A consumer behavioural approach to food waste

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Abstract

Purpose – Food waste occurs in every stage of the supply chain, but the value-added lost to waste is the highest when consumers waste food. The purpose of this paper is to understand the food waste behaviour of consumers to support policies for minimising food waste.

Design/methodology/approach – Using the theory of planned behaviour (TPB) as a theoretical lens, the authors design a questionnaire that incorporates contextual factors to explain food waste behaviour. The authors test two models: base (four constructs of TPB) and extended (four constructs of TPB plus six contextual factors). The authors build partial least squares structural equation models to test the hypotheses.

Findings – The data confirm significant relationships between food waste and contextual factors such as motives, financial attitudes, planning routines, food surplus, social relationships and Ramadan.

Research limitations/implications – The data comes from an agriculturally resource-constrained country: Qatar.

Practical implications – Food waste originating from various causes means more food should flow through the supply chains to reach consumers' homes. Contextual factors identified in this work increase the explanatory power of the base model by 75 per cent.

Social implications – Changing eating habits during certain periods of the year and food surplus have a strong impact on food waste behaviour.

Introduction

A country is considered food secure when all its people at all times have physical, social and economic access to sufficient, safe and nutritious food that is in line with their dietary needs and food preferences (FAO, 2006). Food waste is a global and complex problem that affects each of the three pillars of sustainable development: environment, economic and social (FAO, 2013). Food loss is defined as the decrease in quantity or quality of food, whereas food waste is the removal from the food supply chain of food which is fit for consumption, or which has spoiled or expired mainly due to economic behaviour, poor stock management, or neglect (FAO, 2014). The Food and Agriculture Organisation of the United Nations estimates that around one-third of the edible parts of the food produced for human consumption in the world gets lost or wasted globally, which corresponds to about 1.3bn tons of food per year (Gustavsson *et al.*, 2011). Food loss and food waste are closely associated with food security as reducing it will help feed more people, alleviate the pressure on natural resources, and mitigate the negative impact on environment from greenhouse gas emissions of food chain operations and loss of biodiversity due to agricultural activities.

Food loss occurs upstream in the supply chain and previous research extensively focussed on post-harvest losses (Alamar *et al.*, 2018). Food waste on the other hand occurs more frequently downstream the supply chain, specifically at the retail and consumption stages. For example, in the Netherlands, 10–15 per cent of the food waste is attributable to the consumers, a considerably high figure compared to 2–6 per cent waste in retail markets, 2–5 per cent waste in transport, 2–10 per cent waste in trade operations and 1–2 per cent waste in production (Rabobank, 2014). In another study, a food waste figure as high as 35 per cent is attributed to consumers (Chalak *et al.*, 2016).

Since consumers are significant contributors to food waste, several studies have investigated consumers' food waste behaviour from different perspectives such as factors affecting food choices (De Boer *et al.*, 2007), the effect of social influence on food waste (Comber and Thieme, 2013), or food shopping practices and their relationship to food waste (Farr-Wharton *et al.*, 2014). Hence, the research problem domain for our work is consumer food waste and the research question is:

RQ1. How can we explain the food waste behaviour of consumers?

To answer this research question, this paper has the following three objectives: to synthesise the existing work on consumers' food waste behaviour; to develop a comprehensive research model of food waste behaviour; to test empirically this model with data from a country that is dependent on foreign food imports, leading to growing concerns about food security: Qatar.

The work presented in this paper is part of a larger research project titled SAFE-Q: Safeguarding Food and Environment in Qatar, which aims to contribute to food security efforts in Qatar through minimising waste in the distribution and consumption of food, hence improving the environmental impact of food supply chains in Qatar. This paper focuses on the consumption aspect, arguing that contextual factors affecting food waste help increase our understanding of food waste behaviour, thus informing policies for minimising food waste and contributing to strengthening food security.

Literature review

The food being wasted cannot be defined through any single behaviour, but rather through a combination of multiple behaviours that can increase or decrease the likelihood of food being wasted. Food waste at the consumer end has the greatest economic, social and environmental impacts because of its value-added lost, the opportunity cost of not feeding other people who might be living in hunger, and the loss of natural resources, biodiversity and other resources such as labour and energy. To reduce food waste, we need to understand the factors associated with food waste behaviour.

