BABEŞ-BOLYAI UNIVERSITY, CLUJ-NAPOCA
DEPARTMENT OF GEOGRAPHY

PhD Thesis
Summary

INTEGRATED ASSESSMENT OF HYDROLOGICAL RISKS IN BISTRITA HILLS

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CONTENTS

Key words**:** *integrated assessment, risk, institutional vulnerability, interdisciplinary, bank retreat, hydrological interferences, management.*

INTRODUCTION

The thesis attempts to provide a vision of an interdisciplinary approach for hydrological risk analysis through interactive research meant to integrate conceptual knowledge and practical support for stakeholders and decision makers.

The objective of such evaluation is to improve the functioning of risk management by recognizing gains and losses arising from the exchanges and interactions between water and the environment in order to establish a balance between development and associated risks related to water.

Research was focused on the main hydrological risks induced in this area by the extreme events, (floods and flash-floods) hydrodynamic processes (lateral migration and bank erosion) and hydrological interferences (water chemistry and its diversity in relation to local factors) based on field investigations, bibliographical studies and various archival sources in order to shape a synthesizer and analytical work mechanism (Fig. 1).

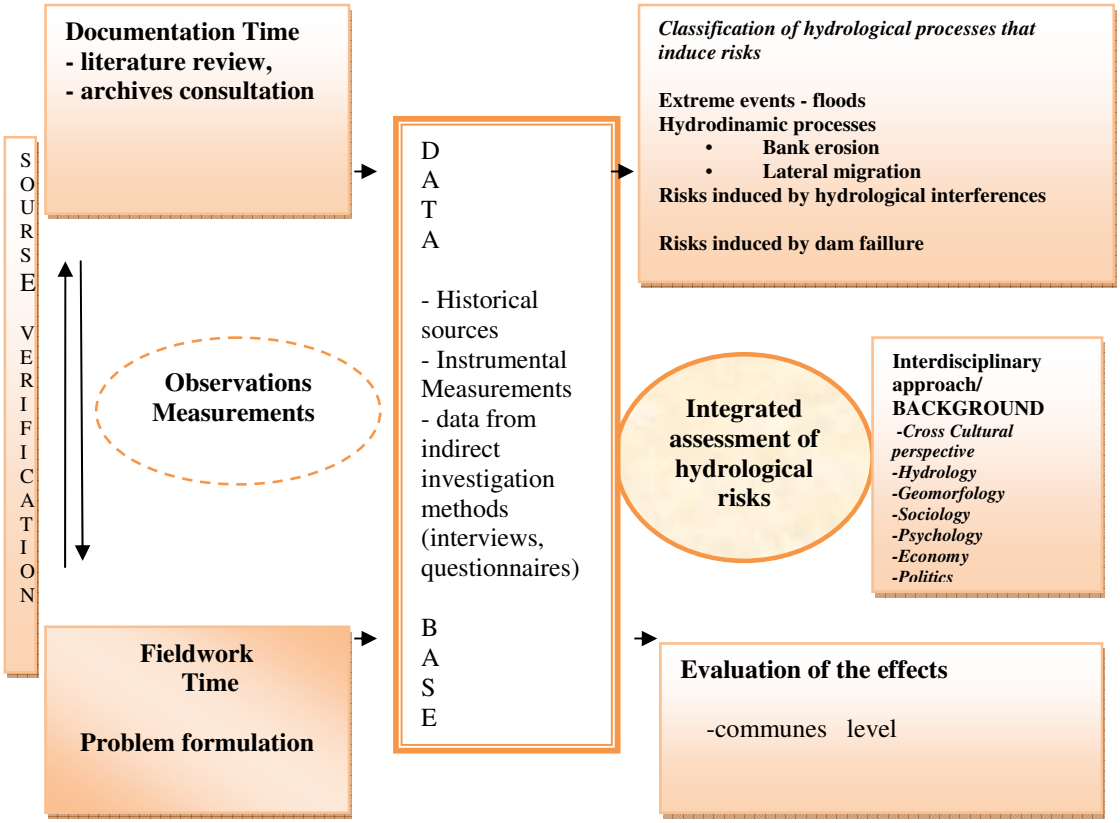


Fig.1. *General Research schema*

Integrated assessment network comprises three essential phases (WHO | Integrated Risk Assessment, 2007): *problem formulation* - is to define the objectives, and activities covered in the assessment analysis; the next step is to realize a *data collection* and *modeling exercises* to characterize the exposure of the vulnerable elements in time and space, and to finally obtain a *characterization of risk* as an overview of the vulnerable elements and the effects of exposure occurred (fig.2).

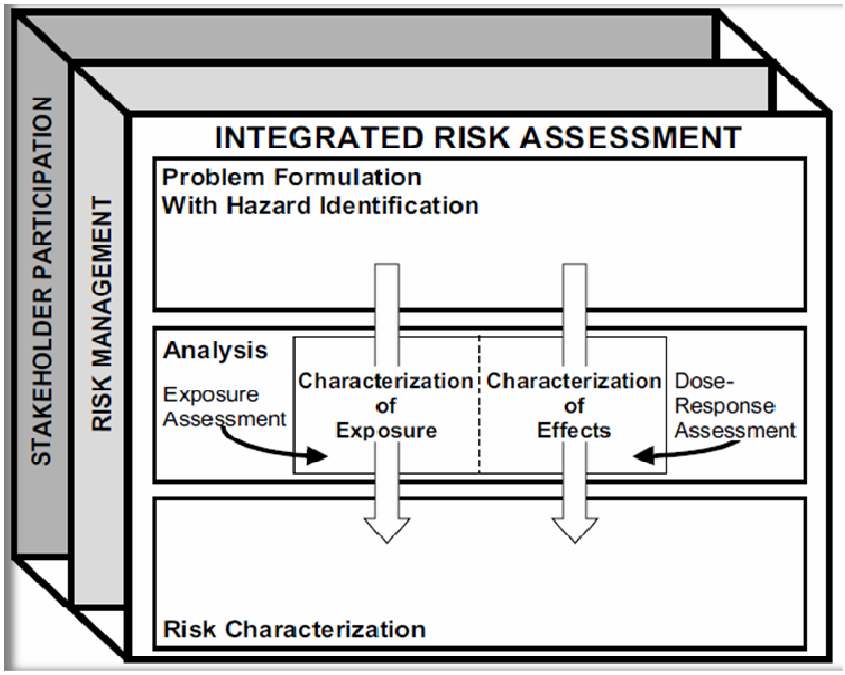


Fig.2. *Conceptual model for integrated risk assessment (World Health Organization 2007)*

Results of present assessment are communicated to the authorities involved in the management process but they are also targeted for public access to information in order to determine its active involvement in decision making process.

CHAPTER I

Elements of territorial individuality and regional characteristics

The study area is a distinct and complex morphological unit located at the eastern border of Transylvanian Plateau, incorporating a predominantly rural space with high Sub-Carpathian hills landscape, the territory being largely overlapped on Şieu River Basin (1800 km², including the mountain region) (fig.3).

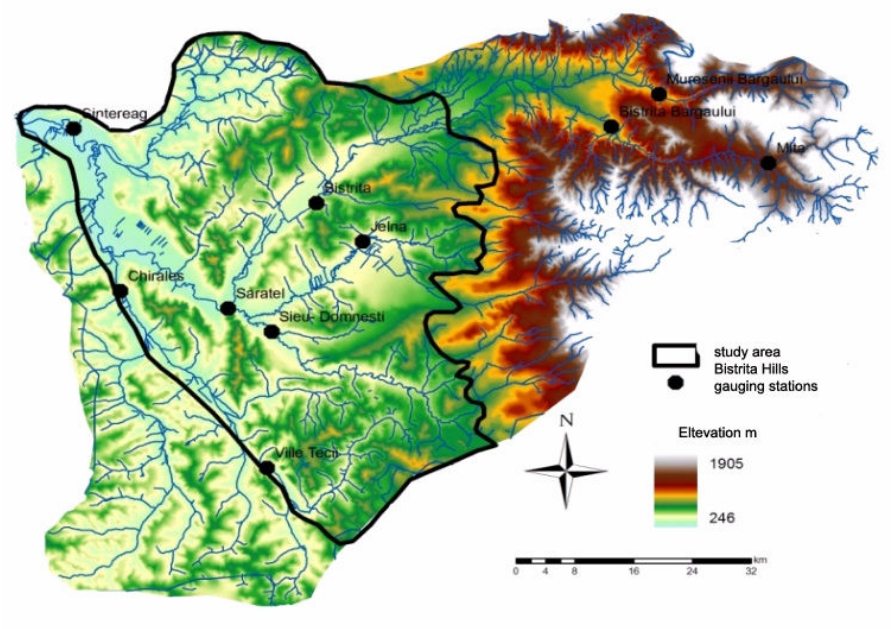


Fig. 3. *Location of Bistrița Hills within Şieu Basin*

Location of study area will be considered in terms of geomorphologic unit perspective (hence the name of Bistrita Hills), hydrological basin aspect (taking into account Şieu catchment), but also administratively (at commune level, as financial damage caused by hydrological risks are being analyzed based on administrative territorial units).

