

Perceptions on the impact of climate change and natural disasters. A pilot study among citizens in the urban area of Groningen

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Abstract

This research focuses on perceptions and preparedness of impacts of climate change and earth quakes among citizens of the urban area of Groningen. It focuses on four specific threats which can occur in the study area: Flooding, heat waves, extreme weather and earthquakes. As there is little known on the topic of preparedness and perception of climate change impacts in the urban area of Groningen, this is a pilot study with a limited number of 38 respondents. The study seeks to find out whether there are differences in perception of risks based on education level of the respondents, as well as it measures the level of preparedness against these threats, based on both perception and indicators by the safety region Groningen. Respondents answered a questionnaire with closed questions, on a nominal and ordinal scale, which were analysed with statistical tests and methods.

No significant differences in risk perception were found based on education level, however some results were significant, in the way citizens think to be prepared, and the way they estimate a chance for this threat, and how they are prepared, based on indicators. Some non-significant differences in perception on the chance of natural disasters were found based on education level, where higher educated respondents were estimating these chances higher than lower educated respondents. However, in levels of preparedness almost no difference was found, and lower educated respondents seemed actually a bit better prepared than higher educated respondents.

Overall, respondents were in fact less prepared than they think they are, even though they already perceive themselves not to be so well prepared. Respondents perceived risks of threats which occur more often in the research area higher than risks of threats which occur less often. Still, the overall level of preparedness is to be called bad, based on both perceptions of the respondents, as well as on indicators. This means authorities have serious issues in reaching and convincing citizens to take measures and be prepared for potential natural disasters, as they need their citizens to become more resilient and less vulnerable.

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1. Introduction

Climate change adaptation is a term that is quite abstract and probably not yet well-known among citizens. It is one of the major challenges for the next decade for almost all over the world, especially for urban areas (Brooks, 2013). There will, however, be differences in climate change impacts between regions. In Europe, there will be an increase of temperature between 0,3 and 4,8 degrees Celsius, and extreme weather will also increase (Boezeman et al, 2014).

Climate change is not a phenomena which can simply be 'turned off', but it is a challenge we need to deal and cope with (Brooks, 2013). In urban areas, for example, there are risks of flooding, heat waves and extreme weather. Current measures take into account that, for example, once in a lifetime for a citizen, there will be a flooding (Veiligheidsregio Groningen, 2014). But this does not tell us when this will happen, neither does it say what happens if reality does not follow these calculations. That is why it is important for government in urban areas that their citizens are able to adapt to climate change and its risks. It is especially important for urban areas, as population densities are higher here than in rural areas, and more vulnerable groups are living in these urban areas (Ferrier&Haque, 2003).

In order to become less vulnerable as an urban area, resilience is needed. This is the level in which urban areas can recover after any type of disaster, based on individuals' capacities to deal with environmental changes (Smith et al, 2012). Municipalities thus need their citizens to be informed well about potential disasters, in order to become less vulnerable as a whole. That is why it is interesting to measure the level of informedness and thus perception of specific natural disasters, which is resilience.

A recent study (Conix et al, 2012) has shown that the area of Groningen (Figure 1) is extremely vulnerable towards climate change, due to the fact that it is in the category of the highest level of potential impact of climate change in Europe. This makes it even more interesting to measure the level of resilience and perception among citizens, as authorities need these citizens to become less vulnerable as a city (Aldrich, 2011).

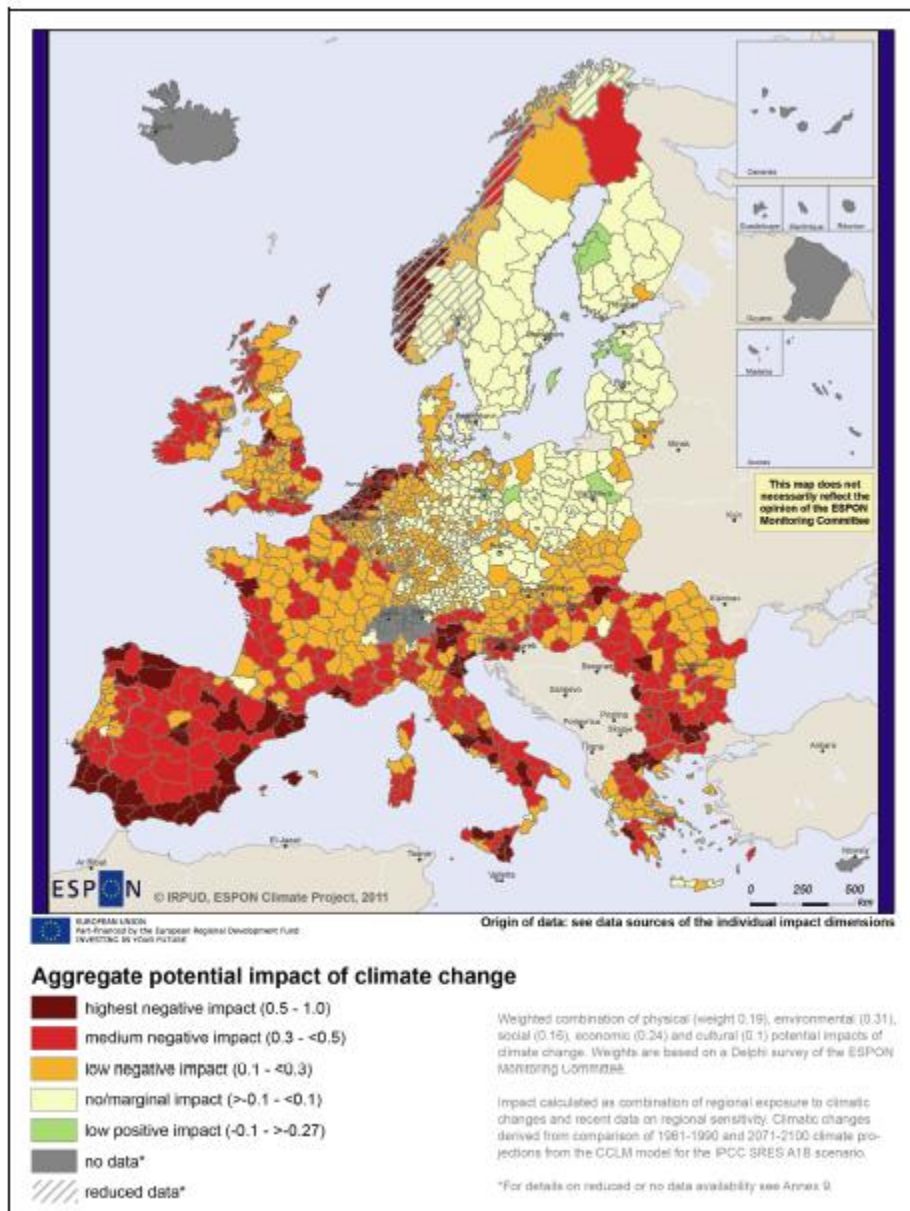


Figure 1: Potential impact of climate change in Europe. Groningen is having the highest level of negative impacts. Source: Greiving (2011).

This study focuses on the way citizens in the urban area of Groningen perceive the risks of climate change in their environment, and is measuring whether education level is having a correlation with this perception. Recent studies (Aldrich, 2011) have shown that people of lower socioeconomic class and with lower levels of education are more vulnerable to risks of climate change. That is why it is interesting to measure the perception on individual an educational level, especially for policy makers in these regions, because they need to implement policies and measures to adapt to climate change and become less vulnerable as a whole. Because without cooperation of their inhabitants, these policies and measures will be useless, if citizens are not informed well enough, and perceive these risks different than what policy makers desire.

2. Theoretical framework

2.1 Research question

The research question is: 'To what extent are the citizens of the urban area of Groningen prepared against the threats of floods, heat waves, extreme weather and earthquakes, based on the safety Region Groningen?' The sub questions of this research are:

- What are the difference in perceptions of climate change impacts among citizens of the urban area of Groningen, based on education level?
- How do citizens of the urban area of Groningen estimate the chances of the natural disasters flooding, heat waves, extreme weather and earthquakes
- How do citizens of the urban area of Groningen perceive themselves to be prepared against the natural disasters flooding, heat waves, extreme weather and earthquakes?
- What are the differences in the way citizens of the urban area of Groningen perceive certain threats and the way they are prepared, based on indicators of the safety region Groningen?

The aim of the study is to find out whether citizens of Groningen are well enough prepared and informed about and against certain risks in their living area. This is important, as the safety region Groningen is responsible for the preparedness of their citizens (Veiligheidsregio Groningen, 2014) against all types of threats. They thus need their citizens to be informed and adapted well, in order to become less vulnerable and more resilient. Perception plays a key role here, as citizens level of informedness is based on value judgements and information they get (Ferrier&Haque, 2003, Kellens et al, 2012). That is why this study is measuring in the individual level.

Resilience is a key term here, because urban areas need their citizens to be prepared well in order to become less vulnerable against certain threats. It is important that citizens are willing to be prepared (Restemeyer, 2012), and informed well against specific threats in their living area. Without these citizens being prepared well, a natural disaster will have more severe impacts, because most people do not know how to handle in such a case. Because a city cannot completely take away these threats, these preparedness and thus resilience is important. With higher levels of informedness, willingness and thus resilience, impacts of a natural disaster will be less severe.

There will be a focus on policies and measures of climate change adaption, instead of mitigation. Mitigation involves measures to reduce the effect of human activities on climate change (Brooks, 2013), like reducing CO² emissions. Adaptation, in contrast, are policies and measures to sustainably live in a (climate) changing world (Brooks, 2013).

This research will focus on adaptation, as it is important for governments in urban areas that their citizens are able to be flexible and adapt to (risks of) climate change, as informedness is linked with resilience, as mentioned in the introduction. Municipalities can help citizens in the context of mitigation, but simply cannot tell their citizens when a flooding or heat wave exactly will come. Therefore it is important to focus on adaptation, and measure the way these citizens perceive this (potential) risks. As perception is based on knowledge of an individual, knowledge will also be measured when perception is measured. And as knowledge is important for adaptive capacities, perception of risks of climate change and specific threats in the urban area of Groningen is an indicator for this knowledge.

