Vol. 153, No. 1 · Research article

DIE ERDE
Journal of the Geographical Society of Berlin

Food waste and shopping behaviour – quantitative household investigations based on local case studies from Germany

Ulrich Jürgens

University of Kiel, Department of Geography, Ludewig-Meyn-Str. 8, 24118 Kiel, Germany, ngg02@rz.uni-kiel.de

Manuscript submitted: 30 December 2021 / Accepted for publication: 27 February 2022 / Published online: 31 March 2022

Abstract

The connection between food waste and grocery shopping behaviour is investigated using a regional example from Germany. Quantitative surveys apply the food waste related lifestyle concept and multivariate analysis methods to identify four different attitude groups related to dealing with food in private households. The shopping patterns of these groups display a high degree of congruence with the attitude patterns. The retail formats and the food products purchased in them are investigated as the original source of food waste in private households, and waste-prone product types and reasons for disposal are explored. It is possible to identify the particular susceptibility of individual product groups to food waste, and also differences in the handling of food and food waste between the segmented groups of individuals. Originally fresh products dominate food waste. This can be linked to the material origins of these products that are purchased in both so-called alternative shops and in conventional retail formats. The identification of the attitude groups and behavioural groups allows relevant demographic structures that are not immediately obvious to be deduced. This can provide target groups for educational measures, for which reliance on a one-dimensional approach is insufficient.

Zusammenfassung

Untersucht wird der Zusammenhang von *food waste* zum Lebensmitteleinkaufsverhalten anhand eines regionalen Beispiels aus Deutschland. Quantitative Erhebungen identifizieren unter Anwendung des *food waste related lifestyle-concept* und multivariater Analysemethoden vier unterschiedliche Einstellungsgruppen im Umgang mit Lebensmitteln in privaten Haushalten, deren Einkaufsmuster diesen Einstellungsmustern mit hoher Kongruenz folgen. Die Einkaufsformate werden mit den hieraus eingekauften Produkten als Urquelle von *food waste* in den privaten Haushalten auf abfallanfällige Produktarten und Entsorgungsgründe untersucht. Herleitbar ist nicht nur die besondere Anfälligkeit einzelner Produktgruppen im *food waste*, sondern auch der variable Umgang mit *food* und *food waste* in den segmentierten Personengruppen. Vor allem ursprüngliche Frischeprodukte dominieren das *food waste* Geschehen, das sich in seinen materiellen Ursprüngen sowohl in sog. alternativen als auch konventionellen Handelsformaten verorten lässt. Aus den Einstellungs- und handelnden Gruppen heraus werden demographisch erklärende und ursprünglich verborgene Strukturen abgeleitet, die als Zielgruppen für Aufklärungsmaßnahmen dienen können, wofür eindimensionale Antworten nicht ausreichen.

Keywords food waste, food-related lifestyle, retailing, grocery shopping, consumer behaviour, quantitative analysis

Ulrich Jürgens 2022: Food waste and shopping behaviour – quantitative household investigations based on local case studies from Germany. – DIE ERDE **153** (1): 28-59

DOI:10.12854/erde-2022-600

1. Introduction

Social discourse on food in general has increased rapidly in recent years. In addition to public media and political discussions, the topic is addressed by a variety of scientific disciplines and considers questions of individual health and the place of origin of food from local to global. Other focuses are on the processing and availability of groceries, quality and price development, cultural significance, marketing techniques and impacts on the natural environment (see for example *Atkins* and *Bowler* 2001*; Kline* 2011; *Althans* and *Billstein* 2016; *Yadav* et al. 2019*; Iwama* et al. 2021). Since the 2010s, the systematic examination of food waste has also established itself as *one* topic in the field of food, thus becoming of socio-political relevance relatively recently. The growth of scientific output on this matter is demonstrated in various review articles and book publications (*Principato* 2018; *Schanes* et al. 2018; *Blakeney* 2019; *Reynolds* et al. 2020; *Dou* and *Toth* 2021; *Mustamin* et al. 2020; *Principato* et al. 2021) and is also reflected in high-profile, wide-reaching TV documentaries (*Kaul* and *Lange* 2020).

Especially in the case of food disposal (but rarely in the case of other raw materials), the rather colloquial expression 'waste' is commonly used even in academic work, a term with negative connotations both ethically and morally. This terminology promotes constant media attention, which not only focuses on the 'misuse' of food products that were originally suitable for human consumption, but also the 'misuse' or 'underuse' of primary resources like labour, land or nature and capital that are used for the production of this food (*Abbade* 2020; *Chen* et al. 2020; *Read* et al. 2020; *Barrera* and *Hertel* 2021).

There is correspondingly great interest in recording or calculating the extent and differentiation of food waste, the susceptibility of different product groups to waste, and the extent of wasted resources originally invested in food for human consumption (*World Bank* 2020; *Cattaneo* et al. 2021). In 2015, the United Nations (*UN* 2015: 24) identified food waste and food loss as a global challenge and included it among the 17 Sustainable Development Goals as Target 12.3 of the 2030 Agenda for Sustainable Development. In order to achieve sustainable consumption and production patterns, the aim is to halve global food waste and food loss by 2030.

There are, however, limited data on this issue. On a global scale, relevant and significant results have only ever been randomly collected for a few countries (*UNEP* 2021). It has certainly not been possible to trace a path of development over time showing 'improvements' in the handling of food across the diverse actor groups, such as primary production, industry, retail, gastronomy and private households. Figures from the *FAO* (2011, 2019) and *UNEP* (2021) on the global scale or broken down to the national level are therefore explicitly cursory and only give a vague idea of the extent of food waste, even assuming the data have a scientific basis. Just for Germany, in the 2010s food waste figures provided by various sources and institutions range between 12 million tonnes a year (*University of Stuttgart* 2012: 134; *Schmidt* et al. 2019: 60) and 18 million tonnes a year (*WWF* 2015: 59). Here variations in definition and exhaustiveness play a role, as demonstrated by *Biehl* (2021) in a comparative article in the *Lebensmittel Zeitung*. Despite the recent tendency to determine figures using increasingly complex surveys and calculation models, the basic data used in the public sphere in Germany has remained unchanged for years. The figures vary with the use of narrower or broader definitions, which has itself become a political issue (*Biehl* 2021: 30).

The *UNEP* (2021: 70ff.) estimates that 931 million tonnes of food was wasted worldwide in 2019, 61% of this is attributable to private households. The *UNEP* (2021: 71f.) itself points out discrepancies amounting to several 100 million tonnes between this estimate and global food waste recorded by another UN organisation (*FAO* 2011, 2019), because the calculations use different definitions of food waste and vary by including or excluding segments such as agriculture. *Barrera* and *Hertel* (2021: 4) consider future developments and suggest that growth in world's population and increasing social middle-class demands in countries of the global South mean that the extent of food waste will continue to grow in coming decades, even if the share attributable to 'high income' world regions (as defined by the World Bank) shrinks relatively (*World Bank* 2020).

A multifaceted definitional framework for the delimitation and differentiation of food waste can be derived from the literature. Such a framework faces specific problems related to the capture and operationalisation of data given the different sources of food waste such as private households, gastronomy,

retail and production (*Eriksson* et al. 2012; *Ponton* et al. 2012; *Richter* and *Bokelmann* 2016; *Hermsdorf* et al. 2017; *Cicatiello* et al. 2017; *Giordano* et al. 2018: 2886; *González-Santana* et al. 2020: 2; *Goodman-Smith* et al. 2020). Differing objectives and methods mean that the data collected are rarely comparable. Nevertheless, there is agreement that food waste should be distinguished from food loss. *Food waste* explicitly includes only those goods that are marketable and edible ("avoidable food waste"), but are sorted out of the utilisation chain before human consumption (*Visschers* et al. 2016: 66; *Porpino* et al. 2015: 620). This occurs because the goods do not (or no longer) meet qualitative and aesthetic requirements and are thus "perceived as inedible" in different biographical and cultural contexts (*Blichfeldt* et al. 2015: 90) or because the food stuffs have been 'forgotten' or inappropriately transported or stored. This means that not all (e.g. inedible, rotten) thrown-away food can be classified as food waste (termed "possibly avoidable food waste" and "unavoidable food loss"; *Visschers* et al. 2016: 66). These definitional building blocks reveal that *when* an originally edible good becomes a no longer edible food is a fluid transition (*Evans* 2012: 42: "passage of food into waste"; *Thyberg* and *Tonjes* 2016: 112; *Aleshaiwi* and *Harries* 2021). Especially in the private sphere, this transition is dependent on long-term or short-term attitudes, perceptions, moods, experiences and biographical changes. It is thus impossible to make an exact demarcation between food and food waste, rather what is required is a distinction based on the realities of life. In contrast, so-called food loss, where quantitative shrinkage or qualitative loss occurs before processing or consumption of food, is caused by inefficient agricultural technologies, incorrect storage or transport deficiencies (*World Bank* 2020: 11). The FAO estimates that about 14% of all food or crops are lost before they can be marketed (*Barrera* and *Hertel* 2021: 1).

There is consensus in the discussion so far (*Secondi* et al. 2015; *Visschers* et al. 2016; *Herzberg* et al. 2020) that the largest source of food waste is found in the atomistic, anonymous and unobserved environment of private households, where the perpetrators often have no knowledge of how much food waste is produced in the household and suppress the reasons underlying such waste. This is in contrast to sectors such as the food processing industry, retail and gastronomy and the sources of evidence that exist here on 'written-off' food waste. Accordingly, the concern to better understand the black box of private food waste behaviour is and remains central (*Graham-Rowe* et al. 2015; *Di Talia* et al. 2019; *Pelt* et al. 2020). This literature on food waste is dominated by waste sciences, agricultural economics and marketing so that spatial perspectives in particular have only been of secondary importance to date.

The discourse on food waste can thus be complemented and expanded by questions about whether a) food waste structures are subject to spatial patterns, b) there is a correlation between food waste susceptibilities and spatial mobility and shopping types of private households, c) settlement patterns and housing conditions can influence food waste and d) local retail formats also generate local food waste particularities in private households.

2. State of research

The relevant literature is characterised by various strands. The following overview is intended to illustrate the paths on food waste research that have been pursued thus far within a framework of conceptualisation, methods and definitions from the perspectives of very different academic disciplines. Various points of contact emerge from this range of sources for the present investigation.

A first strand can be described as technical-scientific and focuses on the biological-chemical composition of waste and its technical energy processing (*Galanakis* 2015). A second strand focuses on the quantification of food waste, and thus on wasted pre-investments related to the basic factors of labour, land and capital. This is associated with *social consequences* like hunger versus overproduction, effects on food prices, social unrest and economic losses, and with *natural impacts* such as excessive soil pollution in the form of pesticides and fertiliser use, excessive water consumption, CO^2 and nitrate pollution, and energy consumption. This quantification is usually undertaken at the national or global level (*Porter* et al. 2016; *Corrado* et al. 2019; *Chen* et al. 2020; *Caldeira* et al. 2021). The aim is to document the extent and composition of food waste according to different food groups that are more or less prone to waste and to record the sources and causes of food waste from sub-sectors of the food production-consumption chain like agriculture, industry, transport, storage, retail, catering and private households. On the one hand, these investigations focus on the global meta-level and, on the basis

of model calculations and plausibility. They examine the extent and future development of food waste for large regions, differentiating between them either according to their level of economic development or according to geographic criteria (*Read* et al. 2020; *Verma* et al. 2020; *Barrera* and *Hertel* 2021). *UNEP* (2021) illustrates how thin the data actually are by examining the reliability of estimates concerning food waste generation in private households across all 235 world regions and territories (*Table 1*). It is evident that food waste has so far received more attention in countries of the Global North, which tend to be characterised by surplus production and overconsumption, than in countries of the Global South, which are characterised by hunger (*Harvey* et al. 2022).

On the other hand, there are investigations on scales ranging from national to the micro-level that conduct waste fraction analyses on disposal containers and that aim to record the extent and reasons for food waste using write-off and inventory lists in industry and retail, or surveys, focus interviews and diary techniques in private households (*Refsgaard* and *Magnussen* 2009; *Lebersorger* and *Schneider* 2011; *Giordano* et al. 2018; *Ilakovac* et al. 2020; *Quested* et al. 2020). Ultimately, these original surveys are the only data markers on which the projections of global meta-analyses and of *UNEP* (2021) or institutions such as *FAO* (2011, 2019), *World Bank* (2020) and EU are based (*Fusions* 2016). In contrast to other waste fractions such as plastic, paper, glass, electrical scrap, organic waste in general and so-called residual waste, food waste is generally not systematically recorded and differentiated, thus explicit findings to date exist only from case studies (e.g. *Ponis* 2017; *Davenport* et al. 2019; *Annunziata* et al. 2020). Linked to this is the problem of determining the significance and representativeness of these surveys for an unknown population (and how this is measured).

A third strand is pursued by qualitative studies, which are usually based on small and targeted samples of subjects. Semi-structured questionnaires and open-ended dialogues in focus and expert interviews are used to observe the food (waste) practices of participants, or diary techniques are employed, so participants record observations of their own behaviour (as a mass survey in *GfK* 2017; *Herzberg* et al. 2020). The limitations of such approaches are linked to problems retaining sufficiently motivated test persons due to the time investment required (sometimes over several weeks and recurrently), the necessity of withdrawing anonymity in personal data, the possible use of financial incentives to encourage participation, and the

Table 1 Reliability of data in calculations of food waste in private households according to world regions based on all nations and UN territories (%). Source: UNEP (2021: 54, 60ff.)

World regions / Estimate reliability %	High	Medium	Low	Very low	No estimate	No. absolute
AustraliaNewZealand	100.0					2
NorthernEurope	33.3	25.0	41.7			12
EasternEurope		30.0		70.0		10
SouthernEurope	6.3	25.0	62.5		6.3	16
WesternEurope	33.3	33.3	33.3			9
CentralAsia				100.0		5
EasternAsia		28.6		71.4		7
SE-Asia		27.3		72.7		11
SouthernAsia		44.4		55.6		9
WesternAsia	5.6	27.8	61.1	5.6		18
NorthernAfrica				85.7	14.3	7
SubSaharaAfrica	2.0	11.8	80.4		5.9	51
NorthernAmerica	40.0			40.0	20.0	5
LatinAmericaCaribbean		8.0		76.0	16.0	50
Melanesia				100.0		5
Micronesia				100.0		7
Polynesia				45.5	54.5	11
Total No.	14	37	70	94	20	235

issue of dwindling interest due to longer-term time constraints. This micro-space technique has been applied to private households (*Evans* 2011) and selected actors from retail (*Ribeiro* et al. 2019), food production (*Garrone* et al. 2016), governance (*Warshawsky* 2015) and food rescuers (*Horst* et al. 2014; *Lohnes* and *Wilson* 2018) in order to gain deeper insights into the practical handling of and discourse around food and food waste, which standardised surveys based on personal and spontaneous self-assessments cannot provide. On the one hand, this qualitative research strand is able to document food waste (susceptibilities) in situ e.g. in private households at the micro-level of kitchen and dwelling, capturing the diversity of realities and conveying new ideas to quantitative analyses (*Evans* 2011; *Davenport* et al. 2019). On the other hand, these are exploratory 'random' surveys that make no claim to be generally representative for an unknown population.

