Differences in Beef Consumption, Sustainable Behavior and Awareness of Climate Change

A comparative study between residents of urban and rural areas in the Northern Netherlands

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Abstract

The relevance of discussing the environmental impacts generated by beef production has been widely put on the table in international conferences and panels worldwide, and pledges and goals have been settled in an attempt to reduce those impacts on a global scale. In the Netherlands, farmland is one of the most common land use, especially in the Northern region, with extensive grazing livestock use. The majority of the Dutch population believes in climate change, however, there is limited data available implying whether and how this acknowledgment reflects sustainable behavior in the Dutch Northern region. Therefore, the aim of this research is to fill a gap in the literature in terms of whether Beef Consumption, Sustainable Behavior, and Awareness of Climate Change differ between residents of Urban and Rural Areas in the Northern Netherlands. An online questionnaire-based survey was held among residents of the provinces of Groningen, Friesland, and Drenthe and 170 respondents participated in this study. Descriptive and inferential statistics show that the area of residence plays a significant role in terms of weekly beef consumption, but does not play an important role in terms of sustainable behavior and awareness of climate change. Residents of rural areas were revealed to consume more beef on a weekly basis than residents of urban areas in the Northern Netherlands, and the socio-demographic factor age was identified to also play a role in beef consumption patterns, of which the youngest age group (18-23 years old) was revealed to consume less beef when compared to the senior age group (46-65 years old) of this study.

Keywords: beef consumption; sustainable behavior; climate change; differences between urban and rural; regional-scale

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1.   Introduction
1.1.   Background

Beef production has several distinct and significant impacts on the environment. More agricultural land is used to raise cattle than all other domesticated animals and crops combined. In addition, cattle eat an increasing proportion of grain produced from agriculture, are one of the most significant contributors to water pollution and soil degradation, and are a major source of greenhouse gas emissions. Furthermore, beef production has a considerable effect on climate change due to emissions of greenhouse gases such as methane, nitrous oxide, and carbon dioxide. Research shows that ruminant livestock account for between 7% and 18% of global methane emissions from human-related activities (World Wild Life, 2022). The Intergovernmental Panel on Climate Change (IPCC) report of February 2022 established that climate change is linked to global trends such as unsustainable use of natural resources, growing urbanization, social inequalities, food production systems, and more. National governments must strengthen their collaboration with cities, regions, the private sector, and civil society in order to deliver policies to adapt and mitigate climate change and create a climate-resilient future (IPCC, 2022). Recently, the United Nations Climate Change Conference UK 2021 in Glasgow put on table four big initiatives to keep the goal established in The Paris Agreement to limit global warming to 1.5 degrees Celsius (UNFCCC, 2015) on coal, finance, methane, and deforestation. On one of those four, methane, the United States, the European Union, and partners formally launched the Global Methane Pledge, which aims to reduce global methane emissions by at least 30 percent from 2020 levels by 2030, which could eliminate over 0.2 degrees Celsius warming by 2050 (Global Methane Pledge, 2021). Effects of land-use changes are included in estimates of life-cycle greenhouse gas (GHG) emissions, so-called carbon footprints (CFs), from food production. Their omission can lead to serious underestimates, particularly for meat (Cederberg et al., 2011). Moreover, deforestation, the second-largest source of anthropogenic GHG emissions, is largely driven by expanding forestry, agriculture, and pasture land to raise cattle (Pendrill et al., 2019).

1.2.   Research problem

The livestock sector is a significant contributor to global human-induced GHG emissions. Livestock supply chains emitted an estimated total of 8.1 gigatonnes CO2-eq in 2010. Methane (CH_4) accounts for about 50 percent of the total. Beef meat and cattle milk are the two commodities with the highest total emissions, accounting for 3.0 and 1.6 gigatonnes CO2-eq, respectively, according to the Global Livestock Environmental Assessment Model (GLEAM, 2017). Beef, soy, and palm oil are responsible for 60% of tropical deforestation. Beef stands out immediately (Pendrill et al., 2019) and the majority (77%) of the world's soy is fed to livestock for meat and dairy production (United States Department of Agriculture, 2021). The expansion of pasture land to raise cattle was responsible for 41% of tropical deforestation in 2019. That's

2.1 million hectares every year – about half the size of the Netherlands (Pendrill et al., 2019). Emissions reduction from the livestock sector can be achieved by reducing production and consumption, lowering emission intensity of production, or a combination of the two (GLEAM, 2017). In the Northern Netherlands region, agriculture is a very prominent land use (Statistics Netherlands, 2015). Figure 1 shows that in the provinces of Groningen, Friesland, and Drenthe, a great part of the total surface area is used as farmland, with Drenthe presenting a large proportion of farmland at 70 percent (Statistics Netherlands, 2015).
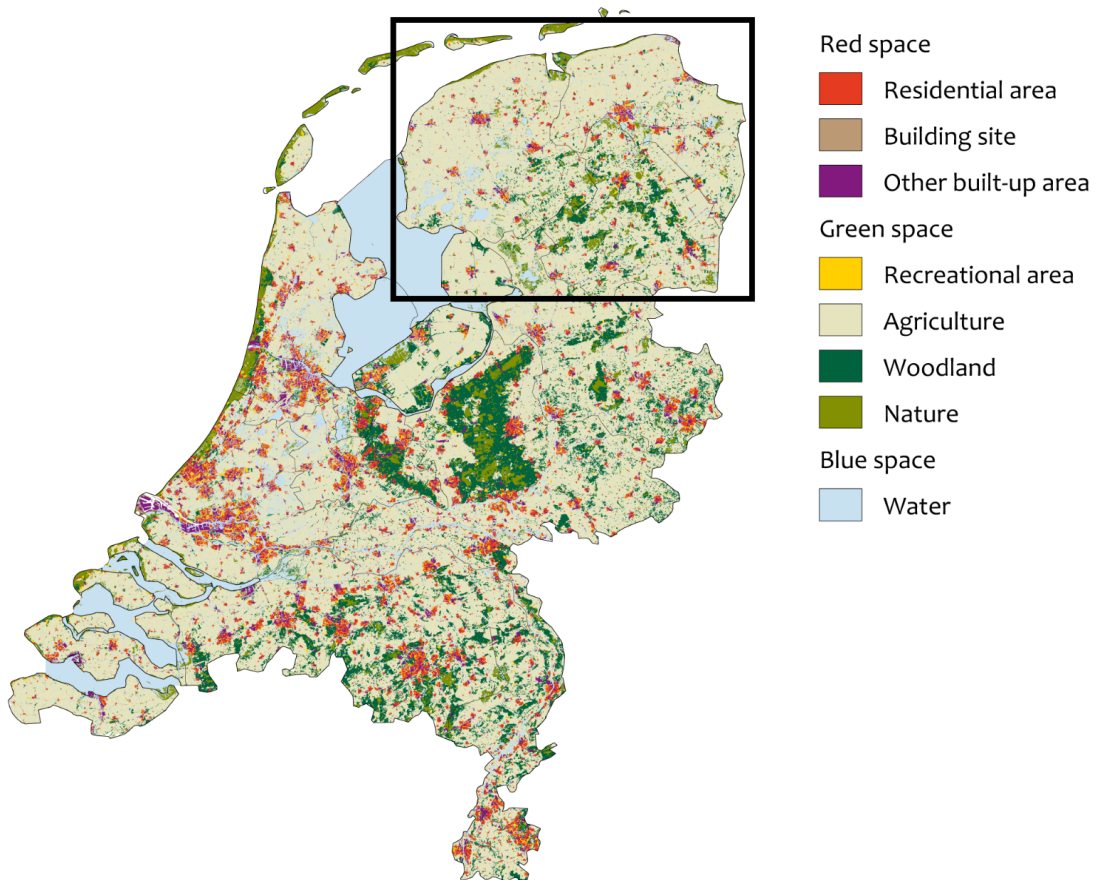
Figure 1 - Land use in the Netherlands in 2015 with the Northern region highlighted (Statistics Netherlands, 2015).

The main geographical differentiation in land-based agriculture is between arable farming and grazing livestock, mainly dairy farming (Boere, 2015). In the Northern region, arable farming is mostly located in the provinces of Groningen and East-Drenthe, whereas dairy farming is mostly located in the provinces of Friesland and Drenthe (see figure 2).

Figure 2 - Agricultural land use in the Northern Netherlands in 2013 (Agricultural Economics Research Institute, 2014).

1.3.   Research gap and societal value

According to Statistics Netherlands, societal awareness is at an all-time high with 94% of Dutch adults believing in climate change (Statistics Netherlands, 2021). A majority of the population of the Netherlands is aware that climate change is a problem and is concerned about the consequences for future generations. However, this awareness does not always translate into sustainable action (Statistics Netherlands, 2021). A research conducted by de Boer et al. (2012) based on a nationwide sample of 1083 consumers in the Netherlands, with the central question of how consumers will respond to the idea of eating less meat for mitigating climate change, shows that consumers tend to have some resistance when simple calls to eat less meat in order to mitigate climate change are addressed and suggest that instead of isolating the meat-climate issue, it is preferable to develop an approach that combines multiple values regarding food choices, including health and nature-related values (de Boer et al., 2012). Recently, the Dutch National Institute for Public Health and the Environment (RIVM) published the RIVM SHIFT-DIETS project, which stands for stimulating consumer habits into futureproof total diets, and knowledge is being developed about effective interventions and policy measures that stimulate the transition to a diet with more vegetables and fewer animal products, especially among young adults (18-35 years old), because different lifestyles are developed in this group, including dietary habits (RIVM, 2020). This project is part of the RIVM Strategic Programme, within the themes Integrated Food Policy and Perception and Behavior. Additionally, in association with the Dutch National Institute for Public Health and the Environment, the Netherlands Nutrition Center has started to decode research done on food consumption for the public to promote awareness of the impact of consumption patterns (Voedingscentrum, 2021). There is limited data available implying that the acknowledgment of the environmental crisis results in sustainable responsible behavior in the Netherlands. Also, no relevant data comparing urban and rural beef consumption patterns in Dutch regions was found. These facts show the complexity of relationships between beef consumption, sustainable behavior, and awareness of climate change, and the need for this topic to be addressed in the Netherlands. For this study, the

Northern region will be highlighted, due to the noticeable agricultural land use with a great part used for grazing livestock.

