

## PERCEPTION OF FLOODS – TOWARDS MORE EFFECTIVE FLOOD MANAGEMENT IN THE CZECH REPUBLIC

**Kamila KLEMEŠOVÁ<sup>1</sup> & Ivan ANDRÁŠKO<sup>2</sup>**

<sup>1</sup>*Department of Geography, Faculty of Science, Masaryk University, Kotlářská 2, 611 37 Brno, Czech Republic, email: kamilak@mail.muni.cz*

<sup>2</sup>*Department of Geography, Faculty of Science, Masaryk University, Kotlářská 2, 611 37 Brno, Czech Republic, email: geoganry@mail.muni.cz*

**Abstract:** Flood perception may significantly influence the implementation of flood control measures and mitigation of flood risk. Despite this fact Czech flood management still fails adequately to include social perception of flood situations as part of flood risk evaluation. The field questionnaire survey evaluates influences on the quality of life in four villages close to the confluence of the rivers Morava and Bečva in Moravia, (the Czech Republic) threatened by flood in 1997, and perception of it. The results presented here illustrate that in the villages that have suffered flooding in the past, fear persists for a long time after the event. Spearman coefficient of 0.405 ( $p < 0.05$ ) also suggests that social relations deteriorate with an increasing degree of risk. In the villages that suffered most, social relations worsened more than in those less afflicted. Results also indicate that satisfaction with the work of local authorities reduced with increasing degree of flood risk. The fact that none of 112 respondents was able to explain correctly the term 100-year flood could be also a problem. Part of the survey focused on willingness to participate financially in flood prevention. Results show that regardless of the degree of risk, in any given village, more than 50% of residents refuse to consider financial participation in flood prevention and control: indeed, with increasing degree of risk, such a recalcitrant attitude even intensifies. Also only 22% of respondents agree that a „flood tax” paid in 2011 in the Czech Republic should still be in place if the money were used appropriately. Results illustrate that respondents consider that the Czech administration, both local and national, bears full responsibility for addressing floods, as well as for the reconstruction of damaged areas.

**Key words:** floods, flood risk, perception of flood risk, questionnaire survey, River Bečva basin, River Morava basin

### 1. INTRODUCTION

Natural disasters have been making a lot of headlines in recent years. Further, a rise in natural disaster events is anticipated in response to climate change (Terpstra, 2011). The Czech Republic, thanks to its geographical position, is relatively immune to many natural disasters (such as severe earthquake, volcanic activity, and others), but floods do constitute a serious problem. Whereas in the past floods were seen as a natural phenomenon, they are now largely considered a problem with the potential to have an adverse influence on all of society, its wealth and general quality of life. Disastrous flood situations in the recent past (1997, 2002, 2010, and 2013) confirm that the Czech Republic is becoming

more vulnerable to an increased risk of flood in built-up areas, perhaps attributable to social changes over the past few decades. There is no way to guarantee zero flood risk (Motoyoshi, 2006; Bradford et al., 2012); the primary goal of flood management is to reduce it in potentially threatened areas to the greatest extent possible. Technical measures are not enough (Wachinger et al., 2012). Alternative methods, enabling mitigation of the risk (and thus also the flood damages) should therefore be sought for high-risk areas. Such alternatives include local flood-control measures based on principles such as: “Make space for water”; “Live with risk”; “Live with floods”; and “Prepare for floods” (Johnson et al., 2007). These approaches have been the subjects of close professional and

academic attention in Great Britain and in the Netherlands mainly in the nineties of the 20<sup>th</sup> century and later (Defra project in Netherlands or Project in Hull; Whittle et al., 2010).

The differences in approaches to floods relate closely to flood perception, analysis of which aims to establish an understanding of how flood situations, risks and the possibilities of area restoration after floods are seen by people living in high-risk flood areas, as well as by representatives of public administration and the wider public.

The paper aims to evaluate selected aspects of life in floodplains in terms of flood control measures and how they are perceived. This is approached by means of three basic questions:

- How is life in floodplains perceived by the residents of them?
- Did social relations within the community change after the flood, and if so, in what way?
- How do people react to the possibility of making any financial contribution to flood control measures?

