

Human-nature Relationship and Public Perception of Environmental Hazards along the Maros/Mureş River (Hungary and Romania)

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Abstract

Public participation is increasingly important in flood and environmental management planning. Accordingly, understanding the attitude of local society to natural values and their relations with the environment is highly important to realize successful development projects. This study aimed to analyze the human-nature relationship, the public perceptions of environmental hazards and people's engagement with water management related and human interventions at Maros/Mureş River through a public survey. The survey was carried out in 11 Romanian and Hungarian settlements using the random walking method to interview the local public. The results show that people are a little pessimistic concerning the state of the river, and there are misbeliefs about the general problems affecting its present environmental status. Meanwhile, the perception of flood hazard is governed by the fading memory of the last high-risk flood event in 1970. The engagement of residents is mostly affected by socio-demographic parameters. However, the regularity they visit the river is also very important. Consequently, informing people on apparent environmental issues and processes can greatly help the socially inclusive implementation of water management measures along the river.

Keywords: Maros/Mureş River; public survey; human-nature relationship; human interventions; river and floodplain management

Introduction

River and floodplain ecosystems are under the pressure of several factors. The most important of these are intensifying rate of human interventions and climate change (Tockner & Stanford, 2002), which can frequently lead to changes in water regime (Kiss et al., 2019), deterioration of water quality (Muyere & Moyce, 2017), degradation of floodplain ecosystems (Entwistle et al., 2019) and morphological changes (Kiss & Blanka,

2012; Amissah et al., 2018). Besides obvious natural hazards, rivers and related ecosystems are also important in providing a diverse set of services for society, such as recreation, food, health, agriculture, and transportation (Hale et al., 2019; Jähnig et al., 2022). Therefore, river-related resources and the effective functioning of the natural environment have high importance to the local population (Wang et al., 2016, Oyedotun

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& Ally, 2021). Water management lately recognized that all these challenges and requirements should be managed in their complexity; thus, a new concept: Integrated Flood and Environmental Risk Management (FERM), has been developed, recognizing the close connection between managing flood risk and managing risks to the physical environment and the biological ecosystems (Osti, 2018). This concept also emphasizes the necessity of stakeholder inclusion, including community participation.

Consequently, the inclusion of local stakeholders and the public in the planning process of flood and environmental management plans and interventions is a key question, as the inputs from locals can minimize the risk of inadvertent negative consequences, and at the same time, local knowledge and interests can make positive contributions to projects (Osti, 2018). Public participation in the planning process of flood and environmental management of rivers is also encouraged by the EU Water Framework Directive (EU WFD 2000), which is advised to allow people to influence the outcome of plans and working processes. Public involvement should involve awareness raising of flood and environmental hazards and risks and address also the need to increase the public's understanding of the problems and the need for solutions (Hophmayer-Tokich, 2005).

To realize an efficient public inclusion, it is important to understand the human–nature relationship, i.e. to reveal the many ways humans are linked with the

natural environment (Seymour, 2016) and the environmental factors influencing the perceptions of the river-floodplain ecosystem (Cockerill, 2015; Flotemersch & Aho, 2021). For analyzing the human-nature relationship and the public's perceptions of environmental values and hazards, qualitative or quantitative social surveys, e.g. questionnaires, can be an effective method and help to comprehensively analyze the perceptions and attitudes of the target population (White et al., 2005).

Rivers, such as the Maros/Mures, and their floodplains are important natural resources in the Carpathian Basin, providing several benefits for the ecosystem and society. The Maros/Mures River is the most significant water resource for irrigation and industrial activity in the Hungary-Romania cross-border region. Besides, it feeds a thriving riparian ecosystem and has a unique geomorphological character. Several factors endanger the availability and quality of its resources. Among these, human interventions and climate change have to be emphasized.

The primary objective of this study was to reveal the relationship of local people to the river and its floodplain ecosystem and their perception of environmental hazards and human interventions in order to identify public preferences and people's engagement with water management issues. Additionally, we also aimed to understand the role of socio-demographic, residential and life-style related parameters behind the environmental awareness of local communities.

Study area

The study was carried out in the south-eastern part of the Carpathian Basin along the lowland section of the Maros/Mureş River, belonging to both Romania and Hungary. The area of the river's catchment is approximately 30 000 km², and situated mostly in Romania (92%). Its total length is 769 km, while its so-called lowland section from Lipova to Szeged is 175 km, out of which 125 km is situated in Romania, 22 km is part of the border between Romania and Hungary, and 28 km is situated in Hungary (Laczay, 1975) (Fig. 1).