When it comes to understanding consumer behaviour, the Theory of Planned Behaviour (TPB) (Ajzen, 1991) has been widely applied in various contexts and has provided predictive power of attitudes, norms, perceived control and intentions on the behaviour. According to the TPB, attitudes represent positive or negative evaluations of self-performance of a specific behaviour; subjective norms represent the perception of social pressures or relevant others' belief that one should or should not behave in a specific way; perceived behavioural control indicates the perceived ease or difficulty of behaving in a specific way; intentions represent the willingness to behave in a specific way; and finally the behaviour is the observable action taken, ranging from simple strategy choices in games to actions of appreciable personal or social significance. The well-established TPB is shown in Figure 1.

In the context of food waste, the TPB has been widely used as a theoretical lens to explain consumer behaviour. For example, Karim Ghani *et al.* (2013) explained food waste separation behaviour at home using the TPB and an additional construct of situational factors. They were able to explain 13.7 per cent of the variance in intention to separate, concluding other factors not included in the study affect intention. Similarly, Graham-Rowe *et al.* (2015) investigated the household food waste reduction using an extended TPB and found that intention to reduce household fruit and vegetable waste were predicted by attitude, subjective norm and perceived behavioural control. Their final model explained 8 per cent of the variance in food waste reduction behaviour. In a similar study, Russell *et al.* (2017) explained food waste behaviour with the TPB, where they defined the intention construct as the "intention to reduce food waste" and behaviour construct as the "food waste behaviour" with a negative relationship between the two. Incorporating emotions and habits as other explanatory variables, they were able to explain 46 per cent of the variance in food waste behaviour.

Mondéjar-Jiménez *et al.* (2016) explored the food waste in the Mediterranean diet, a diet based on highly perishable food items, such as fish, fruits and vegetables. They found that most of the variability in food waste behaviour could be explained by individual
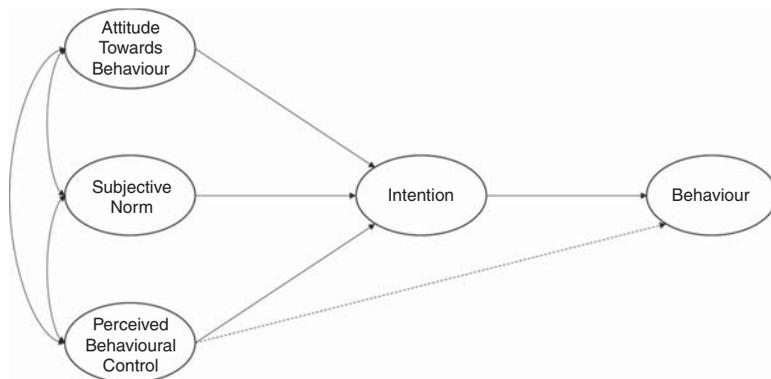

Figure 1.
The theory of planned behaviour

Source: Ajzen (1991, p. 182)

characteristics of a person; however, contextual factors such as economic, socio-cultural, industrial-productive and environmental aspects of the country where individuals live also played a significant role in shaping food waste behaviour. In a comparable study, legislations and economic incentives were found to be negatively associated whereas gross national income and population were found to be positively associated with country-level food waste, using an ordinary least squares regression model that captured 68.4 per cent of the variation in food waste (Chalak *et al.*, 2016).

Our synthesis of previous work explaining the food waste behaviour suggests that the TPB sets a strong basis for explaining food waste behaviour. Therefore, we set the following hypotheses in line with the implementation of TPB in the papers we reviewed:

H1. Positive personal attitudes towards food waste are associated with a higher level of intentions to reduce food waste.

H2. Subjective norms on food waste are positively associated with intentions to reduce food waste.

H3. The higher the lack of perceived behavioural control, the lower will be the intentions to reduce food waste.

H4. Higher intentions to reduce food waste will lead to lower food waste.

H5. The higher the lack of perceived behavioural control, the higher will be the food waste.

The five hypotheses above map to the original constructs of the TPB, which we refer to as the base model (Figure 2). However, the literature has investigated other factors that have explanatory power on food waste behaviour such as food choice motives, financial attitudes, planning routines, social relationships, food surplus, or contextually, Ramadan (Aktas *et al.*, 2017). Food choice motives and eating preferences are related to moral and health aspects of eating and they affect the food purchase decisions that follow (De Boer *et al.*, 2007; Ponis *et al.*, 2017). Since food choice motives affect future food purchases, we capture this aspect under the planning routines construct. Financial attitudes reflect the price consciousness of the consumer and positively affect planning routines, i.e., price-conscious consumers have shopping lists when they go for grocery shopping (Scholderer *et al.*, 2004; Graham-Rowe *et al.*, 2015; Visschers *et al.*, 2016).

