The influence of recent drought events on people's willingness to implement drought mitigation measures in and around Hengelo

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Abstract

The earth's rapidly changing climate is leading to increasingly severe droughts, with dry summers becoming more frequent and catastrophic. This paper examines the impact of these dry summers on people's willingness to implement drought mitigation measures in both urban and rural areas of Hengelo. The research question central to this study is: *To what extent have recent drought events influenced people's willingness to take drought mitigation measures in the urban and rural areas of Hengelo?* Previous research explains how the way people behave towards water conservation is primarily shaped by their beliefs in climate change and their experiences with drought. Data is collected through surveys, resulting in a sample of 131 respondents. The survey data indicates the extent to which respondents are willing to take different drought mitigation measures, and ultimately categorizes each respondent to a certain willingness level. The results indicate that awareness about recent drought events has a significant effect on an individuals' willingness level. Contrary to expectations, urban or rural living does not appear to influence willingness levels. Instead, believe in climate change and drought awareness emerge as primary determinants. Additionally, the results show that the odds of exhibiting a higher willingness score are higher for females than for males. In future research, individuals' drivers and barriers to implement drought mitigation measures could be analysed and included for a better understanding.

Keywords: drought; water scarcity; mitigation measures; willingness to adapt; Hengelo

1. Introduction

The earth is warming and the climate is changing (Milieu Centraal, n.d.). On a worldwide level the earth has warmed 1 degrees Celsius compared to 150 years ago, and the KNMI measured an increase of 2 degrees Celsius in the Netherlands in an even smaller time frame of 110 years (Milieu Centraal, n.d.). Consequences of climate change include sea level rise, flooding, intense droughts, water scarcity, catastrophic storms and declining biodiversity (United Nations, n.d.).

The water issue in the Netherlands is becoming more complex (Waals, 2023). The country should not only focus on the continued protection against flooding, but also on the insurance of sufficient clean water supplies at times of drought (Waals, 2023). The last decade (2011-2020) was the warmest on record, and each of the last decades has been warmer than the previous one since 1850 (United Nations, n.d.). The three consecutive dry years between 2018-2020 fuelled the debate on how to deal with future risks (Brockhoff et al., 2022), as only the drought of 2018 already led to an estimated damage of 450 to 2080 million euros in the Netherlands (Philip et al., 2020). A visualization of the precipitation deficit of the summer of 2020 is given in Figure 1, showing a higher deficit in the inland region of the country. According to Bessembinder et al. (2023) it is expected that the trend of drier summers will only continue, and the future average dry summers will become equally dry as the current extreme droughts.

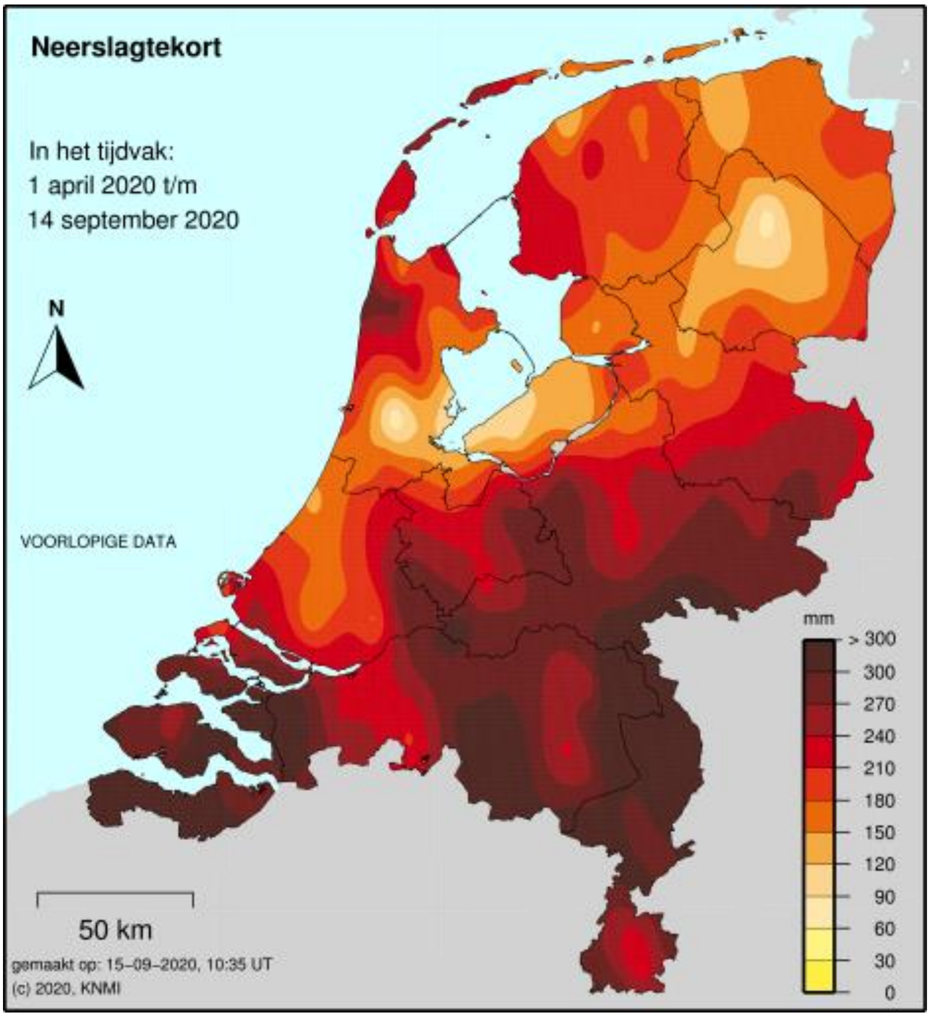

Figure 1. Precipitation deficit 2020. (KNMI, 2020)

Droughts are the result of a prolonged period of little precipitation in combination with higher potential evaporation rates (Van Der Wiel et al., 2021; Wanders, n.d.). This is not only caused by little precipitation in the Netherlands, but also by little precipitation events in Germany and in the Alps. Rain and frost water from the Alps finds its way through the Rhine, and therefor directly influences the freshwater availability in the Netherlands (Wanders, n.d.). Immerzeel et al. (2020) use the term 'water tower' for this phenomenon, referring to the water storage and supply that mountain ranges provide to sustain environmental and human water demands downstream. In the Rhine, approximately 50 percent of the water content is derived from surface water, and the other half from precipitation, glacier, and snow melt (Immerzeel et al., 2020). The overall precipitation volumes over the entire year will in the future suffice to prevent drought (Kennisportaal Klimaatadaptatie, n.d.-a). However, rainwater volumes are not proportionate to seasonal requirements, and rainwater is insufficiently retained to prevent droughts (Kennisportaal Klimaatadaptatie, n.d.-a).

The effects of drought in the Netherlands differ significantly between the coastal region and the inland region with regard to precipitation (Philip et al., 2020). The coastal region tends to have higher precipitation values during summer, whereas the inland Eastern part of the Netherlands has a higher dependency on precipitation for drought mitigation, as their elevation is above sea level, and the soil composition is preliminary of sand (Philip et al., 2020; Wageningen University & Research, 2012). These sandy soils have a rapid percolation due to its high porosity (Andersen, 2020). Wanders (n.d.) states that water shortages result in a lower productivity in the agricultural sector, increase the flood risk due to structural instability of dikes, add to land subsidence below houses, and have a significant effect on inland shipping due to lower water levels. In addition, Blauhut et al. (2022) amplify the increase of salt water intrusion in the coastal regions. Considering the effects and risks in the inland elevated parts of the Netherlands, the main problem is the unavailability of water supply from rivers, leading towards dependency of precipitation and groundwater (Kennisportaal Klimaatadaptatie, n.d.-b). A research by Witte et al. (2012) adds that in the elevated parts of the Netherlands, the results of drought have the largest influence on natural ecosystems which are dependent on precipitation as the only or major source of water. Examples of these natural ecosystems are heathlands, dry grasslands, nutrient-poor moorland pools and bogs (Witte et al., 2012).

From a societal perspective, this research is relevant as it will show governmental parties whether or not there is a proper level of awareness about drought risks, and whether or not certain information and motivation must be provided in order to change people's willingness to adapt drought mitigation measures. Considering the scientific relevance of this research, limited research is done into the willingness of the public to implement drought mitigation measures in comparison to floods. As explained, droughts are starting to have greater impacts to the Netherlands, and therefore it is valuable to have insights into the attitudes and willingness to adapt of the public towards this issue.

1.1. Research Problem

This research aims to investigate the effects of recent drought events on the willingness to adapt to the drought situation of inhabitants of Hengelo, and the surrounding rural areas. An elaborated motivation for the choice of this case study is provided in chapter 3.1. More specifically, the research aims to investigate whether there is a difference in willingness to take measures between urban and rural areas, and whether there are preferred measures to be taken. Therefore, the central question that will be researched in this Bachelor Thesis is:

To what extent have recent drought events influenced people's willingness to take drought mitigation measures in the urban and rural areas of Hengelo?

In order to answer the central research question, the following sub-questions have been formulated:

I. *How is willingness to adapt to drought risks defined?*
II. *Which drought mitigation measures are inhabitants of Hengelo and its surrounding rural areas most and least willing to take?*
III. *To what extent does willingness to take drought mitigation measures differ between Hengelo and its surrounding rural areas?*
IV. *To what extent do recent drought events contribute to people's willingness to take drought mitigation measures?*

1.2. Structure

The research starts by an analysis of the current literature available in the theoretical framework in chapter 2. Based on this framework, a conceptual model is constructed to guide the data analysis. Subsequently, chapter 3 delves into the case study and the chosen research approach, which sets the base for the data analysis in chapter 4. Finally, the thesis ends with a conclusion of the findings, resulting into a response to the research question.

2. Theoretical Framework

2.1.1. Drought behaviour

A study conducted by Brownlee et al. (2014) elucidates that attitudes towards water conservation are shaped by awareness and beliefs in climate change. Considering this awareness, recent data from CBS (2021) reveals that three-quarters of the Dutch population expresses concern regarding the impacts of climate change. The depth of knowledge and belief in climate change correlates positively with individuals' inclination to implement water-saving measures at home, as evidenced by studies conducted by Khodadad et al. (2022) and Van Valkengoed & Steg (2019).

As stated by Lottering et al. (2023), experience, memory, definition and expectations shape the way individuals perceive and behave towards a phenomenon such as drought. Among these factors, experience and memory emerge as pivotal elements in the way people perceive the impacts of drought (Lottering et al., 2023; Taylor et al., 1988). Studies by Edwards (2019) and Sone et al. (2022) confirm that individuals who have directly encountered drought events tend to believe that these will happen more often, and that action is needed. In addition, Khodadad et al. (2022) states that there is a positive correlation between the direct experience of extreme climatic conditions and the willingness to adopt water-saving behaviours. Given the rising frequency of drought events in the Netherlands, it is anticipated that firsthand experience with these occurrences will indeed influence people's willingness to adapt drought mitigation measures.

