, density, nature, hardness, shape, particle size, cohesion / un-cohesion), land use, climate features, hydrological, geological, morphological and topographical of all its tributaries from the studied area.

The variable that has a strong control on the geometry of the bed is solid flow, given by the entry of silt, large or small from the basin slope. Transported solid flow is a dynamic overlap of the upstream catchment contribution as well as an overlap of the contribution due to grain entrainment effect of bed by fluid flow, respectively of the sediments storage shown in the Fig.1

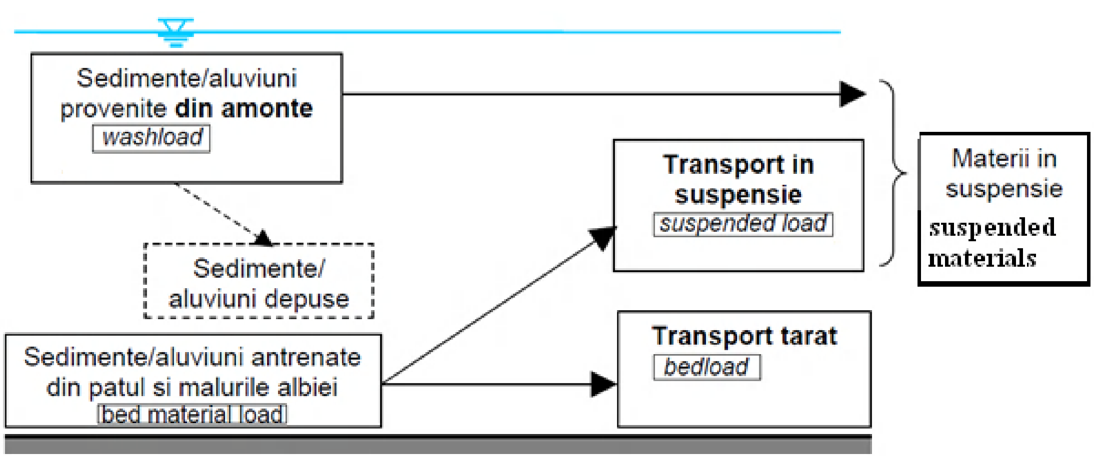

Fig.1 The classification of sediment transport types in rivers. Total bed load = suspended load + bed load.

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2. BARLAD RIVER-GENERAL ASPECT.

The Barlad River basin is a complex system, which crosses from the river sources to the river flowing, two physical-geographical areas. It springs from a hillside area and the mouth is found in the lowlands. It gathers its waters from the Moldavian Plateau located in the eastern part of Romania, has a length of 207 km, draining a basin surface of 7220 square kilometres and has a dendrite shape. The water course of Barlad is one un-uniform, follows a sinuous course, shaped as a question mark where the slope is small, allowing the formation of numerous meanders.

Over the time, the minor bed of the river showed different characteristics under the granulometric aspect between the river bed and the two sides. It was found that sands dominate the Barlad river bed, their size recording a slight increase.

If up to 70th km the grain differentiation between the bed and banks of the riverbed is almost unrecognizable, downstream of this point in the bed is selected silt with the largest diameter. The banks of the river bed reflect the type of deposits from the major bed, being generally fine, with no obvious trend in the longitudinal profile of the sort.

The natural riverbed of Barlad has convolution coefficients up to a value of 3, leading to the development of uniform twist of "goose neck" which favours the process of auto caption. In the below table are listed some dimension characteristics for the river that are dealing directly with the current liquid flow like: radius of curvature of meanders, wavelength, amplitude.

Table 1. The current meanders morphometry of the Barlad River.

Nr.of meanders	Wavelength (λ, m)	Amplitude of meanders (a, m)	Average radius of curvature (Rm)	Sinuosity index (k)
1	280	145	47	1,4
2	165	175	45	2,5
3	100	70	30	1,5
4	200	135	37	1,8
5	165	80	60	1,4
6	215	-	47	1,2
7	150	90	21	1,8

Of particular importance is the shape of the hydrographical basin because of the influence exercised on water concentration times on the main collector.

