THE ANALYSIS OF RIVER BANK EROSION ALONG ŞIEU RIVER

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ABSTRACT. -**The analysis of river bank erosion along Sieu river.** The economical negative effects of bank retreat process for agricultural lands, related by the leaders of Sintereag and Sieu-Magherus comunities, during a field survey from May-June 2008 with a hydrological risks assessment topic of discussion encouraged, us to investigate some particular bank erosion process aspects. Active eroded banks sectors were identified and located for a 27,5 km course river length and detailed bank retreat monitoring using 78 fixed pins were done in two experimental sites (Arcalia and Sieu-Sfantu).

Key words: bank erosion, bank retreat mass failure, monitoring, damage

1. Introduction

Bank erosion represents a "special issue" related to geomorphologic processes of alluvial rivers which is induced by human or natural controls (Piegay et al. 1997), but in the same time it is an important factor in the morphodynamic equilibrium of meandering or braiding rivers (Church, 1992).

Because of its negative aspects (damages for agricultural lands, loss of properties) the erosion process is perceived by the society as a hazard (Piegay et al., 2005).

Bank river stability is influenced by complex variables different from one place to another: the pore water pressure influence (Hooke, 1979, Rinaldi, 2004, Parker et al., 2008), freeze-thaw and wetting-drying (subaerial erosion) (Thorne, 1990;Yumato et al., 2006), the hydrostatical forces of water flow (Simon and Curini, 1998), geotechnical bank material characteristics (Simon et al., 2000).

The aim of our study is not to analyze the bank erosion process by bank material fall or bank retreat (expensive instruments and a lot of time for monitoring being a constraint), but to locate the sectors exposed to such processes and to analyze a short time spatial dynamic for two representative experimental sites.

The motivation of this approach leaves from the premise that bank erosion rate analyze is particularly important in investigating effects of human activities on river bed processes, and for a short-term planning prediction and control in river management.

2. Study area

The study area is located in the lower part of Sieu catchment with an area of about 1800 km^2 (Fig. 1). In the vicinity of Sieu Magheruş village the valley becomes larger, and the river gets a sinuous aspect and locally with meandering course, having well developed point bars and powerful eroded banks.

The multianual discharge at Sintereag gauging station is about 15, 6 m^{3}s^{-1} with a maximum discharge of 1116 m^{3}s^{-1} in 1970. ,

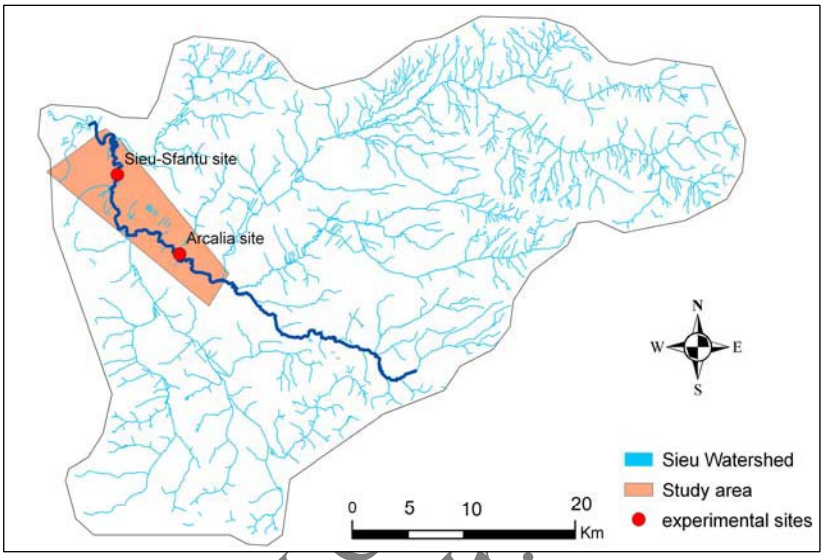

Fig.1. Study area in Şieu river watershed

The erosion banks process is a characteristic element for Şieu River, with negative economic effects by reducing agricultural lands caused by bank retreat.

Human influence in the river bed manifested by sediment mining, deviation courses, and construction of engineering structures to protect against floods caused major adjustments of river bed characteristics and dynamics of hydrological regime.

The sector investigated on the Sieu River has a total length of about 30 km, between the confluence of Sieu with Somes River (Cociu village) and the pig farm located near Arcalia village.

More detailed measurements have been done for the two experimental sites, situated in the vicinity of Sieu-Sfantu and Arcalia villages. The bank erosion length from the first site (Şieu- Sfantu) is about 300 m and 128 m for Arcalia site.