2.1.2. Measuring willingness to take measures

The willingness of individuals to adopt measures against droughts can be assessed using Likert scales, as demonstrated in the study by Van Valkengoed et al. (2022). Similarly, prior research conducted by Van Valkengoed et al. (2021) employed this method to measure climate change perception, behaviour, and policy support. In their approach, researchers assess a set of multiple questions or statements on a 7-point Likert scale, after which average scores are taken per topic. The described method results in an average overall score for individuals, and can therefore be used to determine individuals' willingness level.

2.1.3. Drought mitigation measures

Residents can undertake various measures that help to reduce drought. These measures are generally based on retaining rainwater on their own premises rather than allowing it to drain away (Kennisportaal Klimaatadaptatie (Knowledge portal Climate adaptation), n.d.-a). One effective strategy is to replace tiles in gardens with vegetation, as suggested by Kennisportaal Klimaatadaptatie (n.d.-a). Similarly, swapping out impermeable driveway tiles for permeable pavement, as advocated by Freeborn et al. (2012), can help to retain rainwater on-site. Another practical approach is to disconnect downspouts from the drainage system and redirect the water to permeable areas or collect it in rain barrels for future use (Freeborn et al., 2012).

Moreover, residents can embrace the natural consequences of drought by accepting that grass may turn yellow during dry summers, as advised by the Kennisportaal Klimaatadaptatie (n.d.-a). Ultimately, the most minimal effort measures involve reducing average shower time and installing water-saving showerheads (Milieu Centraal, 2022). Whether or not people are able to integrate certain measures is dependent on the presence of a garden, as some adaptations may not be applicable without one.

2.1.4. Sociodemographic influence

Drought perception can vary significantly among households in the same neighbourhood, as sociodemographic characteristics such as age, gender, education and income play a role (Karanja et al., 2017). Research conducted in America from 2008 to 2010 and in Kenya in 2016 indicates a trend of increasing concern about water availability with age (Bishop, 2013; Karanja et al., 2017). Zooming out to climate change in general, Lübke (2022) suggests that climate change uncertainty generally grows with age. This assertion is contradicted by González-Hernández et al. (2023). Furthermore, Khodadad et al. (2022) found that younger individuals are more likely to agree to uptake water-saving measures, showing unclear and contradicting findings about the influence of age. With regard to gender, Khodadad et al. (2022) discovered significant differences in willingness to adopt water saving measures in Mexico. Males appeared more willing to take such actions, contrary to their expectations. Furthermore, individuals with higher levels of education are more likely to acknowledge the necessity of taking appropriate actions to conserve water. At last, Osberghaus & Hünewaldt (2023) suggest that homeowners exhibit stronger climate change adaptation behaviours compared to tenants. Overall, the section suggests a difference in willingness to take drought mitigation measures between different sociodemographic groups.

2.1.5. Urban / Rural living

Rural residents tend to perceive higher drought risks for their region than urban residents, but express lower confidence in their adaptation ability at the community and regional level (Edwards, 2019). This means that rural residents may feel they have less capacity to make a meaningful difference compared to other urban residents. A study by Iglesias et al. (2021) in Spain adds that residents of urban areas are less aware of water challenges than residents of rural areas. Alarming statistics provided by Bressers et al. (2016) state that ninety percent of the small creeks in Twente run dry during the summer months. Because of this visual drought consequence, differences in willingness to adapt between rural and urban inhabitants are expected. For classification purposes, an area is considered as urban if there are a minimum of 1500 addresses per square kilometre. Area's with less addresses are classified as rural, as defined by CBS (1998).

2.2. Conceptual model

Figure 2 illustrates a conceptual model in which the theoretical framework is visually depicted. This model elucidates how an individuals' willingness to take drought mitigation measures is influenced by several different factors. Within the analysis, the concepts outlined in the conceptual model will serve as the independent variables, indicating the extent to which they influence an individuals' willingness to take drought mitigation measures.

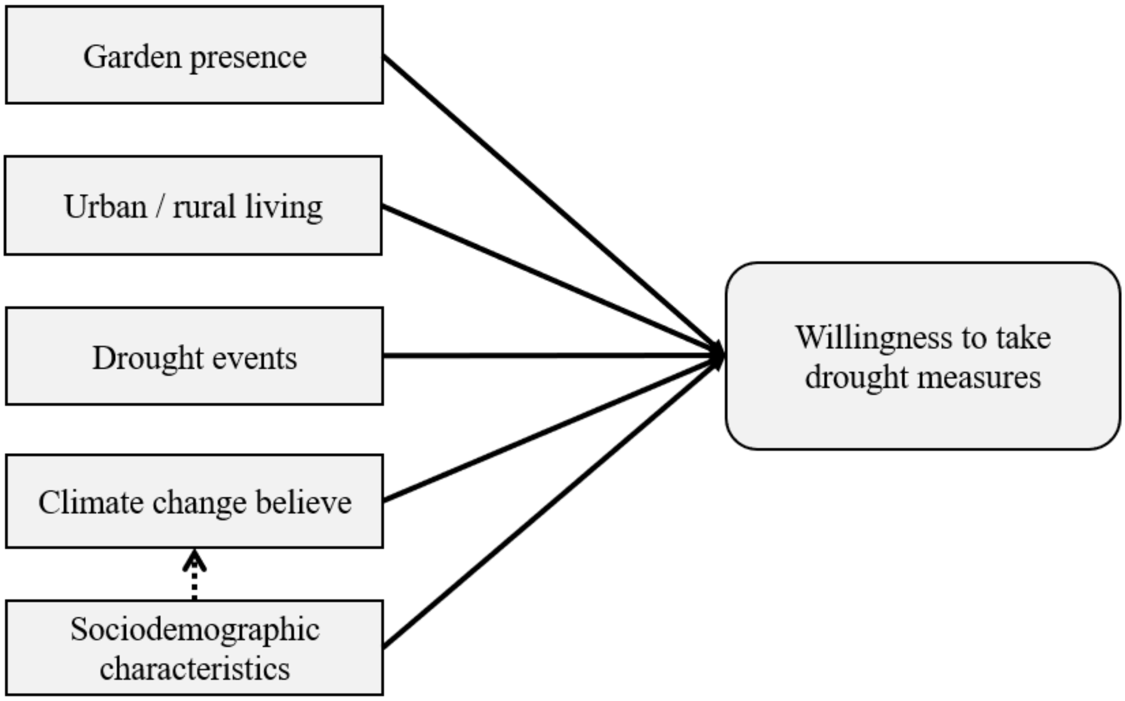

Figure 2. Conceptual model

2.3. Hypothesis

Due to the fact that one's water conservation attitude is mainly influenced by experience and memory (Lottering et al., 2023; Taylor et al., 1988), it is hypothesized that recent drought events do have an influence on the willingness of an individual to take drought mitigation measures. Furthermore, it is anticipated that residents of rural areas, confronted with more visible drought consequences, exhibit greater willingness to take drought mitigation measures. Finally, it is hypothesized that younger individuals and those with higher levels of education are more inclined to implement drought mitigation measures.

3. Methodology

3.1. Quantitative research

This report delves into a case study of Hengelo, situated in the elevated Eastern part of the Netherlands. Hengelo stands out as an interesting case for drought research due to the predominant sandy soil composition in this region, as highlighted in Figure 3 (DINOloket, 2021). The topography of the Hengelo region reveals elevated areas ranging from 16 to 30 meters above NAP, which is a reference height used in the Netherlands that aligns the average sea-level of the North Sea (AHN, 2019). Due to this elevation and the sandy soil, drought risks in Hengelo are higher than in coastal areas (Philip et al., 2020). Hengelo emerges as a more reliable case study than its neighbouring city Enschede, notably due to the absence of overrepresentation by students.

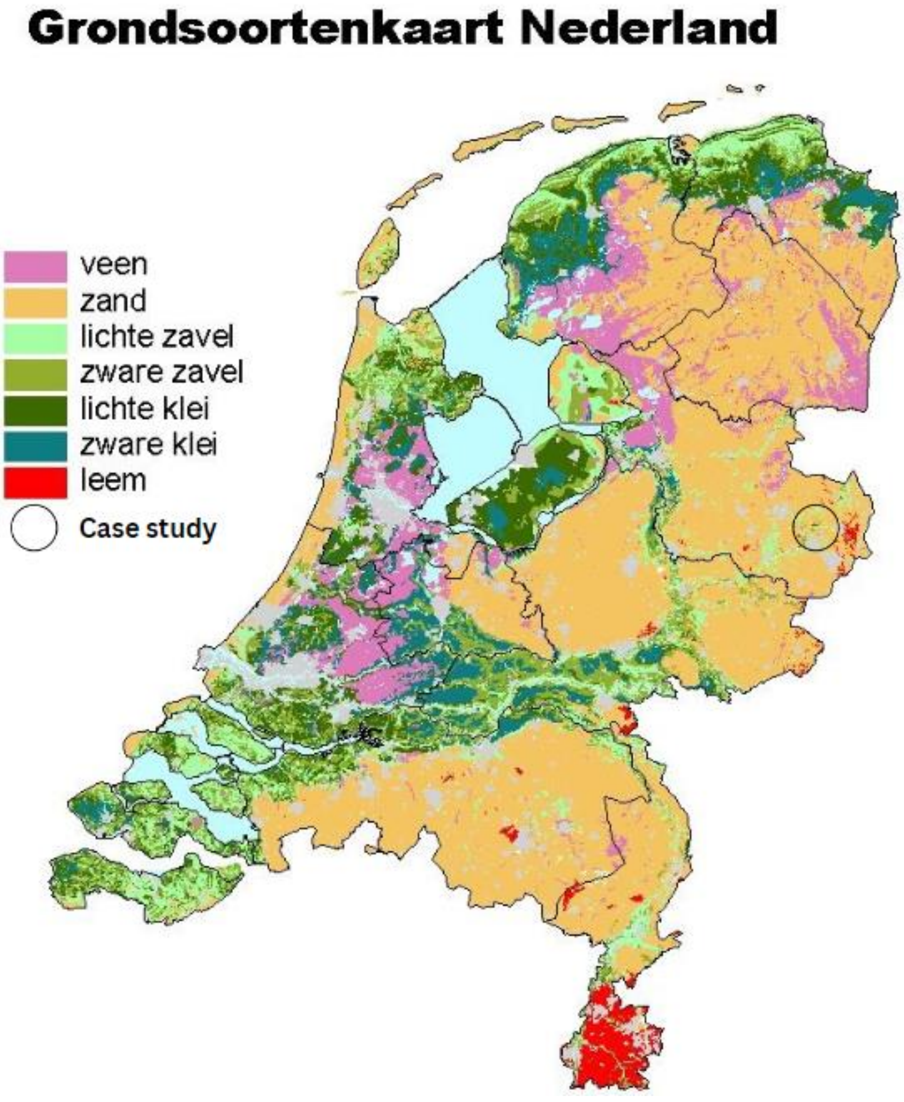

Figure 3. Soil types in the Netherlands, specifically in Hengelo (Wageningen University & Research, 2012, edited by author).

