

Religious Values and Food Waste: A Comparative Study of Roman Catholic Believers and Non-Religious Individuals

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Abstract

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Food waste is a global problem with significant implications for the environment and social justice alike. Despite the importance of religion and faith as social phenomena, their relationship to food waste remains relatively under-researched. This study focuses on Roman Catholicism as one of the most widely practiced religions in the world. The research is based on the analysis of data from the Czech Social Science Data Archive from 2022, which includes responses from 579 respondents aged 15+. The results of research conducted using the CHAID method show that younger and older Roman Catholics have different motivations to reduce food waste. Younger believers focus more on moral issues and feel guilty about wasting food, while older believers prioritise economic considerations and worry about the amount of food wasted. In addition, the study shows that Roman Catholic households with lower monthly food expenditures show more compassion for those in need and feel guilty about food waste, while non-religious individuals in households with higher expenditures are more likely to waste food. These conclusions suggest the influence of Catholics' moral and economic values on consumers' food waste attitudes and behaviour. The study adds a new piece to the mosaic of factors that influence food waste and people's attitudes toward it.

Key words

circular model of food waste; consumption model; ecological behaviour of consumers; environmental responsibility; food waste management; economic considerations; moral values; religious affiliation; Roman Catholicism; sustainable development goals.

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Introduction

Food waste is a long-term negative trend that threatens the sustainable development of society. Food waste is addressed by the United Nations Sustainable Development Goal 12. The European Union supports initiatives according to which countries should implement the circular economy in order to move towards greater sustainability (Aleksnevičienė and Bendoraitė, 2023; Herrero-Luna et al., 2022; Mikhno et al., 2021). Circular economy principles emphasise the reduction of waste at every stage of the product lifecycle.

According to the Food and Agriculture Organisation (FAO), approximately one-third of edible food is wasted each year, and households are responsible for nearly two-thirds of the world's total food waste (Aloysius et al., 2023). There are a number of definitions of food waste, some overlapping and some complementary. According to the FAO, ERS (the U.S. Department of Agriculture's Economic Research Service), and FUSIONS (a European Union project) definitions, food waste consists of the sum of food "landfilled" and food "used for non-food purposes" (FAO, 2023).

However, this is not a correct definition of food waste, because if recovered food is used as an input, for example as animal feed, fertiliser, or biomass to make products, then by definition it is not waste (Bellemare et al., 2017). According to the same critical study, another inconsistency between these definitions is that the FAO and ERS definitions apply only to edible, safe and nutritious foods, while the FUSIONS and EPA (Computer-Assisted Personal Interviewing) definitions apply to both edible and inedible parts of food. In addition, the ERS and EPA definitions exclude food that is not harvested at the farm level from food waste (Bellemare et al., 2017).

Food waste occurs throughout the food distribution chain, from agricultural production to final consumption in households.

Food losses occur in the early stages, while food waste occurs in the later stages at the consumption level (sales, households). When it comes to food waste, most of it is produced by individuals in households, approximately 61% according to the UNEP (United Nations Environment Programme) Food Waste Index 2021 (Forbes et al., 2021). Individuals are therefore key players in the fight against food waste, because by changing individual behaviour, everyone can help to combat it. This study, therefore, looks at food waste through the lens of households. Food waste is the difference between purchased and consumed food raw materials and processed food that is disposed of in municipal waste without further use.

Previous research has examined the demographic, socioeconomic, and motivational determinants of household food consumption (Čvirik, 2023; Kita et al., 2021). Empirical studies have shown a relationship between food waste and gender, age (Ellison and Lusk, 2018; Flanagan and Priyadarshini, 2021), education (Heidari et al., 2020), household income (Aschemann-Witzel et al., 2019; Liu and McCarthy, 2023; Szabó-Bódi et al., 2018), household size (Edjabou et al., 2016), and type of housing (Nguyen et al., 2022; Rispo et al., 2015).

Internal motives of individuals leading to less food waste were identified as financial and environmental motives (dos Santos et al., 2022; Graham-Rowe et al., 2014; Neff et al., 2015; Galant and Cvek, 2021; Ribbers et al., 2023), moral motives (Bretter et al., 2023; Ribbers et al., 2023; Richter and Bokelmann, 2018), and social motives (Kharazishvili et al., 2020; Celestino et al., 2022; Principato et al., 2021; Ribbers et al., 2023).

The relationship between faith and food waste has received relatively little attention in empirical studies, even though faith is an important social phenomenon worldwide

that shapes human values and moral principles. Religions around the world are diverse and varied, but they also share some commonalities while differing in their beliefs, practices, and cultural expressions. For example, most religions have moral and ethical rules that guide the behaviour and actions of their followers and emphasise virtues such as compassion, honesty, and kindness.

This article focuses on Roman Catholicism as one of the most widely represented religions in the world and the most important branch of Christianity. There are approximately 1.3 billion Catholics throughout the world (Oakley et al., 2023). The connection between food waste and Roman Catholicism can be understood in the context of broader Catholic social teaching and the principles of stewardship, care for creation, and solidarity with the poor. In his 2015 encyclical “*Laudato si*”, Pope Francis emphasised the importance of environmental protection, sustainable development, and the moral imperative to address issues such as food waste and its impact on the environment and vulnerable communities (Bergoglio, 2015).

One of the main principles of Catholic social teaching is the idea of stewardship (Ambalu et al., 2013), which emphasises that people have a duty to care for and protect the environment and its resources, recognising them as a gift from God. Food waste contributes to environmental degradation, including increased greenhouse gas emissions, water waste, and inefficient land use. By wasting food, individuals are not fulfilling their role as stewards of creation.

Another central theme of Catholic social teaching is the call to solidarity with the marginalised and less fortunate, including the poor and hungry (Ambalu et al., 2013). Food waste is particularly problematic because it occurs in a world where millions of people suffer from hunger and malnutrition. Reducing food waste can help address the problem of food insecurity and show compassion for those in need.

Both cases involve moral and social motivations. Moral motivations have to do with conscience, fear, and guilt toward people who do not have adequate access to food. Moral motivations to prevent food waste in the home relate to promoting food safety, treating animals ethically, addressing social justice issues, caring for the environment, promoting responsible behaviour, and respecting the value of food and the efforts of those involved in food production (Richter and Bokelmann, 2018). Social motivation to avoid food waste involves a person’s self-representation of how they are perceived by others according to social norms (Principato et al., 2021). Particularly important in the context of food waste are the injunctive norms that result from the expectations of others, regardless of whether they behave according to those norms themselves (Ribbers et al., 2023).