A fourth strand mediates between quantitative and qualitative methods and is taken up by the broad field of causal research and proposed solutions that aim to better understand the amount of food waste produced, especially in private households, which are also the focus of this paper. The explanatory indicators and dimensions are explicitly diverse and sometimes contradictory. On the one hand, socio-economic and socio-demographic indicators such as age, gender, household size, income, education, employment, religion or ethnicity are used to compile one-dimensional correlations to food waste generation. Here age and gender seem to stand out in particular with the 'younger' population displaying higher food waste generation and women being more likely to reduce food waste than men (*Koivupuro* et al. 2012: 189; *Secondi* et al. 2015: 38; *González-Santana* et al. 2020: 5f.). On the other hand, there is a growing realisation that the way we deal with food and resulting food waste is shaped by multi-dimensional attitudes, perceptions, moods, ethical and moral values, knowledge and purchasing behaviour, all of which are differently established and consolidated over time (*Ghani* et al. 2013; *Graham-Rowe* et al. 2015; *Aktas* et al. 2018: 663). From this, notable psychographic patterns or lifestyles can be derived, related not to individuals but rather to groups with specific characteristics, following the research traditions of the social sciences. The food(waste)-related lifestyle (*Aschemann-Witzel* et al. 2021) is a concept that neither excludes the possibility of change over the course of a lifetime, linked to changes in living conditions and attitudes, nor suggests that this is the only lifestyle characteristic of an individual. Rather, there is a mosaic of lifestyle elements in areas such as fashion, health, leisure and communication, which are subject to perpetual biographical adjustments and changes that can contradict each other. From this mosaic, the segment 'eating – drinking – food – food preparation – food waste' also develops a very specific life of its own that is relevant to the self-identification of individuals (e.g. vegan lifestyle) and to their public image (e.g. shopping styles) (*Helmke* et al. 2016; *Klug* 2018). The basic problem of such a survey is its double subjectivity: how do the respondents rate themselves and how do they define food waste for themselves; and which attitude questions are selected for inclusion in the project? Various investigations of private households have been drawn up in cooperation with market research institutes and construct their samples using filters reflecting socio-demographic and socio-economic characteristics and settlement structures (urban versus rural) in order to derive countrywide findings (*Richter* 2017; *Thøgersen* 2017; *Aschemann-Witzel* et al. 2021; *Ananda* et al. 2021; *Brunsø* et al. 2021). Field research, reconnaissance and the observation of regional or local particularities are excluded from this form of quantitative surveys. The datasets are usually metrically scaled or interpreted as metrically scaled data, so that multidimensional statistical applications can be applied (*Stefan* et al. 2013; *Richter* 2017; *Aschemann-Witzel* et al. 2021).

There is consensus on the following findings: a) understandings of food(waste) are subject to a systemic approach ("framework"; *Principato* et al. 2020), which is determined by psychological factors, ethical-social norms, demographic criteria, living conditions such as housing and settlement types, and household routines like shopping (*Davenport* et al. 2019); b) it is possible to identify lifestyle groups that differ not only in their attitudes but also in their practical behaviour and thus can act as target groups for different educational instruments (*Aschemann-Witzel* 2018); c) discussion of the food waste susceptibility of private households cannot be reduced to (consumption) attitudes, activities and infrastructure (refrigerator, freezer) within the household, but should also embrace upstream supply formats (e.g. packaging sizes, food prices, best-before date, freshness) and downstream disposal formats (waste collection regime) (*Secondi* et al. 2015: 34f; *Principato* et al. 2020: 6f.).

Research strand five: generally speaking, these economic and marketing investigations of food waste lack a spatial perspective, although process models and chains of production-consumption-disposal visualise the "paths travelled by food" (*van Bemmel* and *Parizeau* 2020: 217; *Priefer* et al. 2016; *Principato* et al. 2020) and thus reveal causal spatial-geographical references at the macro level. Not only do the actors change on these food (waste) journeys, but so too do their goals and assessments concerning whether food waste already exists and how it may be possible to generate social or economic added value from it (*Richter* and *Bokelmann* 2016: 428; *Mourad* 2016). At the meso-level, investigation focuses on basic items (statement type: "I shop in supermarkets" yes or no / not at all / very often), retail formats (*Brunsø* et al. 2021: 6; *Chen* and *House* 2021: 11) or the price structure of food ("discounted food products [DFP]" *Giordano* et al. 2019: 200) in order to capture shopping procedures upstream of the actual food waste (*Koivupuro* et al. 2012). Findings as to whether specific features of food retail formats influence food waste generation differ diametrically ("people tending to buy cheaper food products…also value food more and end up wasting less" *Koivupuro* et al. 2012: 189; "found no evidence of a correlation between the purchase of DFP and quantities of household food waste*": Giordano* et al. 2019: 207). Other work, such as that by *Belavina* (2021) and *Landry* et al. (2018), investigates whether retail-outlet density and thus food-purchasing opportunities have impacts on food waste incidence, exploring how to calibrate the optimal retail-outlet density to minimise food waste in households and in shops. In analogy to *Evans*' (2012) ethnological research in private households, *Liu* and *Chen* (2019) analyse food and its materialities in the form of recyclable packaging at the micro-level in the workplace ("more concerned about reusing food packaging than food surplus", p. 272) and thus underline the often-suppressed insight that food waste is generated not only in individual domestic households ("generally ignored by both scholars and policymakers", p. 272). Food retail formats can be interpreted as reflecting conscious choices linked to individuals' food lifestyles and represent the most important original source of food waste in private households. However, to the best of the author's knowledge, the literature to date offers no regionalised case studies that provide a differentiated or more complete survey of such retail formats or the extent to which selected formats as sources of food and food waste are even available within a reasonable distance. This article addresses this issue.

3. Theoretical basis and objectives

The concept of food-related lifestyles (FRL) emerged from the work of *Grunert* (1993) *and Grunert* et al. (1993) and aggregates data on individual patterns of attitudes and behaviour relating to food and, more recently, food waste to reveal group-specific disparities. The food-related lifestyle (FRL) represents only *one* part of interwoven and to some extent inconsistent lifestyle domains, which can in their entirety be assigned to the individual as a puzzle of lifestyles (*Thøgersen* 2017: 17). The FRL approach focuses on the very specific domain of the interaction of individuals with food, and correlates psychographic attitude sets with observable actions (*Aschemann-Witzel* et al. 2018: 171). This can reflect basic personal values like social recognition, tradition or hedonism or involve modes of action, e.g. for selecting or handling suitable products, being laid out as scripts or typified processes (*Thøgersen* 2017: 17; *Grunert* et al. 1993: 13). There are analogies between FRL and lifestyle segmentation according to SINUS milieus (*Flaig* and *Barth* 2014) as well as with the discussion about LOHAS or sustainability lifestyles (*Barr* and *Gilg* 2006; *McCarthy* and *Liu* 2017; *Witzling* and *Shaw* 2019; *Wakefield* and *Axon* 2020), which explore differences in open-mindedness about sustainability issues and the extent of congruent (consumption) behaviour, moving away from the notion that individuals are influenced by a holistic and congruent lifestyle concept. Retail research (*Nilsson* et al. 2015; *Grzeskowiak* et al. 2016; *Chen* and *House* 2021) has also explicitly taken up this form of data aggregation and segmentation but focuses even more closely on shopping behaviour and criteria related to retail outlets such as product presentation, shop atmosphere, customer loyalty, product transparency and the quality of specific (food) retail formats, from which food waste arises in private households.

The foundations of these considerations are found in psychology, especially in social and environmental psychology (*Stern* 2000). The aim is to explain modes of action, especially the predictability of an action within the framework of statistical probabilities (Theory of Planned Behaviour according to *Fishbein* and *Ajzen* 1975; *Kraus* 1995). Of particular importance here is the knowledge stored in long-term memory, which is interpreted as a semantic or associative network of diversely combined knowledge and attitudes stored in the human brain. Internal stimuli from stored information in the memory or new external information that supplements or reformats previous

knowledge codes can stimulate semantic nodes and call up a complex network of information and memories via "spreading activation" (*Anderson* 1983; *Seitz* 2015: 11). The critical problem is whether attitudes and beliefs conform to behaviour. The classic theory of cognitive dissonance according to *Festinger* (2012, originally 1957) and the attitude-behaviour gap postulated by *LaPiere* (1934) already demonstrated that attitudes and behaviour do not have to conform, nor do attitudes necessarily trigger behaviour at all.

Transferring these concepts to food waste analyses means: a) food waste is (initially) interpreted as an entrenched (individual) set of attitudes that can be explained by biographical preconceptions and experiences in dealing with food and with grocery shopping, and is embedded in long-term situational conditions such as living arrangements; b) because dealing with food and food waste is inevitably part of the everyday routine of social practices, all potential test persons are characterised by relevant experience and thus combinable types of behaviour concerning the research object ("attitudes formed by direct experience"; *Kraus* 1995: 65); c) it is assumed that the attitude sets investigated here do not aim to produce food waste consciously or in a targeted manner; they rather reveal food waste susceptibilities; d) there is a danger that participants may be subject to "social pressure for consistency" (*Kraus* 1995: 71) and conceal socially and morally undesirable food waste attitudes and behaviours in their answers; there is thus a need for an item set in the empirical surveys that excludes suggestive questions; e) attitude and behaviour sets are entrenched but not unchangeable. The goal of food waste awareness and prevention is not only to uncover statistical knowledge and practices about food waste, but also to identify what kind of "incoming information" (*Seitz* 2015: 10) can trigger adaptation and learning processes in the cognitive structures in order to achieve socially accepted and desirable behaviour to reduce food waste.

Figure 1 captures the original FRL model according to *Grunert* (1993: 154) and *Thøgersen* (2017: 17). However, the model is elaborated to integrate spatio-temporal aspects in a more detailed and differentiated

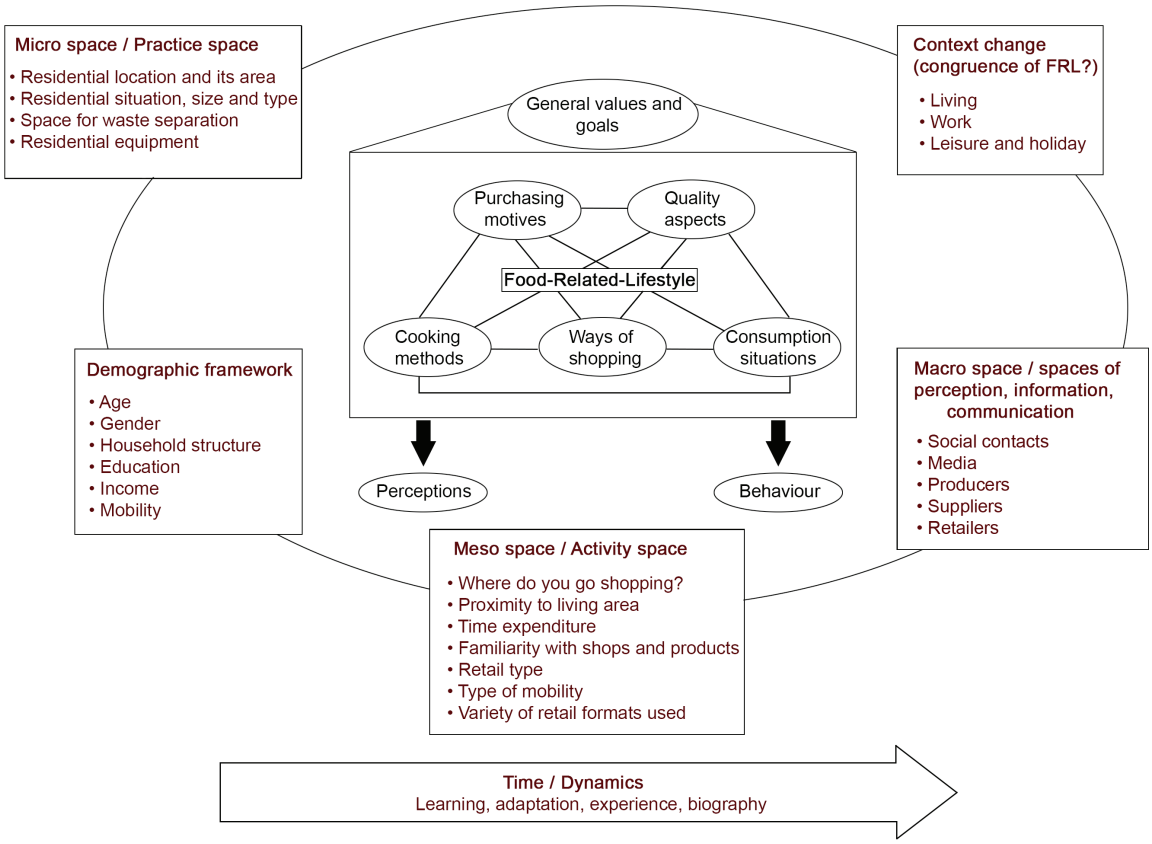

Fig. 1 *The model of food-related-lifestyles (FRL) and its elaboration. Source: author's compilation after Grunert (1993) and Thøgersen (2017)*

way, presenting them as explanatory and dynamic elements for the original criteria of the FRL framework. Thus, attitude sets can only emerge and become entrenched with the appropriate contextual possibilities, i.e. the spatial diversity and potential accessibility of (food) retail formats at the meso-level. At the micro-level, relevant spatial differences can include building type, dwelling size, dwelling facilities, home ownership and garden plot. At the macro level, private households are increasingly inquiring into the supply network and product transparency of the goods they buy. In the following, two core aspects are singled out for further investigation:

What group-specific attitudes exist on the customer side when dealing with food waste against the background of different shopping routines? What is the relationship between shopping behaviour and food waste behaviour? Where does the food waste in households come from?

Are large retail formats and discounters the driving forces behind carelessness with food (*Giordano* et al. 2019)? Or are small-scale retail formats with their fresh produce and LOHAS (lifestyle of health and sustainability) customers (*Sung* and *Woo* 2019) conducive to food waste?

4. Micro- and meso-levels

4.1 The case-study area

The entire range of methodology used is discussed with reference to a case-study region so as to ensure the transparency of the results presented in Section 5. The research area is located in the northernmost part of Germany in the federal state of Schleswig-Holstein, which borders Denmark to the north, the North Sea and the Baltic Sea to the west and east, and the Hamburg metropolitan area to the south. With about 2.9 million inhabitants, there are over 1,108 municipalities and only two cities with more than 100,000 inhabitants. In 715 municipalities there are less than 1,000 inhabitants, in another 181 municipalities less than 2,000 and in another 158 municipalities less than 10,000 people; these municipalities together account for 42.8% of the total population (as of 31/12/2019; *SH* 2019a). This high degree of rurality helps to explain the fact that large parts of the federal state are characterised by low population density and a sparse supply infrastructure. This also contributes to the uneven distribution of food suppliers in the form of supermarkets and discounters, which are mainly concentrated in central places and on the outskirts of towns. 976 municipalities, in which 30.7% of the population live, are not classified as central places (*SH* 2019b: 2). These municipalities tend not to have large-scale food suppliers or specialist shops (any longer), and alternatives such as village shops, rural cooperatives, farm shops, mobile suppliers and homegrown supplies from private gardens have replaced large-scale retailers or supplement time-consuming shopping trips to larger cities. Because these food retail formats of very different provenances (e.g. small-scale versus large-scale, family businesses versus branches, more personal versus anonymous shopping) also represent the most important sources of food and thus food waste in private households, the case study of Schleswig-Holstein offers the possibility to distinguish between rural and urban structures of food supply/disposal and a variety of different business formats as food waste sources.