The first part of the paper explains the term “perception of flood risk” in theoretical terms; the study area and research method follow. The actual research and its results are also introduced briefly. The final part consists of a broader discussion of the knowledge acquired.

## 2. PERCEPTION OF FLOOD RISK

Perception is the process by which we acquire knowledge of the objective world (Maund, 2003). This suggests that it is a very broad term, covering many aspects of our life. Perception of floods has been studied by a number of authors (Whittle et al., 2010; Valente et al., 2008; Motoyoshi, 2006; Tapsell, 2010). The Czech literature, however, does not contain many relevant references. As pointed out by Bradford et al., (2012), perception of floods can no longer be marginalised, because it is one of the key components of flood management. Valente et al., (2008) also remark that perception of risk has been included as a part of flood management only recently, once it had been confirmed that it plays an important role in the behaviour of stakeholders and the integration of measures designed to facilitate flood risk mitigation, control and management. In the Czech Republic, good flood management is required in its alluvial plains in particular. Territories located in floodplains (alluvial plains) are among the most densely populated areas in the world (Kron, 2002). High population density is typical of alluvial plains; the Czech Republic is no

exception and populations in its alluvial plains are indeed dense. Average population density in the study area is 144 people per km<sup>2</sup> (Czech statistical office, 2014). It is only slightly higher than population density in the Czech Republic (133 p. per km<sup>2</sup>). The reason for a small difference is a large area of arable land in the villages in the study area. Similar situation is in other flood areas because of their fertility. Alluvial plains will become even more vulnerable in the near future, requiring increased protection to render secure further anticipated growth of in a prospering society. Areas in which heavy rainstorms (and flash floods) frequently occur are threatened as well. Identification of these areas (Teodor & Matreata, 2011; Bryndal, 2014) and managing the prevention of flash floods, and their consequences, may depend, both positively and negatively, on the perception of flood risk.

## 3. THE STUDY AREA

The area addressed in this contribution is located in central Moravia, near the confluence of the Morava and Bečva rivers, one of the regions most severely affected during the disastrous flood of 1997. The 1997 event was the greatest known flood in the history of Moravia and Silesia in terms of the area inundated, intensity and volume of rainfall, as well as of culmination flow rates (Hladný, 1998).

2.3 km<sup>3</sup> of water fell on the surface of 10 000 km<sup>2</sup> in the northern Moravia between 3<sup>th</sup> and 8<sup>th</sup> July 1997 (Hladný, 1998). Maximum daily precipitation in northern Moravia was measured out in Lysá hora (234 mm). In Dluhonice station (nearby the study area), maximum discharge 838 m<sup>3</sup>/s was measured. This value corresponds to the 100-year flood. The water level was 779 cm. (Matějčiček, 1998).

More than 1250 km<sup>2</sup> were flooded in the Czech Republic. The flood did damage amounting to more than 2.2 billion EUR (Hladný & Matějčiček, 1999). Hundreds of thousands of people were affected and this flood took 50 human lives. More than 29 000 houses were affected by the flood (Hladný, 1998). Troubky – the village it damaged most severely – also lies within this area. Nine people from Troubky died, 47% of its houses had to be demolished and total damage there amounted to nearly 18 million EUR (Vaishar, 2000). The village became a symbol of the 1997 flood. Symbolism is an important aspect of perception and may significantly influence how people relate to the space around them. Further, despite all of the above, no efficient flood control system had yet been put into service in Troubky (Klemešová, 2012).

Four villages were included in the study:

Troubky, Lobodice, Tovačov and Chropyně (Fig. 1). All of them met the following criteria:

- They lie within a Q100 flood zone (over time, the average culmination flow rate is achieved or exceeded once every 100 years; i.e. in any given year, there is a 1% chance of such flooding).
- All the villages were flooded in 1997 (although the extent varied).
- The distance between the villages was small and they had similar natural and socio-economic characteristics.

