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Perceptions of climate change and adaptation in Hungarian agriculture: results of an interview study

In this paper, the results of an interview survey of farmers in Győr-Moson-Sopron, Fejér, Hajdú-Bihar, Jász-Nagykun-Szolnok, Pest and Zala (NUTS 3) counties of Hungary are used to demonstrate the major factors of climate change perception, such as the terms psychological climate, temporality and problem localisation. Adaptation strategies are also discussed. The interview results underline the subjectivity of temporality as well as the fact that the phenomenon of localisation and the narratives for place attachment differ when climate change is interpreted within the locality. Considering adaptation, it seems that Hungarian agriculture includes individuals who can be regarded as leaders or as people escaping ahead in terms of climatic adaptation, but the majority seems to be unable to follow them because they lack the necessary knowledge, technology or financial resources.

Keywords: interviews, temporality, localisation

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Introduction

The social issues pertaining to climate change range from the communication and reception of scientific results to the actual perception of the phenomenon and the adaptation to change, and these issues have been the subject of extensive research. In our study, we examine the latter questions – problem perception and adaptation – but place the emphasis on the perception of the problem, through which adaptation will be approached.

Why is the issue of problem perception important and what implications does it have in agriculture? Climate change – as with other natural phenomena – is experienced not only directly through own experiences; these are modified, biased by mass media and other people. Communication is a discursive process of reality making and thus the subject matter of discourse analyses, which examines the scientific or policy practice therein, or the presence of such questions in different media (press, technical press etc.). The social and scientific reception of an issue such as climate change may have an impact on the individual and, in our case, on farmers' prior knowledge, attitude and attention; belief in climate change is an important factor of experiencing it on the field (Howe and Leiserowitz, 2013; Niles and Mueller, 2016). Thus, personal perception of climate change cannot be separated from prior knowledge and expectations, and similarly from other emotional and cognitive biases, such as imagination based on personal factors including personality, education, cultural background (Moser, 2010; Yusoff and Gabrys, 2011; Clayton *et al*., 2015).

This is a crucial point in the case of climate change as from the perspective of problem communication an important question is whether climate change can be perceived visually. For a city dweller it is far from being obvious. In this respect, extreme weather and the relating discourse are of major importance. It has often been asked whether a particular extreme weather event is regarded as the consequence of climate change, or it would have occurred even without climate change (Moser, 2010; Weber, 2010; Hulme, 2014; Stoknes, 2014). There is no evident answer, as acknowledged by the Intergovermental Panel on Climate Change, even if between their two latest reports there has been some shift towards the view that the probability of anthropogenic causes of certain extreme weather events has increased (IPCC, 2007, 2013). However, according to a more realistic and acceptable explanation, warming of the Earth's climate may lead to more frequent natural disasters and extreme weather events. Nevertheless, this dubious reading also explains the significant number of people who are doubtful about the issue.

Consequently, for a city dweller – as often happens in climate change communication aiming to affect people's attitudes – it has to be explained that the most recent extreme weather events are a consequence of human-made climate change, and it is no coincidence that some kind of iconography of climate change has emerged by now with regard to polar bears, melting glaciers, shrinking icebergs and hurricanes (Manzo, 2010).

Nevertheless, many disasters are happening far from Europe. Problems should be hurting enough for us to change our established customs significantly. If they are not doing so, problems should be localised: they should be explained in the local context, attached to local issues and adapted to national or regional conditions (Brace and Geoghegan, 2010). Studying farmers and others who are engaged in agriculture is an obvious and appropriate way of examining the issue because in their case both factors may be significant (Weber, 2010). For those who live from the land, the transformation of climatic patterns and local problem perception are apparent, and therefore if problems are perceived, responses to such changes, i.e. adaptation, necessarily happens faster.

Therefore, our study examines how climate change appears in the everyday thinking, observations and activities of people living from agriculture: how they perceive the problem, how they react, what knowledge they have, and how they localise climate change in their own local context, influenced by personal factors.

Methodology

Firstly, to establish a comprehensive basis to the discourse analysis of the interviews, we delineate the theoretical background of the issue. Then we analyse the results of struc-

tured interviews conducted in 2013 and 2015 with 40 farmers (including eight women) in Győr-Moson-Sopron, Fejér, Hajdú-Bihar, Jász-Nagykun-Szolnok, Pest and Zala (NUTS 3) counties of Hungary. The interviewees were chosen randomly through contacts from local agricultural advisors, and by snowball sampling to get further contacts from interviewees. The interviews were documented by taking notes by hand or with voice recording. Half of the interviews were conducted by methodologically trained BA and MA students using an interview schedule. A number of questions were posed concerning the sources of climate change-related information, the respondent's opinion, experiences and memories about climate change and how these changes affected his/her farming practice or adaptation strategies. The interviewees included primary producers, grape growers and winemakers, fruit growers and large-scale farmers with wide product ranges. The youngest farmer was 25, the oldest 80 years old.

