Babeş-Bolyai University, Faculty of Geography
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PhD Thesis

RIVER CHANNEL DYNAMICS IN TRANSYLVANIAN PLAIN: CASE STUDIES ON MELEŞ AND DIPŞA RIVER BASINS

Abstract

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INTRODUCTION

The main *purpose of this study is to understand the anthropic influence on river channels from Meleş and Dipşa Basins*. Analysis of the *relationships between man and river over time*, extension *and magnitude of human impacts*, possible *responses to these actions* of *river channels and riverine landscape perception of the local community are the objectives of the thesis*.

CHAPTER I

TRACES ON RIVER CHANNEL DYNAMIC STUDIES

This chapter provides a review of the evolution of the international fluvial geomorphology literature, significant progress made in the study of river channel dynamics in the last 40 years and Romanian tradition in this field area

CHAPTER II

RIVER BASINS EVOLUTION IN TRANSYLVANIAN PLAIN

This chapter synthetizes the main stages of geological evolution of Transylvanian Plateau, which had a decisive influence in the genesis and development of river network in Transylvanian Plain. Thus, formation and evolution of the network depended on a number of factors, such as tectonics of the basin and major surrounding landforms, vertical oscillations of the main river base levels, local variations of geologic structure, petrography and climate.

CHAPTER III

GEOGRAPHICAL CONTEXT OF MELEŞ AND DIPŞA RIVER BASINS FROM TRANSYLVANIAN PLAIN

Meleş and Dipşa basins are located in the north-north-eastern part of Transylvanian Basin, with drainage areas of 323 km^2, respectively 468 km^2 (*Fig. 1*).

The geological structure (*Fig. 2, 3*) imposed the formation of a monoclinical relief with cuestas, subsequent asymmetric valleys, extremely large (hundreds of meters), consequent and obsequent valleys, irregular interfluves and differentiated forms according to degradational processes.

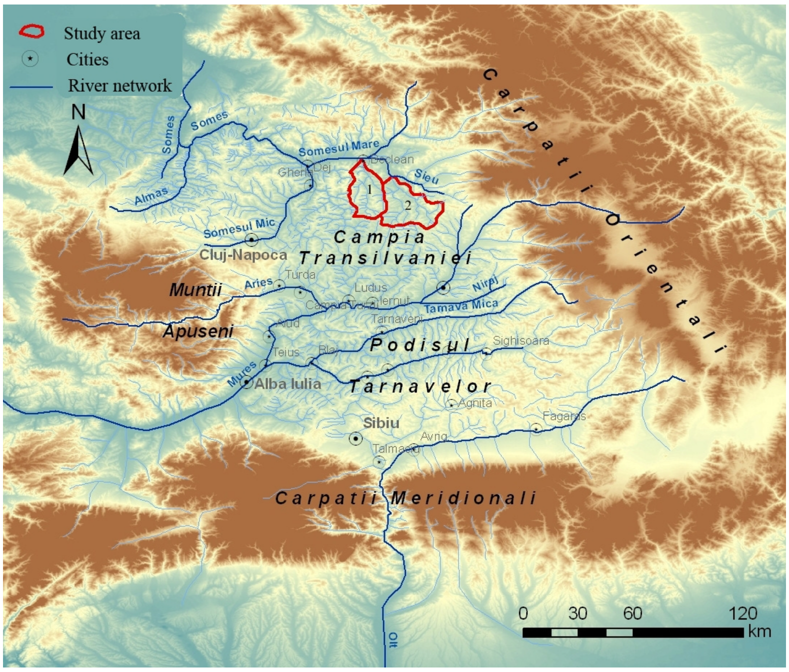


Fig. 1. Location of Meles and Dipsa Basins in Transylvanian Plain

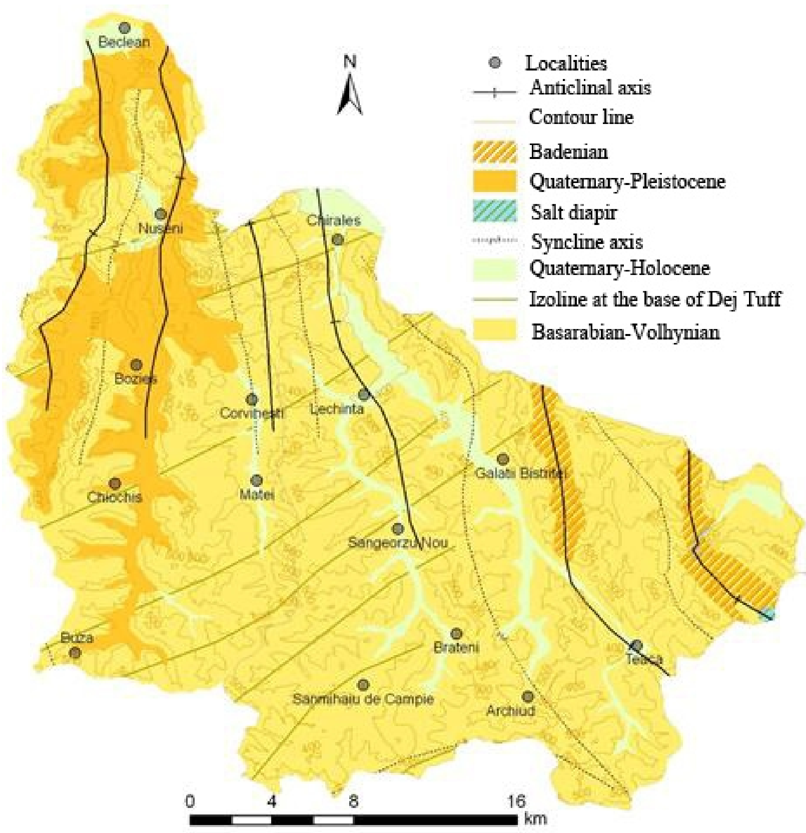


***Fig.2.** Geological map of Meleş and Dipşa Basins (after geological map-1.20000, edition 1974)*

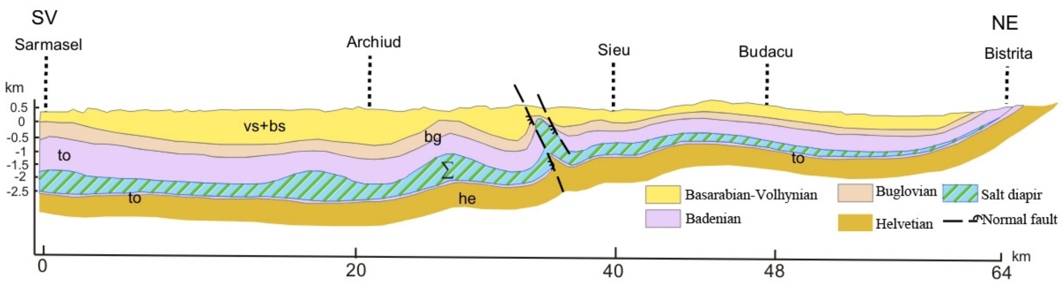


Fig.3. *Geological profile that contains the area of Dipsa river basin (after geological map-1.20000, edition 1974)*

Materials that characterize the river channel deposits consist of Holocene and Pleistocene sediments of gravels, sands, sandstones and clays which overlap a cohesive marl rocks (*Fig.4*).

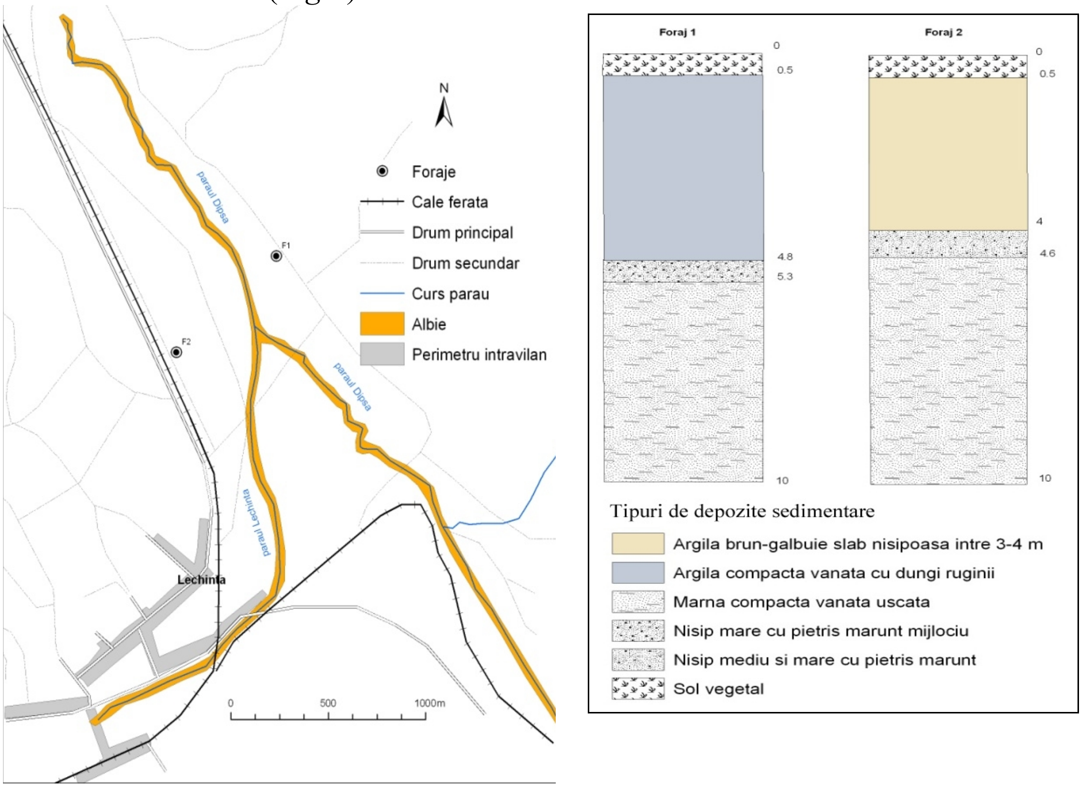


Fig.4. *Location of drilling at the confluence of Dipşa -Lechința streams and the types of Lechința floodplain sedimentation (according to data provided by the Romanian Water Agency-Branch Cluj-Napoca)*

The average altitude of the relief for the two basins are around 400 m, with maximum values on interfluve (over 600 m) (*Fig. 5).* The main geomorphological processes are the landslides and gullies along with soil erosion by surface runoff on slopes

