Water resources and wetlands, *Editors: Petre Gâştescu, William Lewis Jr., Petre Breţcan*
Conference Proceedings, 14-16 September 2012, Tulcea - Romania
ISBN: 978-606-605-038-8

IMPACTS OF WATER POLICY AND FIGHT AGAINST FLOODS ON THE RIVER CHANNEL. THE CASE OF THE LOWER SIRET RIVER

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Abstract

Every water policies which are succeeded each other in the history, have left traces in memories such as in the landscapes. In the context of the implantation of EU Water Framework Directive and Flood Directive, the Romanian government establishes new strategies for water management. In order to better understand the territory in which these new logics are introduced and evaluate their significance, it is necessary to analyze and to spatialize the old strategy. This work focuses on the Lower Siret River, heavily arranged from 1970 to 1990, and especially on the villages of Bilieşti and Suraia. The aim of this work is to demonstrate the impacts, on this sector of 10 km length, of the 70's water policy, on the channel planform and the floods nowadays. A GIS was developed to compare, over time, the evolution of the Lower Siret River, from 1940 to present, and to quantify these changes. The study of technical literature and various reports and laws made over this period, provide the analysis of the arrangement strategy. Finally, field surveys, reports of various arrangements, testimonials, from 2010 to 2012, have enhanced this work. This study shows the density of arrangements on a reduce area whose aim was to control and avoid all the harmful effects of the water, i.e. bank erosion or flood. This sector of the Siret River has undergone significant changes: the active zone decreased over 50%, the bed channelized is disconnected from the floodplain, etc… Many morphological dynamics were determined by floods (especially the July 2005 flood).

Keywords: Water policy, arrangement, morphological dynamic, Lower Siret River

1. INTRODUCTION

All water policies which are succeeded each other in the history, have left traces in memories such as in the landscapes. In the context of the implementation of the EU Water Framework Directive and Flood Directive (Vinke-de Kruijf, 2010), the Romanian government is implementing new strategies for water management. In order to better understand the territory in which these new logics are introduced and evaluate their significance, it is necessary to understand, analyze and spatialize the old strategies. In Romania large-scale arrangement of river basin started in the 70's following major floods which hit the all territory. The lower Siret River is one of those rivers affected by this flood and deeply arranged. Until July 2005, this area had not experienced major flood, establishing in the population a feeling of safety and trust over the arrangements. In 2005 several defense systems have been brought into question and new strategies are being explored today. The aim of this work is to understand the logic of past arrangements to better prepare future strategies on the lower Siret River.

2. STUDY AREA, DATA AND METHODS

2.1. Study area

This work focuses on the Siret River Basin located east of the Carpathians. Siret basin is the largest basin of Romania and the second last major tributary of the Danube River. We will interest particularly on the lower Siret Valley. This area has an altitude of between 3 and 60 meters. The lower valley of the Siret River was heavily arranged in the 70's, especially in the Siret's floodplain near the villages of Bilieşti and Suraia (Figure 1). We explain the choice to study these two villages because they contain a summary of the arrangement strategy and they were affected by the major flood of July 2005.

2.2. Data and methods

This study is based on a dense topographic map material dating from 1891 to 1990 and Google Earth images of 2010. Topographic maps are on different scales of 1:50,000 to 1:20,000. A GIS was developed using these maps to compare over time, from 1940 to today, the Siret River and its active band, and to help to quantify these changes. In order to estimate the general dynamic of the river planform, we calculate: the average braiding index and the variability of the width of the active zone. These indexes were calculated using cross-sections each 250 meters along the studied sector. Meanwhile this paper analyzes the arrangement strategy thanks to the technical literature and legislation of the time. Finally, field surveys, records of various arrangements, testimonials, from 2010 to 2012, complete this work.