The area is located near watercourses and constantly threatened by flooding after excessive rainfall. The most dangerous water courses are the Morava and Bečva rivers. The River Morava, its source below the massif of Králický Sněžník, is the largest watercourse in Moravia. The River Bečva joins the Morava about a kilometre south-west of Troubky (Point A, Fig. 1). The confluence of the two rivers exacerbates the problem far beyond simple overflow of either of them. The villages are flooded repeatedly, with much of the damage resulting from summer floods arising out of intensive rainfalls over a period of days. The greatest damage was done in 1997. Floods in this area are largely characterised by a synoptic situation in which a cyclone follows the Vb trajectory indicated in Van Bebber's classification (Hladný, 1998). This was certainly true of the floods in 1997 and 2010 (Sandej & Valeriánová, 2011).

During and shortly after the flood the inland excess water could also be a problem. Most of the area consists of fluvisols (porous material). The

upwelling type of inland excess water is caused by the upwards push of groundwater (according to division of van Leeuwen et al., (2012)). It is a reason why several technical studies about flood protection failed. Mayors of villages are afraid of creation of a „lake“ in their villages in case of construction of levees or other technical measures.

#### 4. RESEARCH METHODS

The data were collected by means of questionnaire surveys. The literature (Bradford et al., 2012; Terpstra 2011; Tunstall et al., 2006; Valente et al., 2008) acknowledges this as an appropriate approach to collecting data in the study of the perception of floods.

The questionnaire consisted of a combination of open and closed questions. The villages were approached separately. Trained researchers were in direct contact with the respondents. So it is possible to talk about certain combination of questionnaires and interviews. The questionnaire contained 20 questions, divided into three categories (a list of all question is at the end of this chapter):

- life of the community,
- relationships within the community,
- financing of flood control measures.

Results were obtained from a total of 112 respondents. The answers to the questionnaires were then analysed in Statistica 12 software. Villages were ranked to express Spearman rank correlation coefficient. This indicator uses rank to determine the statistical dependence of qualitative data.

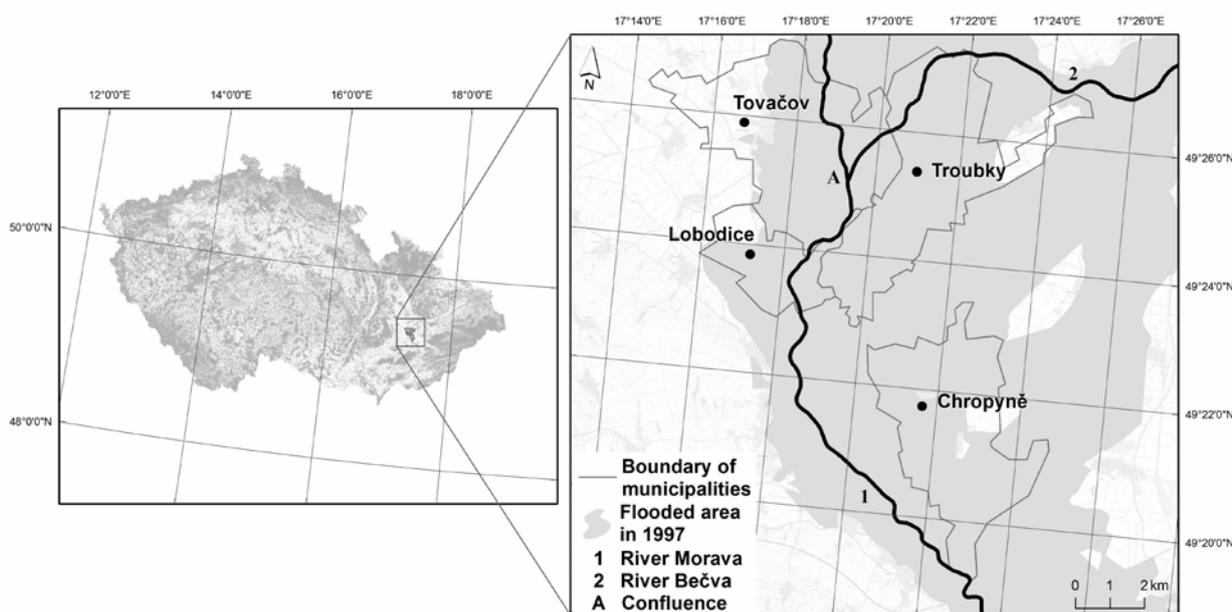


Figure 1. The study area (Source: own processing)

Rank was determined by magnitude of potential threat to the community, represented by authors as a combination of inundation during the 1997 flood (data provided by public bodies), the extent of the Q100 flood zone (Klemešová, 2012) and damage done by the 1997 flood (Hladný, 1998). Evaluation of these indicators ranked the villages from highest potential flood threat to the lowest: Troubky, Lobodice, Chropyně, Tovačov. The higher potential threat in Chropyně compared to Tovačov is due to industrial developments in Chropyně.