This research offers a closer look at faith as the determinant of household food waste. Religiosity has been shown to promote food waste reduction. Specifically, religiosity is positively related to consumers’ attitudes, activism, and personal and subjective norms for reducing food waste (Elhoushy and Jang, 2021). When consumers are aware of the harmfulness of food waste, subjective moral norms (Bretter et al., 2023) and perceived control contribute positively to the intention to reduce food waste (Wang et al., 2023). This study does not address specific expressions of religiosity or different religions, as previous research has done. Instead, it focuses on the declared religious beliefs of Roman Catholics and the associated individual beliefs and public attitudes toward food waste. The goal of the study is to determine the differences in public views on food waste that depend on stated affiliation with the Roman Catholic religion compared to a group of non-religious people.

The study used data from the Czech Social Science Data Archive from 2022. A total of 821 people were interviewed,

representing the population of the Czech Republic aged 15 years and older. The sample is representative in terms of regions of the Czech Republic, size of residence, gender, age, and education. The Czech Republic was selected as an EU (European Union) member state that is experiencing an increase in consumption and food waste as the economy grows.

In the Czech Republic, households discard approximately 2.6 kg of food waste each week on average, which equates to about 1.1 kg per capita. Annually, this extrapolates to about 135.7 kg of food waste per household, or 57.1 kg per capita. Notably, half of this waste was disposed of in municipal bins for mixed waste, indicating a need for improvement in disposal methods to meet sustainability criteria. “Regarding international comparison, the total food waste per person per year of 57 kg is slightly lower than in the other new EU member states with similar socioeconomic and political characteristics (Hungary has 68 kg of the total food waste per person a year) also applying the kitchen diary approach. The avoidable part of Hungarian food waste is quite similar to the Czech part (Czechia 33 kg, Hungary 35 kg)” (Nováková et al., 2021). Vegetables, fruit, and bakery products were identified as the largest categories of food waste, often due to spoilage or overpurchasing (Nováková et al., 2021).

The Czech Republic has many factors in common with other EU member states, such as similar lifestyles, consumption habits, and distribution systems. On the other hand, the Czech Republic leads a secularised, Christian world with the highest percentage (over 70%) of religiously unaffiliated people in the world (Furstova et al., 2021). Historically, the Czech Republic has a complex religious past, marked in modern history by secularisation during the pre-1989 communist era. On the other hand, fewer than 30% of people in Czech society openly profess faith in the Roman Catholic religion,

which has a significant presence in Europe, where it has historically played a central role in shaping the cultural, social, and political landscape of the continent. Examining views associated with food waste can help identify potential links between religiosity and pro-environmental behaviour. This analysis can contribute to broader discussions about the relationship between religion and sustainable development practices around the world.

The following literature review examines the relationship between religion and food waste. Key empirical studies from recent years are cited. The purpose of the literature review is to provide arguments for formulating the hypotheses that will be tested in this study. Data and Methods describe the research design, sample structure and size, and quantitative research methods used to test the hypotheses. The results of the study are then discussed. The conclusions of the study include a summary of the main findings, their practical implications, and suggestions for further research.

1. Literature review

Religion is a multidimensional spiritual concept that includes beliefs, rituals, values, and community (Mathras et al., 2016). All four dimensions influence the behaviour of individuals. Of particular importance to this research are moral, social, and ethical values that influence consumer behaviour (Vitell et al., 2018).

The theory of planned behaviour views religion as a background variable that indirectly influences behaviour through a chain of relationships. Religiosity plays an important role in reducing food waste. This proposition is supported by the idea that a person's belief system is the basis for their behaviour and that religious belief is more general compared to attitude (Minton et al., 2015). Since reducing food waste can be considered a divine commandment, people who believe

in God might be familiar with and accept such restrictions.

Another theoretical framework for the study is the hierarchy of values, attitudes, and behaviour, which assumes that personal values influence consumer behaviour. Religious values, which are deeply rooted and have a wide reach, can significantly influence consumption and non-consumption behaviour. Religious texts and teachings often include guidelines and restrictions regarding food that can both contribute to and discourage food waste, depending on the specific practices (Minton et al., 2020).

Recent empirical studies have shown a positive relationship between food waste aversion and the personality traits of conscientiousness, frugality, and religiosity (Abdelradi, 2018; Elhoushy and Jang, 2021; Kutlu, 2022). Conscientiousness is a personality trait associated with self-discipline, organisation, and responsibility. Individuals with a high degree of conscientiousness are more aware of their actions and consider the consequences of waste. They plan their food purchases and consumption more carefully, avoiding excessive shopping and waste. In addition, conscientious people tend to be more environmentally conscious, which may also have implications for reducing food waste as part of their overall pro-social behaviour. Frugality is the tendency to be thrifty and avoid waste. People with frugal tendencies are more likely to be resourceful, creatively reuse leftovers, and find ways to minimise food waste. Their tendency to conserve resources coincides with reducing food waste, seeing it as an unnecessary waste of money and food.

Consumer activism and personal norms are important mediators of the effect of religiosity on intention to reduce food waste (Elhoushy and Jang, 2021). Those who make a special effort to reduce environmental problems, actively try to convince others to reduce food waste (including family) and recognise the importance of small

individual steps to large collective change were classified as activist consumers. As part of the personal norms assessment, individuals were asked if they felt bad about throwing away food, if they felt obligated not to waste food, and if it was against their principles to have to throw away food. On the other hand, the study (Elhoushy and Jang, 2021) did not demonstrate the influence of consumers' attitudes, injunctive norms (derived from family, neighbours, colleagues, and community), and descriptive norms (sharing the same norms with important people in a person's life) on their intentions to reduce food waste.

Not all religious movements have the same influence on pro-environmental behaviour. Some religions, such as Christianity, Judaism and Buddhism, have a positive influence on the adoption of pro-environmental practices. Islam, Hinduism, and folk religions, on the other hand, show an inverse relationship (Rodríguez-Domínguez and Gallego-Alvarez, 2021). Restrictive religious norms (e.g. food consumption rules, fasting) lead to increased food waste, while supportive religious norms (e.g. sharing food) lead to decreased food waste. At the same time, the likelihood that a religious person will reduce food waste is influenced by a marketing message that is associated with an environmental argument or support for human society (Minton et al., 2020).

Because the literature on the relationship between religiosity and pro-environmental behaviours that reduce food waste is sparse, this study extends existing research by specifically examining the value dimension of the Roman Catholic religion as reflected in views on food waste in the home. Moral, environmental, economic, and health-related views of food waste are examined.

