Exploring the Patterns of Food Waste Generation by Tourists in a Popular Destination

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Abstract:

Tourist food consumption is an important driver of food waste generation within the hotel/restaurant/café (HORECA) sector of popular destinations. Little is however known about the exact magnitude of food wastage by tourists alongside the determinants of their wasteful behaviour. This study contributed to knowledge with an exploratory survey in Lhasa, a popular destination in China, which set to establish the size of food wastage by tourists and explain the role of various socio-demographic and food consumption-related factors in its occurrence. The study found that tourists generated circa 15% of the total food waste in the HORECA sector and taste preferences and portion size are two major causes. The level of tourist education and personal satisfaction with meals exert a significant negative impact on food waste generation. To reduce food wastage, policy-makers and HORECA professionals should educate tourists about the detrimental effect of wasted food and increase their satisfaction with meals.

Keywords:

food waste; tourism; consumption; mitigation; HORECA; China

1 Introduction

Food waste is a global societal challenge which has been recognised by various stakeholders (Aschemann-Witzel, de Hooge, Amani, Bech-Larsen, & Oostindjer, 2015; Papargyropoulou, Lozano, Steinberger, Wright, & bin Ujang, 2014; Parfitt, Barthel, & Macnaughton, 2010). The global wastage of approximately one third of the food

produced for human consumption not only imposes excessive pressures on natural resources, but also generates substantial carbon footprint (FAO, 2013). From the policy perspective, the challenge of food waste is costly: for example, in the USA, where up to 40% of food gets either lost or wasted, the disposal costs of this waste account for 1.3% of the country's GDP (ReFED, 2016). The challenge of food waste is particularly concerning given that more than 820 million people globally suffer from hunger (FAO, IFAD, UNICEF, WFP, & WHO, 2018). Meaning that food wastage does not only imply lost and/or wasted natural and financial resources, but also represents an important moral and social equality issue (Dobson, 2015).

Food consumption constitutes an integral element of a holiday experience and it can therefore be assumed that tourism contributes to global food wastage (S. K. Cheng, Jin, Liu, Liu, & Yu, 2018). This notwithstanding, the research agenda on tourism's food waste is under-developed (L. E. Wang, et al., 2018). Although a growing number of studies are examining the food waste challenge within the national hotel/restaurant/café (HORECA) sectors of popular tourist destinations (see, for example, (Filimonau, Fidan, Alexieva, Dragoev, & Marinova, 2019; Kasavan, Mohamed, & Halim, 2019; Papargyropoulou, et al., 2019), they do not differentiate between food wastage by tourists and local residents. This is primarily attributed to the operational challenges of undertaking research on food waste in HORECA as it is difficult, if not impossible, to separate food waste generated by tourists from the locals (Filimonau, Dickinson, Robbins, & Reddy, 2013). More research on tourism's food waste is required which should aim at better understanding of 1) how much food waste is generated by tourists in comparison to the locals and to their at-home food consumption; 2) what fractions of food are wasted the most by tourists; and 3) the drivers of wastage among tourists. Better understanding of the magnitude of food waste generated in the tourism context, the major fractions of wasted food and the key contributing factors will enable the design of more effective measures to food waste reduction (Koivupuro, et al., 2012; Silvennoinen, Katajajuuri, Hartikainen, Heikkila,

& Reinikainen, 2014; Thyberg & Tonjes, 2016).

Food waste mitigation is an important sustainability objective in China, a populous country with limited natural resources (L. E. Wang, et al., 2017). Domestic tourism in China is growing rapidly and so are the related environmental externalities, such as food waste (Y. Y. Li, Filimonau, Wang, & Cheng, 2020). It is therefore necessary to have an in-depth understanding of the reasons why tourists in China waste food, thus identifying feasible approaches to mitigation (Cheng et al., 2018). The topic of tourism's food waste in China has however been overlooked to-date. Past research has estimated food waste in the national HORECA sector and provided an initial insight into the contribution made by tourism (L. E. Wang, et al., 2018). Past research has further highlighted some of the differences in food consumption behaviour of tourists on the tour and at home, including wastage (Y. Y. Li, Wang, & Cheng, 2019), but no comprehensive outlook has ever been provided. This study will partially fill this important knowledge gap by exploring the patterns of food consumption, with a focus on wastage, among a sample of tourists in Lhasa, a popular destination in China. Lhasa represents a suitable case study to explore tourism's food waste because not only is it popular with domestic Chinese visitors, but also it has limited natural resources and fragile ecosystems (L. E. Wang, et al., 2018). To this end, the study aims to (i) estimate food wastage by domestic tourists and establish the composition of wasted food; (ii) determine the main behavioural determinants of food wastage among tourists; iii) provide recommendations on how food wastage by tourists could be reduced.

