ABSTRACT

Key words: pools, drainage area, sediment discharge, topo bathymetric measurements, silting rate, anti erosion improvements.

Present and future development of the society requires in addition to a good knowledge of the natural potential of an area, a very good resource management. The variation in time and space of the pluvial regime determines a stochastic drainage system, which cannot provide water to downstream at the utilities at their level and dynamics. To correct this situation, it requires regulation of steams and execution of anthropogenic dam lakes.

At the same time the social and economic actuality bursts, with a disarming regularity, in events with disastrous consequences on human communities and the environment. These events often occur due to maladministration of natural resources and in particular water, bringing important social and economic prejudicies.

The method and lifetime of pools are strongly influenced by the silting process. This involves paying attention to early design stage, especially in establishing pool sites. It is also very important as water management plans in a drainage area to be correlated with solid leakage management scheme.

In the context of the topic, we followed the Ciurbesti and Pârcovaci anthropogenic reservoirs, Bahlui drainage area to see how they are affected by the silting rate.

Most pools in the drainage area have been put into operation 40-50 years ago and silting processes that affect them are in advanced stages.

Objective economic laws and water management activities require more complete exploitation of the work already carried. It is therefore necessary to study the pools' operation mode in order to ensure their longer functionality for as much time as possible.

In this context, scientific investigations carried out in the thesis followed:

- The assessment of silting rate based on topo bathymetric measurements. For this purpose it was considered necessary to perform annual topographic surveys in 2012-2014.
- Study of implications due to silting processes on social-economic conditions and the natural environment.
- Analysis of the possibilities of increasing the lifetime of pools through works of beds and slopes. The scientific approach sought to identify measures and works that can be applied locally or regionally depending on environmental conditions and use of land, to mitigate silting process.

A particular importance was given to the interaction between the silting process, operating mode of drainage areas and works of beds and slopes from the drainage area.

The results confirm and support that not only how the exploitation method of pools influences silting of the studied pools but also how beds and slopes are engineered and their exploitation.

The data used in the evaluation of silting processes in the two drainage areas were taken from the Water Basin Administration Prut – Barlad. We used data from topographic measurements made over time and the results of measurements made during the year 2012 under LIDAR project. Using numerical model proposed in the draft estimates of flood risk has enabled a comparative analysis of numerical models of land in present and past with greater accuracy compared to classical methods used.

Evaluation of silting rate for CIURBESTI pool was based on topographical plans scale 1: 10,000 with equidistance of 2 m, in 1963 and topographical plans at scale 1: 5,000 with equidistance 1 m, taken in July 2009.

For Pârcovaci pool we used topo plans at 1: 5,000 with equidistance of 0.25 m, made in 1975 and in 2012, drawn to the same scale, but with equidistance of 0.5 m. It should be mentioned that some of the topographic plans were made exclusively for each pool before starting waterworks, and altitudes were reported to the Black Sea level. Georeferencing system used was Stereo 70.

Study of silting by comparative analysis of numerical models of land for each pool was based on use of the method of level difference between successive numerical models (DoD).

Insertion of bathymetric models resulted from the analysis of numerical models was achieved by use of TIN type algorithms, that convert all equidistant contour lines at 2 m. Thus resulted a series of cells with an area of 2 x 2 m (4 m^2), integrated into a grid specific to each pool. The initial grid insertion resulted from numerical models made before completion of the pools and the one in 2012 (resulting from LIDAR model) returned a number of differences that have transposed numerically into sediment volume.

In Pârcovaci pool it was found that silting processes mainly affect the end of the lake, where the thickness of sediment is greater. Alluvium thickness decreases towards the middle of the lake, rising slightly to the dam where they accumulated after major floods. Transversal profiles across the entire pool also highlights the complete filling with silt of both Bahlui minor riverbed and its tributary stream- the Tisa. The average thickness of the alluvial deposits fall between 8 and 12 cm, with maximum values of about 20 cm.

An important aspect of this pool's silting process is the emergence of a secondary delta along the tributary stream Tisa (on the right side). The presence of this secondary fan-delta - caused by silt brought by the affluent - can greatly influence the silting process, especially in the dam area, determining the decommissioning of emptying the bottom, with immediate impact on the life of the pool.

