

Marioara RUSU, Violeta FLORIAN, Elisabeta ROȘU

*Institute of Agricultural Economics, Romanian Academy, Bucharest, Romania
betty_rosu@yahoo.com*

SOCIO-ECONOMIC VULNERABILITY TO FLOODS OF RURAL HOUSEHOLDS: CASE STUDIES IN THE DANUBE RIVER MEADOW

ABSTRACT

The present paper analyses the vulnerability to floods of households from two rural areas located in the Danube River Meadow: i) the communes Bistreț and Rast from Dolj county and ii) the communes Gostinu and Oinacu from Giurgiu county. The research method used was the survey and the research tool was the questionnaire applied by an interview operator. The SPSS software was used for data processing.

The main objective of the study was to know the ability of rural households to get involved in crisis management, the natural vulnerability perception mechanisms, the ways to combine the economic and social systems for developing local strategies to combat natural risk. In conclusion, from the perspective of analysed rural households, it can be noticed that in the two investigated rural areas there are risk-induced behaviours, attitudes and options, depending on the specificity of each rural community and a mix of tradition and early modernization.

Key words: vulnerability to floods, rural household, the Danube River Meadow.

JEL Classification: Q54, R29.

1. INTRODUCTION

The Danube River has been recognised over time as an important economic and commercial opportunity for the communities living in the areas that it crosses. It is also Romania's case, as our country has a significant share in the Danube Basin area (about 30%) and the longest sector of the river (1,076 km). Although the Danube Meadow has been subject to many changes in the last century (the Romanian sector of the Danube Meadow has been dammed almost in totality by the construction of 1,200 km of dams and 53 agricultural enclosures, with a total area of 430,000 ha), this has remained an area with a significant cultural and social heterogeneity and insufficiently exploited economic growth potential (MDRT, 2010; Vișinescu and Bularda, 2008).

The climate scenarios developed for Romania (POAT, 2013) predict, for the largest part of the territory in the Danube Meadow, a diminution of average annual precipitations and an increase of average annual temperatures, phenomena accompanied by an increasingly important presence of drought and floods. These predicted climate changes could have a negative impact on rural households that should not be neglected.

The degree to which the weather phenomena affects an agricultural/rural system depends on a variety of factors: crop and animal species, farmers' focus on marketing or subsistence, quality of natural resources, quality of human resources (age, education, risk tolerance), etc. In Romania, agricultural/rural vulnerability to global climate change has been addressed in numerous studies (ACCRETE, 2014; Sandu, 2013). These studies mainly focused on the implications that the climate change scenarios have on crops, highlighting the physical impact upon plants and animals and the economic impact resulting from yield losses. The socio-economic aspects of vulnerability to climate change, with a careful examination of the socio-economic and institutional factors to reveal how rural households respond to and cope with the climate risks have been explored to a lesser extent.

2. STATE OF KNOWLEDGE

In recent years, the “vulnerability” concept has gained an increasing visibility in the scientific communities. The concept was used for the first time in geography, natural hazard research and food insecurity analysis. There is no single definition of vulnerability. Bohle considers vulnerability as an indicator of human well-being, which integrates the exposure of natural, economic and political factors to a range of potentially harmful disturbances (Bohle *et al.*, 1994). Liverman highlights the distinction between the vulnerability determined by the natural conditions and the vulnerability determined by the social, economic and political conditions. This leads to the analysis of vulnerability at spatial level (location of vulnerable population and vulnerable areas), in social terms respectively (Liverman, 1989). The vulnerability puts into evidence the degree to which the population and its assets, as part of a socio-ecological system, is exposed to the impact of various risks, indicating the potential level of damages produced by a phenomenon (Bălteanu *et al.*, 2007). In the studies on climate changes, drought and famine, vulnerability is analysed as a product of the society, as a condition derived from historical, cultural, economic and social processes. In this context, vulnerability influences the ability of people and societies to cope with disasters and to develop proper response mechanisms. (Bogard, 1989; Blaikie *et al.*, 1994). Luers *et al.* (2003) proposed a method for quantifying vulnerability, taking into account the system, the result variable and the stress factor. Turner *et al.* (2003) recognise that vulnerability depends not only on exposure to risks (disturbances and stress), but

also on the sensitivity and resilience of the systems facing such risks. These authors developed an integrated conceptual framework of vulnerability, built on these three main dimensions, namely exposure, sensitivity and adaptability.