Indeed, planning is a significant part of the food-related lifestyle instrument developed and tested by Scholderer *et al.* (2004), where the main aim of it is to reduce the food surplus,
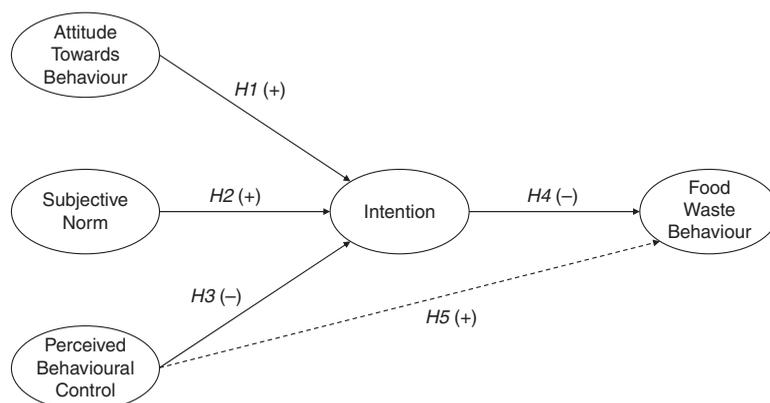

Figure 2.
TPB base model to explain food waste behaviour

which is directly correlated with food waste (Stefan *et al.*, 2013; Stancu *et al.*, 2016), mainly associated with buying more than what can be consumed (e.g. due to promotions and discounts) and impulse buys (unplanned purchases). Social relationships are associated with consuming food with others such as family members and friends both at home and outside, e.g., at a restaurant (Scholderer *et al.*, 2004). The SAFE-Q exploratory research has established that serving food in abundance is a matter of hospitality in Qatar (SAFE-Q, 2016). Another contextual factor identified in SAFE-Q is about changing food consumption habits across specific periods of the year. Specifically, for Qatar, the Ramadan period has been highlighted in the SAFE-Q exploratory research as a factor that needs to be considered separately because during Ramadan people's eating behaviour changes for a month. In fact, previous work from Turkey, which is similar to Qatar in terms of observing Ramadan, has reported changing consumption patterns manifested as unplanned purchases, buying special products, and increased spending amounts (Odabasi and Argan, 2009). Hence, we put forward the following six hypotheses related to the contextual factors that explain food waste behaviour:

H6. Motives are positively associated with planning.

H7. Financial attitudes are positively associated with planning.

H8. Planning is negatively associated with food surplus.

H9. Social relationships and interactions with others result in higher levels of food surplus.

H10. Higher levels of food surplus are associated with higher levels of food waste.

H11. Eating routines during Ramadan lead to higher levels of food waste.

Motives measure food preferences such as a varied diet; financial attitudes measure the price consciousness when shopping for food products; planning routines represent how much preparation one has done before they shop for groceries, whether they have a shopping list or whether they check the food cupboard prior to a trip to the supermarket; social relationships capture the changes in food consumption when socializing with others at home and outside; food surplus indicates the imbalance between the demand and the supply of food; and finally, Ramadan represents changes around food purchase and consumption behaviour as well as waste during this specific period of the year. Figure 3 shows our research model based on the TPB constructs and the contextual factors identified through the literature and empirical work in the SAFE-Q project (SAFE-Q, 2016) to explain food waste.

The positive relationship from attitudes to intentions in *H1* suggests that if one feels bad when uneaten food is thrown away, then they will have a higher intention to reduce food waste. The positive relationship from subjective norms to intention in *H2* suggests that if one's close friends and family think food waste should be reduced, then their intention to reduce food waste will be higher. The negative relationship from perceived behavioural control to intention in *H3* suggests that if one perceives as difficult the prevention of food waste, then they will have lower intentions to reduce food waste. The positive relationship from perceived behavioural control to food waste behaviour in *H5* suggests that the more difficult one perceives the prevention of food waste, the more one will waste food.