CHAPTER II

Terminological and methodological issues concerning the study of hydrological risks

The chapter presents an overview on the terminology and methodology, related to hydrological risks encountered in the international and national literature, including recent trends and methodological key issues concerning risk assessment. The main principles and selected theoretical methodological steps for risk assessment analysis have been incorporated into practical aspects of the research included in subsequent chapters.

CHAPTER III

Hydrological processes and assessment of hazards in Bistrița Hills

3.1. Risk induced by rainfall deficit

Hydrological effects of the rainfall deficit manifested by dryness and drought phenomena, have negative economic consequences by reducing agricultural production and creating difficulty in feeding for local communities, lowering the groundwater level, inducing a temporary influence on rivers drainage, and on the water levels of anthropogenic lakes deserving fishing interest. In Bistrița Hills during the summer deficient rainfall intervals, temporary dryness of the rivers occurs in: Livezilor Creek, Buduş Creek, Arinilor Valley, Goat Valley, Arcalia, and Hidden Creek.

A summary of existing works in Romanian literature (Sorocovschi 2001, Holobâcă et al. 2001, Adina Croitoru, 2002, Moldovan 2003, Holobâcă, 2004, Adina Croitoru, 2006, etc.) providing the main source of climatic data was used in order to determine the pluviometric deficit for the study area**.** According to those sources the annual and seasonal values of the Standardized Precipitation Index (PSI) for the period 1950-1999 show that at Bistrita gauging station the minimum amount of precipitation (383.9 mm) was recorded in 1986, the multiannual average having a value of 648.4 mm.

The period between1990-1992 recorded three consecutive years of rainfall deficiency at Bistrița gauging station (Moldovan et al., 2003). According to ISP the degrees of drought seasonal rainfall distribution highlights the lack of seasons exceptionally dry or excessively dry at Bistrița gauging station being recorded few very dry seasons and more dry seasons (Moldovan et al. 2003).

3.2. Risk induced by extreme events (floods, flash-floods)

Based on available data from 5 hydrological gauging stations provided by Romanian Waters Framework, Someş-Tisa Watershed, Bistrița and Cluj-Napoc Districts, and additional existing documentation related to recorded damages from these events it was possible to draw a diagnosis and a spatial distribution of the economic effects caused by floods.

Thresholds of maximum discharges established for different levels (awareness, flooding, danger level) based on historical discharge values (from 1954-2003) and flow rates, allowed some correlations for the degree of hazard occurrence, the recurrence interval (fig. 4.)

Statistical analysis performed for periods between 27 and 39 years, identified 134 events (floods and flash- floods) for 53 of them were mentioned damage in local archive records. The maximum discharge of 1116 m^3/s for this area was recorded in 1970 (at Şintereag gauging station), when big flood events occurred all over Romania.

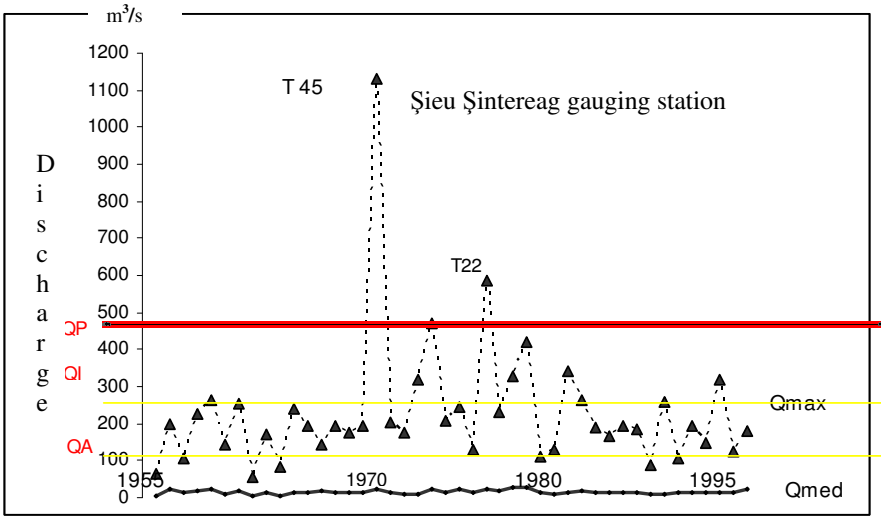


Fig. 4. *Degree of exceeding threshold rates based on historical of maximum discharge, Şieu-Şintereag gauging station (1954-2003),*

T- Recurrence interval
QA- alarm threshold
QI - flooding threshold
QP-danger threshold

We conclude that analysis indicate the fact that there is a potential constant expression of these hazards occurrence, the severity of the impact depends on the amount of damage they cause.

An analysis, at the level of each commune was done to assess the flood damage, based on historical events from (1978-2005), their socio-economic impact and causes (fig. 5), acoording to existing documentation from the archives of the Romanian Waters Framework.

Damages were classified in four categories depending on the importance of the objectives:

I. Households, socio-cultural buildings;
II. Industrial buildings;
III. Infrastructure
IV. Agriculture

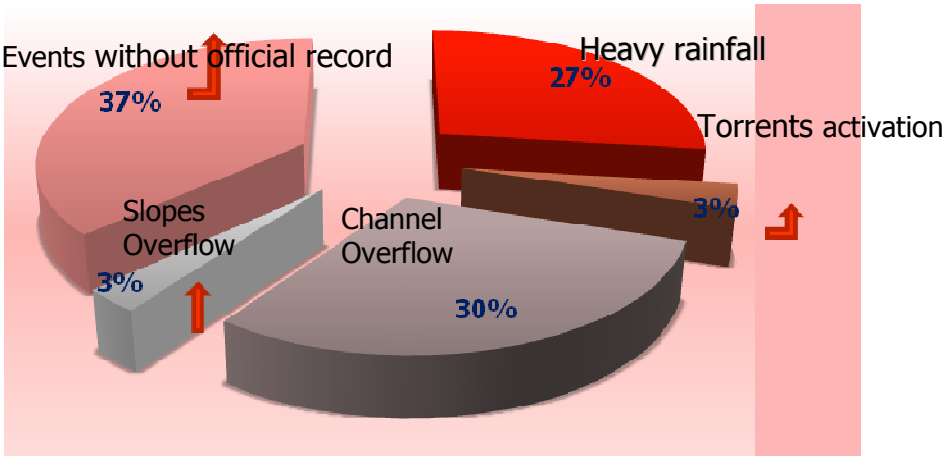


***Fig. 5**. Classification of damages causes based on inventory obtained from archival records of the events (1978-2005), source: Romanian Water Framework, Someş-Tisa Water watershed, Bistriţa District.*

The initial values of a year's corresponding recorded losses have been updated in order to compare the degree of damage at the level of communes and their ciphered change over time. Updating the values from the past was done by taking into account the inflation rate and the denomination from 2005 according to the formula:

A = original amount to be updated * IPC / 100
A = updated value
IPC = inflation rate *100
IPC = index of price consumption

From the ciphered numbering of the registered damages for the period between (1978-2005) we can observe the fact that within the Şieu-Măgheruş commune, there were recorded the highest losses, the damages deriving from the 3rd and 4th classes. The smallest damages were registered at the level of the commune Şieu. As far as the damages included in the Ist and IInd category, Budacu de Jos Commune presents the highest values in losses, being folowed by Mărişelu Commune. The most affected communes in terms of recorded damage are: Şieu Măgheruş Şieu Odorhei Mărişelu; the opposite, with small losses, being the communes of Şieu, Cetate and Şieuţ.

After 1970 protection works carried out along the river channels have reduced the damages included in the priority category of social objectives set (lives and building), but losses remain high in infrastructure and agriculture.

3. 3. Hydrodynamic processes and associated risks

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 for the morphodynamic equilibrium of meandering 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 a complex of variables different from one place to another: the pore water pressure (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).

Negative economic effects reflected in agricultural lands losses and conflict situations between the riparian communities are very representative along Şieu River. Human influence in the river bed, manifested by sediment mining, course deviation, and construction of engineering structures to protect riverain communities against floods caused major adjustments of river bed characteristics and of hydrological regime dynamics.

The sector investigated on the Şieu River has a total length of about 27 km, being extended between the confluence of Şieu with Şomes River close to Cociu Village and the pig farm located near Arcalia Village (fig. 6). Qualitative information regarding anthropical activities (traces of sediment mining activities, engineering structures etc), land use, riparian vegetation, were gathered in order to evaluate the main context of bank erosion.