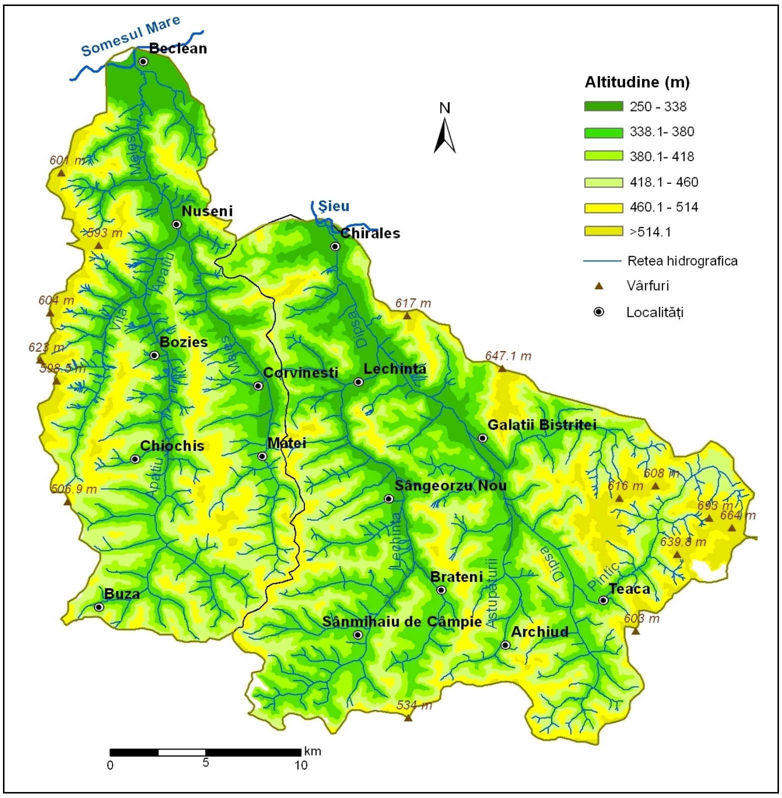


Fig.5. Meles and Dipsa river basins: relief map

Various morphometric analysis using ArcMap of the two basins, based on digital elevation models are summarized in *Table 1.*

Group parameters	Morphological characteristics	Meles	Dipsa
General parameters	Maximum elevation (m)	623	693
	Minimum altitude (m)	250	290
	Average slope (degree)	7,4	6,6
	Drainage area (m^2)	323	468
	Drainage basin surface (km)	112,9	111,6
Linear parameters	Stream order	5	5
	Total river length (km)	367,5	432,9
	Bifurcation ratio	4,3	4,1
Areal parameters	Drainage densityj	1,13	0,92
	Stream frequency	1,2	0,8
	Drainage texture	2,5	2,7
	Elongation rate	0,64	1,27
	Circularity index	0,31	0,47
	Form factor	0,29	0,44

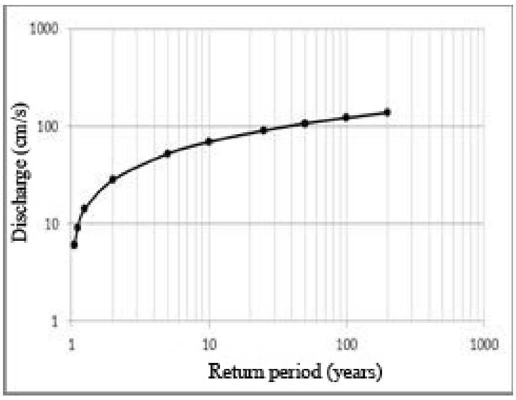
Table 1. *Morphometric parameters of Meles and Dips basins*

From a climate perspective, the average temperature recorded is 9 ° C and average rainfall around 550-600 mm. Annual average lowest temperature (-3, -4 ° C) was recorded in January, while the highest values in July (16-18 ° C).

Average annual flow recorded at gauging stations of the main streams are very low of 1.45 m^3/s at Chiraleş station (Dipsa River) and 1.08 m^3/s- Rusu de Jos station (Meles River), mainly because of the small size of the watersheds, scarce water sources and relatively low rainfall values.

Artificially increased capacity of channels (by widening and deepening) moved away the rivers from their equilibrium condition and from a natural perspective of expressing their hydromorphological particularities. Therefore, the bankfull discharge is not equivalent with dominant discharge in case of the two rivers.

The finding of dominant discharge values or formative discharge for the two streams is based on the classical Log-Pearson III method, which allows estimating the probability of occurence of the annual peak flows. For this purpose we used the annual maximum flow values for 30 years for Dipsa River, respectively 16 years for Meles River. Flow forecasting is achieved by analyzing past events, determine their recurrence interval and extrapolating results to possible future events (*Fig. 6)*.



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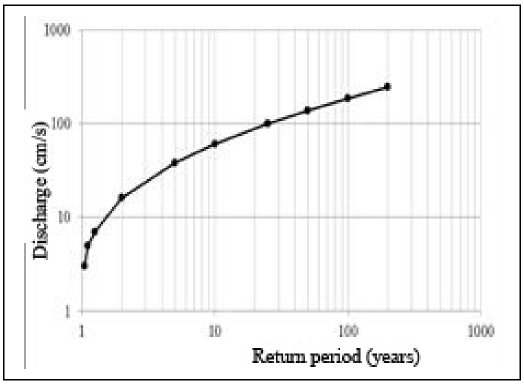
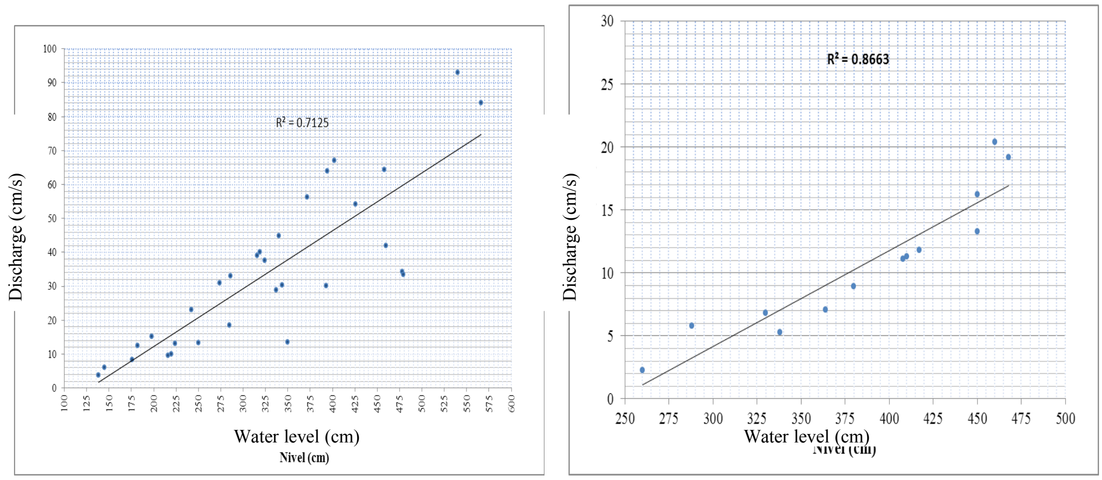


b)

Fig. 6. *Return probability of discharges–a) Rusu de Jos ; b) Ciraleş gauging stations*

We can appreciate that at Chiraleş gauging station, the dominant discharge is 18.3 cm^3/ s corresponding to a water level of 235 cm, while at the Rusu de Jos station, the dominant discharge of 10.5 m^3/s is associated with a water level of about 375 cm. (*Fig. 7*).



a) b)

*Fig. 7. Correlation between annual maximum flows and their associated levels: a) Chiraleş and **Rusu** de Jos (b) gauging station*

CHAPTER IV

THE HISTORICAL EVOLUTION CONTEXT OF THE RIVERBEDS IN THE TRANSYLVANIAN PLAIN

The purpose of this chapter is the understanding of the main stages of development and expansion of agriculture in the region of Transylvania. This activity is thought to have the strongest impact on the riverain landscape in the Transylvanian Plain.

The moment of maximum intensification of the anthropic impact –which overlaps with the agricultural policies of the communist period – is associated with the engineering practices of river channel regulation and drainage of riparian areas. The powerful effect of these actions undoubtedly constitutes an inflection point of extreme importance for streams` life from the two basins.

CHAPTER V

In order to underline the impact of the engineering works on the morphology, hydrology and sediment deposits modifications inside Meleş and Dipşa basins, we have processed the information regarding the character of the regulation works carried out inside the two basins, according to the technical plans used in the projects.

Presently, the Administration of the Romanian Water Sources, at Bistrița-Năsăud, deals with 167 km of channalized river channels inside Someş basin, almost half of which being part of Meleş and Dipşa basins.

The direct anthropic actions, began at the same time with the increase of the collectivisation process in the years 1960's, manifested all across the country. These undertakings were facilitated by the expansion of the mechanical working tools, people being able to act in a short time upon long river lengths and upon large land areas inside the two basins. The engineering works met their peak between 1977 and

1984, when the channels of the main rivers were regulated by performing meander cut-offs, deepening and widening of the channels, by creating new flowing conditions, unique pathflows of the rivers, all of these having as aim the agricultural use of the floodplain lands and prevention of the floodings (*Fig. 8 şi 9*).

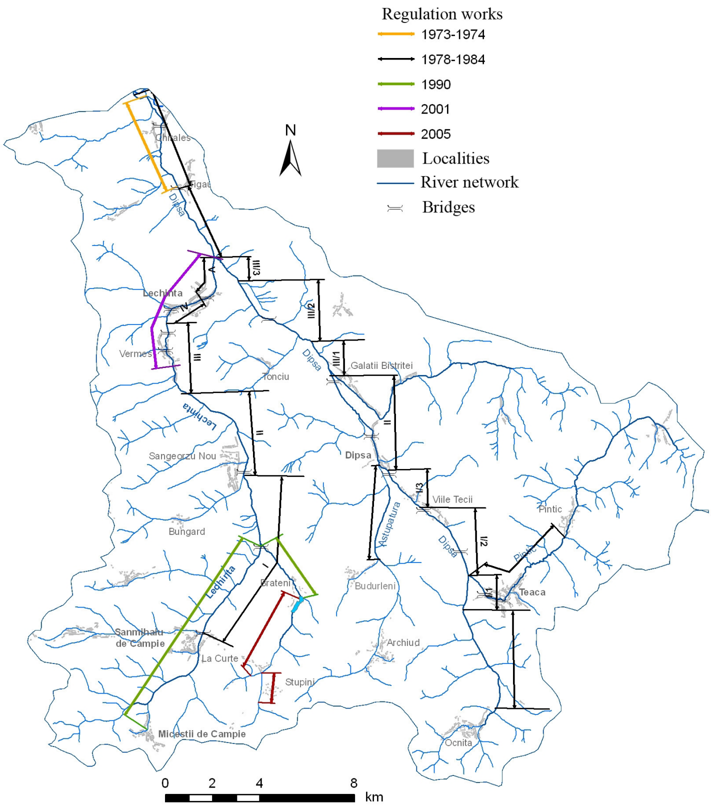


Figure 8. *General Map of the regularization works on Dipsa basin (1978-1984)*

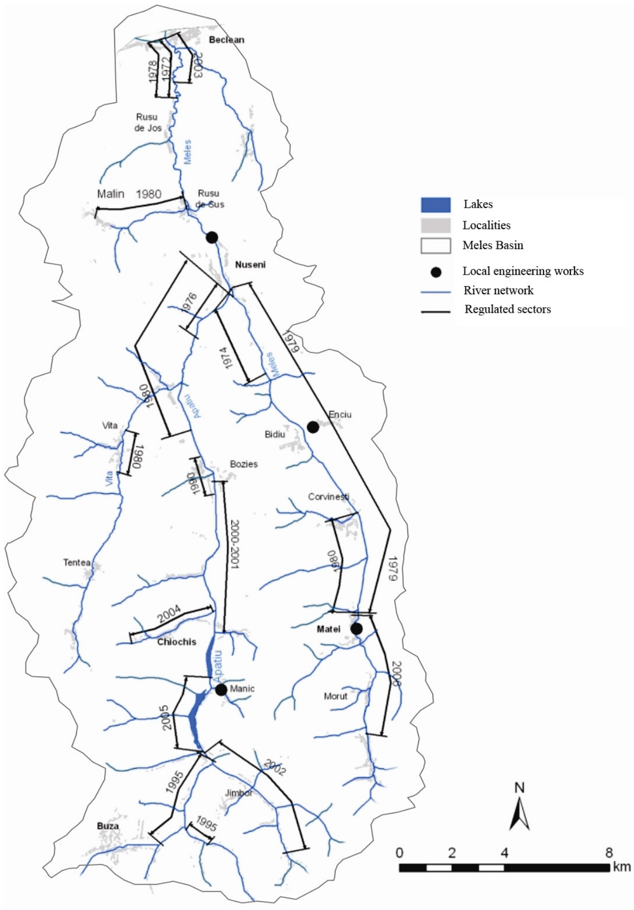


***Fig. 9**. Map of humain interventions on Meles basin*

CHAPTER VI

The forces that acted to shape the current aspect of Dipşa and Meleş river channels are a combination of anthropogenic and biophysical impulses. The engineering work`s effects occurred both directly, through straightening, widening and indirectly by altering the hydrological regime of the river due to changes of morphometric parameters.