This research investigates the extent to which the willingness to adapt drought mitigation measures of inhabitants of Hengelo is influenced by recent drought events, and to which extent there are differences in willingness between urban and rural residents of Hengelo. To address the research question and sub-questions, primary data is collected using a quantitative approach. A quantitative approach is used to ensure that there is enough data from a representative sample from both urban and rural residents. The data is gathered by employing surveys, which are initially distributed using snowball sampling. Snowball sampling involves participants assisting in identifying other potential subjects (Oregon State University, 2012). Hence, respondents were asked to distribute the survey among their acquaintances that live in or around Hengelo. Because of an underrepresentation of certain age groups (26-40 and 70+) and of rural living people, the data collection was expanded by a targeted sampling method. Flyers containing QR-codes (Figure A7) leading to the questionnaire were randomly distributed across rural areas, primarily focusing on villages rather than farms. The flyers were primarily put in mailboxes, but individuals who were outside on the street were also approached randomly to participate in the questionnaire. Individuals who fitted the underrepresented age groups were approached more often.

The questionnaire, provided in Table A8, starts with questions about sociodemographic characteristics, allowing representativeness testing and comparing. Following this, respondents encounter statements related to the content of the study. For these statements, respondents are asked to indicate their level of agreement or disagreement. Subsequently, the average responses to these statements are calculated for each individual, which subsequently are translated into a willingness scale revealing individuals' overall willingness to engage in drought mitigation measures. Respondents are categorized into either urban living people, or rural living people based on their postal code. The urbanity of a postal code is defined by AlleCijfers (2024), stating that an area is strongly urban when there are more than 1500 addresses per square kilometre (urbanity score 1 or 2), and that an area is mediocre to non-urban when there are less than 1500 addresses per square kilometre (urbanity score 3, 4 or 5). Due to this definition, certain postal codes within the municipality of Hengelo are classified as rural areas. The division of urban and rural postal codes is given in Table 1 and visualized in Figure 4. In the middle of the figure, one postal code is left grey, since it has a high urbanity level but is no longer classified as urban Hengelo. Before the representativeness of the sample is considered, the dataset is filtered on irrelevant responses from outlying postal codes. Additionally, missing values are replaced, and irrelevant comments such as 'good luck with your thesis' are removed.

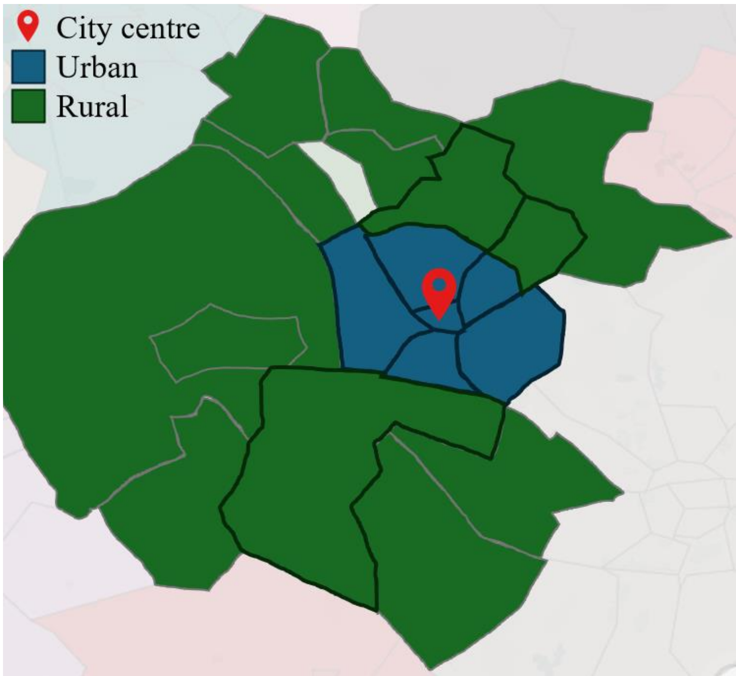

Figure 4. Division Urban/rural postal codes. (Wielakker, n.d., edited by author)

Table 1. Postal codes urban and rural division

Urban postal codes	Rural postal codes		
7551	7490	7548	7621
7552	7491	7554	7623
7553	7495	7558	7625
7555	7497	7559	7626
7556	7547	7561	
7557			

In order to answer the research questions, there is tested to which extent the overall willingness to engage in drought mitigation measures (dependent variable) is explained by the independent variables, for both urban and rural living people. Details regarding the measurement levels and the required statistical tests that fit the nature of the data can be found in Table 2.

Table 2. Measurement levels and required statistical tests

Survey Nr.	Measurement level	SPSS Test	Extra explanation
1	Nominal	Bivariate: Mann-Whitney U-test with 10-16** Multivariate: Ordinal regression	
2	Ordinal	Bivariate: Spearman's rho with 10-16** Multivariate: Ordinal regression	
3	Ordinal	Bivariate: Spearman's rho with 10-16** Multivariate: Ordinal regression	
4	Open question	-	* Based on the postal code, respondents are categorized as 'urban' or 'rural' resident.
4*	Nominal	Bivariate: Mann-Whitney U-test with 10-16** Bivariate: Mann-Whitney U-test with 10 till 16 Multivariate: Ordinal regression	Urban / rural category
5	Nominal	Bivariate: Mann-Whitney U-test with 10-16** Multivariate: Ordinal regression	
6	Nominal	Bivariate: Kruskal-Wallis H test with 10-16** Multivariate: Ordinal regression	
7-8	Ordinal	Bivariate: Spearman's rho with 10-16** Multivariate: Ordinal regression	
9	Ordinal	Bivariate: Spearman's rho with 10-16** Multivariate: Ordinal regression	
10-16	Ordinal	Descriptive statistics Bivariate: Mann-Whitney U-test	** The answers of these questions are aggregated, resulting in a new ordinal variable.
10-16**	Ordinal	Ordinal regression (dependent variable)	Aggregated result of questions 10-16 (Overall willingness to adapt to drought mitigation measures)
17	Open question	-	Optional explanation of respondents about their reasoning.

3.2. Ethical considerations

In order to ensure ethical conduct in this research, it is of importance to consider the following issues. The study had no negative effects for the respondents or other parties as privacy is assured and participation was not time consuming. Furthermore, participation to the study was completely on voluntary basis. In line with the principle of informed consent, the respondents were informed about the aim of the study, the purpose of the study, and their rights. The data does contain sensitive personal information about demographics and respondent's way of thinking, but it is important to realize that the data gathered cannot be related to specific individuals, as for example only the first four digits of respondents' postal codes were collected. In this way, confidentiality and privacy of the participants was realized. Data was stored in the researcher's personal drive and locked with a password. After completion of the thesis, all gathered data is deleted.

4. Results

In this chapter, the collected data is analysed and the results are presented. After testing the data on its representativeness, a univariate analysis is conducted, providing the general characteristics of the dataset. Subsequently, a bivariate analysis is undertaken to explore the relationships between the independent variables and the dependent variable. The analysis is then finalized with a regression analysis to further analyse the relationships.

4.1. Data cleaning and representativeness

Following the outlined data collection procedure, a sample size of 156 respondents was obtained. After filtering to include only the postal codes provided in Table 1, the sample size was reduced to 131 respondents. The dataset exhibited minimal missing values, with only four willingness statements unanswered. To address this, the missing values were substituted with the respondents' rounded personal mean willingness score, following the approach recommended by Downey & King (1998). Additionally, one missing value was identified for survey question 5. To handle this, the missing value was replaced with the mode.

The initial snowball sampling method led to a notable underrepresentation of specific age groups, as illustrated in Figure A8 till Figure A10. Following the expansion of data collection by targeted sampling, the sample has become slightly less representative with regard to the gender distribution (Figure 5). However, in terms of age distribution, the sample has notably improved in representativeness. Nevertheless, there remains a considerable shortage of responses from elderly and a surplus of younger individuals. The potential effect of the lack of age representation is unclear, given the contradictory findings in the literature. Previous studies by Bishop (2013), González-Hernández et al. (2023), Karanja et al. (2017) and Lübke (2022) have presented contradicting findings on the influence of age on water concerns, as presented in chapter 2.1.4. With regard to the house ownership distribution, the representativeness has slightly improved, but not much. The fast majority of the sample has an owner-occupied dwelling, which might result into stronger climate change adaptation behaviour, according to Osberghaus & Hünewaldt (2023).