A list of all questions in the questionnaire is shown below:

1. How are you satisfied with your place of residence and its surrounding as a place for life?
2. Do you live in the community you were born?
3. Do you consider about moving out?
4. Are you aware that your community lies in flood area?
5. How does the fact that you are living in a flood area influence life in your community?
6. If you moved into the community, had you known the community lied in a flood area?
7. Have you ever been informed how to behave during flood? In what manner? How often? By whom?
8. Did your attitude towards floods change after flood in 1997? If yes, in what way?
9. Did relations within the community change after the flood?
10. Is the recent flood protection of your community better than in 1997?
11. Do you think the flood could return to your community again?
12. Was your house/flat affected by flood?
13. Did you consider changing residence because of a flood risk?
14. Are you satisfied with performance of local authorities from the point of view of flood issue?

15. Please explain what a 100-year flood is.

16. Do you agree that the owners of real estates in flood areas should participate in the financing of flood prevention measures in the community?

17. What is your opinion on flood tax (payed in 2011)?

18. How much floods influence your individual quality of life?

19. To what extent do floods influence social quality of life in your community?

20. How are you satisfied with your individual quality of life?

## 5. RESULTS

### 5.1. Aspects of life in frequently-flooded areas

One important primary goal was to obtain a basic overview of certain aspects of life in floodplains. The open question: “How does the fact that you are living in a flood area influence life in your community?” enabled respondents to express their opinions freely. Figure 2 shows that inhabitants of all of the villages expressed a certain degree of fear of future flooding and stress related to it.

Those who live in Troubky fear flood more than all the others. This suggests a link to the fact that Troubky suffered considerably more damage than the other villages, something that is reflected in other issues as well. A gradation of changes in social relations following flood, associated with degree of risk, appears here for the first time, in general form (compare Tovačov, Troubky).

Social relations play an important role in flood control measures and those within the community were the target of the next question: “Did relations within the community change after the flood”?