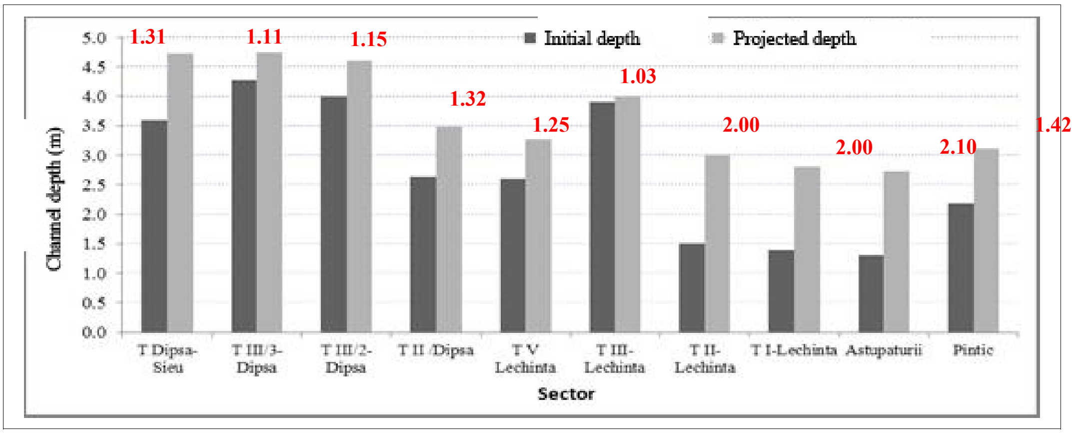
Trend showed by river channels after regulation works (interval of 1977-1983) is the increase of sediment deposition and widening of the channel, revealed by the ongoing actions of maintenance and recalibration of regulated channels. Therefore there are areas where sedimentation issues still occur due to poorly maintained works done in the past or carried out only in limited parts with negative effects on downstream sectors (bank erosion, massive sedimentation).

Early engineering works coincides with a new stage of historical development of river channel`s dynamic on Dipşa basin, imposed by people's desire to control the landscape components.

The concept of geomorphological effectiveness of Hooke, 1994 (rate of movement of the masses, caused by some action or geomorphological processes that determine the appearance of visible effects over a period of time) was used as the starting point for the study of human influence on the river beds. In other words, the study aims to analyze the balance of forces between changes caused by human actions (changing the position and size channel) and channel ability to respond to these changes through their own adjustments.

Quantitative study of cross-sections geometry on Dipsa basin was performed based on existing technical documentation for time periods before and after the execution of regulation projects.

Results on the differences between mean values of the pre-designed or initial channel dimensions (1974-1976) reveals that the beds have suffered significant changes on all sections analyzed, aiming to increase its capacity by streamlining the dimensional elements (reduced to a simple trapezoid shape, increasing slope banks) and consequently cross sectional area *(Fig.10)*.



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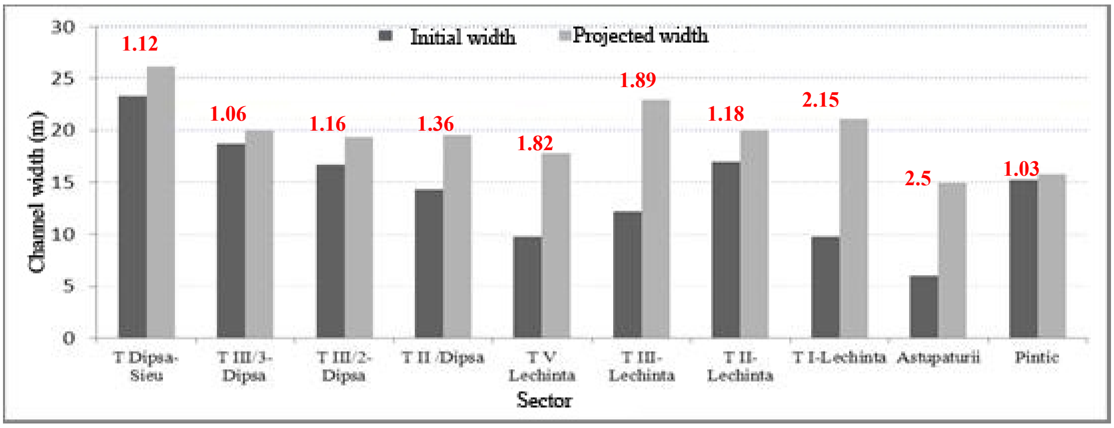

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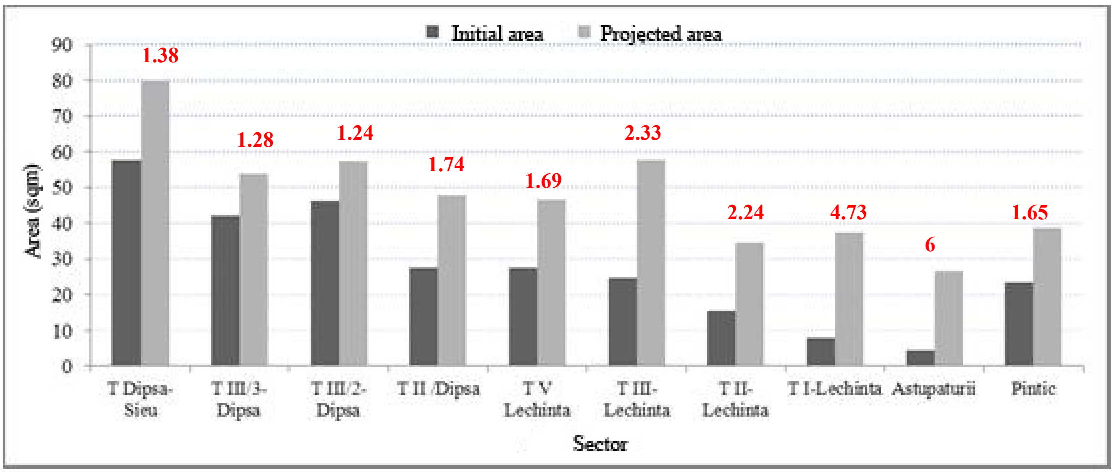


c)

***Fig.10**. Average values of depth (a), width (b) and cross sectional area (c) before the initial project (1974-1976) and the projected (1978-1983) (values in red represent the ratio of the initial size and the projected ones) (data sourse: technical reports on regulation works from Romanian Waters Agency, Bistrita Nasaud)*

Quantitative and qualitative assessments of changes in channel planform were done by using different cartographic sources from the period before and after the regulation works (*Table 2*). The assessment of errors due to the georeferencing process were analyzed by comparing the position of common points on maps with orthophotos taken as the baseline (about 25 common points for each edition). Table 2 summarizes the type of maps used and averaged errors for each edition.

Map	Topographic projection	Map edition	Map scale	Mean errors of digitized maps (m)	Reference year study
The second surveying of Austro-Hungarian military map	Cassini–Soldner projection, Zach-Oriani Ellipsoid	1859–1860 /1869–1870	1:28.800	>100	1860
The third surveying of Austro-Hungarian military map	Tg. Mureş stereo projection, Besel 1841 Ellipsoid	1869–1884 /1890–1910	1:25.000	65	1884
Hungarian Topographic Maps		1942-1943	1:50.000	62	1942
Romanian Topographic Maps	Gauss–Kruger Elisoid Krasovschi	1956 /1960-1962	1:25.000	12.2	1956
Romanian Topographic Maps	Gauss–Kruger Elisoid Krasovschi	1956 (1962)	1:10.000	5.3	1956
Romanian Topographic	Gauss–Kruger Elisoid	1985 (1987-1988)	1:5.000	3.2	1985

Maps	Krasovschi				
Romanian Topographic Maps (second Edition)	Gauss–Kruger Elisoid Krasovschi	1982 (1982-1984)	1:25.000	9.5	1981
orthophotoplans	Elisoid Krasovschi	2005	1:5.000	-	2005

Table 2: *Details of cartographic sources used in the study*

Comparative analysis of planform changes reveals that most disturbed sectors were found during 1956-2005 at the confluence area (S1, S2, S3, S4) and the village a Sânmihaiu *(Fig. 11 , 12, 13, 14).*