Field survey activities aiming to locate and measure the length of eroded river bank sectors allowed realizing an inventory data base including characteristics that show the active erosion of river bank: the lack of vegetation on the bank profile; steep bank slope; the presence of river water level close to the riverbank base, cracks and fissures on the bank edge. 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 has been measured with a Bosh laser telemeter.

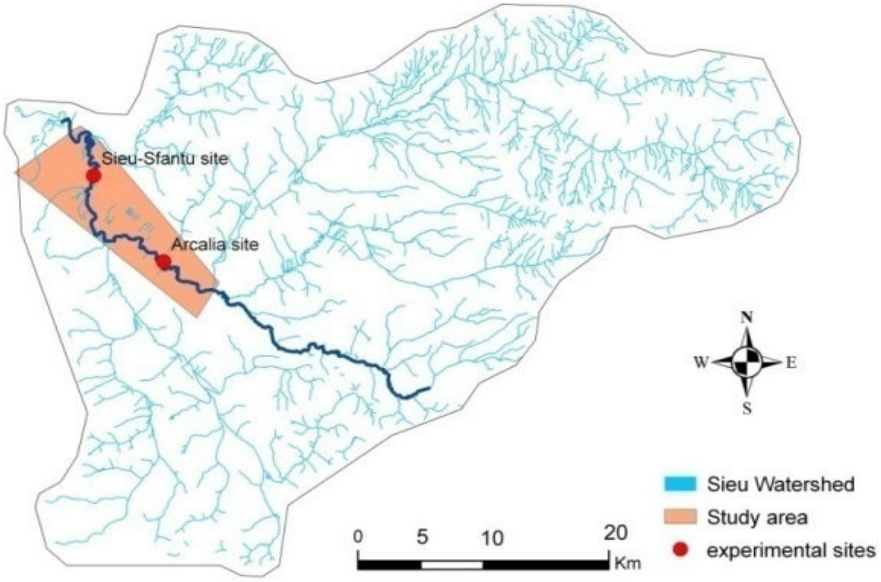


***Fig.6. Location** of the study area in Şieu river watershed*

Detailed measurements for bank erosion have been done for two experimental sites, situated in the vicinity of Şieu-Sfântu and Arcalia Villages. For the Arcalia, the monitoring activity was undertaken for an eight months period (between 04.10.2008 and 23.05.2009), while for Sieu-Sfantu the analysis was for 6 months (between 06.12.2008 and 23.05.2009). The time interval for measurements included periods with alternation of rain-snow precipitation and frequent freeze-thaw processes which are meteorological characteristics with a high influence on river bank stability.

The bank erosion length from the first site (Şieu- Sfantu) is about 300 m and 128 m for Arcalia site. River bank stratigraphy is very complex, highly variable, and includes several sedimentary layers, particularly for Arcalia, with a cohesive upper portion, overlying a gravel toe in the lower part of the bank (fig.7). Base material consists of coarse deposits, (coarse gravel), continuing toward the top with alternate layers of clay, sand mixed with clay of different thicknesses and at the top there is a variable thickness layer of topsoil. The average height of the banks ranges from 3.5 to 5 meters in the two cases.

a) Arcalia site *b)-Saint Şieu site*

Fig. 7. *Bank erosion- aspects of the studied sites*

Despite the lack of more precise instruments for measuring the bank retreat we took advantage of the fact that the bank material collapse has a slice shape, so that fixed points were installed (76 steel pins), of 8 mm diameter and 1 m long, spaced at different intervals which allowed to measure and estimate the bank retreat. To have single measurement directions, alignment series were established using pins installed on the bank edge and inside the bank profile (bank face). Erosion rates were correlated with data from Sintereag gauging station, representative for both investigated sites.

In order to study the responses of bank profile retreat, series of measurements (based on established alignments) were conducted from the upper bank to the water level base every twenty centimeters. Lately, topographic surveys have been done with a Leica Total Station, which allowed only one bank profile, outlining the irregular shape and monitored the position of fixed points.

Bank retreat process in the analyzed periods recorded erosion rates for the fixed points ranging from 0 to101 cm (for Arcalia site) and from 0 to 117 cm (for Şieu-Sfâtu site). Maximum values of erosion, both for Arcalia and Saint-Şieu sites occurred between 4.01.2009 and 06.02.2009. For Arcalia, bank retreat rates decreased sharply, from about 35 cm in February, to 20 cm in March and almost non-existent in April-May. For Şieu-Sfantu site, bank retreat rate was maintained at high values also for the next interval 06.02-28.02.2009, however after that period, it was recorded a gradual decrease of bank retreat values.

The period with the most active retreat (1-24 January) for both sites investigated was characterized by the presence of ice shore, meteorological conditions with solid precipitation (snow) and a minimum temperature of -2.6 degrees. For Şieu-Sfantu site, the high levels of retreat for the next period (from February to March) coincided with two time intervals of solid precipitation of 41.9 and 49.8 mm.

Traces of ice (continuous scratch marks) that were seen at a level of more that 1 m at the bank toe showed the enormous pressure that is exerted at the base of river banks.

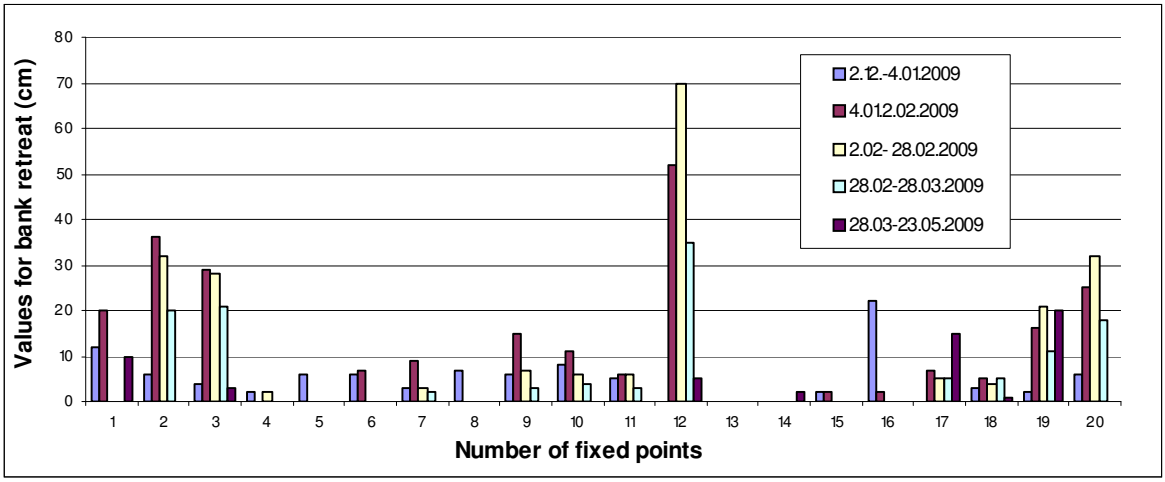


Fig.8. *Values of bank retreat for the period December 2008 - May 2009 (Şieu Sfântu site)*

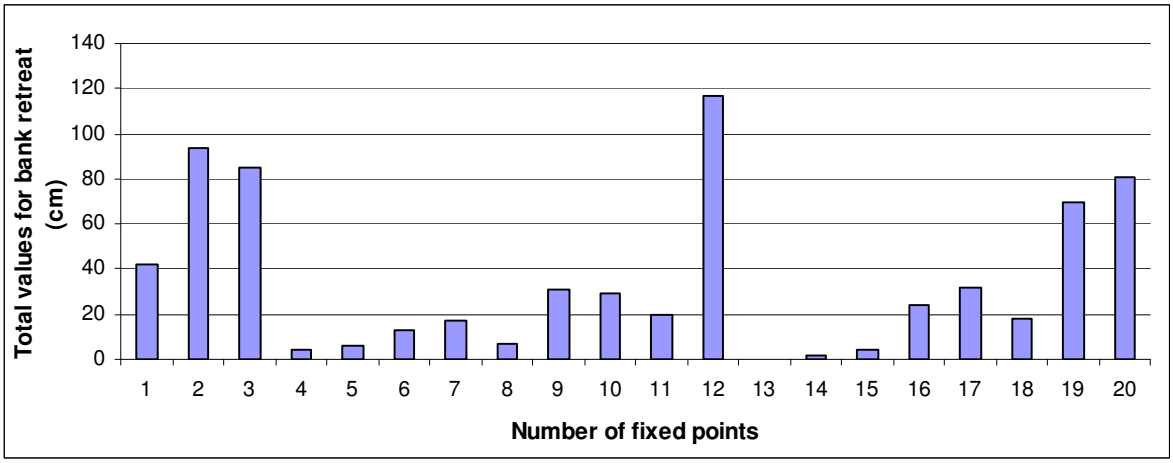


Fig. 9 *Total values of bank retreat December 2008 - May 2009 (Şieu Sfântu site)*