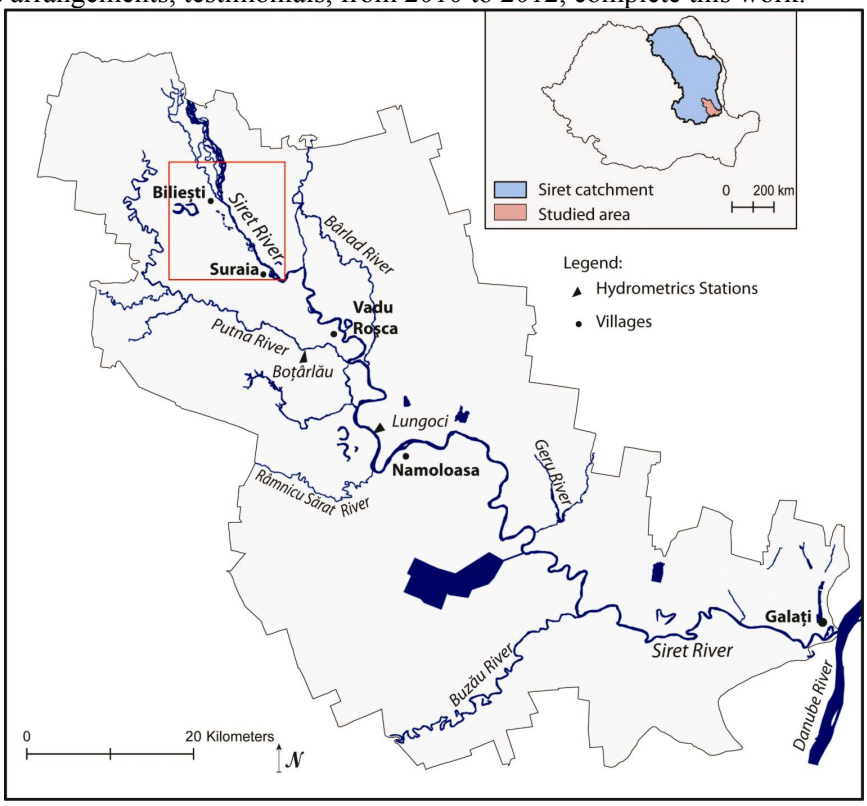


Figure 1: Localization of the studied area on the Lower Siret River

3. RESULTS

3.1. The aim of the water policy on the Lower Siret River

In 1970, the whole Romania known a catastrophic flood. The Siret River was not spared: a maximum flow of 3190 m^3/s was recorded at Lungoci Station on May 19, 1970. The damage was evaluated in millions. Following these events a national strategy against flood was developed; the 15 April 1976, a "National Programme for watershed management of the Republic Socialist of Romania" is established. It had double objective, to improve the runoff and to fight against the “harmful effects” of water such as floods, erosion, accumulation (Hâncu, 1976). In its natural state, the rivers are "a calamity that brings a lot of damage to [their] economy". So the goal of the regularization of the river is to protect arable land and localities (Hâncu, 1976; Băloiu, 1980). The complex regularization of riverbeds should be extending until 1990: over 1000 km of containment and 1500 km of "regularizing" was proposed for the Siret River (Băloiu, 1980).

In order to better understand the logical and practical implementation of these management strategies, this work is based in particular upon two studies conducted during this period: *Regularizarea albiilor rîurilor (River channel regularization)* written by S. Hâncu in 1976 and *Amenajarea bazinelor hidrografice şi cursurilor apă (Arrangement of river catchment and water course)* written by V. Băloiu in 1980. By regularization of the bed, authors mean the work of "correction, rectification and stabilization of the riverbed" and embankments of the floodplains. These arrangements are available in multiple situations.

The embankment of the floodplain is intended to protect villages and especially the agricultural land. Regularization of the riverbeds is considered in several cases: into the fight against bank erosion, the wandering of the bed, and to protect confluences or infrastructure such as bridges. Figure 2 shows two examples of schematic river regularization.