1.4.   Research aim and research questions

The aim of this research is to identify to what extent beef consumption, sustainable behavior, and awareness of climate change differ between residents of urban and rural areas in the Northern Netherlands.

Therefore, the main question that arises is:

Q.1.: To what extent do beef consumption, sustainable behavior and awareness of climate change differ between residents of urban and rural areas in the Northern Netherlands?

In order to answer the main research question, secondary questions are settled:

Q.2.1.: What role does the area of residence play in beef consumption?*

Q.2.2.: What role does the area of residence play in sustainable behavior?*

Q.2.3.: What role does the area of residence play in awareness of climate change?*

Q.2.4.: What role do socio-demographic factors play in beef consumption, sustainable behavior and awareness of climate change?**

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*These questions are settled to support the comparative analysis of independent variables (urban and rural areas) and dependent variables (beef consumption, sustainable behavior and awareness of climate change).
**This question is settled to include socio-demographic factors as a second layer for this analysis.

1.5.   Thesis structure

In chapter 2 the theoretical framework is elaborated upon, including a conceptual model. Chapter 3 describes the methodology that was used to collect and analyze data and ethical considerations. The results of the statistical analyses are summarized and null hypotheses are presented in chapter 4. Finally, in chapter 5, the research questions are answered, conclusions are made and suggestions for future research are given. After the reference list, the questionnaire used in the survey can be found in Appendix I, powered by Qualtrics XM Platform™. Appendix II contains the bar charts of sociodemographic factors, beef consumption and sustainable behavior, generated by means of IBM SPSS® Statistics 28.

2.   Theoretical framework

For this research, the topic "*Regions Against Climate Change*" will be addressed and the subject of "*Beef Consumption"* was selected. In order to provide a substantial foundation for the correlation and relevance of this matter concerned, a theoretical framework is presented, raising Sustainable Food Consumption, Dutch Meat Consumption, and Urban and Rural Areas as the core themes.

2.1.   Sustainable food consumption

The current dietary advice in the Netherlands, promoted by the Dutch National Institute for Public Health and the Environment, defines sustainable food as *"food that meets people's nutritional needs, both now and in the future, while at the same time protecting ecosystems"* (RIVM, 2022). One step towards a more sustainable dietary pattern is to choose more plant-based foods instead of animal-based foods. Meat, dairy, and cheese account for most of the daily greenhouse gas emissions of the Dutch diet. More plant-based food consumption is needed to achieve healthier as well as environmentally friendly diets (RIVM, 2022). Sustainable Food Consumption outlines various goals such as consuming local products, decrease in meat consumption and processed products, increase in fruit and vegetable consumption, and generally consuming products that have small ecological, carbon, and water footprints. Therefore it can be studied and researched from perceptions or attitudes as a way to discover why people choose certain types of food (Kamenidou et al. 2019). Food consumption is amongst the main drivers of environmental impacts. On one hand, there is the need to fulfill a fundamental human need for nutrition, and on the other hand, this poses critical threats to the environment (Notarnicola et al., 2017). A study on the environmental impact of the average food consumption of European citizens was conducted by Notarnicola et al. (2017) and it was assessed using the International Reference Life Cycle Data System (ILCD) methodology. The overall results indicate that, for most of the impact categories, the consumed foods with the highest environmental burden are meat products (beef, pork, and poultry) and dairy products (cheese, milk, and butter). Beef meat, for instance, is the meat-product food type with the greatest environmental burden. Although its annual consumption is the lowest of all the meat products in the BoP (13.7 kg/citizen per year), it has the highest environmental impact per kg (Notarnicola et al., 2017). Reducing animal products from a diet has shown to be related to sustainable behavior, and a study that was made in Ireland, using data from the 2007 Survey of Lifestyles, Attitudes and Nutrition (SLÁN) (Department of Health and Children, 2008), which counts a nationally representative sample of 10,364 adults aged 18 and over, revealed that household size, age, income, and education explain meat and fish consumption; and that marital status, health indicators, and lifestyle are associated with meat and fish consumption (Leahy et al. 2011).

2.2.   Dutch meat consumption

According to the RIVM report *"Meat consumption in the Netherlands"* (RIVM, 2020), 4% of the Dutch never eat meat. This report was supported by the Dutch National Food Consumption Survey 2012-2016, where each participant reported for two days what he or she ate and drank the day before. Of the 12-79 year-olds, 5% ate no meat on either measurement day, 15% ate meat on one of the measurement days and 81% ate meat on both measurement days. Furthermore, 2% indicated a vegetarian (no meat and fish) diet, 1% pescatarian (no meat), and less than 1% vegan (no animal products). Vegetarian, pescatarian, and vegan diets were more common in women than in men. Added together, this 4% corresponds to a fact sheet from the Dutch Vegetarian Association, in which various studies are compared and it is found that 4% of people (almost) never eat meat. Young adults (18-35 years old) eat meat on average 6 days a week. This is slightly less than the other age groups who do this on average on 6.2-6.3 days a week (RIVM, 2020). According to Statistics Netherlands (2021), women have been shown to behave more sustainably than men in day-to-day life. In the Netherlands, the percentage of women who do not eat meat is twice as high as that of men (Statistics Netherlands, 2021). Of the total protein that is consumed, an average of 39% is vegetable and 61% animal. The ratio between animal and vegetable proteins is similar between men and women and the age groups (see figure 3). Young adults eat slightly more vegetable proteins (in grams) compared to the other age groups. In addition, young adults eat relatively the most meat substitutes (on average 2 grams per day). Besides that, highly-educated people eat less meat than low-educated. Low-educated adults eat more meat than highly-educated. Highly-educated young adults (as from holders of a bachelor's degrees or upper degrees) eat meat on average 5.8 days a week, schooled people (holders of up to vocational training, or management and specialist education) 6.2 days, and low-educated people (holders of up to a pre-university secondary education) eat meat on average 6.4 days a week. In terms of quantities, the average meat consumption of the highly educated is also lower than that of middle and lower-educated young adults (see figure 4). Residents of highly urban areas eat almost as much meat and meat products (96 g/day) as residents of non-urban areas (102 g/day) (see figure 5). The meat consumption of young adults does not differ significantly according to work status, degree of urbanization, and family size (RIVM, 2020).
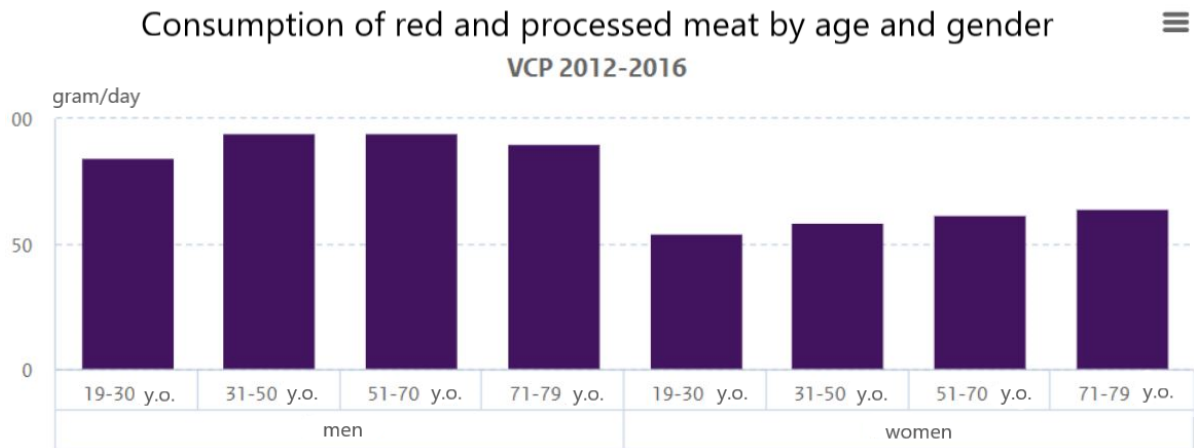
Figure 3 - Average consumption of red and processed meat by age and gender in the Netherlands, between 2012-2016 (RIVM, 2020).
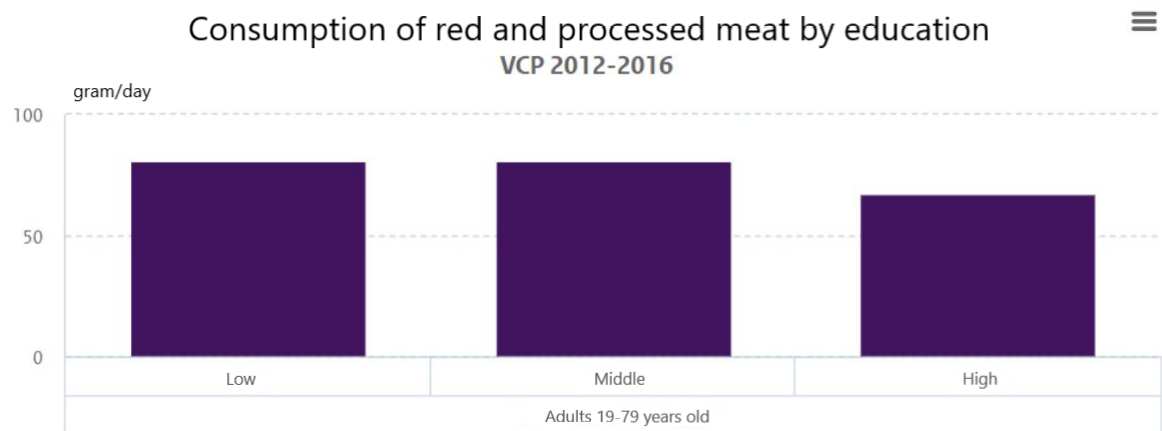