2.2 Concepts

An important concept, as mentioned earlier, is resilience. Resilient citizens are able to be flexible to adapt to changes in environmental (so also climate change) conditions, and they are prepared for change and uncertainty (Smith et al, 2012). However, there is a link with informedness, as these citizens need to be informed out of somewhere about possible changes and how to adapt to that. Once again, this proves that knowledge and perception are important indicators. Resilience can also be measured in terms of reacting on a disaster: The faster the situation is back to pre-disaster, the higher the resilience is (Norris et al, 2008). So a higher level of resilience means a lower level of vulnerability in a community.

Resilient citizens are thus essential for society, as in the field of climate change (adaptation) there are a lot of uncertainties (Hughes et al, 2005 in Smith et al, 2012). This is also why it is important for local authorities and government to have a high level of resilient citizens and thus citizens who are ready for climate change adaptation.

Another important concept here is 'Risk perception'. This is the perception of an individual on a certain threat, in this case: flooding, extreme weather, heat waves and earthquakes, and is based on emotional reaction and on value judgements of the individual (Ferrier & Haque, 2003). This is opposite of 'objective risks', which is knowledge and information about a certain threat, based on scientific knowledge and data (Ferrier & Haque, 2003). So, people might perceive risks of certain threats different than scientific data shows us. This makes it important for municipalities to try and match both perceived and objective risk, in order to become more resilient and thus better adapted for climate change. In this specific case, for example, inhabitants of Groningen should know about certain threats and risks in their daily environment, which the 'risicowijzer' is trying to tell them. But are they well adapted, according to these indicators of this risk information? Perception plays a role in this, that is why it is important to investigate this perceptions, and measure if both the objective and perceived risk are somehow matched in Groningen.

Then, climate change adaptation is the approach in which we 'might sustainably live in a climate-changed world through greater investment in technological advancements that permit us to adapt to the changing conditions' (Kahn 2010; Levitt and Dubner 2010 in Brooks, 2013, p 34). Adaptive capacities are the base of resilience (Norris et al, 2008), which means resilience is a configuration of these capacities, as well as ecological factors and resources like for example soil. So on the individual level, it means that an individual is well adapted if he or she is able to cope with disasters or incidents caused by climate change. This can be measures in the living spaces of the citizens, or on their houses, for example.

There is also a technological restraint to the ability to cope with risks of climate change, which can be seen as mitigation (Pahl-Wostl, 2007 in Tempels, 2013). In fact mitigation means a decrease in the chance of for example flooding, but it does not take this risk away, nor does it takes away the chance of extreme weather which models do not take into account (Tempels, 2013). Therefore there needs to be a focus on climate change adaptation, as a response to climate change itself, especially in urban areas as they will be more exposed to (risks of) climate change and thus the risks will be larger (Boezeman et al, 2014, Brooks, 2014).

2.3 Risks and vulnerable groups

For most people, identification of threats and risks comes from personal experience with a natural disaster (Ferrier & Haque, 2003). So in this case, people might perceive risks of earthquakes and heatwaves higher than floodings, as they have occurred more often in the recent history (RTV Noord, 2014). This does not mean, however, that there are no risks of flooding in Groningen. Just because they do not occur very often, people might forget about that specific threat. Still, to be resilient, municipalities must focus on adaptation to this threat, because people might perceive them lower. If so, authorities need to focus on the preparedness of their city and its inhabitants.

Furthermore, there are groups in communities of the city, which are more vulnerable to threats of climate change (figure 2). These especially include poor, elderly, women and minority groups (Aldrich, 2011). To be a resilient city, there needs to be a focus on these certain groups as well. Recent studies (Aldrich, 2011) have also shown that people of lower socioeconomic class have more difficulties in rebuilding their lifestyle after a disaster than higher socioeconomic class, and are thus more vulnerable. This makes it important for authorities to have all citizens adaptive for disasters. Next to the fact that lower adaptation leads to less resilience, it can also lead to more social pressure on community of the difference between these socioeconomic groups increases. Authorities should thus know where these groups are living or staying, to become less vulnerable. If in this research elderly people perceive risks low, authorities need to map these group in terms of living space, and make sure they are or become less vulnerable.

- | | |
|---|---|
| 1. Aged (particularly the frail) | 11. Large families |
| 2. Very Young | 12. Single Parent Families |
| 3. Disabled (mental and physical) | 13. Workers at Risk from Machinery |
| 4. Poor/people with limited resources to meet essential needs. | 14. Limited Psychosocial Coping |
| 5. Non English (Majority Language) Speakers | 15. People with Limited Financial Resources. |
| 6. Indigenous Peoples | 16. People with Inadequate Accommodation |
| 7. Socially Isolated | 17. People on Holiday |
| 8. Physically Isolated | 18. Foreign Tourists |
| 9. Seriously Ill | 19. People Living Close to Areas of Hazard |
| 10. People dependent upon technology based life support systems. | 20. People Already Affected by an Earlier Hazard |

Figure 2: Groups particular at risk (vulnerable) in case of a natural disaster. Source: Ferrier & Haque (2003)

2.3.1 Urban areas

As cities particularly need to be creative in coping with climate change, as their space is densely populated, they have more specific challenges and they are more vulnerable to climate change (Boezeman et al, 2014). This makes it more important for an urban municipality like Groningen to be resilient. In Groningen in particular, there is a kind of risk which is having nothing to do with climate change: earthquakes. They have been a 'hot topic' in local media for the last year, as the risks of earthquakes are increasing (RTV Noord, 2014). Because of this media attention, citizens are concerned about the risks of it, and might perceive these risks different than risks of climate change.

That is why this research will also measure the way citizens perceive this risks. If there is a difference, it might give insights and ideas for planners and local authorities to inform their citizens in a different way than. Moreover, these specific insights might give planners and local authorities help to reach their goals in making/keeping their regions sustainable to live in, as they need their inhabitants to get their policies implemented well (Moser et al, 2008).

2.4 Communities and social capital

So, it is important for local authorities to have (a high level of) public participation in climate change adaptation. It requires further explanation why this is important. As mentioned above, it is first of all important for local authorities to reach their goals in making regions sustainable to live in, as they will be accounted for these goals, but they are also responsible for a safe environment. Still, there must be more. At the moment, citizens and entrepreneurs are lacking knowledge about the risks of climate change (coalities klimaatbestendige stad, 2013). Furthermore, this coalition of citizens and entrepreneurs states that cooperation between different parties in society (government, local authorities, entrepreneurs and inhabitants) is crucial for successful measures for climate change adaptation. In addition, the knowledge and capital of especially entrepreneurs of the market is very useful (Koster, 2014), as it might not be present in local government.

Furthermore, the role of social capital in becoming less vulnerable is most of the time ignored by cities, while the focus is mainly on infrastructure (Aldrich, 2011). More community participation will lead to a higher level of resilience and thus a lower level of vulnerability (Aldrich, 2011). Up until now, most cities rather use a one way communication in risk and emergency management, while the individuals in the household play an important role as well in risk management (Murphy, 2007). This means there needs to be an effective way in sharing information and knowledge between the responsible authorities and the community about the specific disasters. After all, a higher level of social capital means more resilient communities, which has been proved in many different studies like Murphy (2007). Typically, higher levels of education means higher levels of strong social capital (Murphy, 2007).

Recent studies (Moser et al, 2008, Restemeyer, 2012, Wolf et al, 2010,) show that citizens with higher education levels are having more knowledge and interest about and in climate change. In addition, Goklany (2007) shows that higher educational levels have positive effects on adaptation capacities. Sherrieb et al (2010) conclude as well that people with higher education levels are having a higher amount of social capital, have got higher adaptive capacities and are thus more resilient.

These are reasons why it is interesting to measure whether citizens in Groningen with different educational background and socioeconomic status perceive risks different. If they do so, they might be helpful for local authorities, in order to become even more resilient. If not, the city of Groningen needs to focus more on information of natural disasters to change this perception. They need to be careful not to do this in a 'one way approach' as Murphy (2007) stresses, but rather use an integrated method to change the perceptions among the citizens on climate change and risk management.

2.5 Municipalities and citizens

Local staff of the city must thus have the tools to inform their citizens in a right way, as media and misconception play a large role in the public perception on certain threats (Ferrier & Haque, 2003). These local staff needs to communicate the information based on scientific research and data in a understandable way to their citizens, in order to become more resilient and influence the risk

perception. According to Ferrier and Haque (2003) this is hard for this staff, and this research will measure the perceptions of the citizens of Groningen on certain risks. It is important to know, like stated before, whether the current strategy works out.

As mentioned in Moser et al (2007), public participation in climate change adaptation is important to increase knowledge of it among citizens and will thus help in getting measures implemented well. However, there has never been done research on the way citizens in the urban area of Groningen perceive the risks of climate change, and thus also their level of knowledge on this topic of climate change. This is important to know for local government, so they will be able to know what actions need to be undertaken.

So, for an urban area like Groningen, a lot of individual adaptive capacities are required before situations are likely to change. Local authorities thus need to protect their inhabitants with policies and measures for adaptation, as not all individuals' adaptation capacities are high enough. It might also lead to the need of informing citizens more to increase these capacities (Moser et al, 2008), which will also have the effect that urban areas are having more resilience and adaptation for climate change. That is why it is interesting to measure the extent to which these citizens of Groningen perceive risk, and thus measure in what way they are resilient and adaptive to climate change.

An example of improving skills for adaptation is the so called 'Risicowijzer' in Groningen, which informs citizens about potential risks and tries to tell them how to be prepared for these risks. The authority for safety of the Groningen area is responsible for this. It encourages inhabitants, for example, to be ensured of an emergency packet which contains essential attributes like lighters, batteries and a radio.



Figure 3: A part of the 'Risicowijzer'. Source: Veiligheidsregio Groningen.

Figure 3 is showing a part of the 'risicowijzer', which informs and advises citizens about certain types of risks in the Groningen-area. This research is focusing on risks in relation to climate change, as well as earthquakes, but the authority is as well giving advice on for example gas explosions, riots and diseases. This leaflet was sent to all citizens in the Groningen area by post, so in practice all citizens can be aware of it. This proves that local governments clearly want to have their citizens adapted to climate change

and become more resilient and less vulnerable. But are citizens themselves ready for this, how do they perceive these risks and are they even aware of the 'Risicowijzer'?

2.6 Expectations

Differences are expected to be found in the way the citizens of Groningen will perceive risks of climate change based on their education level, as the Restemeyer (2012) showed in a study. This study showed empirical evidence in the way citizens of the Lower Saxony area perceive risks of climate change. Citizens with different type of labour, educational level, gender and age were perceiving these risk different. This leads to the expectation that similar outcomes will be found in Groningen, as both areas are sharing the same (Saxon) culture. The research was done in the Lower Saxony region, which Oldenburg and Bremen (though it is a different federal state) are part of, and are near the Groningen area. It will not give full guarantee, but citizens of both the Groningen and Lower Saxony area are considered to be quite the same in terms of culture, identity and composition of the population.