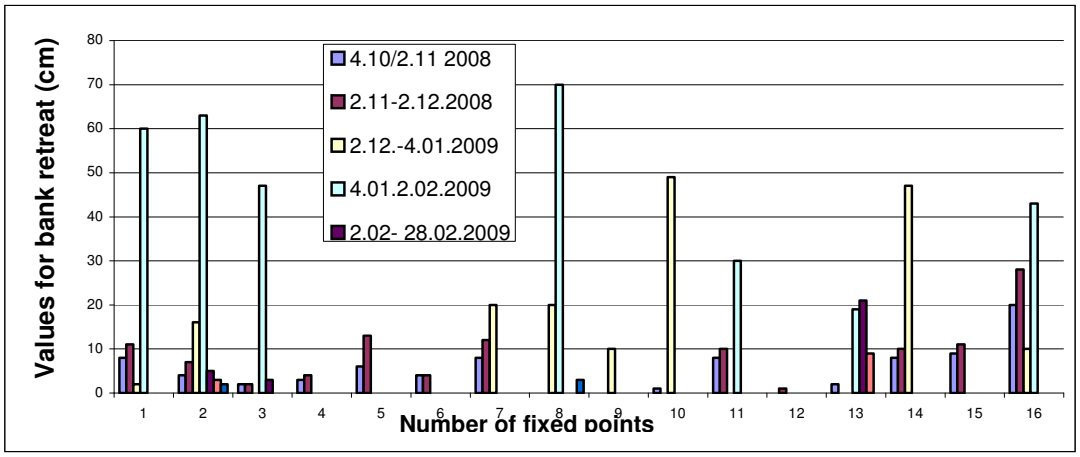


Fig.10. *Values of bank retreat for the period October 2008 - May 2009 (Arcalia site)*

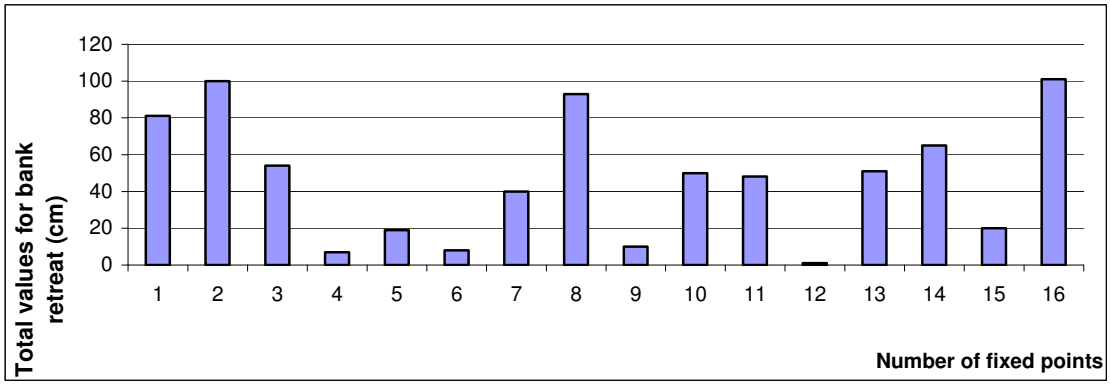


Fig. 11. *Total values of bank retreat October 2008 - May 2009 (Arcalia site)*

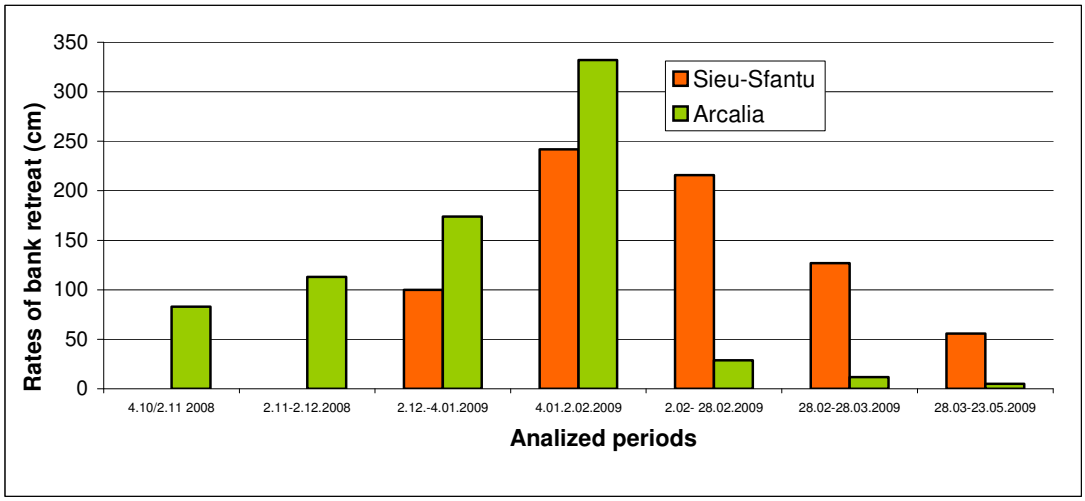


Fig. 12. *Bank retreat rates on the intervals and analyzed for sites Şieu-Saint Arcalia*

As conclusion, we can say that the main causes for investigated bank erosion rates seem to be related to the climatic factors for the study period, a combination of freeze-thaw and a full saturation processes.

The form of bank retreat is different depending on the level reached in the evolution towards an equilibrium profile: for the steep banks with vertical profile and low stability, the retreat evolved from the base to the upper part of the bank affecting both upper and lower layers (fig. 13). For the banks with a higher stability, the retreat affected only the upper brittle layers. The collapsed material is deposited at the bank toe and washed away at high flow level, the bank base remaining again exposed to the direct contact with flowing water. For both cases a general flattening tendency of the bank profiles was clearly observed.

The most resistant layers counteract the erosion processes of the profile appearing as a structural bench that delays the river bank retreat for the entire profile. For the Arcalia site, the grass from the top bank has an important role for upper layer stability delaying the retreat process by root system that actions as an anchor for the soils and maintains it as a bulge at the bank edge.

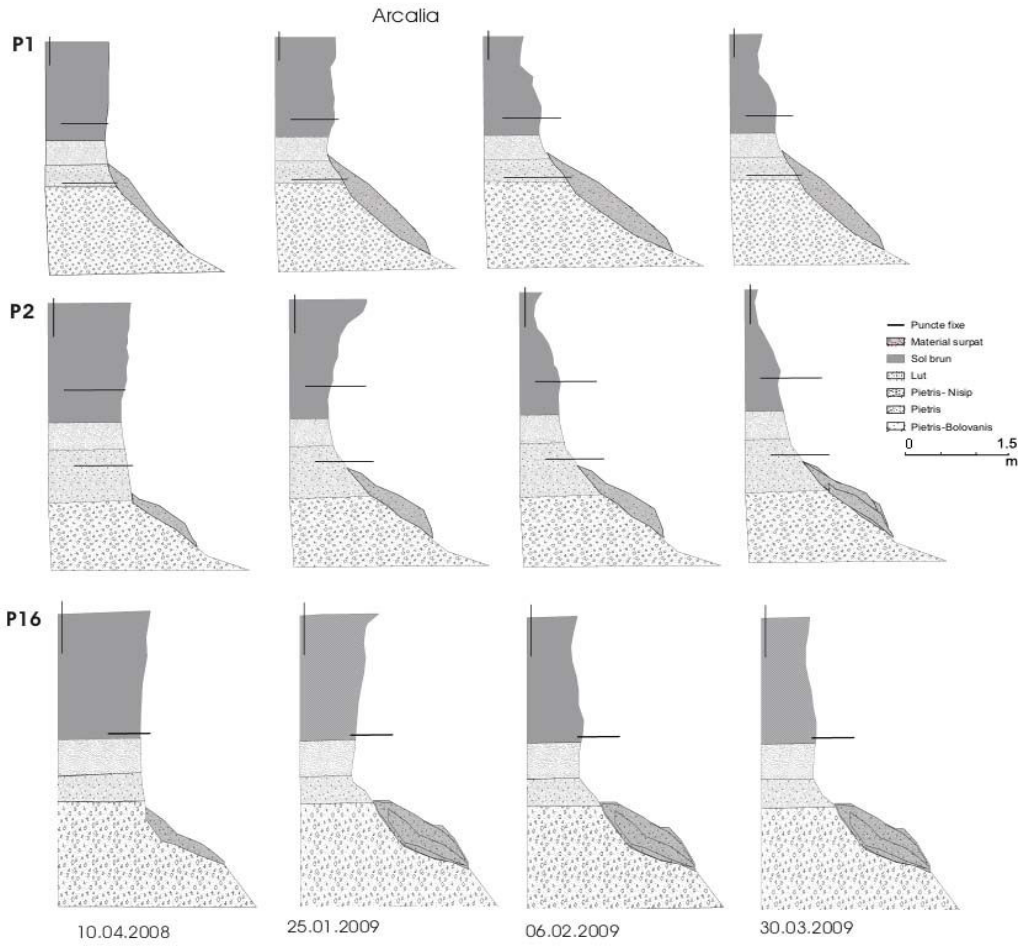
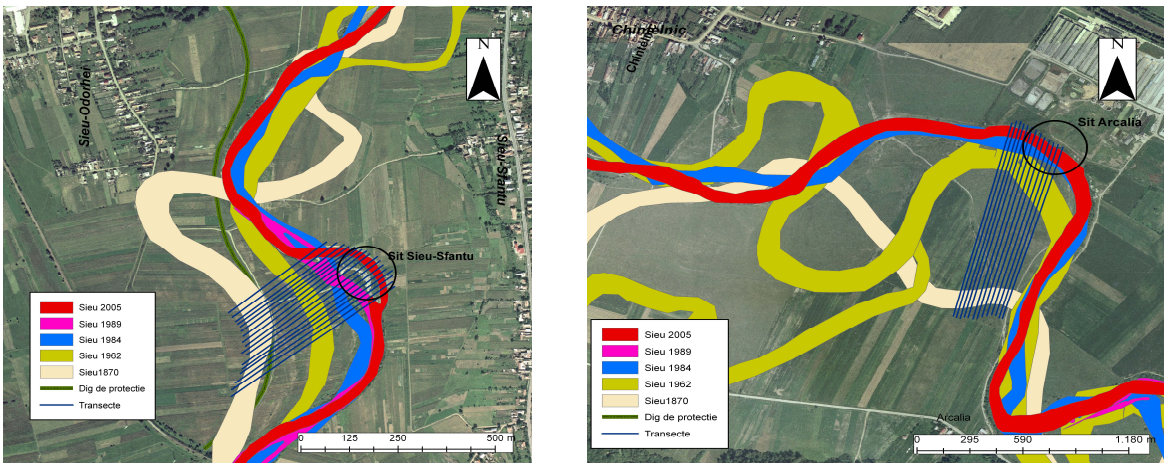