The positive relationship from food choice motives to planning routines in *H6* suggests that one's food choices are positively correlated with their planning routines, i.e., they would consciously decide what to buy when they shop for groceries. The positive relationship from financial attitudes to planning routines in *H7* suggests that the more price-conscious one is, the higher level of planning one will have prior to shopping for groceries. The negative
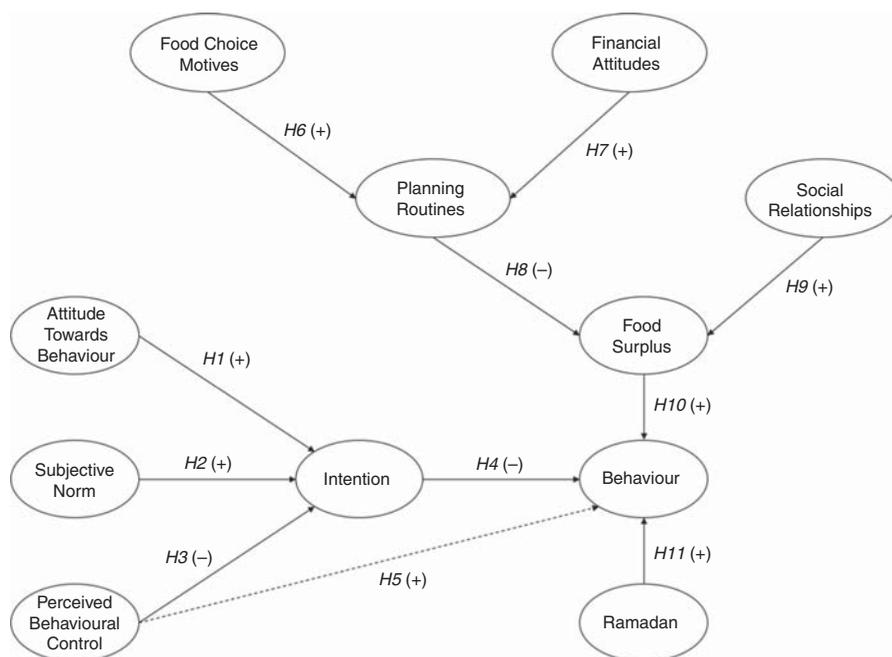
Figure 3.
Extended model to
explain food waste
behaviour

relationship from planning routines to food surplus in *H8* suggests that the planning activity helps reduce food surplus. The positive relationship from social relationships to food surplus in *H9* suggests that social gatherings result in higher levels of food surplus as one may wish to show their hospitality by serving more food than required. The positive relationship from food surplus to food waste in *H10* highlights the cause-effect relationship from surplus to waste, as what is not consumed will be wasted. Finally, the positive relationship from Ramadan to food waste in *H11* suggests that the changing eating habits during this period of the year lead to higher levels of food waste.

Methods

The TPB provides a theoretical framework that is commonly used to explain behaviour systematically (Ajzen, 1991). Our research model is an application of the TPB (personal attitudes, subjective norms, perceived behavioural control, intentions, behaviour), with six contextual factors identified through our extensive literature review and empirical work in Qatar: food choice motives, financial attitudes, planning routines, social relationships, food surplus and Ramadan (Aktas *et al.*, 2017).

To explain the food waste behaviour, we drew on the literature presented above and developed an online questionnaire to collect data from consumers in Qatar. This survey was translated into Arabic as well and piloted in December 2016 before it was fully deployed in January–April 2017. For brevity, we present a sample measurement item of each construct defined in the research model in Figure 3, together with the underlying literature in Table I. The figures given in brackets after the constructs show how many measurement items exists for that construct in the questionnaire. The full survey tool is provided in Table AI.

The respondents stated their agreement with the measurement items on a seven-point Likert scale (strongly disagree, disagree, somewhat disagree, neither disagree nor agree,

Construct	Measurement item	Relevant literature
M: Motives (3)	I like fresh food	De Boer *et al.* (2007)
FA: Financial attitudes (3)	I compare prices between food products to get the best value for money	Scholderer *et al.* (2004)
PR: Planning routines (3)	I make a shopping list of food products I want to buy prior to my shopping trip	Stefan *et al.* (2013), Scholderer *et al.* (2004)
SR: Social relationships (4)	I enjoy having guests at home	Scholderer *et al.* (2004), SAFE-Q (2016)
FS: Food surplus (3)	I tend to buy a few more food products than I need at the supermarket	Stefan *et al.* (2013), Stancu *et al.* (2016)
R: Ramadan (4)	I feel that I throw away food more than usual during Ramadan	Pirani and Arafat (2015), Odabasi and Argan (2009), SAFE-Q (2016)
PA: Personal attitudes (4)	I feel bad when uneaten food is thrown away	Ajzen (1991), Visschers *et al.* (2016), Stefan *et al.* (2013)
SN: Subjective norms (4)	My friends think my efforts to reduce food waste are necessary	Ajzen (1991), Visschers *et al.* (2016)
PBC: Perceived Behavioural control (3)	I find it difficult to prepare food from leftovers	Ajzen (1991), Visschers *et al.* (2016)
I: Intentions (4)	I intend to generate as little food waste as possible	Ajzen (1991), Stefan *et al.* (2013), Stancu *et al.* (2016)
FW: Food waste (4)	I waste food whenever I go out with friends/family	Ajzen (1991), Scholderer *et al.* (2004), Stancu *et al.* (2016)

Table I.
Constructs,
measurement items
and the supporting
literature

somewhat agree, agree and strongly agree). The survey was distributed online through the SAFE-Q research team's networks, the Qatar Ministry of Development Planning and Statistics that is responsible for the country's statistics, and through universities located in the education city, which is in the western part of Doha and covers an area of 1,000 hectares. It is founded in 1995 by the Emir of Qatar and it is home to cutting-edge research centres, universities, and a Science and Technology Park.