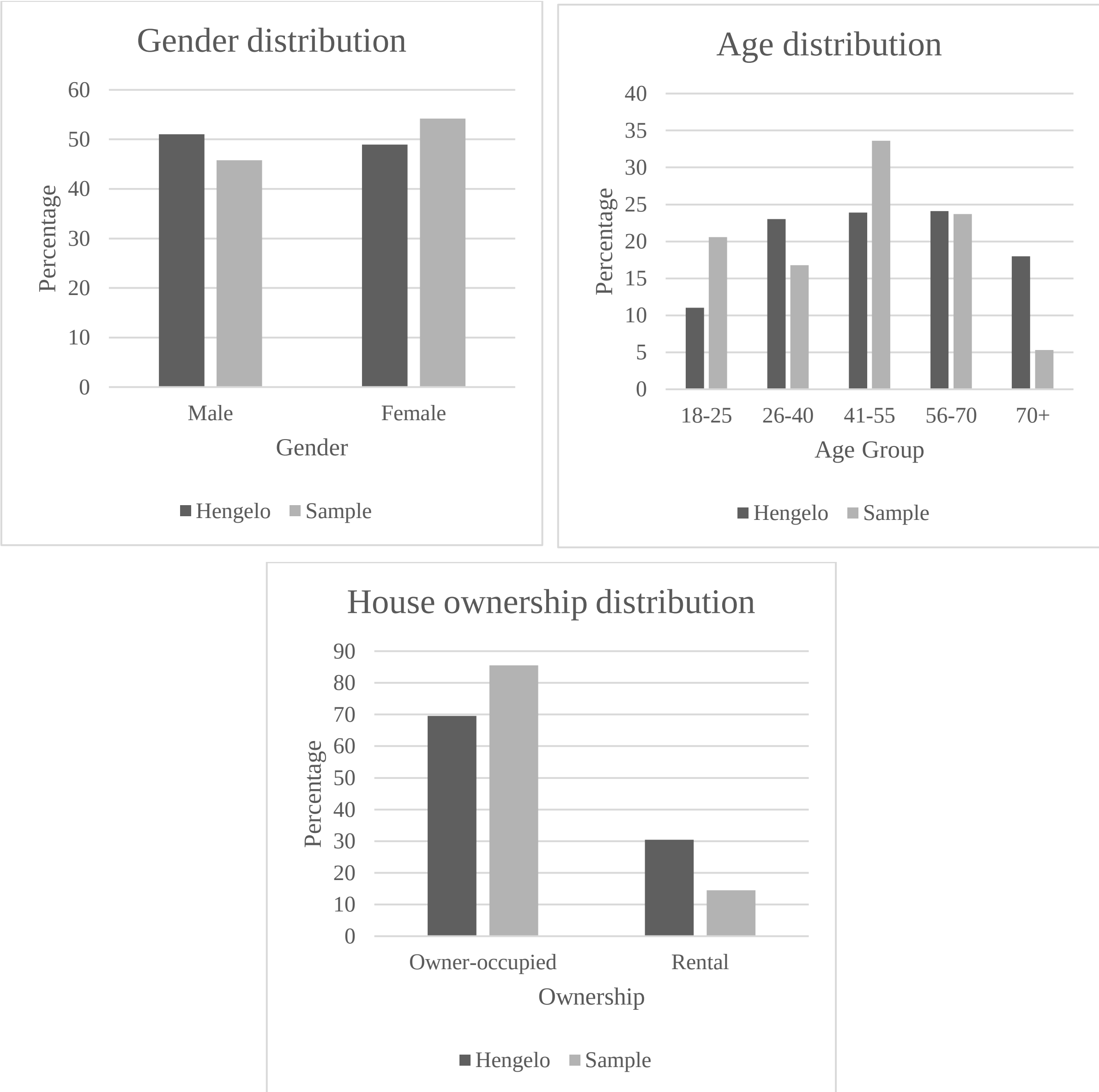

Figure 5. Gender, Age, and House ownership distribution for representativeness

4.2. Univariate analysis

The sample characteristics for this research are provided in Table 3. Next to the previously mentioned gender and age group characteristics, the majority of the sample has finished either MBO or HBO education. Moreover, the sample composition leans slightly towards urban residency over rural, with the vast majority residing in owner-occupied houses with gardens, predominantly featuring grass. However, it appears that 30,5 percent of the respondents have gardens that only contain pavement. The frequencies of the remaining variables are provided Table A9. Overall, the data indicates a prevailing belief in climate change and the human impact on this phenomenon. Additionally, the majority of the sample states to have increased awareness about drought risks in the Netherlands after recent dry summers.

Throughout this chapter, the variables "I believe that climate change is a real existing problem", "I believe that individuals can have a positive impact against climate change" and "Recent dry summers have made me more aware of drought risks" are alternately referred to as "Climate change believe", "Climate change impact" and "Drought awareness".

Table 3. Sample characteristics

Variable	*N*	*Level*	*Frequency*	*Percentage*
Gender	131	Male	60	45.8
		Female	71	54.2
Age category	131	18-25	27	20.6
		26-40	22	16.8
		41-55	44	33.6
		56-70	31	23.7
		70+	7	5.3
Highest finished education	131	Secondary school	11	8.4
		MBO	42	32.1
		HBO	50	38.2
		WO	28	21.4
Urbanity	131	Urban	74	56.5
		Rural	57	43.5
House ownership	131	Owner-occupied	112	85.5
		Rental	19	14.5
Outdoor space	131	Garden with grass	83	63.4
		Garden without grass	40	30.5
		Balcony	7	5.3
		No outside space	1	.8
Total			131	100.0

In order to analyse the most and least preferred drought mitigation measures, the descriptive statistics of the measures are presented in Table A10, Table A11 and Table A12 and summarized in Table 4. The mean value in this table is based on the 1-7 Likert scale data. From this table, there can be stated that people are least willing to disconnect their drainpipe from the sewerage, and to replace tiles in their garden or driveway with vegetation or permeable pavement. The measures that people are most willing to implement are; installing a rain barrel, replacing their showerhead with a water-saving alternative, and reducing their outside water usage during dry periods. With this information, research question two can be answered. The differences between urban and rural residents in willingness to implement measures seems to be small, but whether or not there are significant differences will be tested in the next section.

Table 4. Descriptives drought mitigation measures

Variable	*N Total*	*Mean*	*N Urban*	*Mean*	*N Rural*	*Mean*
"During periods of drought, I am willing to take shorter or fewer showers"	131	5.02	74	5.08	57	4.93
"I am willing to replace my showerhead with a water-saving showerhead"	131	5.46	74	5.32	57	5.63
"During periods of drought, I am willing to reduce my outside water usage" (lawn watering / car washing / private swimming pool)	131	5.45	74	5.53	57	5.35
	131	4.77	74	4.82	57	4.70

"I am willing to replace tiles in my garden or driveway with vegetation (gras / plants) or permeable tiles"	131	5.56	74	5.59	57	5.53
"I am willing to install a rain barrel to my drainpipe, so I can use this water for watering my garden"	131	4.65	74	4.53	57	4.81
"I am willing to disconnect my drainpipe from the sewerage, to let rainwater infiltrate in my garden"	131	4.97	74	5.14	57	4.75
"During periods of drought, I am willing to accept that my gras will turn yellow without water"						
Valid N (listwise)	131		74		57	

For each respondent, an individual willingness scale level is determined. The frequency distribution of these levels is presented in Figure 6, revealing a predominant presence of high and very high willingness levels among the respondents. Moving on to the upcoming sections, this ordinal 'willingness scale' serves as the dependent variable in the analysis.

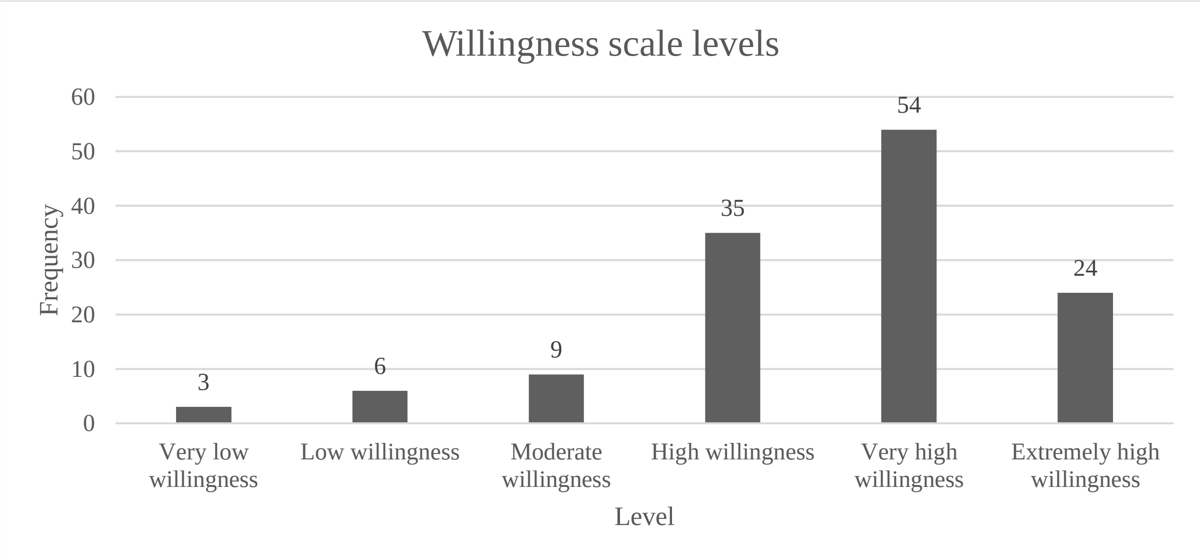

Figure 6. Willingness scale distribution

4.3. Bivariate analysis

In order to analyse whether there are significant differences in willingness to implement the different drought mitigation measures between urban and rural residents, a Mann-Whitney U test is conducted. The data passes all four conditions for a Mann-Whitney U test (Laerd Statistics, n.d.), and results are considered significant at a significance level of <0.05. The results are provided in Table A13 and summarized in Table 5. From the test statistics there can be concluded that there is no significant difference in willingness for any of the drought mitigation measures between urban and rural residents, partially answering research question three.

Table 5. Bivariate analysis Urban/rural living – Willingness to implement drought mitigation measures. Significance results (Mann-Whitney U Test)

Independent variable	*Categories*	*N*	*Sig.*
"During periods of drought, I am willing to take shorter or fewer showers"	7	131	.369
"I am willing to replace my showerhead with a water-saving showerhead"	7	131	.665
"During periods of drought, I am willing to reduce my outside water usage" (lawn watering / car washing / private swimming pool)	7	131	.501
"I am willing to replace tiles in my garden or driveway with vegetation (gras / plants) or permeable tiles"	7	131	.792
"I am willing to install a rain barrel to my drainpipe, so I can use this water for watering my garden"	7	131	.651
"I am willing to disconnect my drainpipe from the sewerage, to let rainwater infiltrate in my garden"	7	131	.494
"During periods of drought, I am willing to accept that my gras will turn yellow without water"	7	131	.281

Since the individuals' 'willingness scale' serves as the dependent variable in this research, analysing the relationship between the independent variables and the 'willingness scale' is of interest. In all cases, the null hypothesis is that there is no difference in the willingness scale among different categories of the independent variables. The alternative hypothesis suggests that there is a difference in the willingness scale among the various categories. Significance for each analysis is determined at a level of .050 or lower.

The results of the bivariate analysis are detailed in Table A14 until Table A22. Summarized findings are provided in Table 6. Significant results are noted for the relationships with gender, age, climate change believe, climate change impact and drought awareness. For these variables, the null hypothesis is rejected and the alternative hypothesis is accepted, indicating that individuals' willingness scales differ across different categories of these variables. This study specifically emphasizes analysing differences in willingness scale levels between urban and rural residents. However, with a significance level of .786, no significant difference in willingness appears to exist, answering research question three.

Table 6. Bivariate analysis with willingness scale. Significance results

Independent variable	*Categories*	*Statistical test*	*N*	*Sig.*
Gender	2	Mann-Whitney U Test	131	.012
Age	5	Spearman's rho	131	<.001
Highest finished educational level	4	Spearman's rho	131	.220
Urban / rural living	2	Mann-Whitney U Test	131	.786
Owner-occupied or rental house	2	Mann-Whitney U Test	131	.829
Type of outdoor space	4	Kruskal-Wallis Test	131	.302
Climate change believe	7	Spearman's rho	131	<.001
Climate change impact	7	Spearman's rho	131	<.001
Drought awareness	7	Spearman's rho	131	<.001

4.4. Multivariate analysis

In this section, a regression analysis is conducted between the dependent variable 'willingness scale' and the independent variables. Given the ordinal nature of the dependent variable, an ordinal regression is preferred. To conduct such a regression, the data must satisfy four assumptions: (*I*) The dependent variable is measured at ordinal level, (*II*) One or more independent variables that are continuous, ordinal or categorial. Ordinal variables should be treated as either nominal or continuous, (*III*) There is no multicollinearity, and (*IV*) The assumption of proportional odds holds true. To satisfy assumption *II*, the ordinal independent variables 'age' and 'educational level' are treated as nominal variables. Additionally, the ordinal independent variables 'climate change believe', 'climate change impact' and 'drought awareness' are treated as continuous variables.