As Restemeyer (2012) found that citizens with lower levels of education and lower social class perceived risks lower than citizens of higher levels of education and higher social class, it leads to the expectation that citizens with higher education levels perceive risks of climate change differently than citizens with lower education levels. In contrast, however, Jones et al (2012) conclude that inhabitants in the city of Heraklion (Greece) with lower education levels, perceive risks of climate change higher than those with higher education levels.

It is therefore difficult to estimate the differences of perceptions of climate change and its threats among citizens of the urban area of Groningen, as well as their level of preparedness and informedness, based on education level. It is expected to find differences in the estimation of certain risks, based on the Risk perception theory by Ferrier&Haque (2003).

Cities are especially important in climate change adaptation, as they are in greater danger of climate change, as they are more densely populated and climate differs from their rural periphery, there are more challenges to overcome (Moser et al, 2008). That is why it is interesting to measure how citizens from urban areas (in this case the urban area of Groningen) perceive these risks, as consequences in case of a natural disaster, flooding for example, can be more more severe for urban areas than rural areas, due to population density.

3. Methodology

3.1.1 Data collection instrument

To measure how citizens of Groningen perceive (potential) risks of climate change, there is a method needed to gain information about the citizens' attitudes, informedness and perception towards and about the topic. As questionnaires are a research method 'for gathering information about the characteristics, behaviours and/or attitudes of a population' and 'in geography, questionnaire surveys have been used to explore people's perceptions, attitudes, experiences, behaviours and spatial interactions in diverse geographical contexts' (McLafferty, 2010, p. 77), this is the most appropriate method for data collection. Furthermore, according to McLafferty (2010) surveys are particularly useful for gathering information about people's attitudes and opinions on different social and environmental topics (McLafferty, 2010). This makes a questionnaire survey a suitable method, as this research is focused on individuals. Finally, it is also useful to gather information about these attitudes and

perceptions which are not available yet from other sources (McLafferty, 20120). So in this case, a questionnaire will be very useful, as there is not yet another published resource about the attitudes and perceptions of citizens of Groningen towards climate change.

3.1.2 Survey questions

With questions on an ordinal scale, this research measures citizens' attitudes towards potential risks of climate change which are most likely to happen in the Groningen area based on the 'risicowijzer': Flooding, heat waves, extreme weather and earthquakes. The 'risicowijzer' is an instrument that the safety region Groningen is using to inform her citizens about certain threats in the area, how they can respond to it, and how they can prepare for these threats as well. It is available on her website, and has been issued door to door to all citizens in the urban area of Groningen (Veiligheidsregio Groningen, 2014).

Questions on the topic relate to preparedness and perception, in the light of risk perception. The questionnaire will start with general questions about gender, age and zip code. On this way, you might find a spatial differentiation in perceptions, or a difference based on gender or age. In addition, the respondents (highest) education level was asked, in order to answer the research question. Next, there are questions about whether the respondent thinks of himself to be ready to deal with climate change (adaptive capacities based on perception), and if he or she is prepared for risks in the Groningen area in general.

The next questions will zoom in on the perception of the specific risks in the Groningen area: Flooding, heat waves, extreme weather and earthquakes. Respondents are asked how they estimate the chance of such a natural disaster to occur, based on an ordinal scale from 'very small' through 'very large'. The respondents were also asked if they think climate change is having influence on these disasters to happen or not.

The questionnaire then has questions whether the respondents think they are prepared for the specific natural disasters if they occur. The answers are once again on an ordinal scale, from 'not at all prepared' through 'very well prepared'. Respondents were asked to specify or motivate their answers. Finally, respondents were asked if they have taken certain, specific measures to be more resilient for natural disasters. These indicators were based on the authority for safety in the Groningen area. This authority set up a list which every person should have in their house, or certain measures the citizens should have taken, such as a 'noodpakket' (special emergency packet items like a radio on batteries, fresh water a flash light), or if they have made up a list with items they need to take out of their house in case of an evacuation due to an emergency. These indicators were simply answered with 'yes' or 'no', which makes it easy to check whether the everyday life of citizens meets the desires of the authorities. The complete questionnaire is attached in appendix C.

3.1.3 Level of measurement

The data will be collected at the individual level. As mentioned earlier in this article, resilient citizens and individuals with adaptive capacities to climate change are essential for local communities and authorities. So, these local authorities need individual citizens to reach their goals and policies concerning climate change adaptation and resilience. Moreover, as climate change is having a lot of uncertainties, society needs flexible individuals, as a lower chance of flooding, for example, still does not tell us when there will be a flooding and what its impact will be. That is why it is important to study and

measure these capacities and perceptions on an individual level, so governments and local authorities can learn from it and understand the knowledge of their inhabitants on climate change. At the same time, it can help these authorities to reshape their policy to reach their citizens effectively, if their advices are not followed up in praxis.

3.2.1 Population and sampling method

The population of this research is living in the urban area of Groningen, as the field of research is the urban area of Groningen. This area is within the boundaries of the safety region Groningen (veiligheidsregio Groningen, 2014), where the indicators in the questionnaire are derived of. Respondents were surveyed on the street near shopping centres and supermarkets, to get a random selection of citizens. The questionnaires were conducted on different days and times, which should decrease the level of bias in it.

As the respondents were asked to fill in the questionnaire, some thought the student and researcher was a salesmen and walked on, while some others were not interested in joining. Overall there were 38 respondents, collected over three days during morning, noon and afternoon. In total, some 50 people were asked to join the research, which means the response rate is about 75 up to 80% in this case.

As it is not possible to select potential respondents based on their education level, due to privacy, there is no scientific generalization to make. That is why the population of the sample has been selected by convenience sampling. Due to the fact that the respondents were found near shopping centres and outside supermarkets, they are random, but nevertheless just selected by convenience because they were there. This does not mean that every person or group of society is in the sample, which might mean there is a bias in the sample. The outcomes, however, might still be useful as a pilot study on the topic, as there is no data available yet on the perception on risks and climate change in the urban area of Groningen. This can help authorities to further investigate their goals and methods, if this study shows that the safety instructions are not well known, for example. Future research can be done based on this pilot study, in order to deepen or check the outcomes.

3.2.2 Distribution of respondents

Figure 4 shows a map of the research area, in which the concentration of the respondents is shown, based on their zip code. The map is clearly showing a concentration of respondents in the West and Northwest parts of the city. This is due to the fact that the surveys were conducted in these areas, at shopping centre 'Vinkhuizen', 'Paddepoel' as well as supermarkets 'Spar Kramer' and 'Jumbo Wilhelminakade'. This means the research is limited to citizens mainly living in these areas. However, the surveys were conducted at the exits of different supermarkets which are having different target groups (Jumbo, Albert Heijn, Spar, Aldi and Lidl), in order to get a mixed composition of respondents. Still, this limitation means that during a larger or different research on the topic, different outcomes can be expected. In this case, there were more respondents with higher education level (College or higher) than there were of lower education levels: 27 over 11.

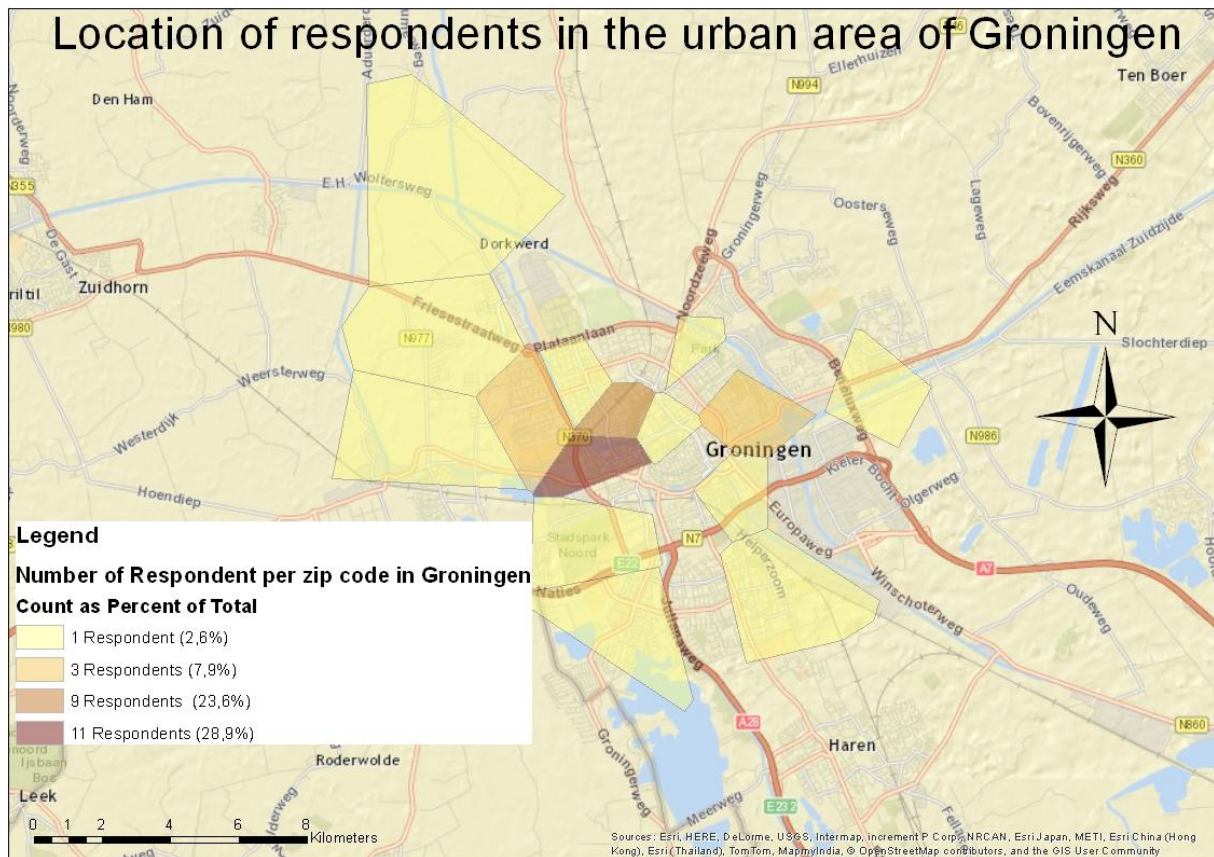


Figure 4: Map of the locations of the respondents, based on their zip-code. Source: ESRI, own data.