We test the base model presented in Figure 2 and the extended model presented in Figure 3 with the non-parametric PLS-SEM method for the following reasons: PLS-SEM does not require the data to meet certain distributional assumptions and can work with non-normal data (Henseler *et al.*, 2014); it works effectively with a wide range of sample sizes (Hair *et al.*, 2017); and it is a variance-based technique recommended to test and validate exploratory models (Mondéjar-Jiménez *et al.*, 2016) as is the case in our research.

In terms of the measurement of latent constructs, we treat all constructs as reflective. If a latent construct has a set of observable indicators, the reflective specification implies that the indicators will measure the latent construct with some error and the latent gives rise to the observed measurements (Diamantopoulos and Siguaw, 2006). The non-parametric nature of PLS-SEM mean that parametric significance tests such as those in regression analysis cannot be used to test the significance of outer weights, outer loadings and path coefficients but instead a non-parametric bootstrap procedure should be employed to test the significance of path coefficients (Hair *et al.*, 2017). Bootstrapping method comprises subsamples of randomly drawn observations from the original data, which are then used to estimate the PLS path model and establish the significance of the hypothesised relationships. We set the process to repeat until 1,000 subsamples are drawn and subsequent PLS models are fit. We assess the model fit using the standardized root mean square residual (SRMR), which is an absolute measure fit representing the standardized difference between the observed and the predicted correlation. For SRMR, a value less than 0.08 is considered a good fit (Hu and Bentler, 1999).

Results and research synthesis

In total, 305 responses were collected from the survey. We applied a location filter to focus on the responses from Qatar. The reason for having responses from outside Qatar is the fact that the survey link was shared on the SAFE-Q project blog, which is open to public (https://blogs.commons.georgetown.edu/safeq/). After the location filter, the sample comprises 277 responses. We used mean replacement to treat the missing values in the 39 indicators of the model. Mean replacement has the benefit of not altering the sample size and also the mean value of variables in the sample does not change (Hair *et al.*, 2017).

The demographics of the survey are as follows: the respondents, all working and living in Qatar, come from 56 different countries, showing the multicultural and international environment in Qatar. In terms of the most represented countries, 16 per cent of the participants are originally from the UK, 13 per cent are from Qatar and 10 per cent are from India. A total of 56 per cent of the participants are female and 22 per cent of them are male; 22 per cent did not state their gender. In total, 54 per cent of the participants are married and 21 per cent single; 25 per cent did not state their marital status. A balanced age and education distribution is observed as evidenced in Figure 4. In terms of annual income, 70 per cent of the participants have an income between QAR 10,000 (GBP 2,000 or $2,750) to QAR 70,000 (GBP 14,000 or $19,225).

We analysed the questionnaire data using SmartPLS 3 (Ringle *et al.*, 2015). All constructs were measured reflectively as we explained in the methodology section. In the case of reflectively measured constructs, all measurement items had a loading greater than 0.70 (Sarstedt *et al.*, 2014), suggesting indicator reliability is achieved. Composite reliability (Jöreskog, 1971) values above 0.70 are considered "satisfactory to good" (Hair *et al.*, 2017). The model's composite reliability values were 0.801 and above for all reflective constructs, satisfying internal consistency reliability. Average variance extracted (AVE) measuring the convergent validity should be 0.50 and above (Ringle *et al.*, 2018). The AVE values of all constructs were greater than 0.604 suggesting convergent validity is ensured.

Once the measurement model satisfies the reliability and the convergent validity for the constructs, it is subjected to the discriminant validity test, which determines the extent to which a construct is empirically distinct from other constructs. The most conservative criterion that evaluates discriminant validity, the Fornell and Larcker criterion compares the square root of the AVE of each construct with the inter-construct correlation of that construct with all the other constructs (Fornell and Larcker, 1981). Measurement model results are presented in Table II, with the square root of AVE in the diagonal in italic and the correlations among constructs in the lower triangle of the matrix. The model satisfies the discriminant validity with no inter-construct correlations higher than the square root of the AVE.