Figure 4 - Average consumption of red and processed meat by education in the Netherlands, between 2012-2016 (RIVM, 2020).
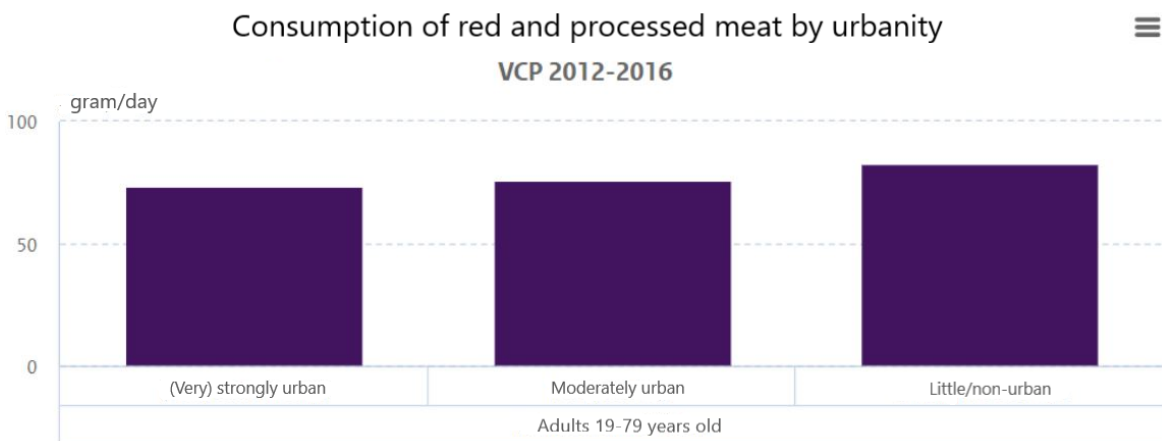

Figure 5 - Average consumption of red and processed meat by urbanity in the Netherlands, between 2012-2016 (RIVM, 2020).

2.3.   Urban and rural areas

Rural areas consist of small villages where inhabitants are involved in agricultural activities. (Gracia, 1998). In Spain, the lifestyle in these areas used to be different from that of urban settlements and, therefore, food consumption patterns differed as well. These differences were due to cultural and educational factors, differences in food distribution channels, income levels, and age structure. However, urbanization resulted in a homogenization of cultural patterns, distribution channels, and, consequently, food consumption behavior (Gracia, 1998). Additionally, the findings of a questionnaire-based survey conducted by Pogurschi et al. (2018) with a national representative sample of 1495 Romanians have shown that the food consumption pattern of the rural population is greatly dependent on household purchasing power and their own food production capacity. On the other hand, the urban population is strictly dependent on the household purchasing power, which in this case is significantly higher than the rural inhabitants, and on whether they still have relatives living in rural areas and the amount of food they receive from them (Pogurschi et al. 2018). Looking at regional and local levels, according to Granberg et al. (2019), the local scale is where climate change impacts manifest and are experienced, whereas regional-scale governance can play an important role by addressing gaps and challenges in adaptation at local levels. Regional-scale adaptation practices were studied in two cases, one in Victoria, Australia, and one Gothenburg region, Sweden. The findings suggest that the regional scale may be a powerful site that enables collaboration among multiple local stakeholders for effective adaptation because the implications of climate change cut across administrative and territorial boundaries, which drives the need for coordination that does not lose relevance at the local level (Granberg et al., 2019).

2.4.   Conceptual model

Figure 6 illustrates the outline of the conceptual model, showing urban and rural areas as the independent variables whereas beef consumption, sustainable behavior, and awareness of climate change, as dependent and interrelated variables, with beef consumption playing the main role among the dependent variables. The comparison of relationships between the independent and dependent variables may result in whether and to what extent beef consumption, sustainable behavior, and awareness of climate change differ between residents of urban and rural areas in the Northern Netherlands.
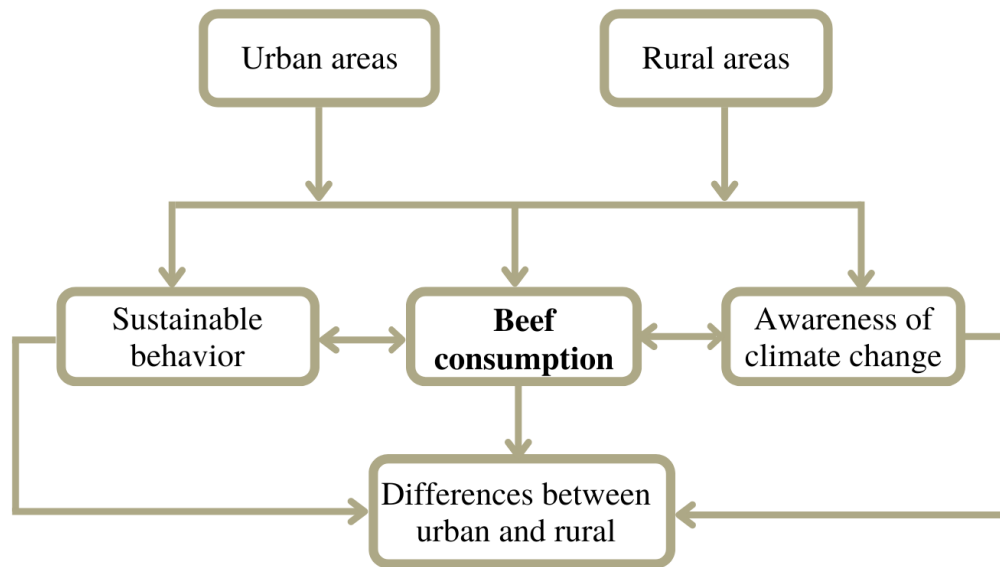
Figure 6 - Conceptual model showing the relationship between the dependent and independent variables. (Lopes, 2022).

3. Data and methodology

3.1. Data collection instrument

Methodology

In order to collect and analyze information in regards to beef consumption, sustainable behavior and awareness of climate change among residents of the Northern Netherlands, the method picked is an online questionnaire-based survey, powered by Qualtrics XM Platform™, Version April 2022, Copyright© 2020. The goal of survey research is to acquire information about the characteristics, behaviors, and attitudes of a population by administering a standardized questionnaire to a sample of individuals. (Clifford et al., 2010).

Respondent criteria

The respondents chosen are residents of the three provinces that consist of the Northern region of the Netherlands, therefore Groningen, Friesland, and Drenthe due to the fact that farmland is an outstanding land use in this region (Statistics Netherlands, 2015).

Ethical considerations

The research ethics carried out during this research were upheld by the standards outlined in the Netherlands Code of Conduct for Research Integrity. The survey respondents were notified of the purpose of the study and were asked to consent to the use of their information by signing a consent form before partaking in the online questionnaire-based survey. Participation is voluntary, all data collected is anonymized and all the information collected is confidential and was used only for this research. Furthermore, respondents have the option to inquire about results and data processing. The questionnaire-based survey was pre-tested as a pilot with random residents of the Northern Netherlands, mostly students, in order to identify bias and be refined before starting the fieldwork. Overall, 25 respondents took part in this pilot study. Note that these initial 25 responses are not included in the final set of results presented in Section 4 below. The official version of the questionnaire-based survey was distributed through social media and personal and regional networks, and 170 respondents took part in this study. In collaboration with the company MUG Ingenieursbureau (Leek, NL), the survey was also distributed among its employees living in the Northern Netherlands region. I am currently an employee of MUG Ingenieursbureau and the company's vision of sustainability goals matches the aim of this research, which was a critical factor to be chosen as a collaborative partner in collecting data for this study.

3.2.   Data analysis scheme

Descriptive statistics were used to summarize and organize the characteristics of the population (An Introduction to Descriptive Statistics, 2020), where sociodemographic factors were taken into account as a means to provide an overall view of the characteristics of the respondents. The independent variable used was the location where the respondent lives, thus the population was divided into two groups: residents of urban and rural areas. Inferential statistics were used in this study to describe the many ways in which statistics derived from observations of the sample can be used to deduce whether or not those populations are truly different (Hill, 2006). Once the sample is small and not representative, the statistical test picked for this analysis was the non-parametric Mann-Whitney U test, which compares whether there is a difference in the dependent variable for two independent groups. It compares whether the median of the dependent variable is the same for the two groups and therefore from the same population (Sheffield Hallam University, n.d.). For the dependent variables, indicators were taken into account. For beef consumption, the indicators are binary yes/no answers in regard to whether they consume beef and also the weekly average of beef consumption. Sociodemographic factors, such as age, level of education and monthly net income were used as secondary indicators for beef consumption. For sustainable behavior, the type of diet the respondent is currently following was taken as an indicator. In this case, gender was taken as a secondary indicator. Finally, for awareness of climate change, questions about climate change with binary answers yes/no were considered indicators and monthly net income was taken as a secondary indicator.