In terms of moral norms, religious adherents have different moral values than secular people (Brown et al., 2023). Roman Catholics, as followers of a particular faith, are influenced by religious teachings that

emphasise dominion theory (according to which nature exists to serve human needs (Konisky, 2018)), stewardship theory (according to which religious beliefs lead people to care for and protect nature (Clements et al., 2014)), compassion, and care for God's creation. According to stewardship theory, religious people believe that they are morally obligated to care for nature and therefore should care more about the environment. Stewardship theory supports Christians' increased concern for immediate environmental problems rather than long-term environmental threats in the future (E. K. Smith et al., 2018). Christian teaching often promotes the responsible use of resources, including minimising waste and sharing with those in need. On the other hand, non-believers may not have specific religious teachings that inform their views regarding food waste, and their moral values may be shaped by other philosophical or ethical perspectives.

The attitude toward environmental protection is related to the role of Roman Catholics as stewards of God's creation, who have the duty to protect and preserve the environment, which is a gift from God. This view may lead to a greater emphasis on sustainable practices and food waste reduction as part of their commitment to protecting the earth (Filimonau et al., 2022). Christianity, as an important social actor, coexists with and can reinforce concern for and respect for nature (Petrescu-Mag et al., 2020). Regarding expressions of religiosity, it was found that among Roman Catholics, participation in sociocultural religious activities and self-assessed spirituality were positively and significantly associated with different dimensions of environmental engagement, but church attendance as an expression of belonging to a particular religion was not (Briguglio et al., 2020). It has been empirically demonstrated that religious values and family upbringing reinforce personal moral motives, beliefs, attitudes,

and norms to reduce food waste in heavily Catholic Poland (Filimonau et al., 2022). In contrast, a previous study found that among Christians, religiosity was positively related to pro-environmental behaviour, but not to pro-environmental attitudes or beliefs (Clements et al., 2014).

According to recent research, however, religion does not have a unidirectional influence on people's attitudes toward the environment, and neither the dominion theory nor the stewardship theory can be fully supported. Religious people do not need to worry about environmental threats because their faith helps them cope with immediate concerns about those threats (in the sense of "God has everything under control" or "God will not subject me to any test I am not prepared for"). On the one hand, people who are more religious experience a lower sense of threat from environmental threats, but show increased general concern about the environment because this concern is focused on more than just environmental threats (Michaels et al., 2021; Peifer et al., 2016; N. Smith and Leiserowitz, 2013).

While previous research has shown a link between religiosity and attitudes toward food waste, it has not addressed which specific moral, environmental, economic, and health beliefs related to food waste are typical of religious people and which are typical of non-religious people. Only this deeper analysis will make it possible to distinguish the views of people of Roman Catholic faith from those of people without religious faith, and thus explain the specific values associated with the Roman Catholic faith that relate to food waste.

H1: Moral views related to food waste differ between Roman Catholics and non-religious people.

H2: Environmental views related to food waste differ between Roman Catholics and non-religious people.

H3: Economic views related to food waste differ between Roman Catholics and non-religious people.

H4: Health beliefs related to food waste differ between Roman Catholics and non-religious people.

2. Methodology

2.1. Data and sample

The main data source for the study is secondary data from the Food 2022 survey, obtained from the Czech Social Science Data Archive (CSDA), a national data service centre for the social sciences that acquires, processes, documents, and stores digital data files from scientific projects and makes them available for further analytical use in scientific research and teaching at universities. CSDA is part of the Institute of Sociology of the Academy of Sciences of the Czech Republic and is the Czech national node of the pan-European research infrastructure CESSDA ERIC (Consortium of European Social Science Data Archives) and its service provider in the Czech Republic (Czech Social Science Data Archive, 2022).

A total of 821 respondents representing the population of the Czech Republic aged 15 years and older were interviewed. Not all respondents completed the questionnaire; 579 respondents comprised the final sample. Respondents were selected by quota sampling. The quota characteristics were region (NUTS 3, Nomenclature of Territorial Units for Statistics), size of residence, sex, age, and education. Data were collected by means of a standardised interview using the CAPI method (Computer-Assisted Personal Interviewing). Data collection was conducted by trained interviewers from the Centre for Opinion

Research of the Institute of Sociology of the Czech Academy of Sciences from 14 July 2022 to 4 September 2022.

The study focused on food waste, shopping and consumption behaviour of Czech households, the discarding of visually unsound fruit and vegetables, the Czech public's awareness of the Czech Association of Food Banks, the type of eating, shopping and environmental behaviour of Czech society, and the opinions and attitudes of the Czech public toward food waste.

The dataset was weighted after stratification to achieve structural representativeness for the population in the Czech Republic. The weights were created using an iterative proportional weighting method. The weighting variables are education (four categories) $\times$ NUTS 2, age (four categories) $\times$ NUTS 2, sex $\times$ region, size of residence (eight categories) $\times$ age (four categories), and education (four categories) $\times$ age (four categories). The data source for the weights is the Czech Statistical Office. The size of the weights is restricted to the range 0.333 to 3.

2.2. Variables

Belonging to the Roman Catholic Church was determined by the question "To which religion or religious community do you belong?" According to the weighted data, 24.3% of people in the Czech Republic belong to the Roman Catholic religion, 67.3% of people are non-denominational, and 8.4% of people belong to another religion. Other denominations were not considered in this study, meaning that only the Roman Catholic denomination and the population of no faith were included. Table 1 examines the relationship between religious affiliation and subjective food waste compared to a household of the same size.

Table 1. Relationship between the Roman Catholic religion and relative food waste rates relative to the same household size

Religion	Unit	I waste more	I waste the same	I waste less	Total
No religion	Number	56	183	206	445
	%	12.6%	41.1%	46.3%	100.0%
	Adj. Residual	2.1	3.5	-4.7	
Roman Catholic	Number	8	33	93	134
	%	6.0%	24.6%	69.4%	100.0%
	Adj. Residual	-2.1	-3.5	4.7	
Total	Number	64	216	299	579
	%	11.1%	37.3%	51.6%	100.0%

Note: Pearson Chi-square = 22.241 ($p < 0.001$), Phi = 0.196 ($p < 0.001$), Cramer’s V = 0.196 ($p < 0.001$)

Source: own elaboration

Pearson’s Chi-square test shows a statistically significant relationship between Roman Catholic religious affiliation and the relative rate of food waste compared to households of similar size. People of the Roman Catholic religion waste less than people with no religion. The Roman Catholic religion is thus related to food waste, and is, therefore, a relevant variable in food waste research.