Once the measurement model was satisfactory, we fitted the PLS-SEM model to explain the food waste behaviour initially with the first five hypotheses originating from the core TPB model and then with the 11 hypotheses proposed in the literature section. We observe that all hypotheses are supported with the data.
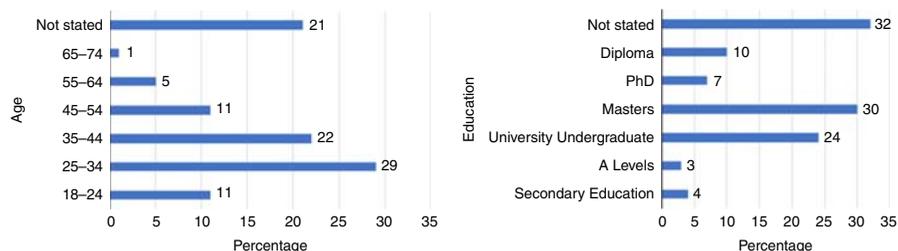

Figure 4.
Age (left panel) and education (right panel) distribution of the sample

	CA	CR	AVE	FA	FS	FW	I	M	PBC	PA	PR	R	SR	SN
FA	0.82	0.89	0.73	*0.86*										
FS	0.61	0.80	0.56	−0.02	*0.75*									
FW	0.79	0.86	0.61	−0.20	0.36	*0.78*								
I	0.80	0.87	0.63	0.13	−0.09	−0.40	*0.79*							
M	0.65	0.80	0.58	0.08	−0.09	−0.16	0.11	*0.76*						
PBC	0.73	0.82	0.53	−0.08	0.26	0.28	−0.16	−0.09	*0.73*					
PA	0.78	0.86	0.60	0.17	0.05	−0.25	0.47	0.09	−0.07	*0.78*				
PR	0.74	0.85	0.65	0.23	−0.24	−0.18	0.17	0.25	−0.15	0.05	*0.81*			
R	0.94	0.96	0.85	−0.12	0.18	0.40	−0.27	−0.13	0.09	−0.14	−0.05	*0.92*		
SR	0.68	0.82	0.61	0.15	0.26	−0.05	0.16	0.14	−0.05	0.06	0.03	−0.05	*0.78*	
SN	0.84	0.89	0.67	0.25	−0.12	−0.21	0.24	0.13	−0.01	0.29	0.16	−0.15	0.18	*0.82*

Table II.
Measurement
model results

Notes: CA, Cronbach's; CR, Composite reliability; AVE, Average variance extracted; FA, Financial attitudes; FW, Food waste; I, Intentions; M, Motives; PBC, Perceived behavioural control; PR, Planning routines; R, Ramadan; SR, Social relationships; SN, Social norms

As explained in the Methods section, the significance of path coefficients can be determined by bootstrapping, which we performed next. We present the estimations from the bootstrap samples along with the p-values in Table III. The bootstrap confidence interval for the Squared Root Mean Residual is [0.043, 0.053], lower than the suggested threshold of 0.08 (Henseler *et al.*, 2014). All of the hypotheses we tested are supported by data. We expected the *H1–H5* to be supported since these are constructs and relationships well-established and confirmed by the TPB. The hypotheses that build on contextual factors (*H6–H11*) are based on the literature and were tested and confirmed in different studies individually, but not together. Since we used measurement items that were validated by studies as shown in Table I, we are pleased to observe that the empirical data supports the conceptualised relationships.

When we try to explain the food waste behaviour only using the TPB constructs in *H1–H5*, the Base Model explains 20 per cent of the food waste behaviour. This figure is comparably higher than the explanatory powers of models reported earlier in the literature review (Karim Ghani *et al.*, 2013; Graham-Rowe *et al.*, 2015). With the inclusion of contextual factors in *H6–H11*, the Extended Model explains 35 per cent of the variation in food waste behaviour, a 75 per cent increase in the predictive power.

The positive relationship between personal attitudes and intentions hypothesised in *H1* is supported: attitudes towards food waste positively affect the intentions to reduce food waste. Subjective norms and intentions are positively correlated, as *H2* is supported.