Initially, an ordinal regression is conducted with all independent variables that are included in Table 6. While the first three assumptions are met, the dataset fails to satisfy the assumption of proportional odds, since the test of parallel lines results to be significant. Preference is still given to conducting an ordinal regression rather than transitioning to a multinomial regression, as this better fits the dependent variable. Consequently, several independent variables are excluded from the regression analysis. According to the bivariate analysis, 'educational level' and 'house ownership' are not significantly associated with 'willingness scale'. Therefore, these two variables are excluded from the regression. Furthermore, the 'climate change impact' variable is excluded from the regression, as the theoretical framework prioritizes the 'climate change believe' variable over the 'climate change impact' variable.

The new results are provided in Table A25 until Table A30. Before delving into the analysis, the four assumptions are reassessed. The first two assumptions are passed given the nature of the data. For assumption *III*, a linear regression is conducted, including collinearity diagnostics, as presented in Table A24. With all VIF values below 1.900, there is limited multicollinearity, thus satisfying the assumption (Dodge, 2010). For assumption *IV*, a parallel lines test is executed, outlined in Table A30. The non-significant p-value of .992 indicates that the assumption holds true. Therefore, all assumptions hold.

The model fitting assessment is presented in Table A26. The model exhibits a significant improvement over the 'intercept only' model, as evidenced by a p-value of <.001. Subsequently, the Goodness-of-Fit is evaluated and provided in Table A27. The Pearson and Deviance statistics show contrary results, as their significances are respectively <.001 and 1.000. Generally, a significance value of >.050 would assume a poor model fit. However, a Deviance value of 1.000 assumes a good fit. The observed significance in the Pearson test may be attributed to the high number of 'zero frequency' cells in the regression, as this test is particularly sensitive to this factor. Despite this, the Goodness-of-Fit is still considered as good, as the Deviance value indicates a good model fit, and the model fitting information states the same. Finally, the Pseudo R-Square value is presented in Table A28. The Nagelkerke value of .466 explains a moderately explanatory capacity of the model, as it explains 46.6% of the maximum possible variance in the dependent variable.

Following the assessment of the regression model, a Generalized Linear Models test was conducted to deepen the understanding of the data. For this test, the model fitting information remains consistent with that of the ordinal regression. Detailed results of the Generalized Linear Models test are provided in Table A31 till Table A38. From the summarized Parameter Estimates presented in Table 7, it can be inferred that the odds of individuals scoring a higher level on the 'willingness scale' are .429 times higher for males compared to females. Given that this value is less than 1, females seem to be more likely in achieving a higher rank on the 'willingness scale'. The independent variables 'age category', 'urban or rural living' and 'type of outdoor space' all appeared insignificant. Therefore, it can be concluded that within this model, these variables do not significantly contribute to the explanation of the dependent variable. The insignificant result for 'urban or rural living' confirms the answer on research question three in the previous section. For the continuous variables 'climate change believe' and 'drought awareness' both significant relationships are found. For every unit increase in 'climate change believe', the odds of individuals belonging into a higher 'willingness scale' level increases with a factor of 1.420. Similarly, for each unit increase in 'drought awareness', the odds of people falling in a higher 'willingness scale' level are 1.955 times higher. With this final result, research question four is answered as well; recent dry summers have resulted in an increase in drought awareness and have indeed led to a higher willingness to implement drought mitigation measures.

Table 7. Summarized Parameter Estimates, Generalized Linear Models

Parameter		*B*	*Exp(B)*	*Sig.*
Threshold	[Willingness scale = 1]	.904	2.470	.689
	[Willingness scale = 2]	2.363	10.619	.288
	[Willingness scale = 3]	3.634	37.879	.105
	[Willingness scale = 4]	6.062	429.400	.009
	[Willingness scale = 5]	8.603	5447.406	<.001
[Gender = 1]		-.846	.429	.020
[Gender = 2]		0[a]	1	.
[Age_category = 1]		-.992	.371	.282
[Age_category = 2]		-.434	.648	.641
[Age_category = 3]		-.460	.631	.597
[Age_category = 4]		-.034	.967	.969
[Age_category = 5]		0[a]	1	.
[Urban_rural = 1]		-.111	.895	.750
[Urban_rural = 2]		0[a]	1	.
[Outdoor_space = 1]		2.063	7.871	.246
[Outdoor_space = 2]		1.505	4.503	.403
[Outdoor_space = 3]		1.275	3.580	.529
[Outdoor_space = 4]		0[a]	1	.
Climate change believe		.351	1.420	.018
Drought awareness		.671	1.955	<.001

4.5. Summary

In summary, the results of the univariate, bivariate and multivariate analysis offer insights into the research questions. In the univariate analysis there was suggested that individuals seem to be most willing to implement a rain barrel, and least willing to disconnect their drainpipe from the sewerage. Subsequently, the bivariate analysis adds that there is no significant difference in willingness to implement any of the drought mitigation measures between urban and rural living individuals. After translating the individual willingness variables into a single 'willingness scale' variable, another Mann-Whitney U Test was conducted, indicating again that there is no significant difference in willingness between urban and rural living residents. Finally, the ordinal regression suggested that females are more likely to achieve a higher rank on the 'willingness scale'. Moreover, the odds of individuals belonging into a higher 'willingness scale' are higher when people have a higher climate change believe and a greater drought awareness.

Conclusion

In this report, an analysis was conducted to assess the impact of recent drought events on residents' willingness to adopt drought mitigation measures in both urban Hengelo and its surrounding rural areas. The theoretical framework suggested that an individual's attitude towards water conservation is primarily influenced by their believe in climate change (Brownlee et al., 2014). Additionally, experience and memory of drought events were identified as shaping factors in individuals' behaviour towards this phenomenon (Lottering et al., 2023; Taylor et al., 1988). Moreover, less intuitive aspects such as peoples' living situation and sociodemographic characteristics were recognized as influential in how people behave towards drought issues (Karanja et al., 2017; Khodadad et al., 2022; Osberghaus & Hünewaldt, 2023).

To address the research question and its sub-questions, three levels of analysis have been conducted. Initially, a univariate analysis was conducted to present the sample characteristics and the main descriptive statistics. Through the descriptive statistics there was discovered that there are limited differences in the mean willingness score of urban and rural living respondents. However, individuals seem to be most willing to install a rain barrel, and least willing to disconnect their drainpipe from the sewerage, answering the second sub-question. Subsequently, the bivariate analysis confirmed that indeed there is no significant difference in willingness for any of the drought mitigation measures between urban and rural living respondents in Hengelo, thus partially answering the third sub-question. Moving on, the relationship between all independent variables and the dependent variable 'willingness scale' was examined in the bivariate analysis. Significant relations were identified with 'gender', 'age', 'climate change believe', 'climate change impact' and 'drought awareness'. Notably, the independent variable 'urban or rural living' was found to have an insignificant result, indicating that there is no difference in 'willingness scale' level between urban and rural living people in Hengelo, answering the third sub-question.

Finally, an ordinal regression was conducted, which, after successful model fitting, was further extended by a Generalized Linear Models test. Again, insignificant results were found for 'age category', 'urban or rural living' and 'educational level', confirming that indeed living in an urban or rural environment has no impact on an individual's 'willingness scale' level. A significant result was found for the 'gender' variable, indicating with an odds level of .429 that females are more likely to exhibit a higher 'willingness scale' level than males. Additionally, significant results were found for the variables 'climate change believe' and 'drought awareness'. For every unit increase in the continuous variables 'climate change believe' and 'drought awareness', the odds of scoring a higher 'willingness scale' level are respectively 1.420 and 1.955 times higher. Therefore, sub-question four is answered as well; recent drought events generally have increased people's awareness about drought risks, and significantly contribute to people's willingness to take drought mitigation measures.

All in all, the main question is answered by explaining that awareness of recent dry summers does have an influence on people's willingness to implement drought mitigation measures in Hengelo, and that there is no significant difference between urban and rural residents in Hengelo.

The findings of this research offer valuable insights for policymakers and other parties interested in promoting sustainable water management and enhancing drought resilience. Given that the analysis shows that individuals' willingness to adapt is primarily influenced by their perception of the problem rather than personal characteristics, policymakers can adapt their strategies to effectively convince residents in taking drought mitigation measures.

Discussion

Overall, the findings of this research do not fully align with the stated hypothesis. While recent drought events do appear to influence individuals' willingness levels as anticipated, no significant differences were found between rural and urban residents. This finding is in contrast with the expectations based on the research by Edwards (2019) and Iglesias et al. (2021), which suggested that there would be differences. However, different results might be found when analysing other cities or municipalities, as the number of residents in Hengelo is much smaller than in urban areas located in the Randstad (AlleCijfers, 2024b). Furthermore, characteristics such as age, educational level and home ownership were hypothesized to have an influence on an individuals' willingness level, as supported by the theoretical framework. However, non-significant results were found. Where studies by Bishop (2013), González-Hernández et al. (2023), Karanja et al. (2017) and Lübke (2022) all presented varying effects of age an individual's water perception attitude, this new study suggests no relationship at all. Next to that, Osberghaus & Hünewaldt (2023) suggested that home-owners exhibit stronger climate change adaptation behaviour compared to tenants. However, the results of this study, focusing solely on drought adaptation, found no significant differences between homeowners and tenants. The significant relationship between gender and 'willingness scale' indicated that females are more likely to have a higher willingness to adapt drought mitigation measures than males. This result is contrary to the findings of Khodadad et al. (2022), but in line with their preliminary expectations.

However, the results of this research have to be interpreted with careful consideration due to several factors. First of all, the dataset used lacks representativeness, as there is an overrepresentation of younger individuals, and a shortage of elderly. Although the sample size in this research is sufficient for driving valid conclusions, a larger sample would have provided more precise and possibly different results. Moreover, the data collection was initially done by only a snowball sampling method, which might have resulted in a biased sample as it includes people of similar backgrounds and circumstances (Dovetail, 2023). Furthermore, the timing of data collection was during a period in which the Netherlands faced heavy rain and floodings. As this is contradictory to the topic of this study, respondents might have had an influenced view towards the topic of droughts and their experience of the phenomenon, resulting in a lower willingness. Given the potential biases, the contradictory conclusions to the theoretical framework cannot be considered reliable.

For future research, it would be interesting to include additional factors in the analysis, such as the drivers and barriers of implementing drought mitigation measures. This approach would provide a clearer understanding about what is needed to let the respondents actually implement measures, and why people are not willing to implement certain measures.