4. Results

The data set with a sample size N = 170 was analyzed by means of IBM SPSS® Statistics, Version 28.0 (2021). The presentation of the results focuses on perceived associations and relationships with as a decision rule the rejection of the null hypothesis at a confidence level of 95%. The research findings were interpreted truthfully and the limitation of the sample to describe the general population is noted.

Socio-demographics

Descriptive statistics show that the majority of respondents fall into the age group *"between 24-30 years old"* (see figure 7), identify themselves as *"male"* (see figure 8), hold the highest educational level of Bachelor's degree (see figure 9), are "*employed working full-time"* (see figure 10), have a monthly net income ranging "*from €1,635.01 to €3,271.20"* (see figure 11), live in the "*Province of Groningen"* (see figure 12) and live in *"Urban Areas"* (see figure 13). Bar chart graphs can be visualized in Appendix II.

Age group the respondent belongs to

	N	%
18-23	27	15.9%
24-30	57	33.5%
31-45	53	31.2%
46-65	32	18.8%
65+	1	0.6%

Figure 7 - Frequency table "Age" (Lopes, 2022).

Gender the respondent identifies herself/himself

	N	%
Female	77	45.3%
Male	91	53.5%
Other	2	1.2%

Figure 8 - Frequency table "Gender" (Lopes, 2022).

Highest education level the respondent has received

	N	%
Secondary school diploma or equivalent	20	11.8%
College or university but no degree	25	14.7%
Bachelor degree	64	37.6%
Master degree	34	20.0%
Candidate/PhD	23	13.5%
I prefer not to say	4	2.4%

Figure 9 - Frequency table "Level of Education" (Lopes, 2022).

Current employment status of the respondent

	N	%
Employed, working full-time	85	50.0%
Employed, working full-time,Employed, working part-time,	1	0.6%
Employed, working full-time,Student	2	1.2%
Employed, working part-time	32	18.8%
Employed, working part-time,Student	12	7.1%
Other:	1	0.6%
Retired	1	0.6%
Student	24	14.1%
Student,Other:	2	1.2%
Unemployed	8	4.7%
Unemployed,Student	2	1.2%

Figure 10 - Frequency table "Employment Status" (Lopes, 2022).

Monthly net income range of the respondent

	N	%
Lower than € 1,635.00	46	27.1%
€ 1,635.01 - € 3,271.20	66	38.8%
€ 3,271.21 - € 4,906.80	28	16.5%
€ 4,906.81 - € 6,542.40	14	8.2%
More than € 6,542.41	3	1.8%
I prefer not to say	11	6.5%
Missing System	2	1.2%

Figure 11 - Frequency table "Monthly Net Income" (Lopes, 2022).

Province where the respondent lives in (Northern Netherlands)

	N	%
Groningen	98	57.6%
Friesland	47	27.6%
Drenthe	22	12.9%
Missing System	3	1.8%

Figure 12 - Frequency table "Provinces" (Lopes, 2022).

Region where the respondent lives in (Rural or Urban area)

	N	%
Urban area	126	74.1%
Rural area (countryside)	40	23.5%
Missing System	4	2.4%

Figure 13 - Frequency table "Urban and Rural Areas" (Lopes, 2022).

Beef consumption

Descriptive statistics show that 12.4% of the respondents do not eat beef (see figure 14), which is a higher percentage when compared to the Dutch population as a whole since 4% of the Dutch do not include meat in their diets (RIVM, 2020).

Beef consumers and Non beef consumers (Northern Netherlands)

		N	%
Yes		145	85.3%
No		21	12.4%
Missing	System	4	2.4%

Figure 14 - Frequency table "Beef Consumers and Non-beef Consumers" (Lopes, 2022).

When the population is separated into urban and rural areas, there are no significant differences from the percentages found for the whole region, being 13.5% of non-beef consumers living in urban areas (see figure 15) and 10% living in rural areas (see figure 16).

Beef consumers and Non beef consumers (Urban areas)

	N	%
Yes	109	86.5%
No	17	13.5%

Beef consumers and Non beef consumers (Rural areas)

	N	%
Yes	36	90.0%
No	4	10.0%

Figure 15 - Frequency table "Beef Consumers and Non-beef Consumers in Urban Areas" (Lopes, 2022).

Figure 16 - Frequency table "Beef Consumers and Non-beef Consumers in Rural Areas" (Lopes, 2022).

Inferential statistics were used to verify whether there is a difference in beef consumption between residents of urban and rural areas in the Northern Netherlands. The null hypothesis used for the Mann-Whitney U test is:

H_0: *"Beef consumption is equal between residents of urban and rural areas in the Northern Netherlands."*

The outcome is a p-value = 1.000 > 0.05 (see figures 17 and 18). Thus, the test is not significant and the null hypothesis is not rejected. The conclusion is that beef consumption does not differ between residents of urban and rural areas in the Northern Netherlands, which supports the theory that the degree of urbanization does not influence meat consumption. (RIVM, 2020).

Ranks

	Region where the respondent lives in (Rural or Urban area)	N	Mean Rank	Sum of Ranks
Beef consumers	Urban area	109	73.00	7957.00
	Rural area (countryside)	36	73.00	2628.00
	Total	145		

Figure 17 - Ranking table "Beef Consumers in Urban and Rural Areas" (Lopes, 2022).

Test Statistics[a]

	Beef consumers
Mann-Whitney U	1962.000
Wilcoxon W	2628.000
Z	.000
Asymp. Sig. (2-tailed)	1.000

a. Grouping Variable: Region where the respondent lives in (Rural or Urban area)

Figure 18 - Test statistics table "Beef Consumers in Urban and Rural Areas" (Lopes, 2022).

The weekly average of beef consumption was categorized as 1 = never; 2 = rarely (1-2 times); 3 = about half the time (3-4 times); 4 = frequently (5-6 times); 5 = always (daily). Descriptive statistics show that the majority of respondents living in the Northern Netherlands consume beef rarely (1-2 times per week), which is a very low weekly average when compared to the Dutch meat consumption average, which is 6 times per week (RIVM, 2020). The graph of this analysis can be found in Appendix II.

Inferential statistics were used to verify whether there is a difference in weekly average beef consumption between residents of urban and rural areas in the Northern Netherlands. The null hypothesis used for the Mann-Whitney U test is:

H_0: *"The weekly average beef consumption is equal between residents of urban and rural areas in the Northern Netherlands."*

The outcome is a p-value = 0.013 < 0.05 (see figures 19 and 20). Thus, the test is significant and the null hypothesis is rejected. The conclusion is that weekly average beef consumption differs between residents of urban and rural areas in the Northern Netherlands. According to the mean rank presented, residents of urban areas consume less beef than residents of rural areas, on a weekly average. These findings go against the theory that residents of urban areas eat almost as much meat and meat products as residents of non-urban areas (RIVM, 2020).

Ranks

	Region where the respondent lives in (Rural or Urban area)	N	Mean Rank	Sum of Ranks
Weekly average of beef consumption of the respondent	Urban area	125	78.10	9762.50
	Rural area (countryside)	40	98.31	3932.50
	Total	165		

Figure 19 - Ranking table "Weekly Average of Beef Consumption in Urban and Rural Areas" (Lopes, 2022).

Test Statistics[a]

	Weekly average of beef consumption of the respondent
Mann-Whitney U	1887.500
Wilcoxon W	9762.500
Z	-2.488
Asymp. Sig. (2-tailed)	.013

a. Grouping Variable: Region where the respondent lives in (Rural or Urban area)

Figure 20 - Test statistics table "Weekly Average of Beef Consumption in Urban and Rural Areas" (Lopes, 2022).

Taking age as a socio-demographic factor, the youngest age group (18-23 years old) was compared with the senior age group (46-65 years old) in terms of weekly average beef consumption. The age group 65+ years old was not taken into consideration because the sample counts with only one respondent in this category. The null hypothesis used for the Mann-Whitney U test is:

H_0 : *"The weekly average beef consumption is equal between young people and senior people residing in the Northern Netherlands."*

The outcome is a p-value = 0.019 < 0.05 (see figures 21 and 22). Thus, the test is significant and the null hypothesis is rejected. The conclusion is that weekly average beef consumption differs between young people and senior people residing in the Northern Netherlands. According to the mean rank presented, young people consume less beef than senior people, on a weekly average, which complies with the overall Dutch population, where young adults (18-35 years old) have shown to eat less meat than the other groups, on a weekly average (RIVM, 2020).

Ranks

	Age group the respondent belongs to	N	Mean Rank	Sum of Ranks
Weekly average of beef consumption of the respondent	18-23	25	23.22	580.50
	46-65	31	32.76	1015.50
	Total	56		

Figure 21 - Ranking table "Weekly Average of Beef Consumption among young and senior age groups" (Lopes, 2022).

Test Statistics[a]

	Weekly average of beef consumption of the respondent
Mann-Whitney U	255.500
Wilcoxon W	580.500
Z	-2.341
Asymp. Sig. (2-tailed)	.019

a. Grouping Variable: Age group the respondent belongs to

Figure 22 - Test statistics table "Weekly Average of Beef Consumption among young and senior age groups" (Lopes, 2022).