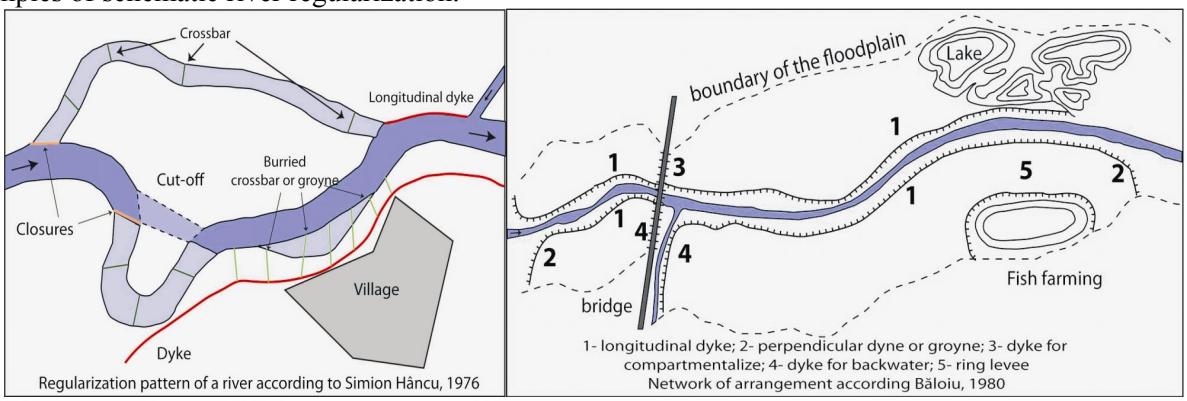


Figure 2: Scheme of the regularization work on a river. Scheme of the regularization of a river according to Hâncu (on left). Arrangement to protect a bridge according to Băloiu (on right).

The network of arrangements is complex in both cases and is composed of longitudinal dykes, perpendicular dykes, crossbars or spur dykes. We can notice three aims of these works: to prevent the wandering of the bed, to limit multiple channels and bank erosion. Field surveys conducted over the past three years, allowed us to find these schemas in the Lower Siret Valley and to present an overview of these arrangements.

3.2. The river works on the Lower Siret River

The arrangement of the lower Siret and in particular of the sector of the villages of Bilieşti and Suraia, has been dated by comparing topographic maps from 1970, 1972 and 1981 and through the testimonials of population (some of whom participated in the construction of the dykes). On this sector, along fifteen kilometers, there are six categories of engineering techniques: longitudinal dykes to protect against flood, dykes and riprap to protect the bridge; crossbars or groyne (buried or not) to limit the wandering of the bed; reinforced concrete pylons to fight against bank erosion (table 1).

These engineering techniques have three purposes: reduce the active band width between Bilieşti and Suraia, protect stream banks and protect the bridge from the railway at Suraia (Figure 3). It is only the remains of old arrangements. As we can see in the photographs, the crossbars fall into the riverbed, the pylons were discovered. In addition there has been degradation of these crossbars between 2009 and 2011 (following the flood of June-July 2010), and the bank just downstream of the bridge of Suraia continues to erode.

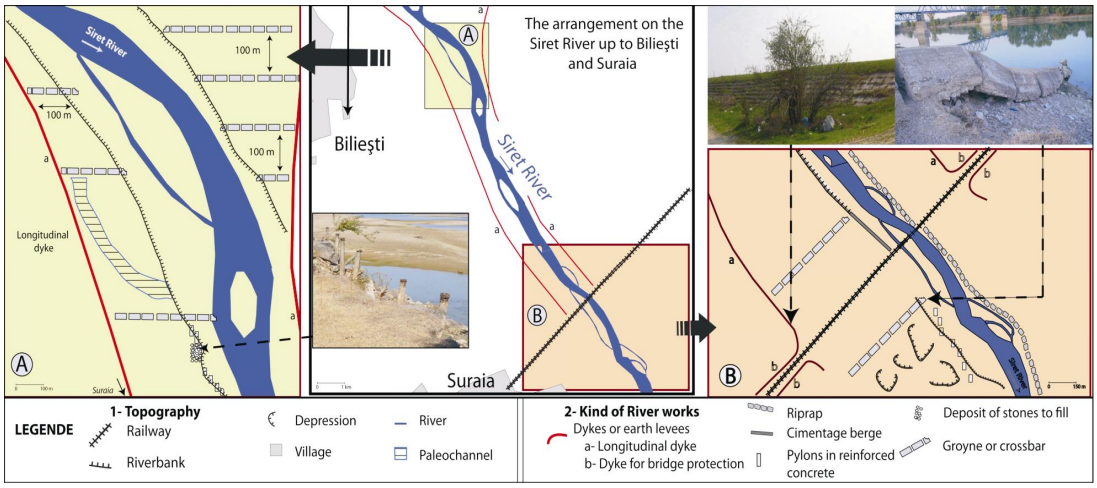
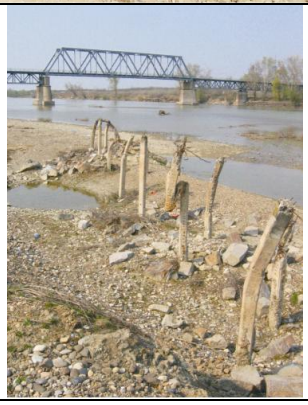