Longitudinal profiles made along the former minor beds of the Tisza and the Bahlui best indicate the directions of silting of this pool, silt thickness exceeding 15 m often.

A comparative analysis of patterns of land on the pool Pârcovaci in 1981 and 2012 revealed a series of statistical information outlining the degree of silting. Even if the use is quite limited in

time (only 28 years) it is noted that the estimated volume of sediments is approximately 54,000 m3, corresponding to a 55% rate of silting. This value was obtained by dividing the current volume of pool of about 1,509 million m3 (NNR) and the initial volume of pool (NNR) estimated at 2,750 mln. m3. Pool Pârcovaci is located in a wooded area but higher amounts of rainfall (700-800 mm annually), steeper slope catchment and the presence of inexhaustible sources of sediments in the vicinity of pool (oolitic sandstone slabs and sands characteristic of the coastal zone of Moldova) make the silting process to be extremely active. In this situation, the study undertaken estimated that 28 to 30 years of silting processes will lead to decommissioning of pool, if not interfere with measures and works to reduce the amount of solid material arriving to settle in lacustrine basin.

Thus, we consider it appropriate to build channels to intercept runoff and silt collection in the slopes or tributaries or of polders in the upstream reservoir.

In the pool Ciurbesti,the estimation of dynamics of silting process was done taking into account the results obtained by other researchers. During operation there are three characteristic intervals. 1963-1975 corresponds to the time period in which were recorded the highest amounts of rainfall in the entire Nicolina basin (implicitly in the sub-basin of Locea). Between 1975 and 1987, close upstream were conducted three sub-sections for capture silt and some land improvement works which consisted mainly in land anti-erosion of the slopes of the catchment and setting protection forest belts. The last period , since 1987, is characterized by the reduction of the annual quantities of rainfall, induced by climate change and the abandonment of plans to reduce the intake of slope alluvium and lack of maintenance of the previously performed.

In terms of contribution of sediments, at the end of the first period (1963 - 1975) Ciurbesti pool was silted in proportion of 19%. In 1987, the degree of silting was 33% , presently the pool is silted in a proportion of 54%. In terms of quantity, volume accumulation of silt deposited in the basin decreased from approximately 40,500 m3 / year in the first period to about 25,500 m3 / year currently, the average for the entire period of operation of around 29,000 m3 / year, corresponding to an alluvial production of 3.41 t / ha / year.

The analysis carried out on the processes of silting of the two reservoirs is found that the mud cake is similar - Pârcovaci (55%) and Ciurbesti (54%), despite that the operating periods are different, the pool of Ciurbesti having 20 years of service before Pârcovaci pool. Considering the production of sediment carried in each pool, in the case of Pârcovaci pool (6.36 t / ha / year) the amount is double towards the pool Ciurbesti (3.41 t / ha / year).

On the use of land located on slopes greater than 5% (dominant in the area), in both catchments dominance is established as used arable land (43% of the territory), followed by pastures and meadows (27%), mixed farming, predominantly located in the city (10%), forests (10%), construction (3.4%) and vineyards (0.1%).

In drafting the anti-erosion works, it has been admitted that the category meadows is not possible to be exploited as arable land and forest-covered areas not subject to possible changes of use. Therefore, to establish a rational land use, planning and organization of the arable land was considered necessary and anti-erosion harnessing of the arable land and areas with a slope of

25% and / or those affected by intense processes of degradation, to be used as grassland or protected by forestry species.

Thus, at the Ciurbesti pool, the area used as arable land could make up 32% of the pool, vineyards and orchards 5%, 22% pastures and hayfields and forest plantations may exceed 15%. It is foreseen to maintain the existing forests and lakes sites which pertain to hydro-technical management of the pool.

Maintaining the erosion within tolerable limits on arable land requires practice of cultivation system in strips with grass bands, strips width between 40 and 100 m, differentiated according to the slope.

During the anti-erosion arrangement of the territory attention was given to redesigning the traffic network.

It is estimated that works, organizational and anti-erosional measures proposed can provide effluent erosion reduction by more than 25%, thereby increasing the life of the pools studied.