From September 2020, municipal case studies were identified as suitable for qualitative and quantitative surveys at the household level. For this purpose, written contact was made with the full-time and higher-level administrative units responsible for the small municipalities. This facilitated use of their multiplier function vis-à-vis the rural municipalities and thus helped trigger local interest, a willingness to engage, acceptance and ideal support in the case-study municipalities. Various offices were contacted, representing about 190 municipalities. Seven municipalities volunteered to participate in the investigation. Six other municipalities and a district in Kiel (Mettenhof) were recruited after being contacted in person. Over time, two municipalities dropped out again. The inclusion of urban areas as case studies was achieved with the town of Gettorf (approx. 6,750 inhabitants) and selected large apartment blocks in Kiel. Due to the second wave of Covid-19 from October 2020 to February 2021, it was not possible to present the project at local council meetings in Kiel, with one exception (the Mettenhof district), and it was thus difficult to gather sufficient conceptual and ongoing support (e.g. in identifying focus groups and collection points for quantitative surveys). The selection of case-study municipalities and urban areas (12 cases in total) was not undertaken randomly in the sense of statistical probability theory, representing the averages of the population for the entire federal state. Selection was

rather a complex process of collecting, searching and persuading so that sustainedly interested municipalities, including their local gatekeepers from politics and supply institutions, were repeatedly contacted over a longer period of time in a top-down approach. This convenience sample further involved engaging the local community with the core issue. *Figure 2* documents the spatial distribution of the case-study areas, which can be described as peri-urban and peripheral rural municipalities, a small town (Gettorf) and a large city (Kiel). In all case studies (except Gettorf), focus group discussions were held with interested citizens on the topic of food waste in preparation for quantitative surveys, but these discussions are not presented in this paper.

Fig. 2 Case-study areas. Source: own elaboration

4.2 Implementation

Quantitative surveys of private households were carried out (*Table 2*) with the aim of including both rural and urban milieus and the associated differences in access to grocery shopping and retail formats, different sizes of dwellings and housing formats (with and without gardens or grow-your-own) for the storage, preparation and disposal of 'waste' and different food lifestyles. The surveys were carried out by post and as an exhaustive survey, so that *all* private households each received a standardised and printed six-page questionnaire with 64 questions, an invitation to participate and reference to the local collection points and return deadline via local distributors. Attitude items on food, shopping priorities, disposal routines and social norms (A) (*Table 3*), disposal, housing and shopping structures (B) and socio-demographic criteria (C) determined the basic structure of the questionnaire, which in essence captured the statements of the *person interviewed or completing the form* (within the interviewed household). As a rule, the questions were closed. Answers to attitude items were structured using a Likert scale of 1-5. The term 'food waste' was not explicitly used in the questionnaire as its rather negative connotation implies a moral and ethical judgement, which would have further jeopardised acceptance of the survey by respondents ("sensitive topic": *Hermsdorf* et al. 2017: 2536).

Table 2 Case-study municipalities, size and timing of empirical surveys in Schleswig-Holstein; (r) = rural; (u) = urban. Interviewees: (1) Brodersby: mayor and municipal councillor; (2) Osdorf: mayor; (3) Gettorf: mayor and business promoter; (4) Neuwittenbek: mayor and local shopkeeper; (5) Dannau: mayor; (6) Bokel: mayor; (7) Schinkel: mayor; (8) Todenbüttel: mayor; (9) Bünsdorf: mayor; (10) Warder: mayor; (11) Mettenhof: representative of Vonovia Property Management; (12) Achterwehr: mayor and municipal councillor; (13) Press office of the City of Kiel and Neumünster. Source: own elaboration, survey Jürgens 2021

Serial No.	Municipality	Period	Prize draw (yes/no)	Total sample absolute (No. of households)	Distributed by	No. of collection points	Returns absolute	% of total
1	Brodersby/Ostsee (r)	20/03-02/04/2021	no	281	Local distributor	2	86	30.6
2	Osdorf (r)	26/03-10/04/2021	yes	1,160	Newspaper: *Osdorfer Nachrichten*	4	117	10.1
3	Gettorf (u)	26/03-10/04/2021	no	3,400	Newspaper: *Flüstertüte*	4	320	9.4
4	Neuwittenbek (r)	12/04-03/05/2021	yes	500	Local distributor	3	114	22.8
5	Dannau (r)	12/04-03/05/2021	no	290	Local distributor	3	37	12.8
6	Bokel (r)	12/04-03/05/2021	no	250	Local distributor	2	38	15.2
7	Schinkel (r)	12/04-03/05/2021	no	450	Local distributor	3	101	22.4
8	Todenbüttel (r)	12/04-03/05/2021	no	475	Local distributor	2	66	13.9
9	Bünsdorf (r)	12/04-03/05/2021	no	300	Local distributor	2	49	16.3
10	Warder (r)	12/04-03/05/2021	no	200	Local distributor	3	42	21.0
11	Mettenhof/Kiel (u)	12/04-03/05/2021	no	596	Local distributor	3	40	6.7
12	Achterwehr (r)	19/04-07/05/2021	no	450	Local distributor	3	91	20.2
	Total rural (r)	March-May 2021		4,356			741	17.0
	Total urban (u)	March-May 2021		3,996			360	9.0
	Total overall	March-May 2021		8,352			1,101	13.2
13	Online City of Kiel Facebook, Twitter, Instagram via LimeSurvey; City of Neumünster	03/04-07/05/2021	no		LimeSurvey Uni Kiel	1	357	<1.0

Table 3 Recording of standardised attitude items and behaviour patterns related to grocery shopping, food disposal and food preparation. Source: own elaboration, survey Jürgens 2021

Serial No.	Content components	Number of items or questions	Dominant dimension	Data
1	Retail formats	6	Spatial	Likert 1-5
2	Mobility	5	Spatial	Likert 1-5
3	Planning	9	Material/temporal	Likert 1-5
4	Product choices	6	Material/spatial	Likert 1-5
5	Motivation	4	Personal	Likert 1-5
6	Information	3	Personal	Likert 1-5
7	Sociality	2	Material/temporal	Likert 1-5
8	Food preparation/handling	5+4	Material	Likert 1-5
9	Biographical background	9	Personal/temporal	Likert 1-5
10	Housing conditions	1 +rural/urban	Spatial	Metric/nominal
11	Shopping patterns	4	Spatial/material	Nominal
12	Waste patterns	6	Spatial/material	Nominal

The questionnaires were sent to the households separately by local distributors, in three cases as an insert in a local newspaper or as a newsletter (*Flüstertüte* in the municipality of Gettorf, *Osdorfer Nachrichten* in the municipality of Osdorf, newsletter in the municipality of Bünsdorf). Over a period of two to three weeks, this allowed all households to complete the survey anonymously, complied with the Covid-19 regulations, and provided a barrier-free and manual process (no personal contact with interviewees, no technical facilities necessary for an online survey, self-explanatory questionnaire with answer guidelines and patterns). Collection points for the questionnaires were organised locally with the negotiation of financial incentives (including small local retail businesses or use of the letterboxes of municipal institutions) and were listed in the letter to the households. In some municipalities, reports in local newspapers such as *Kieler Nachrichten* and *Schleswig-Holstein-Zeitung* helped provide information about the topic and publicised the survey data.

In two cases, the survey campaign was combined with prize draws that involved handing out a raffle ticket in person (combined with the anonymous submission of the questionnaire in an urn) at the collection points in order to provide incentives for both local retailers and households to participate in the survey as a collection point or as respondents. After the survey, the winning ticket numbers were selected from those issued and displayed in the collection points. The survey campaign was conducted during the third Covid-19 wave from the end of March to the beginning of May 2021. This wave was less pronounced in those parts of the state of Schleswig-Holstein where the case-study communities were located than elsewhere in Germany, so this period was used for the surveys in light of the possibility of further Covid developments. In at least one case, it was noted that new customers started frequenting the shop during or as a result of the survey campaign.

The responses (*Table 4*) show that there is a great deal of spatial variation in participation. The larger, more compact and socially anonymous the case-study units were, the lower the relative participation figures were, so that in the urban areas participation was below 10%. On the other hand, the considerable range of response rates between 12 and 30% in rural areas is striking. These rates were higher than in the urban environment, but it was not possible to further control or increase any rate despite support from local stakeholders, announcements in the local press and in two cases the help of prize draws. It was therefore all the more important to generate a high absolute number of responses from the 12 case regions in order to be able to draw statistically sound conclusions. The response rate of 17.0% in rural regions corresponds almost exactly to the response rate achieved in a research project on the topic of food deserts (*Jürgens* 2018), which underpins the notion that this level of participation is a realistic achievement.

As an alternative to postal surveys in the Covid-19 pandemic, an online questionnaire with the same content as the postal survey was posted on the LimeSurvey portal at the computer centre of Kiel University.

Table 4 Response rate of questionnaires and significance: representativeness of respondents based on selected population indicators. Source: own elaboration, data sources: Sources: [1]Stadt Kiel (2020a); [2]Statistisches Amt für Hamburg und Schleswig-Holstein (2021); [3]Stadt Kiel (2020b); [4]Statistisches Amt für Hamburg und SH (2014); [5]Statistisches Bundesamt (2022)

Note 1: Four respondents who ticked a 'diverse' gender were recorded but are not shown. There are no comparable data in the official statistics, nor is the group large enough to allow statistically relevant conclusions to be drawn.

Note 2: The population indicators presented here (TP=total population) refer to the total population of the respective municipalities and thus also to children and adolescents. The latter are thus reflected in the TP data but were not included in the actual survey as independent respondents.

Municipality/ town	Percentage female in TP	Percentage female in sample	Percentage 30-49 in TP	Percentage 30-49 in sample	Percentage 65+ in TP	Percentage 65+ in sample	Percentage single households in TP (census 2011)[4]	Percentage single households in sample
Achterwehr (2019)[2]	49.7	67.4	26.4	26.1	19.4	32.6	20.0	21.7
Bokel (2019)[2]	49.1	68.4	25.9	21.6	20.4	24.3	22.5	10.5
Brodersby (2019)[2]	53.0	72.3	17.7	14.6	36.0	41.5	30.5	23.2
Bünsdorf (2019)[2]	49.5	71.7	24.1	16.3	19.0	40.8	27.1	18.8
Dannau (2019)[2]	50.0	75.7	19.2	18.9	18.4	27.0	18.8	18.9
Gettorf (2019)[2]	51.2	73.5	23.9	29.6	22.6	42.5	26.2[5]	26.0
Mettenhof (2020)[1]	51.1	66.7	24.2	20.5	18.7	48.7	38.3 (2019)[3]	50.0
Neuwittenbek (2019)[2]	51.4	78.8	21.5	16.6	24.3	42.1	21.0	24.6
Osdorf (2019)[2]	50.4	75.0	26.2	31.9	19.2	33.6	23.4	25.0
Schinkel (2019)[2]	50.7	71.9	23.5	19.2	21.4	40.4	24.1	23.2
Todenbüttel (2019)[2]	49.4	61.5	23.5	24.3	19.0	33.3	28.5	27.7
Warder (2019)[2]	50.4	69.0	22.3	34.2	30.1	26.8	32.6	21.4
Kiel (2020)[1]	50.7				18.9		56.3 (2019)[3]	
Online		84.2		38.0		7.2		31.4

The online version was tested and completed by 14 people in order to check the technicalities and understanding of content. The questionnaire was advertised online using the official structures of the City of Kiel, and a link to the questionnaire was added to all the city's relevant social media channels in order to strengthen diversity, especially among younger people who are strongly underrepresented in the postal procedure. The basic problems of such a survey is well known from the literature (*Evans* and *Mathur* 2005; *Fan* and *Yan* 2010) and were also apparent here: a) the response rate was sporadic reflecting the posting of Twitter and Facebook messages in which the link was embedded; in the case of the City of Kiel, it was possible to post a reminder tweet via Instagram and Facebook and thereby trigger a final spurt of responses; b) the sample size can only be estimated, not conclusively determined; c) simple reference to the number of followers for the relevant digital channels suggests a response rate of completed questionnaires of less than 1%; d) as a rule, only digital-savvy readers are informed about the topic and the online survey; a special peer group is thus involved, which on the one hand expands the sample of people surveyed by post but on the other hand relativises it; e) the origin of potential test persons cannot be limited to the core area

of Schleswig-Holstein or selected municipalities due to the unbounded nature of digital distribution via the internet; f) the sample structure must be defined as a convenience sample which can give rise to findings on the clustering of attitudes and practices, but does not depict a representative sample of an unknown population; g) the number of responses returned from the different digital channels cannot be documented due to the anonymity settings in the LimeSurvey portal; h) the selection of the digital portals was not random, but was primarily dictated by convincing people from previous expert interviews to provide access to their digital channels and to place a link to the online survey. The links could not be placed by the author himself. Most of the portals used here target user groups who can be assumed to be conceptually open-minded about topics such as food and food waste, so that, conversely, people who are outside this portal mainstream are either underrepresented or remain completely unconsidered.

Data entry and analysis was undertaken using SPSS26. In terms of response patterns, the one-dimensional demographic filters (*Table 4*) show that above-average numbers of those completing the questionnaire in the postal surveys were female and older (*Fig. 3*). In the online survey, the response pattern was also dominated by female participants, but the age structure was significantly younger (*Fig. 4*). The proportion of single households in the population is relatively well reflected in the sample. It should be noted that since 1987 there has been no personalised and household-based full census in Germany. More recent structural data on the population exist only as an update or as a micro-census (household sizes were last included in 2011), which automatically limits comparison of the survey data with the total population. In addition, there are further problems that limit the completeness and objectivity of the data collected and submitted (*Table 5*).

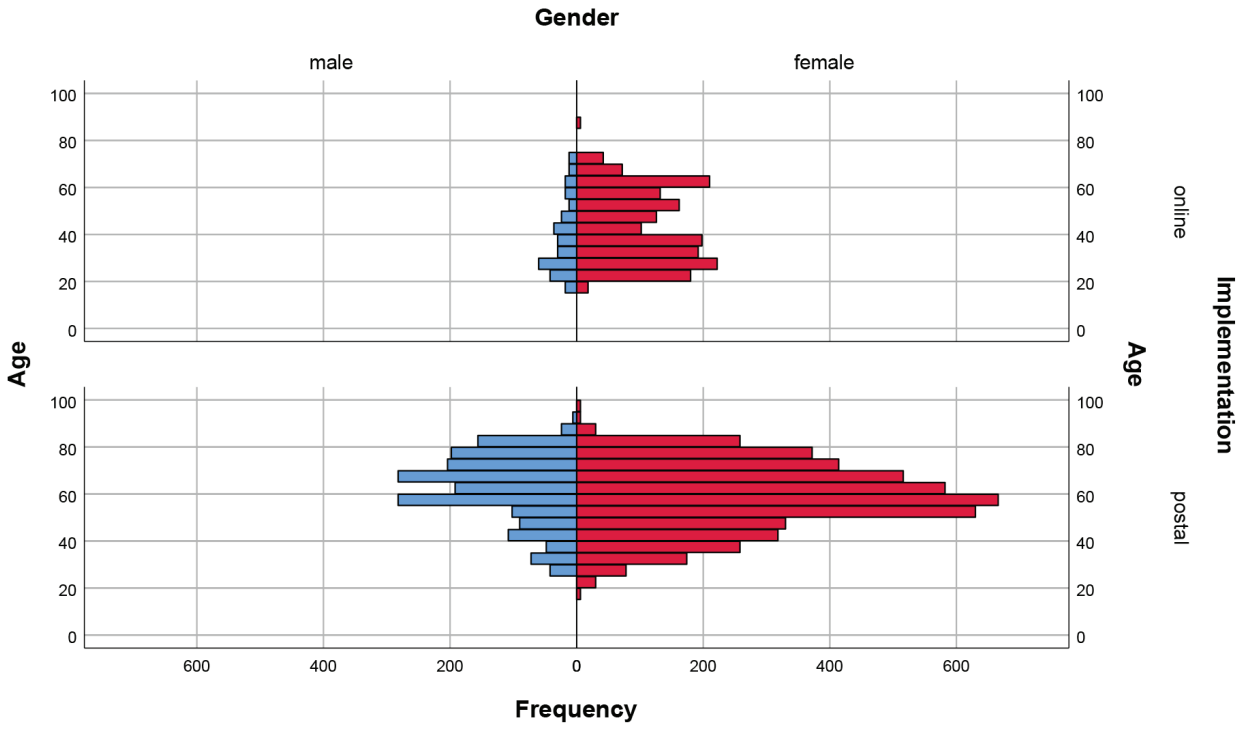

Fig. 3 Respondent pyramids (online versus postal) by gender and age. Source: own elaboration