3.3 Statistical analysis

The data has been analysed in SPSS for Windows. Several tests were made to check if there are correlations between education level and the risk perception of respondents, as well as correlations between education level and the level of preparedness for certain risks. The data has also been used to check if there are correlations between the risk perception and level of preparedness of the same natural disasters, as well as on the indicators of preparedness of these natural disasters. The correlation checks were done by the Spearman's rho test, and Kendall's Tau B, as both are non-parametric tests, and the data is ordinal and nominal, which makes these tests suitable (McLafferty, 2010).

In addition, chi-square tests were made to measure differences and correlations between education level, risk perception on specific natural disasters and the preparedness for these natural disasters, as well as on the indicators on preparedness. The crosstabs which come out of this method of data-analysis as well, can show a certain view of the differences in perception of the topics. These differences will be illustrated by graphs.

The zero-hypothesis is: 'in the population, there is no correlation between education level and the estimation of natural disasters to occur'. In other cases, the zero-hypothesis is: 'In the population, there is no correlation between the estimation of a natural disaster to occur, and the level of preparedness'. Finally, the zero-hypothesis of the indicators is: 'in the population, there is no difference between the level of preparedness, and the indicators.'

3.4 Ethics

All respondents were clearly instructed and informed about the research and the questionnaire, before they answered the questions. The contents and type of questions were explained, the time it will approximately take to fill in the questions was told, and the respondents were told they could stop at any moment, if they like. The respondents were as well told that their answers will be used anonymously, and they can have access to the outcomes whenever they like. This meant that some respondents left their e-mail address on the questionnaire to be informed.

4. Data analysis

4.1 General outcomes

First of all, there has been made a recode of the variables for the data-analysis, based on education level. As there were four categories (High school, craft school, college, university and higher), the data-analysis showed no significant differences or correlations between education level and the estimation of a threat, and between education level and the perceived preparedness against the same threats. However, it gave a lot of large tables and graphs as well. There has been made a distinction between 'lower education level', that is: high school and craft school, and 'higher education level', that is: college and higher. The same has been done in other studies (Goklany, 2007, Moser et al, 2008, Restemeyer, 2012, Sherrieb et al, 2010, Wolf et al, 2010) on this topic. On this way, it makes more sense to compare the outcomes with other studies, and makes the data easier to analyse within graphs and crosstabs as well.

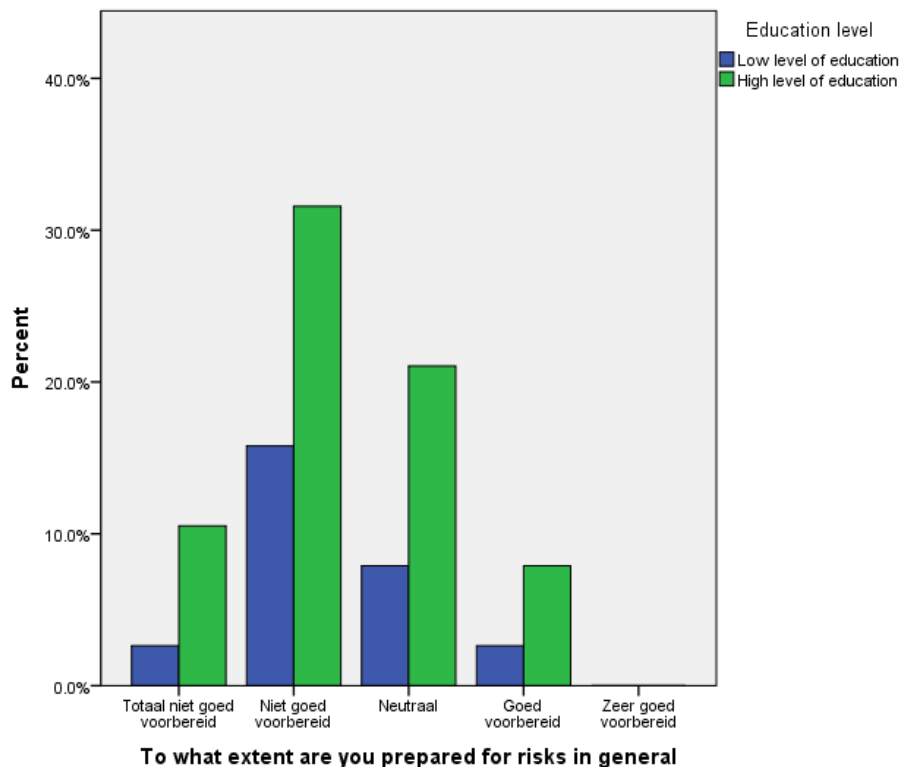


Figure 5: The extent citizens of Groningen think to be prepared for risks in general.

The first questions of the survey asked the respondents some general questions about climate change and preparation in general. These outcomes are made visible in figures 5, 6 and 7. What is remarkable, is that no more than 15% of all the respondents consider themselves well prepared for risks in general (figure 6). In the graphs, both low and high education level make up 100%, which means that the lower education levels have lower percentages in these graphs, as they only account for 11 out of 38 respondents in total. This means that the bars accounting for lower education levels seem less in the charts.

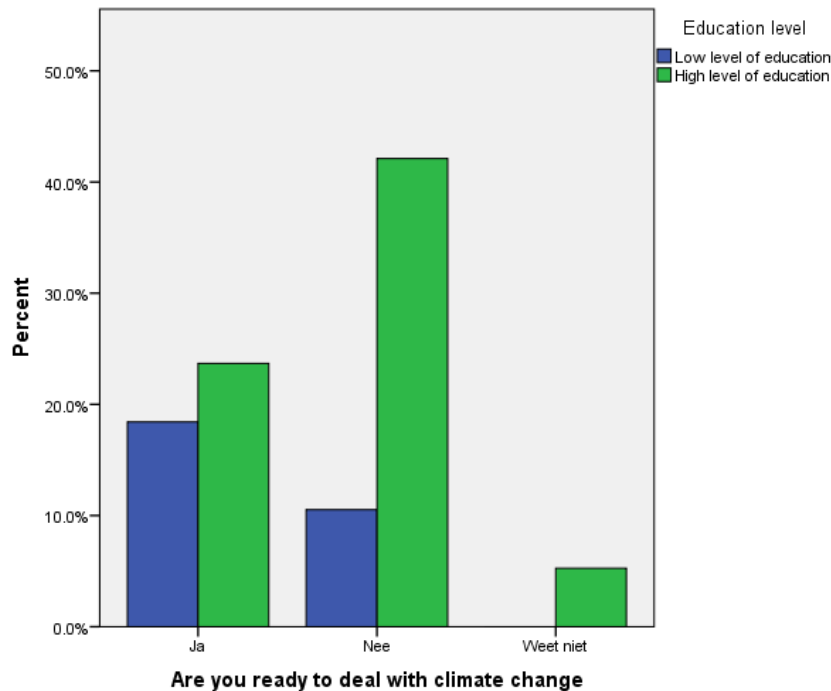


Figure 6: Do citizens of Groningen feel ready to deal with climate change?

Another remarkable observation, is that less than half of the respondents consider themselves 'ready to deal with climate change' (figure 7), whereas more than half of all respondents considers themselves to be aware of potential risks in Groningen (figure 8). So, on first hand, citizens of Groningen consider themselves to be aware of risks in their environment, but do not feel well prepared against these risks. This is an observation which we will continue to see in this research.

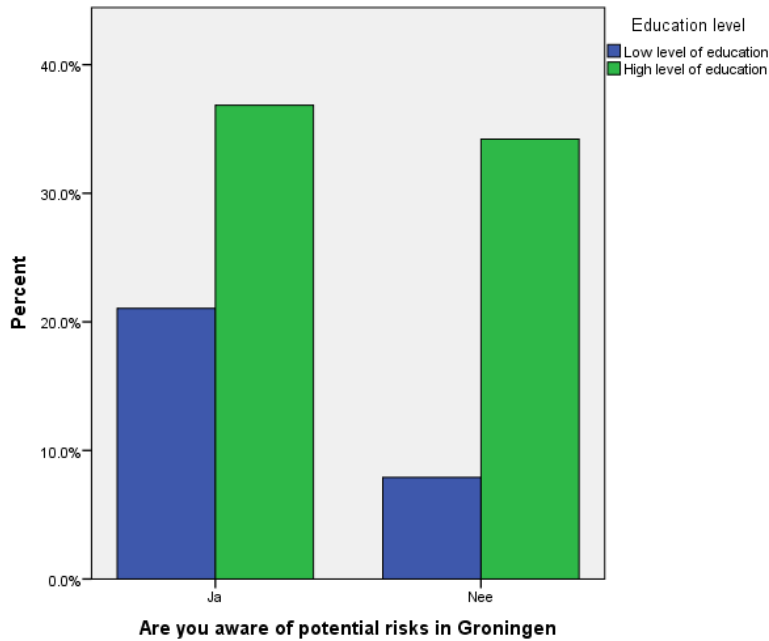


Figure 7: Do citizens of Groningen consider themselves to be aware of potential risks in Groningen?

4.2.1 Significance

Based on the data, there is no significant proof of difference or a correlation between education level and risk perception, in this sample. This means the zero-hypothesis is not rejected, which was: 'In the population, there is no correlation between the estimation of a natural disaster to occur, and the level of preparedness'. Educational level is thus, at least in this sample of the population, not a major factor in the way citizens of the urban area of Groningen perceive risk on climate change. Nor are the indicators based on the authority for safety of Groningen significantly different answered by the different educational levels.

The correlation coefficient is in most cases over and under zero until 0.2, which means there is no or a small correlation between the variables. All the statistic tests are in appendix A, where figure 8 is giving an example of the correlation test between education level and flooding.

		Education level	How do you estimate the chance of a flooding	To what extent are you prepared for potential floodings
Kendal's tau-b	Correlation Coefficient	1.000	-.151	.058
	Sig. (2-tailed)	.	.318	.703
Education level	N	38	38	38
	Correlation Coefficient	1.000	-.164	.063
Spearman's rho	Sig. (2-tailed)	.	.324	.708
	N	38	38	38

Figure 8: Correlation coefficient between education level and the risk perception and preparedness among citizens of Groningen.