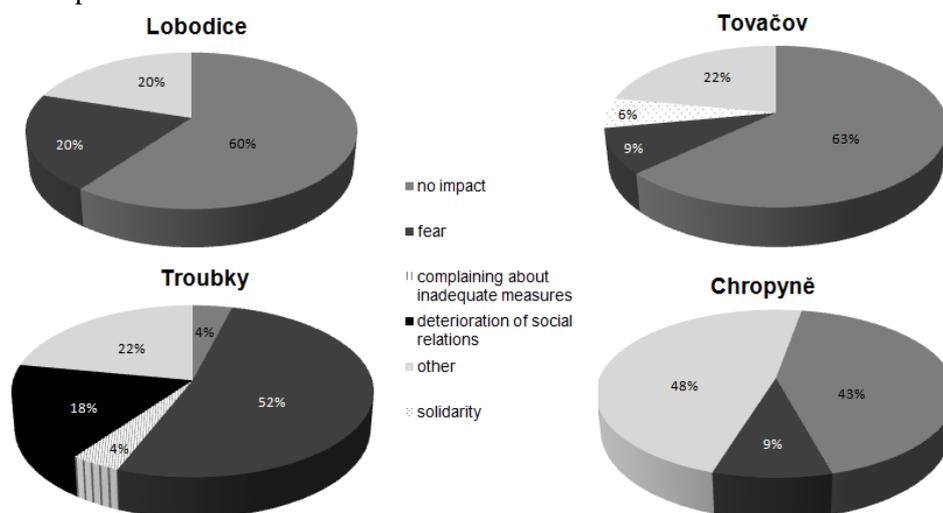


Figure 2. Impacts on life in flood areas

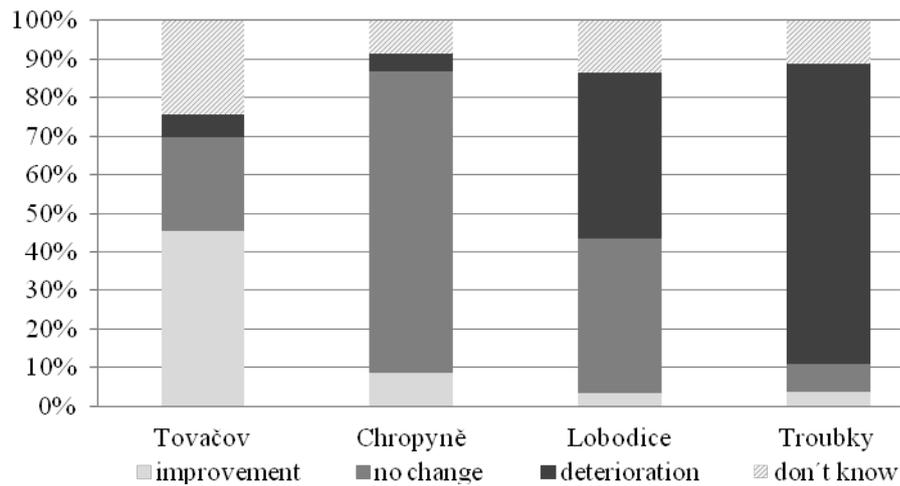


Figure 3. Changes in social relations in the villages after floods

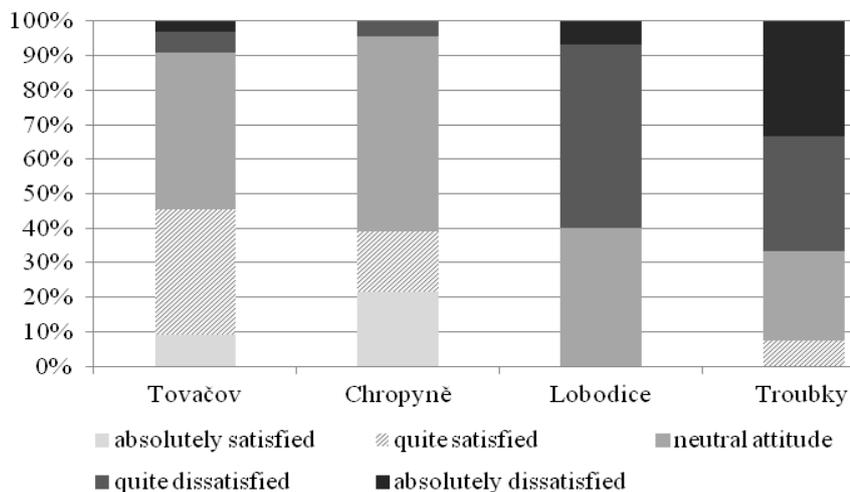


Figure 4. Satisfaction with the performance of local authorities

The results appear in figure 3. A Spearman coefficient of 0.405 ( $p < 0.05$ ) suggests that social relations deteriorate with an increasing degree of risk. In the villages that suffered most, social relations worsened more than in those less afflicted. Reasons suggested by respondents include emotional aspects, among them envy, reproach, perceived unjust distribution of compensation money, and lack of consideration for others.

Level of satisfaction with local flood management bodies (under prevailing Czech legislation, the local authorities) was also investigated. A Spearman coefficient of 0.624 ( $p < 0.05$ ) indicated a medium to very strong relation between the degree of risk and satisfaction with the performance of local authorities. The lowest satisfaction was expressed in Troubky once more (Fig. 4). It is important to note that respondents often fail to differentiate between local and state authorities and rate the two together. The perception

of floods is closely related to the issue of awareness. It is very likely that both the degree of knowledge already possessed and effectiveness of communication influence the degree of awareness of flood threat (Raaijmakers et al., 2008). On the other hand, misinterpreted notions and misunderstandings (e.g. wrongly assumed knowledge of the periodicity of floods indicated by their return period – “N-count”) may reduce preparedness and lead to problems for the implementation of flood control measures (Bradford et al., 2012). Degree of understanding was investigated by the question: “Please explain what a 100-year flood is.” None of the respondents was able to explain the term correctly. Most people like many outside the Czech Republic as well, (Wachinger et al., 2012) thought that such a flood could only occur once in a hundred years. However, nearly all the respondents who had lived in one of the villages all their lives (97.3%) were aware that part of their community’s territory lay within a floodplain.