Floods are phenomena responsible for human, economic and environmental losses, representing “high-water stages where water overflows its natural or artificial banks onto normally dry land, such as a river inundating its floodplain” (Schmidt-Thomé, P. *et al.*, 2006) or accumulation of water from rainfall or snow melting in areas with insufficient natural drainage” (WMO/UNESCO, 2012).

Floods are included in the category of natural hazards and represent “threatening events with the probability of occurrence of a natural phenomenon with destructive potential in a given region or period” (Greco, F., 2009) or “potentially harmful physical events that can cause loss of lives or injuries, material losses, social and economic disruptions, or environmental degradation” (United Nations in UNISDR, 2004).

Regardless of their causes, “floods can produce many damages, like serious impact on people health, severe power blackout, transportation and communication disruption, losses in agriculture and industry”; “the flood damage varies depending on the vulnerability of the affected receiver” (Țâncu, R., Zesere, H.L., Lazăr, G., 2017).

Floods are expected to become more frequent with a changing climate. Society’s vulnerability and exposition to floods are also increasing due to increasing exploitation of floodplains and the increasing complexity of technical infrastructure (Norén, V. *et al.*, 2016). This makes the assessment of present and future flood risk a particularly challenging task (Alfieri, L. *et al.*, 2015).

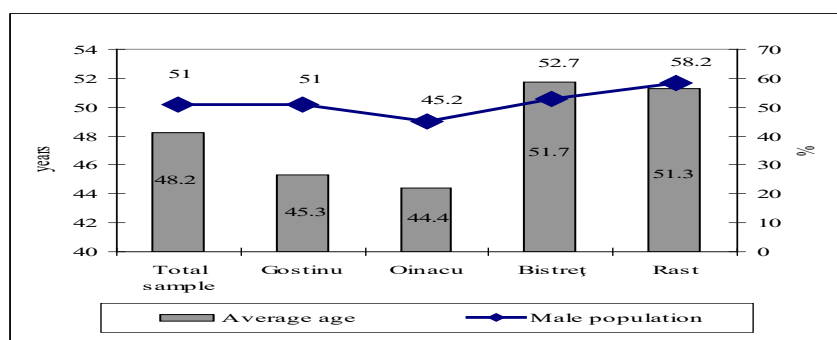
3. MATERIAL AND METHOD

The main objective of the socio-economic study of rural communities was to know the capacity of rural population to get involved in crisis management, the mechanisms of perceiving natural vulnerabilities, how to combine the economic and social systems to develop local strategies to fight against natural risk. To reach the proposed objective, we conducted a quantitative survey of rural households from the localities Bistreț and Rast in Dolj county and Gostinu and Oinacu in Giurgiu county. The number of questionnaires was established proportionally with the size of the target population in each component locality. The final questionnaire totalled 201 persons with the following territorial distribution: Bistreț 73, Rast 45, Gostinu 38, Oinacu 45 (maximum tolerated error: +/- 6.91 % at a 95% confidence level). The research method used was the survey, and the research tool used was the questionnaire, administered by an interview operator. Data processing was performed using SPSS. The sphere of interest of the socio-economical study was delimited by the possible relations between the modernity/development level and

the existence of attitudes specific to the risk culture; we tried to quantify the existing relationships between the sociological, socio-demographic and economic characteristics of rural households and the attitudes specific to risk culture or traditional culture.

4. RESULTS AND DISCUSSIONS

Demographic structures and characteristics. The demographic characteristics of the representative sample for the two rural micro-zones define a population with an average age 48.2 years, with a slight male preponderance, the male population accounting for 51.2% of total population in the sample.



Source: Authors' processing of field survey data

Figure 1. Demographic characteristics of sample

The structure by educational level is characterised by the preponderance of the population with primary and secondary studies. The share of population with post-high school and tertiary education was 6.27% in total sample, ranging from absence of post-high school graduates (commune Gostinu) to 11.81% in the commune Bistreţ.