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Appendix

A1. Survey

Table A8. Survey

1. Wat is uw geslacht?
- Man
- Vrouw
- Anders
- Zeg ik liever niet

2. In welke leeftijdscategorie behoord u?
- 18-25
- 26-40
- 41-55
- 56-70
- 70+

3. Wat is uw hoogst afgeronde onderwijs niveau?
- Lagere school
- Middelbare school
- MBO
- HBO
- WO
- Geen onderwijs gevolgd

4. Wat zijn de 4 cijfers van uw postcode? (bijbehorende letters zijn niet van belang)

____

5. Woont u in een koop- of huurhuis?
- Koophuis
- Huurhuis

6. Wat voor soort buitenruimte heeft u thuis?
- Ik heb een tuin met gras
- Ik heb een tuin zonder gras
- Ik heb een balkon
- Ik heb geen buitenruimte

7. "Ik geloof dat klimaatverandering een echt bestaand probleem is"

Volledig mee oneens						Volledig mee eens
○	○	○	○	○	○	○

8. "Ik geloof dat individuen een positieve impact kunnen hebben tegen klimaatverandering"

Volledig mee oneens						Volledig mee eens
○	○	○	○	○	○	○

9. "Recente zomers hebben mij meer bewust gemaakt over droogte risico's" Volledig mee oneens ○ ○ ○ ○ ○ ○ ○ Volledig mee eens
10. "In periodes van droogte ben ik bereid om minder lang, of minder vaak te douchen" Volledig mee oneens ○ ○ ○ ○ ○ ○ ○ Volledig mee eens
11. "Ik ben bereid om mijn douchekop te vervangen met een waterbesparende douchekop" Volledig mee oneens ○ ○ ○ ○ ○ ○ ○ Volledig mee eens
12. "In periodes van droogte ben ik bereid om mijn watergebruik buitenshuis te verminderen" (gras sproeien / autowassen / privé zwembad vullen) Volledig mee oneens ○ ○ ○ ○ ○ ○ ○ Volledig mee eens
13. "Ik ben bereid om tegels in mijn tuin of oprit te vervangen met vegetatie (gras / planten) of water doorlaatbare tegels" Volledig mee oneens ○ ○ ○ ○ ○ ○ ○ Volledig mee eens
14. "Ik ben bereid om een regenton te installeren aan mijn regenpijp, zodat ik dit water later kan gebruiken voor het besproeien van mijn tuin" Volledig mee oneens ○ ○ ○ ○ ○ ○ ○ Volledig mee eens
15. "Ik ben bereid om mijn regenpijp los te koppelen van de riolering, zodat het regenwater kan infiltreren in mijn tuin" Volledig mee oneens ○ ○ ○ ○ ○ ○ ○ Volledig mee eens
16. "In periodes van droogte ben ik bereid om te accepteren dat mijn gras geel zal worden zonder water" Volledig mee oneens ○ ○ ○ ○ ○ ○ ○ Volledig mee eens
17. Is er iets wat u zou willen toevoegen over uw redenering, of wilt u nog iets anders delen met betrekking tot het onderwerp van dit onderzoek?

A2. Flyer leading towards survey

Figure A7. Flyer leading to survey

B1. Representativeness initial snowball sampling

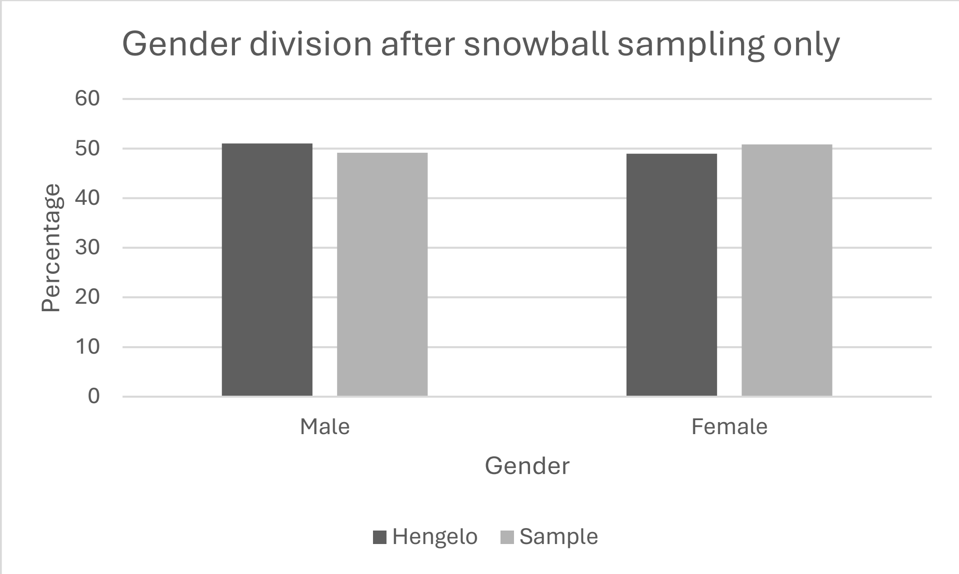

Figure A8. Representativeness Gender, snowball sampling only

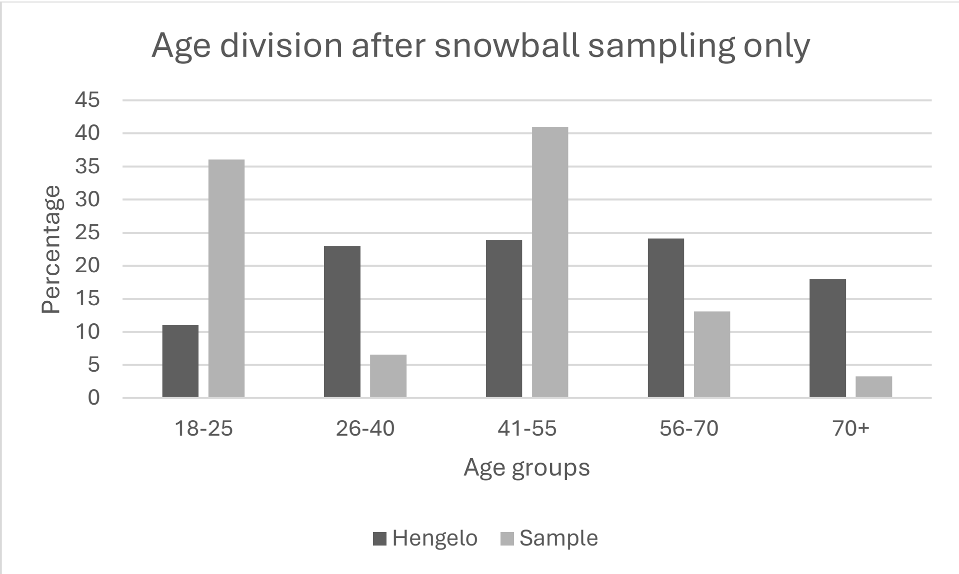

Figure A9. Representativeness Age, snowball sampling only

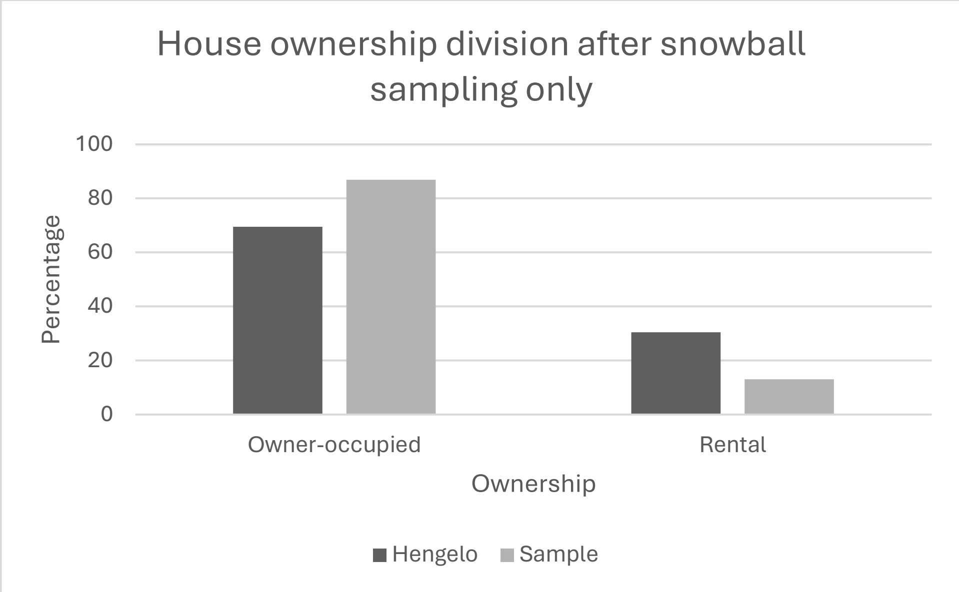

Figure A10. Representativeness House ownership, snowball sampling only

C1. Frequency analysis

Table A9. Frequency analysis all statements

Variable	*N*	*Level*	*Frequency*	*Percentage*
"I believe that climate change is a real existing problem"	131	Strongly disagree	5	3.8
		Disagree	3	2.3
		Somewhat disagree	2	1.5
		Neutral	9	6.9
		Somewhat agree	24	18.3
		Agree	26	19.8
		Strongly agree	62	47.3
"I believe that individuals can have a positive impact against climate change"	131	Strongly disagree	3	2.3
		Disagree	12	9.2
		Somewhat disagree	11	8.4
		Neutral	23	17.6
		Somewhat agree	26	19.8
		Agree	26	19.8
		Strongly agree	30	22.9
"Recent dry summers have made me more aware of drought risks"	131	Strongly disagree	6	4.6
		Disagree	9	6.9
		Somewhat disagree	9	6.9
		Neutral	11	8.4
		Somewhat agree	36	27.5
		Agree	33	25.2
		Strongly agree	27	20.6
"During periods of drought, I am willing to take shorter or fewer showers"	131	Strongly disagree	4	3.1
		Disagree	10	7.6
		Somewhat disagree	9	6.9
		Neutral	20	15.3
		Somewhat agree	33	25.2
		Agree	24	18.3
		Strongly agree	31	23.7
	131	Strongly disagree	4	3.1

"I am willing to replace my showerhead with a water-saving showerhead"		Disagree	8	6.1
		Somewhat disagree	10	7.6
		Neutral	11	8.4
		Somewhat agree	20	16.3
		Agree	25	19.1
		Strongly agree	53	40.5
"During periods of drought, I am willing to reduce my outside water usage" (lawn watering / car washing / private swimming pool)	131	Strongly disagree	5	3.8
		Disagree	4	3.1
		Somewhat disagree	8	6.1
		Neutral	11	8.4
		Somewhat agree	28	21.4
		Agree	32	24.4
		Strongly agree	43	32.8
"I am willing to replace tiles in my garden or driveway with vegetation (gras / plants) or permeable tiles"	131	Strongly disagree	9	6.9
		Disagree	9	6.9
		Somewhat disagree	14	10.7
		Neutral	23	17.6
		Somewhat agree	21	16.0
		Agree	26	19.8
		Strongly agree	29	22.1
"I am willing to install a rain barrel to my drainpipe . so I can use this water for watering my garden"	131	Strongly disagree	2	1.5
		Disagree	8	6.1
		Somewhat disagree	3	2.3
		Neutral	19	14.5
		Somewhat agree	20	15.3
		Agree	27	20.6
		Strongly agree	52	39.7
"I am willing to disconnect my drainpipe from the sewerage, to let rainwater infiltrate in my garden"	131	Strongly disagree	7	5.3
		Disagree	14	10.7
		Somewhat disagree	10	7.6
		Neutral	21	16.0
		Somewhat agree	38	29.0
		Agree	17	13.0
		Strongly agree	24	18.3
"During periods of drought, I am willing to accept that my gras will turn yellow without water"	131	Strongly disagree	7	5.3
		Disagree	9	6.9
		Somewhat disagree	9	6.9
		Neutral	22	16.8
		Somewhat agree	23	17.6
		Agree	31	23.7
		Strongly agree	30	22.9
Willingness scale	131	Very low willingness	3	2.3
		Low willingness	6	4.6
		Moderate willingness	9	6.9
		High willingness	35	26.7
		Very high willingness	54	41.2
		Extremely high willingness	24	18.3
Total			131	100.0