Taking the level of education as a socio-demographic factor, as from holders of a bachelor's degree were considered the highly-educated group, whereas respondents with up to a secondary education diploma were considered the low-educated group. The null hypothesis used for the Mann-Whitney U test is:

H_0: *"The weekly average beef consumption is equal between highly-educated and low-educated residents in the Northern Netherlands."*

The outcome is a p-value = 0.103 > 0.05 (see figures 23 and 24). Thus, the test is not significant and the null hypothesis is not rejected. The conclusion is that weekly average beef consumption does not differ between highly-educated and low-educated residents in the Northern Netherlands.

This finding goes against the overall picture of the Dutch population, where highly-educated people were declared to eat less meat than low-educated. (RIVM, 2020).

Ranks

	Highest education level the respondent has received	N	Mean Rank	Sum of Ranks
Weekly average of beef consumption of the respondent	Secondary school diploma or equivalent	20	48.10	962.00
	Bachelor degree	61	38.67	2359.00
	Total	81		

Figure 23 - Ranking table "Weekly Average of Beef Consumption among highly-educated and low-educated groups" (Lopes, 2022).

Test Statistics[a]

	Weekly average of beef consumption of the respondent
Mann-Whitney U	468.000
Wilcoxon W	2359.000
Z	-1.629
Asymp. Sig. (2-tailed)	.103

a. Grouping Variable: Highest education level the respondent has received

Figure 24 - Test statistics table "Weekly Average of Beef Consumption among highly-educated and low-educated groups" (Lopes, 2022).

Sustainable behavior

When asked about eating habits, respondents selected the type of diet they are currently following. The diet types were categorized as Lacto-ovo vegetarian (No beef, poultry, seafood, or meat products. The diet still includes eggs and dairy products); Lacto-vegetarian (No meats, as above, plus no eggs and products containing eggs. The diet still includes dairy products); Pescatarian (The only meat eaten is fish. The diet still includes eggs and dairy products); Vegan (No meats or eggs plus no dairy products or honey); Beegan (Vegan, with honey included in the diet); Flexitarian (Eat mostly plant foods, but include small amounts of meat in the diet); None of above (Regular meat-eaters). Descriptive statistics show that 66.1% of the respondents are regular meat-eaters and 17% are flexitarians. The remaining percentage corresponds to non-beef consumers (see figure 25). The graph of this analysis can be seen in Appendix II.

Current diet of the respondent

	N	%
Lacto-ovo vegetarian	6	3.5%
Lacto-vegetarian	4	2.3%
Pescatarian	4	2.3%
Vegan	8	4.7%
Beegan	1	0.6%
Flexitarian	29	17.0%
Regular meat eater	113	66.1%
Missing System	6	3.5%

Figure 25 - Frequency table "Current diet of the respondent" (Lopes, 2022).

Reducing or excluding beef and animal products from the diet was taken as an indicator of sustainable behavior among respondents. Inferential statistics were used to verify whether there is a difference in sustainable behavior between residents of urban and rural areas in the Northern Netherlands. The variable "regular meat-eaters" were picked for this analysis, considering the respondents that do not reduce or exclude beef and animal products from their diet. The null hypothesis used for the Mann-Whitney U test is:

H_0: *"Sustainable behavior is equal between residents of urban and rural areas in the Northern Netherlands."*

The outcome is a p-value $= 1.000 > 0.05$ (see figures 26 and 27). Thus, the test is not significant and the null hypothesis is not rejected. The conclusion is that sustainable behavior does not differ between residents of urban and rural areas in the Northern Netherlands, which supports the theory that the degree of urbanization does not influence meat consumption. (RIVM, 2020).

Ranks

	Region where the respondent lives in (Rural or Urban area)	N	Mean Rank	Sum of Ranks
Regular meat eaters	Urban area	87	56.00	4872.00
	Rural area (countryside)	24	56.00	1344.00
	Total	111		

Figure 26 - Ranking table "Regular meat-eaters in Urban and Rural Areas" (Lopes, 2022).

Test Statistics^a

	Current diet of the respondent
Mann-Whitney U	1044.000
Wilcoxon W	1344.000
Z	.000
Asymp. Sig. (2-tailed)	1.000

a. Grouping Variable: Region where the respondent lives in (Rural or Urban area)

Figure 27 - Test statistics table "Regular meat-eaters in Urban and Rural Areas" (Lopes, 2022).

Taking gender as a socio-demographic factor, female and male groups were compared. The gender category "other" was not taken into consideration because only 2 respondents identified themselves as belonging to this group. The null hypothesis used for the Mann-Whitney U test is:

H_0: *"Sustainable behavior is equal between women and men residing in the Northern Netherlands."*

The outcome is a p-value = 1.000 > 0.05 (see figures 28 and 29). Thus, the test is not significant and the null hypothesis is not rejected. The conclusion is that sustainable behavior does not differ between women and men residing in the Northern Netherlands. These findings go against the overall declaration for the Dutch population, where women have been shown to behave more sustainably than men on a daily basis (Statistics Netherlands, 2021).

Ranks

	Gender the respondent identifies herself/himself	N	Mean Rank	Sum of Ranks
Regular meat eaters	Female	45	55.50	2497.50
	Male	65	55.50	3607.50
	Total	110		

Figure 28 - Ranking table "Regular Female and Male meat-eaters" (Lopes, 2022).

Test Statistics[a]

	Current diet of the respondent
Mann-Whitney U	1462.500
Wilcoxon W	3607.500
Z	.000
Asymp. Sig. (2-tailed)	1.000

a. Grouping Variable: Gender the respondent identifies herself/himself

Figure 29 - Test statistics table "Regular Female and Male meat-eaters" (Lopes, 2022).

Awareness of climate change

Respondents were asked about their awareness of climate change-related to beef consumption by means of questions with binary answers "yes" or "no". For the question *"Do you know that addressing beef-related emissions could help reduce methane emissions and deforestation?"*, a comparative analysis between respondents residents of urban and rural areas was conducted. The null hypothesis used for the Mann-Whitney U test is:

H_0: *"Awareness of climate change is equal between residents of urban and rural areas in the Northern Netherlands."*

The outcome is a p-value = 1.000 > 0.05 (see figures 30 and 31). Thus, the test is not significant and the null hypothesis is not rejected. The conclusion is that awareness of climate change does not differ between residents of urban and rural areas in the Northern Netherlands. This result shows that 75% of the Dutch Northern population is declared to be aware of climate change, and when comparing it with the entire Dutch population, the percentage is smaller, since 94% of the Dutch adults believe in climate change and its impacts. (Statistics Netherlands, 2021).

Ranks

	Region where the respondent lives in (Rural or Urban area)	N	Mean Rank	Sum of Ranks
Yes	Urban area	99	64.00	6336.00
	Rural area (countryside)	28	64.00	1792.00
	Total	127		

Figure 30 - Ranking table for respondents answering "yes" to the question "Do you know that addressing beef-related emissions could help reduce methane emissions and deforestation?", in Urban and Rural Areas (Lopes, 2022).

Test Statistics^a

	Do you know that addressing beef-related emissions could help reduce methane emissions and deforestation?
Mann-Whitney U	1386.000
Wilcoxon W	1792.000
Z	.000
Asymp. Sig. (2-tailed)	1.000

a. Grouping Variable: Region where the respondent lives in (Rural or Urban area)

Figure 31 - Test statistics table for respondents answering "yes" to the question "Do you know that addressing beef-related emissions could help reduce methane emissions and deforestation?", in Urban and Rural Areas (Lopes, 2022).

Taking income as a socio-demographic factor, the monthly net income group "€ 4,906.81 - € 6,542.40" was chosen to represent respondents with high net income, whereas the group "Lower than €1,635.60" was taken to represent respondents with low net income. The question taken to this analysis is *"Do you know that ruminants produce methane through their digestion and waste?"*. The null hypothesis used for the Mann-Whitney U test is:

H_0: *"Awareness of climate change is equal between residents with high net income and low net income in the Northern Netherlands."*

The outcome is a p-value = 1.000 > 0.05 (see figures 32 and 33). Thus, the test is not significant and the null hypothesis is not rejected. The conclusion is that awareness of climate change does not differ between residents with high net income and low net income in the Northern Netherlands.

Ranks

	Monthly net income range of the respondent	N	Mean Rank	Sum of Ranks
Yes	Lower than € 1,635.00	34	24.00	816.00
	€ 4,906.81 - € 6,542.40	13	24.00	312.00
	Total	47		

Figure 32 - Ranking table for respondents with high and low net incomes answering "yes" to the question "Do you know that ruminants produce methane through their digestion and waste?" (Lopes, 2022).

Test Statistics[a]

	Do you know that ruminants produce methane through their digestion and waste?
Mann-Whitney U	221.000
Wilcoxon W	312.000
Z	.000
Asymp. Sig. (2-tailed)	1.000

a. Grouping Variable: Monthly net income range of the respondent

Figure 33 - Test statistics table for respondents with high and low net incomes answering "yes" to the question "Do you know that ruminants produce methane through their digestion and waste?" (Lopes, 2022).

In order to check if this awareness reflects differences in beef consumption patterns between high and low-income residents, a second analysis was made, looking at the beef consumers and the same two monthly net income groups,"€ 4,906.81 - € 6,542.40" and "Lower than €1,635.60". The null hypothesis used for the Mann-Whitney U test is:

H_0: *"Beef consumption is equal between residents with a high net income and low net income in the Northern Netherlands."*

The outcome is a p-value = 1.000 > 0.05 (see figures 34 and 35). Thus, the test is not significant and the null hypothesis is not rejected. The conclusion is that beef consumption does not differ between residents with high net income and low net income in the Northern Netherlands.