The variability of the water stage is high even in the lowland section. Two major floods may develop annually on the river. The first is due to snowmelt in early spring, and the second is caused by early summer rainfall, usually in June (Boga & Novaky, 1986). The greatest flood on record occurred in 1970 and caused severe problems along the entire river. After 1970 significant floods occurred in 1974, 1975, 1981, 1998, 2000 and 2006. Following the April-June floods, the rest of the year is characterized by low stages. Dur-

ing the past 20 years, the length and intensity of low stages increased, partly due to climate change and increasing reservoir capacity on the tributaries in the upland catchment (Konecsny & Bálint, 2009).

Along the Hungarian section, the floodplain is dominated by forests, but in the surroundings of the settlements, croplands and more or less cultivated gardens can also be found. At the same time, the Romanian floodplain is dominated by grasslands, although floodplain forests also occur in smaller or larger patches (Oroszi, 2009). The most important human impacts at present are reservoir construction since the 1980s' on the upland reaches and gravel and sand extraction on the lowland sections (Konecsnyi & Balint, 2009). Gravel and sand have been quarried from the river for a long time; however, extraction volume has increased significantly in the past decades, especially in Romania. The activity is the most intensive on the Pauliș-Mandruloc section, where the banks and the channel have practically quarried away.

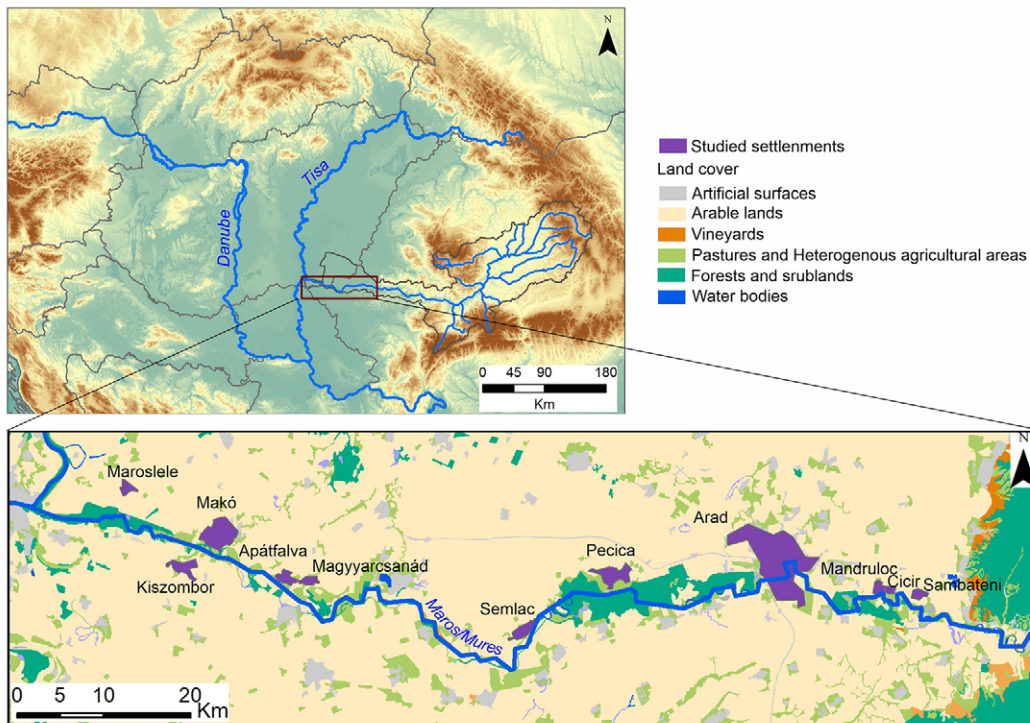


Figure 1. Location of the studied settlements along the Maros/Mures River

Data and methods

The perception and opinion of people on the Maros/Mureş River and its environment were investigated by a public survey. The survey was carried out on six Romanian settlements: Arad (county seat and largest town in the region, population over 160 000), Pecica (a smaller town, population about 13 000) and four villages with a population below 5 000 (Sâmbâteni, Cicir, Mandruloc and Semlac) (RPL, 2011); and on 5 Hungarian settlements: Makó (the largest settlement on the Hungarian section, population about 23 000), and on four villages with population below 5000 (Magyarcsanak, Apátfalva, Kiszombor and Maroslele) (KSH 2018) (Fig. 1).