The interviews were intended to provide qualitative information and material for text (discursive) analysis and representativeness was not our goal. Discourse analysis is a qualitative method: quantitative information is not in the focal point. The method might have different objectives; our aim was to identify the narratives of climate change: the stories and memories around it, the metaphors, attributes and rhetoric used, relations between cognition and imagination. These features are demonstrated with quotations from the interviews.

Theoretical background

Climate as a social construction

In this paper, climate change is not regarded as a term that starts from the positivist and scientific perspective which has a lopsided and deterministic impact on the ecosystem, on different regions or on human society, and which provides a deterministic explanation for many things in our lives (extreme weather events, risks, threats etc.). Instead, we take it as a term which may mean something different for everyone, and which has to be understood and explained (Hulme, 2009). Similarly, landscape is not only a mediator which models global climate change in the same form for everybody, but it also offers a framework for interpretation for local people who perceive the phenomenon in their own lives, in their space and time (Brace and Geoghegan, 2010). However, as Hulme (2010) puts it, climate change makes everyone somewhat cosmopolitan, because it transcends boundaries and connect places with each other. We regard the term 'climate' as a term that forms part of the culture, which also has social components. In dominant scientific discourse, the term 'global climate' is used; however, it is easy to understand that this is a mere construction, a statistically created figure which has little to say to ordinary people. For the lay public it is very important to attach climate change to something specific, to localise and connect it to their own climate concept, i.e. to the psychological climate, otherwise it will remain an invisible or distant problem. IPCC (2013) also raised the question: when would the human influence on local climates be seen as evident?

The term 'climate' has several components. The lay public may have some understanding of the statistical concept of climate as some average weather pattern, the ordinary course of weather and the relating data (temperature, rainfall etc.), but this is complemented by psychological and cultural concepts. The former is to be understood in the individual's own time scale and life, which is based on individual experiences, memories and the construction process that stems from them: the individual's own climate concept is constructed several times through different itineraries based on the weather conditions experienced during the past weeks, months or years. In addition to this, the concept of cultural climate is also very important, which may also be interpreted in spatial dimensions, therefore we can talk about an ordinary climate for a particular country or region that is based on collective remembrance and is also attached to folk traditions (Brace and Geoghegan, 2010; Hulme *et al.*, 2009). However, this might also be deceiving since we all know that even little children are taught that in winter there is snow, and Christmas should be always white.

Similarly, we regard the concept of landscape as something that is socially constructed; not as a scientific term but rather in the sense of a cultural landscape, where the importance of individual perception is emphasised. Landscape is a subjective construction based on experience, partly on the level of the individual and of the community, which provides a framework for interpretation for several natural-social phenomena. Thus, landscapes give an opportunity to understand climate change spatially and to locate it to our everyday life. The subjectivity of time perception may not require further explanation, and the perceived rate of the lapse of time, the length of the time elapsed and the different perceptions of the future are also very important factors in the individual reception of climate change. Together with landscapes, temporality provides a relational context to the investigation and understanding climate change (Brace and Geoghegan, 2010; Hulme, 2010; Stoknes, 2014).

Agricultural adaptation and climate change

Climate change is one of the environmental stress factors of agriculture. Extreme weather has always contributed to yield variability. Globally, one problem affects another, which means that yields or production performance has an impact on the world market value of agricultural or food products, and in the medium or longer term the changes in climatic conditions in certain regions may have a significant impact on the world market position of certain food products.

Among the interwoven problems of agriculture, global food security seems to be the most significant today, seeing that the growth rate of the Earth's population – though it now represents a decreasing tendency for over four decades – has exceeded the annual growth rate of global crop production since the mid-1990s. Satisfying the growing need for sufficient and healthy food products, environmentally-friendly technologies, biodiversity and soil protection, and the growing raw material requirements for biofuels, biochemistry and bioenergetics, all place further burdens and expectations on agriculture. In this respect, climate change may not only affect daily farming practices but might also result in

the transformation of existing farming systems and regions (Vermeulen *et al.*, 2012; Howden *et al.*, 2013).