Ranks

	Monthly net income range of the respondent	N	Mean Rank	Sum of Ranks
Beef consumers	Lower than € 1,635.00	38	25.50	969.00
	€ 4,906.81 - € 6,542.40	12	25.50	306.00
	Total	50		

Figure 34 - Ranking table "Beef consumers with a high and low net income" (Lopes, 2022).

Test Statistics[a]

	Beef consumers
Mann-Whitney U	228.000
Wilcoxon W	306.000
Z	.000
Asymp. Sig. (2-tailed)	1.000

a. Grouping Variable: Monthly net income range of the respondent

Figure 35 - Test statistics table "Beef consumers with a high and low net income" (Lopes, 2022).

5. Conclusions

The aim of this research was to fill a gap in the literature in terms of whether beef consumption, sustainable behavior, and awareness of climate change differ between residents of urban and rural areas in the Northern Netherlands. In order to collect data for this study, the method chosen was an online questionnaire-based survey, as a means to collect information regarding the characteristics and perceptions of the respondents through a structured questionnaire. Some resistance from people to fill it in was encountered and some respondents dropped it out before finishing, resulting in missing data. The statistical analysis was made through descriptive and inferential statistics by means of IBM SPSS® Statistics 28. Assuming that the sample is small and not representative, the non-parametric Mann–Whitney U test was used to compare the differences between two populations, whether urban and rural areas or two groups from a socio-demographic factor. The method presented limitations when attempting to include more than two indicators for the dependent variable in the analysis. For instance, to analyze the difference in weekly beef consumption (indicator for the dependent variable beef consumption) between residents of urban and rural areas (independent variables) considering their gender (secondary indicator for the dependent variable beef consumption).

Beef consumption

The area of residence does not play a role in beef consumption in terms of whether the residents consume it or not. There are no differences between urban and rural areas regarding beef consumption itself. These findings confirm the statistics presented by the Dutch National Institute for Public Health and the Environment in 2020, that the degree of urbanization does not influence meat consumption. However, when comparing beef consumers in urban and rural areas, the weekly average consumption is noted to be higher amongst residents of rural areas. This result goes against the theory that residents of urban areas eat almost as much meat and meat products as residents of non-urban areas in the Netherlands (RIVM, 2020).

Age plays an important role in beef consumption. When divided into two groups, the youngest group (18-23 years old) is noted to consume less beef on a weekly average, when compared to the senior age group (46-65 years old). These findings comply with the overall Dutch picture, where in the population, young adults (18-35 years old) consume less beef than people belonging to other age groups on a weekly basis (RIVM, 2020).

The level of education does not play a significant role in beef consumption. When divided into two groups, highly-educated and low-educated residents in the Northern Netherlands, no differences were found in beef consumption on a weekly basis. These results do not comply with the data found for the Dutch population, where highly-educated people are declared to eat less meat than low-educated. (RIVM, 2020).

Sustainable behavior

The area of residence does not play a significant role in sustainable behavior. These findings show that there is no difference between residents in urban and rural areas in terms of excluding or reducing beef from their diets. Again, this confirms the theory that the degree of urbanization does not influence meat consumption (RIVM, 2020).

Gender does not play a role in sustainable behavior. When divided into females and males, no differences could be noted in sustainable behavior. This goes against the theory presented for the overall Dutch picture, where women are declared to behave more sustainably in terms of reducing or excluding meat from their diets.

Awareness of climate change

The area of residence does not play a role in terms of awareness of climate change. There are no significant differences in this awareness between residents of urban and rural areas in the Northern Netherlands. However, 75% of the respondents are aware of climate change, which is less than the stated Dutch average, since 94% of Dutch adults are declared to believe in climate change (Statistics Netherlands, 2021).

Monthly net income plays a role neither in awareness of climate change nor in beef consumption. When divided into two groups, high monthly income "€ 4,906.81 - € 6,542.40" and low monthly income "Lower than €1,635.60", no differences were found.

Recommendations for further research

For further research, it is recommended to collect a larger and more representative sample as well as to pick a statistical test that allows the input of more variables/indicators for comparative analysis. Also, comparing differences in Beef Consumption, Sustainable Behavior and Awareness of Climate Change between Dutch regions, for instance, the Northern Netherlands and the Randstad area, would be a relevant and outstanding topic to be further addressed.

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Appendix I - Questionnaire

The questionnaire-based survey distributed in this research was powered by Qualtrics XM Platform™, Version April 2022. Copyright© 2020.

INTRODUCTION

Perceptions of climate change and sustainable behavior among beef consumers: a study in the Northern Netherlands

Welcome! You are invited to participate in a research study encompassing regions against climate change. Your responses will take part in a statistical analysis of individuals' aspects such as awareness of climate change and willingness to change habits toward sustainable food consumption.

The aim of this study is to contribute both socially and academically by analyzing to what extent perceptions and sustainable behavior on beef consumption in the Northern Netherlands might be related. This study is being done by Marcella Marques Lopes from the University of Groningen.

For questions on data processing or to obtain results from this research study, please contact: m.marques.lopes@student.rug.nl

CONSENT FORM

Please read through the following:

- I understand that my participation is voluntary.
- I understand that all data is collected anonymized, which means that the data cannot be traced back to the participant.
- I understand that the information collected is confidential and will only be used for this research (premaster's thesis).
- I understand that this data could also be used in articles, chapters in books, in published and unpublished works and presentations.

By clicking "I agree" below you are indicating that you are at least 18 years old, have read and understood this consent form and agree to participate in this research study.*

*If you agree to this consent form and participate in this study you will be asked to answer an online survey/questionnaire that should take approximately 5 minutes to complete.

○ I agree
○ I disagree

SOCIO-DEMOGRAPHICS

What age group do you belong to?

○ 18-23
○ 24-30
○ 31-45
○ 46-65
○ 65+
○ I prefer not to say

How do you identify yourself?

○ Female
○ Male
○ Other

What is the highest level of education you have completed?

○ Lower than secondary school diploma
○ Secondary school diploma or equivalent
○ College or university but no degree
○ Bachelor degree
○ Master degree
○ Candidate/PhD

○ I prefer not to say

What is your current employment status? Multiple answers are allowed.

☐ Employed, working full-time
☐ Employed, working part-time
☐ Unemployed
☐ Student
☐ Retired
☐ Disabled, not able to work
☐ Other: [_____]

What group does your monthly net income belong to?

[_____ ∨]

What province do you reside in?

○ Groningen
○ Friesland
○ Drenthe

"Urban areas are created through urbanization and are categorized by urban morphology as cities, towns, conurbations (the merging of several towns), or suburbs. In contrast, rural areas refer to areas with low population density, such as villages and hamlets." Source: https://pallipedia.org/

What category best describes the area where your residence is located?

○ Urban area
○ Rural area (countryside)

BEEF CONSUMPTION AND SUSTAINABLE BEHAVIOR

Do you consume beef?*

*(beef = meat from a cow). In case you are a flexitarian or consume beef ocasionally, please answer "yes".

○ Yes

○ No

What category does your current diet belong to?

○ Lacto-ovo vegetarian (No beef, poultry, seafood, or meat products. The diet still includes eggs and dairy products)

○ Lacto-vegetarian (No meats, as above, plus no eggs and products containing eggs. The diet still includes dairy products)

○ Pescatarian (The only meat eaten is fish. The diet still includes eggs and dairy products)

○ Vegan (No meats or eggs plus no dairy products or honey)

○ Beegan (Vegan, with honey included in the diet)

○ Flexitarian (Eat mostly plant foods, but include small amounts of meat in the diet)

○ None of above

Why do you consume beef? Multiple answers are allowed.

☐ Because it is necessary for my diet/health

☐ Because I like the way it tastes

☐ Because it is sustainable

☐ Because it is cheap

☐ Because of my religion/cultural background

☐ Because my family/friends/others do it

☐ Because this is out of habit

☐ Other: [_____]

Why don't you consume beef? Multiple answers are allowed.

☐ Because it is not necessary for my diet/health

☐ Because I don't like the way it tastes

☐ Because it is not sustainable

☐ Because it is expensive

☐ Because of my religion/cultural background

☐ Because my family/friends/others don't do it

☐ Because this is out of habit

☐ Other: [   ]

On an average, how often do you eat beef per week?

○ Never

○ Rarely (1-2 times)

○ About half the time (3-4 times)

○ Frequently (5-6 times)

○ Always (Daily)

How important is beef to your diet?

Not at all important	Slightly important	Moderately important	Very important	Extremely important
○	○	○	○	○

Where do you usually buy beef?* Multiple answers are allowed.

*In case you don't consume beef but still buy it for other household members, please choose the options that indicate where you usually buy it.

☐ Butcher's shop

☐ Supermarket/grocery store

☐ Producer

☐ I don't buy beef at all

☐ Other: [   ]

Which factors motivate you when choosing where to buy beef?* Multiple answers are allowed.

*In case you don't consume beef but still buy it for other household members, please choose the options that indicate your motivations when choosing where to buy it.

☐ Price

☐ Convenience

☐ Distance from home/work

☐ Sustainable source

☐ I don't buy beef at all

☐ Other: _____

What is your main mean of transportation when you go grocery shopping?

○ Walking

○ Bike

○ Shared scooter

○ Public transportation (bus, train, tram, metro)

○ Car

○ Other: _____

How often do you include organic farming products in your usual groceries?