Table 1

Educational characteristics of sample

	Total sample	Gostinu	Oinacu	Bistreţ	Rast
No schooling	9.40	12.24	11.11	7.64	6.33
Primary school	14.09	20.41	13.49	15.97	3.80
Secondary school	26.40	23.47	27.78	28.47	24.05
High school	24.38	28.57	18.25	17.36	41.77
Agricultural high school	4.700	-	0.79	6.94	12.66
Vocational school	14.09	15.31	23.02	11.11	3.80
Post-high school, faculty	6.27	-	3.97	11.81	7.59
Other	0.67	-	1.59	0.69	-

Source: authors' processing of field survey data

The quality of human capital can define not only the social acceptance of innovation, but also passive attitudes towards natural risks and persistence of behaviours specific to traditional culture. The specific demographic processes, identified at the level of investigated rural households, are the following:

- contraction in the demographic size, the rural family in the investigated communities has reached almost the same size as the urban family. This is certainly not determined by the demographic modernization phenomena, as it is, first of all, a consequence of precarious economic conditions, a reaction of the rural household to the challenges of economic and social restructuring. In the rural micro-zone Giurgiu, the household size ranges from 2.51 members/rural household (commune Gostinu) to 2.93 members/rural household (commune Oinacu). In the rural micro-zone Dolj, the values are much lower, as a materialization of the demographic crisis manifested at the level of rural actors: 1.95 members/rural household in the commune Bistreţ and 1.76 members/rural household in the commune Rast;
- the demographic ageing – the phenomenon is certified by the extremely low share of young population; the average number of persons under 15 years/rural household is 0.07 in the commune Bistreţ and 0.02 in Rast; in the localities from Giurgiu county, the values indicate the same demographic dysfunctional process: 0.28 members/rural household in the commune Gostinu and 0.40 members/rural household in the commune Oinacu aged under 15 years.

Economic structures and characteristics. The occupational modernization is low as a result of the excessive dependence of rural households on urban communities and of the high precariousness level of their own economic activities: the share of persons employed in the industrial and construction units is 9.4% (in general, these units are located in the urban polarising centres), while the share of persons employed in agro-industrial units is 1.2% (the agro-industrial units as visible signs of agricultural activity modernization do not represent a generous job offer). State pensioners have a significant share instead, i.e. 29.3% (the jobs were generally urban). The rural communities in Oinacu have a slightly modernised occupational structure: the share of persons employed in agro-industry is 2.4% which adds to the share of persons employed in industry and constructions of 4.8%. Nevertheless, state pensioners have a significant share in each investigated commune: 24.5% in Gostinu, 25.4% in Oinacu, 30.5% in Bistreţ and 39.2% in Rast.

The structure of money incomes reflects this occupational type and at the same time it is one of the factors influencing the social behaviour towards natural risks. In the hierarchy of money incomes, salaries and state pensions have a top position: the share of salaries ranges from 36.34% in total incomes in Bistreţ to 52.64% in Rast. The percentage value of state pensions is 29.63% in Gostinu and

41.56% in Oinacu. In Bistreţ, Oinacu and Rast, percentage values for incomes from private activities were also identified: 5.38% of total money incomes in Oinacu, 6.97% in Bistreţ and 2.11% in Rast. There is low labour employment in the private economic sectors, the state sector being the main source of cash incomes, which reveals a low entrepreneurial spirit and a conservative financial behaviour. The evaluation of incomes obtained from agriculture is specific to subsistence farming, on the one hand, the production obtained is used for self-consumption and not for sale; on the other hand, it seems slightly undersized, an attitude specific to rural actors.

The structuring of economic activities is also determined by the natural resources of the investigated rural households; the relations between the households and the agricultural land are objective frameworks for the development of economic activities; arable land has the highest share, which determines the practice of farming activities. The investigated households in the commune Oinacu operate and have into ownership only arable land; the shares are also significant in the case of households from Gostinu (81.25%) and Bistreţ (80.63%). The only complex model of spatiality relations is noticed on the households from Bistreţ and Rast, where several types of agricultural land are found, which could support agricultural diversification to a greater extent.