Another important perspective is the issue of water. Globally, many of the regions with the fastest growing population experience water scarcity, and increasing water demand is not solely induced by climate change. Clarke (1999) forecasted that 25 African countries will face severe water scarcity by 2025. So-called rainfall-fed agriculture supplies just 60 per cent of the world's food production and, if the forecasts for unfavourable climate change prove correct, this figure may even fall in the future (Cooper *et al.*, 2008).

In the case of historic agricultural societies, successful adaptation to changing environmental conditions basically depended on agriculture (Pappné Vancsó, 2014). Today's societies are much more complex, both in terms of construction and operation; however, if adaptation in agriculture is inappropriate, the occasional success of the other sectors will also be futile. Accordingly, the adaptation of agriculture to climate change is one of the most researched fields within adaptation research.

The theoretical frames of such research are provided by the terms exposure, sensitivity, adaptation capacity and vulnerability-flexibility as summarised by Chen *et al.* (2010) or Preston *et al.* (2013) in the context of agriculture. Every area or production region has its typical climatic risks such as the fluctuations in precipitation or temperature, early or late frosts, hail etc. The agricultural ecosystem of the region is formulated accordingly with its distinctive variety of species, technological-technical culture including the farming methods, mechanisation, the use of fertiliser and pesticides and daily-yearly routines. Exposure arising from the risks is also formulated depending on such factors and vulnerability is born when the social-economic environment is added (labour costs, market value of the products, marketing channels, costs of agricultural resources, agricultural insurance systems). Adaptation capacity depends on the macro-economic environment and the micro-economic conditions of farming (objectives, division of work, financial position, governance structure, social capital etc.) in the broader sense, and on the abilities and knowledge of the human resources, on the available financial resources, lands, technologies and alternative livelihoods in the narrower term. Basically, these factors in a condensed form determine the vulnerability or flexibility of a particular region or a farmer. Individual farmers, where possible, make their decisions by taking into consideration the perception of the problem, the risks perceived and their vulnerability, and the success of such decisions influences their planning and future activities. In this respect, the decision-making environment, the source and quality of the information, and analysing the reasons for success or failure are significant factors.

Adaptation research became more dominant after the turn of the millennium (Preston *et al.*, 2013), but in the US detailed farm-level studies focused on adaptation strategies even at the beginning of the 1990s. These studies were focused on what actual measures could help to protect against negative environmental influences on the one hand, and on simulating crop yields by using model calculations with different-level adaptation strategies introduced on the other (Easterling, 1996; Kaiser, 1999). In this research, the main focus is on developing countries, which are regarded as the most vulnerable, and the emphasis is placed on the development of institutional environment, technological transfer and competencies (Cooper *et al.*, 2008; Chen *et al.*, 2010; Chhetri *et al.*, 2012; Lybbert and Sumner, 2012). Such research also offers promising fields for studying the development of traditional and local knowledge in, for example, African countries as it is gradually adapting to changing environmental and climatic conditions (Newsham and Thomas, 2011).

For the purposes of our paper, studies of farm-level adaptation in developed countries that are focused on its social-ecological factors as opposed to technological developments, plant biological experiments, plant breeding etc. (e.g. Geoghegan and Leyshon, 2012; Lereboullet *et al.*, 2013; Niles and Mueller, 2016) are more important. On the one hand, they illustrate the wide range of adaptation strategies – choice and supplement of varieties, changes in natural farming methods, moisture conservation, diversification of farming structures, diversification of land use, improvement of water management, protection of water-base, promoting diversification within and outside the sector. Compared to the above, in the Second National Climate Change Strategy of Hungary (NÉS, 2013), wider and higher-level objectives were formulated. On the other hand, they identify the factors that determine the success of adaptation including the place of farming in the lifecycle, the scope of available technologies, the size of the farms, traditions, institutional environment, the availability of information, the community nature of the parties involved and the regulatory environment (Nicholas and Durham, 2012; Raymond and Robinson, 2013).

Results

Perception of the changing climate

All the interviewees perceived changes in the climate recently, reporting that climate change was evident in changes in the natural order of the seasons, the blurred boundaries between the seasons, in gradually warmer and dryer summers, unpredictable and changeable weather, uneven precipitation, reduced rainfall, problems with rainfall patterns or in reduced duration of snow cover in winter.