Fig.13.*Models of bank retreat evolution (examples of profiles monitored in the field)*

Historical channel adjustment analysis (using historical maps, orthophotoplans from the last 200 years) emphasized a constant lateral migration of the channel (fig.14). Erosion rates were analyzed on transects, by measuring the shift of bank edge for each map and dividing the values of the retreat by the number of years between successive maps, Hooke's method (1980).



a) Şieu-Sfântu *b) Arcalia*

Fig.14. *Lateral migration of Şieu River between 1870 and 2005*

Analysis of historical maps show that the migration rates for Arcalia site had higher rates during 1870-1962 (2.5-4 m per year), dropping in the next period (1962-2005) until approximately 1 m annually (fig 15).

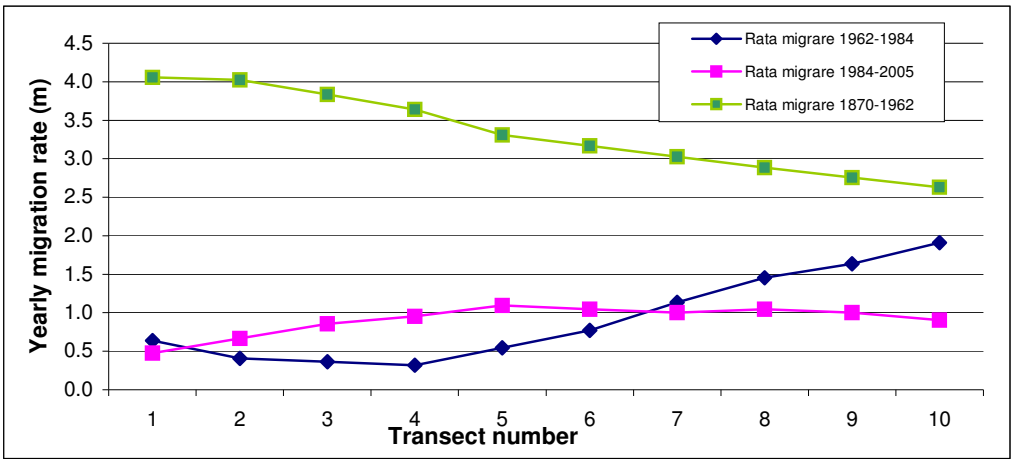


Fig. 15. *Lateral migration rate for the period 1870-2005 Arcalia site*

For Şieu Sfântu site, between1870-1962, the annual migration values are constant, around 1 m / year, after which the migration rate increased to over 4 m / year in some parts of the analyzed sector (Fig. 16). In the period 1984-1989 the river migrated both to the right and

left by erosion, the traces of migration (abandoned channels) from the left side being a clear testimony of this fact.

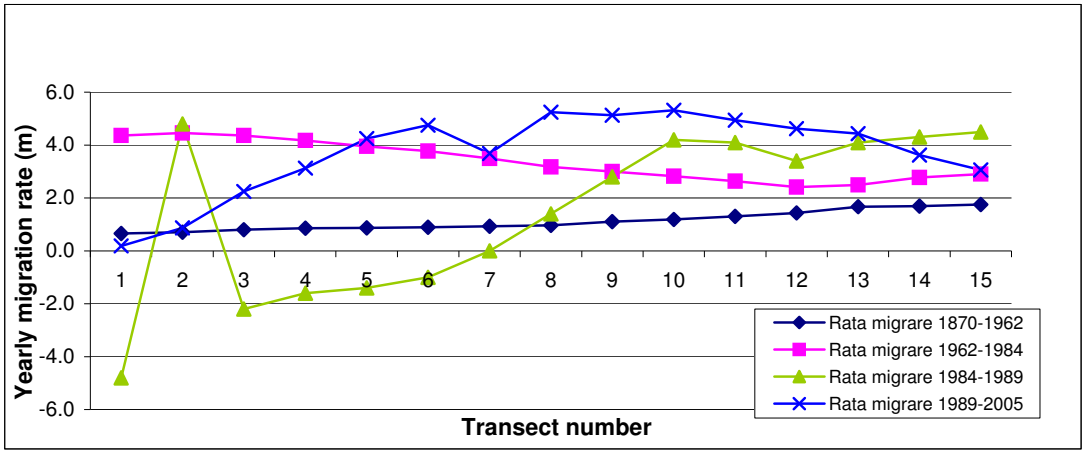


Fig.16. *Lateral migration rate for Şieu-Sfântu site during 1870-2005*

From analysis of historical migration rates, it appears that at the site Şieu-Sfântu, the trend of migration of the river to the right seems to have taken place since 1870. Agricultural land on the left bank, much lower than that of the right bank, is "a testament" to the scenes of river action in historical time. Discussions with few old riparian owners revealed that the river has migrated through continuous erosion at least for the period 1962-2005. New land, fertile, left behind by the river during historical migration and used as farmland by local people represents another form of pressure that the river has undergone, which probably overlaps on the natural tendency to migrate to the right. Another constraint on river evolution occurred in 1988, when a flood protection embankment was built along Şieu-Odorhei riparian perimeter. This trend has a double meaning: on the one hand, landowners of riparian communities from the left bank of the river (Şieu-Odorhei village) gain land every year, while, on the other hand, landowners lose significant areas on the right bank (Şieu-Sfântu village).

However, erosion rates vary greatly from one period to another, from one designated location to another, which demonstrates the high complexity of processes and phenomena that maintain and generate its dynamics. Quantifying the proportion in which one phenomenon or another contributes in the development of bank dynamic processes is extremely difficult demanding sophisticated and expensive monitoring instruments.

Information on location, mode of evolution in time and space provides the scientific bank erosion should be taken into account in the assessment of the economic "cost-benefit" key river management plans.

The obtained results show a percentage of 11, 6 % of eroded banks from the entire lenght of study sector of 27,6 km. For almost 60 %, the eroded banks are associated with antropical activities (especially mining sediments). It was found that the most affected areas are in the villages Şintereag, Şieu-Sfântu, Şieu-Odorhei, with lengths exceeding 500 m (fig.17).The banks affected by erosion vary in height from 0.8 m (in the case of banks clearly influenced by the presence of animals) up to 6 m, showing that the bank retreat process does not respond preferentially depending on the height of the bank.

The few sectors with banks protected by engineering structures (concrete slabs, boulders, etc., in the villages Cociu, Şieu-Odorhei communal area near the bridge and road Şirioara) are presenting different stages of degradation more or less encouraging.