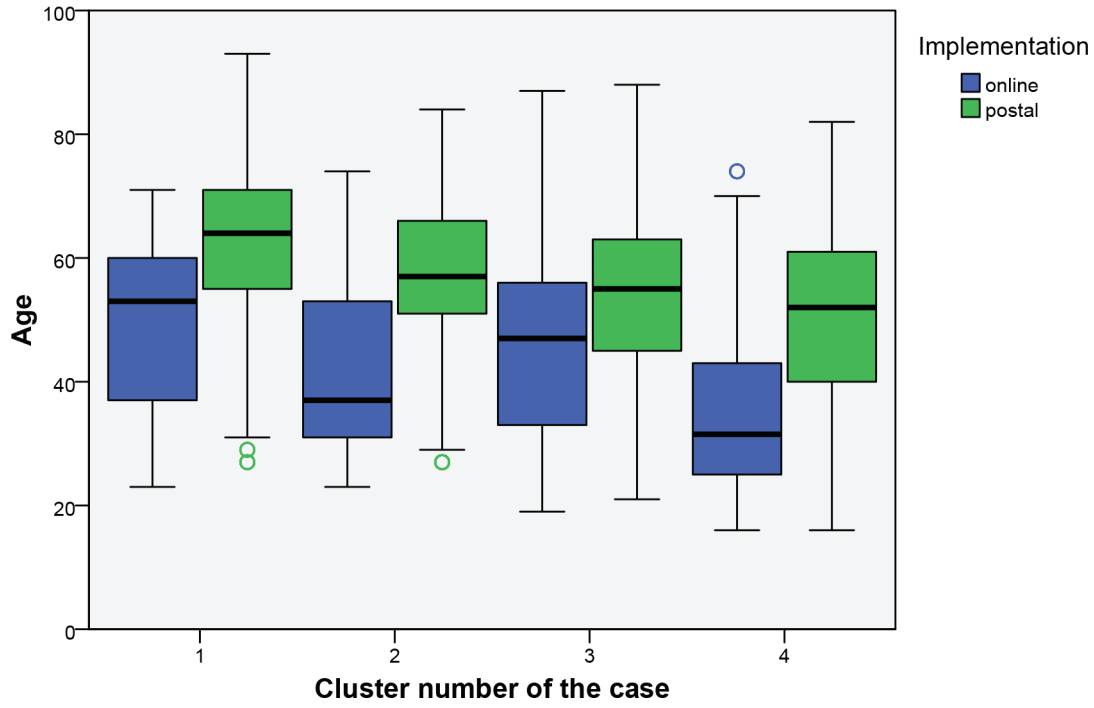

Fig. 4 Boxplot diagram on the age structures of respondents according to clusters and survey type (online versus postal). Source: own elaboration

Table 5 Limitations of the data. Source: own elaboration, survey Jürgens 2021

Limitation	Cause
1	Unintentionally incorrect entries by the respondents (e.g. multiple ticks for the single-answer type question)
2	Incomplete answers
3	Intentionally incorrect and illogical entries
4	Multiple responses from the same household (if identified, these were removed from the responses)
5	For metric questions, answers were given in the form of intervals (e.g. 2-3 instead of 2 or 3); mean values were used in these cases
6	Illegible entries
7	Only extreme answers of 1 or 5 were given with a Likert scale of 1-5
8	Incorrect input in SPSS by the author (logic check via Descriptive Statistics in SPSS)
9	Refusal to answer (e.g. with household net income)
10	Avoidance of subject ("we don't waste food in this household")
11	Open questions where text was required were omitted

4.3 Validity

The surveys were carried out at the meso-level of a German federal state using 12 micro-studies. Before the quantitative survey, all localities were visited and inspected by the author. Qualitative expert and focus group discussions were also held. The localities are thus known to be comparable with one another in terms of spatial location, building structures, food supply infrastructure and local food producers. This allowed food supply routes related to food waste behaviour to be reconstructed. Studies at the national meta-level cannot establish such micro-relationships due to their completely different sampling approach. They aim for representative samples constructed according to demographic data on a national level, so that they usually are unable to analyse specific experiential case-study regions with particular food discourses. The (postal) surveys presented here were full surveys, so that all interested households could theoretically participate in the study. The aim is not to capture a superficial representativeness according to individual demographic criteria, but to use multidimensional data reduction to analyse the overall dataset of postal and online surveys and identify group peculiarities and niche groups through attitude sets and (spatial) behaviour patterns. Such groups transcend socio-demographic and socio-economic indicators in the form of life attitudes and lifestyles, and can serve as target groups for policies to combat food waste susceptibilities.

4.4 Case and variable reduction

The survey included 40 items, covering different FRL (food-related lifestyle) dimensions and operationalised on a Likert scale of 1 to 5. The FRL dimensions and the order of the items in the questionnaire are shown in *Table 6*. They are intended to reflect a reasonable range of relevant food experiences and a practicable number of statements for responses. The dimensions were spread out and mixed up in order to minimise simplified answer patterns by respondents (always giving the same answers, conspicuous answer patterns, extreme answer sets), which are a danger with batteries of questions. Furthermore, this 'challenges' respondents in their answers and increases the meaningfulness of responses. Opposing items were also used, i.e. statements citing 'good' and 'bad' behaviour alternated, which was intended to stimulate the attention of the respondents.

To consolidate the data and as preparation for group segmentation, a principal component analysis was carried out (*Table 7*) with 32 items included in line with the communalities extraction (see *Table 6*). The analysis was conducted using the criteria "pairwise" and varimax rotation (test values: KMO=.759, Bartlett's significance =.000). The explained total variance across the 11 factors is 61.851%. Only factor loadings ≥+/-.500 were considered. The factor scores were subsequently used for cluster analysis. Cluster analysis used the KMEANS and "pairwise" method. Four clusters were pre-set (N cluster1=352; cluster2=218; cluster3=296; cluster4=300; total=1,166). The plausibility of the clusters was tested using discriminant analysis (Wilks-Lambda method; calculated from group size). The smaller the Wilks-Lambda (*Table 8*), the larger the differences between the groups. 96.8% of the originally grouped cases and 96.7% of the cross-validated cases were correctly classified.

The Smart Group (*Table 9*) is characterised by pronounced planning of shopping and meals. Shopping lists are made, advertising flyers are consulted and various retail formats are used. As a rule, nothing gets forgotten in the refrigerator. If the appearance and best-before date of a food product are not considered ideal, then the product is probably not selected. There is no need to take restaurant leftovers home because there is plenty available in the household. Or there are no leftovers because members of this group are as well organised when going out as they are at home.

The Spontaneous Group is the maximum contrast to the Smart Group in 10 of 32 items. The planning and organisational trait of this type of household is clearly below average. Short-term spontaneous meals and behaviour, a rather low self-assessment of the consumption of food in the household and below-average interest in cooking, a high number of visits to discounters and little interest in regional or fresh products complete the picture. This group does not display much pleasure in food or in shopping processes.

The Convenience Group is something of an intermediary group between the other clusters. Members of this group plan their shopping well, make food purchases along established routes (close to home, ideally in *one* shop) and are particularly car oriented. With this approach, there is no need for (Covid-19) stockpiling, because there always seems to be the option of buying more. In complete contrast to shopping planning, members of the Convenience Group acknowledge they

Table 6 Statements used (Likert scale 1-5; 1=not at all true; 2=seldom true; 3=sometimes true; 4=often true; 5=totally true/very often true). Source: own elaboration, survey Jürgens 2021

Serial No.	Statement	Communalities extraction	Included in the factor analysis	Explanatory dimension
1	I go shopping in discounters (Aldi, Lidl, Penny)	.596	yes	Retail format
2	I go shopping in supermarkets (Edeka, Sky, Rewe)	.433	no	Retail format
3	I usually think about what food I want to buy before I go shopping	.637	yes	Planning
4	I make a shopping list before I buy food	.631	yes	Planning
5	I plan my meals for a few days in advance so I can shop in a more targeted way	.637	yes	Planning
6	I like to cook and buy my groceries for this purpose	.586	yes	Motivation
7	I always buy all my groceries from one shop of my choice	.641	yes	Retail format
8	I go to the shop closest to my home	.562	yes	Mobility
9	I go to the shop closest to my place of work	.639	yes	Mobility
10	I want to be able to reach the shop easily by car	.539	yes	Mobility
11	I want to be able to reach the shop easily on foot	.697	yes	Mobility
12	I want to be able to reach the shop easily by bicycle	.679	yes	Mobility
13	When shopping for groceries, the price is most important to me	.555	yes	Product choice
14	Fresh products are important to me	.531	yes	Product choice
15	Organic products are important to me	.547	yes	Product choice
16	I sometimes forget something in the fridge	.568	yes	Planning
17	I like to buy food spontaneously	.545	yes	Planning
18	Shopping for food is simply a MUST for me	.370	no	Motivation
19	What I (we) eat at home is often a last-minute decision	.596	yes	Planning
20	I like to eat with other people	.547	yes	Sociality
21	I use advertising leaflets from supermarkets and discounters to select special offers	.559	yes	Information
22	Especially since Covid-19, I have stockpiled more food in the form of jars and canned goods	.492	yes	Planning
23	I like to eat in restaurants	.648	yes	Sociality
24	If there are any leftovers, I have them packed up in the restaurant to take away	.526	yes	Dealing with food
25	I like always having plenty of food at home	.527	yes	Planning
26	In my home everything is always eaten up	.627	yes	Dealing with food
27	I have a guilty conscience when I have to throw food away	.463	no	Motivation
28	The appearance of fruit and vegetables is important for my purchase decision	.483	yes	Product choice
29	When I go shopping, I choose food products with a long best-before date	.512	yes	Product choice
30	I dispose of suitable food waste in the organic waste bin and/or in the compost	.413	no	Dealing with food
31	If food is left over, I also eat it later	.530	yes	Dealing with food
32	I freeze food to preserve it	.401	no	Dealing with food
33	I buy products that come from the 'region'	.581	yes	Product choice
34	In my childhood, food waste was an important topic in the family	.354	no	Information
35	I need variety in my food	.521	yes	Motivation
36	I am good at estimating how much food I need in the household	.507	yes	Planning
37	I also use other shopping alternatives like online grocery shopping on my PC	.244	no	Retail format
38	I also use other shopping alternatives like a village/farm shop	.597	yes	Retail format
39	I also use other shopping alternatives like a weekly market	.555	yes	Retail format
40	I follow media reports on the topic of food	.298	no	Information

Table 7 Principal component analysis and factor solution. EV: Eigenvalue; V: Explained variance (rotated sum of squared loadings). Source: own elaboration, survey Jürgens 2021

Serial No.	Statement	1	2	3	4	5	6	7	8	9	10	11	Construct
4	Shopping list	.770											Planning shopping
5	Plan food	.756											EV: 3.785
3	Think before shopping	.729											V: 8.828
17	Spontaneous shopping	-.656											
19	Last-minute meals	-.656											
38	Village shop		.755										Organic/alternative
33	Regional food		.718										EV: 3.289
39	Weekly market		.698										V: 7.407
15	Organic products		.522										
13	Price												
26	Eat up everything			.783									Planning use
16	Forgotten in fridge			-.721									EV: 2.057
36	Good estimates			.612									V: 6.589
11	Easily on foot				.830								Accessibility
12	Easily by bicycle				.802								EV: 1.829
10	Easily by car				-.543								V: 6.020
28	Appearance fruit					.736							Best-before date/appearance
29	Long best-before date					.719							EV: 1.669; V: 5.508
7	Only in one shop						-.769						Economical
1	In discounters						.669						EV: 1.491
21	Advertising leaflets						.529						V: 5.344
6	Like to cook							.714					Demands on food
14	Fresh products							.650					EV: 1.360; V: 4.891
22	Stockpiling Covid-19								.769				Stores
25	Plenty at home								.684				EV: 1.159; V: 4.480
23	Like restaurants									.695			Sociality
20	Eating in company									.656			EV: 1.116
35	Variety									.555			V: 4.442
9	Close to work										.778		Shopping location
8	Close to home										.585		EV: 1.034; V: 4.295
24	Take leftovers home											.700	Food compromises
31	Eat later			.503								.538	EV: 1.003; V: 4.046

have problems dealing with food in the home in terms of frequently forgetting products in the fridge or overly large food portions.

The Sustainable Group members are characterised by an excessive interest in preparing their own meals and differ from the other clusters in three points: a) For grocery shopping, the car is not decisive. b) Grocery shopping is neither guided by prices (discounters) nor by advertising flyers if the food does not meet certain quality criteria such as being of organic origin. c) Neither a suboptimal appearance of fruit or vegetables nor an unfavourable best-before date are relevant for purchase decisions if the food has other advantages or if the intention is to 'salvage' this particular product.

The interpretation of these clusters results from initial strategic decisions that depend on the items used, the bundling of variables with a principal component analysis, the bundling of cases with an explicable number of clusters, and a focus on particularly relevant differences. The grouping presented is therefore to be understood as a compromise and a model for the best possible plausibility derived from data and case reduction and does not exclude the possibility that there are other procedures and solutions.