Table 2

Structure of the land fund (%)

	Total sample	Gostinu	Oinacu	Bistreţ	Rast
Arable	75.39	81.25	100.0	80.63	16.67
Pastures	4.05	-	-	3.75	12.96
Hayfields	7.17	18.75	-	3.75	25.93
Forests	12.15	-	-	10.63	40.74
Orchards	0.93	-	-	0.63	3.70
Vineyards	0.31	-	-	0.63	-

Source: Authors' processing of sample data

Agricultural land fragmentation is relatively high, revealing the impossibility of competitive and economically efficient farming activity; the average number of parcels into own operation is 2.08 for arable land, 1.20 for forestland, 2.00 for pastures, 2.50 for hayfields, 1.00 for orchards and 1.00 for vineyards. The highest fragmentation was noticed in the rural micro-zone Giurgiu: 3.50 parcels into own operation for the households in Gostinu and 2.43 for the households in Oinacu. Crop structure indicates the clear option for extensive farming, for traditional crops in the respective areas (wheat and maize), with very large areas under these crops.

The inertial behaviours are also materialised in the reduced use of modern farming methods: monocropping – only 4.0% of rural households practice crop

rotation, low amounts of purchased certified seeds, low amounts of pesticides used; no investigated subject has bought veterinary medicines.

Table 3

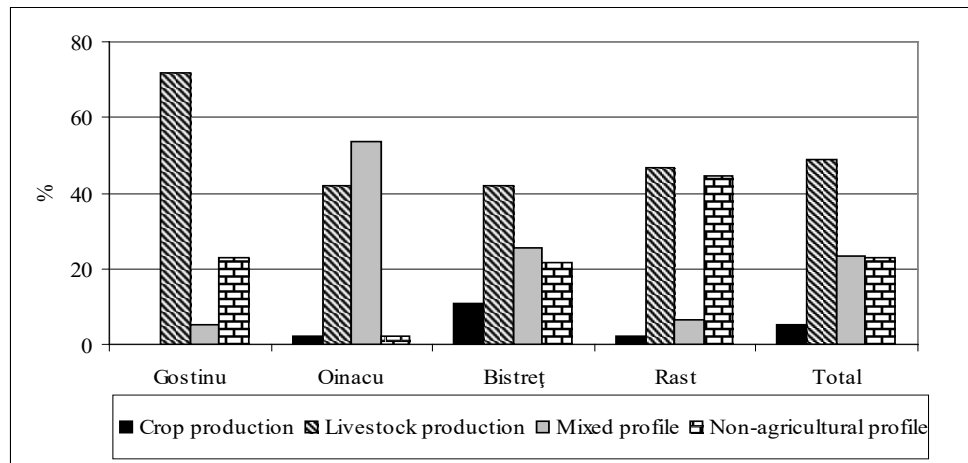
Structure of cultivated areas (%)

	Wheat	Maize	Barley	Sunflower	Clover	Fruit	Vegetables
Gostinu	66.67	33.33	-	-	-	-	-
Oinacu	65.79	28.95	2.63	2.63	-	-	-
Bistreț	53.57	33.73	9.92		0.02	0.78	1.98
Rast	56.26	42.19				0.70	0.84
Sample	57.08	32.90	7.39	0.67	0.01	0.56	1.38

Source: Authors' processing of sample data

The agricultural profile of the four investigated communes is dependent on the peri-urban status; for the communes in Giurgiu county there is a complex polarization generated by the proximity to an urban centre with multiple functions; the communes in Dolj county lie in the proximity of a locality with a recent urban status.

According to their agricultural profile, the situation of rural household farms is the following: the largest share of households raising animals is found in the commune Gostinu – 71.8%, the households with crop production profile are found in the commune Bistreț – 10.8%, and with mixed profile in the commune Oinacu – 53.5%.



Source: Authors' processing of sample data

Figure 2. Agricultural profile of investigated rural households

Crop production is mainly intended for sale; at sample level, 48.8% of production was sold (the share of sold production obtained in the commune Rast

was 66.0% and 55.5% in Bistreț); 77.0% of maize production was sold (in Gostinu 70.0% of total maize production was sold, and 50.0% in Rast). Fruit and vegetable production in the communes Bistreț and Rast was sold at the markets from the fairs in the proximity and from Băilești, namely 80.4% and 75.0% respectively. As regards the sale of livestock production, pigs (Gostinu, Rast) and poultry (Rast) were mainly sold.

Structures and characteristics of technical infrastructure. The built space preserves unitary characteristics of houses and annexes with multiple domestic and household functions. The average age of households in total sample is 51.5 years.