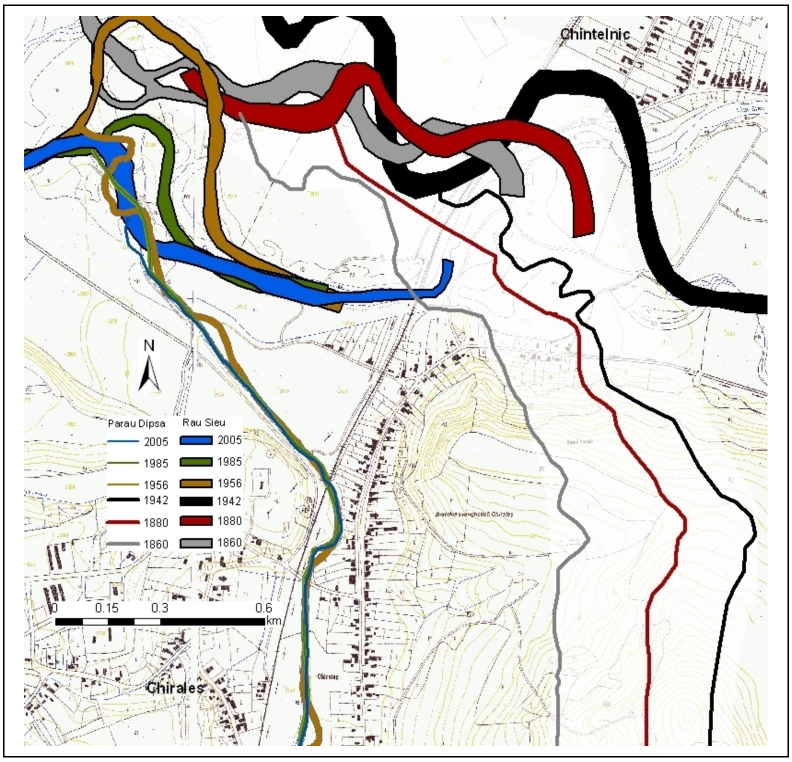


Fig. 11.*Planform changes at Dipşa and Şieu confluence (Sector 1)*

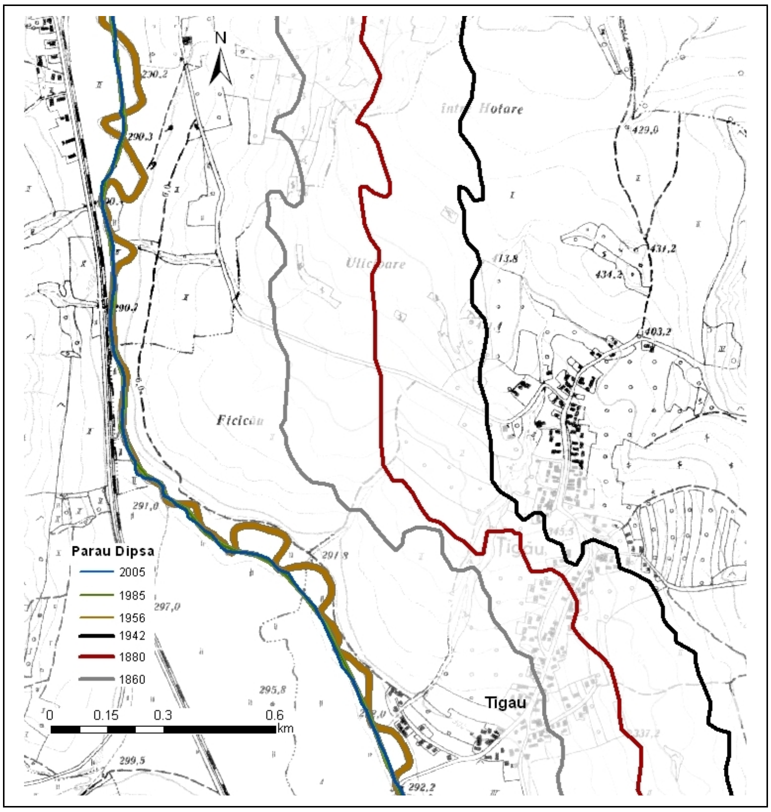


Fig.12. *Sector 2 (Chiraleş şi Ţigău villages)*

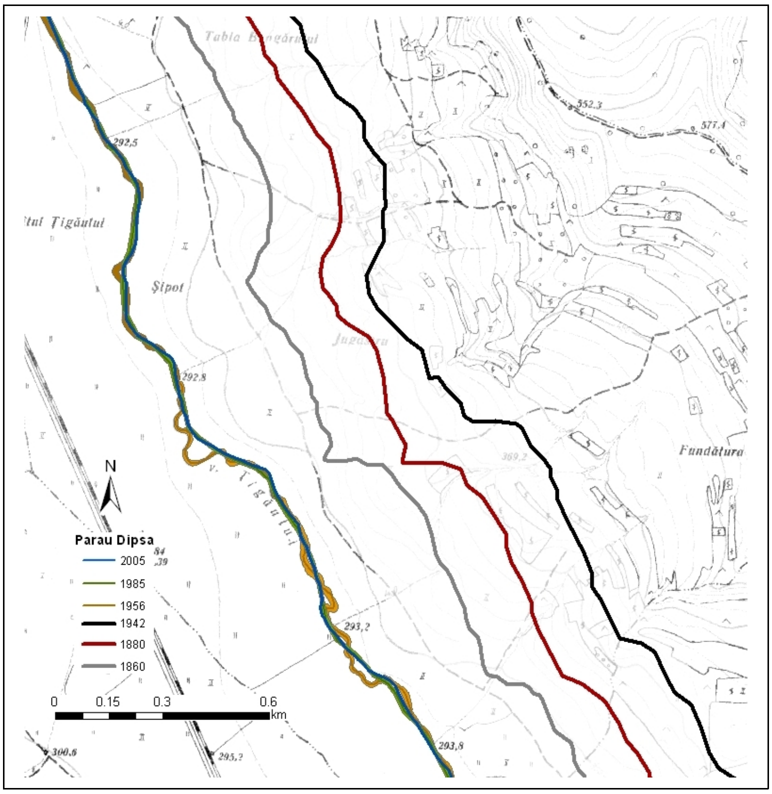


Fig. 13. *Sector 3 (upstream Ţigău village)*

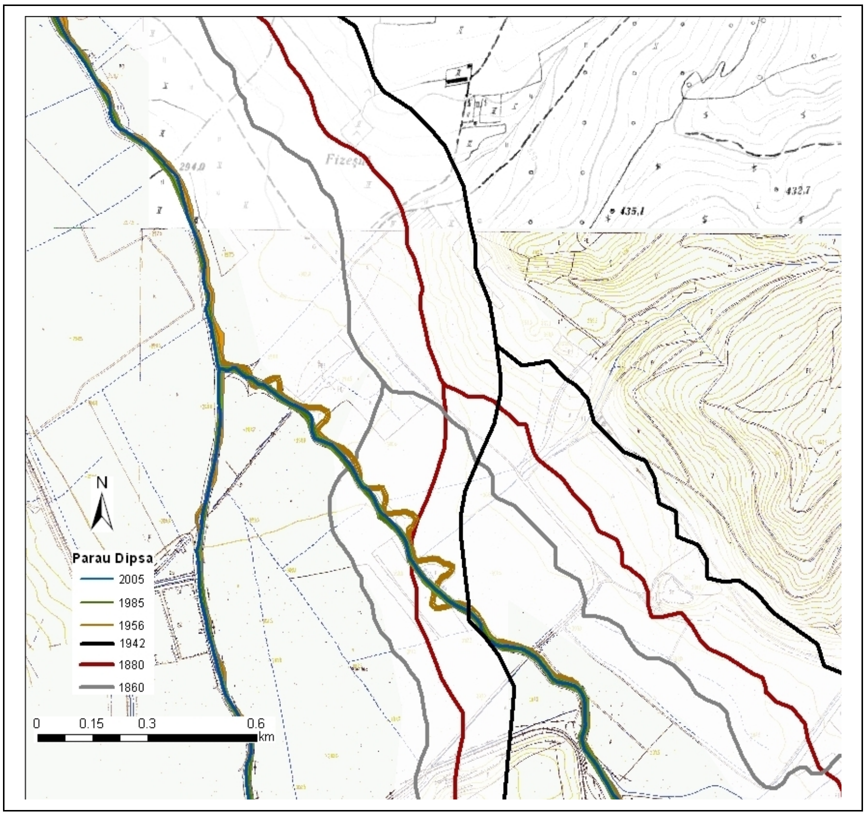
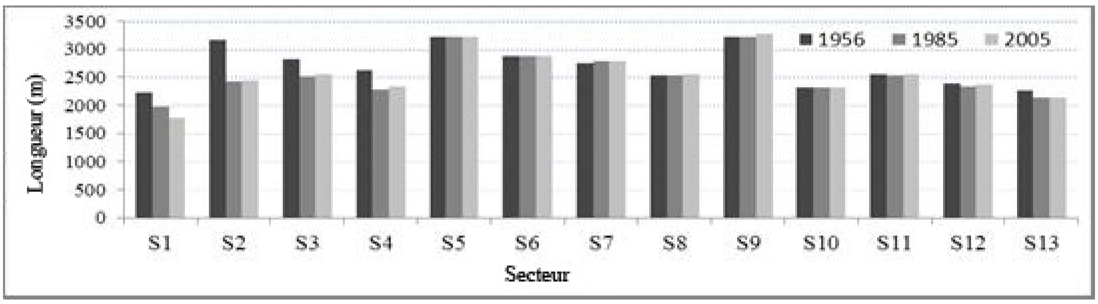


Fig. 14. *Sector 4 (Dipşa-Lechința Rivers confluence)*

The regulation works followed the course of the old riverchannel upstream the confluence of Dipşa and Lechința rivers, while downstream, the human interventions consisted in massive correction of the channel (meander cut-offs-new channels), which led to the increase of the river channel slope (in the case of sectors 2 and 4, of over 85%) and, invariably, to the increase of stream power. The local works involved a prompt answer of the channels, as they increased their sinuosity, while the general regulation works limited their morphological response capacity. The weak postregulation response of the channels (limited to the map errors) proves the fact that the natural changes, by fade tendencies of sinuosity increase, cannot compete in any way with those of human interventions. The lack of any response capable of causing obvious planview alterations of the channel also stands as proof of the great efficiency of the anthropic effort in this basin *(Fig. 15)*.



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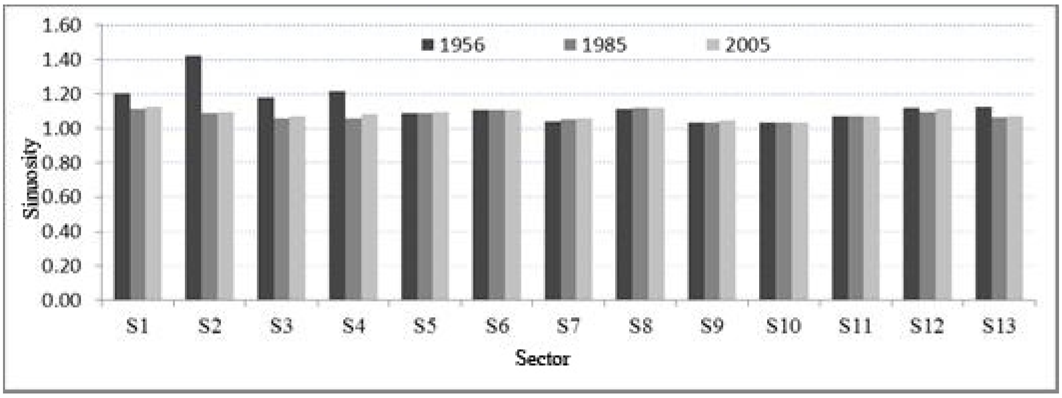

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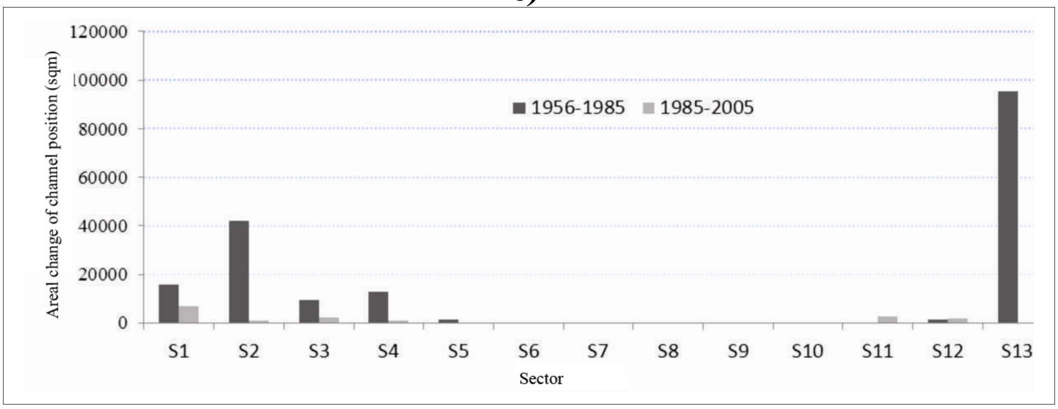


c)

Fig. 15. *Elements defining the spatial changes (the river length, variation of river-b, changing bed area position-c)*

In the case of **Meleş basin**, the ampleness of the engineering actions was less drastic, taking into consideration the fact that there were only a few planview alterations of the river channels at the site.