General opinion on food waste (PL_7) was rated on a scale of 1 = food waste is not a societal problem (9.3%), 2 = food waste is not right, but there are more pressing problems (44.1%), 3 = food waste is a big problem (46.6%).

Sub-opinions about food waste were rated on a Likert scale in the following questions (question codes from the original data set). Respondents indicated their agreement with the statements on a scale of 1 (strongly disagree), 2 (disagree), 3 (neither agree nor disagree), 4 (agree), 5 (strongly agree). The frequencies of responses to the questions are shown in Appendix A. The questions were divided into four groups according to whether they were related to moral, environmental, economic, or health views.

A. *Moral views* (related to remorse associated with food waste)

- PL_126c Agree with the statement – I try not to waste food but I do so.
 - PL_126a Agree with the statement – I have a guilty conscience when I waste food.
 - PL_126b Agree with the statement – I feel guilty when I waste food because other people have nothing to eat.
 - PL_126d Agree with the statement – frequent food waste could be prevented.
- B. *Environmental views* (related to the perceived environmental impact of food waste)
- PL_126f Agree with the statement – food waste is a problem for the environment due to biodegradability.
 - PL_126g Agree with the statements – food packaging is worse for the environment than food waste.
 - PL_126e Agree with the statement – when wasting food, I think about its impact on the environment.
- C. *Economic views* (related to efforts to plan purchases and consumption, to optimise spending on food purchases and to make efficient use of food supplies)

- PL_126i Agree with the statement – I only buy products from the shopping list.
 - PL_126j Agree with the statement – I plan meals ahead for more efficient shopping.
 - PL_126k Agree with the statement – I buy more than intended at a discount.
 - PL_126h Agree with the statement – I am concerned about the amount of food wasted.
 - PL_126m Agree with the statement – I am concerned about the cost of wasted food.
 - PL_126n Agree with the statement – I try to use everything I can when preparing food.
 - PL_126o Agree with the statement – I freeze leftover food for later.
 - PL_126p Agree with the statement – leftovers are eaten by the next day.
 - PL_126q Agree with the statement – I always prepare more food than needed.
 - PL_126l Agree with the statement – I never buy food that I already have at home.
- D. *Health views* (related to the visual attributes of food and perceptions of the past use-by date and its health consequences)
- PL_126r Agree with the statement – I decide what to throw away based on appearance/smell.
 - PL_126s Agreeing with the statement – I take care not to consume food after the expiry date.
 - PL_126t Agree with the statement – it is better to throw food away than risk it being unhealthy.
 - PL_126u Agree with the statement – I forget to eat food before it spoils.
 - PL_126v Agree with the statement – it is nice to empty the fridge and get rid of old food.
- Among the demographic and socioeconomic variables, the following variables were tested, which are those most commonly tested in empirical studies:
- Gender: 1 = male, 2 = female. The sample is 49.1% male and 50.9% female, which is consistent with the population structure.
 - Age of the respondent in 2022. Age was transformed into categories as suggested by the CSDA: 15 to 19 years (5.7%), 20 to 29 years (12.2%), 30 to 39 years (16.8%), 40 to 54 years (28.4%), 55 to 64 years (14.8%), 65 years and over (22.1%). Age is related to the economic activity of the respondent and therefore the economic activity of the respondent was not considered separately.
 - Education according to the International Standard Classification of Education (ISCED): Level 1 (44.7%) = 3C (General Certificate of Secondary Education, International Baccalaureate); Level 2 (33.8%) = 3A/4A (college with A level); Level 3 (21.5%) = 5A (university degree: bachelor's, master's, doctorate).
 - Municipality size by population. 1 = up to 1,999 inhabitants (26.2%); 2 = 2,000 – 4,999 inhabitants (12.7%), 3 = 5,000 – 19,999 inhabitants (16.6%); 4 = 20,000 – 49,999 inhabitants (12.7%); 5 = 50,000 – 199,999 inhabitants (12.1%); 6 = 200,000 or more (19.6%).
 - Household size is assessed by two questions.
 - Living with a partner: 1 = yes (58.5%), 2 = no (41.5%).
 - Number of dependent children: 1 = one (15.1%), 2 = two (13.0%), 3 = three (2.5%), 4 = four or more (0.5%), 5 = none (68.9%).
 - The household's standard of living is rated by the respondent's subjective standard of living: 1 = good (58.2%),

2 = neither good nor bad (34.2%),
3 = bad (7.6%).

- Level of household expenditure on food per month. Eight levels of expenditure were monitored: 1 = up to 80 EUR (4.4%); 2 = 80 – 160 EUR (17.0%); 3 = 160 – 240 EUR (21.2%); 4 = 240 – 320 EUR (21.6%); 5 = 320 – 400 EUR (17.0%); 6 = 400 – 480 EUR (12.1%); 7 = 480 – 560 EUR (3.3%); 8 = more than 560 EUR (3.3%).

2.3. Method (CHAID)

A non-parametric classification tree method was used to determine opinions about food waste because all variables are categorical. The tree-like sequential partitioning of data into homogeneous subsets is a technique that lends itself to the study of relationships, which is the purpose of this research. At the same time, the analysis is more descriptive in nature, as it aims to identify variables that distinguish the group of people who are Roman Catholics from those who are not religious.

The advantage of classification trees is their ability to visually represent relationships in a clear and transparent manner. Classification tables also allow for the evaluation of results and model fit. The model developed in this study does not have predictive ambitions, as a number of other variables unrelated to food waste views have an impact on Roman Catholic religious denomination. A visual analysis of the tree branches will find specific subgroups and relationships that are not obvious at first glance or that traditional statistics would find difficult and laborious to uncover. The classification procedures, and thus the rules, are represented as branches, and the nodes represent subgroups. In this way, a classification rule gradually leads to a more precise determination of the target variables and the final classification classes.

In practice, one of the four most common classification algorithms can be chosen – CHAID (Chi-Square Automatic

Interaction Detection), Exhaustive CHAID, CRT (Classification and Regression Trees) and QUEST (Quick Unbiased Efficient Statistical Tree). CHAID is a fast statistical algorithm based on the optimal value of the Chi-square or F-test. It examines the data quickly and efficiently, forming segments and profiles in a sequence of optimal steps, each time dividing the groups into an appropriate number of statistically homogeneous subgroups. CHAID is based on statistical hypothesis testing at each step, with the optimal step usually given by maximum significance (Kass, 1980). Exhaustive CHAID is a modification of the CHAID algorithm that examines all possible splits for each predictor (Biggs et al., 1991). The CRT algorithm generates binary trees (a group is always divided into two parts) and maximally homogeneous groups according to statistical criteria (Gordon et al., 1984). QUEST is a statistical algorithm that selects variables without bias and generates accurate binary trees quickly and efficiently (Loh and Shih, 1997).