Table 8 Quality summary of clustering using discriminant function. Source: own elaboration, survey Jürgens 2021

Discriminant function	Eigenvalue	% of variance	Cumulative %	Canonical correlation
1	1.430	41.6	41.6	.767
2	1.059	30.8	72.3	.717
3	.951	27.7	100.0	.698
Test of functions	**Wilks-Lambda**	**Chi-Square**	**df**	**Significance**
1 to 3	.102	15923.848	33	.000
2 to 3	.249	9719.728	20	.000
3	.512	4671.539	9	.000

Table 9 Cluster structure (mean values 1=not at all true; 5=totally true/very often true; blue: maximum value in item; red: minimal value in item). Source: own elaboration, survey Jürgens 2021

Serial No.	Factor	Question/Cluster	Smart	Spontaneous	Convenience	Sustainable	Nonparametric H-test (comparison of means) after Kruskal and Wallis
4	1	Shopping list	4.7	3.1	4.6	4.5	.000
5	1	Plan meals	4.2	2.8	3.5	4.1	.000
3	1	Think before shopping	4.8	3.8	4.8	4.8	.000
17	1	Spontaneous shopping	2.2	3.1	2.6	2.3	.000
19	1	Last-minute food	2.4	3.3	3.2	2.3	.000
38	2	Village shop	2.9	2.7	2.9	2.7	.000
33	2	Regional food	4.2	3.6	3.9	3.9	.000
39	2	Weekly market	3.6	2.9	2.7	2.9	.000
15	2	Organic products	3.6	2.9	3.5	3.8	.000
26	3	Eat up everything	4.1	3.7	3.6	4.1	.000
16	3	Forgotten in fridge	2.1	2.3	2.7	2.1	.000
36	3	Good estimates	4.5	3.8	4.0	4.3	.000
31	3	Eat later	4.6	4.2	4.6	4.8	.000
11	4	Easily on foot	3.2	2.7	2.5	3.3	.000
12	4	Easily by bicycle	3.4	2.5	2.7	3.6	.000
10	4	Easily by car	3.7	3.6	4.3	2.9	.000
28	5	Appearance fruit	4.3	3.9	4.0	3.1	.000
29	5	Long best-before date	4.2	3.5	3.7	2.7	.000
7	6	Only in one shop	2.3	2.2	2.9	2.7	.000
1	6	In discounters	3.5	3.6	3.3	3.1	.000
21	6	Advertising leaflets	3.5	2.9	2.6	2.5	.000
6	7	Like to cook	4.8	3.9	4.4	4.8	.000
14	7	Fresh products	4.8	4.0	4.6	4.5	.000
22	8	Stockpiling Covid-19	2.6	2.3	1.9	2.1	.000
25	8	Plenty at home	3.7	3.3	3.3	3.3	.000
23	9	Like restaurants	3.1	3.4	3.1	3.2	.000
20	9	Eating in company	4.0	3.7	3.6	4.1	.000
35	9	Variety	4.4	3.9	3.5	3.8	.000
9	10	Close to work	1.8	2.3	2.2	2.3	.000
8	10	Close to home	3.2	3.0	3.3	3.2	.000
24	11	Take leftovers home	2.6	2.8	2.9	3.6	.000
31	11	Eat later	4.6	4.2	4.6	4.8	.000

5. Results

Table 10 illustrates that, in addition to differing in their attitudes, the different clusters demand significantly different retail formats and thus draw on complex shopping networks for regular food purchases. They hence demonstrate shopping practices that conform to their attitudes, in which some retail formats dominate but without completely excluding others. The Sustainable Group is characterised by an above-average number of mentions of small and alternative formats, more than twice as many as in the Spontaneous Group. Deliberately, no weight was given concerning the frequency or size of purchases made in the listed retail formats and chains, but rather the self-assessment concerns how relevant diverse shopping formats are for household-related shopping behaviour based on the number of mentions. Response combinations of retail format *and* location were recorded as open questions, including double responses of retail formats like supermarkets and discounters if they were at different locations. The question arises as to whether conspicuous food waste patterns can be derived from the original sources of food purchases when the groups are compared. *Table 10* records the sources that the test persons assigned to the last known food waste in their households. **Neither** the weight **nor** volume of food waste was recorded, but only past cases of food disposal that could still be recalled to mind. Inquiries about these cases included the retail source of the food, type of product and reason for disposal. The pattern that emerged differs significantly across the groups. It should be taken into account that the variety of goods sourced from alternative formats and thus the possibility of disposing of such products differs in size compared to supermarkets. It can be seen that no single retail format is exempt from generating food waste in private households. The large differences in food waste susceptibilities between the groups ("how can I still salvage the product?", e.g. in the Sustainable Group) and retail formats may to some extent be due to the more targeted and planned shopping undertaken in alternative retail formats and specialist shops with products that tend to be of higher value in terms of freshness, regionality or apparent quality than in discounters or supermarkets. However, the dominance of supermarkets and discounters contributes to the fact that these formats are the most important sources of food waste for all groups in absolute terms (*Figure 5*).

If a different perspective is taken, moving away from the multidimensional realities of the clusters to one-dimensional correlations between demographic indicators and food disposal behaviour, it becomes possible to demonstrate only limited or indeed no significant differences in disposed food or reasons for disposal, e.g. between genders or income levels. The examples of significance tests in *Table 11* show that significant differences are found only between income levels and choices of shopping formats and between household size and structures of waste food.

Consideration (*Table 12*) of how often food waste is generated in general and according to the self-assessment in the households reflects significant differences between the groups, not only in terms of practices, but also in terms of openness and willingness to consciously tackle the topic of food waste. The Smart Group, for example, stands out with a particu-

Table 10 Mentions of retail formats used for regular grocery shopping in % (multiple responses) and mentions of sources of the last known food waste in % within the clusters; Significance for shopping formats used by group membership Phi .100 (Sign.000), Cramer-V .058 (Sign.000); Significance for origin of waste by group membership: Phi .049 (Sign.043), Cramer-V .028 (Sign.043). Source: own elaboration, survey Jürgens 2021

Retail format/Source of waste versus cluster	Smart retail format cluster	Smart source of waste	Spontaneous retail format	Spontaneous source of waste	Convenience retail format	Convenience source of waste	Sustainable retail format	Sustainable source of waste
Organic_farm_shop Village_shop Mobile/Weekly_market	19.9	13.0	11.5	13.8	18,6	12.7	25.1	9.0
Discounters	26.6	23.4	34.8	29.3	25,1	21.7	26.0	21.2
Specialist_shop/other	16.6	10.9	15.3	8.1	16,2	9.9	12.3	15.7
Supermarket_Warehouse	36.9	47.4	38.4	46.3	40,1	51.6	36.6	50.3
Homegrown/made		5.2		2.4		4.1		3.8
No. answers	1,256	384	706	246	971	314	967	312

larly large number of older respondents who rarely or never produce food waste. This does not mean that other statements relevant to food waste were made in the questionnaire. All other groups are clearly more realistic in their assessments. The Convenience Group with its car-oriented, one-stop shopping is particularly susceptible to food waste and is only surpassed in its assessments by households with children (*Table 12*). Significant differences between postal and online surveys indicate not only the presence of different target groups here, but also that the online respondents decisively diversify the overall dataset in terms of attitudes and practices.

Table 13 records not only the susceptibility to food waste of groups of people, but also that of food product groups in relation to individual retail formats. In the nature of things, the range of food waste also reflects the variety of food products in the individual retail formats. The organic, market and specialist formats (including above all the bakeries) produce large shares of food waste in private households (judged by number of disposal mentions) among fresh products such as bread, vegetables and fruit. Dairy products and cold meats are added to food from the discounters and supermarkets, which reduces the relative importance of bread, fruit and vegetables but does not challenge their dominance in disposal occurrences overall. These findings confirm the results of other investigations (*GfK* 2021). However, differentiation according to attitude groups shows that the disposal pattern varies to reflect shopping behaviour and attitudes. For example, the Spontaneous Group, purchasing from discounters, which they prefer, disposes of several times more bread or dairy products (in %) than other groups (*Table 13*).

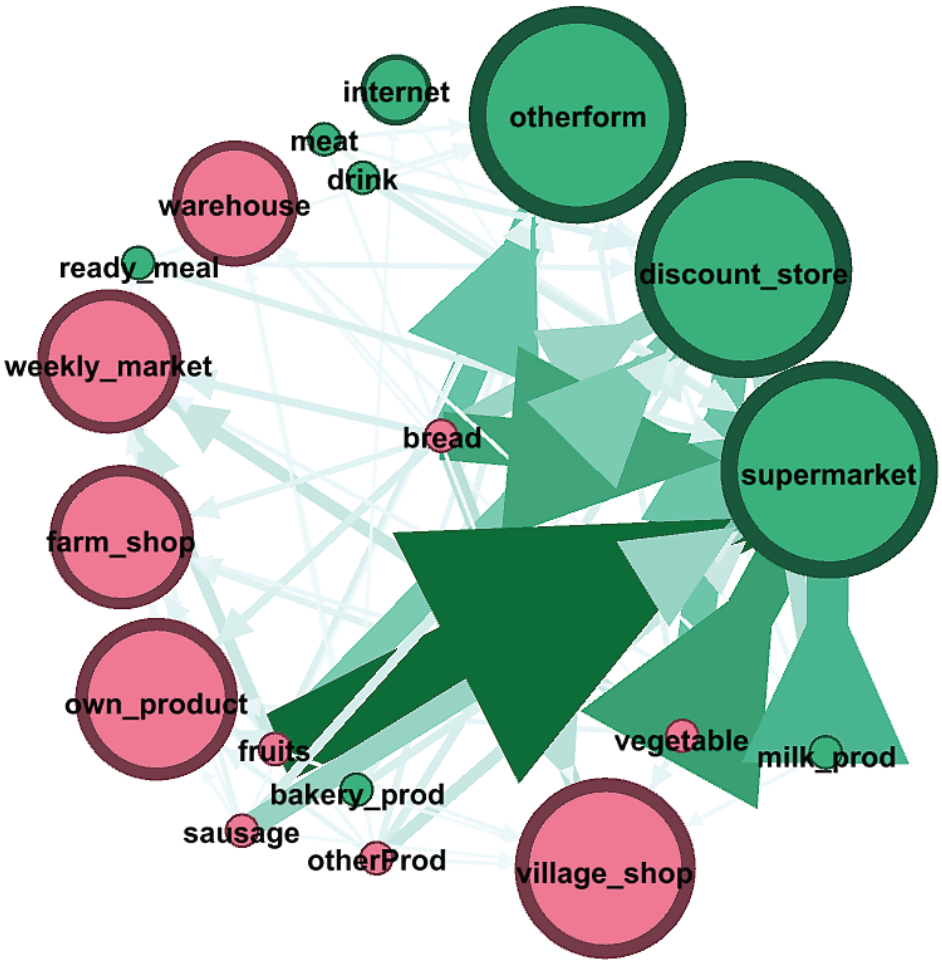

Fig. 5 Relational network of regularly utilised food retail formats and last disposed products according to food groups; retail type "specialist_shop" primarily under "otherform"; Software: gephi092 (circular layout degree; representation via input degree); for further notes see Figure 6; all cases=1,704; of which usable double-sided response sets in Figure 5=1,437; modularity=0.106. Source: own elaboration, survey Jürgens 2021

Table 11 Significance tests for selected demographic data and waste behaviour. Source: own elaboration, survey Jürgens 2021

Correlations	Test A (Chi-Square)	Test B (Cramer-V)
Income class – Waste food	.770	.770
Income class – Reasons for waste	.434	.434
Income class – Retail format	.001	.001
Income class – Retail origin of waste	.093	.093
Household size (3 groups single-, two-, multiple-person) – Waste food	.005	.005
Household size – Reasons for waste	.303	.303
Gender – Waste food	.584	.584
Gender – Reasons for waste	.268	.268

Table 12 How often does your household produce food waste (excluding peelings and bones)? Figures in %; Significance test for clusters: Cramer-V .149 (Sign.000), Contingency coefficient .249 (Sign.000); Significance test for age groups: Cramer-V .230 (Sign.000), Contingency coefficient .309 (Sign.000); Significance test für type of survey: Cramer-V .252 (Sign.000), Contingency coefficient .244 (Sign.000); Significance for children in household: Cramer-V .210 (Sign.000), Contingency coefficient .205 (Sign.000). Source: own elaboration, survey Jürgens 2021

Frequency	Smart	Spontaneous	Convenience	Sustainable	Postal survey	Online-survey	Age below 40	Age 41-64	Age 65+	Children under 13 in household
Daily	9.5	7.0	11.3	6.1	7.8	7.5	11.0	7.6	5.5	15.6
Up to weekly	21.0	34.8	35.4	22.3	30.9	15.6	29.3	30.8	20.9	36.3
Several times a month	16.4	15.8	19.9	19.9	14.3	27.5	25.3	17.9	10.7	18.0
Monthly	11.0	14.0	12.7	19.3	10.7	21.3	17.2	14.2	9.0	12.1
More seldom	33.4	25.6	18.9	30.4	29.6	27.8	15.9	26.9	42.8	16.4
Never	8.6	2.8	1.7	2.0	6.6	0.3	1.3	2.6	11.2	1.6
No. answers	347	215	291	296	1,070	334	308	661	421	256

Even the Sustainable Group cannot prevent bread from dominating mentions of waste products, although it comes from other retail formats than in the other groups, such as organic food shops and specialist shops. It is obvious that discounters and supermarkets are used as an additional source of fresh products for the Sustainable Group, which explains the high percentage of waste in the fresh categories without bread (dairy, fruit, vegetables from discounters in the Smart Group: 60.4%; Spontaneous Group: 62.1%; Convenience Group: 68.8%; Sustainable Group: 71.4%).

If we ask (*Table 14*) why food waste is generated, it becomes apparent that the criteria that dominate the public discussion, such as best-before date, large packaging sizes or aesthetic appearance, are of rather marginal importance in this survey (*Figure 6*), and this is the case systematically and stably across all differentiated groups (in contrast to *GfK* 2021 and quantitative diary surveys). Nevertheless, the criterion "best-before date" has more than twice as much impact in the Spontaneous Group as in the Sustainable Group. The central reason for disposing of a food product is that it is 'mouldy, rotten, sour, turned' and 'unsalvageable'. The different purchasing, storage and processing capacities within the groups are expressed in the criterion 'forgotten', which can be interpreted as an 'overstocking' of products of uncertain quality which may then be forgotten. The question allowed multiple answers, so that overlaps with answers such as 'appearance', 'rotten' or 'best-before date' cannot be completely ruled out. The criterion 'too hard, too dry' refers to the fact that bread products, in particular, may fail to meet required standards without being inedible, unhealthy or unusable. There are statistically significant differences in the comparison of ages, the type of survey (postal versus online) and the groups, which make the Sustainable Group (which is mainly fed by the online survey) stand out. Settlement type (urban versus rural) and households with/without children do not differ in the pattern of their reasons for disposing of food.

Table 13 Food retail formats versus discarded food in private households (in % related to retail format) (What was the last food that you remember throwing away at home?). Source: own elaboration, survey Jürgens 2021

Format/Product	Organic_farmshop Village_shop Mobile/Weekly_market	Discounters	Specialist_shop/ other	Supermarket_ Warehouseother	Homegrown/made
Smart Group					
Baked goods	0.0	1.2	5.3	3.4	15.4
Bread	35.0	16.0	57.9	17.4	38.5
Ready meals	0.0	3.7	0.0	3.4	7.7
Meat	0.0	1.2	2.6	0.6	0.0
Vegetables	30.0	29.6	7.9	19.1	15.4
Drinks	0.0	3.7	0.0	2.8	0.0
Dairy products	2.5	4.9	2.6	15.2	0.0
Fruit	27.5	25.9	7.9	24.7	15.4
Cold meats	5.0	6.2	0.0	10.1	0.0
Other	0.0	7.4	15.8	3.4	7.7
No. answers	40	81	38	178	13
Spontaneous Group					
Baked goods	0.0	1.5	10.0	0.9	0.0
Bread	36.7	27.3	55.0	20.5	60.0
Ready meals	0.0	1.5	0.0	0.0	0.0
Meat	3.3	1.5	10.0	0.9	0.0
Vegetables	26.7	22.7	5.0	14.3	20.0
Drinks	0.0	1.5	0.0	2.7	0.0
Dairy products	3.3	15.2	10.0	16.1	0.0
Fruit	16.7	24.2	10.0	31.3	20.0
Cold meats	3.3	3.0	0.0	10.7	0.0
Other	10.0	1.5	0.0	2.7	0.0
No. answers	30	66	20	112	5
Convenience Group					
Baked goods	0.0	3.1	3.4	2.5	20.0
Bread	45.0	12.5	82.8	16.9	10.0
Ready meals	0.0	0.0	0.0	3.1	0.0
Meat	0.0	0.0	0.0	1.9	0.0
Vegetables	20.0	23.4	0.0	22.5	10.0
Drinks	0.0	1.6	3.4	0.6	0.0
Dairy products	15.0	18.8	0.0	13.8	0.0
Fruit	10.0	26.6	6.9	26.9	10.0
Cold meats	7.5	6.3	0.0	8.8	10.0
Other	2.5	7.8	3.4	2.5	40.0
No. answers	40	64	29	160	10
Sustainable Group					
Baked goods	3.8	4.8	2.3	2.0	14.3
Bread	30.8	4.8	53.5	11.3	42.9
Ready meals	0.0	4.8	2.3	0.7	0.0
Meat	3.8	0.0	2.3	0.7	0.0
Vegetables	30.8	33.3	11.6	23.3	0.0
Drinks	0.0	1.6	2.3	3.3	0.0
Dairy products	7.7	17.5	4.7	20.0	0.0
Fruit	19.2	20.6	14.0	24.7	42.9
Cold meats	3.8	9.5	0.0	8.0	0.0
Other	0.0	3.2	7.0	6.0	0.0
No. answers	26	63	43	150	7