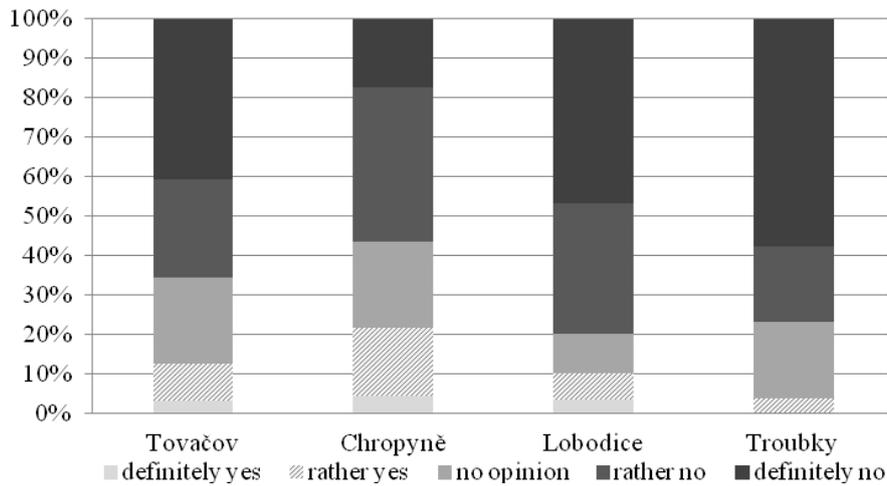


Figure 5. Willingness to participate financially in flood prevention measures

The situation is different with incomers to the village – 49% of them did not know that they were moving into an area within a defined flood zone. Those who had moved into a village and were aware of the flood zone, 38% of inhabitants, cited their spouse and job opportunities as the main reasons for moving in. None of the respondents expressed any intention of moving out in response to potential flood risk.

Answers to the question: “Did your attitude toward floods change after 1997? If yes, in what way?” highlighted the repetition of certain opinions regardless of the degree of risk in the each village. A change of attitude was reported by 62% of respondents. Inhabitants of all the villages agree that after the floods they became more aware of a possibility that the place could be flooded again.

## 5.2. Willingness to participate financially in flood prevention

Attention has been increasingly drawn to low-

cost flood prevention and control measures at local level. However, some funding needs to be found for these measures. The willingness of people living in flood zones to participate financially in flood control measures was examined. As figure 5 indicates, regardless of village of residence, over 50% of residents consistently provided a negative answer. This unwillingness becomes more evident the more threatened the village. Such unwillingness to contribute applies not only to local protection, but to flood prevention measures in general. A form of flood tax was introduced with the aim of helping finance flood prevention and flood damages (also known as the “100-CZK flood banknote”). It was introduced in 2011. This tax, initially levied for only one calendar year, reduced relief from the income tax of physical entities by 44.5 EUR per year. The research also asked whether the residents would agree with the reintroduction of this flood tax (the same rate was assumed, i.e. 3.7 EUR per month). Reactions to the flood tax are shown in figure 6.

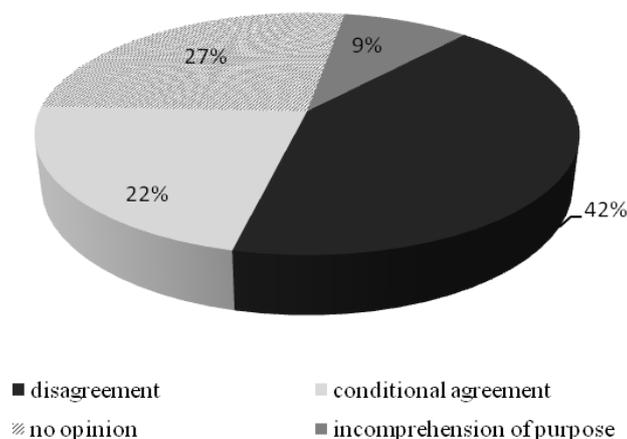


Figure 6. Opinions on the reintroduction of a “flood tax”

Some 42% of respondents disagreed with the reintroduction of flood tax. Only 22% agreed that such a tax should still be in place if the money were used appropriately. No opinion was expressed by 27% of respondents, or they did not even know that they had paid such a tax in 2011. A complete lack of understanding as to why they should be paying such a tax was expressed by 9% of respondents.