Hypotheses	Path coefficient	p-value	Conclusion
H1: Attitudes > Intentions (+)	0.42	< 0.01	Supported
H2: Subjective norms > Intentions (+)	0.12	0.03	Supported
H3: Perceived behavioural control > Intentions (−)	−0.13	0.03	Supported
H4: Intentions > Food waste behaviour (−)	−0.29	< 0.01	Supported
H5: Perceived behavioural control > Food waste behaviour (−)	0.14	0.010	Supported
H6: Motives > Planning routines (+)	0.23	< 0.01	Supported
H7: Financial attitudes > Planning routines (+)	0.21	< 0.01	Supported
H8: Planning routines > Food surplus (−)	−0.25	< 0.01	Supported
H9: Social relationships > Food surplus (+)	0.26	< 0.01	Supported
H10: Food surplus > Food waste behaviour (+)	0.25	< 0.01	Supported
H11: Ramadan > Food waste behaviour (+)	0.26	< 0.01	Supported

Table III.
Structural
model results

We find a negative relationship between perceived behavioural control and intentions to reduce waste. When it is difficult to control the food waste, the intentions to reduce it are low. The relationship between intentions to reduce waste and the amount of food waste is hypothesised in *H4* to be negative, and from Table III we conclude the intentions to reduce waste help reduce the behaviour leading to food waste. The positive relationship between the difficulty to control food waste (perceived behavioural control) and food waste behaviour in *H5* is also supported in line with the TPB.

Both food choice motives and financial attitudes positively affect the planning routines, as *H6* and *H7* are supported. While planning routines help reduce the food surplus (*H8*), the social relationships construct that reflects hospitality and eating with others result in higher food surplus (*H9*). The food surplus as a contributor to food waste is explained by planning routines and social relationships (hospitality, risk averseness towards not having enough food to serve, cultural habits around how food is served) and leads to food waste, as *H10* is supported. A unique finding of our research is that the contextual construct, Ramadan, is found to be positively associated with food waste behaviour in *H11*.

Understanding the contextual variables which affect consumers' food waste behaviour could help develop strategies and policies for food waste reduction. The findings reveal the strong impact of changing eating habits during certain periods of the year (Ramadan) and food surplus on food waste behaviour.

Situating these results in the context of enterprise and information flows along the food supply chain (Irani and Sharif, 2016), and the resulting positioning points of waste along the food supply chain (Sharif and Irani, 2016). We further identify where the resultant consumer behaviour factors and hypotheses may therefore occur in terms of people, process and policy interventions, as shown in Table IV.

This particular mapping adapted from (Sharif and Irani, 2016) highlights the additional interplay between the identified consumer behaviours in Qatar in relation to enterprise and information chain process and policy factors. Hence, suggesting that economic (financial) impacts of food waste in Qatar are relatively inconsequential as far as purchasing power and price indices effects are concerned (*H7*); whilst further segmenting behavioural constructs across the lines of consumption – where "pure" consumer behaviours may be

Waste phase	Waste driver	Enterprise/ Organisation level	Information/ Technological level	People	Process	Policy	Hypothesis identified
Economic	Poor demand management	Economic	Consumption trends and KPIs	Purchasing power and price indices			*H7*
Consumption	Purchasing habits Purchasing incentives	Retail	Consumer trends	Consumption behaviours	Distribution and sales cycle	Food waste behaviours Consumer rights Trading standards Health policies	*H1, H2, H3, H6, H9, H11*
Lack of disposal options	Disposal cheaper than recycling	Environmental	Reverse logistics metrics (recovery and recycling)	Awareness of the product and service design lifecycles	Lifecycle management Recovery and extraction		*H4, H5, H8, H10*

Source: Adapted from Sharif and Irani (2016)

Table IV.
Positioning Qatari consumer food behaviours in terms of waste and information in the food supply chain

further supported or accelerated through food distribution and sales cycles, which may also explain the unique nature of food waste where/when Ramadan is concerned (*H1–H3*, *H6*, *H9* and *H11*), and further, across the lines of viewing food waste in terms of a potential perceived lack of waste disposal wherein the consumer behaviour driver may be couched in perceptions and awareness of the realities of disposal vs recycling/recovery in the food chain (*H4*, *H5*, *H8* and *H10*).

In doing so, we offer the view that waste behaviours in themselves are not completely devoid of inter-relationships across the wider food chain elements where both information and organisational/enterprise-level processes and flows occur – and which still need to be included as part of ongoing research into the resiliency and adaptability of food consumption and food waste chain systems in countries with little or poor self-sustainable means of food production.

Impact
A total of 2.6m people live in Qatar (MDPS, 2018). The annual population growth of 2.87 per cent (World Bank, 2017) places Qatar above the average population growth in the Gulf Cooperation Council countries in the region. This increasing population, and the food provision depending on imports that comprise more than 90 per cent of the food consumed in Qatar, make food security a top priority for policy makers (Almohamadi, 2017).