Temporality takes shape in different forms in the responses received. Some of the respondents regard the weather patterns and climate perceived in the past few years as unprecedented. Others – representatives of the older generations – remember experiencing similar periods before. One of the respondents, who cultivates 20 hectares of land with his son, was considering the relativity of remembrance, i.e. the psychological climate, which made him rather uncertain when answering the question "Is our climate changing?":

> "Well, yes. If I can [recall] my childhood, because I was a peasant's child, […] there used to be [changes in the climate] and at that time we said what kind of weather we had. We did not know anything about temperatures. We had no thermometers. […] But about the temperature – no, probably not. Perhaps those winters were colder, we had more snow, and perhaps more rain

too. I can remember […] that back at primary school I think we learnt that the distribution of rainfall was around 700 mm here in West Transdanubia, but in the Great Plains it was 4-500 and so on. And this has changed by now. I recorded rainfall figures for ten years, how much rain we had a month, so there were times when we had only 400 mm of rain a year. […] About the temperature? Well, I don't know. Whether this global warming has any impact, I don't know. I don't know much about it. Where I see the changes in the weather that seasons are blurred, there are no four seasons distinctly separated any more. Spring, we used to have nice springs, and summers – warm ones, and autumns – and something, and then winters – cold ones. Now somehow we typically have summer very early in the spring, but I don't know what these things were like a long time ago. We used to have cold winters because plants were also frozen sometimes if it was colder a long time ago. […] Something has changed. It is rather that the four seasons are not so distinctly separated, I guess. […] Was the situation similar a long time ago? Well, we cannot be sure. Because there were no weather forecasts, and people were making predictions. […] These somehow came true, but I don't know if something has changed. Something must have changed, but not very much." [man over 80, Zala].

The perception of time, similarly to remembering the climate or earlier weather phenomena, is naturally a subjective factor. Some people see the beginning of the changes at the distance of three or four years while others, looking back to ten years before, feel that the climate has been changing as a trend. At the same time, some older people claim that the borderline was in the 1980s and 1990s, however younger farmers can sometimes only reference to narratives of older farmers not having exact climate memories from their childhood. The different perceptions can also be observed in the nature of the changes perceived, and the role of the locality as a reference point is also a factor in rhetoric:

"How long have we been experiencing great changes; how long have we been saying that the order of nature has changed? There occurred such a thing once ten years ago back in 2003. At that time, we experienced the very first deviation from usual weather patterns. Well, here we usually have 800 mm of rain a year, and if I can remember well, we only had 450-600 mm. It was a problem because we did not choose other varieties or ripening periods but used the usual ones. So in 2003, we closed the whole season with a deficit." [man over 50, Zala]

"I worked at the collective farm, there are such periods, I can remember that our maize production was rather disturbed due to the dry period, so because of the drought. Thus, this year seems to be similar. The only exception is sunflower, a miraculous plant, because it yielded three tonnes or above in last year's weather, and it has yielded three tonnes again this year. In this extreme place, where we are, in this part of the Great Plain, in this part of Hajú-Bihar, where we have hard ground that is meadow clay soil, so we should have very good maize yield, but now stability is provided by sunflower. […] Two years ago we had 1,200 mm of rain here on the Great Plain where the yearly average is 5-600 mm – isn't it? – so, we had as much rain as in the Alpokalja region. And it turned everything upside down. […] We had a similar period about 15 years ago when we had drier or rainier weather, and that was natural, but now it changes every year." [man over 40, Hajdú-Bihar]

Our interviews were conducted in years with particularly extreme weather patterns (2013 and 2015). In many cases we felt that, despite our request, the respondents were not able to disassociate themselves from the weather conditions perceived during the actual year.

Understanding climate change

The respondents mentioned the media, the events organised by the Chamber of Agriculture, professional magazines and their own interest as their source of information on climate change. Climate change is an important issue for the farmers because "[we] usually consult one another and the farmers as well to decide who should do what and in what ways. No one knows the right answer as we can see. But others also regard it in the same way." [man over 30, Hajdú-Bihar].