Never	Sometimes	About half the time	Most of the time	Always
○	○	○	○	○

If you consider reducing beef consumption, what would be the main reason for it?

○ Health

○ Climate change

○ Price

○ Animal welfare

○ Religion/cultural background

○ Influence of family/friends/others

○ I don't consider reducing beef consumption

○ Other: _____

What is the main reason that made you decide to quit beef consumption?

○ Health

○ Climate change

○ Price

○ Animal welfare

○ Religion/cultural background

○ Influence of family/friends/others

○ Other: _____

PERCEPTIONS OF CLIMATE CHANGE

Do you know that methane is a worse pollutant in the atmosphere than CO2?

○ Yes

○ No

"Even though methane is a short-living pollutant, whilst it is in the atmosphere, it has a more detrimental effect than CO2. Methane is up to 85 times worse than CO2, over a 20-year time frame." (Source: European Commission, 2021)

Please skip to the next question.

Do you know that ruminants produce methane through their digestion and waste?

○ Yes

○ No

"Greenhouse gas emissions along livestock supply chains represent 14.5% of all human-induced emissions and beef commodities are responsible for 41% of the sector's emissions. Ruminants, for example, produce methane through their digestion and waste." (Source: Food and Agriculture Organization of the United Nations, 2013)

Please skip to the next question.

Do you know that beef is considered the leading driver of deforestation?

○ Yes

○ No

"Beef is the leading driver of deforestation, being responsible for 41% of tropical deforestation. That's 2.1 million hectares every year — about half the size of the Netherlands." (Source: https://ourworldindata.org)

Please skip to the next question.

Do you know that addressing beef-related emissions could help reduce methane emissions and deforestation?

○ Yes

○ No

"At COP26* global leaders pledged to reduce methane emissions by 30% and end deforestation by 2030. Addressing beef-related emissions could help countries meet both pledges." (Source: United Nations Climate Change Conference, 2021)

*COP26 = Conference of the Parties, 26th annual summit, 2021, Glasgow.

Please skip to the next question.

Concerning greenhouse gas emissions, please rate your opinion to the statements as it follows:
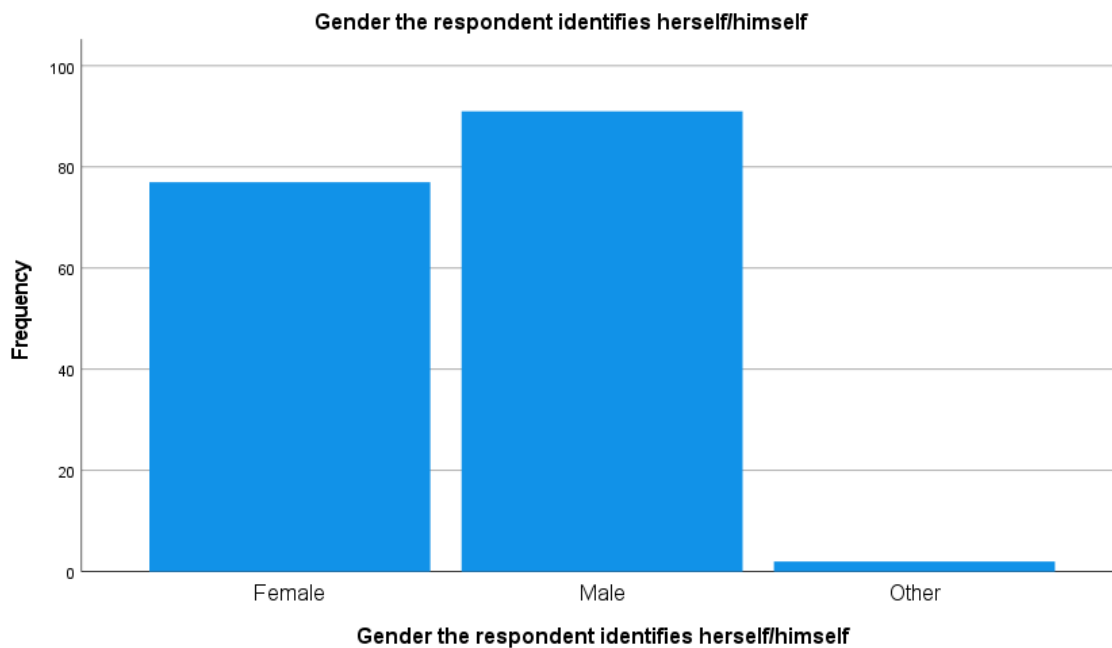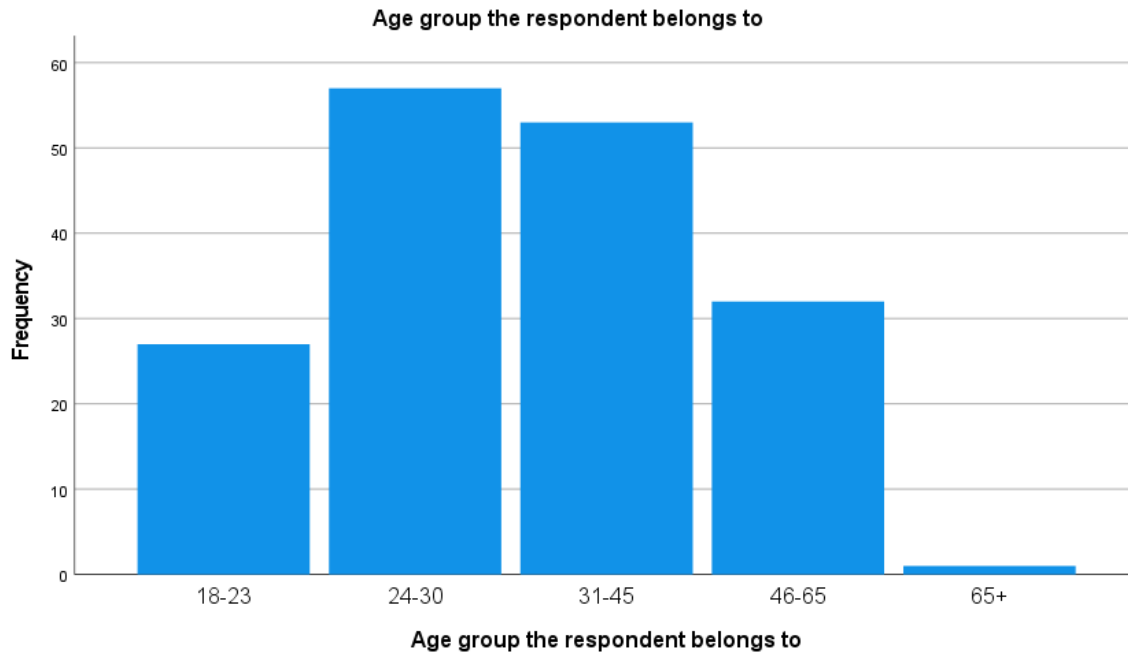
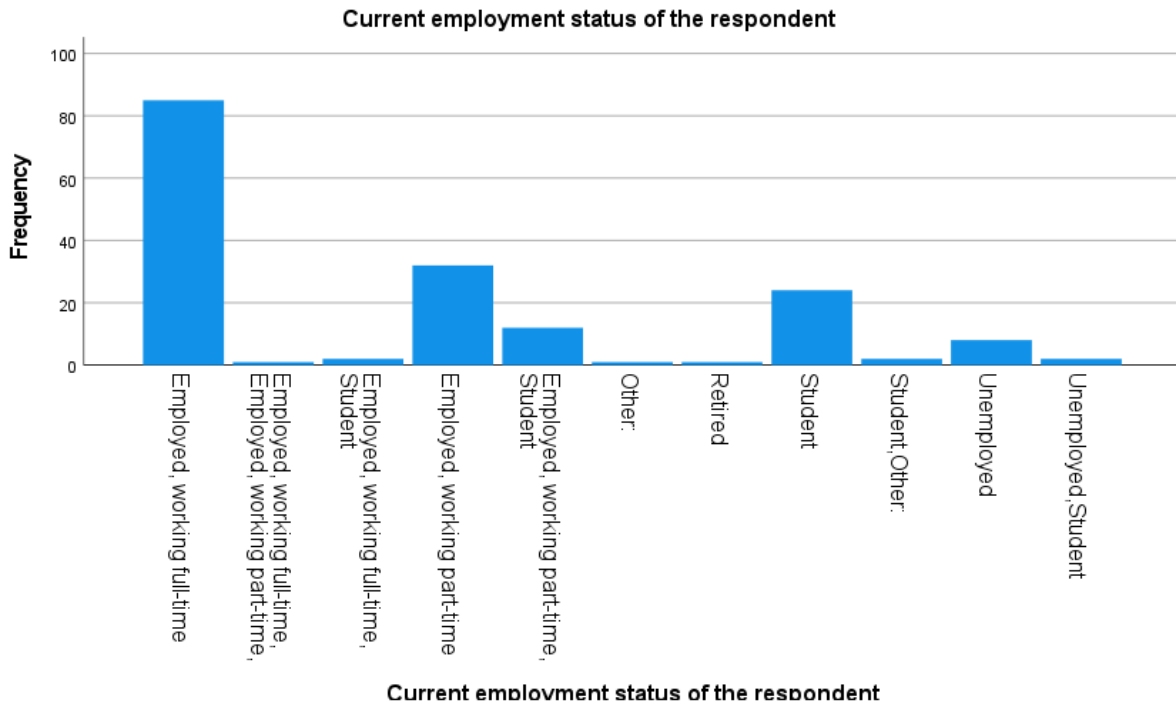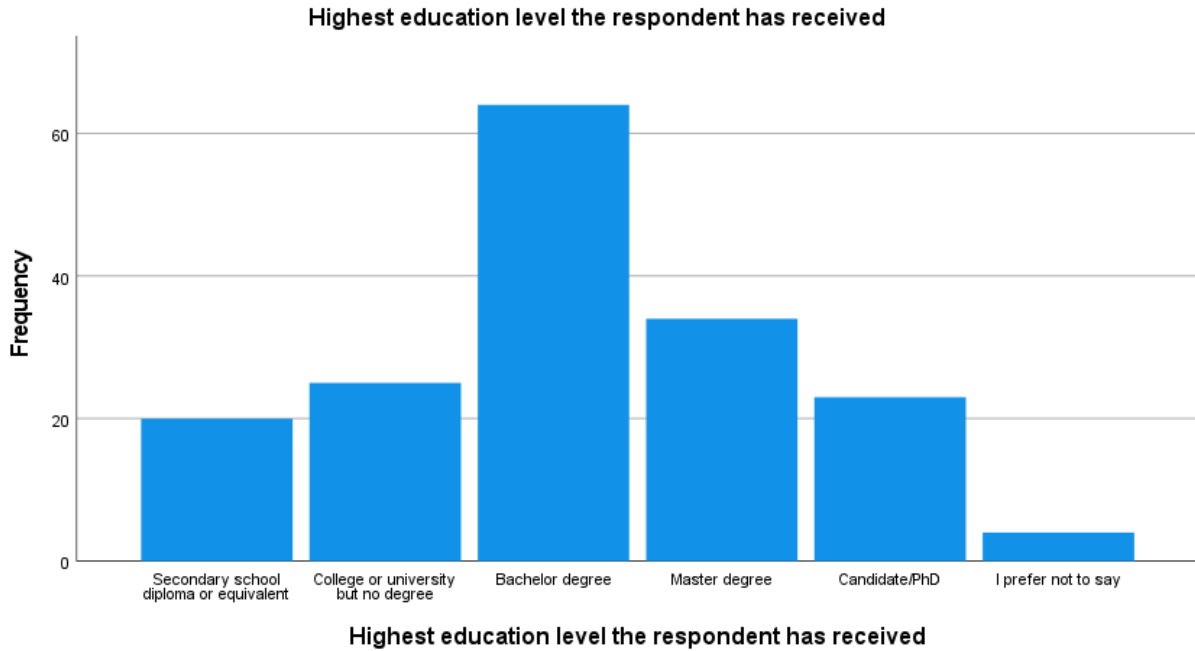|	Strongly disagree	Disagree	Neutral	Agree	S
"Eating less beef is a good way to help keep greenhouse gas emissions down"	○	○	○	○	
"Changing the way we produce beef would also change the levels of human-induced greenhouse gas emissions."	○	○	○	○	
"Reducing beef numbers from the livestock sector would also reduce greenhouse gas emissions."	○	○	○	○	