The overall methodology of the research was both qualitative and quantitative. As Letenyei (2004) emphasizes, the two approaches can and should be combined in social research, as certain issues can only be evaluated based on expert-oriented interviews, while the overall representativity can only be reached by alienating ourselves from the respondents and using statistical methods (Bryman, 2001).

During social surveys, reliability and validity are key issues. Reliability can be increased by ensuring the representativity of the sampling (Babbie, 2003; Neuman, 2006; Firebaugh, 2008), while validity highly depends on good question formulation and that responders understand the questions and provide mean-

ingful answers (Letenyei & Racz, 2011). In the case of the present research, representativity and reliability were increased by questioning a large sample (0.2 % of the population at Arad, 1 % at Mako and 1-2 % at other settlements) and by designating separate interview zones at each settlement either to cover the entire settlement or to represent each of the urban geographical districts. The survey was made using the random walking method, meaning that the interviewers were allowed to ask anybody within a previously set zone. The delineation of interview zones also prevented the repeated questioning of respondents. The number of required questionnaires at a given settlement was determined based on the settlement's weight concerning the region's total population. In all, 1062 surveys were finally completed. The validity of the surveys was based on preliminary interviews performed in three settlements along the studied section of the river to test the questions of the survey and on the local experience of experts studying the geographical and environmental problems along the river for a long time. The dataset of the questionnaires was processed and analysed in SPSS software.

The questionnaire was mostly composed of closed-ended nominal, ordinal and multi-option-al questions. Warm-up questions were related to the major challenges of the settlement and the values

worth of protection. In the second set of questions, respondents were asked about general environmental issues and problems related to the Maros/Mureş River. Subsequently, locals' relationship to the river was explored, i.e. how frequent and what for they

visit it. Finally, their preference for future management of problems and developments was investigated. The interview was closed by entering some of the respondent's social parameters (age, gender, education, occupation).

Results

Human-nature relationship

The perception of the local population on the natural values was surveyed to reveal their preferences and opinion about the state of the environment and the factors influencing public perceptions. Furthermore, the engagement of the people with the river-floodplain ecosystem was assessed by their interactions with the river and the usage of the recreational and provisioning ecosystem services.

Perceptions of natural values along the Maros/Mureş

The opinion of the local population about the natural values was assessed by asking respondents to rank the importance of different natural values in their environment. The Maros/Mureş River was ranked to be the 2nd and 3rd most important natural value in Hungarian and Romanian settlements, respectively (Fig. 2). The first place was taken by forests in Romania and by clean air in Hungary. It is noteworthy that in the case of Arad, the importance of forests (40%) outscored clean air (27%), which we expected to be in the first place. The Maros/Mureş was ranked to 1st place mostly by respondents with a university degree, i.e. 32% of them mentioned it as the most important natural value in or around their settlement. In comparison, these values were 25% and 19% for people of secondary and primary educational background, respectively. Those who visit the Maros/Mureş regularly (73% of respondents) were more concerned about the river (27%) and forests (34%) than those who did not. The latter group voted mostly for clean air (46%).

As the condition of the riverside greatly determines the local use of the river, the opinion of the respondents about the state of the river's environment was surveyed by asking their opinion on how well the riverside is managed at their settlement and whether their community respects the river and its natural values or not. The evaluation of the people's opinion about the management of the riverside was made on a 4-point rating scale. In this respect, a significant difference was found between the two countries: Romanian and Hungarian settlements scored on average 2.17 and 2.90, respectively (Fig. 3a). In Romania, the worst results were received at Cicir (average score: 1.33) and Mandruloc (1.66). In these two villages, none of the respondents thought the riverside was well managed, which is understandable as the river is most affected by gravel and sand quarrying at these settlements. The situation in Arad (2.28) and Pecica (2.15) seems to be better; here, more than 30% thought the riverside was rather well managed or well managed. This suggests that great-scale quarrying and the destruction of natural values are striking for locals too. On the Hungarian side, the state of the riverside was evaluated significantly better. The best value was measured at Makó (3.05); here, more than 70% of respondents rated the riverside rather well managed or well managed, which is definitely due to the recreational developments (adventure park) made recently on the riverside. In Hungary, the lowest value was measured on the anyway unregulated and unmanaged border section of the river.