The really low power of the two streams calculated according to the surface unity (aprox. 12 W/m² for Dipşa river and 9 W/m² for Meleş), at the hydrologic stations, justifies the low response capacity of the riverbeds to the anthropic actions and also the unequal balance between the human capacities and the natural ones.

The evolution of Dipşa riverbed

The analysis of the morpho-hydrographic readjustments of Dipşa river channel, as a response to the engineering actions and the assessment of its evolution status, represents the essential purpose of this part of the thesis.

The aim was to develop an evolution model based on comparative analysis of the morphological aspects of two river sectors (sector Ţigău and the ex-SAI of Lechinţa-(*Fig 16*) from the initial periods – pre-project (period 1962-1976- before the extended channelization works), during the regulation works between 1978-1983 and presently (2009).

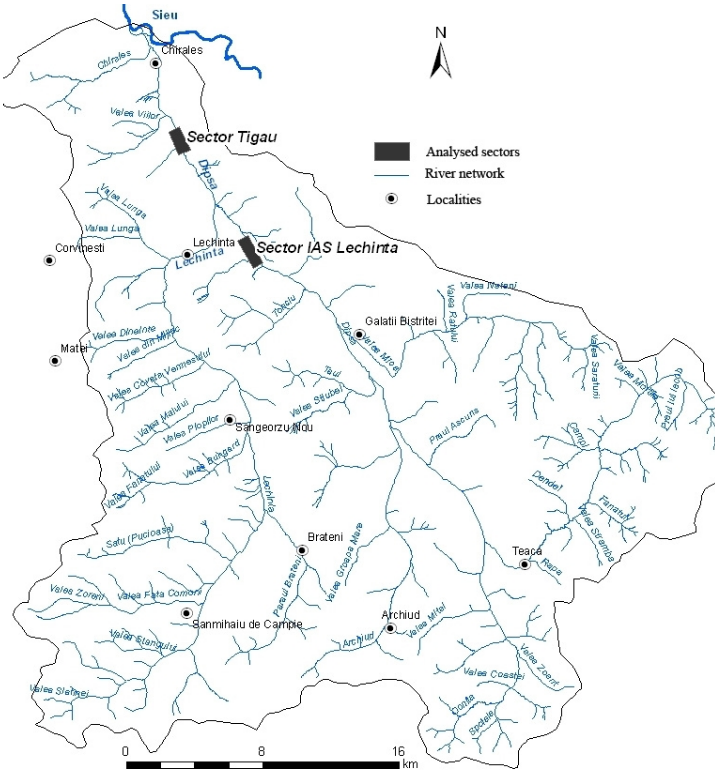
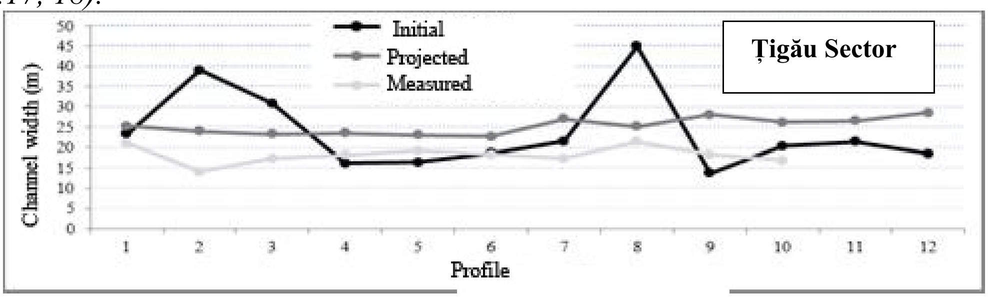


Fig. 16. Location of analysed sectors

The completion of this aim was based on data from the project, topographic maps and measurements on the field, in 2009.

The field study involved the measurement of cross sections of the channel (10 cross sections for Ţigău sector and 12 for Lechinţa sector) and of the thickness of the sediment deposits which cover the riverbed. The spacing of the analysed cross sections was between 80 and 100 m. The regularity aspect of the post-project channel was determined by measuring the degree (index) of asymmetry of the transversal sections (IA).

The values of the dimensions of the channel in pre-project and project phases, as they come out from the data analysis of the regulation project, are superior to those found on the field, which could lead to the questioning of the degree in which the dimensions stipulated in the project were respected or not during its execution *(Fig.17, 18).*



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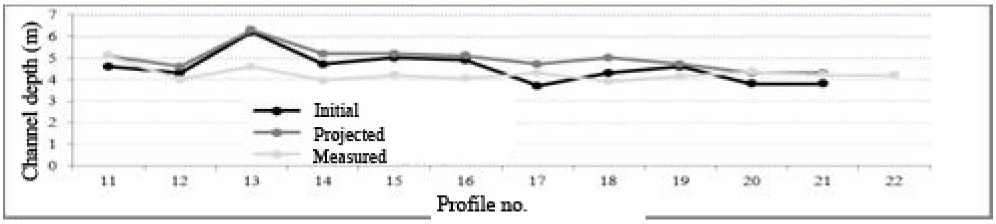

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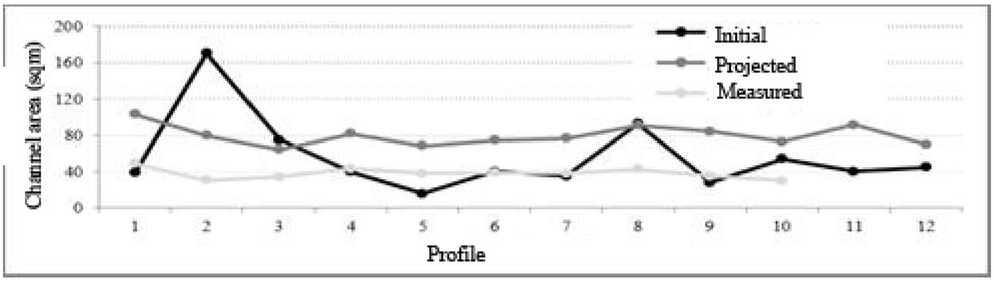
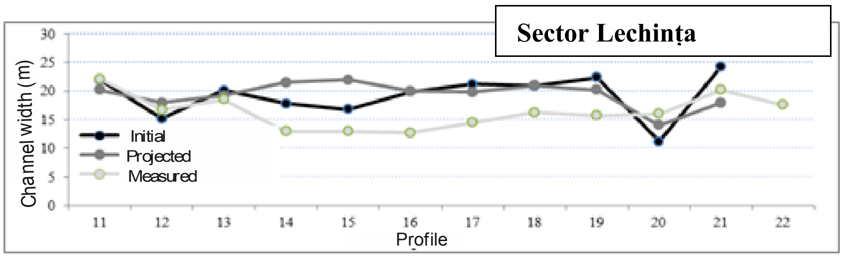


c)

Fig. 17. *Comparative values of the variation of the river channel dimensions (a-width; b-depth; c-area) in Țigău sectors, as shown by the data in the regulation project (initial values/pre-project- reference period 1974-1976 and projected values– reference period 1978-1983) and the field measurements (2009)*



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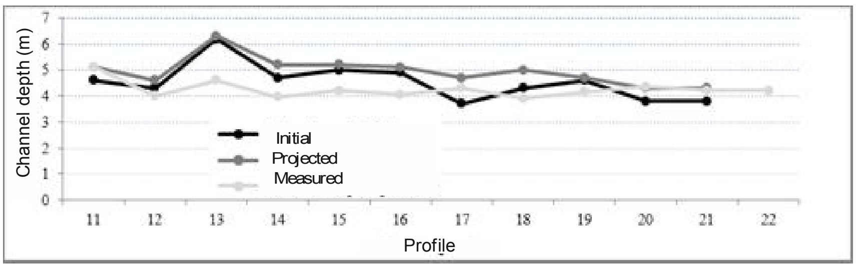

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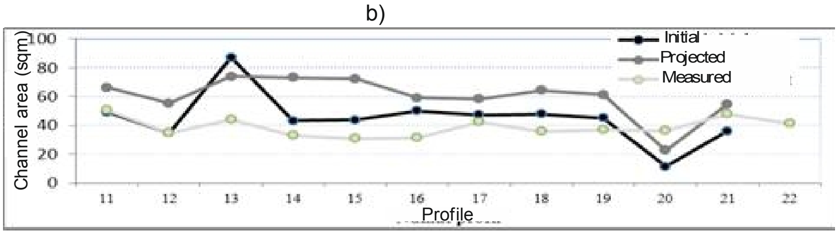


c)

Fig. 18. *Comparative values of the variation of the riverbed dimensions (a-width; b-depth; c-area) in Lechinta sectors, as shown by the data in the regulation project (reference period: 1974-1976) (initial values, pre-project) and the period 1978-1983-the projected ones) and the field measurements (2009)*

For both analysed sectors, the shape of the cross sections is very irregular, asymmetrical, marked by riverbank slides, which are obvious in all the analysed cross sections (there were sliding steps measured up to 3-4 m). The upper part of the riverbanks composed of very low cohesive material, illustrate, in their great majority, the phenomenon of bank retreat. The slopes of the riverbanks in Țigău sector appear to be mostly smaller as compared to the average of the projected ones. A different situation appears in the area of Lechința sector, where there is a larger variation of the slope values (from 1:0.98 to 1: 2.5) *(Fig. 19).*