Table 14 Reasons for disposal of food waste (multiple answers) in % by groups; Significance test for cluster: Cramer-V .043 (Sign.000), Contingency coefficient .074 (Sign.000), Chi-square .006 (49,059, df 27); Significance test for age groups: Cramer-V .041 (Sign.006), Contingency coefficient .058 (Sign.006); Significance test for type of survey: Cramer-V .085 (Sign.000); Significance test for urban/rural residential area: Cramer-V .074 (Sign.349); Significance test for children in household: Cramer-V .43 (.930). Source: own elaboration, survey Jürgens 2021

	Smart	Spontaneous	Convenience	Sustainable	Postal survey	Online-survey	Age under 40	Age 41-64	Age 65+	Children under 13 in household	Urban	Rural
Bad buy	1.8	1.5	0.5	0.6	1.3	1.5	0.9	0.9	2.3	0.7	1.2	1.4
Taste	3.3	1.5	3.3	2.2	3.1	2.4	2.4	3.0	3.3	3.0	2.4	3.4
Expiry date	7.6	10.8	8.2	5.1	7.7	5.4	7.9	6.4	8.1	8.0	9.0	6.0
Appearance	3.6	3.5	2.5	1.9	3.0	2.1	2.6	2.2	3.9	2.7	3.0	2.7
Packaging	2.3	1.2	1.9	1.6	2.4	1.5	2.4	1.6	3.1	2.3	2.2	2.1
Rotten	57.5	57.9	57.0	70.5	56.5	72.9	64.4	61.8	53.6	58.5	60.0	59.6
Forgotten	11.5	11.2	11.0	7.6	12.4	5.1	6.8	11.6	13.0	10.0	11.1	11.0
Too hard	6.9	10.8	11.5	6.7	9.6	6.3	8.8	9.4	8.3	10.6	7.7	10.0
Other	5.6	1.5	4.1	3.8	4.0	2.7	3.8	3.1	4.4	4.0	3.4	3.8
Total answers	393	259	365	315	1.306	332	340	768	517	301	675	943

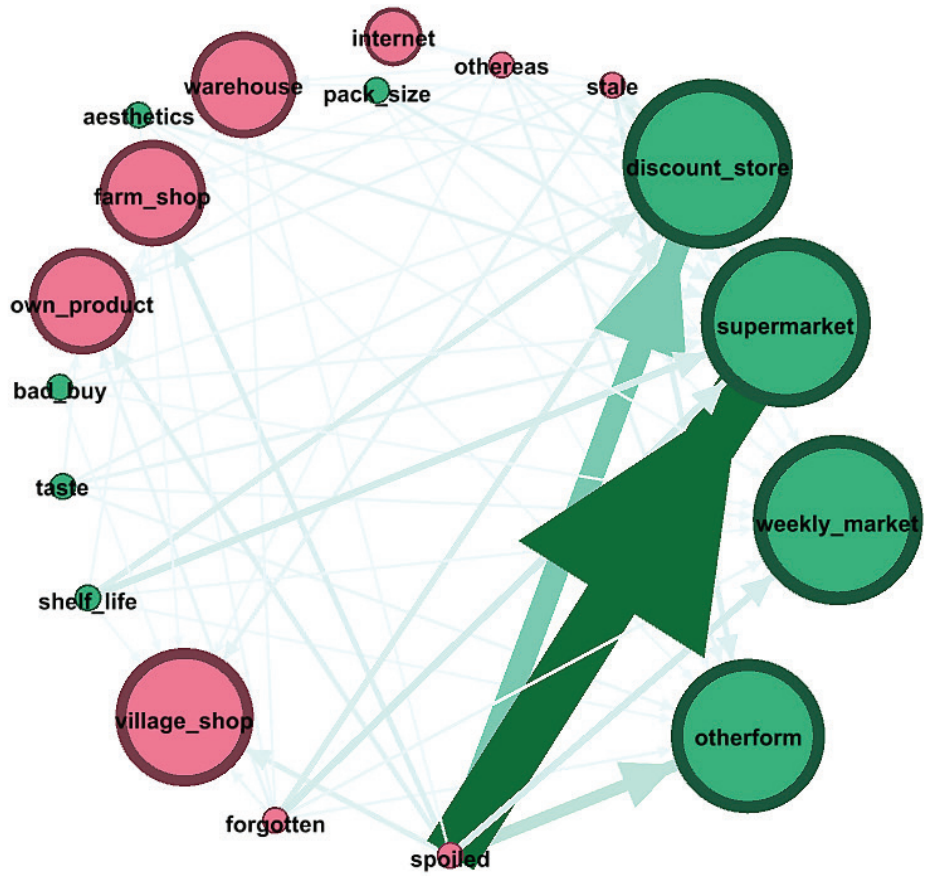

Fig. 6 Relational network of regularly utilised food retail formats and reasons for food waste; retail type "specialist_shop" primarily under "otherform"; Software: gephi092 (circular layout degree; representation via "input degree"); definition of circle or node sizes according to the number of incoming connections from different nodes; definition of lines or edges according to the same node combinations; definition of colours as clusters of similarly dense connecting structures between the points (modularity=0.127), all cases=1,704; of which usable double-sided response sets in Figure 6=1,458. Source: own elaboration, survey Jürgens 2021

Across all retail formats, supermarkets and discounters accounted for 80% of discards that were due to 'bad buys' (N=15), 60% of discards due to taste (N=40), 90.9% of discards due to best-before date (N=88), 74.2% of discards due to appearance (N=31), 91.4% of discards due to packaging size (N=35), 76.5% of discards due to rottenness (N=961), 73.3% of discards due to food being 'forgotten' (N=120) and 46.7% of discards due to it being 'too hard' (N=118). In terms of overall food baskets and retail formats used, supermarkets and discounters are (as expected) the main source of food waste in private households, whereby it is apparent that for purchases from alternative retail formats or specialist shops various criteria such as best-before date and packaging size play only a subordinate role as a reason for food disposal in private households. An exception is bread products, which are disposed of more frequently (in relative terms) when derived from specialist shops and alternative formats and are thrown away because of being 'too hard' despite their perceived higher value in terms of quality, origin or price.

The linking of attitude sets to demographic structures (*Table 15*) shows that the *Smart Group* is of above-average age, is characterised by a high proportion of pensioners and a low proportion of children in the households, and comprises a high-income clientele. Although there are more females than average in the overall sample, the *Spontaneous Group*, who are particularly susceptible to food waste, is characterised by an increased share of males across all age groups (33.3% in the youngest up to 40 years, 31.4% among 41-64 year olds and 56.1% among the over 65s) and also comprises the highest share of single-person households. The *Convenience Group* is mainly from rural areas, is over-proportionally well-equipped with cars and is characterised by an age structure and numbers of children that suggest established families. The *Sustainable Group* can mainly be described as young and urban, with two peaks in income in the lowest and highest income bracket compared to all other groups.

The attitude sets and the linked behaviour patterns of private households are viewed as diffuse or are even unknown among practitioners in politics, administration, educational sections of waste management companies, the retail trade and primary production. Research in waste management companies has shown that even here the topic of food waste has only played a subordinate role so far (*Jürgens* 2021). *Table 15* aims to link these attitude sets with demographic characteristics and thus to identify target groups for food

Table 15 Demographic structures and attitudes in the clusters (in %). Source: own elaboration, survey Jürgens 2021

Structure/Cluster	Overall sample	Postal	Online	Smart	Spontaneous	Convenience	Sustainable
Female	74.9	72.1	84.2	78.3	61.7	76.2	79.2
Male	25.1	23.9	15.8	21.7	38.3	23.8	20.8
Age -40	21.8	12.8	51.5	11.5	18.1	23.7	46.1
41-64	47.2	49.0	41.3	48.4	54.9	58.1	42.4
65+	31.0	38.3	7.2	40.1	27.0	18.2	11.4
Children under 13	19.1	15.7	29.7	14.8	15.1	27.4	24.0
Single person household	26.2	24.6	31.4	23.1	28.0	21.4	27.5
Retired	33.1	40.0	10.8	43.6	28.0	21.0	13.5
Employee	38.0	35.7	45.3	31.5	40.7	46.7	47.3
Pupils and students	5.6	1.4	19.5	2.0	2.8	3.1	17.2
Income below 1500 euros	12.5	10.3	18.4	9.4	13.0	9.1	16.7
1501-2500 euros	24.2	22.6	28.4	23.8	22.8	19.0	24.4
2501-5000 euros	50.4	53.3	42.8	56.0	53.3	55.6	41.9
5001 euros+	12.9	13.8	10.3	10.8	10.9	16.3	17.0
Urban	42.6	32.7	77.1	43.2	39.8	34.8	58.9
No car	6.9	2.6	21.0	4.3	6.1	1.0	16.3
Follow media reports (1-5)	3.2	3.1	3.5	3.5	2.8	3.0	3.3
Topic in the family (1-5)	3.5	3.6	3.3	3.8	3.3	3.3	3.4
Conscience (1-5)	4.5	4.5	4.6	4.6	4.2	4.5	4.8
No. cases	1,166-1,458	1,101	357	352	218	296	300

waste susceptibilities (*Aschemann-Witzel* et al. 2021). The Spontaneous Group, for example, displays much less interest in external information on food than the other groups. Moral-ethical questions of conscience have no discernible relevance: they are consistently rated above average in all groups (*Table 15*). The most important finding is that the public do not display homogeneous behaviour in terms of food waste and that educational work (*Aschemann-Witzel* et al. 2021: 10) must be geared not only to age but specifically also to household, region and types of retail format. Although descriptively striking at times, significant differences by income or gender could not be detected (*Table 11*). *Figure 7* shows starting points for educational measures directed at private households and food suppliers and producers. These include encouraging organised shopping behaviour in the household (shopping lists), the adaptation and downscaling of individual food demands (acceptable freshness), education (on acceptable appearance and best-before dates), media access to education (also via advertising leaflets), and appreciation of goods (prices also based on regionality and organic production) (values from *Table 9*).

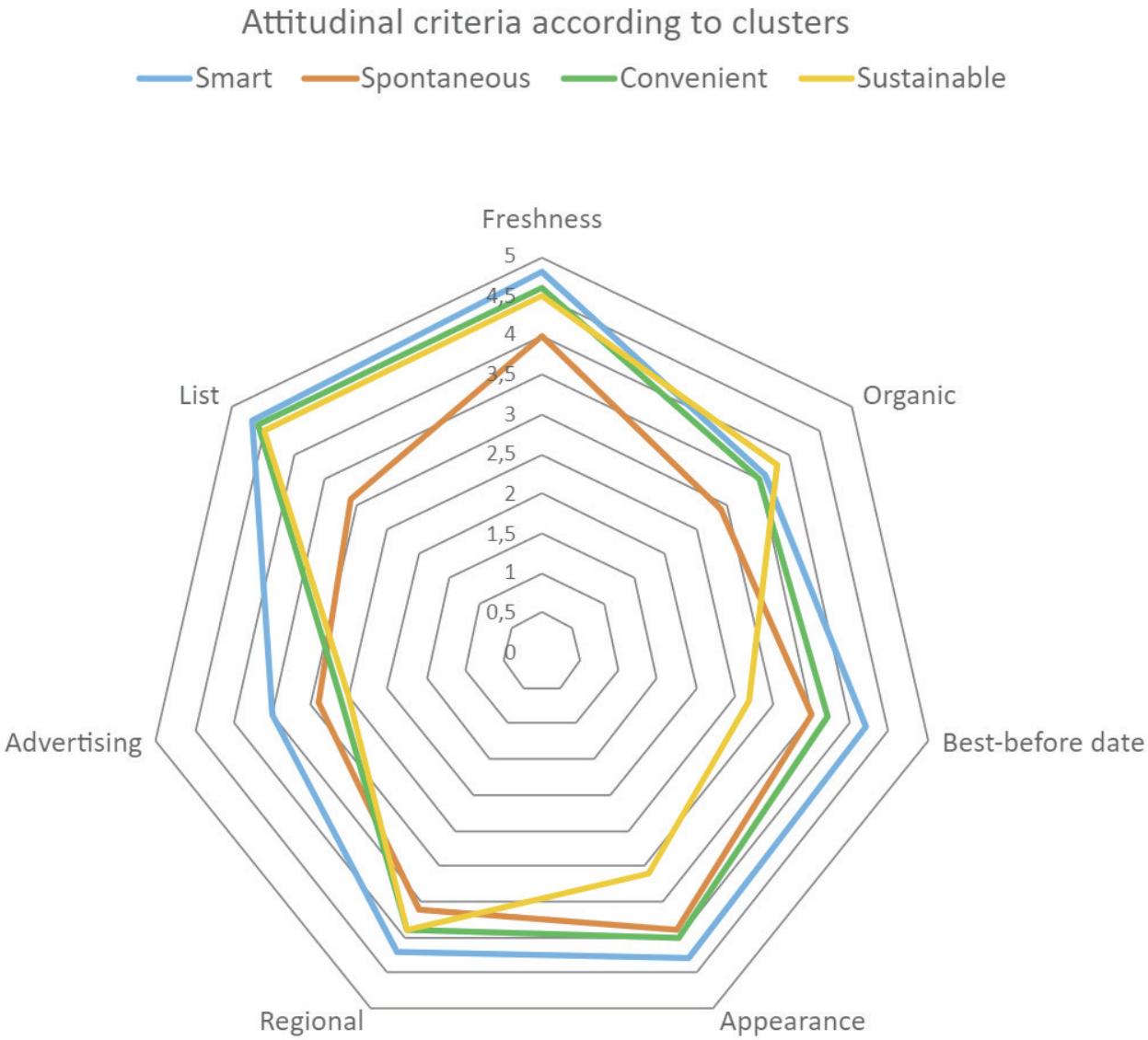

Fig. 7 *Selected attitudinal criteria as educational levers against food waste (mean values 1=not at all true; 5=totally true/very often true). Source: own elaboration, survey Jürgens 2021*

6. Discussion and perspectives

The methodology presented above uses data compression to segment and distinguish groups of private households according to their attitudes and practices related to the everyday handling of food and food waste, thus also identifying target groups for educational activities. It is explicitly noted that this approach is not new; it is in line with work undertaken by *Graham-Rowe* et al. (2015), *Di Talia* et al. (2019) and *Aschemann-Witzel* et al. (2021) (see discussion on the fourth research strand in Section 2). In all these investigations, dependent on the breadth and depth of the attitudinal questions posed, it was possible to identify certain groups that had a clearly more open-minded, sustainable and structured approach and behaviour towards the topic of food than other groups. It should be noted that the world of beliefs and attitudes does not always conform to behaviour. The findings of the present investigation show that even the most enlightened households dedicated to saving food are subject to bad buys, mis-storage or failed culinary experiments. Other households deny per se that they generate food waste (*McCarthy* and *Liu* 2017: 2527). Thus, various groups of households are spontaneous, absent-minded or disinterested in the topic of food, or even display reactance in response to attempts to impose rules to do with food. This is a finding that clearly goes beyond the tendency of politics, the administration and retail organisations in Germany to associate the issue of food waste with social conformity which does not exist.

The linking of self-assessments about the handling of food with actual food shopping behaviour in terms of shopping formats and locations was explored through the use of an open question in two dimensions, which allowed the reconstruction of complex shopping networks. It was thus possible to address the question of where food waste in private households comes from and why food becomes waste. This approach is derived from the perspective of retail geography (an extension of the fifth research strand 5 discussed in Section 2), which is so far unfamiliar to established research on the topic of food waste. In addition, data collection took place on a regional meso level, which, in contrast to the anonymised national meta-levels of other publications, opens up the possibility of tapping into local contexts on the ground, of examining the logic of respondents' answer patterns, and of conducting expert interviews and personally visiting the shopping locations as original sources of food waste.