Table 4

Structures and characteristics of the built space of rural households – the house

	Average age of house – years	Building materials * (%)				Average distance to the Danube river–km
		AAC	Bricks	Adobe	Timber work	
Bistreț	58.03	10.8	44.6	37.8	-	6.5
Rast	52.29	8.9	42.2	48.9	-	8.6
Gostinu	50.87	2.6	15.4	2.6	74.4	3.1
Oinacu	39.95	14.0	20.9	32.6	27.9	9.3
Sample	51.57	9.5	33.3	32.3	20.4	6.9

*refers to the share of houses made of main building materials; the remaining houses are built of concrete blocks (0.5%), doublet (0.5%), wood (1.0) and beaten wall (1.0)

Source: Authors' processing of sample data

The building materials used define two extreme categories: 33.3% of houses are built of bricks and 32.3% of houses are adobe structures. These characteristics are completed by those specific to the investigated micro-zones; the timber frame is present only in the communities Gostinu (74.4%) and Oinacu (27.9%); in the micro-zone Dolj, there is a differentiation depending on the quality of material, indicating significant differences of dwelling: the adobe structures in the community Bistreț account for only 37.8%, as compared to the brick houses (44.6%), while in the community Rast their share is 48.9%, which is a much larger share compared to the share of brick houses (42.2%). The building materials impact not only the quality of housing, but also the resistance to natural disasters such as floods; the adobe and timber frame increase the vulnerability of structures due to the constituent elements.

In the investigated rural areas, it was noticed that each community has its specific economic and social profile, depending on its agrarian and community history. The differences marked by the demographic and productive structures are mingled with the way in which the rural community assumed its “peri-urban” status. In this empirical paradigm, the relationships between the investigated rural actors and the built space of household annexes have certain characteristics. The share of owners of “storage facilities” for the household domestic activities had the

highest value, i.e. 40.3%; in the commune Oinacu, this share amounted to 86.9%, which reveals the need of these households to have premises with multiple, non-specialised functions, to cover in the same space the household needs as production and domestic unit. The “shed”, an often rudimentary annex, is present mainly in Giurgiu: Gostinu, with 33.3% and Oinacu, with 32.6%; it has a multiple utility, from fodder storage to storing tools. The annexes specific to households where animals are raised have shares ranging from 3.5% for “sheep shelter” and 38.8% for “stable”. The building materials used are different depending on the type of annex: the stable was made mainly from adobe (20.5%), the sheep shelter from wood (71.4%) and the shed also from wood (60.0%).

Compared to house age, the age of annexes is relatively lower; the average age of “stable” is 35.9 years, the same as the “storage facilities”; the “sheep shelter” and “shed” have an average age of 30.0 years and 26.4 years respectively; the “greenhouses” and “solariums” have been recently built in general, the former are aged 8.2 years and the latter 9.2 years on the average, being modalities to overcome the subsistence status, which is almost the characteristic of all investigated households. The oldest annexes were found in the community Gostinu: “stable” 44.2 years, “shed” 39.8 years; the most recent annexes are on the households from Rast: “stable” 21 years, “storage facilities” and “shed” – 20 years.

Table 5

Structure of household annexes (%)

	Stable	Storage facilities *	Sheep shelter	Shed	Greenhouses	Solariums**
Bistret	39.2	44.6	8.1	25.7	2.7	2.7
Rast	11.1	8.9	-	8.9	2.2	2.2
Gostinu	33.3	17.9	-	33.3	-	5.1
Oinacu	72.1	86.9	2.3	32.6	2.3	20.9
Total sample	38.8	40.3	3.5	24.9	2.0	7.9

*storage facilities: lofts, barns, storehouse, etc.

** solariums: mobile plastic tunnels

Source: Authors' processing of sample data

The vulnerability of the house and household annexes can be enhanced by their location in the proximity of the risk source; on the average, the house is located at 6.9 km distance from the Danube; the houses closest to the Danube are those from the community Gostinu: 3.1 km, while the houses at the greatest distance from the Danube were those in Oinacu: 9.3 km.

The assessment of the extent of damage to houses and household annexes following the 2006 floods provides an identification of memory spaces/dimensions – it has not been quantified to what extent the affective memory contributed to these assessments; we mention that by applying the questionnaire, the memory was

directed using quantifiable data; what is certain is that in the two communities the assessments regarding the house are different, depending on certain endogenous factors: in Rast, the assessments are grouped around the evaluation of damages in a range of 1–24%, as 80.0% of houses were identified as belonging to this category; the remaining 20.0% were damaged to a much greater extent, between 50.0 – 74.0%.