The form of the river basin can be judged according to certain quantitative indices as follows:

1. The form factor (after R.E. Horton) :

$$\mathbf{F_f = F/L^2}, \quad (1)$$

where: F is the catchment area (km^2) and L is the basin length (km).

$$\mathbf{F_{f\ \text{Bârlad}}} = 7220 / 170^2 = 0,24 \quad (2)$$

2. Roundness factor (proposed by Miller VC):

$$\mathbf{R_c = 4\pi F/ P^2}, \quad (3)$$

where: F is the catchment area (km^2) and P is the perimeter of the basin (km).

$$\mathbf{R_{c\ \text{Bârlad}}} = 4\ \pi\ 7220 / 469^2 = 0,41 \quad (4)$$

3. Elongation ratio (introduced by SA Schumm):

$$\mathbf{R_a = Dc/ L}, \quad (5)$$

where: D_c is the diameter of the circle with area equal to the basin surface(km^2) and L is the maximum length of catchment (km) measured parallel to the axis of the main collector.

$$\mathbf{R_{a\ \text{Bârlad}}} = 95,90 / 170 = 0,56 \quad (6)$$

4. Form report:

$$\mathbf{R_f = F / (P/4)^2}, \quad (7)$$

where: F is the catchment area (km^2) and P is the perimeter of the basin (km).

$$\mathbf{R_{f\ \text{Barlad}}} = 0.53 \quad (8)$$

5. The development coefficient (convolution) of water sweep:

$$\mathbf{K_d = P / 2\sqrt{\pi F}}, \quad (9)$$

where: P is the perimeter of the basin (km) and F is the catchment area (km^2).

$$K_{d\ Bârlad} = 469 / 301,13 = 1,55 \quad (10)$$

The Basin length and width are form parameters that define the shape of the reception area. The Barlad basin with higher development rate in the upper stream has a maximum width of 62.8 km and an average one of 42.47 km. Also the coefficient of asymmetry is an important parameter of the basin and is calculated by the relationship:

$$Kas = 2\ (FS-FD)/F, \quad (11)$$

where: FD is the area on the right bank, FS - Left Bank area and F is the entire basin area.

The Bârlad has a very small asymmetry (negligible) since from the total area of 7220 km2, 49.63% (about 3584 km2) is available on the left side of the river basin and 50.37% (3636 km2) on the right. The asymmetry coefficient of the river has a value 0.01.

The average altitude of basin, which is among the most important parameters influencing a number of meteorological and hydrological phenomena, is 211 m. Branching watercourses in the Barlad basin is a common phenomenon. It takes place in areas with low slopes where are noted various degrees of clogging of the bed with alluvial material.

For the Barlad riverbed, cross-sectional shape is trapezoidal and is generally a feature of riverbeds widened in dusty-clay cohesive materials. In many sectors, especially in the lower side of the river, cross section is changed anthropic during the decorations and corrections made in the years 1975-1980.

Form factor, calculated as a relationship between surface area of the river bed section and the surface area of a trapezoid section that is included in the bed section, showed values between 0.56 and 0.90. The longitudinal profile form of Barlad River (Fig. 2) presents a pronounced concavity, comparable to the rivers. First break profile, more important, is visible upstream of the confluence with Rebricea and coincides with the sector where the river began to develop a major channel well shaped. Moreover, this threshold is a notable change of slope between the upper river and the rest of the profile.

Once the tributaries enter the river bed, it is pointed out a slight deformation of the longitudinal profile through ‘aggradations’ the river not having the power to remove the material brought by tributaries.

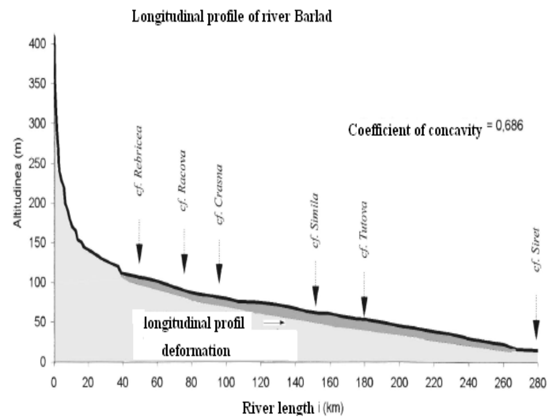

Fig. 2. The Barlad valley ‘aggradations’ phenomenon highlighted in longitudinal profile deformation.