To the best of the author's knowledge, this triple combination of data relating to attitudes, actual shopping behaviour as the original source of food waste, and waste behaviour has not yet been pursued anywhere in the literature. Where relationships have been established between shopping formats and their susceptibility for food waste generation in private households, they have generally been presented as one-dimensional correlations (*González-Santana* et al. 2020; *Chen* and *House* 2021). In our case, this would mean that even the most enlightened group produces most waste from food sourced at supermarkets and discounters because even this group shops there relatively often. However, where the individual system of shopping is more small-scale, local, fresh and diverse, then supermarket-specific reasons for disposal like shelf-life, packaging, appearance and expectations become less important (*Table 14*). Food waste only then occurs when the product is self-critically assessed as having become inedible. The Sustainable Group provides evidence of the way in which this reduces food waste susceptibility, as food waste occurs significantly less often in their households than in the comparison groups (*Table 12*).

Various food producers and retailers are already looking for ways to assist their customers, for instance with recipes that can give food waste new life or an upgrade (e.g. turning old bread into beer or biscuits and creating juice from waste vegetables). Such products are balanced 'on a knife-edge' to food waste status. It could thus be of interest to extend the research approach presented here to consider whether they are actually an option for minimising food waste, whether they are accepted by private households and perception groups as marketable products, and whether there is a demand for them. This raises the question of whether retail formats, with their different product ranges, already have an encouraging or discouraging effect on the food-waste attitudes and practices of private households.

7. Conclusions and limitations

The investigation shows: the reality of food waste cannot be identified or explained through the use of individual population indicators. Although indicators such as age or income reveal significant differences, these convey a rather erratic pattern of food waste anomalies (*Table 11*).

Food waste behaviour reflects complex attitudes (*Table 9*), which in turn influence food demands and the purchasing activities that precede food waste[1]. Such grocery shopping events not only form conspicuous purchasing patterns based on the choice of preferred retail formats (*Table 10*), but also represent the most important original sources of food waste in private households. None of the clusters could be reduced to just one single retail format that is used for shopping or as a food waste source, although (relatively speaking) small formats and specialist shops turn out to be particular freshness traps (*Table 13*). Reasons for disposal such as best-before dates or packaging sizes typically occur mainly with food sourced in supermarkets and discounters.

Food waste behaviour can only be derived indirectly and in a roundabout way. These surveys show that the topic leads different attitude groups to justify their own positively perceived actions, viewing themselves as 'food salvagers', but it also prevents other people from 'admitting' to food waste at all (*Secondi* et al. 2015: 30) (*Table 12*).

Two decisive waste blockers can be identified. On the one hand, organisation, planning and preparation of shopping activities and food preparation help to reduce food waste (*Giordano* et al. 2018: 207) (*Table 7*). This is not contradicted by having 'plenty of food in the house' or loving 'variety' (according to the self-assessment of the Smart Group). On the other hand, it is also possible to identify a construct involving self-reflection and a willingness to be informed and limit one's own demands. This means that food continues to be used despite best-before restrictions, overly long storage or, in the case of bread products, it being 'too hard', so that only 'unsalvageable' products are disposed of (Sustainable Group; *Table 14*).

The study presented here opens up perspectives that have been given little consideration in the mainstream of food waste literature to date. This explicitly does not concern the adaptation of the FRL concept. The focus is rather on its extension to the spatial contexts that result from relationships between food shopping activities and food waste susceptibilities, thus highlighting the responsibilities of private households and upstream actors in the generation of food waste. The approach was undertaken on the micro-/meso-level, providing starting points for further regionally specific research. No claim to representativeness for national meta-levels is made. The type and scope of the surveys and the methods chosen reflect pragmatic decisions that had to take into account the micro-level of the case studies. Attitude sets and activities were recorded through self-assessments by the households, which were interpreted as group-specific characteristics and relational networks. The surveys did not record frequencies of shopping trips related to retail formats, expenditure on product groups in different retail formats, or weights or volumes of food waste, which on the one hand shows the limits of the present investigation, but on the other hand opens up opportunities for extended research.

Acknowledgements

Thanks are due to the German Research Foundation (DFG), which is funding the project under the number JU332/19-1. Translation by Dr. Katharine Thomas.

Note

[1]Short-term effects of the Covid-19 crisis cannot be discerned in the attitude sets. After a year of Covid-19 experience, online grocery shopping ranked 40th of 40 items, gaining the lowest possible approval (mean 1.26; online survey=1.4; postal survey=1.2; age up to 40=1.4), while food storage due to the Covid-19 crisis ranked 38th (mean 2.27).

References

Abbade, E. 2020: Estimating the nutritional loss and the feeding potential derived from food losses worldwide. – World Development **134**, doi:10.1016/j.worlddev.2020.105038

Aktas, E., H. Sahin, Z. Topaloğlu and *A. Oledinma* 2018: A consumer behavioural approach to food waste. – Journal of Enterprise Information Management **31** (5): 658-673, doi:10.1108/JEIM-03-2018-0051

Aleshaiwi, A. and *T. Harries* 2021: A step in the journey to food waste: How and why mealtime surpluses become unwanted. – Appetite **158**, doi:10.1016/j.appet.2020.105040

Althans, B. and *J. Bilstein* 2016: Essen – Bildung – Konsum. – Wiesbaden

Ananda, J., G. Karunasena, A. Mitsis, M. Kansal and *D. Pearson* 2021: Analysing behavioural and socio-demographic factors and practices influencing Australian household food waste. – Journal of Cleaner Production **306**, doi:10.1016/j.

jclepro.2021.127280

Anderson, J. 1983: A spreading activation theory of memory. – Journal of Verbal Learning and Verbal Behavior **22** (3): 261-295, doi:10.1016/S0022-5371(83)90201-3

Annunziata, A., M. Agovino, A. Ferraro and *A. Mariani* 2020: Household food waste: a case study in southern Italy. – Sustainability **12** (4), doi:10.3390/su12041495

Aschemann-Witzel, J. 2018: Helping you to waste less? – Journal of Food Products Marketing **24** (5): 522-538, doi:10.1080/10454446.2018.1472693

Aschemann-Witzel, J., I. de Hooge, V. Almli and *M. Oostindjer* 2018: Fine-tuning the fight against food waste. – Journal of Macromarketing **38** (2): 168-184, doi:10.1177%2F0276146718763251

Aschemann-Witzel, J., I. de Hooge and *V. Almli* 2021: My style, my food, my waste! Consumer food waste-related lifestyle segments. – Journal of Retailing and Consumer Services **59**, doi:10.1016/j.jretconser.2020.102353

Atkins, P. and *I. Bowler* 2001: Food in society: economy, culture, geography. – London

Barr, S. and *A. Gilg* 2006: Sustainable lifestyles: framing environmental action in and around the home. – Geoforum **37** (6): 906-920, doi:10.1016/j.geoforum.2006.05.002

Barrera, E. and *T. Hertel* 2021: Global food waste across the income spectrum: implications for food prices, production and resource use. – Food Policy **98**, doi:10.1016/j.foodpol.2020.101874

Belavina, E. 2021: Grocery store density and food waste. – Manufacturing & Service Operations Management **23** (1): 1-18, doi:10.1287/msom.2019.0800

Biehl, B. 2021: Ehrliche Mengenlehre. – Lebensmittel Zeitung 01.10.2021: 29-33.

Blakeney, M. 2019: Food loss and food waste – causes and solutions. – Cheltenham, UK

Blichfeldt, B., M. Mikkelsen and *M. Gram* 2015: When it stops being food. – Food, Culture & Society **18** (1): 89-105, doi:10.2752/175174415X14101814953963

Brunsø, K., D. Birch, J. Memery, Á. Temesi, Z. Lakner, M. Lang, D. Dean and *K.G. Grunert* 2021: Core dimensions of food-related lifestyle: a new instrument for measuring food involvement, innovativeness and responsibility. – Food Quality and Preference **91**, doi:10.1016/j.foodqual.2021.104192

Caldeira, C., V. De Laurentiis, A. Ghose, S. Corrado and *S. Sala* 2021: Grown and thrown: Exploring approaches to estimate food waste in EU countries. – Resources, Conservation and Recycling **168**, doi:10.1016/j.resconrec.2021.105426

Cattaneo, A., G. Federighi and *S. Vaz* 2021: The environmental impact of reducing food loss and waste: A critical assessment. – Food Policy **98**, doi:10.1016/j.foodpol.2020.101890

Chen, C., A. Chaudhary and *A. Mathys* 2020: Nutritional and environmental losses embedded in global food waste. – Resources, Conservation & Recycling **160,** doi:10.1016/j.resconrec.2020.104912

Chen, L. and *L. House* 2021: Food lifestyle patterns among contemporary food shoppers. – International Journal of Consumer Studies **00**, doi:10.1111/ijcs.12739

Cicatiello, C., S. Franco, S., *B. Pancino, E. Blasi* and *L. Falasconi* 2017: The dark side of retail food waste: evidences from in-store data. – Resources, Conservation & Recycling **125**: 273-281, doi:10.1016/j.resconrec.2017.06.010

Corrado, S., C. Caldeira, M. Eriksson, O.J. Hanssen, H.-E. Hauser, F. van Holsteijn, G. Lio, K. Östergren, A. Parry, L. Secondi, Å. Stenmarck and *S. Sala* 2019: Food waste accounting methodologies: challenges, opportunities, and further advancements. – Global Food Security **20**: 93-100, doi:10.1016/j.gfs.2019.01.002

Davenport, M., D. Qi and *B. Roe* 2019: Food-related routines, product characteristics, and household food waste in the United States: A refrigerator-based pilot study. – Resources, Conservation and Recycling **150**, doi:10.1016/j.resconrec.2019.104440

Di Talia, E., M. Simeone and *D. Scarpato* 2019: Consumer behavior types in household food waste. – Journal of Cleaner Production **214**: 166-172, doi:10.1016/j.jclepro.2018.12.216

Dou, Z. and *J. Toth* 2021: Global primary data on consumer food waste: rate and characteristics – a review. – Resources, Conservation & Recycling **168,** doi:10.1016/j.resconrec.2020.105332

Eriksson, M., I. Strid and *P. Hansson* 2012: Food losses in six Swedish retail stores: wastage of fruit and vegetables in relation to quantities delivered. – Resources, Conservation and Recycling **68**: 14-20, doi:10.1016/j.resconrec.2012.08.001

Evans, J. and *A. Mathur* 2005: The value of online surveys. – Internet Research **15** (2): 195-219, doi:10.1108/IntR-03-2018-0089

Evans, D. 2011: Blaming the consumer – once again: the social and material contexts of everyday food waste practices in some English households. – Critical Public Health **21** (4): 429-440, doi:10.1080/09581596.2011.608797

Evans, D. 2012: Beyond the throwaway society: ordinary domestic practice and a sociological approach to household food waste. – Sociology **46** (1): 41-56, doi:10.1177/0038038511416150

FAO (*Food and Agriculture Organization of the United Nations*) 2011: Global food losses and food waste. – Rome. – Online available at: http://www.fao.org/3/mb060e/mb060e00.pdf, accessed 23/12/2021

FAO (*Food and Agriculture Organization of the United Nations*) 2019: The state of food and agriculture. Moving

forward on food loss and waste reduction. – Rome. – Online available at: https://www.fao.org/publications/sofa/2019/en/, accessed 23/12/2021

Fan, W. and *Z. Yan* 2010: Factors affecting response rates of the web survey: a systematic review. – Computers in Human Behavior **26** (2): 132-139, doi:10.1016/j.chb.2009.10.015

Festinger, L. 2012 originally 1957: Theorie der kognitiven Dissonanz. – Bern

Fishbein, M. and *I. Ajzen* 1975: Belief, attitude, intention and behavior: an introduction to theory and research. – Reading, MA

Flaig, B. and *B. Barth* 2014: Die Sinus-Milieus 3.0. – In: *Halfmann, M.* (ed.): Zielgruppen im Konsumentenmarketing. – Wiesbaden: 105-120

Fusions 2016: Estimates of European food waste levels. – Stockholm: Swedish Environmental Research Institute. – Online available at: https://www.eu-fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf, accessed 23/12/2021

Galanakis, C. 2015: Food waste recovery – processing technologies and industrial techniques. – London, UK

Garrone, P., *M. Melacini, A. Perego* and *S. Sert* 2016: Reducing food waste in food manufacturing companies. – Journal of Cleaner Production **137**: 1076-1085, doi:10.1016/j.jclepro.2016.07.145

GfK (= *Growth from Knowledge*) 2017: Systematische Erfassung von Lebensmittelabfällen der privaten Haushalte in Deutschland. Studie für das Bundesministerium für Ernährung und Landwirtschaft. – Nürnberg. – Online available at: https://www.zugutfuerdietonne.de/fileadmin/zgfdt/inhalt/daten/GfK-Studie.pdf, accessed 23/12/2021

GfK (= *Growth from Knowledge*) 2021: Systematische Erfassung von Lebensmittelabfällen der privaten Haushalte in Deutschland. Schlussbericht 2020. Studie für das Bundesministerium für Ernährung und Landwirtschaft. – Nürnberg. – Online available at: https://www.bmel.de/SharedDocs/Downloads/DE/_Ernaehrung/Lebensmittelverschwendung/GfK-Analyse-2020.pdf?__blob=publicationFile&v=3, accessed 23/12/2021

Ghani, W., *I. Rusli*, *D. Biak* and *A. Idris* 2013: An application of the theory of planned behaviour to study the influencing factors of participation in source separation of food waste. – Waste Management **33** (5): 1276-1281, doi:10.1016/j.wasman.2012.09.019

Giordano, C., *S. Pira*, *M. Boschini* and *L. Falasconi* 2018: Are questionnaires a reliable method to measure food waste? A pilot study on Italian households. – British Food Journal **120** (12): 2885-2897, doi:10.1108/BFJ-02-2018-0081

Giordano, C., *F. Alboni, C. Cicatiello* and *L. Falasconi* 2019: Do discounted food products end up in a bin? – International Journal of Consumer Studies **43** (2): 199-209, doi:10.1111/ijcs.12499

González-Santana, R., *J. Blesa*, *A. Frígola* and *M. Esteve* 2020: Dimensions of household food waste focused on family and consumers. – Critical Reviews in Food Science and Nutrition, doi:10.1080/10408398.2020.1853033

Goodman-Smith, F., M. Mirosa and *S. Skeaff* 2020: A mixed-methods study of retail food waste in New Zealand. – Food Policy **92**, doi:0.1016/j.foodpol.2020.101845

Graham-Rowe, E., *D. Jessop* and *P. Sparks* 2015: Predicting household food waste reduction using an extended theory of planned behaviour. – Resources, Conservation and Recycling **101**: 194-202, doi:10.1016/j.resconrec.2015.05.020

Grunert, K. 1993: Towards a concept of food-related life style. – Appetite **21** (2): 151-155, doi:10.1016/0195-6663(93)90007-7

Grunert, K., K. Brunsø and *S. Bisp* 1993: Food-related life style. – Aarhus: University of Aarhus (MAPP working paper No. 12). – Online available at: https://pure.au.dk/portal/files/88/wp12.pdf, accessed 23/12/2021

Grzeskowiak, S., *M. Sirgy, T. Foscht* and *B. Swoboda* 2016: Linking retailing experiences with life satisfaction. – International Journal of Retail & Distribution Management **44** (2): 124-138, doi:10.1108/IJRDM-07-2014-0088

Harvey, J., G. Nica-Avram, M. Smith, S. Hibbert and *J. Muthuri* 2022: Mapping the landscape of consumer food waste. – Appetite **168**, doi.org/10.1016/j.appet.2021.105702

