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Method for monitoring of the sediment movement along a river

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Abstract

This paper has as a oject to establish in a section, in time and along a stream, the acrreation and the erosion by a direct method of calculation. The proposed method determines on the section and time intervals the sediment discharge. This balance can be established: deposition and erosion in areas far from a given reference time, the time evolution and forecast volumes deposition / erosion in each section and the entire length of the watercourse. On sections tha can not write solid flow balance, the process can be completed by differences in time intervals between the rates of these deposits. Opportunities and needs of this paper are obvious basis for determining the degree of the silting –up a river (canal irrigation, navigation, etc), the transport capacity (flow, level, flow, etc.), of the hydrological forecasting (flood levels). Direct method proposed in this paper from the classic paper used (with cross –section) is faster, requires a lower total volume of work and precision that you can accept the practice of designing, operating respectively.
Keywords: the silting –up, the sediment discharge, the sediment balance

1. INTRODUCTION

The Bega is a 254 km long river in Romania (178 km) and Serbia (76 km). It rises in the Poiana Ruscă Mountains in Romania, part of the Carpathian Mountains and it flows into the Tisa River, Serbia.
The river passes through Făget, Balinţ and Topolovăţu Mic, where it enters the low Banat plains. There, it begins to spill over, so the Bega canal was constructed tracking Bega Veche, which is also channeled for 97 km, as a parallel waterway for 114 km, before the two rejoin northeast of Zrenjanin, Serbia. The Bega canal runs through Timişoara and continues to the southwest, enters Serbia near the village of Hetin.

Surduc Reservoir situated on the Gladna River, which is an affluent of Bega, obtains the compensation of the Bega River's flows. Indirectly, the compensation of Bega's flows can be realized also with the help of Poiana Marului Reservoir, which can be discharge supplementary flows then Ruieni Hydro-powerplant normally uses it. Beside these two reservoirs of considerable dimensions, Surduc Reservoir with a total volume of $44.124x10^6$ m^3 and operating volume of $24.225x10^6$ m^3 and Poiana Marului reservoir with a total volume of 11.772 x 106 m^3 and operating volume of 4.607x10 m^3, in the Bega - Timis hydro-technical system there are also another seven permanent reservoirs of smaller dimensions and twelve non-permanent reservoirs, having an intercepting, attenuation and delay role of the floods waves in the catchments area of the Bega and Timis rivers.

Fig. 1 – River Bega

Also, for the fight against the floods, the system is provided with three plain reservoirs, the most important of which, Hitias Plain-reservoir, with a volume of $4.607x10^6$ m^3, being situated between Bega and Timis rivers, along the Topolovat Connection. The other two plain-reservoirs are situate on the course of the Tirnis River, near the Romanian - Yugoslavian border, and they have a volume of $35xl0^6$ m^3 for the Padureni Plain-reservoir and $20xl0^6$ m^3 for the Gad Plain-reservoir.

It is doubtful if it is use optimally in case of integrated management, directed at an effective and efficient performance of desired functions.
For an integrated, multi-use project scheme the computation can be approached in two ways:

- the computation scheme and model satisfy the quantitative and qualitative water requirements for dry and middle water periods, while investigating the conditions imposed by high water periods as restrictions in the computation model;
- the computation scheme and the computation model satisfy the quantitative and qualitative water requirements for the users, but also

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take into account dry periods and flood periods.

2. ASSESSMENT OF THE SEDIMENTS VOLUME THROUGH THE DIRECT METHODS - BALANCE

It has been calculated with the purpose of analyzing the upper part of the Bega River catchment area and estimating the inflow of sediments on the canal.
Figure 2 presents a schematic picture of the Bega - Timis system. In this system two derivation channels play an important role in regulating the Bega Canal in such a way that it serves its functions optimally. The first, the supply channel, brings as much water from the Timis River into the Bega River as is required. At Costei a weir controls the flow to the Bega River. The weir will be closed when the discharge in the Bega River is sufficient or too large. In case of increasing discharges the second channel, the outflow channel, is used. At Topolovat the surplus of water is sent to the Timis River. Under exceptional circumstances a large area along this channel will be flooded.

One can imagine that management of this system requires a huge effort. From the many readings of rain and water level gauges in the catchment area, which are passed on by telephone or radio, the managing engineer in Timisoara decides daily what must be done at Costei and Topolovat. In the sections of the Bega Canal the water levels are regulated by manipulation of the weirs at Timisoara, Sinmihaia and Sinmartinu.