As for the major cause of climate change, the respondents mentioned anthropogenic environmental pollution most frequently, including the iconic car use, industry, deforestation, consumer society, urbanisation and globalisation, which suggest the respondents' perception of more complex relationships. Responses which mentioned acid rain, ozone layer depletion, earthquakes or tsunamis in connection with climate change suggest the entanglement of environmental problems. However, six respondents regarded, at least partly, natural processes as the major cause for climate change. One of our respondents engaged in plant production summarised the gravity of the problem in the following way by localising and combining distant climatic phenomena in the Carpathian Basin:

"Unfortunately, mankind interfered with nature a long time ago […] And now, […] we are digging our own graves, also in a global context. […] Mankind lives a self-destructive way of life. […] It is important to develop an environmental protection system or such a technology that will not make the present situation any worse so that it may become even more serious. Because the more destruction we make, and the more frequently we interfere with the order of nature, the more likely it is that nature will 'take revenge'; that is why we have these cyclones and hurricanes in the Carpathian Basin, which we did not have before. We have such phenomena in our basin which were not typical here before. And this is all because of the above I think." [man over 40, Hajdú-Bihar]

Naturally, there are such respondents – with similar discursive strategies – who are uncertain about the extent of the predicted changes – "Many exaggerate global warming, but I do not believe that we will chase desert fox in the Carpathian

Basin" [man over 55, Győr-Moson-Sopron] – or about the role of mankind, which only fosters the naturally induced changes. Interestingly, one of them doubted climate change by localising the problem and using his own experiences, but expressed a different opinion with regard to arctic climate change learnt from the media. This quotation underlines the problem of visibility as well:

> "Basically, I do not really believe in this climate change, because we might as well make statistics about certain periods. But as I see in nature programmes, these are cycles, and it is not sure that the climate is actually changing. Perhaps it is changing, and it can be measured when compared to periods 10 or 100 years before, and in this regard it is not really significant. However, I would not exclude the impact of human activities on the climate. So, when I look beyond my own environment, to the arctic region for instance, that really appeals to me as well. At that level, and considering what is happening there, I can see the connection with climate change and the emission of greenhouse gases, but when I look at my own environment, climate change does not seem to be apparent." [man over 50, Hajdú-Bihar]

However, in other responses relating to the question of problem perception and searching for responsible actors, localisation was very important. This is also supported by the interesting responses received. Several respondents referred to the practice of cloud seeding by their 'neighbours', which might result in droughts in certain regions or produce precipitation in others. In this case, it might be the technology of hail protection which has been included in local folklore, and become a scapegoat in local discourse, as one of the factors representing unauthorised human interference with nature. However, the responses also included regional and micro-level localisation narratives:

> "Some people say and it is also supported by observations that since the Yugoslav Wars aeroplanes have been using different air routes, so they are flying above us, which has also changed our climate slightly, or pushed our cloud zone into another direction. Thus, the distribution of our rainfall has changed accordingly." [man over 50, Zala]

> "Back to the amount of rain, rainfall and water balance are closely linked to the existing sewage system in the neighbourhood of our family house. Since we had the sewage system installed, groundwater has receded to lower layers in the soil. Perhaps it is not connected to climate change, but to the former problem. I usually associate climate change with water and water management. The amount of water or rain we have in the area. I do not want to drain water around the house, I would rather want to preserve it there." [man over 50, Hajdú-Bihar]

Adaptation to climate change

In the interviews, the options of adaptation to climate change also appeared. It can be generally stated that large-scale farmers have usually more detailed knowledge about the features of adaptation, while small scale farmers better refer to traditional knowledge, or consider only watering possibilities. In the responses, four focus points were mentioned: irrigation, the choice of technologies (precision agriculture, mulching, modern cultivation and tillage methods) and varieties, and the factor of abilities, aptitude and knowledge. The latter have been attached by our oldest respondent to the issue of diversification:

> "If you grow different plant varieties, you can survive, and there is no disaster. You have to grow three different species at least. Another form of diversification is that you raise animals as well." [man over 80, Zala]

To reach even higher yields, many respondents are open to testing and implementing the newest technologies: soil melioration with bacterial or water retainer technology, high-tech machines etc. but some respondents emphasised the importance of old, traditional knowledge, which could be a solution to new challenges as well: "The knowledge of the elders is needed here […] The old knowledge should be sought!" [man over 55, Győr-Moson-Sopron]. Interestingly, two of our respondents farming over 1,000 hectares – one of them from Zala and the other from Hajdú-Bihar – both presented their farm as exemplary in terms of adaptation, however some respondents tend to be inactive even if they know the solutions to the problems induced by climate change.