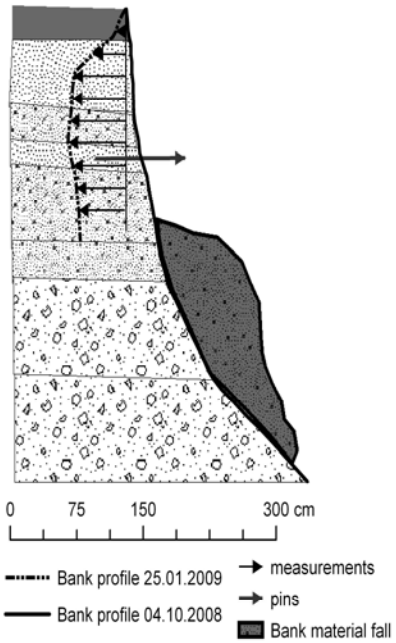

Fig. 3. Arcalia- Bank profile 3 measured in 04.10.2008

Fig. 4. Arcalia- Bank profile 3 measured in 25.01.2009

Fig. 5. Şieu –Sfântu experimental site

Bank river stratigraphy is very complex and includes several sedimentary layers, particularly for Arcalia site, with a cohesive upper portion (layers 3-5), overlying a gravel toe (layers 1-2) in the upper part of the bank.The average height of the banks ranging from 4 to 5 meters in the two cases. (Fig.2, 3, 4, 5)

3. Metodology

Field survey activities have been done in order to locate and to measure the eroded river bank sectors. We took into account those bank sectors that have the following characteristics: the bank is actively retreating; the lack of vegetation on the bank profile; steep bank slope; the water level is close to the riverbank base. The total length of the eroded sectors was established taking points from the both sector's extremities using a GPS Magellan. In the same time, the height of the bank have been measured with a Bosh telemeter (Fig. 6, 7).

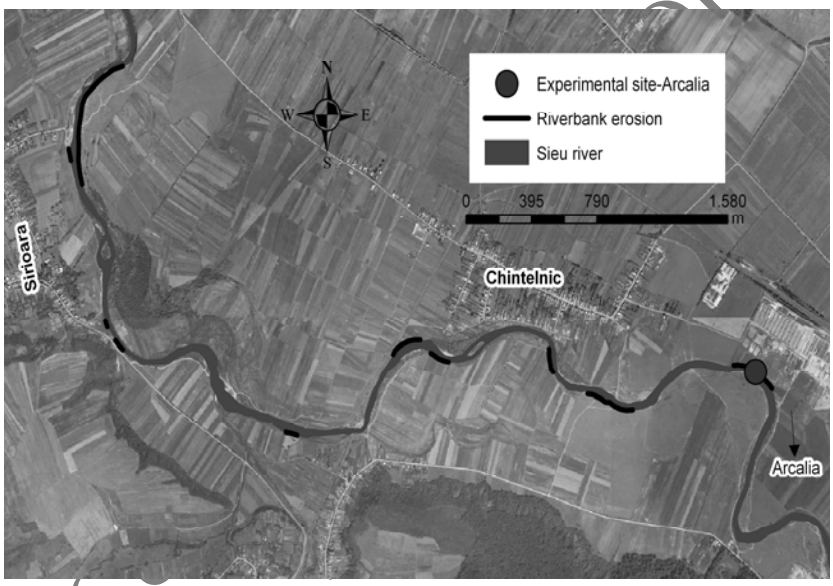

Fig. 6. Eroded banks locations (between Arcalia and Cristur Şieu villages)

Qualitative information regarding antropical activities (traces of sediment mining activities, engineering structures etc), land use, riparian vegetation, were gathered in order to evaluate the main context for bank erosion analyze.

In the second part of field survey we had to choose the most representative sectors for detailed analysis of bank retreat by punctual erosion measurements. The time period for measurements includes 3 months (October 2008- end of January

2009), characterized by an alternation of rain-snow precipitation and frequent freeze-thaw processes which influenced the river bank stability.

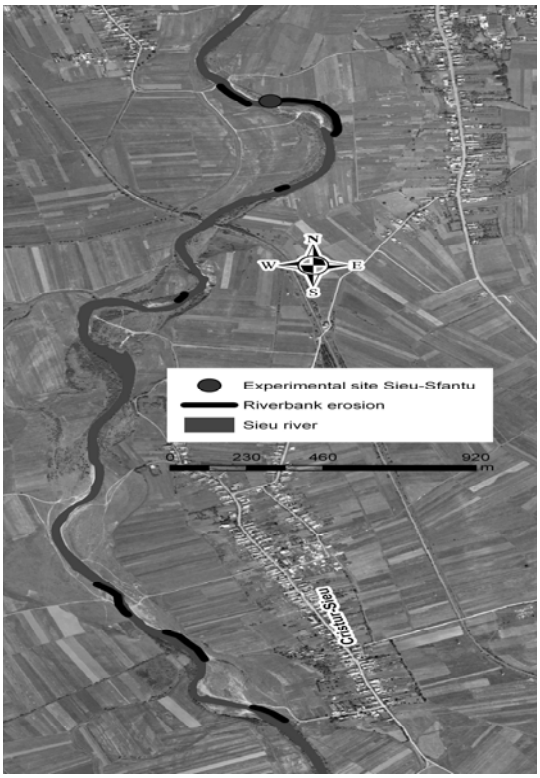

Fig. 7. Bank erosion between Şintereg and Şieu Sfântu villages

Despite the lack of more precise instruments measurement for bank retreat (e.g. total station) we took advantage of the fact that the bank material fall has a slice shape , so that we have installed fixed points (76 steel pins), spaced at different intervals which allowed us to measure and estimate the bank retreat.