In the commune Bistreţ, the most significant assessments were in the range 25.0 – 49.0% (29.2% of households fall into this category) and 1–24% (the share of households is 25.0%). If we analyse only two types of annexes we find out that the share of damaged annexes is suggestively high: 40.0% of the affected “stables” and 40.0% of the “storage facilities” were fully destroyed.

Table 6

Assessment of damage (%)

Degree of damage	Bistreţ			Rast		
	house	stable	storage facilities	house	stable	storage facilities
100	16.7	40.0	40.0	-	40.0	40.0
75–99	16.7	10.0	10.0	-	10.0	10.0
50–74	12.5	20.0	10.0	20.0	20.0	10.0
25–49	29.2	10.0	20.0	-	10.0	20.0
1–24	25.0	20.0	20.0	80.0	20.0	20.0

Source: Authors' processing of sample data

The impact of floods on farming activities is assessed as minimum by rural households, crop production being mainly affected; the investigated subjects reported wheat and maize production losses in both communes. Although these assessments place the impact of floods in the category of significant material losses for the rural household, the behavioural reaction is not entirely rational.

Thus, in terms of institutionalised preventive behaviour, there were no obvious structural changes. Each rural community and each household has its own “risk portfolio” determined by specific priorities, by “*estimating the social risk objectives, by the values, usually attached to order or equality, collectivity or individual. The ability of the collectivity, of groups to impose their risk-related priorities determines the ability to preserve or improve the social position and to promote their ideas.*” (Peretti-Watel, 2005)

The formalised behaviour, indicator of the risk culture, has not become a characteristic, and behaviours specific to the culture of poverty continue to exist. If we compare the shares of insured rural households in 2006 to the current shares, we can notice a significant increase, yet at values that reveal an early modern behaviour. In Bistreţ, the share of households that took out insurance increased from 8.1% to 21.6%, and in Rast from 2.2% to 11.1%. In the communes from

Giurgiu county, a formalised behaviour emergence was noticed: 10.3% of subjects from Gostinu and 7.0% from Oinacu took out insurance.

5. CONCLUSIONS

From the perspective of investigated rural households, it can be noticed that in the two investigated rural areas, risk-generated behaviours, attitudes and options exist, depending on the specificity of each rural community, and there is a mix between traditional and early modernization.

The sample demographic characteristics reveal the existence of a slightly aged population, with low educational level (the population with primary and gymnasium education prevails), under a process of demographic size contraction, the rural family size in the investigated communities getting closer to the urban family size.

The occupational modernization level is low as a result of excessive dependence on the urban communities and the high precariousness of their own economic activities. The structure of money incomes reflects this occupational level and at the same time is one of the factors influencing the social behaviour in relation to natural risks. In the hierarchy of money incomes, salaries and state pensions prevail. There is a weak dependence on the private economic sectors, the state sector being the main source of money incomes, which implies a low entrepreneurship spirit and a conservative financial behaviour.

The structuring of economic activities is also determined by the natural resources of investigated rural households; the arable land has the highest share in total land resources and the traditional farming practice prevails. The crop structure indicates the clear option for a certain type of extensive agriculture, for growing traditional crops (wheat and maize) in the respective areas. The inertial behaviours are also materialised in the low utilization of modern farming methods.

The built space preserves the unitary characteristics of houses and annexes with multiple domestic and household functions: the average age of houses is 51.5 years; the quality of building materials defines two extreme categories: one third of houses are made of bricks and one third of houses are made of adobe. The building materials have an impact not only on the quality of housing, but also on the resistance to natural disasters of flood type.

There is a high diversity of behaviours and attitudes in the face of natural risks; the behavioural reactions are not fully rational, do not belong to the instrumental activism that always aims at action and not contemplation; in the rural households from the four communities, it can be noticed that the rational attitude has turned into a form of social resignation. However, each rural community and

each household has its own “risk portfolio”. Formalised behaviour, as an indicator of the culture of risk, has not become a characteristic, and behaviours specific to the culture of poverty continue to exist.

6. ACKNOWLEDGEMENTS

Study carried out within the project PN-II-ID-PCE-2012-4-0587, “Taming the Postsocialist Nature: Floods, Local Strategies and National Policies along the Lower Danube” coordinated by the “Francisc I. Rainer” Institute of Anthropology.