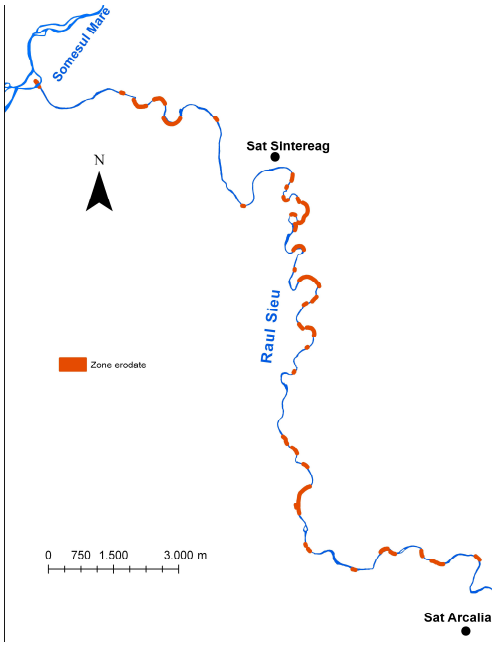


Fig. 17. *General map of bank erosion distribution along the investigated sector on Şieu River*

For the sector Şieu-Sfântu, the value of each eroded centimeter of land is important because the land is cultivable. In this sector, a "conflict of interests" exists between riparian landowners, the municipality Sintereag, which should "stabilize" the situation and the institutional authority of the Romanian Waters that exploits the riverbed gravel.

3.3. Risks induced by hydrological interferences

Chemical compatibility between surrounding rock, groundwater or surface water is an essential factor that should be considered for long-term or permanent forecasts of water quality. This factor involves lithological and hydrological interferences having relevant influence in determining the risk of failure to attain good environmental status.

The approach and the methodology used for assessing the risk induced by hydrological interferences was based on similar steps provided by European Network Directives particularly aiming to highlight exceeding values of required emission and pollution standards.

Choosing the location of sampling points was an important task because of diapir layers presence along Șieu River and their influence on the quality of groundwater (Fig.18).

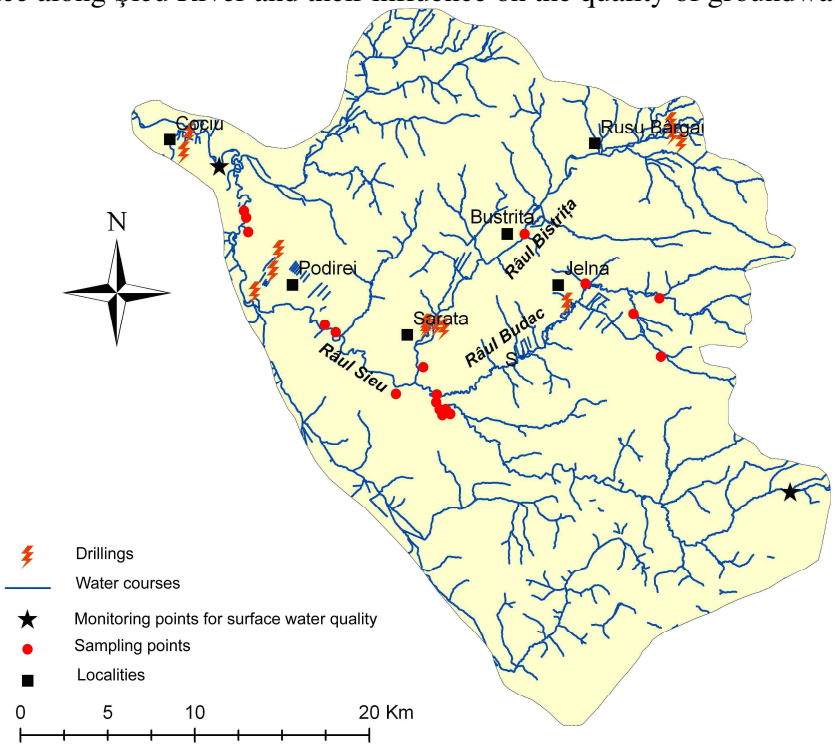


Fig.18. *Location of surface water and groundwater monitoring points*

To describe the groundwater quality and to classify the risk induced by hydrogeological conditions, data from technical reports of the drilling sections, located in flood plain area and on terrace (Jelna, Bârgăului Rusu and Cociu) were used (the drillings were undergone in 1972 August-September, by the Institute of Meteorology and Hydrology Bucharest) (fig. 19).

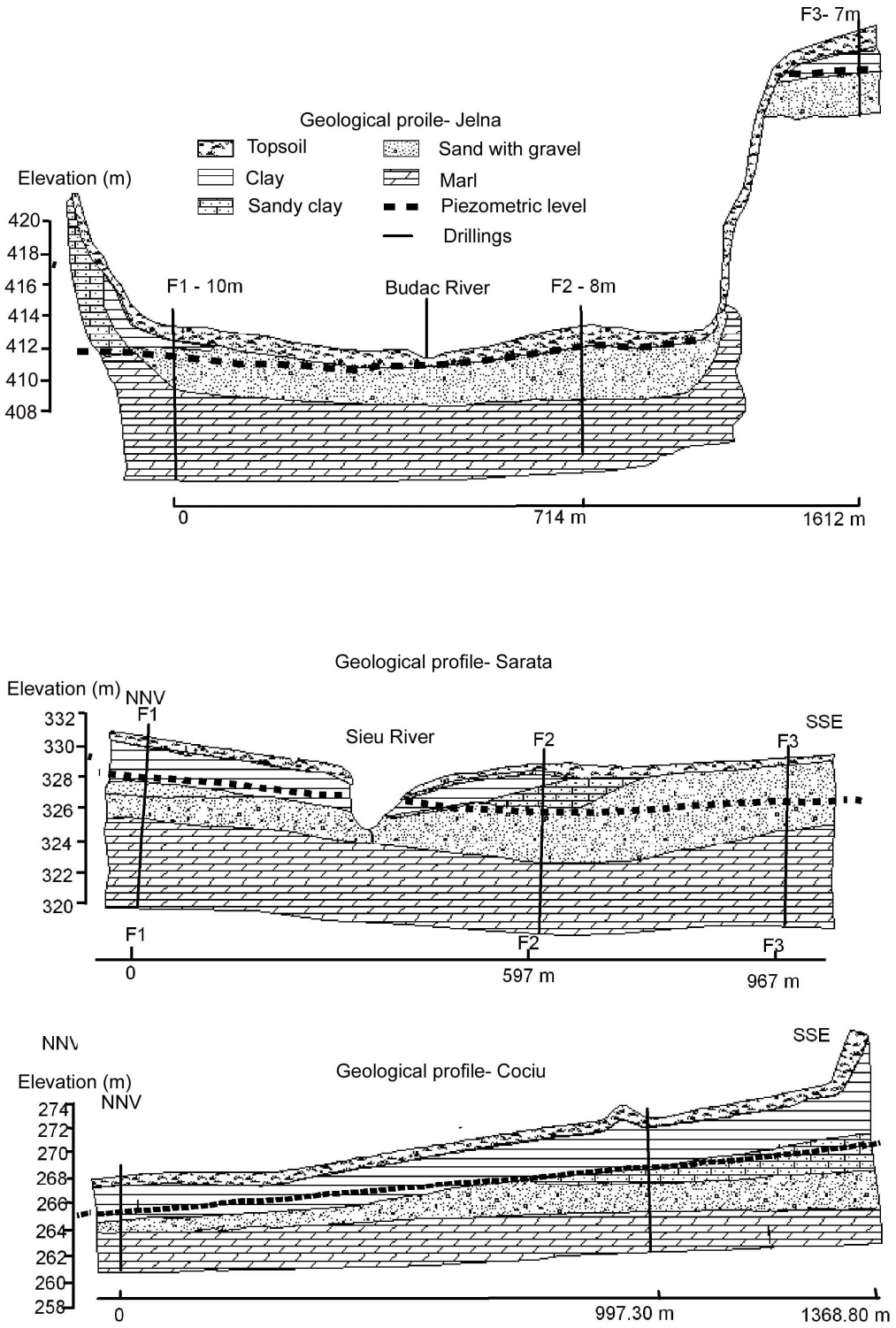


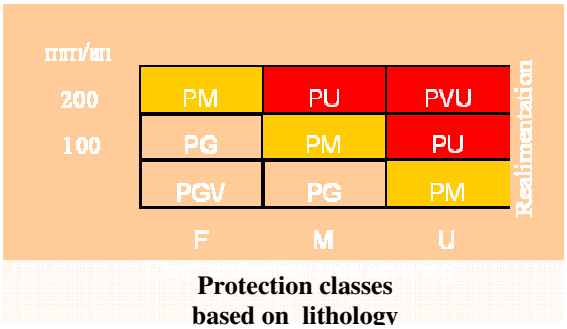
Fig.19. *Hydrogeologic drillings (source: based on sketches from Romanian Waters Archives*

The characterization of groundwater quality for the main watersheds investigated (Bistrița, Budac, Şieu) was based on analysis of general indicators related to the natural regime of groundwater chemistry (salinity) and specific indicators present due to pollution sources (nitrate / nitrite).