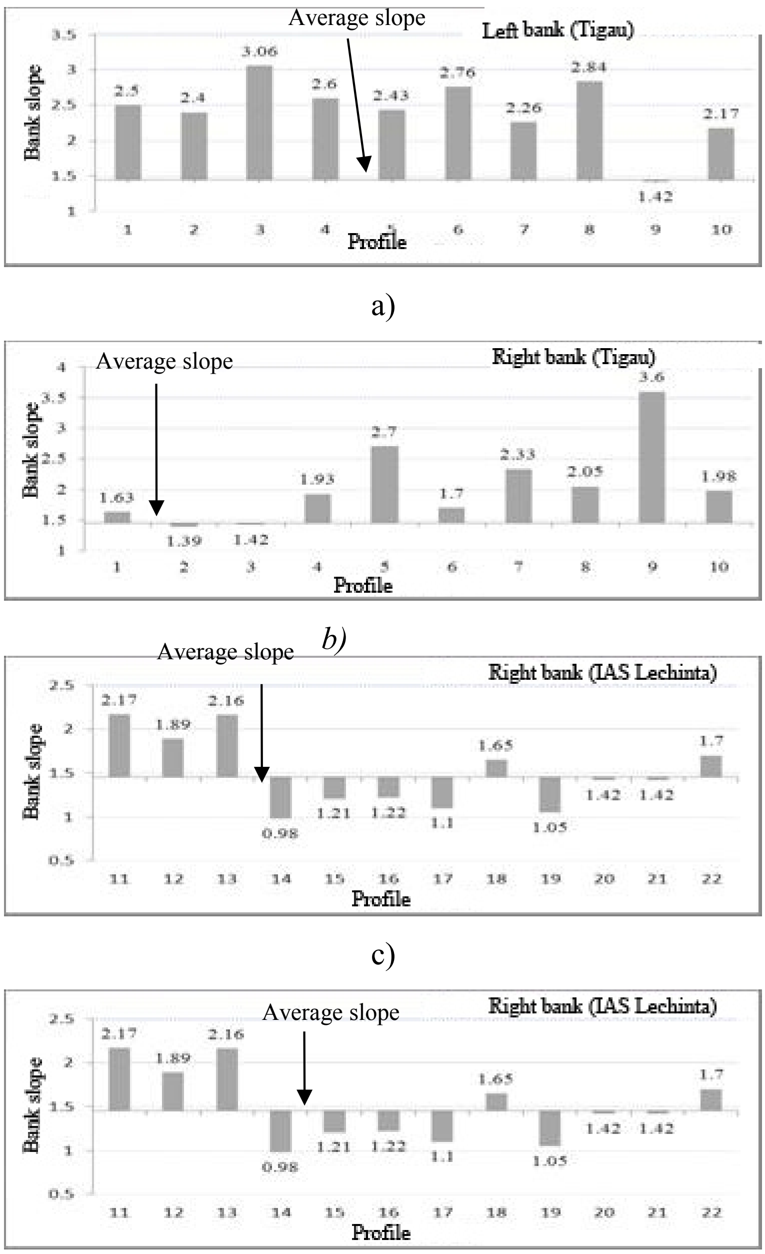
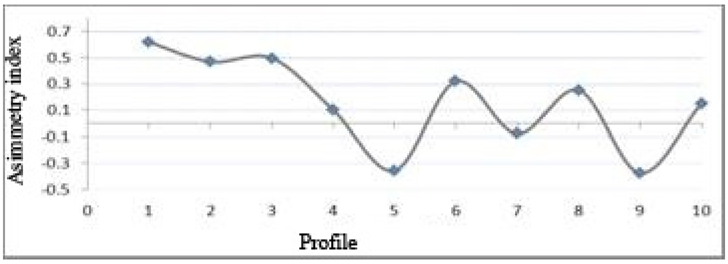
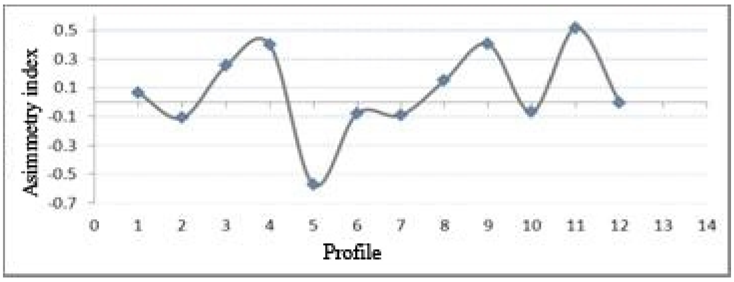


Fig. 19. *Banks slope values measured relative to average projected slope of 1: 1.5; Tigau sector (a, b), sector Lechința (c, d)*

The channel asymmetry *has values between 0.61 and -0.37 for the Țigău and the* *IAS Lechința 0.51 and -0.57 (Fig.20*)



a)



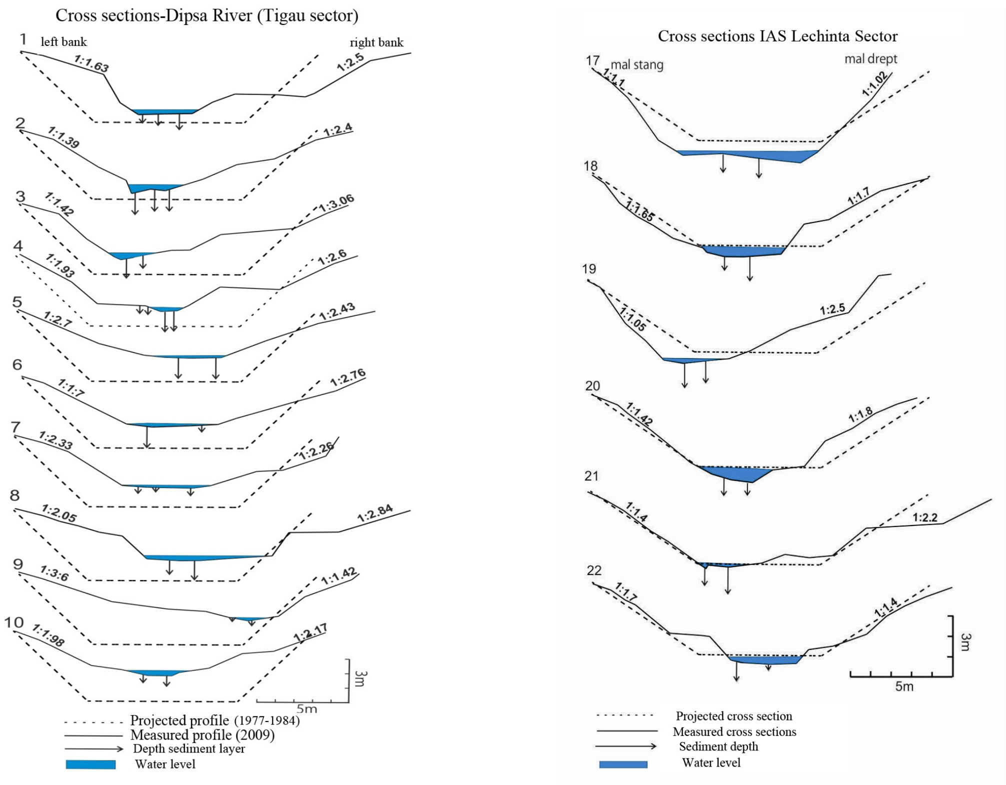
b)

Fig.20. *Asymmetry index variation forŢigău sectors (a) and Lechinţa (b) cross sections*

The values of the channel's width on the orthophotoplans in 2005 correspond to those measured in the field. The same thing does not stand true for channel dimensions from the project. The average width of the channel in Ţigău area, as shown in the analysis of the orthophotoplans, is of 17.05 m (the field measurements in 2009 indicated an average value of 18.16 m), while in Lechinţa sector, the average value is aprox. 16.3 m on the orthophotoplans, respectively 17.5 m in 2009.

The dimensions of the channel for Ţigău sector (as shown in the measurements on the field) show medium depths of aprox.3.6m (maximum depth of 4.4m and a minimum of 3.1m). For the area of SAI Lechinţa sector, the average of the depth of the channel, calculated for the 12 cross sections, is 4.21m (the extremes are 5.1m and 3.9m). The width respects the same spatial variation of the measurements. So, inside Ţigău sector, the medium width of the measured cross sections is 18.6m (the maximum is 21.4m and the minimum,14m), while in Lechinţa sector, the value of the width of the sections present an oscillation of the values, between 22.15m (maximum) and 12.7m (minimum)- the medium value being 17.56m *(Fig. 17*).

The thickness of the sediment deposits presented maximum values around 150-160cm in both sectors, which indicates a high sedimentation of the riverbed. The level of the riverbed base in Ţigău sector, was found at depths between 3.85 and 5.6m (a medium of 4.8m). In Lechinţa sector, the base corresponds to extreme values between 5.15 -6.14m (a medium of 5.6m). As results from these values, the level of the base of the riverbed in Ţigău sector varies in an interval of aprox.1.85m, while in Lechinţa sector, in an interval of 1m *(Fig. 21).*



a) b)

Fig. 21. *Cross sections at Ţigău (a) and Lechinţa sectors(b)which contain the value of the slope of the riverbanks, the thickness of the sediment deposits and the depth of the water during field measurements (2009)*

In the present study, the actual values of the channel width (except for the sections 9 and 11 in Lechinţa sector) seem mostly to be under the dimensions stipulated in the breastwork project, while the narrowing of the channel is impossible because of the its obvious tendencies towards expansion due to the different processes of bank erosion. This creates a contrast between the dimensions of the riverbed stipulated in the project and those carried out in the end.

The actual slopes of the riverbanks and the asymmetry indexes of variable values are clear indicators of the morphological structuring, both in horizontal plane and in the vertical one. The values of the asymmetry indexes, indirectly confirm the observations on the field regarding the development of the riverbed microforms (riffles and pools).

The form of the bank profile, the existence of the sliding materials (on the riverbank profile or inside the riverbed) indicate forms of retreat of the riverbank profile, according to the stage of its evolution towards an equilibrium profile.

A synthesis of the effects induced by such actions makes the evolution models of the two sectors resemble the ones in literature. So, the shortening of the length of the channel by realignment leds to hydraulic changes, such as the increase of the slope and an increase of the power of the river flow. The stabilising of the system was achieved by dissipating the energy in excess of the water current, by the erosion of the bed and of the banks. The new channel of Dipşa, larger and deeper, is more efficient in the dissipation of energy by the increase of the transport capacity of the liquid and solid discharge.

In the analysed sectors, there are a few morphological differences of the transversal sections, due to the different flow energy. In this respect, the slopes of the slighter banks and the lack of depth of the riverbeds (including the initial bed) in Ţigău sector, as compared to those in Lechinţa sector, could prove different types and phases of evolution.

In Ţigău sector, the amplified power of the water current which results from the confluence of Lechinţa and Dipşa rivers, determined a more rapid geomorphologic evolution of the channel. Although, in the case of this sector, the dimensions of the actual channel are smaller than the ones indicated in the project, the value of the base level of the riverbed (higher than the one in the project) indicates that the strong alignment of the river flow is followed by a short deepening of the channel. The small values of the slopes are proof of the fact that the energy of the current was redirected sideways, the layer of clay, resistant to the action of the water, limiting the evolution of the deep erosion. Moreover, it is very likely that the deposition stage in this sector was triggered quicker than in Lechinţa sector. The work from 1997 in Lechinţa also contributed to the increase of the sideway dynamics of the riverbed in this sector.

As for the evolution of the channel in Lechinţa sector, the very high values of the initial riverbed base (given by the measurements of the thickness of the sediment deposits), strengthen the idea that, in this sector also, the deposition processes were preceded by an incision of the riverbed, due to the nature of the above mentioned interventions. The more abrupt slopes of the banks, as compared to those in Ţigău sector, would indicate that the riverbed degradation process is slower, with the transgression from erosion to deposition not being as fast as the one in Ţigău sector. This could be associated to the type and period of orientation of the geomorphologic processes (the current might have acted in a longer period of time upon the riverbed in Lechinţa sector than in the downstream one).