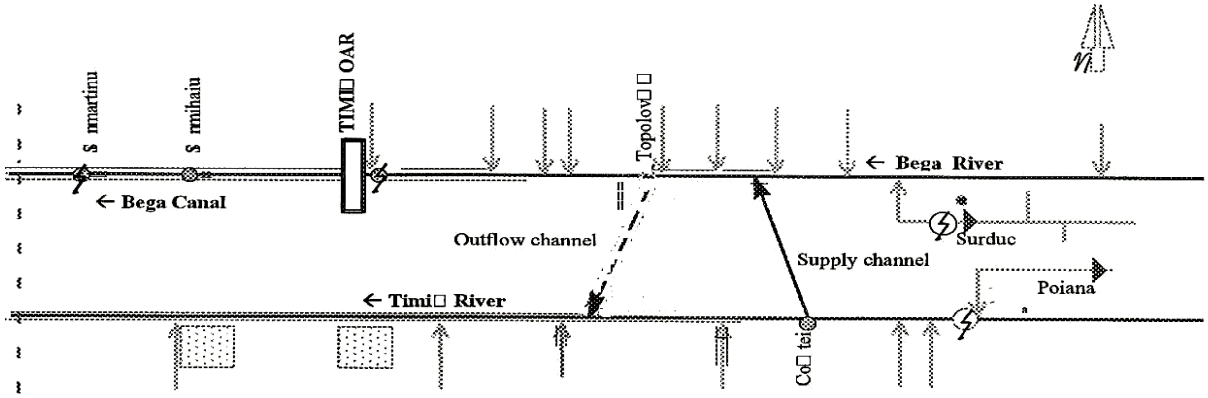
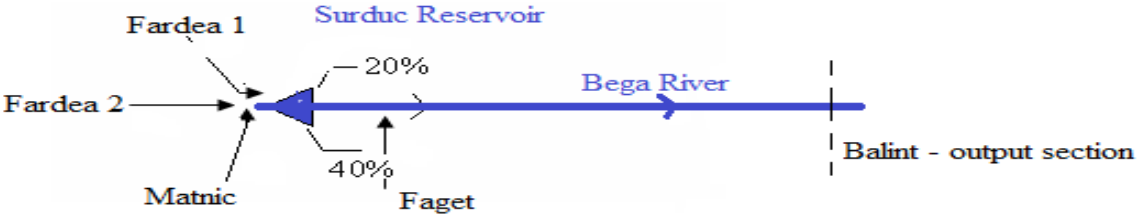


Fig. 2 – The Bega - Timis System

• Source – Balint gauging station

The balance between the inflow and outflow of sediments was estimated for an eleven-year period, from 1986 to 1996, considering the measured data at the gauging stations.

On the Source – Balint sector is analized the volume of sediment in the input and output sections.
The input sections for the first sector (Sorce – Balint) are: Fardea 1, Fardea 2 si Matnic (fig 3) for Surduc Reservoir and Faget, and the output section – Balint.



$$V = (V_{Fardea1} + V_{Fardea2} + V_{Matnic})$$

$$20\%V_{SurducReservoir} + V_{Faget} - V_{Balint} = \pm V_{sediments}$$

The impact of the Surduc Reservoir upon the sediment load has been taken into account in one alternative: 80% of the sediment load is retained into the lake, 20% is carried downstream the reservoir.
Therefore, the erosion is prevalent.
The total volume of sediments that was scoured within the reach from 1986 until 1996 is 88716.38 m^3, around 8065.00 m^3/year (Fig.4).