Measurements related to water conductivity and pH were taken directly in situ from 18 key locations using two types of instruments (multi - parameter Analyser, Consort C532 and Tetra Con 325), and laboratory analysis were realized for areas with high bank erosion processes in order to determine concentrations of nitrates and nitrites.

Additional data came from Romanian Waters Monitoring Network (groundwater wells and monitoring points for surface water) covering representative spots from the study area and a valid set of data from 2006 to 2008 used to determine water quality from domestic wells in rural areas was provided by the Public Health Authority and the Water Management Bistrița.

The diagram for assessing the overall protection / versus Matrix of risk induced by hydro geological interferences to groundwater bodies is obtained by taking into account the two key parameters: the lithology and degree of infiltration or effective infiltration (Fig.20).



Favorable (F): continuous layer, thickness (greater than 10 m), predominantly cohesive (clay, loess, marl).
Medium (M): discontinuous coating, variable thickness, variable permeability, (cohesive Silt to sand, marl fractured
Unfavorable (U): small thickness, cohesive constitution cohesive, high permeability (sand-gravel).

Fig. 20. *Degree of overall protection of a groundwater body of /versus Matrix of risk induced by hydrogeologic interferences to groundwater bodies (Adapted from http://www.apecrisuri.ro)*

Surface waters generally have a good or a very good quality status being classified into classes I and II, some exceptional situations are encountered for two sensitive areas : *outlet section located on the river Bistrita Bistrita Bargaului - Sarata* and *Şieu river section upstream Şieu – Şintereag:* CCO-Mn indicator (quality class III -medium quality) on Bistrița River, at Unirea village, sulphates at SC Volady (quality class II) downstream of Castaic Valley ROMBAT SA, the chlorides SC Volady (quality class II, and III) close to Beclean upstream the confluence (Someşul Mare and Şieu).

Current issues related to water quality are mainly related to contamination by various substances from agricultural land or industrial pollution sources but also by entrainment of geomorphologic processes (erosion of the banks and sediment transport).

3.4. *Risks induced by dam accumulation*

The first part of the chapter includes a summary of the steps regarding the standard methodology used in the dam accumulation failure risk assessment, representing a base of technical information and documentation from various guides, technical manuals and plans. Colibița accumulation represents a hydrological reservoir that was regarded as a potential risk element coming from the mountain area to Bistrița Hills in case of dam's failure.

Dam safety monitoring carried out by Bistrița Năsăud Water Management System and control of specialized services from Somes Tisa Watershed District and the designer of the accumulation, ISPH Bucharest show that no serious technical problem occurred since 1999.

CHAPTER IV

Assessment of institutional vulnerability to hydrological risks

Another part of this interdisciplinary research was focused on institutional vulnerability analysis using sociological and psychological methods of investigation in order to determine government`s ability (via local institutions) to support community for any consequences due to the impact of natural hazards, to anticipate danger and to assess the training capacity to successfully cope with crisis. Institutional vulnerability assessment was based clearly on the political level and it is addressed to policy makers in different contexts. Research to quantify institutional vulnerability has been conducted during 15-20 May 2008 (local pre-election context), by investigating the realities of ten communes from Şieu Watershed using structured, semi-structured questionnaires and interviews carried out on the local authorities (mayors or deputy mayors, secretaries of the local commission of emergency). Quantifying a range of psychometric sets (Index of perceived capacity, awareness and perceived danger) applied among local community leaders has been obtained a typology of institutional reactions to natural hazards in order to promote an adaptive risk management strategy.

To calculate the capacity index a series of criteria and indicators selected from the literature were used for the quantification (Davidson, 1997, Cutter, 1999, Luis Mata, 2005, Simpson DM, 2006) (Table 1).

Criteria	***Indicators***
Spontaneity	*Reaction/ time of reaction and importance given ttowards the research topic*
Openness	*Attitude*
Transparency	*Facilitating access to information*
	Information efficiency
Empowering /Social responsability	*Manifestation of the desire to cooperatee*
	Assuming failures
Intelligibility	*Ability to discuss alternative for risk management*
	Ability to describe and identify 'a risk problem '
Credibility	*Openness to communicate / honesty of the information*
Resilience	*Ability to introduce changes in community*
	Build upon community solidarity
	Getting community support
	Flexibility
Administrative efficiency	*Degree of perceived risk awareness*
	Knowledge of attributions in case of emergency
	Degree of technical support (equipment) in case of intervention
	Existence of educational programmes for the community related to risk reduction
	Number of volunteers involved in the committees of emergency situations
	Taking the adaptative management challenge

Table.*1 Criteria and indicators for assessing institutional vulnerability*

The standard approach in the study of hazard risk perception is represented by hazards taxonomy for understanding the nature of risk and human responses to these risks. Psychometric paradigm is operating on three sets of corresponding elements (*Fear, knowledge of risk (Awareness), Preparedness to face risk*) according to which perception is being quantified, and obtained results are represented in terms of institutional response/ versus institutional vulnerability based on Raaijmakers et al. (2008) model (fig. 21).

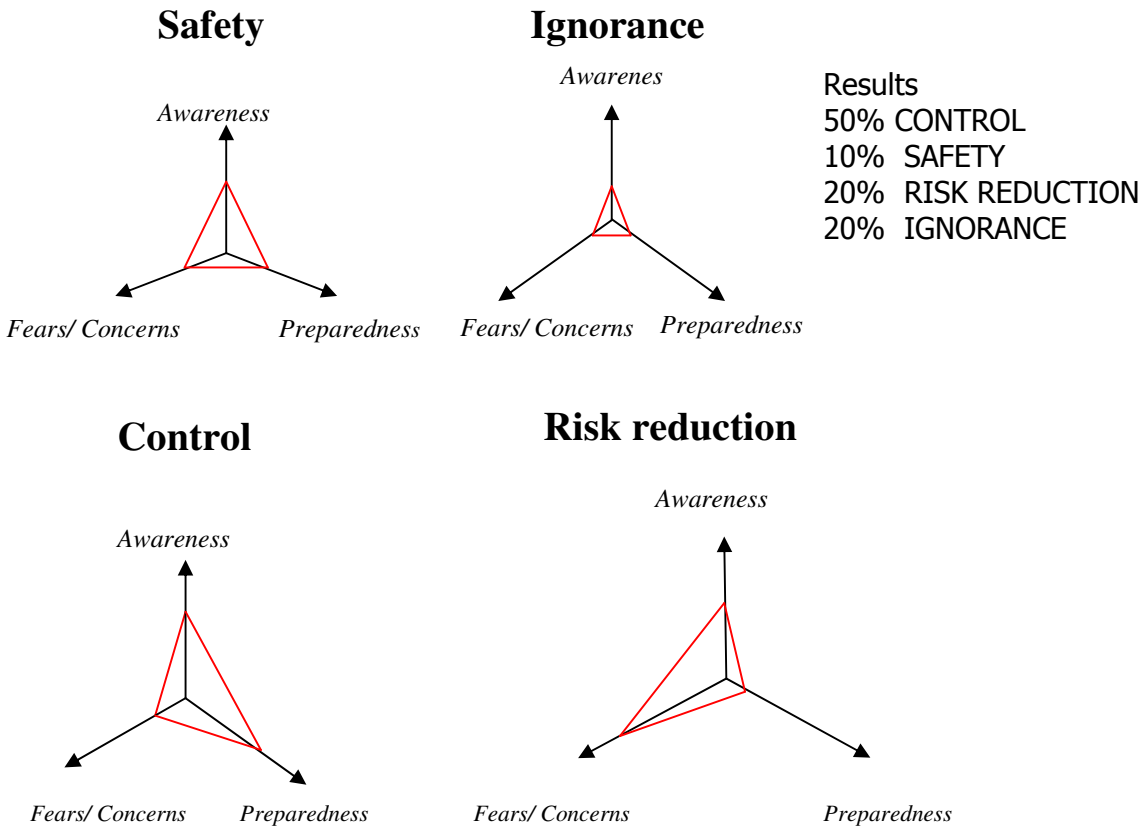


Fig. 21. *Typology of institutional response / versus institutional vulnerability to hazards, based on Raaijmakers et al. psychometric model (2008).*

Qualitative information extracted from interviews taken via "in depth" semi-structured questionnaire applied on representatives leaders of the community, (mayors, deputy secretary of the local emergency committee) showed that for 10 communes (Budacu de Jos, Dumitrița, Cetate, Mărișelu, Sieu, Teaca, Galații Bistriței, Șieu-Măgheruș, Șieu-Odorhei, Șintereag) such a model can have surprising results included in the administrative capacity index (table 2).