Helmke, S., *J. Scherberich* and *M. Uebel* 2016: LOHAS-Marketing: Strategie – Instrumente – Praxisbeispiele. – Wiesbaden

Hermsdorf, D., *M. Rombach* and *V. Bitsch* 2017: Food waste reduction practices in German food retail. – British Food Journal **119** (12): 2532-2546, doi:10.1108/BFJ-06-2017-0338

Herzberg, R., *T. Schmidt* and *F. Schneider* 2020: Characteristics and determinants of domestic food waste: A representative diary study across Germany. – Sustainability **12** (11), doi:10.3390/su12114702

Horst, H., *S. Pascucci* and *W. Bol* 2014: The "dark side" of food banks? Exploring emotional responses of food bank receivers in the Netherlands. – British Food Journal **116** (9): 1506-1520, doi:10.1108/BFJ-02-2014-0081

Ilakovac, B., *M. Cerjak* and *N. Voca* 2020: Why do we waste food? In-depth interviews with consumers. – Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, doi.org/10.1080/15567036.2020.1787564

Iwama, N., T. Asakawa, K. Tanaka, M. Sasaki, N. Komaki and *M. Ikeda* 2021: Urban food deserts in Japan. – Singapore

Jürgens, U. 2018: `Real´ versus `mental´ food deserts from the consumer perspective – concepts and quantitative methods applied to rural areas of Germany. – Die Erde **149** (1): 25-43, doi:10.12854/erde-149-56

Jürgens, U. 2021: Diskussion um Lebensmittelverschwendung am Beispiel öffentlich-rechtlicher Abfallwirtschaftsbetriebe – Theorie versus Praxis. – Müll und Abfall **53** (8): S. 451-457, doi:10.37307/j.1863-9763.2021.08.07

Kaul, S. and *S. Lange* 2020: Politische Ziele und ästhetische Strategien von Umweltdokumentarfilmen. – Braunschweig: Thünen-Institut (= Thünen Report 70), doi:3220/REP1585820523000

Kline, S. 2011: Globesity, food marketing and family lifestyles. – New York

Klug, K. 2018: Vom Nischentrend zum Lebensstil – der Einfluss des Lebensgefühls auf das Konsumentenverhalten. – Wiesbaden

Koivupuru, H., H. Hartikainen, K. Silvennoinen, J.-M. Katajajuuri, N. Heikintalo, A. Reinikainen and *L. Jalkanen* 2012: Influence of socio-demographical, behavioural and attitudinal factors on the amount of avoidable food waste generated in Finnish households. – International Journal of Consumer Studies **36** (2), 183-191, doi:10.1111/j.1470-6431.2011.01080.x

Kraus, S. 1995: Attitudes and the prediction of behavior: a meta-analysis of the empirical literature. – Personality and Social Psychology Bulletin **21** (1): 58-75, doi:10.1177%2F0146167295211007

Landry, C., *T. Smith* and *D. Turner* 2018: Food waste and food retail density. – Journal of Food Products Marketing **24** (5): 632-653, doi:10.1080/10454446.2018.1472697

LaPiere, R. 1934: Attitudes vs. actions. – Social Forces **13** (2): 230-237, doi:10.2307/2570339

Lebersorger, S. and *F. Schneider* 2011: Discussion on the methodology for determining food waste in household waste composition studies. – Waste Management **31**: 1924-1933, doi:10.1016/j.wasman.2011.05.023

Liu, C. and *J. Chen* 2019: Takeaway food, waste, and their geographies in workplace. – Geographical Research **58** (3): 265-274, doi:10.1111/1745-5871.12387

Lohnes, J. and *B. Wilson* 2018: Bailing out the food banks? Hunger relief, food waste, and crisis in Central Appalachia. – Environment and Planning A **50** (2): 350-369, doi:10.1177%2F0308518X17742154

McCarthy, B. and *H. Liu* 2017: Waste not, want not – exploring green consumers´ attitudes towards wasting edible food and actions to tackle food waste. – British Food Journal **119** (12): 2519-2531, doi:10.1108/BFJ-03-2017-0163

Mourad, M. 2016: Recycling, recovering and preventing „food waste": competing solutions for food systems sustainability in the United States and France. – Journal of Cleaner Production **126**: 461-477, doi:10.1016/j.jclepro.2016.03.084

Mustamin, M., *E. Rombe, S. Hadi* and *G. Vesakha* 2020: Food loss and food waste: a literature review in 2009-2018. – International Journal of Psychosocial Rehabilitation **24** (3), doi:10.37200/IJPR/V24I3/PR200842

Nilsson, E., *T. Gärling*, *A. Marell* and *A. Nordvall* 2015: Who shops groceries where and how? – International Review of Retail, Distribution and Consumer Research **25** (1): 1-19, doi.org/10.1080/09593969.2014.940996

Pelt, A., *R. Saint-Bauzel, L. Barbier* and *V. Fointiat* 2020: Food waste: disapproving, but still doing. An evidence-based intervention to reduce waste at household. – Resources, Conservation & Recycling **162**, doi:10.1016/j.resconrec.2020.105059

Ponis, S. 2017: Household food waste in Greece: A questionnaire survey. – Journal of Cleaner Production **149**, doi:10.1016/j.jclepro.2017.02.165

Ponton, A., *J. Mäule* and *S. Ludwig* 2012: Reduzierung von Lebensmittelabfällen am Beispiel von Backwaren. – Müll und Abfall **44** (6): 288-291, doi:10.37307/j.1863-9763.2012.06.03

Porter, S., *D. Reay*, *P. Higgins* and *E. Bomberg* 2016: A half-century of production-phase greenhouse gas emissions from food loss & waste in the global food supply chain. – Science of the Total Environment **571**: 721-729, doi:10.1016/j.scitotenv.2016.07.041

Porpino, G., J. Parente and *B. Wansink* 2015: Food waste paradox: antecedents of food disposal in low income households. – International Journal of Consumer Studies **39** (6): 619-629, doi:10.1111/ijcs.12207

Priefer, C., *J. Jörissen* and *K. Bräutigam* 2016: Food waste prevention in Europe – a cause-driven approach to identify the most relevant leverage points for action. – Resources, Conservation and Recycling **109**: 155-165, doi:10.1016/j.resconrec.2016.03.004

Principato, L. 2018: Food waste at consumer level – a comprehensive literature review. – Cham, Switzerland

Principato, L., *G. Mattia*, *A. Di Leo* and *C. Pratesi* 2020: The household wasteful behaviour framework: A systematic review of consumer food waste. – Industrial Marketing Management **93**: 641-649, doi:10.1016/j.indmarman.2020.07.010

Quested, T., *G. Palmer*, *L. Moreno*, *C. McDermott* and *K. Schumacher* 2020: Comparing diaries and waste compositional analysis for measuring food waste in the home. – Journal of Cleaner Production **262**, doi:10.1016/j.jclepro.2020.121263

Read, Q., *S. Brown*, *A. Cuéllar*, *S. Finn*, *J. Gephart*, *L. Marston*, *E. Meyer*, *K. Weitz* and *M. Muth* 2020: Assessing the environmental impacts of halving food loss and waste along the food supply chain. – Science of the Total Environment **712**, doi:10.1016/j.scitotenv.2019.136255

Refsgaard, K. and *K. Magnussen* 2009: Household behaviour and attitudes with respect to recycling food waste – experiences from focus groups. – Journal of Environmental Management **90** (2): 760-771, doi:10.1016/j.jen-

vman.2008.01.018

Reynolds, C., *T. Soma*, *C. Spring* and *J. Lazell* 2020: Routledge handbook of food waste. – London/New York

Ribeiro, A., *J. Rok, R. Harmsen, J. Carreón* and *E. Worrell* 2019. Food waste in an alternative food network – a case-study. – Resources, Conservation & Recycling **149**: 210-219, doi:10.1016/j.resconrec.2019.05.029

Richter, B. and *W. Bokelmann* 2016: Approaches of the German food industry for addressing the issue of food losses. – Waste Management **48**: 423-429, doi:10.1016/j.wasman.2015.11.039

Richter, B. 2017: Knowledge and perception of food waste among German consumers. – Journal of Cleaner Production **166**: 641-648, doi:10.1016/j.jclepro.2017.08.009

Schanes, K., *K. Dobernig* and *B. Gözet* 2018: Food waste matters – A systematic review of household food waste practices and their policy implications. – Journal of Cleaner Production **182**: 978-991, doi:10.1016/j.jclepro.2018.02.030

Schmidt, T., *F. Schneider, D. Leverenz* and *G. Hafner* 2019: Lebensmittelabfälle in Deutschland – Baseline 2015. – Braunschweig: Thünen-Institute (=Thünen Report 71). – Online availaible at: https://literatur.thuenen.de/digbib_extern/dn061131.pdf, accessed 23/12/2021

Secondi, L., *L. Principato* and *T. Laureti*, T. 2015: Household food waste behaviour in EU-27 countries: A multilevel analysis. – Food Policy **56**, 25-40, doi:10.1016/j.foodpol.2015.07.007

Seitz, C. 2015: The perception of and the attitude towards regional food products. – Dissertation, TU München

SH (*Schleswig-Holstein*) 2019a: Ländlicher Raum – Die Siedlungsstruktur in Schleswig-Holstein. – Online available at: https://www.schleswig-holstein.de/DE/Landesregierung/Themen/Landwirtschaft/Agrarstatistik/ZahlenFakten/laendlRaum_Dossier.html?notFirst=true&docId=6b8a8eb1-33b2-43ca-bb8c-c201d81a441e, accessed 19/03/2022

SH (*Schleswig-Holstein*) 2019b: Raumordnungsbericht Zentralörtliches System. – Schleswig-Holsteinischer Landtag Drucksache 19/1504. – Online available at: https://www.landtag.ltsh.de/infothek/wahl19/drucks/01500/drucksache-19-01504.pdf, accessed 26/12/2021

Stadt Kiel 2020a. Quartalsdaten aus den Stadtteilen 3. Quartal/2020. – Kiel: Stadt Kiel. – Online available at: https://www.kiel.de/de/kiel_zukunft/statistik_kieler_zahlen/_quartalsdaten_stadtteile/2020/Quartalsdaten_aus_den_Stadtteilen_III_2020.pdf, accessed 09/03/2022

Stadt Kiel 2020b: Die Kieler Ortsteile 2019 (= Statistischer Bericht 270). – Kiel: Stadt Kiel. – Online available at: https://www.kiel.de/de/kiel_zukunft/statistik_kieler_zahlen/_kleinraeumige_berichte/Statistischer_Bericht_Nr._270_-_Kieler_Ortsteile_2019.pdf, accessed 09/03/2022

Statistisches Amt für Hamburg und Schleswig-Holstein 2021: Regionaldaten. – E.g. https://opendata.schleswig-holstein.de/dataset/regionaldaten-fur-die-gemeinde-gettorf; accessed 09/05/2021; newer data available at: https://region.statistik-nord.de/detail/001000000000000000/1/351/976/, accessed 09/03/2022

Statistisches Amt für Hamburg und SH 2014: Zensus 2011 – Bevölkerung und Haushalte. – Hamburg: Statistisches Amt für Hamburg und SH

Statistisches Bundesamt 2022: Untitled. – Online available at: https://ergebnisse2011.zensus2022.de/datenbank/online/#StaticContent:010585824121,ROOT, accessed 09/03/2022

Stefan, V., *E. van Herpen, A. Tudoran* and *L. Lähteenmäki* 2013: Avoiding food waste by Romanian consumers: the importance of planning and shopping routines. – Food Quality and Preference **28** (1): 375-381, doi:10.1016/j.foodqual.2012.11.001

Stern, P. 2000: Toward a coherent theory of environmentally significant behavior. – Journal of Social Issues **56** (3): 407-424, doi:10.1111/0022-4537.00175

Sung, J. and *H. Woo* 2019: Investigating male consumers´ lifestyle of health and sustainability (LOHAS) and perception toward slow fashion. – Journal of Retailing and Consumer Services **49**: 120-128, doi:10.1016/j.jretconser.2019.03.018

Thøgersen, J. 2017: Sustainable food consumption in the nexus between national context and private lifestyle: a multi-level study. – Food Quality and Preference **55**: 16-25, doi:10.1016/j.foodqual.2016.08.006

Thyberg, K. and *D. Tonjes* 2016: Drivers of food waste and their implications for sustainable policy development. – Resources, Conservation and Recycling **106**: 110-123, doi:10.1016/j.resconrec.2015.11.016

UN (*United Nations*) 2015: Transformation unserer Welt: die Agenda 2030 für nachhaltige Entwicklung. – UN-Generalversammlung am 25. Sept. 2015 (=UN 70.Tagung der Generalversammlung Material A/RES/70/1 vom 21.10.2015). – Online available at: https://www.un.org/depts/german/gv-70/band1/ar70001.pdf, accessed 16/03/2022

UNEP (*United Nations Environment Programme*) 2021: Food waste index report 2021. – Nairobi: UNEP. – Online available at: https://www.unep.org/resources/report/unep-food-waste-index-report-2021, accessed 23/12/2021

Universität Stuttgart 2012: Ermittlung der weggeworfenen Lebensmittelmengen und Vorschläge zur Verminderung der Wegwerfrate bei Lebensmitteln in Deutschland. – Stuttgart: Institut für Siedlungswasserbau, Wassergüte- und Abfallwirtschaft. – Online available at: https://www.bmel.de/SharedDocs/Downloads/DE/_Ernaehrung/Lebensmittelverschwendung/Studie_Lebensmittelabfaelle_Langfassung.pdf?__blob=publicationFile&v=3, ac-

cessed 23/12/2021

Van Bemmel, A. and *K. Parizeau* 2020: Is it food or is it waste? The materiality and relational agency of food waste across the value chain. – Journal of Cultural Economy **13** (2): 207-220, doi:10.1080/17530350.2019.1684339

Verma, M., *L. Vreede, T. Achterbosch* and *M. Rutten* 2020: Consumers discard a lot more food than widely believed: estimates of global food waste using an energy gap approach and affluence elasticity of food waste. – PLoS ONE **15** (2), doi:10.1371/journal.pone.0228369

Visschers, V., N. Wickli and *M. Siegrist* 2016: Sorting out food waste behaviour: A survey on the motivators and barriers of self-reported amounts of food waste in households. – Journal of Environmental Psychology **45**: 66-78, doi:10.1016/j.jenvp.2015.11.007

Wakefield, A. and *S. Axon* 2020: "I´m a bit of a waster": identifying the enablers of, and barriers to, sustainable food waste practices. – Journal of Cleaner Production **275**, doi:10.1016/j.jclepro.2020.122803

Warshawsky, D. 2015: The devolution of urban food waste governance: Case study of food rescue in Los Angeles. – Cities **49**: 26-34, doi:10.1016/j.cities.2015.06.006

Witzling, L. and *B. Shaw* 2019: Lifestyle segmentation and political ideology: toward understanding beliefs and behavior about local food. – Appetite **132**: 106-113, doi:10.1016/j.appet.2018.10.003

World Bank 2020: Addressing food loss and waste: a global problem with local solutions. – Washington, DC. – Online available at: http://hdl.handle.net/10986/34521, accessed 23/12/2021

World Resources Institute 2019: Reducing food loss and waste: setting a global action agenda. – Washington, DC., doi:10.46830/wrirpt.18.00130

WWF (World Wide Fund For Nature) 2015: Das große Wegschmeißen – vom Acker bis zum Verbraucher: Ausmaß und Umwelteffekte der Lebensmittelverschwendung in Deutschland. – Berlin. – Online available at: https://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/WWF_Studie_Das_grosse_Wegschmeissen.pdf, accessed 23/12/2021

Yadav, S., R. Redden, J. Hatfield, A. Ebert and *D. Hunter* 2019: Food security and climate change. – Hoboken, NJ