The basic element which characterizes the hydrological regime of a river is the average flow which can be expressed by Q_M average flow (m^3 / s) representing the amount of water that flows through the river in a time unit, the specific flow qm (l / s km^2) Y_m flow layer (mm) W_m water volume (cubic meters), the coefficient of leakage (n) mode coefficient (k) and percentage values.

The multiannual average leakage is expressed with Q_0 multiannual average flow (m^3 / s), which is computed using the relationship:

$$Q_0 = \Sigma^n_1 Q_m / n \quad (12)$$

This was influenced by rainfall, the evapotranspiration, retention and disposal capacity of water, the geological conditions.

In Table 2 are specific to the multiannual average flow and flow gauging stations determined by reference to the main river and tributaries.

Table 2. Multiannual average flow and average flow gauging stations in particular the main basin Barlad.

Nr.crt	River	Hydrometric station	Distance from source (km)	Catchment area(km^2)	Q_0 (m^3 /s)	q_0 (l/s km^2)
1	Barlad	Negresti	41	817	1.64	2.00
2	Barlad	Barlad	109	3952	4.15	1.05
3	Barlad	Tecuci	191	6778	10.50	1.54
4	Vaslui	Moara Domneasca	71	497	1.00	2.01
5	Simila	Barlad	43	260	0.352	1.35
6	Tutova	Pogonesti	79	661	1.05	1.53
7	Berheci	Feldioara	69	519	0.903	1.73
8	Zeletin	Galbeni	75	404	0.740	7.83

The figure 3 shows the variation depending on the multiannual average flow of the catchment area recorded at the main gauging stations

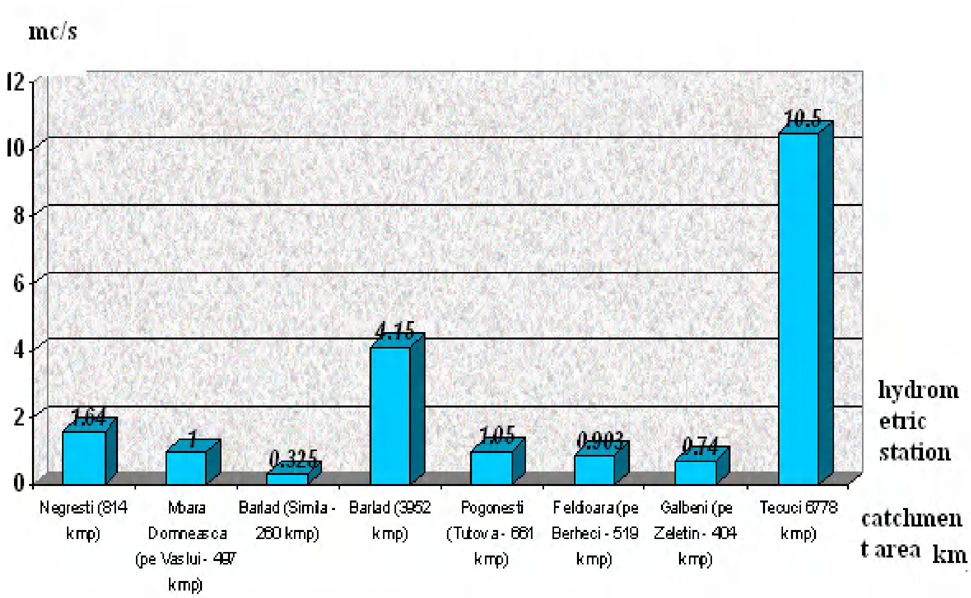

Fig.3 Variation of the multiannual average flow gauging stations in the main basin Barlad.

The Barlad riverbed silt transport to be achieved by: creep and suspension. The silt movement by creep rate due to watercourse. If the creep process of the Barlad river silt is met only if fine particles with a diameter of several millimetres.

For understanding the drainage system of solid flow must be analyzed: solids flow (R kg/s), average turbidity's (ρ g/m^3) and specific solid leakage (γ t/ha. year).