Should you have any further comments concerning beef consumption, climate change, sustainable behavior and regional development, please insert your thoughts in the field below. If not, please just skip this question.
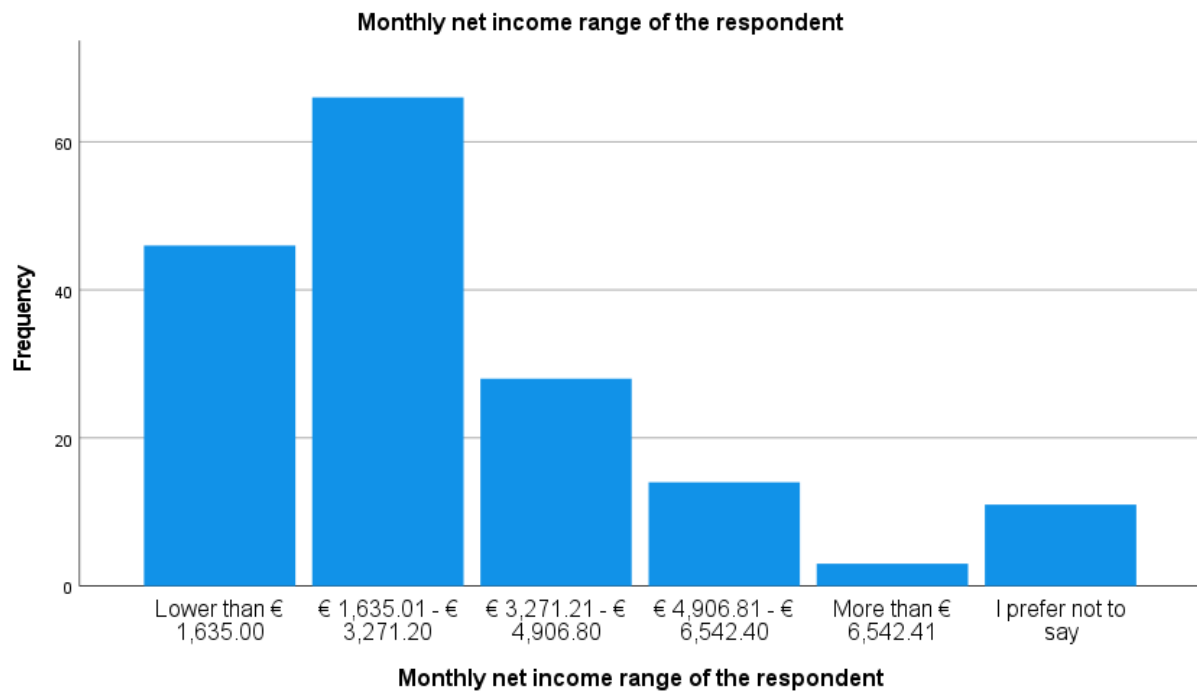
[   ]

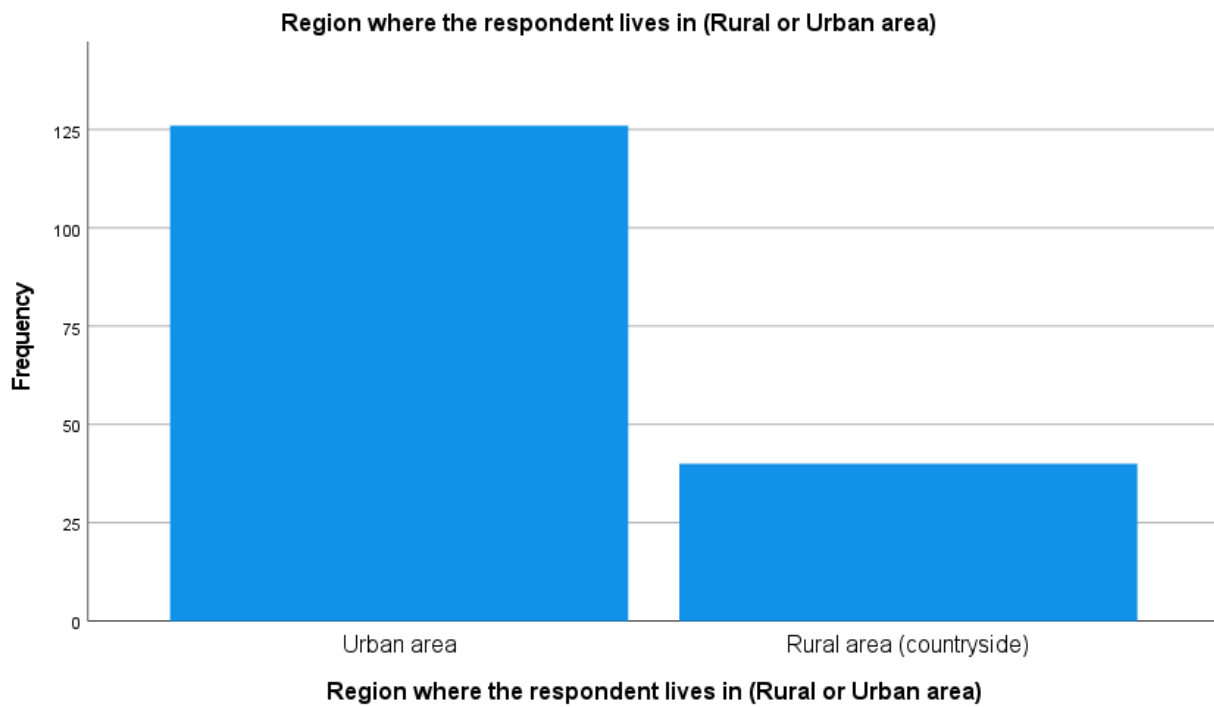# Appendix II - Bar charts

The bar charts of the data set were generated by means of IBM SPSS® Statistics, Version 28.0 (2021).

Socio-demographics

Age group the respondent belongs to

Gender the respondent identifies herself/himself

Highest education level the respondent has received

Highest education level the respondent has received

Current employment status of the respondent

Current employment status of the respondent

Monthly net income range of the respondent

Monthly net income range of the respondent

Province where the respondent lives in (Northern Netherlands)

Province where the respondent lives in (Northern Netherlands)

Region where the respondent lives in (Rural or Urban area)

Region where the respondent lives in (Rural or Urban area)

Beef consumption

Weekly average of beef consumption of the respondent

Weekly average of beef consumption of the respondent

Sustainable behavior

Current diet of the respondent

Current diet of the respondent