2 Materials and Methods

2.1 Measurement tools and questionnaire design

To fulfill the aim of this study, a self-completion questionnaire was developed for

primary data collection. The questionnaire used the food waste rate (FWRE) and the food waste ratio (FWRO) to establish the magnitude of food wastage among tourists. FWRE set to reveal the percentage of remaining/uneaten food of the total ordered food and FWRO strove to disclose the percentage of each type of wasted food. The types of wasted food under study included grain, meat, vegetables, fruits, dairy products, aquatic products and drinks as these are the most commonly consumed foodstuffs by the Chinese which holds true for this study given its focus on domestic tourists. Previously, FWRE and FWRO have been used to identify food waste and its drivers in rural households (F. Li, Jiang, Zhu, & Qian, 2017) and in the sector of foodservice provision in schools (Yoon & Kim, 2012). These were preferred to the method of direct weighting due to the laborious (which includes high cost) nature of the latter as shown by (L. E. Wang, et al., 2018). Another reason for using FWRE and FWRO instead of the method of direct weighting in this study is the unwillingness of local restaurant managers in Lhasa to grant researchers permission to weigh food waste in their kitchens. Managerial reluctance to collaborate with academics on studying the challenge of food waste has long been recognised and attributed to the perceived business sensitivity of this topic (Filimonau, Krivcova, & Pettit, 2019) which, as this study demonstrates, finds further confirmation in the context of China. The drawback of FWRE and FWRO is in that their results may deviate from the actual amounts of food wasted by tourists which is due to social desirability biases as well as the general problem of poor public recall of past events (of eating out). To minimise the negative effect of social desirability biases, the anonymous nature of this study was repeatedly emphasised at the stage of participant recruitment. To reduce the detrimental effect of poor recall, wherever possible, participant recruitment took place immediately after the eating out occasions, i.e. at lunch and/or dinner times.

The survey questionnaire included four sections (Fig. 1). The first section of the questionnaire aimed at collecting information on food consumption and waste behavior, thus estimating food wastage by tourists. To this end, six questions were

asked:

(1a) On this trip to Lhasa, how much (by percentage) food was left on the plate you ordered, on average, for a meal? (FWRE); (1b) To the best of your recall, what was the composition of wasted food? Please divide wasted food into grain, meat, vegetables, fruits, eggs, dairy products, aquatic products and drinks by percentage (FWRO). (2a) When you cook at home, how much (by percentage) food is usually left on the plate you prepared, on average, for a meal? (FWRE); (2b) To the best of your recall, what was the composition of wasted food? Please divide wasted food into grain, meat, vegetables, fruits, eggs, dairy products, aquatic products and drinks by percentage (FWRO).
(3a) When you eat out in your place of permanent residence (not on this trip to Lhasa), how much (by percentage) food was left on the plate you ordered, on average, for a meal? (FWRE); (3b) To the best of your recall, what was the composition of wasted food? Please divide wasted food into grain, meat, vegetables, fruits, eggs, dairy products, aquatic products and drinks by percentage (FWRO).

Socio-demographic characteristics of consumers alongside the levels of their knowledge and perception of the challenge of food waste are important prerequisites of food waste generation (Aschemann-Witzel, et al., 2015; Filimonau, Matute, Kubal-Czerwińska, & Krzesiwo, 2019; Thyberg & Tonjes, 2016). Thus, the second section of the questionnaire aimed at acquiring tourists' socio-demographic characteristics, which included gender, age, education, family status, career stage, income, hometown and religion.

The third section aimed at acquiring tourists' perceptions on food consumption/waste. These were captured with the help of four statements/questions:

(1) I am still more accustomed to the cuisine and eating habits of my hometown

(perceptions were recorded via Likert scale of 1-7 where 1 stood for strongly disagree and 7 stood for strongly agree);

(2) I know Tibetan cuisine very well (knowledge was recorded via Likert scale of 1-7 where 1 stood for strongly disagree and 7 stood for strongly agree).

(3) What do you think about the food (table) waste during the tour? (perceptions were captured via a dedicated scale of a-d, where a stood for I understand its occurrence because it is inevitable during the tour; b stood for I do not think this issue is serious although food indeed wasted during the tour; c stood for I think this is a serious issue and need to be recognised by various stakeholders; and d stood for I am not interested in this issue).

(4) Which of the following do you think is most relevant to table (food) waste prevention? (perceptions were captured via a multiple choice answer: a. government b. hotel/restaurant c. consumer d. others (HORECA industry management departments and HORECA industry associations)).

Further, tourists exemplify different consumption behavior patterns on different food consumption occasions, i.e. when cooking at home, when eating out and when on travel (Y. Y. Li, et al., 2019). It was assumed that the tourism situation (including duration of stay, the purpose of visit, companions and frequency of travel to the destination/familiarity) could impact the food waste behavior of tourists. To capture the effect of these factors, relevant measures were included in the fourth section of the questionnaire asking participants to provide basic information about their trip to Lhasa.