Considering that not only binary tree splitting is required, but also optimising the number of statistically homogeneous subgroups, the CHAID algorithm is used. According to the results of the comparison of CHAID algorithms, it generates the most classification rules and has the highest error prediction accuracy (Lin and Fan, 2019).

The CHAID algorithm is a statistical method for building classification trees. It was originally developed for categorical variables only. It is a non-parametric technique that recursively divides the data into mutually exclusive subsets and creates a tree structure. The main goal of CHAID is to identify the key predictors and their interactions that best explain the variability in the target variable (in this case, Roman Catholics compared to non-religious individuals). The algorithm works with the following sequential steps:

1. Distribution of data: The CHAID algorithm starts with the entire data set and the search for a predictor (independent

variable) that best divides the data into two or more homogeneous groups based on the target variable (dependent

variable). Pearson's Chi-square test was used to determine the statistical significance of these distributions.

$$\chi^2 = \sum \frac{(o_i - e_i)^2}{e_i} \quad (1)$$

where o_i denotes the observed frequencies of occurrence of the variation and e_i denotes the expected frequencies of occurrence of the variation. The significance value for the distribution of nodes and merging categories can be influenced. For both criteria, the default significance level is 0.05. For multiple comparisons, the significance values for the merge and split criteria are adjusted using the Bonferroni method to reduce the probability of a Type I error.

Within the algorithm, the categories are merged. In the case of ordinal variables, adjacent categories are merged.

2. Node creation: once the best predictor and its value for the data distribution are found, the algorithm creates a tree node for that combination. A node represents a rule that decides the next routing in the data analysis.
3. Recursive partitioning (node partitioning): The algorithm repeats the splitting of the data and the creation of the nodes for each newly created group (node). For each node, the best predictor and its value are searched again to create more nodes in the tree structure. The procedure is repeated until a certain termination criterion is met (e.g., the minimum number of samples in a node). For each predictor and its pooled categories, a chi-square test and an F-test are performed to test for dependence on the target variable. The merged categories form child nodes (sub-nodes) if $p < \alpha_{\text{split}}$. Otherwise, splitting is terminated, and the node is terminal.
4. Stopping criteria: To avoid overlearning the model, the algorithm uses stopping criteria to limit further splitting of the data or creation of new nodes:

- the number of instances in the node is less than the specified limit (parent node size), in this case 100;
 - the number of instances in the node that would result from the most appropriate split is less than the specified limit for the child node (child node size), in this case 50;
 - the depth of the tree would exceed the specified limit (depth), in this case three levels;
 - no chi-square test or F-test is more significant than the specified limit (significance), in this case 0.05;
 - all observations in the node have the same target category value;
 - all observations in the node have the same values in all predictors.
5. Node adjustment: after the tree is created, the algorithm can perform node adjustment to remove branches that do not contribute significantly to the predictive ability of the model. This step helps to obtain a simpler and more efficient classification tree.
 6. Terminal tree: the result of the CHAID algorithm is a classification tree with a root node (first node) and leaf nodes (terminal nodes). Each terminal node contains a predicted category or value of the target variable for the new data based on the rules in the tree.

Although in the case of descriptive analysis the evaluation of the predictive ability of the model is not relevant, a classification table of sensitivity and specificity values is shown for completeness. Sensitivity is the probability that the model predicts a positive outcome for a positive subject (i.e. the correct classification of a case into the Roman Catholic group). Specificity is the

probability that the model predicts a negative outcome for a negative subject (i.e. the correct classification of a case into the group with no religious affiliation). The overall accuracy of the model is then the relative classification success of all evaluated cases. The default cutpoint is 0.5.

The Received Operation Characteristic (ROC) curve shows the sensitivity versus specificity for each cutpoint. The area under the ROC curve (AUC) is the most common quantitative index describing the ROC curve and also expressing the accuracy of the test. The following cut-off values are used to rate the test: 0.9–1 excellent, 0.8–0.9 very good, 0.7–0.8 good, 0.6–0.7 fair, 0.5–0.6 poor (Pampel, 2000).

The performance of the nodes in the classification tables is evaluated using three key metrics: gain, index and response.

Gain is the most basic metric in SPSS classification tables. It indicates how well the table classifies observations compared to the original distribution of categories. It is expressed as the ratio of classified observations to the total number of observations in a given node. Gain increases from zero to one, with a value of one (100%) indicating perfect classification. Higher gain values mean better model performance.

The index is another useful metric for evaluating node performance in classification tables. It considers not only the quality of classification, but also the composition of categories in a node. It expresses how well the observations in a given node are classified into different categories. The index ranges from 0 to 1, with a value of 1 (100%) indicating the ideal distribution of observations among categories. Higher index values mean that the node is well distributed and has high homogeneity within a category.

Response in classification tables indicates how quickly nodes adapt to changes in input data. A node with a high response will have abrupt changes in classification as the values of the input variables change. Conversely, a node with a low response will be less affected by changes in the input data and its classification will remain more stable. The optimal response value depends on the specific requirements and goals of the model.

3. Results

3.1. Classification Table

The results are presented in the form of a classification table showing statistically significant variables at the 0.05 significance level.

Table 2. Classification table

Node	No religion (0)		Roman Catholic (1)		Total		Pred. Cat.	Parent Node	Primary Independent Variable				
	N	%	N	%	N	%			Variable	Sig. ^a	Chi-Square	df	Split Values
0	496	73.6%	178	26.4%	674	100.0%	0						
1	201	86.6%	31	13.4%	232	34.4%	0	0	Age	0.000	47.648	2	<= 30-39
2	198	73.6%	71	26.4%	269	39.9%	0	0	Age	0.000	47.648	2	[30-39,55-64]
3	97	56.1%	76	43.9%	173	25.7%	0	0	Age	0.000	47.648	2	> 55-64
4	90	95.7%	4	4.3%	94	13.9%	0	1	EN_126a	0.007	11.321	1	<= 3