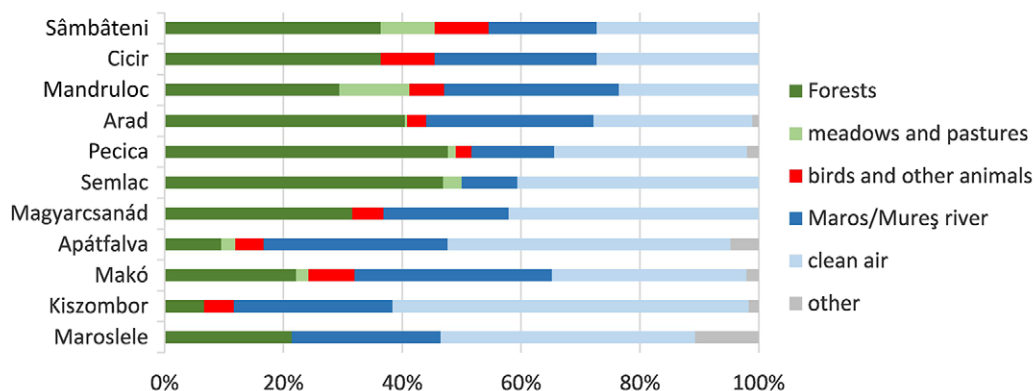


Figure 2. The relative importance of natural values for respondents at the surveyed settlements

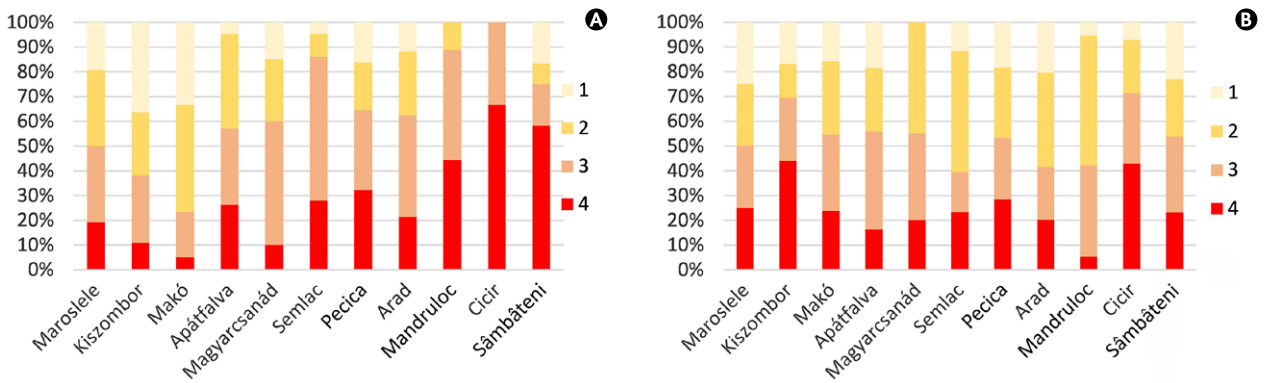


Figure 3. a) The evaluation of the state of the riverside (4 - well managed, 3 - rather well managed, 2 - rather unmanaged, 1 - unmanaged). b) Public opinion about whether the local community respects the river and its natural values or not (4 –respect, 3 – yes rather than no, 2 - no rather than yes, 1 – not respect)

It was also surveyed whether the local community respects the river and its natural values or not. The evaluation was also made on a 4-point rating scale. Only slight differences were found between the two countries, as average values were 2.49 and 2.69 in Romania and Hungary, respectively. Therefore, on a community level, people feel that the river is slightly more valued in Hungary than in Romania. In terms of settlement types, we did not find significant variability. It is positive that even at the settlement where the lowest ranking was measured, 40% of the respondents thought that their community respected the river and its natural values (Fig. 3b).

Interaction of the people with the floodplain ecosystem

The interaction of the local people with the river/floodplain ecosystem was surveyed by exploring the respondent’s habits of visiting the river and the type of recreational and provisioning benefits they use.