Figure 3: The arrangement on the Lower Siret River. A- Up to the village of Bilieşti. B- Up to the bridge at Suraia

Table 1: Inventory of river works on the Lower Siret River

Name	Description	Photography
Longitudinal dyke	Earth levees. 3 to 5 meters high. Built in 1970 to 1990.	
Dyke to protect the bridge	Dyke with rock work. Parallel to the river and perpendicular to the bridge	
Rock work (riprap) on the bank	Plaques of concrete built on the bank. Deeply damaged. On 10 meters dowstream the bridge.	
Concrete blocks which form a groyne	Concrete blocks of one meter long. Bound to each other, they formed a crossbar. Deeply damaged	
Buried crossbars	Buried crossbar made of concrete block; they fell into the river now due to bank erosion.	
Pylons of reinforced concrete	Series of pylons made of reinforced concrete. They follow each other among the river bank.	

3.3. The impact of the river works on the river morphology and on floods

These river works are not without consequences on the morphology of the Siret river (Spink & colab., 2009). By comparing topographic maps of 1944 and 1981 and thanks to the construction of a GIS, we can quantify the dynamics of the river in this area (Figure 4). The width of the active band, defined as the sum of the channel and non-vegetated alluvial benches (Malavoi & Bravard, 2010), goes from 1600 meters on average in 1944 to 792 meters in 1981 and is reaching 620 meters today.

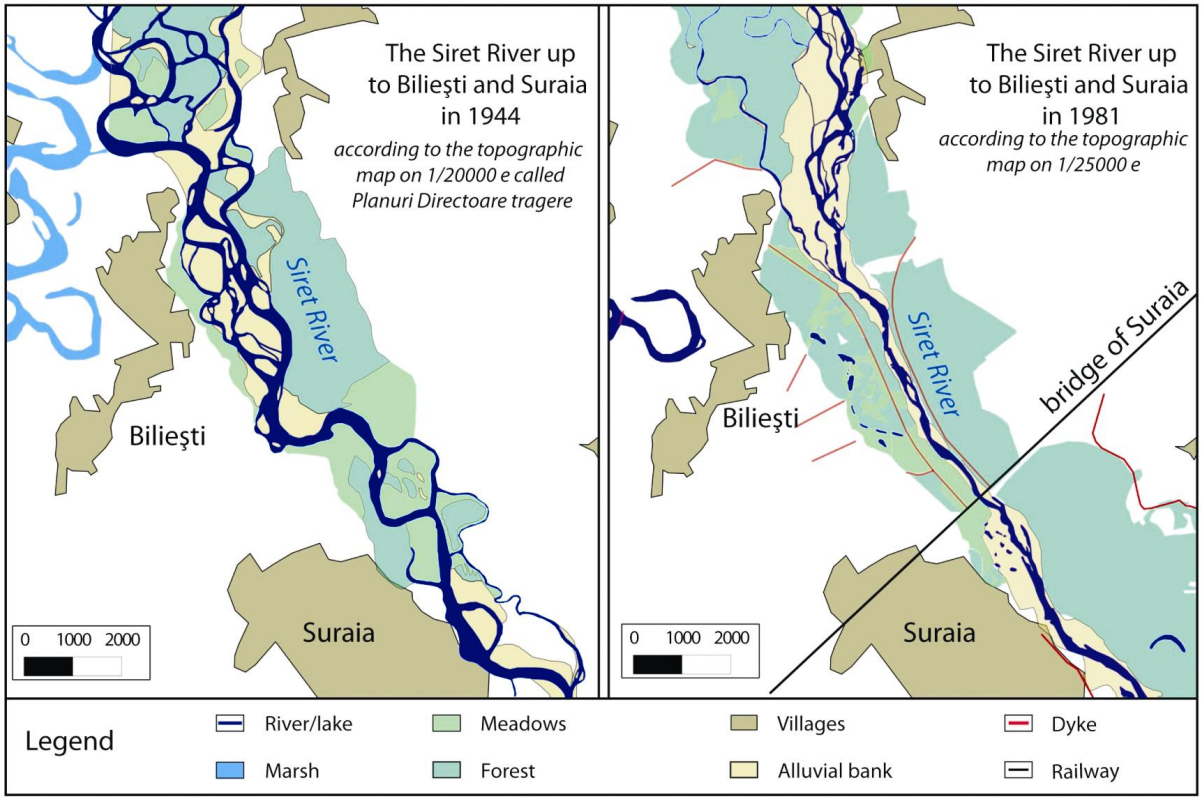
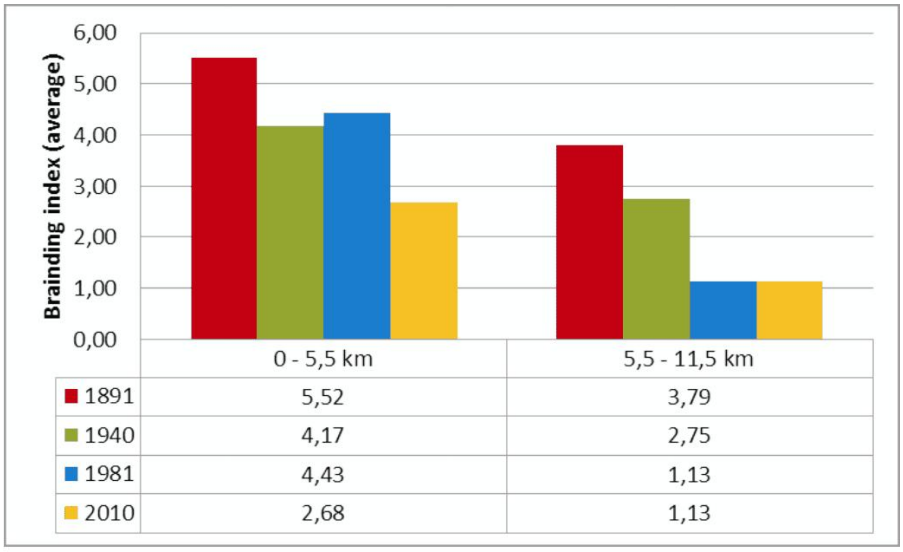