Node	No religion (0)		Roman Catholic (1)		Total		Pred. Cat.	Parent Node	Primary Independent Variable				
	N	%	N	%	N	%			Variable	Sig. ^a	Chi-Square	df	Split Values
5	111	80.4%	27	19.6%	138	20.5%	0	1	EN_126a	0.007	11.321	1	> 3
6	87	61.3%	55	38.7%	142	21.1%	0	2	Food expend.	0.000	23.568	1	<= 240–320 EUR
7	111	87.4%	16	12.6%	127	18.8%	0	2	Food expend.	0.000	23.568	1	> 240–320 EUR
8	48	72.7%	18	27.3%	66	9.8%	0	3	PL_126h	0.005	12.021	1	<= 3
9	49	45.8%	58	54.2%	107	15.9%	1	3	PL_126h	0.005	12.021	1	> 3
10	48	81.4%	11	18.6%	59	8.8%	0	6	PL_126b	0.000	17.165	1	<= 2
11	39	47.0%	44	53.0%	83	12.3%	1	6	PL_126b	0.000	17.165	1	> 2
12	44	78.6%	12	21.4%	56	8.3%	0	7	PL_126q	0.031	7.093	1	<= 2
13	67	94.4%	4	5.6%	71	10.5%	0	7	PL_126q	0.031	7.093	1	> 2

Notes: Opinions on food waste were rated on a Likert scale. Respondents expressed agreement with the statements on a scale of 1 (strongly disagree), 2 (disagree), 3 (neither agree nor disagree), 4 (agree), 5 (strongly agree). a. Bonferroni adjusted

Source: own elaboration

Age has the greatest influence on religious denomination. The proportion of Roman Catholics is higher for older people (55–64 years, 43.9%, Node 3) than for younger people (30–39 years, 13.4%, Node 1). For younger people, moral motives to reduce food waste are particularly important. The group of young people who did not indicate a guilty conscience about food waste is dominated by non-religious people (95.7%, Node 4). In comparison, the group of young people who have a guilty conscience about food waste contains a smaller proportion of young people with no religion (80.4%, Node 5) and a larger proportion of Roman Catholics (19.6%, Node 5) compared to Node 4.

In contrast, economic motives to reduce food waste are important among older people (55–64 years) because they are concerned about the amount of food wasted. A higher proportion of elderly Roman Catholic

people are concerned about the amount of food wasted (54.2%, Node 9) compared to people with no religion (45.8%, Node 9). The group of elderly people who did not report being concerned about the amount of wasted food is dominated by people with no religion (72.7%, Node 8).

For both age groups (30–39, 55–64), the amount of monthly food expenditures is important. Both younger and older people need to consider this purely economic factor. The amount of monthly food expenditure is divided by an interval from 240 to 320 EUR. Households with higher food expenditure than 240 to 320 EUR are characterised by a higher proportion of people with no religion (87.4%, Node 7) than households with lower food expenditure (61.3%, Node 6). In other words, households with lower food expenditures have a higher proportion of people of Roman Catholic faith (38.7%, Node 6) than households with higher food

expenditures (12.6%, Node 7). However, each of these segments is characterised by different motivations for reducing food waste.

Roman Catholic households with lower food expenditures tend to feel guilty about wasting food because other people have food constraints (53.0% vs. 47% of non-religious households with feelings of guilt; Node 11). Conversely, the group of households that do not feel guilty is dominated by non-religious households (81.4% compared to 18.6% of Roman Catholic households that do not feel guilty; Node 10). It is clear, then, that moral motives and consideration for others in need are typical of Roman Catholic households.

The second group of households spends more on food than 240 – 320 EUR. For these households, the economic motive is important because they are aware that they waste food mainly because they always prepare more food than they need. This behaviour is predominantly admitted to by non-religious individuals (94.4% versus 5.6% of Roman

Catholics, who also give the same reason for wasting; Node 13). In contrast, Roman Catholic households with higher food expenditures are more likely to disagree with this statement (21.4% compared to those who admit to this reason for waste; Node 12). Thus, Roman Catholic households generally optimise their purchases and consumption of raw materials, groceries, and prepared foods so that they do not waste food unnecessarily by making excessive purchases that they cannot use.

3.2. Post hoc tests

The resulting model is able to predict Roman Catholic religion at 57.3% (sensitivity) and non-religious at 82.3% (specificity). The overall accuracy of the model is 75.7%. The area under the ROC curve is 0.697 with a 95% confidence interval (0.653; 0.740) and standard error of the estimate of 0.022 ($p < 0.001$), indicating the fair predictive ability of the model. Table 3 contains the performance data of the Gains for Nodes.

Table 3. Gains for Nodes

Node	Node		Gain		Response	Index
	N	Percent	N	Percent		
9	107	15.9%	58	32.6%	54.2%	205.3%
11	83	12.3%	44	24.7%	53.0%	200.7%
8	66	9.8%	18	10.1%	27.3%	103.3%
12	56	8.3%	12	6.7%	21.4%	81.1%
5	138	20.5%	27	15.2%	19.6%	74.1%
10	59	8.8%	11	6.2%	18.6%	70.6%
13	71	10.5%	4	2.2%	5.6%	21.3%
4	94	13.9%	4	2.2%	4.3%	16.1%

Note: The node numbers correspond to the node numbers in the rows of Table 2.

Source: own elaboration

The most profitable nodes are Nodes 9 and 11. Node 9 contains the proportion of people with no religion and Roman

Catholics in the 55–64 age group who are more concerned about the amount of food wasted. Dissatisfaction predominates

among Roman Catholics (54.2%). Node 11 contains the proportion of people with no religion and Roman Catholics in households with lower monthly food expenditures who feel guilty about wasting food because other people have food constraints. This moral factor is predominant among those of Roman Catholic faith (53.0%).

4. Discussion

The study revealed a number of interesting findings. First, younger and older people alike were found to have different motives for reducing food waste. A lower percentage of younger people (aged 30–39) profess Roman Catholic beliefs than older people (aged 55–64). Younger Roman Catholics are more likely to give preference to moral motives and feel guilty about wasting food. Conversely, older Roman Catholics prefer economic motives and are more concerned about the amount of food wasted than non-religious individuals. Regarding the formulated hypotheses, we can tend to accept the veracity of hypothesis H1 for younger individuals (moral beliefs related to food waste are different between Roman Catholics and non-religious individuals) and hypothesis H3 for older individuals (economic beliefs related to food waste are different between Roman Catholics and non-religious individuals).

For younger Roman Catholics, the moral aspects of their religion may play an important role in shaping their attitudes toward food waste. Religious teachings that emphasise responsibility for others and care for the poor may lead to feelings of guilt or blame for behaving irresponsibly and wasting food. The theoretical justification for this conclusion regarding the tenets of the Roman Catholic faith may be related to moral responsibility. Roman Catholic religious teaching emphasises the moral responsibility of individuals toward others and toward God's creation. Younger Roman Catholics who prefer moral

motives may be influenced by these teachings and perceive food waste as an immoral act. This may lead to feelings of guilt and reproach if they engage in such irresponsible behaviour (Elhoushy and Jang, 2021).