73% of the respondents claimed that they visit the river regularly. There is a slight but not very significant difference between genders in this respect, as 78% of men and 68% of women answered yes to this question. Differences can also be observed between different age groups. The proportion of people who

visit the river is decreasing with age. Under the age of 50, 80% visited the river, while it was 68% over 50 and only 55% over 65. A much more significant dependence was found in terms of the educational level of respondents. Only 49% of people with primary education visit the river regularly, while at those with secondary and tertiary levels this value grows to 75% and 89%, respectively. This observation can be explained by various factors, e.g. differences in the overall mobility, economic situation and age of the respondents. Visiting the river seems to have a clear relationship with the physical distance and the accessibility of the riverside from the settlement. The most important finding is that more than two-thirds of local people are related in some ways to the river; thus, their needs and expectations must be considered when planning river management and development measures. (Fig. 4)

Those who visit the river regularly mostly go for walking at the riverside, fishing, and bathing in the river, regardless of location, age, gender, and educational level (Fig. 5). In Romania, 88%, in Hungary, 79% of respondents who visit the river go there with the purpose to take a walk. The difference is not significant and is caused mainly by the results of Arad (93%). Around one-fourth of the people visiting the Maros/Mureş do fishing and angling. The third most

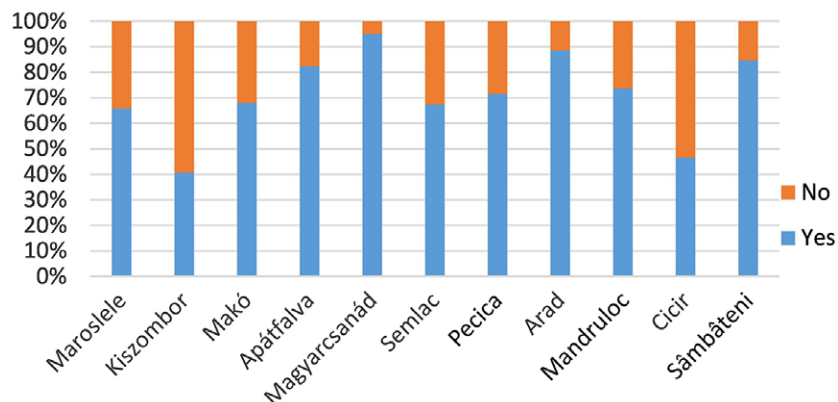


Figure 4. The proportion of those who visit the river regularly

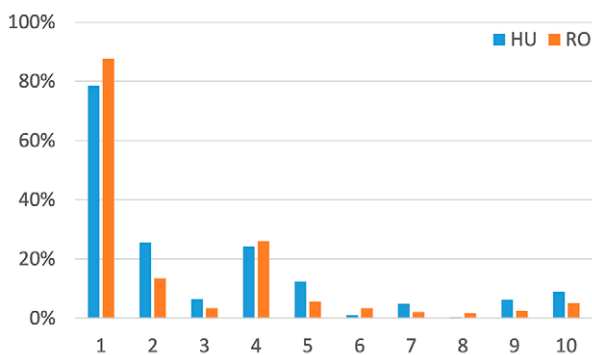


Figure 5. The distribution of activities made at the Maros/Mureş (1: walking on the riverside, 2: bathing, 3: water sports, 4: fishing and angling, 5: cultivating land, 6: grazing animals, 7: collecting firewood, 8: washing cars, 9: taking away sand, 10: other)

popular activity was bathing. In this respect, Hungarian results were significantly higher. Similar differences were found in the case of water sports, probably due to the availability of more facilities along the Hungarian section. In the case of agricultural activities, cultivation of land is generally more popular in Hungary; however, in Romania, it shows high spatial variability. Both crop growing and animal grazing are widely performed activities in the smaller villages upstream of Arad; there, 30-60% marked cultivation of lands and 20-33% marked animal grazing as major activities.

Environmental hazards

The perception of the local population on environmental problems and hazards and some adaptation and development measures were also surveyed. To an open-ended question about the last environmental problem the responder had met, 25% of the respondents reported something in relation to the river. The settlements where river-related answers were the most frequent were Arad (33%), Mandruloc (60%) and Apatfalva (47%). Responders at Mandruloc emphasized the destruction of the river bank by sand extraction, while at Apatfalva, people were mostly concerned about pollution and the state of forests along the river.

The respondents were also asked to select three environmental hazards from a list of seven which affect the Maros/Mureş the most. On both sides of the border, solid-waste disposal was considered the most important issue (Fig. 6). This is understandable, as plastic bottles drifting on the river and heaps of garbage on the floodplain are well visible and understandable problems for everybody. The second and third places were taken by industrial and sewage water contamination. Although water quality has improved considerably through the years, the Maros/Mureş has still got a quite bad reputation among locals in this respect.

Sewage water was highlighted by the greatest number of respondents in Arad (71%) and Pecica (69%), while industrial pollution was mostly emphasized in Arad (50%) and Apatfalva (50%). Interestingly, Romanian respondents (except at Arad) were significantly less worried about industrial pollution than Hungarians. However, in preliminary interviews, Hungarians said water quality problems are mostly related to the Romanian industry.