When the risk perception on specific natural disasters was measured with the preparedness of citizens for these specific disasters, one significant outcome was found: flooding. All the other natural disasters, extreme weather, heat waves and earthquakes, were not significant. The null-hypothesis of flooding ('there is no correlation between the perception on the chance of a flooding and the level of preparedness for flooding') was rejected, so a difference has been proven, and is visible in figure 9. All other test are to be found in appendix A and B.

			To what extent are you prepared for potential floodings
Kendall's tau_b	How do you estimate the chance of a flooding	Correlation Coefficient	.376**
		Sig. (2-tailed)	.008
		N	38
Spearman's rho	How do you estimate the chance of a flooding	Correlation Coefficient	.442**
		Sig. (2-tailed)	.005
		N	38

Figure 9: Correlation coefficient between estimation of the chance of a flooding (risk perception), and preparedness among citizens of Groningen.

This has, however, no relation with education level, but it does mean that people are significantly differently prepared for flooding than they perceive the chance of flooding. In this case, it means that citizens think themselves to be better or less prepared than they estimate the chance of a flooding. In all other cases, there is no significant difference between risk perception and preparedness. This means there is no significant evidence that if citizens estimate the chance of a natural disaster high, they think themselves to be well prepared at the same time. So, if awareness on a certain threat is raised, this does not directly mean citizens perceive themselves to be prepared well.

4.2.2 Indicators for preparedness

In their risk manager, the safety region Groningen advises their citizens to take certain measures to be less vulnerable, on an individual basis, against a number of threats which may occur in the Groningen area (veiligheidsregio Groningen, 2014). In this research, advice of the safety region Groningen on the threats flooding, extreme weather, heat waves and earthquakes were used in the questionnaire. Respondents were asked if they had this indicator, or not. The indicators are:

- Do you have an 'Emergency package'?
- Does your cell phone support 'NL-alert'?
- Are you familiar with the risk manager of the safety region Groningen?
- If yes: Are you familiar with the risks of flooding, heat waves, extreme weather and earthquakes, which are stated in the risk manager?
- Do you regularly check weather warnings by the KNMI (Royal Dutch Meteorological Institute)
- Do you always have an extra jacket, blanket and bottle of fresh water in your car?
- Do you have sufficient fresh water and cooling possibilities in your house during summerperiod?
- Do you know if your house and surrounding is sensible for flooding?

- Do you have a location to go if you need to leave your house, if you need to evacuate it due to a flood?
- Do you have a list with stuff you want to take with you if you need to leave your house due to a flood?
- Do you have valuable items (like wardrobes or clocks) well attached to your wall so they cannot fall during an earthquake?
- Do you regularly check if you hanging objects in your house are still attached well?
- Do you regularly check if roof tiles and roof gutters are still attached well to your house?

With these indicators, it can be measured if respondents are in fact well prepared against the specific threats in the urban area of Groningen. This makes it possible to combine risk perception with reality. If citizens are not well prepared according to these indicators, links can be made with their estimation and perception of preparedness. This makes it easier for the safety region to find out how their citizens can be better informed.

			Do you have a list with stuff you want to take if you need to leave your house		Total
			Ja	Nee	
To what extent are you prepared for potential flooding	Totaal niet goed voorbereid	Count	1	7	8
		% within To what extent are you prepared for potential floodings	12.5%	87.5%	100.0%
	Niet goed voorbereid	Count	4	15	19
		% within To what extent are you prepared for potential floodings	21.1%	78.9%	100.0%
	Neutraal	Count	0	7	7
		% within To what extent are you prepared for potential floodings	0.0%	100.0%	100.0%
	Goed voorbereid	Count	1	2	3
	% within To what extent are you prepared for potential floodings	33.3%	66.7%	100.0%	
	Zeer goed voorbereid	Count	0	1	1
	% within To what extent are you prepared for potential floodings	0.0%	100.0%	100.0%	
Total	Count	6	32	38	
	% of Total	15.8%	84.2%	100.0%	

Figure 10: The extent respondents think to be prepared for potential flooding, measured against if they have a list with stuff they want to bring if they need to leave their house.

An example how to measure one of these indicators, is figure 10. In this figure, on the left side it is visible how the respondents estimate the chance of a flooding. On the top side, it is made visible of the same respondents do or do not have made up a list with stuff they want to take with them, if they need

to leave their house, which is one of the indicators. It is clear that the majority of the respondents who do not think themselves to be prepared well, do not have this list.

The indicators for preparedness, based on the safety region Groningen, do show significant outcomes in some cases. This means that there is a difference in the way citizens of Groningen think to be prepared, and the way they are prepared, according to the indicators. The level of significance does, however, not tell us whether citizens are better or less prepared than they think they are, only that there is proven difference between the perception on preparedness, and the way the respondents are expected to be prepared. This can be explained by the statistical method used, the chi-square test.

The first significant difference was found in the extent citizens think to be prepared against heat waves, and whether they have enough cooling possibilities and fresh water in their house. The significant level was 0,01, and is mainly caused by the fact that all the people who think to be well prepared, answered 'yes' for this specific indicator, as well as more than 30% of the respondents who think to be 'not well prepared', answered 'yes' as well (figure 11). This means that there is a significant difference in the expected number of respondents to be well prepared based on this indicator, and the counted number of respondents. This is due to the statistical method used (McLafferty, 2010).

			Do you have sufficient water and cooling possibilities in your house during summer period		Total
			Ja	Nee	
To what extent are you prepared for potential heatwaves Total	Totaal niet goed voorbereid	Count	0	1	1
	Niet goed voorbereid	Count	5	9	14
	Neutraal	Count	9	2	11
	Goed voorbereid	Count	12	0	12
		Count	26	12	38

Figure 11: The extent respondents think to be prepared against potential heat waves, measured against if they have sufficient water and cooling possibilities during summer period.

The same is the case for the extent citizens think to be prepared against potential heat waves, measured against whether respondents check the weather warnings of the Dutch Royal Weather forecast institute. Again, this is mainly due to the fact that significantly more respondents do check this warning, while they think not to be well prepared, and the other way around. Again, this does not have a lot to do with education level, but does show that perception of respondents differs from indicators.

Other remarkable observations in the indicators are that a lot of respondents do not have an emergency package, the majority is not familiar with the risk manager of the authority for safety Groningen, they do not have an extra blanket and bottle of water in their car, they do not have a list of stuff they want to take with them if they need to leave their house, and almost none of the respondents is checking sensitive spots in and around their house for earthquakes, like wardrobes and roof gutters. Most of the respondents do not have NL-alert on their smartphone, and do not know if their house is sensitive for flooding. In contrast, however, a lot of respondents in the sample are familiar with the weather warnings, and have sufficient cooling possibilities and water during summer, and do have a place to go in case they need to evacuate their house. This explains the significance level, as these specific indicators are answered better than was expected (due to the statistical method) by the respondents,

who think they were not so well prepared. Based on these indicators, they are thus prepared. Other differences in perceived preparedness and corresponding indicators are not significant and thus not proven, but can still differ, of course.

4.3 Non-significant differences

So, there are some significant differences visible in the way the respondents perceive certain risks, and in the way they consider themselves to be prepared against these specific natural disasters. There are non-significant difference visible as well, which are still remarkable, as they show a trend which is . For example, figure 12 shows the extent citizens think themselves to be prepared for flooding, based on education level. The trend is for both groups the same, though respondents with higher level of education tend to think themselves a little bit less prepared in this case. What is remarkable as well, is that the majority of both groups based on education level consider themselves less prepared than average, In this graphs, both bars for low and high level of education sum up to 100%. As there are less respondents with low education level, these bars are smaller than those of high education level, as mentioned earlier. In the case of flooding, the trend is about the same.

Figure 13 shows the extent the respondents estimate the change of flooding, based on education level. What is remarkable here, is that in both education level groups the majority estimates the chance of a flooding low, that is: less than average. This was expected, based on the theory of risk perception by Ferrier & Haque (2003). On the same time, respondents of higher education levels estimate the chance of flooding a bit higher than respondents of lower education levels. It is remarking that the respondents of the higher education levels perceive the chance of a flooding higher, which is corresponding with the findings of Restemeyer (2012), but on the same time perceive themselves less prepared than lower education levels.

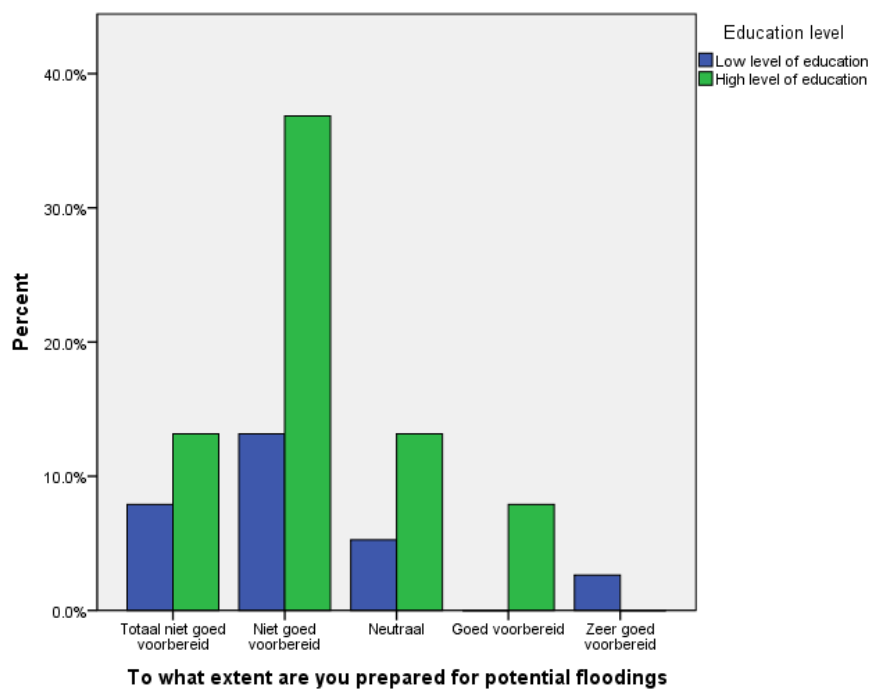


Figure 12: The extent citizens of Groningen think to be prepared for flooding.