Conversely, older people may be more sensitive to the economics of food waste because they are likely to have experienced different economic situations in their lifetimes. They may remember times of scarcity, which in the Czech context was the period of central planning during socialism from 1949 to 1989, and therefore value food and see waste as an unwise and irresponsible practice (Večerník, 2008). The theoretical justification for this conclusion in relation to Roman Catholic principles can be related to traditional economic principles. Older Roman Catholics who prefer an economic motive may be influenced by traditional economic principles that are part of religious education and preaching. These may be principles of thrift, economy, and the responsible use of resources, which may have the side effect of making them concerned about food waste because it is seen as inefficient and uneconomical in the context of societal norms (De Groot et al., 2021).

The way society perceives food waste may also influence individuals' lifestyles (Tahal and Formánek, 2022). The younger generation may be more exposed to information and discussions about environmental issues, sustainability, and responsible consumer behaviour, which could lead to an emphasis on the moral aspects of waste. Conversely, the older generation may have less exposure to such information and focus more on the economic consequences of waste (Ioniță, 2017).

Regardless of age, the amount of monthly spending on food purchases is critical for households. The amount spent may be related to both household size and the household's overall standard of living. Roman Catholic households with lower monthly expenditures on food tend to be

compassionate toward others and feel guilty about wasting food because other people have food constraints. Roman Catholic religious teaching emphasises compassion for others, especially those in need. This moral value can be rooted in faith and promoted in the religious community. Roman Catholic households with lower food expenditures may be influenced by these religious teachings and feel guilty if they waste food inefficiently, consuming resources that could be used for those in need (Wang et al., 2021). In addition, households with fewer financial resources may be more sensitive to the needs of others and more aware that some do not have enough food to meet their basic needs. This may lead to a sense of compassion and responsibility to manage food efficiently and minimise waste (Filimonau et al., 2022).

Conversely, non-religious individuals in households with higher expenditures on food create significant amounts of food waste, as they always prepare more food than they need. Households with higher spending on food may have greater financial capacity and flexibility to shop for and prepare meals. This may lead them to purchase more ingredients and food than necessary, and then waste may occur if not all food is consumed in a timely manner (Aschemann-Witzel et al., 2019). Relatedly, other authors have found that strategies designed to save money – such as buying food in bulk, shopping monthly, favouring supermarkets, and cooking with meat – actually lead to more food waste (Porpino et al., 2015).

Roman Catholic households that optimise their purchases and consumption may be influenced by a desire to minimise waste and avoid irresponsible consumption. In Roman Catholic households, perceptions of food may be based on faith and religious teachings, which may lead to a greater awareness of the value of food and responsibility for its efficient use (Elhoushy and Jang, 2021; Hinčica et al., 2022). Conversely,

individuals without religious beliefs may not have the same motivations for thinking about the importance of food and its use.

Regarding the hypotheses, the associations between Roman Catholic religion and environmental attitudes (H2) and health beliefs related to food waste (H4) could not be demonstrated. This is consistent with recent findings that religion does not have a unidirectional influence on people's environmental attitudes and cannot be fully supported by either dominance theory or stewardship theory (Michaels et al., 2021).

Conclusions

This study addressed the relationship between Roman Catholic religious affiliation and food waste in Czech households. The literature review revealed that there are relatively few empirical studies on this topic, despite the fact that faith and piety influence human values and moral principles worldwide.

Theoretical implications

With particular attention to the Roman Catholic denomination, younger and older individuals were found to have different motivations for reducing food waste. Younger Roman Catholics tend to prefer moral motivations and feel guilty about wasting food, whereas older Roman Catholics prefer economic motivations and are concerned about the amount of food wasted. These differences may be related to different aspects of Roman Catholic religious teachings, which emphasise caring for the poor, frugality, and the responsible use of resources.

Environmental and health beliefs regarding food waste have been shown to be unrelated to Roman Catholic beliefs, which is consistent with the results of recent research that has shown no unidirectional effect on the environmental attitudes of religious people. Moral and economic

beliefs related to food waste appear to be more important in the context of reported Roman Catholic denomination. It is possible that the relationship between Roman Catholicism and environmental attitudes toward food waste is mediated by moral values and views, which needs to be tested in follow-up studies.

The study also confirmed that Roman Catholicism was positively related to consumer attitudes, activism, and personal and subjective norms for reducing food waste. Individuals with no religious affiliation in households with higher food expenditures were found to typically waste food and always prepare more food than they need. In contrast, Roman Catholic households show a stronger tendency to optimise their purchases and consumption of raw materials, groceries, and prepared foods and to feel a sense of belonging to those in need.

Practical implications

This study provides a deeper insight into the relationship between religion and food waste. The findings may contribute to a better understanding of these relationships and open discussions on how food waste can be reduced by emphasising Christian values. The research findings can be relevant to countries with a higher proportion of the population with Roman Catholic religious affiliation (e.g. Poland, Spain and Italy in Europe).

Religion and religious teachings have the potential to influence individuals' attitudes and behaviour toward issues such as food waste. Since the study showed that religious beliefs have an impact on reducing food waste, this could encourage activists and organisations working on environmental issues to reach out to different religious communities and engage them in sustainable initiatives. People who profess Roman Catholic faith typically find support and meaning in their religious

community. Through social interactions and the sharing of common values, they can reduce food waste. Non-religious people can also be influenced and inspired by the study's findings to reduce food waste and become more responsible food stewards. Ethical and moral principles that are often part of religious beliefs do not have to be exclusive to believers and can serve as inspiration to non-believers as well.

In this study, we have explored the intricate relationship between household food waste management, religious affiliations, and ecological behaviour. Our findings illuminate the potential of integrating these aspects into a circular model for sustainable development. To this end, we propose practical recommendations for policymakers and stakeholders.

Practical recommendations for sustainable development focus on the following topics: 1) Incorporating religious values: recognise and integrate the diverse religious beliefs of households in developing waste management policies. This approach can enhance community engagement and compliance with sustainable practices. 2) Behavioural economics in waste management: utilise principles of behavioural economics to design incentives and programmes that encourage households to reduce food waste and participate in recycling and composting initiatives. 3) Education and awareness: implement educational campaigns that focus on the ecological impacts of food waste and the benefits of sustainable practices, tailored to respect and incorporate various religious perspectives.