In the spring is record the 9.04 kg / s in the upper (at Negresti) representing 20.81% of annual flow and 33 kg / s in the lower (in Tecuci) representing 9.16% of average annual volume. The maximum leakage Flow Rivers of solid sources corresponding to surface feeds, and the minimum of ground

3. THE HUMAN IMPACTS ON MORPHOLOGICAL EVOLUTION OF BARLAD RIVERBED

"Arranged " the watercourse of the rivers, the man disregarded the fact that any changes in the natural state has negative effects.

The steepest human intervention on river systems have been building dams and rehabilitation of artificial lakes.

The main features of riverbeds downstream development of dams are subject to changes that occur in liquids and solids flow regime.

The deepening of the riverbed and cross-sectional geometry changes can have numerous environmental and societal effects, such as: endanger bridges, dams and other engineering structures, loss of agricultural land, discharges of large volumes of silt, aquatic and riparian damage, loss of habitat diversity, the spawning conditions, the ichthyofauna depletion, effects on relationship between river and groundwater, damage to riparian vegetation.

The anthropogenic intervention had an impact on the geographical landscape of Barlad basin. Changes made as a result of anthropogenic influences directly or indirectly report leak. The changes made as a result of human activity directly or indirectly influence the flow ratio.

The main causes of imbalance in this region, due to human intervention are: deforestation forestry, aiming to use agricultural land as a result of the action network development and industrialization of human settlements.

The most of Barlad river basin is consists by: arable land (73.63%), pastures and meadows (23.62%), vineyards (3.05%) and orchards (0.7%).

In Table 3 is apparent, that during the years 1999 to 2006, the arable land area has grown considerably and areas occupied by meadows, pastures, meadows, vineyards and orchards are often increased.

Table 3. The categories of the land use in the hydographic basin Barlad,. in 1999-2006.

Nr.crt	Land use category	Surface (ha)							
		1999	2000	2001	2002	2003	2004	2005	2006
1	Arable land	278334	283978	286229	286923	287307	292230	291299	291437
2	Meadow	96134	95888	94304	94756	94614	93693	95044	94784
3	Natural pastures	88785	88512	86694	86947	87034	85455	87131	86829
4	Vineyards	17744	16532	16027	14886	14656	12225	12275	12276
5	Orchards	4178	4083	3979	3355	3185	2793	2721	2806
Total agricultural land		396390	400481	400539	399920	399762	400941	401340	401270

The anthropogenic intervention in the pelvis also had main effect of the erosion process. In areas subject to erosion increased Torrentiality Rivers, by signaling the emergence of strong degradation phenomenon of white and rye.

The Direct interventions on rivers flow from the catchment Barlad made for drinking water to people in Vaslui County, filling water reserves needed to protect the population and economic activity of agricultural land under the influence of floods and floods, besides their beneficial effects and adverse effects. They can destroy the aquatic life and self-purification capacity of river, the water quality, by destroying the appearance of stratification phenomena, prone to become salted, clogging, etc.

Knowing the maximum river flow is particularly important considering the many negative effects that they produce high waters and floods. The Maximum flow of knowledge depends on hydro construction safety, agricultural crops and not least human settlements. Knowing the maximum flow with minimum flow is particularly important, considering the many uses that have rivers (agriculture - fisheries, public water supply, hydro construction, receiving bodies for wastewater treatment plants, etc.).

The runway changes due to vertical and lateral instability along the alluvial river beds, often induced by various types of human intervention, can become

Unacceptable for human activity itself, when the main riverbed adjacent densely populated and well developed.

4. CONCLUSION

The valley of Barlad river is a landscape with a complex morphology and an intense morph dynamic.

In the process of humanizing of the valley of Barlad were happened the changes in physiognomy of geographic landscape, affecting, the vegetation, hydrographical network, soil and wildlife. The development of the localities, the communications channels and lands have led to the formation of anthropogenic landscape which affecting the meadow, terraces and interfluves.

In conclusion we can say, that the deepening of knowledge as the current trends of rivers and the human interventions manifested over time, we can prevent and mitigate the negative environmental and social easier product in the rivers and the population.

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