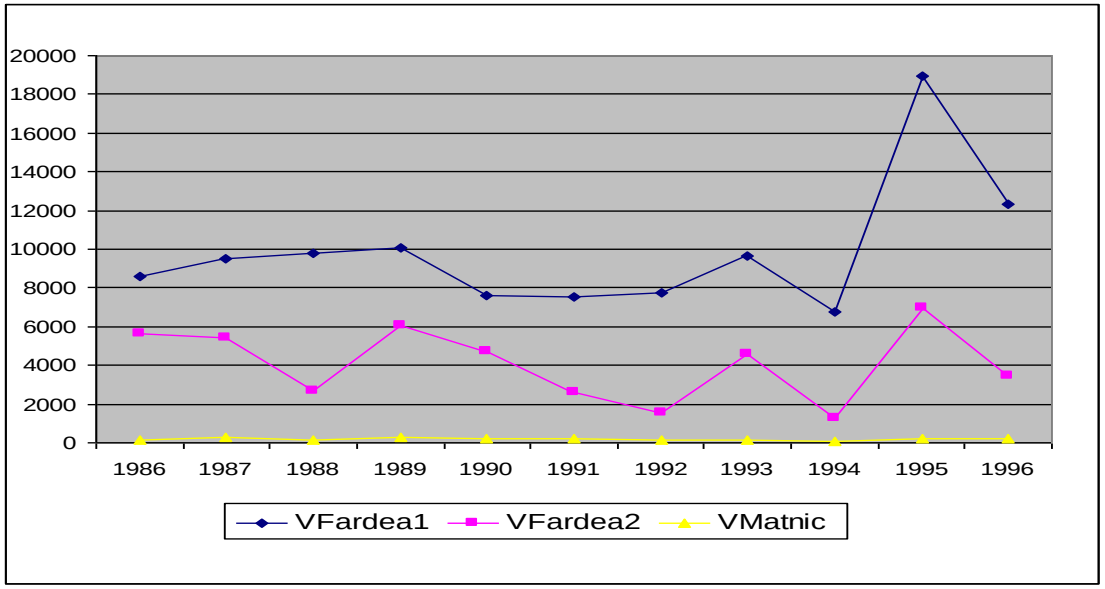


Fig. 3 The sediment volume that enters in the Surduc Reservoir

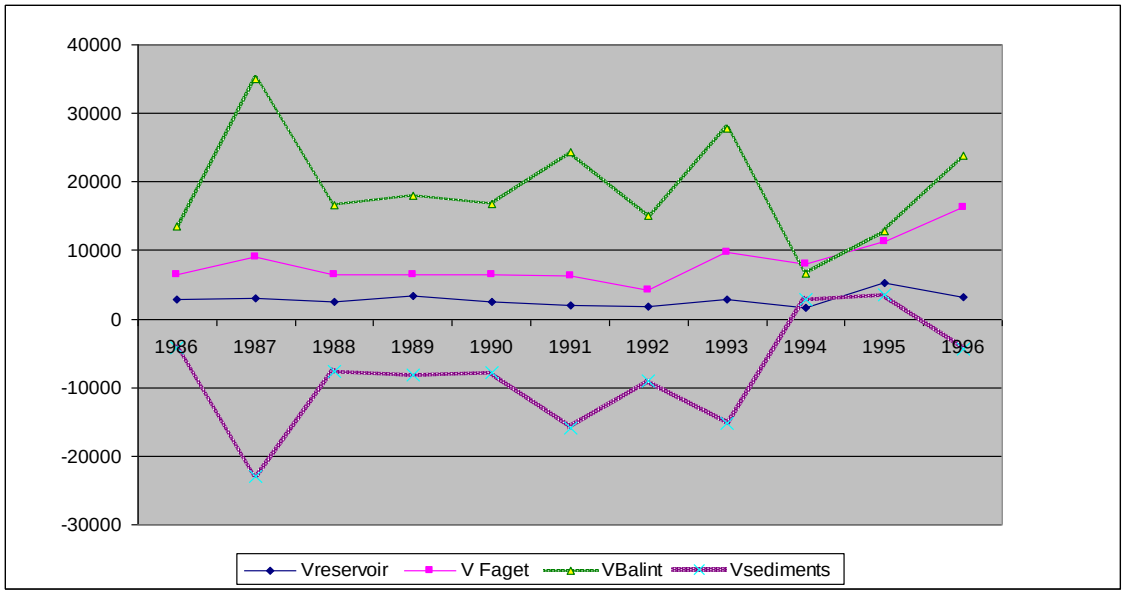
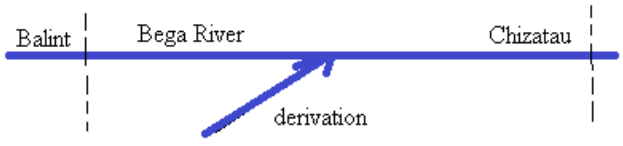


Fig. 4 The sediment volume on Source – Balint sector

• **Balint gauging station - Chizatau gauging station**

The balance between the inflow and outflow of sediments was estimated for the same eleven year period as before, from 1986 to 1996, considering the measured data at the gauging stations.

The input section is Balint and the output section is Chizatau.



$$V_{sediments} = V_{Balint} + V_{derivation} - V_{Chizatau}$$

The annual balance is positive in 6 out of 11 years. The volume of deposition along the reach during 1986 - 1996 is 42437.56 m^3, approximately 858.00 m^3/year (Fig.5).