C2. Descriptive analysis drought mitigation measures

Table A10. Descriptives drought mitigation measures

Variable	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
"During periods of drought, I am willing to take shorter or fewer showers"	131	1	7	5.02	1.659

“I am willing to replace my showerhead with a water-saving showerhead”	131	1	7	5.46	1.746
“During periods of drought, I am willing to reduce my outside water usage” (lawn watering / car washing / private swimming pool)	131	1	7	5.45	1.609
“I am willing to replace tiles in my garden or driveway with vegetation (gras / plants) or permeable tiles”	131	1	7	4.77	1.838
“I am willing to install a rain barrel to my drainpipe . so I can use this water for watering my garden”	131	1	7	5.56	1.589
“I am willing to disconnect my drainpipe from the sewerage, to let rainwater infiltrate in my garden”	131	1	7	4.65	1.745
“During periods of drought, I am willing to accept that my gras will turn yellow without water”	131	1	7	4.97	1.758
Valid N (listwise)	131				

Table A11. Descriptives drought mitigation measures (Urban)

Variable	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
“During periods of drought, I am willing to take shorter or fewer showers”	74	1	7	5.08	1.789
“I am willing to replace my showerhead with a water-saving showerhead”	74	1	7	5.32	1.190
“During periods of drought, I am willing to reduce my outside water usage” (lawn watering / car washing / private swimming pool)	74	1	7	5.53	1.590
“I am willing to replace tiles in my garden or driveway with vegetation (gras / plants) or permeable tiles”	74	1	7	4.82	1.778
“I am willing to install a rain barrel to my drainpipe . so I can use this water for watering my garden”	74	1	7	5.59	1.621
“I am willing to disconnect my drainpipe from the sewerage, to let rainwater infiltrate in my garden”	74	1	7	4.53	1.889
“During periods of drought, I am willing to accept that my gras will turn yellow without water”	74	1	7	5.14	1.682
Valid N (listwise)	74				

Table A12. Descriptives drought mitigation measures (Rural)

Variable	*N*	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
“During periods of drought, I am willing to take shorter or fewer showers”	57	1	7	4.93	1.486
“I am willing to replace my showerhead with a water-saving showerhead”	57	1	7	5.63	1.508
“During periods of drought, I am willing to reduce my outside water usage” (lawn watering / car washing / private swimming pool)	57	1	7	5.35	1.642
“I am willing to replace tiles in my garden or driveway with vegetation (gras / plants) or permeable tiles”	57	1	7	4.70	1.927
“I am willing to install a rain barrel to my drainpipe . so I can use this water for watering my garden”	57	1	7	5.53	1.560
“I am willing to disconnect my drainpipe from the sewerage, to let rainwater infiltrate in my garden”	57	1	7	4.81	1.540
“During periods of drought, I am willing to accept that my gras will turn yellow without water”	57	1	7	4.75	1.845
Valid N (listwise)	74				

D1. Bivariate analysis Urban/Rural and Drought mitigation measures

Table A13. Bivariate analysis Urban/Rural living and Drought mitigation measures (Mann-Whitney U)

	Urban or rural living	*N*	*Mean Rank*	*Sum of Ranks*
“During periods of drought, I am willing to take shorter or fewer showers”	Urban	74	68.56	5073.50
	Rural	57	62.68	3572.50
	Total	131		
“I am willing to replace my showerhead with a water-saving showerhead”	Urban	74	64.79	4794.50
	Rural	57	67.57	3851.50
	Total	131		
“During periods of drought, I am willing to reduce my outside water usage” (lawn watering / car washing / private swimming pool)	Urban	74	67.90	50.24.50
	Rural	57	64.54	3621.50
	Total	131		
“I am willing to replace tiles in my garden or driveway with vegetation (gras / plants) or permeable tiles”	Urban	74	66.76	4940.00
	Rural	57	65.02	6706.00
	Total	131		
	Urban	74	67.26	4977.50

"I am willing to install a rain barrel to my drainpipe . so I can use this water for watering my garden"	Rural	57	64.36	3668.50
	Total	131		
"I am willing to disconnect my drainpipe from the sewerage, to let rainwater infiltrate in my garden"	Urban	74	64.05	4739.50
	Rural	57	68.54	3906.50
	Total	131		
"During periods of drought, I am willing to accept that my gras will turn yellow without water"	Urban	75	69.08	5112.00
	Rural	57	62.00	3534.00
	Total	131		

Test statistics[a]

	"During periods of drought, I am willing to take shorter or fewer showers"	"I am willing to replace my showerhead with a water-saving showerhead"	"During periods of drought, I am willing to reduce my outside water usage" (lawn watering / car washing / private swimming pool)	"I am willing to replace tiles in my garden or driveway with vegetation (gras / plants) or permeable tiles"	"I am willing to install a rain barrel to my drainpipe . so I can use this water for watering my garden"	"I am willing to disconnect my drainpipe from the sewerage, to let rainwater infiltrate in my garden"	"During periods of drought, I am willing to accept that my gras will turn yellow without water"
Mann-Whitney U	1915.500	2019.500	1968.500	2053.000	2015.500	1964.500	1881.000
Wilcoxon W	3572.500	4794.500	3621.500	3706.000	3668.500	4739.500	3534.000
Z	-.898	-.533	-.673	-.264	-.452	-.684	-1.078
Asymp. Sig 2-tailed	.369	.665	.501	.792	.651	.494	.281

a. Grouping variable: Urban or rural living

D2. Bivariate analysis variables with willingness scale

Table A14. Test result bivariate analysis Gender (Mann-Whitney U-test)

	Gender	*N*	*Mean Rank*	*Sum of Ranks*
Willingness scale	Male	60	57.38	3443.00
	Female	71	73.28	5203.00
	Total	131		

Test statistics[a]

	Willingness scale
Mann-Whitney U	1613.000
Wilcoxon W	3443.000
Z	-2.511
Asymp. Sig 2-tailed	.012

a. Grouping variable: Gender

Table A15. Test result bivariate analysis Age category (Spearman's rho)

			Willingness scale	*Age category*
Spearman's rho	Willingness scale	Correlation coefficient	1.000	.305**
		Sig. (2-tailed)	.	<.001
		N	131	131
	Age category	Correlation coefficient	.305**	1.000
		Sig. (2-tailed)	<.001	.
		N	131	131

**. Correlation is significant at the 0.001 level (2-tailed)

Table A16. Test result bivariate analysis Highest finished educational level (Spearman's rho)

			Willingness scale	*Highest finished educational level*
Spearman's rho	Willingness scale	Correlation coefficient	1.000	.108
		Sig. (2-tailed)	.	.220
		N	131	131
	Highest finished educational level	Correlation coefficient	.108	1.000
		Sig. (2-tailed)	.220	.
		N	131	131

Table A17. Test result bivariate analysis Urban / Rural living (Mann-Whitney U test)

	Urban or rural living	*N*	*Mean Rank*	*Sum of Ranks*
Willingness scale	Urban	74	66.75	4939.50
	Rural	57	65.03	3706.50
	Total	131		

Test statistics[a]

	Willingness scale
Mann-Whitney U	2053.500
Wilcoxon W	3706.500
Z	-.271
Asymp. Sig 2-tailed	.786

b. Grouping variable: Urban or rural living

Table A18. Test result bivariate analysis Owner-occupied / Rental house (Mann-Whitney U test)

	Owner-occupied or rental house	*N*	*Mean Rank*	*Sum of Ranks*
Willingness scale	Owner-occupied	112	66.28	7423.50
	Rental	19	64.34	1222.50
	Total	131		

Test statistics[a]

	Willingness scale
Mann-Whitney U	1032.500
Wilcoxon W	1222.500
Z	-.217
Asymp. Sig 2-tailed	.829

a. Grouping variable: Owner-occupied or rental house

Table A19. Test result bivariate analysis Type of outdoor space (Kruskal-Wallis test)

	Type of outdoor space	*N*	*Mean Rank*
Willingness scale	Garden with grass	83	70.17
	Garden without grass	40	58.24
	Balcony	7	65.21
	No outside space	1	36.00
	Total	131	

Test statistics[a,b]

	Willingness scale
Kruskal-Wallis H	3.650
df	3
Asymp. Sig.	.302

a. Kruskal Wallis Test
b. Grouping variable: Type of outdoor space

Table A20. Test result bivariate analysis Climate change believe (Spearman's rho)

			Willingness scale	"I believe that climate change is a real existing problem"
Spearman's rho	Willingness scale	Correlation coefficient	1.000	.486**
		Sig. (2-tailed)	.	<.001
		N	131	131
	"I believe that climate change is a real existing problem"	Correlation coefficient	.486**	1.000
		Sig. (2-tailed)	<.001	.
		N	131	131

**. Correlation is significant at the 0.001 level (2-tailed)

Table A21. Test result bivariate analysis Climate change impact (Spearman's rho)

			Willingness scale	"I believe that individuals can have a positive impact against climate change"
Spearman's rho	Willingness scale	Correlation coefficient	1.000	.519**
		Sig. (2-tailed)	.	<.001
		N	131	131
	"I believe that individuals can have a	Correlation coefficient	.519**	1.000
		Sig. (2-tailed)	<.001	.

	positive impact against climate change"	N	131	131

**. Correlation is significant at the 0.001 level (2-tailed)

Table A22. Test result bivariate analysis Drought awareness (Spearman's rho)

			Willingness scale	"Recent dry summers have made me more aware of drought risks"
Spearman's rho	Willingness scale	Correlation coefficient	1.000	.538**
		Sig. (2-tailed)	.	<.001
		N	131	131
	"Recent dry summers have made me more aware of drought risks"	Correlation coefficient	.538**	1.000
		Sig. (2-tailed)	<.001	.
		N	131	131