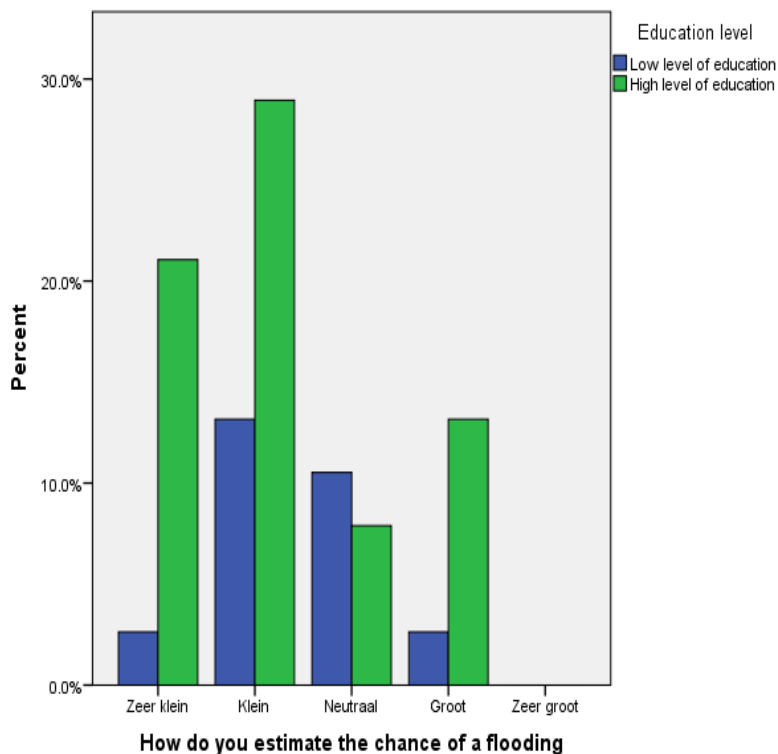


Figure 13: The way citizens of Groningen estimate the chance of a flooding.

A lot of respondents said, when motivating their answers, ‘that flooding does not occur in the Groningen area’, ‘as we have good dikes, and there are no waterways in Groningen in which the water will rise high enough to threaten the city.’ As well as ‘you cannot do so much about it, it just happens’. This is remarkable, as there are two major waterways (van Starckenborghcanal and the Reitdiep) which can rise high in case of a lot of rain and certain circumstances in which they cannot empty in the Waddensea (veiligheidsregio Groningen, 2014). However, a serious flooding has not been the case for at least 10 years in the urban area of Groningen (RTV Noord, 2014), which might explain why the respondents perceive the risk of flooding quite low.

It is alarming though, that the respondents think that flooding does not occur anymore, and there is ‘not so much to do about’. This means citizens perceive risks lower than the safety region wants, but on the same time the same respondents think there are no measures which can be taken. In this case, there is a lot of work to do for the safety region Groningen, because informedness is a key factor for more resilience and a less vulnerable area.

Furthermore, recent studies (Alterra Wageningen UR, 2012) show that the intensity of precipitation has been increased in the last decade, and is expected to keep on increasing. Another extra 30% of increase in precipitation is expected by 2050. This means the risk of flooding in Groningen will increase, which makes it an important issue in vulnerability, and makes it more clear that citizens need to be better prepared and informed against flooding.

In addition, Kellens et al (2012) have shown that the seeking for information of people concerning flooding is not mainly caused by experience of a flood, but is mainly determined if citizens are living longer and permanently in the area. Younger citizens who are not living in the same area for a long time, are not seeking information about the risks of flooding so much (Kellens et al, 2012). This means it will be even harder to inform all citizens about flooding and thus be more resilient as an urban area, as even

the occurring of a flood might not even help to reach all citizens. There must thus be found a strategy to reach and inform all citizens about the local risks. Otherwise, the urban area of Groningen will not be resilient and thus less vulnerable against flooding.

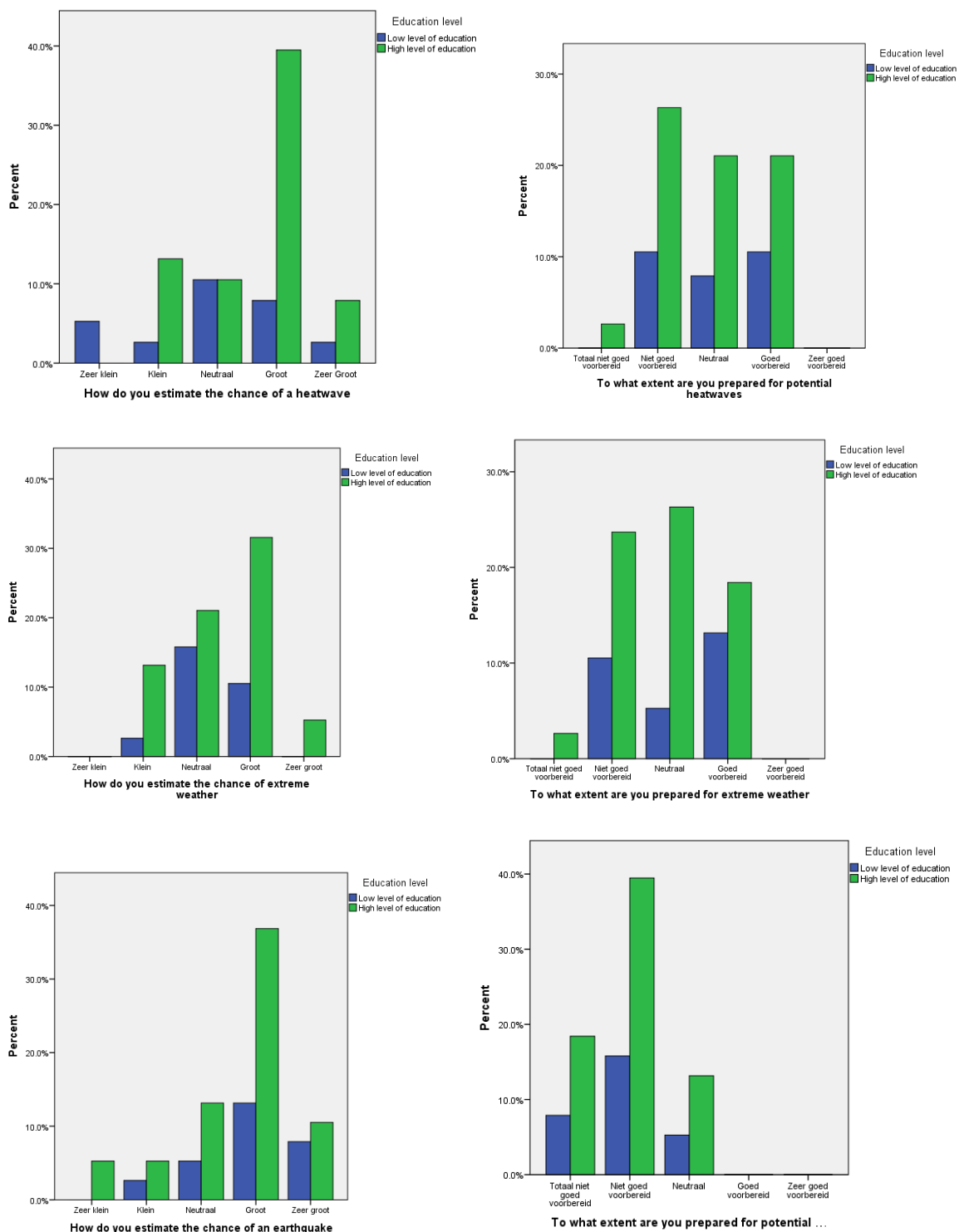


Figure 14: The estimations and extent of preparedness of citizens of Groningen for heat waves, extreme weather and earthquakes.

In figure 14, the same research and analysis has been done as in figures 12 and 13. This means that the estimation and preparedness against certain threats are measured, based on education level. This time, the natural disaster is not flooding, but heat waves, extreme weather and earthquakes. As stated

before, there are no significant differences based on education level. However, there are differences visible in the way respondents perceive themselves to be prepared and estimate the chance of threats mentioned above. These can be found mainly in extreme weather and heat waves, whereas flooding and earthquakes are about the same perceived. These differences are not so large, and thus not significant, but there are some differences, based on education level. Higher educated citizens tend to perceive the chance of these natural disasters a bit higher than lower educated citizens. This is comparable with the outcomes of Goklany (2007), Moser et al (2008), Restemeyer (2012), Sherrieb et al (2010), Wolf et al (2010).

Citizens do estimate the chance of heat waves, extreme weather and earthquakes higher than flooding, probably because they occur more often. This is comparable with the theory of risk perception of Ferrier & Haque (2003), citizens perceive risks on value judgement, and if certain events or disasters happen more often, people perceive these risks higher. However, based on the data of this research, it does not directly mean that they are better prepared.

At the same time, the respondents gave different answers in the way they think to be prepared. For flooding, there is not so much of a difference in estimation and preparedness against the natural disasters between education levels. The majority of the respondents think they are not well prepared against flooding. The explanation was mentioned above, citizens think they are quite safe. For heat waves and earthquakes, the level of perceived preparedness is about the same for both education levels, whereas it is remarkable that respondents think they are not well prepared (at all) for earthquakes.

When asked why the respondents perceive themselves to be prepared against earthquakes, respondents answered that 'there is nothing to do about, it just happens', and asked the researcher what they could do about it. So in this case, many citizens estimate the chance quite high, which can be explained by the fact that it is a hot topic in the area (RTV Noord, 2014), and earthquakes happen quite often. This, once again, is comparable with the theory of Ferrier & Haque (2003). Indicators have shown that almost no one is taking possible measures to be prepared against the consequences of earthquakes, like attaching valuable objects more strongly against the wall, or check regularly if roof gutters are still attached well against the house. So, citizens think they cannot do anything about the outcomes of earthquakes, there still are options and measures they can take, but they are simply not aware of them.

For extreme weather, there are differences in respondents' perceptions about the level of preparedness, based on education level. Lower educated citizens consider themselves to be a little bit better prepared than citizens with higher levels of education. Respondents motivated their answers with the fact that 'the outcomes are not really dangerous', and 'there is not so much to do against'. The indicators have shown a mixed result as well.

For heat waves, respondents told, in their motivation, that 'you cannot do so much about it, it just happens'. In other words: they think there are simply no sophisticated measures to be taken. Indicators have shown that a lot of respondents are well prepared in terms of the safety authority. A lot of respondents did have sufficient options for cooling during the summer, and enough fresh water in their house. This is the case for almost all the respondents, and there is no significant difference based on age.