## 6. DISCUSSION

In order to carry out risk management with public participation it is necessary to establish how residents perceive flood risk in their area (village, community, and beyond) to determine which factors may influence the acceptance of risk floods by the public (Motoyoshi, 2006). It is also important to consider differences of perception on the parts of experts and lay people (Raaijmakers et al., 2008; Bradford et al., 2012), where expert technical assessments appear counter-intuitive to lay opinions. This is why the research herein focused on village residents, rather than local authorities. Similarly, there are differences between perception of lay people and local authorities (Ceobanu & Grozavu, 2009).

A flood and its consequences impact on the individual as extreme or even ultimate stress (Mikšík, 2005), both physical and mental. According to Raaijmakers et al., (2008), worry is one of three key characteristics used to study perception of flood risk (awareness, worry, preparedness). The results presented here illustrate that in villages that have suffered flooding in the past, fear (or stress, worry) persists for a long time after the event. Despite this, certain authors record that the psychological impacts of flood situations are often overlooked and neglected (Alderman et al., 2012). Although it is not clear how fear influences flood preparedness (compare Raaijmakers et al., 2008; Terpstra 2011; Bradford et al., 2012), the results of the research performed here demonstrate that this factor should be investigated further and in greater depth.

Relations within communities, both among residents and between residents and representatives of local authorities, were investigated here. Unity of community feeling and willingness to co-operate and participate in flood prevention processes may facilitate implementation of local flood control measures which, as e.g. Geis (2000) maintains, may help enhance the quality of life in communities and positively affect people's attitudes and psychological well-being (Whittle et al., 2010). However, our research revealed that with such a high degree of risk as is prevalent in the village of Troubky,

relations worsened after flooding. Where good co-operation at local level was most needed after flooding, the opposite occurred. To judge by the questionnaire responses, this was further exacerbated by what is perceived as unjust allocation of financial support and subsequent, frequently-mentioned, feelings of resentment, envy, reproach, and other negatives. Allocation of financial support and overall coordination of the management of a flood situation, together with the follow-up restoration of affected areas, relate closely to trust in local flood control bodies and satisfaction with their work. The importance of this is mentioned e.g. by Flynn & Slovic (2000). A positive attitude on the part of the public towards local authorities may significantly facilitate the implementation of flood management measures. On the other hand, too much trust in local authorities may, especially during periods with no floods, reduce awareness of flood risk. Such awareness falls away because, from past experience, residents know that they were perfectly informed during the flood and help was distributed efficiently at the time. People therefore shift responsibility onto local authorities (Kuhlicke et al., 2011). According to the results presented here, satisfaction with the work of local authorities reduced with increasing degree of risk. One reason for such discontent could be the current (non-) implementation of flood prevention measures in these areas. Lack of awareness or misinterpretation of conveyed information could also be causative. Misinterpretation of technical terms relating to floods was also encountered. Media and the "expert" public frequently employ the notion of N-year floods. Despite repeated flood situations, the general public still fails to comprehend this term correctly. Non-Czech studies (Bradford et al., 2012; Tapsell, 2010) also suggest a similar low level of understanding elsewhere. This leads to the question of whether it would be better to stop using this term in the Czech Republic altogether and replace it with some other equivalent that more appropriately conveys the periodicity (or lack of it in lay terms) and the potential extreme character of floods. Degree of risk could be expressed, for example, more graphically (Klemešová et al., 2014), by means of flood marks or water level counts that convey information about the intensity of floods. This contribution indicates that, in terms of awareness, people do not consider potential flood risk as a key factor in the choice of location for a future home.