**. Correlation is significant at the 0.001 level (2-tailed)

E1. Multivariate analysis. Multicollinearity

Table A23. Test result linear regression for multicollinearity all variables

	Unstandardized coefficients		*Standardized coefficients*			*Collinearity statistics*	
Coefficients[a]	*B*	*Std. Error*	*Beta*	*t*	*Sig.*	*Tolerance*	*VIF*
(Constant)	1.444	.721		2.003	.047		
Gender	.363	.154	.158	2.360	.020	.951	1.052
Age category	.057	.071	.059	.807	.421	.799	1.252
Highest finished educational level	-.048	.091	-.037	-.524	.601	.481	1.190
Urban or rural living	.081	.160	.035	.506	.614	.890	1.123
Owner-occupied or rental house	.202	.240	.063	.843	.401	.779	1.283
Type of outdoor space	-.257	.137	-.142	-1.871	.064	.742	1.347
"I believe that climate change is a real existing problem"	.110	.071	.148	1.539	.126	.465	2.152
"I believe that individuals can have a positive impact against climate change"	.133	.066	.195	2.021	.056	.459	2.176
"Recent dry summers have made me more aware of drought risks"	.265	.064	.388	4.171	<.001	.496	2.016

a. Dependent variable: Willingness scale

Table A24. Test result linear regression for multicollinearity limited variables

	Unstandardized coefficients		*Standardized coefficients*			*Collinearity statistics*	
Coefficients[a]	*B*	*Std. Error*	*Beta*	*t*	*Sig.*	*Tolerance*	*VIF*
(Constant)	1.520	.498		3.049	.003		
Gender	.370	.154	.162	2.405	.018	.969	1.302

Age category	.096	.069	.100	1.401	.164	.865	1.156
Urban or rural living	.026	.158	.011	.163	.871	.928	1.077
Type of outdoor space	-.238	.123	-.132	-1.928	.056	.937	1.067
"I believe that climate change is a real existing problem"	.178	.064	.240	2.806	.006	.596	1.678
"Recent dry summers have made me more aware of drought risks"	.289	.062	.422	4.686	<.001	.538	1.858

b. Dependent variable: Willingness scale

E2. Multivariate analysis. Ordinal regression

Table A25. Case Processing Summary ordinal regression

		N	*Marginal Percentage [%]*
Willingness scale	Very low willingness	3	2.3
	Low willingness	6	4.6
	Moderate willingness	9	6.9
	High willingness	35	26.7
	Very high willingness	54	41.2
	Extremely high willingness	24	18.3
Gender	Male	60	45.8
	Female	71	54.2
Age category	18-25	27	20.6
	26-40	22	16.8
	41-55	44	33.6
	56-70	31	23.7
	70+	7	5.3
Urban or rural living	Urban	74	56.5
	Rural	57	43.5
Type of outside space	Garden with grass	83	63.4
	Garden without grass	40	30.5
	Balcony	7	5.3
	No outside space	1	.8
Valid		131	100
Missing		0	
Total		131	

Table A26. Model fitting information

Model	*-2 Log Likelihood*	*Chi-Square*	*df*	*Sig.*
Intercept only	361.943			
Final	285.953	75.990	11	<.001

Link function: Logit.

Table A27. Goodness-of-Fit

	Chi-Square	*df*	*Sig.*
Pearson	867.147	559	<.001
Deviance	271.619	559	1.000

Link function: Logit.

Table A28. Pseudo R-Square

Cox and Snell	.440

Nagelkerke	.466
McFadden	.201

Link function: Logit.

Table A29. Parameter estimates

		Estimate	Std. Error	Wald	Df	Sig.	95% confidence interval Lower Bound	Upper Bound
Threshold	[Willingness_Scale = 1]	.904	2.403	.142	1	.707	-3.806	5.614
	[Willingness_Scale = 2]	2.363	2.365	.998	1	.318	-2.272	6.998
	[Willingness_Scale = 3]	3.634	2.371	2.349	1	.125	-1.013	8.282
	[Willingness_Scale = 4]	6.062	2.438	6.183	1	.013	1.284	10.841
	[Willingness_Scale = 5]	8.603	2.478	12.058	1	<.001	3.747	13.459
Location	ClimateChange	.351	.145	5.870	1	.015	.067	.634
	DroughtAwareness_RecentSummers	.671	.152	19.386	1	<.001	.372	.969
	[Gender = 1]	-.846	.360	5.524	1	.019	-1.552	-.141
	[Gender = 2]	0[a]	.	.	0	.	.	.
	[Age_category = 1]	-.992	.873	1.293	1	.256	-2.703	.718
	[Age_category = 2]	-.434	.870	.249	1	.618	-2.140	1.271
	[Age_category = 3]	-.460	.808	.324	1	.569	-2.044	1.124
	[Age_category = 4]	-.034	.828	.002	1	.967	-1.656	1.588
	[Age_category = 5]	0[a]	.	.	0	.	.	.
	[Urban_rural = 1]	-.111	.350	.100	1	.752	-7.96	.575
	[Urban_rural = 2]	0[a]	.		0	.	.	.
	[Outdoor_space = 1]	2.063	1.989	1.076	1	.300	-1.834	5.961
	[Outdoor_space = 2]	1.505	2.007	.562	1	.454	-2.429	5.438
	[Outdoor_space = 3]	1.275	2.134	.357	1	.550	-2.906	5.457
	[Outdoor_space = 4]	0[a]	.	.	0	.	.	.

Link function: Logit.

a. This parameter is set to zero because it is redundant.

Table A30. Test of Parallel Lines[a]

Model	*-2 Log Likelihood*	*Chi-Square*	*df*	*Sig.*
Null Hypothesis	285.953			
General	261.343[b]	24.610[c]	44	.992

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.[a]

a. Link function: Logit

E3. Multivariate analysis: Generalized Linear Models

Table A31. Model information

Dependent Variable	Willingness scale[a]
Probability Distribution	Multinomial
Link Function	Cumulative logit

a. The procedure applies the cumulative link

Table A32. Case Processing Summary

Included	131	100.0%
Excluded	0	0.0%
Total	131	100.0%

Table A33. Categorial variable information

			N	*Marginal Percentage [%]*
Dependent variable	Willingness scale	Very low willingness	3	2.3
		Low willingness	6	4.6
		Moderate willingness	9	6.9
		High willingness	35	26.7
		Very high willingness	54	41.2
		Extremely high willingness	24	18.3
Factor	Gender	Male	60	45.8
		Female	71	54.2
	Age category	18-25	27	20.6
		26-40	22	16.8
		41-55	44	33.6
		56-70	31	23.7
		70+	7	5.3
	Urban or rural living	Urban	74	56.5
		Rural	57	43.5
	Type of outside space	Garden with grass	83	63.4
		Garden without grass	40	30.5
		Balcony	7	5.3
		No outside space	1	.8
		Total	131	100

Table A34. Continuous variable information

		N	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Covariate	"I believe that climate change is a real existing problem"	131	1	7	5.82	1.542
	"recent dry summers have made me more aware of drought risks"	131	1	7	5.05	1.675

Table A35. Goodness of Fit[a]

	Value	*df*	*Value/df*
Deviance	271.619	559	.486
Scaled deviance	271.619	559	
Pearson Chi-Square	867.147	559	1.551
Loh Likelihood[b]	867.147	559	
Akaike's Information Criterion (AIC)	317.953		
Finite Sample Corrected AIC (AICC)	322.756		
Bayesian Information Criterion (BIC)	363.956		
Consistent AIC (CAIC)	379.956		

Dependent variable: Willingness scale

Model: (Threshold), Gender, Age category, Urban or rural living, Type of outdoor space, "I believe that climate change is a real existing problem", "Recent dry summers have made me more aware of drought risks"

a. Information criteria are in smaller-is-better form

b. The full log likelihood function is displayed and used in computing information criteria

Table A36. Omnibus Test[a]

Likelihood Ratio Chi-Square	*df*	*Sig.*
75.990	11	<.001

Dependent variable: Willingness scale

Model: (Threshold), Gender, Age category, Urban or rural living, Type of outdoor space, "I believe that climate change is a real existing problem", "Recent dry summers have made me more aware of drought risks"

a. Compares the fitted model against the thresholds-only model.

Table A37. Tests of Model Effects

Source	*Likelihood Ratio Chi-Square*	*df*	*Sig.*
Gender	5.508	1	.019
Age category	3.630	4	.458
Urban or rural living	.102	1	.750
Type of outside space	3.656	3	.301
"I believe that climate change is a real existing problem"	5.801	1	.016
"recent dry summers have made me more aware of drought risks"	20.353	1	<.001

Dependent variable: Willingness scale

Model: (Threshold), Gender, Age category, Urban or rural living, Type of outdoor space, "I believe that climate change is a real existing problem", "Recent dry summers have made me more aware of drought risks"

Table A38. Parameter Estimates

				95% Wald confidence interval		*Hypothesis Test*				*95% Wald Confidence Interval for Exp(B)*	
		B	*Std. Error*	*Lower*	*Upper*	*Wald Chi-square*	*df*	*Sig.*	*Exp(B)*	*Lower Bound*	*Upper Bound*
Threshold	[Willingness_Scale = 1]	.904	2.2582	-.3522	5.330	.160	1	.689	2.470	.030	206.435
	[Willingness_Scale = 2]	2.363	2.2245	-1.997	6.723	1.128	1	.288	10.619	.136	831.064
	[Willingness_Scale = 3]	3.634	2.2401	-.756	8.025	2.632	1	.105	37.879	.469	3056.410
	[Willingness_Scale = 4]	6.062	2.3041	1.547	10.578	6.923	1	.009	429.400	4.695	39271.688
	[Willingness_Scale = 5]	8.603	2.3467	4.004	13.202	13.440	1	<.001	5447.406	54.791	541593.018
[Gender = 1]		-.846	.3642	-1.560	-.133	5.402	1	.020	.429	.210	.876
[Gender = 2]		0[a]	.	.	.	.	.	.	1	.	.
[Age_category = 1]		-.992	.9226	-2.800	.816	1.157	1	.282	.371	.061	2.261
[Age_category = 2]		-.434	.9309	-2.259	1.390	.218	1	.641	.648	.104	4.016
[Age_category = 3]		-.460	.8693	-2.164	1.244	.280	1	.597	.631	.115	3.469
[Age_category = 4]		-.034	.8842	-1.767	1.699	.001	1	.969	.967	.171	5.469
[Age_category = 5]		0[a]	.	.	.	.	.	.	1	.	.
[Urban_rural = 1]		-.111	.3465	-.790	.568	.102	1	.750	.895	.454	1.766
[Urban_rural = 2]		0[a]	.	.	.	.	.	.	1	.	.
[Outdoor_space = 1]		2.063	1.7800	-1.426	5.552	1.343	1	.246	7.871	.240	257.740
[Outdoor_space = 2]		1.505	1.7986	-2.020	5.030	.700	1	.403	4.503	.133	152.912
[Outdoor_space = 3]		1.275	2.0267	-2.697	5.247	.396	1	.529	3.580	.167	190.089
[Outdoor_space = 4]		0[a]	.	.	.	.	.	.	1	.	.
Climate change believe		.351	1.1481	.060	.641	5.600	1	.018	1.420	1.062	1.898
Drought awareness		3671	.1528	.371	.970	19.262	1	<.001	1.955	1.449	2.638
(Scale)		1[b]									

Dependent variable: Willingness scale

Model: (Threshold), Gender, Age category, Urban or rural living, Type of outdoor space, "I believe that climate change is a real existing problem", "Recent dry summers have made me more aware of drought risks"

a. Set to zero because this parameter is redundant
b. Fixed at the displayed value