4.4 Perception and indicators

As mentioned earlier in this thesis, no significant differences were found based on educational level and the indicators. However, there are some differences in the way respondents answered these questions, which are visible in figures 16, 17 and 18.

There is a mixed result visible. For some indicators, the majority of the respondents answered positive, that is: yes, while for others they answered negative, that is: no. As the safety region tries to inform all citizens to take measures, it is remarkable that there are a lot of respondents that do not meet all required indicators. Concerning the 'NL-alert' system, the majority of the respondents is having a cell phone which is supporting it. The NL-alert system is a system where all cell phones near an incident or disaster automatically receive a text message with instructions how to act in case of this emergency. The authority for safety in Groningen strongly advises all citizens to have a cell phone which is suitable for this system (veiligheidsregio Groningen, 2014). In this case, more respondents with a high level of education did have a cell phone which is supporting the NL-alert system, which can be explained by the fact that a Smartphone is needed to support this NL-alert system. This is more expensive than a regular phone, that might be a reason why respondents with higher levels of education are having one.

On the same time, most elderly respondents did not have a cell phone which supports the NL-Alert system, which can be seen in figure 15. This figure makes clear that most younger respondents do have a cell phone which supports the system, while most elderly people do not have such a cell phone. This makes the elderly more vulnerable against certain threats, as they cannot get instant information and advice about a disaster which has just occurred or might occur very soon.

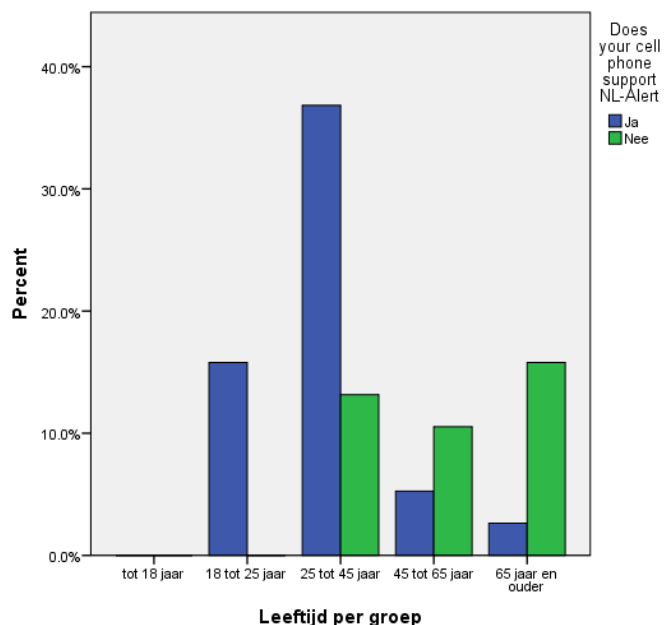


Figure 15: The percentage of respondents who are having a cell phone which supports 'NL-Alert' system, based on their age.

For the indicators concerning the weather warnings of the royal meteorological institute, sufficient cooling possibilities and water during summer period, and a place to go if the respondents need to leave their house in case of an evacuation, the majority of the respondents had a positive answer to the question. For all other indicators (list with stuff to take, knowledge on flood sensibility of the house), the

majority of the respondents answered negative to the question, so the majority is not well prepared on these indicators. This was also visible in the answers of the respondents, as they thought themselves best prepared against heat waves. The indicators for weather warnings and cooling possibilities during summer correlate to this threat. This is corresponding with the risk perception theory of Ferrier & Haque (2003), as these events happen more often and thus influence the perception of citizens. For a location to go in case of an evacuation, respondents told they had family or friends to rely on. This indicator correlates with all of the threats.

Concerning the other indicators by the safety region (emergency package, familiar with the risk manager, extra blanket, jacket and fresh water in the car, and the indicators for earthquakes), which correlate with all other threats, respondents are not well prepared. This is an alarming result, as the authority for safety Groningen wants and strongly advises all citizens to follow their instructions which are stated in the risk manager, take measures and thus be prepared well. The authority thus needs to find a way to do convince citizens to take these measures. It is most striking that most citizens do not have an emergency package and are not familiar with the risk manager of the authority, which was issued to all citizens.

When zoomed in on education level in these indicators, it is remarkable that respondents with higher levels of education are less prepared than lower educated people, based on these indicators. This is remarkable, because they tend to estimate the chance of the specific threats higher than lower educated people. Clearly, perception (the level respondents think to be prepared) is not corresponding with reality, that is preparedness, in this case. Once again, differences in education level is not significant, but lower educated people tend to be a little better prepared, when zooming in to these indicators. This can be seen in figure 16. All the figures on education level and indicators can be found in Appendix D.

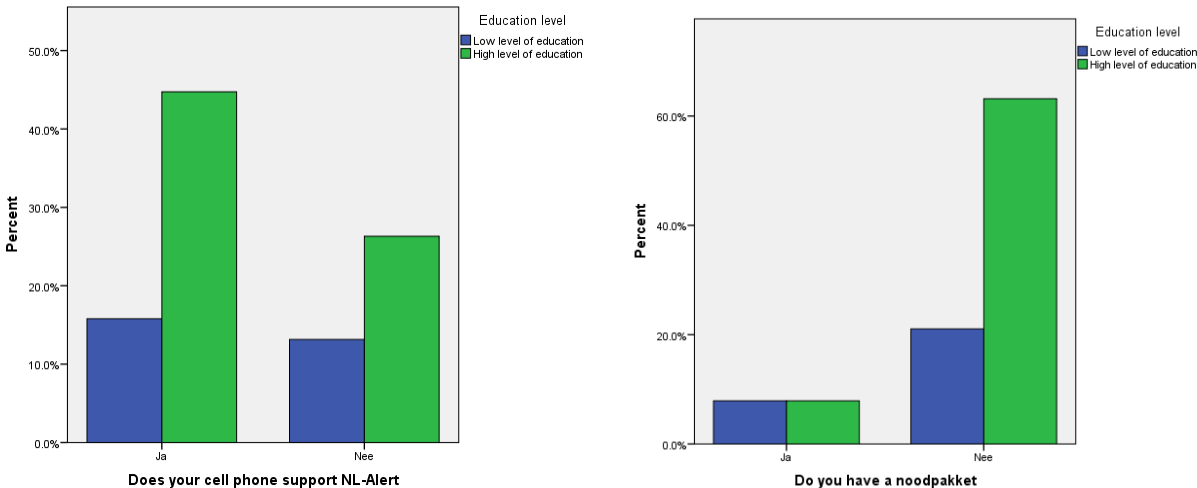


Figure 16: The percentage of respondents who are or are not having the indicators ‘NL alert’ and Noodpakket.

Finally, it is remarkable that the majority of the respondents are not familiar with the ‘basic indicators’ of the safety region, which the authority advises all citizens to have or be familiar with. In this case 80% of the respondents is not having an emergency package (figure 17), and only 40% of the respondents is familiar with the risk manager of the safety region (figure 18). This alarming as well, as this basic form of

informedness is not familiar with the respondents. This means the urban area of Groningen is more vulnerable to threats and thus less resilient.

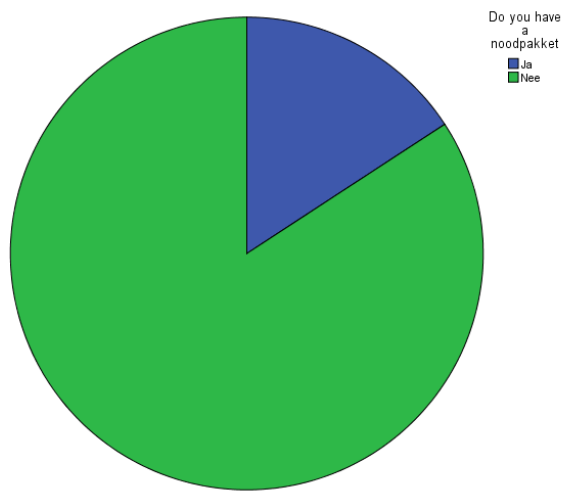


Figure 17: The share of respondents which are having an emergency package.

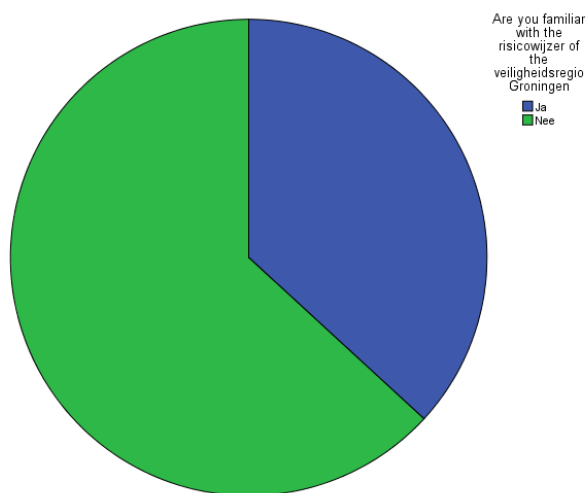


Figure 18: The share of respondents which are familiar with the risk manager of the safety region.

Finally, figure 19 is showing some indicators with corresponding threats. First of all, it is remarkable to see that the change of flooding is estimated lowest, which is responding with the risk perception theory of Ferrier&Haque (2003). Furthermore, in the case of earthquakes, heat waves and extreme weather, respondents who estimate the chance of the disaster high, are a little bit better prepared. So, in order to raise preparedness, it is helpful to raise awareness and informedness on the threats.