REFERENCES

1. Alfieri, L., Feyen, L., Dottori, F., Bianchi, A., (2015), *Ensemble flood risk assessment in Europe under high end climate scenarios*. Glob Environ Change. 35:199–212, available at <https://www.sciencedirect.com/science/article/pii/S0959378015300406>
2. Bălțeanu, D., Sima, Mihaela, Chendeș, V., (2007), *Extreme climatic events and hydrological hazards in Romania*, in: Ielenicz, M., Bălțeanu, D., Atalay, I. (eds.), *Environment and Society. Present-day diversity and dynamics*. Proceedings of the 4th Romanian-Turkish Geographic Seminar, p. 25–34, Ed. Universitară, Bucharest.
3. Blaikie, P., Cannon, T., Davis, I., Wisner, B., (1994), *At risk: Natural hazards, people's vulnerability and disasters*. London: Routledge
4. Bohle, H.G., Downing, T.E., Watts, M.J., (1994), *Climate change and social vulnerability: Toward a sociology and geography of food insecurity*, *Global Environmental Change* 4(1):37–48.
5. Grecu, Florina, (2009), *Hazarde și Riscuri Naturale*, Editura Universitară, București
6. Liverman, Diana (1990), *Vulnerability to Global Environmental Change* in: R. E. Kasperson, K. Dow, D. Golding, and J. X. Kasperson (eds.): *Understanding Global Environmental Change: The Contributions of Risk Analysis and Management*. Worcester, MA: Clark University, Chapter 26, pp. 27–44
7. Luers, A.L., Lobell, D.B., Skar, L.S., Addams, C.L., Matson, P.A., (2003), *A method for quantifying vulnerability, applied to the agricultural system of the Yaqui Valley, Mexico*, *Global Environmental Change* 13: 255– 267.
8. Norén, V., Hedelin, B., Nyberg, L., Bishop, K., (2016), *Flood risk assessment – practices in flood prone Swedish municipalities*. *Int J Disaster Risk Reduct.* 18:206–217
9. Peretti-Wattel, P., (2005), *La culture du risque, ses marqueurs sociaux et ses pradoxes. Une exploration empirique*, *revue Economic&Sociologie*, volume 56
10. Sandu, I., (2013), *Schimbări climatice în România și efectele asupra resurselor de apă în agricultură*, available online: http://www.ier.ro/webfm_send/5189
11. Schmidt-Thomé, P., et al., 2006, *The Spatial Effects and Management of Natural and Technological Hazards in Europe - ESPON 1.3.1*. GTK, available at https://www.espon.eu/sites/default/files/attachments/fi-1.3.1_revised-full.pdf
12. Turner, B.L., et al. (2003), *Illustrating the coupled human-environment system for vulnerability analysis: Three case studies*, *Proceedings of the National Academy of Sciences, USA*. PNAS 100: 8080–8085.
13. Vișinescu, I., Bularda, M., (2008), *Modificări severe ale regimului hidrologic al Dunării și impactul acestora asupra agriculturii în lunca îndiguită*, <http://www.incda-fundulea.ro/ana-le/76/76.9.pdf>

14. Țâncu, R., Zesere, H.L., Lazăr, G., (2017), Identification of elements exposed to flood hazard in a section of Trotuș River, Romania, in *Geomatics, Natural Hazards and Risk Journal*, volume 9, 2018 – issue 1, Taylor and Francis Online, available at <https://www.tandfonline.com/doi/full/10.1080/19475705.2018.1486891?src=recsys>
15. *** Ministerul Dezvoltării Regionale și Turismului (MDRT), 2010. Regiunea Dunării din România – perspectivă teritorială, http://www.datourway.eu/documents/88-701-8827-datourway_ro_brochure_ro.pdf
16. *** UNISDR 2004. Living with Risk. A global review of disaster reduction initiatives. United Nations International Strategy for Disaster Reduction Secretariat (UNISDR) ed. New York and Geneva: United Nations.
17. *** POAT Project, Raportul “Sectorul mediu și schimbări climatice”, martie 2013
18. *** WMO/UNESCO, (2012), *International Glossary of Hydrology*, World Meteorological Organization and United Nations Educational, Scientific and Cultural Organization, available at https://www.wmo.int/pages/prog/hwrr/publications/international_glossary/385_IGH_2012.pdf