Under these circumstances, both sectors are characterised by intense processes of deposition and a different evolution of the riverbank profiles. As for the Simon model, we could say that the third degradation stage, the most rapid one, was overpassed in both sectors, and the corresponding evolution stage would be stage 4 (*the threshold stage*) (although Ţigău sector, because of the latest intensification of the bank overflow, signals a transgression towards the 5th stage of agradation). The agradation stage is actually the longest: according to Simon (1992) for a system with an energy of over 35 W/m², the degradation stage will expend over 150 years, so, in the case of Dipşa river, with an energy of under 35 W/m², the duration of the stage is much longer.

The analysis of the evolution of Dipşa river channel in the area of Chiraleş hydrometric station comes as a confirmation of the above mentioned scenarios, at least in Ţigău sector. Another indicator would be the promptness of the channel's response to the works (an aprox. 50cm degradation of the riverbed and the retreat of the left bank with almost 2m, 2 years after the completion of the works) and also the moment of transgression from one evolution stage to the next *(Fig. 22).*

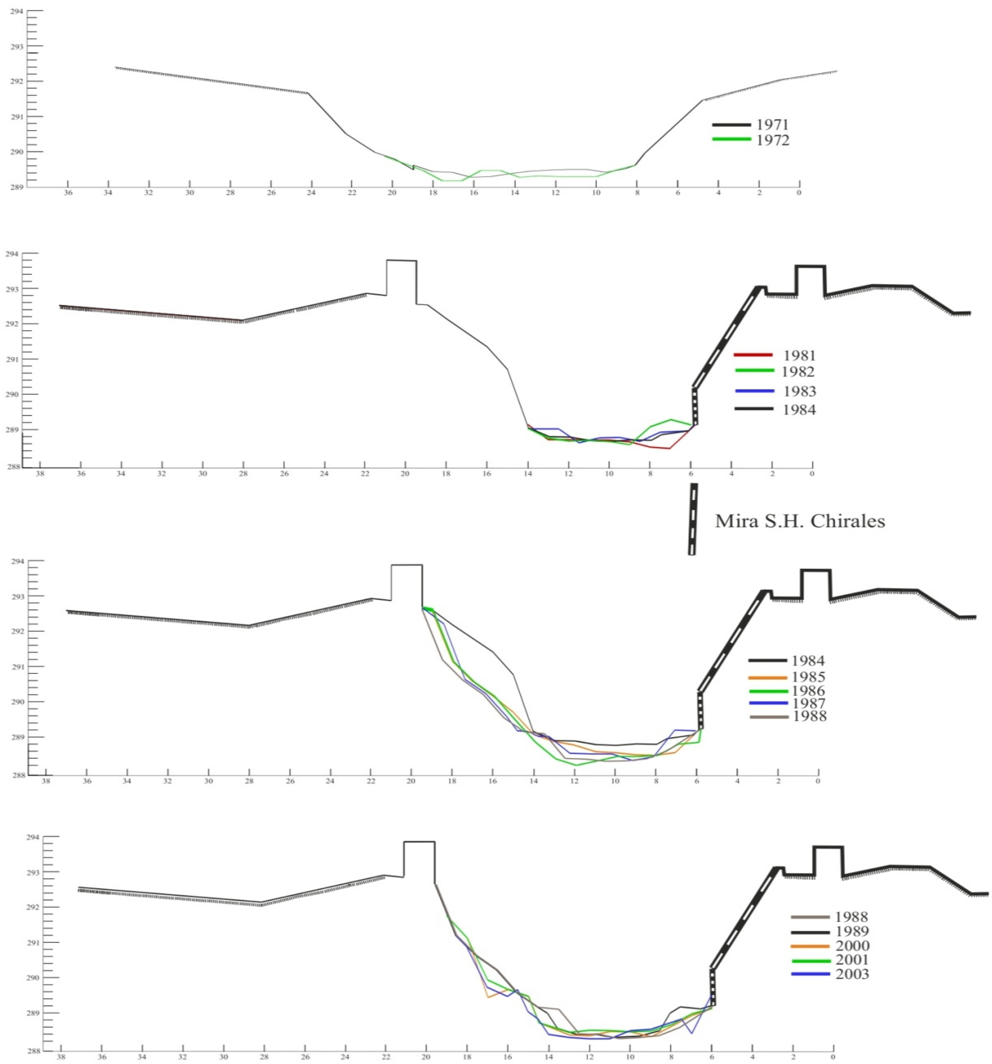


***Fig. 22**. Evolution of cross sections profile at Chirale*ş *gauging station (according to data from Romanian Water Agency-Branch Bistrita-Nasaud)*

CHAPTER VII

SEMI-NATURAL REGIME DYNAMICS OF MELEŞ RIVER CHANNEL

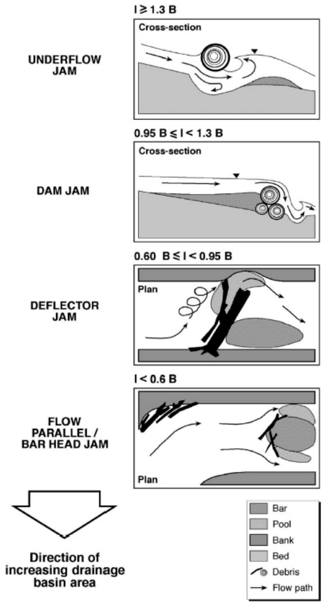
The aim of the present study is represented by an analysis of the role of the woody debris upon the type of morphological and deposition structuring of a sector that has not been directly affected by the anthropic engineering works.

In this respect, a river sector of about 1 km, 3 km away from the confluence of Someşul Mare river, was chosen to illustrate a different geomorphologic landscape by its morphology and dynamics, as compared to the areas radically affected by the engineering actions.

The field study consisted of a mapping based on water depth measurements, deposit layer thickness and the characterisation of the type of deposits in the riverbeds, all of them compared to the characteristics of the woody debris(*Fig.23*) (the dimension and the state of degradation of the key elements, the orientation in respect of the water current, the type of the materials forming the woody debris accumulations) (*Fig.24*).

The sprouts that grew vertically on the tree logs felt or bent in the river allowed to enregister by dedrochronological method the moment of riverbank`s sliding that cause the collapse of the branch.

The results materialised into 10 maps corresponding to 10 sectors, which comprise information referring to the morphology of the riverbed, as well as maps of the types of deposits and of the thickness of these deposit beds, all of them in relation to the presence of the woody debris accumulations (*Fig. 25, 26,27, 28).-*



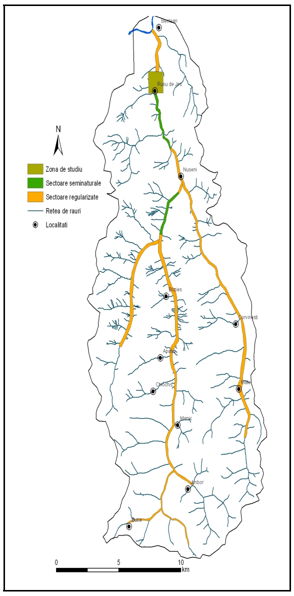


***Fig. 23**. Classification based on the shape woody debris accumulation Lemo*

(l = average height of the tree trunk, B = average width of the river. (By Wallerstein et al. 1997)