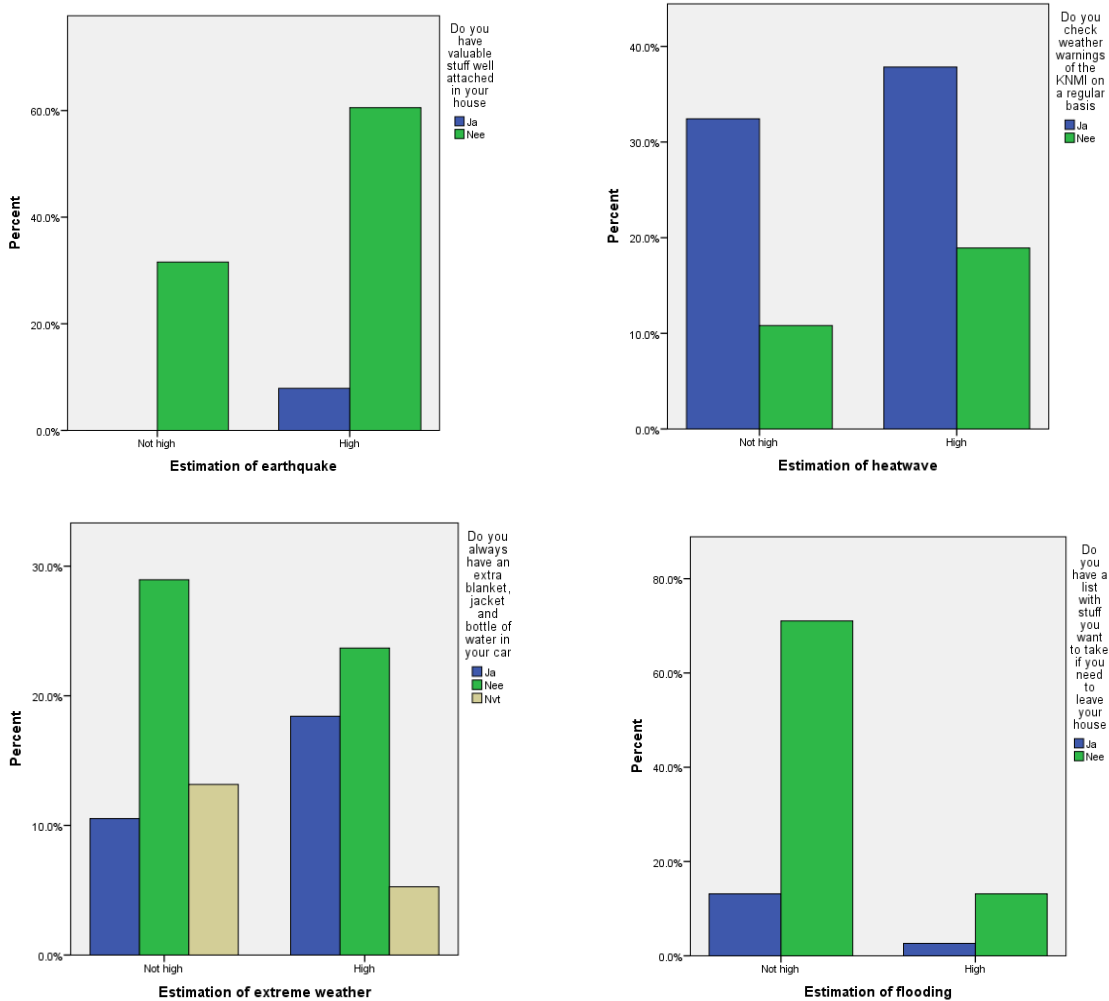


Figure 19: The estimation of specific threats of respondents, compared with some of the indicators of preparedness.

5. Conclusion and recommendations

5.1 Conclusions

This study is a pilot study on the topic of perception of climate change and natural disasters among citizens of Groningen. As there is no data available yet on the topic, a small sample of respondents was questioned with a survey. The aim of the study was to measure the perceptions of citizens of the urban area of Groningen on the natural disasters flooding, heat waves, extreme weather and earthquakes, and compare these outcomes of perception with preparedness based on indicators by the safety region Groningen.

The research question was: 'To what extent are the citizens of the urban area of Groningen prepared against the threats of floods, heat waves, extreme weather and earthquakes, based on the safety Region Groningen?' This can be answered rather negative, as indicators have shown the respondents are not well prepared at all against all specific threats, except the indicators based on a location to go in case of an evacuation, and cooling possibilities in their house during summer period. As these indicators were derived from the safety region Groningen, it is alarming that most respondents did not meet them, which means the urban area of Groningen is more vulnerable and thus less resilient against the mentioned threats.

To continue with the sub questions, there will first be made a start with education level. Based on the data, there are no significant differences and correlations based on education level, in the way citizens of Groningen perceive risks of climate change in the urban area of Groningen. Furthermore, there are no significant outcomes in the level of preparedness on the specific threats (flooding, heat waves, extreme weather and earthquakes), based on both the perceptions of the respondents and the indicators. So, education level is not a major factor in the level of preparedness. There were found outcomes comparable to Restemeyer (2012), however this does not tell us whether different citizens with different education levels perceive risks different and thus require a different approach for informedness.

In levels of preparedness, there is no visible difference between education levels on flooding, heat waves and earthquakes, however lower educated respondents perceived themselves a bit better prepared for extreme weather. For the indicators, lower educated respondents tend to be a little bit better prepared than higher educated respondents. However, in general citizens tend to be not so well prepared based on this indicators. They perceive themselves not so well prepared for most threats, but are actually not prepared at all. Citizens consider themselves better prepared against heat waves, and some indicators show they are so. However, all other indicators showed citizens are not prepared at all, which means perception and reality are very different.

Other outcomes, which were not significant, did show differences between the education levels. Higher educated respondents (college and higher) perceive risks of the threats flooding, heat waves, extreme weather and earthquakes a bit higher than lower educated respondents. This is comparable with recent studies of Restemeyer (2012), Wolf et al (2010), Moser et al (2008), Goklany (2007) and Sherrieb et al (2010), which stated that higher educated people perceive risks of climate change higher than lower educated people.

There can be made a distinction in the way citizens of the urban area of Groningen perceive the earlier mentioned threats. The estimation of a flooding is lower than the estimation of earth quakes, extreme weather and heat waves. This is corresponding with Ferrier&Haque (2003), which state that disasters which occur more often, are estimated and thus perceived higher than events which do not occur that often, as there has not been a flood in at least 10 years in the study area (RTV Noord, 2014). The other natural disasters are estimated quite high, that is: the majority thinks the chance of them is average or higher. Again, this was expected, as these events occur more often and can be found more in the news.

The perceived preparedness is not directly higher if respondents estimated the chance of a certain threat high as well. This is remarkable, as this was expected based on the literature (Wolff et al, 2010). Citizens tend to be not so well prepared and average against most threats, except for earthquakes. In this case, citizens think that 'there is nothing to do about', and the majority considers themselves to be prepared less than average against earthquakes. In general, the majority respondents thought themselves to be prepared average or less.

Finally, there were differences in the way respondents perceived to be prepared against the specific threats, and the way they are prepared, based on the indicators of the safety region Groningen. Except for the weather warnings, a location to go in case of an evacuation and sufficient fresh water and cooling possibilities in their house during summer period, which were answered positive by the majority of the respondents, all the other indicators were answered negatively by the majority of the

respondents. This means the respondents are even worse prepared than they perceived themselves to be prepared.

The outcomes on perception can be compared with the theory of risk perception by Ferrier & Haque (2003), which states that people base their perception on threats on personal experience. This means people perceive risks of certain threats which occur more often higher, than those which occur less often. In this research, respondents perceive risks of earthquakes and heat waves highest, followed by extreme weather. These threats occur more often in the urban area of Groningen (veiligheidsregio Groningen, 2014, RTV Noord, 2014), while flooding has not occurred for at least ten years. The risk of flooding is perceived lower by the respondents. This is in correlation with the theory of Ferrier and Haque(2003) and Kellens et al (2012).

There were some alarming outcomes, mainly caused by low levels of informedness on the threats. Because this level is not high, that is: respondents did not meet the indicators of the safety region, adaptive capacities of the respondents are rather low. This means that the urban area of Groningen is vulnerable to impacts of climate change and other natural disasters: extreme weather, flooding, heat waves and earth quakes. Based on this study, this means the urban area of Groningen is not resilient enough to deal with negative impacts of climate change and earth quakes.

5.2 Future research

As this is a pilot study on perception of climate change among citizens of Groningen, there are recommendations for future research. As this research is limited to 38 respondents, which are more or less clustered in the western part in the city of Groningen (Figure 5), a larger, more representative research is needed, to check these outcomes, based on education level. Clearly there are some differences based on education level, which as well can be investigated in qualitative research to find out why respondents answered this way, especially on risk perception and levels of preparation.

5.3 Recommendations for authorities

The outcomes showed some alarming results in the way citizens are prepared for specific threats in the urban area of Groningen, as well as the ways they perceive themselves to be prepared. Indicators have shown that in almost all cases the majority of respondents are not prepared at all against natural disasters, which surely can occur in Groningen. It is most alarming that the majority of respondents are not familiar with the risk manager of the authority for safety Groningen, and they do not have a special emergency package. In addition, not all respondents had a cell phone which supports the 'NL-alert' system.

In order to become less vulnerable and thus become more resilient as a community and city, authorities need their citizens to have adaptive capacities and be well prepared against specific threats. This is stated by Norris et al (2008) and Moser et al (2008), and these adaptive capacities were not found in this sample. Future research needs to find out if this indeed is the case (in a more representative sample), but it already needs to ring bells at the authorities, to change their policies and to reach the citizens and convince them to take measures against the threats. Otherwise, the urban area of Groningen will not become more resilient and less vulnerable against current and future threats of climate change.

Furthermore, the safety region should, in order to raise awareness, come up with different strategies to reach all different groups in society, especially the most vulnerable ones. The different threats require

variable ideas to reach these groups, as not all of them are vulnerable to all the threats. For example: Elderly are more vulnerable to the impacts of heat waves (Kahn, 2010, Wolff et al, 2010). This requires more research as well, as this study does not exactly show which groups are specifically vulnerable to specific threats.

Furthermore, Kellens et al (2012) stated that citizens not always seek information about threats, not even if one has occurred. This needs to be taken in mind in order to reach all groups of citizens to take measures against these threats, and become less vulnerable and more resilient as a whole.

6. Reflection

As mentioned above, this research is a pilot study for perceptions of climate change among citizens of Groningen. This means it has serious limitations, especially in representativeness. This means the results can be different in future research. However, the research is showing serious implications for authorities, as well as some non-significant results based on education level and risk perception. These results can be checked, deepened, but still authorities should already find a way to convince citizens to take measures to become more resilient and less vulnerable. It might be done by a social media campaign, more radio and tv commercials on the topic, or information meetings before regular meetings of society groups and associations.

Overall, I think this research is not shocking in terms of representative outcomes, but it should seriously ring a bell with authorities and citizens. There might not be so much of a difference based on education level, there still is a difference in the way these people perceive risks of the specific threats. And over the whole line of respondents, preparation is not so good. So authorities have a lot of work to do, but we need to keep in mind that citizens themselves have a responsibility to get information and be prepared as well.

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