> "So, for three or four years I have not grown early or mid-season maturing species. One of the reasons is that early-season varieties yield several decitonnes less, that is ten decitonnes fewer per hectare. […] If you walk around the fields you can see that smallholder farmers [planted] early-maturing varieties or they do not reconsider what type of varieties to plant now. They plant FAO 380 variety, for example. If you walk around the fields, you can see that those varieties get burnt, they are ripe. Actually, they are not ripe but they are forced ripe. But you can see our maize that we grow on a large scale, so if you walk around the fields you can see that our maize is still green, or was green until the early frost this morning. […] After the change of the regime, […] I planted and harvested maize, and no additional knowledge was required. I did not have to apply rotation; maize could be grown as a monoculture. But now we have moths and maize rootworms. So, basically maize is an expensive plant to grow. And if I fail to pay attention to the details, there is no harvest at all." [man over 50, Zala]

> "What we did is to push April planting season until the end of May or sometimes until the beginning of June if the varieties required so. […] You plant the maize in April, but you have to face drought throughout April and May until the end of June, a serious problem that tends to be typical these days. The problem is that maize needs rain during the ripening period that is after the pollination period. If it does not get rain at that time, and there is no grain formation, it makes no difference when the next rainfall comes, if grain formation itself does not start, it does not matter what you do later on. This is what we

have observed, and it works, thank God, this year we can see that it really works. Others planted maize earlier – we planted it in the middle or at the end of May. In some areas, we planted it even at the beginning of June. And it was in the summer that we had the first excessive rain. And our maize started to ripen, while others' maize was over the ripening period and started to get burnt." [man over 30, Hajdú-Bihar]

During our interviews, the issue of climate change was mentioned among other day-to-day problems the villages have to face – unemployment, migration, ageing – or among the personal problems of the respondents – diseases, family, earning a living etc. – and similarly to such problems it appeared as a problem which many of them are puzzled by. They regard climate change as a problem against which individuals' wills and activities make little difference. With this mentality, people cannot help perceiving the problem in search for mitigation, and trying to answer the question "What can we do to stop it?" Here, the individual's opportunities or responsibilities are dwarfed many times, however, some people emphasise that everybody has to do something based on his/her abilities. Nevertheless, those who regard climate change as the question "how should I adapt to it?" are considering adaptation, and the management of the problem. For such respondents, climate change appeared as a factor – similarly to market conditions or legislation – which rendered farming more difficult. In this respect, individuals' leeway is different: some respondents claim that the success of adaptation lies in individual opportunities, people's own knowledge or aptitude, while others think that it depends on legislation and the introduction of coercive and influencing measures.

Our respondent growing wheat, maize and sunflower by the river Körös expressed his opinion in the following way:

"It is negative for those who are unable to adapt, and positive for those who are capable of adaptation. You can always find a better market. Now I think that if you have your market, and you can grow your crops in sufficient quantities while others who cannot adapt, cannot produce sufficient quantities, then practically you will also get a better price." [man over 30, Hajdú-Bihar]

Discussion

Our study focused on farmer's narratives, how they understand and explain perceived changes in local climatic patterns. Using quotations from interviews we demonstrated the significance of the term psychological climate, temporality and localisation in experience and perception of climate change; our results are thus consistent with similar approaches such as Geoghegan and Leyshon, (2012) or Lereboullet *et al*. (2013). Particularly in the developed world, several studies examined other aspects in perception such as personal beliefs, political views, and local factors including place attachment or existing adaptation infrastructure, e.g. irrigation (Arbuckle *et al*., 2013; Howe and Leiserowitz, 2013; Prokopy *et al.,* 2015; Niles and Mueller, 2016). These results show that perception of climate change could be much more contested in different countries and contexts; however, our results underlined some significant factors, e.g. the role of extreme weather events and knowledge, highlighted also in the existing Hungarian literature (e.g. Csatári *et al.*, 2015; Vántus *et al.*, 2015). Lereboullet *et al*. (2013) pointed out also further aspects in successful adaptation: for example, system characteristics, economic health and social background. Thus, further research is needed in Hungary to understand the complex environment of adaptation planning.

Adaptation is an issue to consider to all, but also differently: traditional knowledge is sometimes in contrast with innovative knowledge; it seems that Hungarian agriculture includes individuals who can be regarded as leaders or as people escaping ahead in terms of climatic adaptation, but others seems to be unable or unwilling to follow them because they lack the necessary knowledge, technology or financial resources (cf. for example, Barnes and Toma, 2012). However, further research has to be carried out to reveal the adaptation capacity of Hungarian agriculture, as well as to study the different factors of the adaptation environment from national to local levels. Moreover, comprehensive research in the Carpathian Basin could show the diverse circumstances of climate change perception and adaptation behaviour and capacity in agriculture.

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