Tree logging seems to be a significant problem on both sides of the border; however, Hungarians assume it is a slightly greater problem, which is interesting if we consider that Romanian respondents were much more concerned about the state of forests in an earlier question. A possible reason can be that at settlements, such as Cicir, hardly any forests have remained by now. According to Romanian respondents, gravel and sand quarrying proved to be the fourth most important environmental problem affecting the river. Unsurprisingly, residents of Cicir (93%) and Sambateni (92%) were very concerned, though one-third of respondents at Arad also emphasized this issue. Climate change was considered a less important hazard. Interestingly, going downstream, people were increasingly concerned about this issue.

The environmental state of the river is considered to be changing by 59% of respondents (67% of Hungarians and 54% of Romanians). In terms of the direction of change (positive or negative), Romanian respondents are more pessimistic. The distribution of answers was affected by settlement type; urban residents felt positive changes a little more frequently than people living in villages. The difference might be that people living in Arad, Makó or Pecica can experience more infrastructural developments next to the river.

Respondents were also asked what information circulated on the river in their community. Most of the answers were related to increasing pollution and

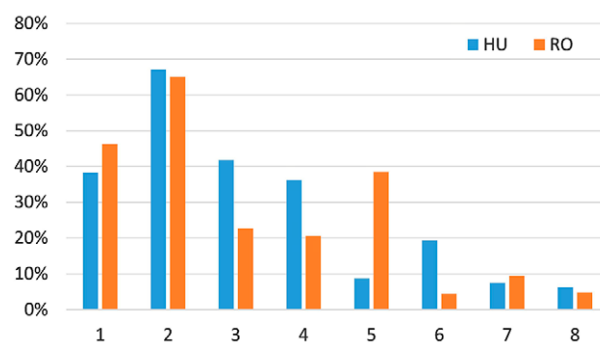


Figure 6. The relevance of various environmental problems along the Maros/Mureş according to the respondents (1. municipal wastewater effluents, 2. solid-waste disposal, 3. industrial pollution, 4. logging, 5. sand and gravel quarrying, 6. climate change, 7. artificial structures on the floodplain, 8. other)

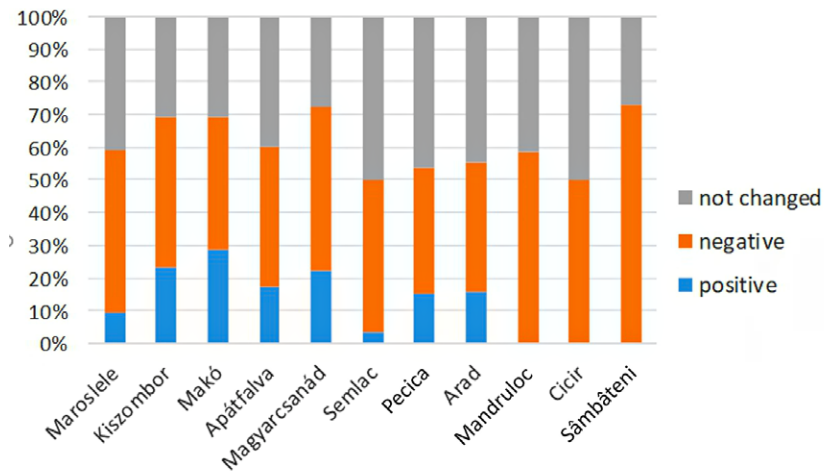


Figure 7. Public perception of changes in the environmental state of the river

decreasing water levels as the most widely known and believed changes. Positive answers mostly referred to riverside developments in Makó and Arad (Fig. 7).

As a consequence of the hydrological character of the river, flooding is a significant natural hazard. However, only 52% and 32% of respondents are anxious about the floods of the Maros/Mureş in Hungary and Romania, respectively (Fig. 8). This result is especially interesting in the case of Hungarian settlements, which are more endangered (most of the Romanian settlements surveyed are situated on terraces, above the flood level of the river). The proportion of respondents who are afraid of floods is increasing by age: below the age of 30 only 39%, between 30 and 50 already 49%, between 50 and 70 54%, and over the age of 70 as much as 70 % has fears about flooding. Concerning the answers to flood hazard remarkable differences were found in terms of genders. Based on

the results, men perceived much lower flood hazard than women, especially in Romania (23% vs 44%) but in Hungary (43% vs 55%) as well.