***Fig.24** Aspect from the field: woody debris accumulation measurements, dendrochronology sampling*

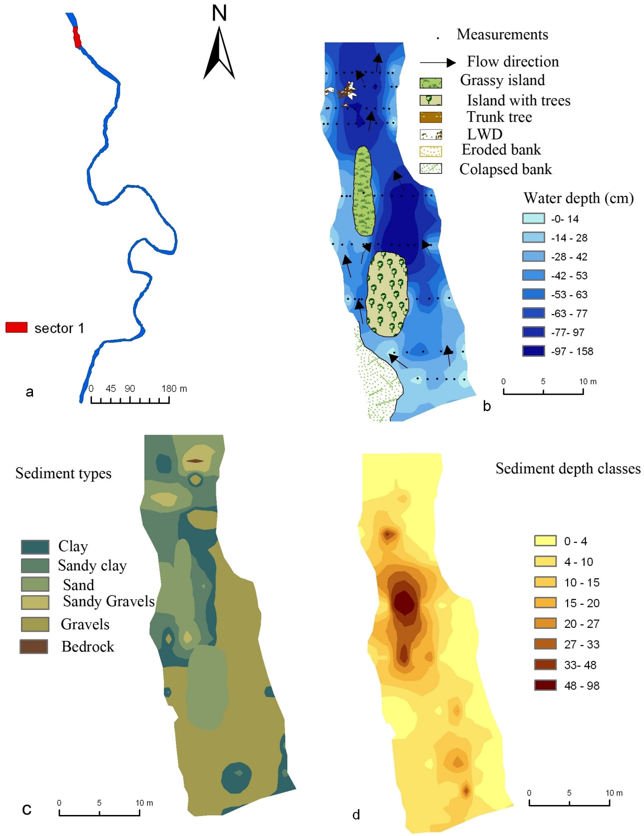


***Fig. 25**. Subsector 1*

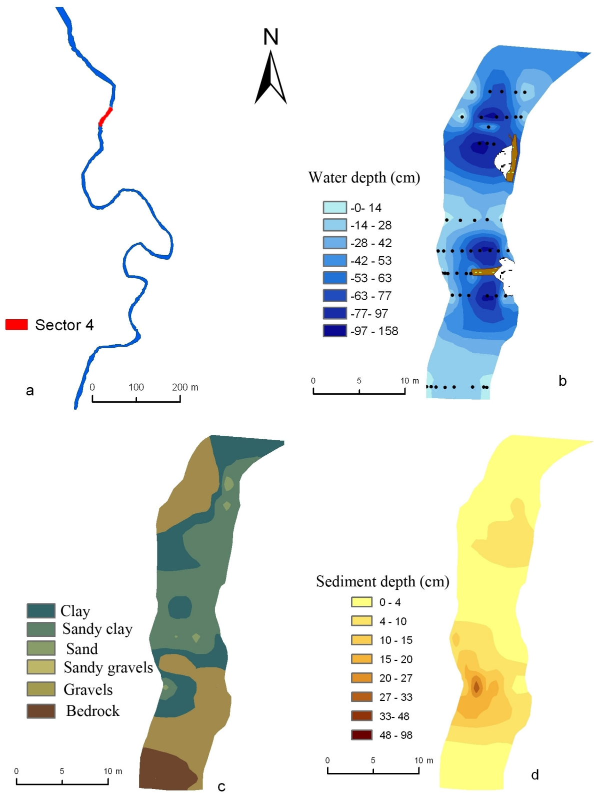


***Fig.26**. Subsector 4*

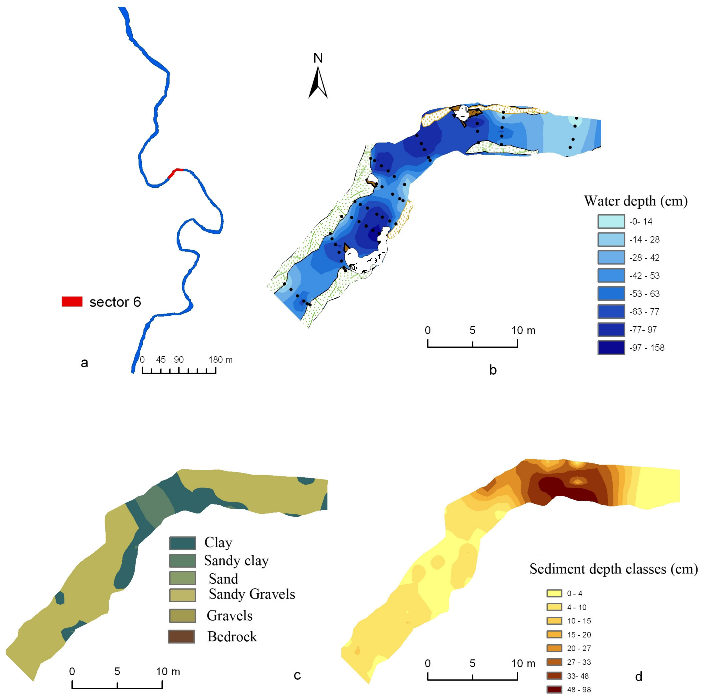


Fig.27. *Subsector 6*

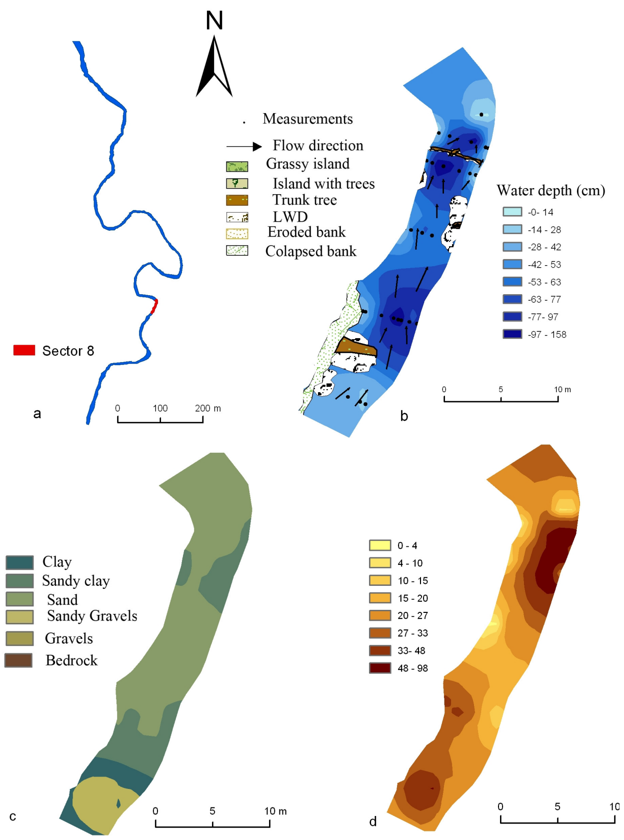


Fig.28. *Subsector 8*

Analysing the data, we notice that the riverbed in this sector is very complex morphologically, with a high density of riffles and pools. The average spacing of the pools is 3.3m of channel width, an inferior value to those found in most situations. *Leopold and co., (1964), Keller şi Melhorn (1978)* found that pool spacing values varies between 5 and 7 of channel width. This low spacing value in Meleş river is an indicator of the riverbed's high sensitivity to woody debris.

The forming of the pools is mostly controlled by the presence of the woody accumulations. Among the 35 analysed pools, 26 were associated to the presence of the woody material. The values of the maximum pools cannot be connected to the types of accumulations found, because of the complexity of the factors that interact during their formation *(Fig.91)*. The presence of the vegetation accumulation leads to an increase of complexity of the erosion and deposition processes, according to the angle they form with the river flow, to their dimensions, density, permeability etc. For that reason it difficult to quantify the imfluence of the woody debris in the determining of the riverbed's morphology and dynamics.

From the point of view of their position to the water current, all the types of accumulations classified by Wallerstern (1997) were identified here: submerse, dam, deflector – most of them, and parallel. From the point of view of the material that they are made of, there are woody debris formed of isolated logs that have fallen in the river, of branches and also mixed accumulations. Among the mixed ones, we can add the garbage waste, a specific feature of the river landscape in this sector, and not only.

The angles formed by woody debris accumulations with the direction of the current vary between 10% and 90%, and the obstruction of the riverbed is realized, in certain cases, totally (for instance, in sector 8).

As can be seen, the woody accumulations play a special role in the distribution of the sediment deposits. The ones that have a higher degree of permeability function as real deposit traps. For instance, there is an accumulation in subsector 1, which reduces the speed of the water current, forcing the sediments to overlap the zone were this accumulation repose. With the accumulations that are perpendicular with the water current, the deposition happens in the nearby vicinity (on the margins of the accumulations or on the opposite side), as a consequence of the energetic discharge of the water current in direct contact with these accumulations.

The existence of accumulations that are not directly connected to the depths and of their position inside the riverbed could be an indicator of their high mobility and periods of low residence. Such an example could be the accumulation in sector 3, placed in the middle area of the riverbed, which lacks in association to any morphological structure.

The perpendicular accumulations, with a low permeability, are associated to two pools, upstream and downstream (for instance, in subsectors 4, 8, 9). They render the image of the way in which the water current energy is distributes. The similar morphology of the accumulations having key elements that are not perpendicularly placed inside the riverbed could indicate the old position of the tree log (for instance, the upstream accumulation in sector 2 or sector 9).

The morphological effects of the woody debris accumulation manifest as follows : erosion by the reduction of the water flow section (creating depths and the washing of the fine deposits that are more easily transported downstream) and deposition in the vicinity of the woody debris.

Many of the trees that fell in the riverbed come from the collapsed banks and, as time passed, they became fixed by the sediment deposits. They represent the forming basis for the woody accumulations that locally deform the riverbed.

The pools are characterised by the presence of the large grain size sediments, while the depth areas abound in fine deposits or washed beds.

The relative age of the analysed sliding processes vary from 3 to 21 years, different ages of the sprouts being noticed inside the same slipping, fact which demonstrates complex local dynamics with consecutive triggering of the sliding processes in certain areas, according to the local characteristics.

CHAPTER VIII.

ETHICS AND AESTHETICS IN RIPARIAN LANDSCAPES: ILLUSTRATIONS FROM THE MELEŞ AND DIPŞA BASINS

The present study starts with the assumption that there is a connection between the way in which people perceive and 'conceive' the world around them, on the one hand, and the behavior that they exhibit towards the environment on the other hand. To this point, the rural space that contains the Meleş and Dipşa basins offers unique characteristics.

The main objective of this undertaking was to obtain detailed descriptions of the way in which the subjects perceive the rivers, while at the same time creating a typology of the riparian landscapes for the Meleş and Dipşa basins, based on the lived experience and on the significant landscape indicators *(table 3).*

The main methodological instruments used to reconstruct the meanings, perception and the ethical position of both the locals and the authorities involved in managing the river bends were semi-structured and in-depth interviews. In this way, it was possible, during success of stages of fieldwork, to gain insight especially from the farmers, the riparians, but also from people who play an important role in making decisions for the community, the authorities, the mayor's office, the staff of the Administration of Land Enhancements, etc.

The regulation works represented the main focus of the interviews conducted in this study. The questions centered around the regulation practices and activities, as well as the stage of the works situated in the riparian range. The interviewees were asked about the type of the works, the way of implementation (the excavating technique), but also about the purpose of the works, etc.

Although the number of the people engaged in discussions about the evolution of riverbeds in time and the practice of these regulation works was much greater (exceeding 60 over the course of the whole fieldwork process), the complete questionnaire was applied to 30 of these subjects, resulting in representative information.

The inquiries turned out to be face to face meetings with the locals in order to understand the different practices related to the regulation works and their associated impacts on the dynamic of rivers. Eventually, this participative undertaking resulted in mutual exchanges of information which have proved to be useful both for geomorphological studies with practical environmental applications and for raising awareness for the principle of environmental responsibility within the local community.

The riparian landscapes characteristic for the Meleş and Dipşa basins have been subsumed under four categories, by taking into account the essential features resulting from the fieldwork and the criteria and indicators from table X, namely:

artificial landscapes, *transitional landscapes*, *ephemeral landscapes*, *traditional landscapes*.


a) *b)*

Fig.29. *Artificial riverain landscapes, Lechința*


a) b)

Fig. 30. *Transitional riverain landscapes*


a) *2008 Meleş sector* *b) same sector in 2009*

Fig. 31. *Ephemeral landscapes*


a) *Meleş 2008* *b) d) Jimbor Cătun, 2006.*

Fig. 32. *Traditional landscapes*

Criteria	**Indicators**
• **Naturalness/ Artificiality**	Inventory of human intervention through regulation works along the riverbed/ Degree of artificiality
	Character of the water flow: turbulent/limpid
	Local characteristics of the riverbed: presence/ absence of gravel or boulders
	Characteristics of the riparian vegetation
	Presence of driftwood accumulations in rivers/ flow obstructions, etc,
	Olfactory senses (smells, etc.)
	Recovery potential (Natural recovery)
• **Aesthetics (agricultural)**	Tillage/Abandoning lands (Productivity / Non-productivity)
	Farming and conservation techniques
	Crop variety
• • **Scenic beauty**	*Intrinsic atmosphere* Serenity, Calmness , Familiarity, Harmony , Unity, Privacy, Mystery *Artistic quality* Contrast, Form, Color, Symbolism
	Orderliness, cleanliness / Disarray
	Complexity/ Landscape homogeneity
	Utilities
• **The visual quality of the landscape**	Permanent/Ephemeral characters
	Traditionalism
	Authenticity
	Degree of change: Original/Altered
	Capacity of absorbing change
• **Values**	Pro-environmental/Responsibility towards the environment

Table 3.*Critera and indicators used in riparian landscape assessement*

The conclusions that can be drawn from this research can be summarized as follows:

- There are no campaigns aimed at informing, promoting and preserving the natural characteristics of the habitat under study;
- The way in which the farms and riparian lands are managed continues to be a matter of education and good taste in the rural areas;

- Understanding the perception of such landscapes and grasping the ‘ethics’ of the actions that have taken place as a result of agricultural policies or of hydrographic basin policies is necessarily the departure point for establishing connections between the community and the environment which, in turn, are necessary to the future evolution of riparian landscape aesthetics bearing direct implications on the riverbeds.

The purpose of such perceptual studies is to strengthen the environmental aesthetic virtues of a landscape, while at the same time encouraging reflection on the nature of landscapes, authentic values and the harmonious evolution of man’s relationship to nature, based on ethical construction principles.

Promoting landscape education is also one of the principles included in the Convention of the European Landscape (2000). Public participation and its facilitation in the process of decision-making constitute fundamental elements for the preservation of authentic landscape values and the improvement of the quality of anthropic landscapes.

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