To have single measurement directions, series of alignment have been established using pins installed on the bank platform and inside the bank profile.

The upper bank retreat was analised for three time periods for Arcalia site (04.10.2008, 06.12.2008, 25.01.2009) and two time periods (06.12.2008 and 25.01.2009) for Sieu-Sfantu site and the results were represented statistically by Excel.

In order to exemplify the bank profile retreat during october 2008- january 2009, two series of measurements (based on established alignments) were measured from the upper bank to the water level base every twenty centimeters.

Unfortunetely, correlation between changes on bank retreat and climatic conditions couldn`t be made for the time being because of missing data .

4. Results and conclusions

The percentage of eroded banks is of 11,6 % from the entire lenght study sector of 27,6 km. For almost 60 % of eroded banks the process is associate with antropical activities (especially mining sediments).

Inside Sintereag, Sieu-Odorhei, Sieu-Sfantu villages the bank erosion affects agricultural lands (the total affected land is about 1,5 km).

Bank retreat process is more obvious for Arcalia experimental site (Fig.8,9, *Tabel 1*), a pronounced evolution occuring for the third profile, more than 60 cm bank retreat being recorded. Inside the bank, the overgang has 6,2 meters, and the upper bank is still anchored by grassy roots.

Analysing the evolution of three bank profiles we can conclude that the erosion affects not only the upper layers but, the intermediate layers as well (Fig.2).

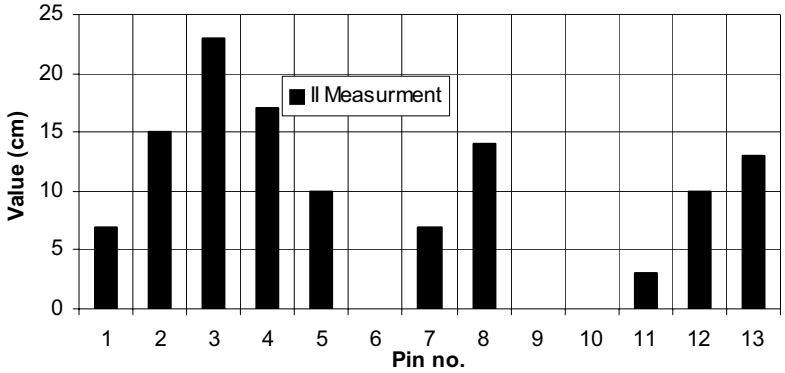

Fig. 8. Şieu-Sfântu bank retreat) (cm) values for bank retreat between 06.12.2008 and 25.01.2009

The main causes seems to be related to the climatic factors for the study period, a combination between freeze-thaw and a full saturation processes.

For Şieu-Sfântu experimental site the measurements doesn`t recorded yet spectacular evolutions, as those from Arcalia site (Fig. 8), but the value for each centimenter of eroded bank has a higher value, the land being cultivated at one meter from the bank margin (Fig.5).

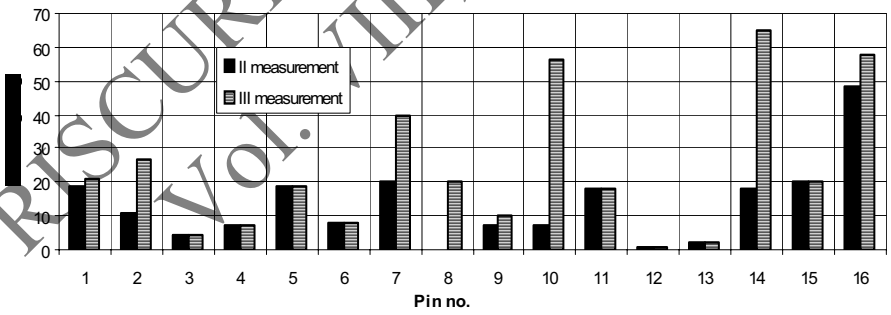

Fig. 9. Arcalia bank retreat (cm) values for bank retreat between first measurements (04.10. 2008), second (06.12.2008) and third (25.01.200)

Tabel 1. Estimated profile bank retreat
(difference profile levels Arcalia-04.10.2008-25.01.2009)

Profile bank level (cm)	Profile 1	Profile 2	Profile 3
20	6,7	2	8,8
40	7	29,7	39,1
60	14,7	37,6	68,1
80	12,2	38,6	70,6
100	11,8	43,6	73,2
120	7,6	44,6	77
140	7,1	52,5	84,6
160	3,5	45,6	83,3
180	8,8	46,6	83,3
200	10,5	-	

Further monitoring measurments will be performed in the next months and other type of investigatins are going to be realized (granulometry analysis, corelation between major events, hydrological and meteorologic).

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