The total volume of sediments carried downstream the reach during 1986 - 1996 is 167981.00 m^3, approximately 15271.00 m^3/year.

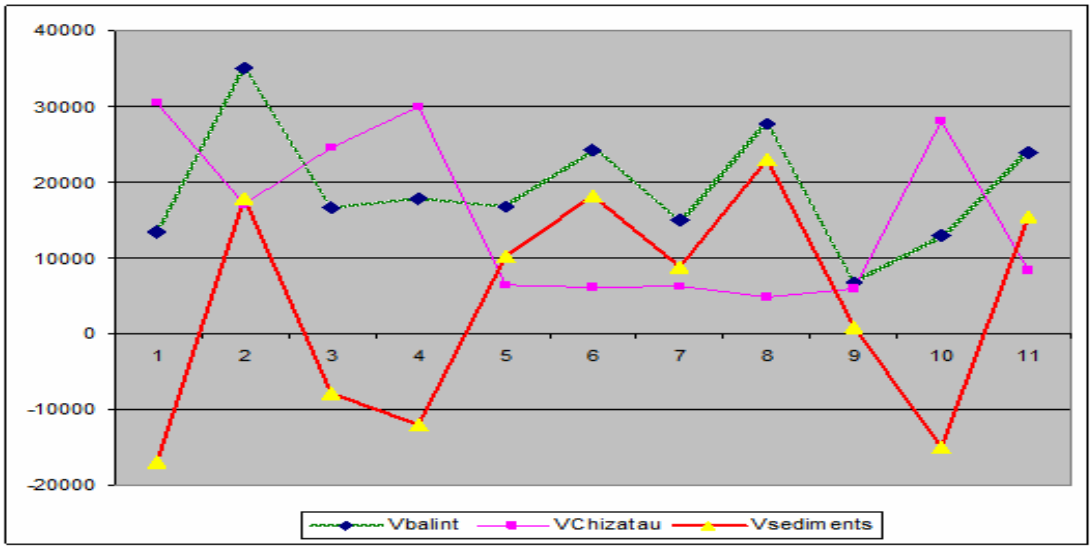
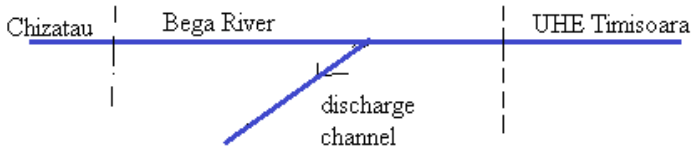


Fig. 5 The sediment volume on Balint - Chizatau sector

• **Chizatau gauging station - UHE Timisoara**

The input section is Chizatau and the output section is UHE Timisoara.



$$V_{sedimentsUHE} \cong 0.8 \cdot V_{Chizatau}$$

There are no significant data regarding the transport of sediment at the UHE Timisoara site. As a consequence, a balance of sediment load cannot be estimated. It has been assumed that the volume of sediments at the UHE Timisoara site is 15271.00 m^3/year and equal to the one at the Chizatau gauging station. The value mentioned above is allowable due to the fact that the tributaries on the right hand side of Bega River are controlled by impounding reservoirs. Additionally, there is a channel that discharges the floods from the Bega River into the Timis River and reduces to some extent the volume of sediments alortg the reach.
A minimum water level should be ensured at UHE Timisoara site to meet the demands for the small hydropower plant and the supply of water to the resident population or Timisoara. As a result, the flow velocities decrease and the deposition is accelerated. It has been considered that 80% of sediment load, meaning roughly 12000.00 m^3/year deposits close to UHE Timisoara site.

3. DISSCUTATION. CONCLUSION

Direct method – the balance of the sediment discharge - along a stream allows assessment of the liquid and solid runoff, if the database required exist for a significant period of time. However the chances of having available, both the database regarding the solid runoff and the liquid runoff, the chance is greater than that of to elevate cross sections on the streams, especially in the superior part of its.

The final section of this study case (UHE Timisoara) allows, using longitudinal profile and the cross section of Bega Canal from the project till now, to determine the accreation and erosion areas by the clasic method, on the sector UHE - Serbia border.
The calculation effectuated in this manner showed that the sediment volume resulted by the method described in this paper coincides with the sediment volume obtained by other methods. [1],[2]

4. REFERENCES

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