Moving forward, a strategic approach is necessary for managing food waste within the frameworks of a circular and behavioural economy. This strategy should prioritise the optimisation of resource use, promote the recycling and repurposing of food waste, and foster a culture of sustainability at the household level.

The study is also a plea for support for policy initiatives aimed at reducing food waste and improving the sustainability of the food system. Policy organisations and government institutions can use the research findings as a basis for policy decisions that could promote responsible food use.

Limits of research

The research has its limitations. First, the study relies on a specific sample from one country and focuses on one religious denomination, which limits the generalisability of the findings to a broader international population. Second, the study relies on subjective statements from the respondents themselves, which may be biased or inaccurate. Participants may tend to provide socially desirable responses, leading to under- or overestimation of views on food waste. This bias could affect the accuracy of the data and potentially skew the results. Future studies might consider the use of objective measures or observational data to validate the self-reported information provided by respondents. More objective measurement of food waste can be undertaken through a combination of household records of food purchases and consumption and inspection of municipal waste.

Directions for further research

Given the interesting results and possible social implications of this study, here are some suggestions for further research. In addition to the aforementioned direction of testing the mediating effect of moral motives on the relationship between environmental views on food waste and Roman Catholic religious beliefs, other research challenges suggest themselves. This study focused only on the Roman Catholic denomination. For further research, it would be interesting to include other religious

groups in the study to compare the views and attitudes of different religious communities on food waste and sustainability. This could help identify specific characteristics and differences in behaviour and views between different religious groups. For further research, it would be useful to monitor people's behaviour and attitudes toward food waste over the long term. This would make it possible to observe long-term changes and trends in perceptions and attitudes about the issue, for example in the form of a longitudinal study.

Overall, the directions for future research should focus on international comparative studies, policy impact analysis and technological innovations. International comparative studies should investigate how religious beliefs influence consumer behaviour and attitudes towards food waste management across different European countries. They could provide a broader understanding of the cultural dynamics in sustainable practices. Policy impact analysis would assess the effectiveness of policies that integrate religious and ecological considerations in food waste management. Finally, studies on technological innovations should explore the role of technology in enhancing food waste management, particularly in segregating and recycling processes, and how it aligns with various cultural and religious practices.

In conclusion, the interplay of religious affiliations, ecological behaviour, and food waste management presents a unique opportunity to drive sustainable development. By embracing a holistic approach that considers these factors, we can develop more effective strategies for resource conservation and environmental protection. The proposed future research areas will not only deepen our understanding but also guide us in creating more inclusive and effective sustainability policies.

List of abbreviations

- CAPI: Computer-Assisted Personal Interviewing. Refers to a survey data collection method where an interviewer uses a computer or electronic device to assist in conducting face-to-face interviews, typically in surveys and research studies.
- CHAID: Chi-Square Automatic Interaction Detection. A statistical technique used for data mining and decision tree analysis. CHAID is used to uncover relationships within categorical variables in a dataset, aiming to find patterns and interactions between variables.
- CSDA: the Czech Social Science Data Archive. An organisation in the Czech Republic that collects, preserves, and provides access to social science data for research purposes.
- CRT: Classification & Regression Trees. A type of decision tree algorithm used for classification and regression tasks in machine learning and data analysis. It recursively splits the dataset based on the most significant variables to create a tree-like model.
- CESSDA ERIC: Consortium of European Social Science Data Archives European Research Infrastructure Consortium. A collaborative network of social science data archives across Europe, aiming to provide researchers with access to a wide range of social science data for cross-national and comparative research.
- EPA: the Environmental Protection Agency. A United States government agency responsible for regulating and enforcing environmental laws and policies to protect human health and the environment.
- ERS: the U.S. Department of Agriculture's Economic Research Service. The research arm of the U.S. Department of Agriculture, providing economic and statistical information related to agriculture, food, natural resources, and rural development.
- EU: the European Union.
- FAO: the Food and Agriculture Organisation. A specialised agency of the United Nations focused on addressing issues related to food and agriculture to ensure global food security, eliminate hunger, improve nutrition, and enhance rural development.
- FUSIONS was a European Union-funded project aimed at addressing food waste and its environmental impact. It worked to develop strategies to reduce food waste throughout the food supply chain, from production to consumption.
- NUTS: Nomenclature of Territorial Units for Statistics. A hierarchical system used by the European Union for dividing regions into statistical units for various data reporting and analysis purposes.
- QUEST: Quick Unbiased Efficient Statistical Tree. A decision tree algorithm used for classification and regression tasks, designed to create a decision tree by recursively splitting data based on statistical tests.
- UNEP: the United Nations Environment Programme. A UN agency that coordinates environmental activities, assists countries in implementing sustainable development practices, and addresses global environmental challenges.

Annexes

Appendix A: Relative frequencies of responses to questions on food waste (%)

Variable	Valid N	1 (strongly disagree)	2	3	4	5 (strongly agree)
EN_126a	802	5.4	14.0	18.4	38.5	23.6
PL_126b	786	5.9	23.8	24.2	33.9	12.1
EN_126c	807	9.2	33.6	23.8	29.4	4.1
EN_126d	819	23.7	41.8	18.1	14.0	2.4
PL_126e	791	6.4	32.9	24.7	27.0	8.9
EN_126f	787	13.7	40.5	20.1	20.2	5.5
EN_126g	768	1.1	9.4	22.1	42.0	25.5
PL_126h	784	2.0	12.7	24.6	38.9	21.8
PL_126i	811	9.4	35.5	23.4	24.7	7.0
EN_126j	804	6.5	21.5	19.6	38.9	13.5
PL_126k	813	8.4	28.7	22.5	32.3	8.1
EN_126l	808	2.9	30.1	24.5	32.9	9.6
EN_126m	798	6.3	18.2	15.6	34.5	25.4
EN_126n	803	0.4	3.7	12.5	52.2	31.2
PL_126o	810	6.3	16.9	14.6	40.9	21.2
EN_126p	806	1.2	11.1	19.0	51.4	17.4
PL_126q	815	8.8	44.5	23.7	18.7	4.3
EN_126r	798	4.3	14.0	12.8	50.2	18.6
PL_126s	809	4.7	19.2	24.1	36.6	15.4
PL_126t	810	1.4	10.4	14.3	45.6	28.4
EN_126u	818	13.7	43.2	21.9	18.5	2.7
PL_126v	762	3.0	16.9	25.5	38.0	16.6

Source: own elaboration

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