Food has a significant role in economic, social, political and cultural lives. By adopting or avoiding certain behaviour patterns regarding food, individuals can contribute substantially to economic, social, political and environmental sustainability. Therefore, it is important to understand the motivational and structural factors and processes that facilitate or are barriers to reducing food waste behaviour. Our research tests and confirms that food waste behaviour can be explained by the TPB as well as contextual factors such as planning or social relationships. Our findings may be used to increase awareness around food waste, and contribute to changing consumer behaviour towards reducing surplus food in households, which is food that goes to waste if not consumed in time. Minimising the surplus food wasted at the end of the value chain is the most impactful objective since it reduces the loss of the highest value-added after food is grown, harvested, processed, packaged, stored, transported and distributed.

Conclusion
Concerns around food security and its close connection to physical resources like arable land, lakes, and seas, prompt a rethink regarding food waste, and specifically regarding where and how it occurs throughout food chains (Irani *et al.*, 2018). In this paper, we focussed on consumer-generated food waste and investigated how consumers' food waste behaviour can be explained using the TPB as a theoretical lens together with contextual factors we identified in the literature and the SAFE-Q project. We identified food choice motives, financial attitudes, planning routines, social relationships, food surplus and Ramadan as the contextual factors that help explain the food waste behaviour beyond the TPB.

Outcomes of this research have the potential to impact policy through informing the policies on managing food waste and regulating food markets whilst enabling a food-secure environment for the citizens. The originality of our work is captured in the research model which shows the strong impact of changing eating habits during certain periods of the year and of food surplus on food waste behaviour. Thus, our findings and conclusions inform and impact upon the development of food security and food waste policy.

Future research could focus on the measurement of food waste rather than using a self-reported scale as we did in this work. We limited our sample to people who are currently based in Qatar to explain the food waste behaviour in Qatar with the factors affecting it.

Moreover, further studies can focus on other countries in the region which have similar conditions in terms of climate, food dependence and socio-cultural aspects. We incorporated Ramadan as a socio-cultural element changing food consumption behaviour in Qatar; a follow-on analysis could focus on other significant times of the year such as Christmas, Easter, or other periods with increased level of celebrations. In our work, we could not focus on weddings or other celebrations where increased amount of food waste is observed; so, future research can investigate how people's behaviour changes at such events compared to their day-to-day practices.

Acknowledgements

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Appendix

All measurement items and their corresponding constructs are given in Table AI.

Construct	Measurement item
Personal attitudes	I feel bad when uneaten food is thrown away
	I was raised to believe that food should not be wasted
	I think food should not be wasted
	Throwing away food does not bother me
Subjective norms	My friends think my efforts towards reducing food waste are necessary
	My family thinks my efforts towards reducing food waste are necessary
	My friends think my efforts towards preparing food from leftovers are necessary
	My family thinks my efforts towards preparing food from leftovers are necessary
Perceived behavioural control	I find it difficult to store food at high temperatures
	I find it difficult to store food in its required conditions
	I find it difficult to store certain type of food products
	I find it difficult to shop for food products for one person
Intentions	I intend to eat leftover food
	I intend not to throw away food
	I intend to generate as little food waste as possible
	I intend to find a use for food trimmings
Food waste	I waste food whenever I go out with friends/family
	I waste food whenever I have guests at home
	I waste food at work/school
	I waste food at home whenever I am due to travel
Food choice motives	I like to vary my meals
	I am curious about new tastes
	I like fresh food
Planning	I make a shopping list of food products I want to buy prior to my shopping trip
	I check my cupboard/fridge/pantry prior to a trip to the supermarket
	I plan my meals in advance and keep to my plan
Financial attitudes	I check prices even on small food items
	I notice when products I regularly buy change prices
	I compare prices between food products to get the best value for money
Social relationships	I enjoy having guests at home
	I enjoy going to wedding parties
	I enjoy going to work dinners
Food surplus	It is my culture to serve a lot of food to show my hospitality
	I have a tendency to buy a few more food products than I need at the supermarket
	I serve more food than can be eaten to show my hospitality
Ramadan	I feel that I throw away food more than usual during Ramadan
	During Ramadan, the food I prepare for guests is wasted
	During Ramadan, I make unplanned last-minute decisions on food which means I throw away food
	My food preferences during Ramadan result in higher waste than other times of the year

Table AI.
Constructs and measurement items

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Professor Zahir Irani joined the University of Bradford as Dean of the Faculty of Management and Law in December 2016. He has held several senior management positions at Brunel University London, the most recent of which being the Dean of College (Business, Arts and Social Sciences) which he set up following an organisational restructuring from eight schools into three colleges. Prior to this role, he was seconded full-time to Whitehall, where he was Senior Policy Advisor at the Cabinet Office during part of the coalition Government. He completed a BEng (Hons) at Salford University before then accepting a research position in industry where he finished his Master's Degree by research.

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