Communes	Index of institutional capacity
Budacu de Jos	42%
Dumitrita	85%
Cetate	14%
Mariselu	14%
Sieu	57%
Teaca	85%
Galatii Bistritei	71%
Sieu-Magherus	14%
Sieu-Odorhei	14%
Sintereag	85%
Total medie	48%

Table2. *Index of administrative capacity at commune level*

Results do not objectively assign a positive connotation for the preparedness of institutions to deal with natural disasters but could suggest a "positive feeling perceived" and launched by the authorities in terms of low previous events impact compared with other regions from the vicinity.

CHAPTER V

Management of hydrological risks

The chapter includes a synthesis of conceptual approaches regarding the historical development of modern risk management, capturing some practical issues encountered in the management of hydrological risks from study area. It also contains a synthesis of the legislative European risk mitigation and the Romanian position in this context.

The theoretical risk management concept relies on the original forms of social, political and economic organization, towards the emergence of schools of thought (rational school, scientific school, school of human relations and contemporary models of management).

Schematically, the hydrological risk management in the Bistrita`s Hills at the community level should include aspects related to: stress management for extreme risk events, different types of negotiation strategies at the commune level regarding "conflict situations" due to "advantages and disadvantages" created by hydrodynamic processes (by reducing or expansion of useful farmland for a number of riverains).

An important and effective step for solving the issues related to hydrological risk is to identify and communicate the sources of risk. Passivity in the notification of problems

inevitably leads to a worsening of negative effects and to the "habit" of not reacting in a protective manner.

It should be noted that the suburban area of Bistrița is in a continuous development process in terms of buildings construction and residential areas. In particular, this development was done in areas that before 1989 have had an agricultural profile and where in the past various agro-technical works were made.

Such diverse works were undertaken in 1988, initially being employed to protect the soil from erosion especially in the Bistrița River Basin, downstream of Bistrița City, on both sides of the river to the confluence with Şieu River (in the localities Livezile, Ghinda, Viişoara, Slătinuța, Sărata). This area was considered a representative example for understanding how the socio-economic interests, which clearly prevail in this region, requires an integrative management process, whose analysis is made by knowing the past events and correlating them with the effects from the present in terms of land use changes.

In the above mentioned area an explosive and chaotic extension occurred after the 1989 of residential area with agricultural land use. Since the social interest has had priority and potential risks associated with the presence of groundwater at shallow depths were neglected, a series of risk management problems began to appear in these areas.

Damages due to surface water and groundwater affected the population, particularly in new construction areas. Aquaproject Institute realized a study in 2008 about the flooding risk in this area, and from the study; the example of Viişoara village, where flooding hazards caused by channel overflow are reduced was retained. A real danger of flooding the majority of agricultural land on the right and left side could appear only in the case of a flood having a discharge probability of 1%.

Risk reduction to a reasonable level is a legal and moral obligation of owners, protection projects contractors against disasters and also of the local administration that allow construction in areas of risk. Maintenance and preservation of protection works should be also an obligation for civilians exposed to risk. In this area, other engineering works besides those from 1988, were also conducted in 2005-2006 aiming to diminish the effects of flood events from 2005 (the funds were provided by government decisions).

According to PUG (General Urban Plan) on the land of the village Viişoara, Bistrița – Năsăud was planned a small residential district in an area of major bed of the river Bistrita. The district is located in the immediate vicinity of the river in an area where the right bank of the river Bistrita is affected by erosion.

The paradox is that regional planning and socio-economic interests take priority over ethics related to the safety of new construction in flood prone area. Following field surveys carried out in municipalities, 70% of authority's representatives were not able to identify the flooding areas on the PUG plans

Enlarging the European Union implies a homogenization of spatial data and reported environmental risks. Some European countries have strategies that focuses on risk management policies (England, France, Germany, Switzerland), others on crisis management, such as Greece and Portugal, while in other countries (Italy, Hungary, including Romania), rules for risk management are evolving (Veyret, Garrry, Meschenet of Richemond, 2002).

In most European countries insurance is not mandatory, France and Spain are the exceptions in this regard, and it seems that soon, Romania also will be among them. In Romania, the introduction of mandatory insurance against natural disasters, which was not

yet adopted, inevitably leads to the need of responding to some questions regarding the realities of today's society:

- Are Romanians prepared to afford the insurance?
- Is the introduction of this law ethic and moral for all citizens whether they live in or outside of a risk area?
- Are insurance / reinsurance coming from private industry capable to provide a solution to this problem?
- Which will be the State's contribution in a possible partnership with the private sector?

In the analysis of institutional vulnerability (chapter IV) it could be found an overall reaction of authorities investigated in favor of mandatory insurance. It is interesting that almost all the authorities (except Şintereag commune), consider that over 50% of the population will be able to pay their insurances.

Interesting discussions were carried out on the basis of insurances payment types, including insurance idea in the form of "fees" that should not be too expensive and collected with the regular taxes (an idea from Măgheruş Şieu administration). However, most mayors are aware of the fact that a certain category of people would not allow the payment of such insurance and they should be helped based on a principle of social solidarity.

CONCLUSION

Results of applied psychometric model place the analyzed area "in a safe climate ' , the total average values being of 48% for administrative capacity to cope with extreme events, 62.5% for risk awareness and 42% for the perceived danger. This fact does not objectively attribute a positive connotation for the degree of preparedness of institutions to deal with risk situations generated by the hydrological risk phenomena but could only suggest a "perceived positive feeling" released by authorities in terms of reduced impact of previous events compared to other neighboring regions.

About 50% of the types of reactions shown by the leaders of municipalities are classified as "control", 10% in the category of "safety," 20% in the category of "risk reduction" and 20% in "ignorance." Specifically, in the present context the "control" results amid the apparent 'habit' of the mayors to deal with risk situations, better said to overlook all the issues the communities are facing which are in general in a reactionary climate of passivity . The main issues raised in this region are the lack of an environmental culture in the citizens and ethical rigors of management of riverside sectors, which implies the need to "stimulate" educational campaigns and to take action to reduce risk.

Integration of structural and non-structural measures in order to obtain optimal strategies for managing risk phenomena do not represent a new idea, this being present in different management practices of the hydrological basin, but the interaction with the active society and the involvement of the scientific world as mediator of these problems, would be an ideal way for a better management of hydrological risk phenomena.

Referring to the processes of bank erosion and the derived complex managerial conflicts a real issue that requires solving imply the need for accountability from all parties

involved, starting with the riparian owner, local authorities and the Romanian Waters Framework. Although the stabilization of banks through various engineering methods of intervention can be applied localy, adverse effects adverse effects may occur downstream, as is the case in Şieu Sfântu village.

The installation and maintenance of a riverain corridor and the creation of some "freedom space" for the natural mobility of the courses represent the most effective measures to solve the effects of hydrodynamic processes.

Concerning the floods from 1970, it must be specified that these events produced victims and substantial damage also due to the wrong planning strategies, which were developed especially after the Second World War (1945-1970) and focused on the development of the communities in a flood prone area under the action of the river courses.

Subsequently these devastating events, the construction of high embankment of the river courses has meant changes for the natural flow and expression of long-term involvement of a number of other "potential risks".

In order to prevent and mitigate the effects generated by extreme events in this study area, priority should be given to public awareness on the correct perception of flooding, Truth-seeking and legal accountability by taking measures to prevent, control and reduce risk at the individual, community and local government level.

Although the concept of risk culture is highly used, in fact what is lacking in this area is a strong environmental culture.

The harmonious integration of the community within the environment can only be done on the basis of a suitable educational process in which need to participate a number of responsible factors, and the respect of the legal framework.

If at first sight between the" hydrological risk phenomena " and "law" one could not see any connection, however, reality shows that these phenomena cannot be effectively evaluated without understanding how management policies are implemented starting with the local level up to the international level.

This approach represents a fundamental shift in how hydrological risk phenomena are viewed by society and represented in the legal framework. From this point of view in practice were encountered two types of reactions: one based on "need for control", where hydrological risk phenomena are considered to be threatening, and viewed as an uncontrollable part of a natural cycle; and another type of reaction which has the source in the "need to face/cope with", involving the survival and development, meaning also beneficial (positive) elements in terms of socio-economic advantages.

Recognizing the benefits of such an integrative assessment may be related to the diminishing of the "disruptive nature" by involving communities from riparian areas in developing projects that might find an echo starting with the concept of a re-naturalization of river courses that would inspire people to live differently.

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