More than half of the respondents participating in this study changed their attitudes towards floods in terms of realising that floods could return. This has not been the case in some research

elsewhere (Kundzewicz et al., 2010), which draw attention to “short memory syndrome”, in which people try to forget all about floods. Denying the risks of flooding (also trying to forget about them) in areas that have been hit by floods in the past, has been labelled the “ostrich effect” by certain authors (Burningham et al., 2008). The higher degree of awareness disclosed here may have arisen out of the recurrence of extreme flood situations in a comparatively short time – over only the past decade or so. The intensity of these floods did not match that of the disaster in 1997, but they did affect the villages studied and served as a reminder of the capacity of floods to constitute catastrophe.

The unwillingness of respondents to participate financially in flood prevention was notable. Regardless of the degree of risk, in any given village, more than 50% of residents refused to consider financial participation in flood prevention and control: indeed, with increasing degree of risk, such a recalcitrant attitude even intensified. Discontent with the performance of flood control bodies may lie behind this; Whittle et al., (2010) record that some people blame institutional failure for flood damage. In the particular political development of the modern Czech Republic, it is worth noting that, for around half of the life of the country as an independent entity, the communist authorities kept flood-prevention strategies and actual flood events secret often (Munzar & Ondráček, 2010) in order to maintain a general feeling of security. This led to the abrogation of any sense of personal responsibility. In the post-war years, until 1989, “the state was to care for the citizen.” This concept is still deeply rooted in the Czech Republic. One way out of this situation, by making people involved in flood prevention, was suggested by Aakre et al., (2010). These authors also drew attention to rational (or irrational) behaviour on the part of the inhabitants of flood areas – they are willing to increase their preparedness for floods only if this yields tangible benefits. However, it remains questionable whether this model could work in the Czech Republic.

The high degree of unwillingness to participate in the financing of flood prevention measures is evident in the responses to the question regarding “flood tax”. The answers appeared to reflect respondents’ mistrust in all of Czech politics. Only 22% were willing to pay the tax, and only with the proviso that the money actually be used for the purpose for which the tax was collected. Such distrust in how the money would be used was a frequently-mentioned reason for the respondents oppose the reintroduction of the tax. The idea that

these funds might be inappropriately used in the Czech Republic was also supported by the media in 2012 (shortly after the cancellation of the flood tax) when they reported the alleged impossibility of tracking where the funds raised actually went. Although the Ministry of Finance in public media (TV) disclaimed any rumours of malpractice, trust that even some of these funds would find their way to their purported purpose was not reinstated. Further, 9% of respondents did not understand why they had to pay a flood tax in the first place. They appeared to believe that paying already-established taxes was sufficient to fund all state mechanisms, including flood control and management.

## 7. CONCLUSION

The development of civil society has been accompanied by an increasing need to address flood-related issues at various levels and from different points of view. Western countries, in particular, have come to realize the importance of research into the perception of flood risk. How floods are perceived may significantly facilitate the implementation of flood prevention and control measures, as well as the application of sustainable development principles in floodplains and areas exposed to flood risk, resulting in improvements to the quality of life in such areas.

This overview of perception of selected aspects of life in flood zones in an area covering the villages near the confluence of rivers Morava and Bečva (Troubky, Lobodice, Chropyně, Tovačov). These villages exposed to different degrees of flood risk were evaluated in terms of overall perception as well as spatial differentiation of perception. The villages were ranked in terms of several variables, and the results clearly showed a difference between the highest-ranked – Troubky – and the rest. In 1997 and 2010 the village of Troubky was affected more gravely than the others, and the answers from there are far more “extreme”. Some of our work confirms many of the results of studies from beyond Czech borders, especially into issues related to the interpretation of information and persisting fear of floods. There is a difference between Czech and other studies in terms of loss of flood memory, but a higher awareness of the potential return of floods is probably a result of a higher frequency of disastrous flood occurrence in the Czech Republic in the recent past.

The respondents’ persistent reluctance to accept any personal involvement appears to be the most serious problem for any future implementation of local flood control measures. Respondents consider that the Czech administration, both local

and national, bears full responsibility for addressing floods, as well as for the reconstruction of damaged areas. Refusal of financial participation is not limited to local measures; it also applies to flood management in general. The authors of this contribution are convinced that communication between the residents of flood area and public authorities might be improved by education that raises awareness of personal responsibility. This paper offers some information about selected aspects of life; it will be followed by deeper investigation into individual problem areas and the involvement of local authorities in research.

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