Management and development measures

The acceptance of human interventions was not influenced by respondents' gender, age or educational level; however, there were some remarkable differences between the two countries. On average, 17% of respondents said that no intervention should be allowed on the river, but in this respect, the Hungarian value (22%) was significantly higher than the Romanian (12%) (Fig. 9).

Not surprisingly, flood protection was the most supported type of possible action (60%), and it was equally accepted on both sides of the border. Nevertheless, we expected higher values in this case. A possible explanation for lower support can also be related to the generally moderate fear of flooding (Fig. 8). The

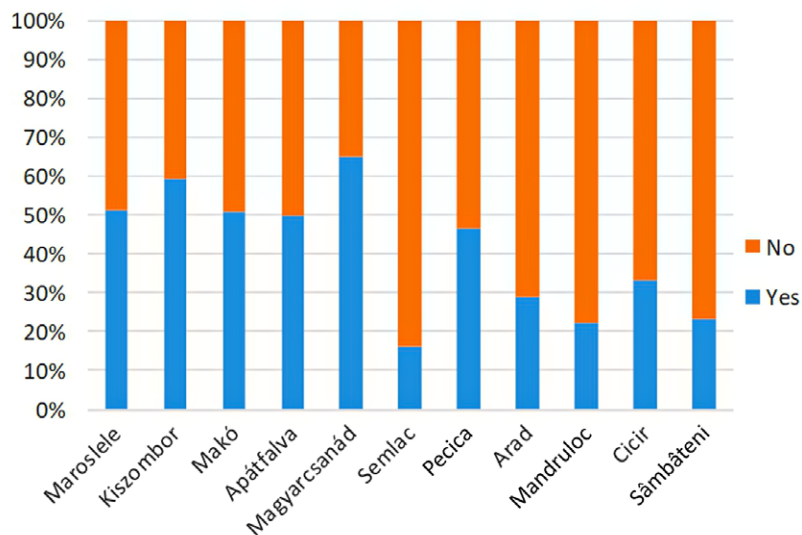


Figure 8. Public perception of flood hazard at the surveyed settlements. The proportion of respondents being afraid or not of floods

greatest difference between countries was observed in tourism-related actions. It is striking that Hungarian respondents (26%) seemed to be much less supportive in this respect than Romanians (51%).

The respondents less favoured hard interventions. However, Romanian residents were significantly more supportive, as 25% said that actions related to improving river navigation (dredging, construction of stone structures) are acceptable. In contrast, in the case of Hungarian residents, this value was only 15%. Finally, on average, only 11% of the respondents said that industrial interventions such as quarrying should be allowed in the future. In this respect, the values measured in the two countries were less different.

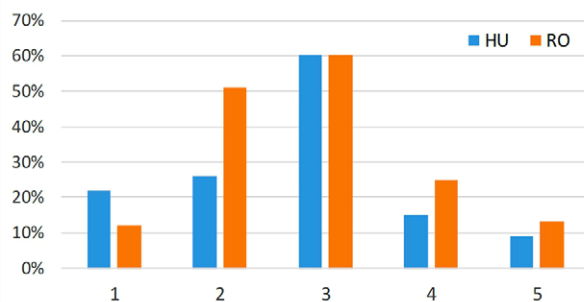


Figure 9. The acceptance of different human interventions according to the respondents (1: no interventions, 2: interventions for tourism, 3: interventions for flood protection, 4: interventions for transportation, 5: interventions for the industry)

Discussion

Public perception in river and floodplain management is important to improve and protect the quality of river-floodplain ecosystems and to mitigate environmental hazards since the public acceptance of any actions improves the success and sustainability of measures (de Groot, 2012; Souza et al., 2021).

Regarding the present survey, the perception of natural values and environmental hazards, as well as their relationship to the river, is greatly affected by socio-demographic variables, especially by the educational level of the respondents. Those who have a higher level degree are more engaged with the problems related to the river. This finding is in line with the observations of some other researchers (e.g. Ioana-Toroimac, 2020; Gomez-Cunya, 2022). On the other hand, Schaich (2009) concluded that lifestyle-related variables are more important in perceiving river ecosystems than socio-demographic variables. This approach can also be adapted to our results if we consider the tendency of increased engagement by those who regularly visit the river. Nevertheless, the two groups largely overlap in the case of the study area, i.e. those who are well educated and those who regularly visit the river. This dichotomy emphasizes the plurality of perceptions, which must be considered during the preparation of management plans (D'Souza et al., 2021)