Figure 4: Dynamics of the Siret River during 1944 to 1981

The evolution of the braiding index reflects this trend of channelization of the bed (Figure 5). In this figure two sections were differentiated, the first (0 to 5.5 km) represents the Siret until early longitudinal dykes, and the second (5.5 to 11.5 km) to the bridge of Suraia.



	0 - 5,5 km	5,5 - 11,5 km
1891	5,52	3,79
1940	4,17	2,75
1981	4,43	1,13
2010	2,68	1,13

Figure 5: The evolution of the braiding index on the Lower Siret River from 1891 to 2010 up to the villages of Bilieşti and Suraia

The channelization of the river is accompanied by an acceleration of flow speeds on this sector. The ABA Siret (the river basin organization) made velocity measurements at three points, upstream of the levees system, in the center and downstream of the system (just downstream of the bridge). They demonstrated an acceleration of the flow velocity between the dykes and a reduced capacity to mitigate floods (Ministerul Mediului, 2009) especially during the major flood of 2005.

4. CONCLUSION

Following an extensive program of river arrangement, the morphology and dynamics of the Siret River have deeply changed. The water policies, such as setting up in 1976, have left traces in the landscape and still have consequences today. The Siret River knew heavy flood in July 2005: 23 death was reported in this sector, and arrangements carried out during the previous period, have amplified the phenomenon on various sector (Salit & colab., 2011). In the context of the integration of Romania into the European Union new strategies are thoughts but it is necessary to incorporate into this thinking, the remains of past regularization logical in order to not create layers of river works with conflicting purposes. Also the population has trust in the old system of protection; they saw its benefits for four decades. Information campaigns and education are among the non-structural measures to be implemented by the Romanian government in its new strategy against floods (Zaharia, 2010).

Acknowledgement

This study was supported by the EU EGIDE BRÂNCUŞI program «*Système hydrogéomorphologique et risques associés : impacts et aménagement territorial »* (2011-12).

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