The public opinion regarding the well-management of the riparian area is determined mostly by the type and intensity of human interventions made at the riverside of the Maros/Mureş. The recreational and aesthetic developments improve the perception compared to the less manicured riverside. Infrastructural developments characterize mostly urban settlements; therefore, people in villages are less satisfied with the condition of the river. Similar tendencies were report-

ed by Suren (2009) and Khew et al. (2014), who found that excessive plant growth in riparian areas reflects the lack of management for the public. However, other studies emphasized that the public prefers wild, more natural riparian zones and floodplains (de Groot, 2012; Saha et al., 2020). The discrepancy emerges mainly because of the difference in target groups surveyed, i.e. people generally prefer lush vegetation at the riverside, but those visiting and using the river regularly may have a different perception and prefer a more intensively managed environment. Of course, over-exploited sections, such as those affected by sand extraction, adversely affect locals' perception.

It is positive that about half of the surveyed people thought that their community respect the river and its natural values. It is noteworthy, however, that among people who do not visit the Maros/Mureş the average rating on the local community's respect for the river and its natural values was higher than those who have a more direct relationship with the river, which suggests that the latter group is more pessimistic or more sensitive concerning the state of the river and its environment. An important finding of our study was that almost three quarters of local people (73%) have a direct relationship with the river. They mostly visit the river for recreational purposes, but agricultural activities are also important. This means that the needs and expectations of the local public have to be considered during river management; thus, improving public engagement in planning river management measures is crucial.

The studied section of the Maros/Mureş river faces several environmental problems and hazards. The most visible and, therefore, the most frequently mentioned is solid waste disposal. Among environmental problems, industrial and sewage water contamination of the riv-

er was also frequently mentioned by the respondents, which means that although water quality has improved since the 1990s, the bad reputation of the river in this respect remained. People emphasized gravel and sand quarrying only in the settlements mostly affected by great-scale sediment extraction. On both sides of the border, people see rather negative changes in the state of the river. Based on local opinions, the deterioration of the environment is a very significant issue in Romania, while Hungarians reported fewer problems. In all, we can see that locals are usually aware of the problems related to the Maros/Mureş. However, they are mostly concerned about things affecting their close environment and apparent at their settlements, and they are unaware of overall processes along the river.

In terms of river management, it is also an important issue that a relatively low proportion of respondents are concerned about flood hazard, which suggests that the 1970 flood is fading from the collective memory of local societies. This hypothesis is also supported by the fact that the older the respondents were, the higher risk they perceived, meaning that the

lack of direct experience leads to decreasing awareness among younger generations. Several other authors made similar findings in various contexts (e.g. Burningham, 2008; Pagneux et al., 2011; Comănescu & Nedelea, 2016), thus, decreasing flood risk perception with time passing since the last event is a general problem and has to be considered during strategic planning. Besides, similarly to the findings of David (1971) and House (1996), males were less worried about floods than females because of their greater risk acceptance (Marshall, 2004)

Nevertheless, the most accepted interventions on the river are related to flood protection, while people are against the industrial utilization of the Maros/Mureş. Developments related to tourism were supported less than expected in Hungary, assuming that Hungarians are either pessimistic about the developments or are unaware of the river's touristic potential. On the other hand, Romanian residents probably see an important opportunity in developments or think any soft tourism interventions would help improve the river's deteriorated environment.

Conclusion

In all, the people living along the lowland section of the Maros/Mureş are a little pessimistic concerning the present and the future of the river. We assume, however, that there are certain misbeliefs on a community level concerning the general problems affecting the river. Nevertheless, it is positive that most people have a direct relationship with the river by visiting the riverside, and half of the surveyed people thought that their community respect the river and its natural values.

The results indicate that the preferences and motivations of local people are very complex and influenced by several socio-demographic and environmental factors. Thus, further analyses would be beneficial in the topic to better understand public perceptions and preferences

of the river-floodplain ecosystem and human interventions and to reveal existing knowledge gaps and misbeliefs. Consequently, we think that informing people on apparent processes, finding the ways of inclusive planning processes, and improving the cooperation willingness of the local population would be very important. This way, they would accept future management decisions and activities more easily. As there is a considerable demand for the recreational use of the river, supporting riverside developments would be highly desirable. We assume that in this way, the relationship of local people to the river would be more direct, and the necessary improvement of environmental conditions, especially in Romania, would attract more people to the Maros/Mureş in the future.

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