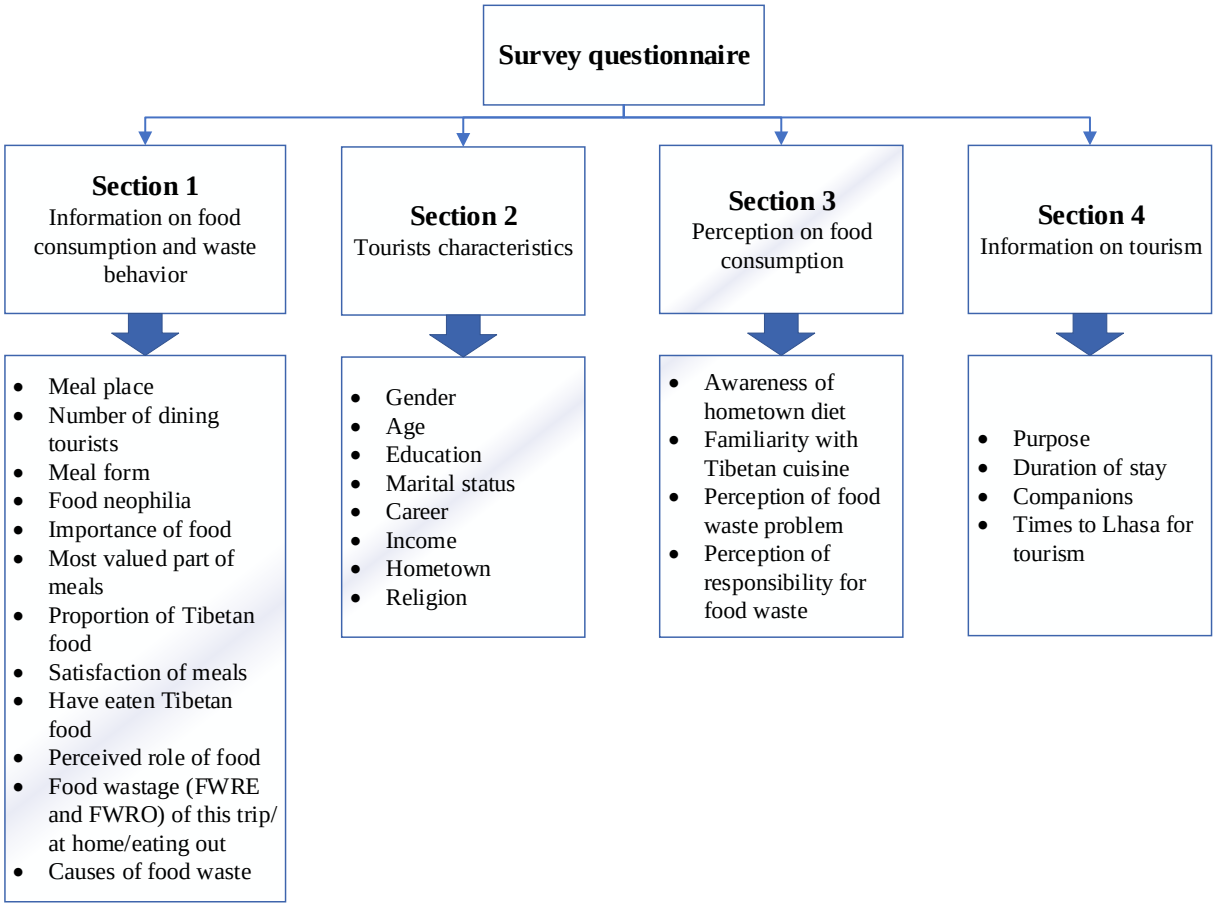

Fig. 1 Four sections of the questionnaire

Although self-completion questionnaires represent a popular tool to explore the phenomenon of food waste (Ghinea & Ghiuta, 2019; van der Werf, Seabrook, & Gilliland, 2020), they have been criticised for their tendency to under- or over-estimate the magnitude of food wastage (Chung, 2008), thus prompting inaccurate conclusions (Kormos & Gifford, 2014). This notwithstanding, self-completion questionnaires are preferred by many academics (Elimelech, Ert, & Ayalon, 2019) due to their cost-effectiveness, especially in comparison to such time-consuming and laborious method as direct weighting (van der Werf, et al., 2020). Self-completion questionnaires are also capable of reaching for larger samples (Zorpas & Lasaridi, 2013), thus, leading to a better standardisation and improved robustness of analysis (Secondi, Principato, & Laureti, 2015). Lastly, it is argued that

self-completion questionnaires represent the only meaningful approach to capturing the magnitude of tourist food waste in HORECA. This is because most HORECA enterprises in a destination cater not only for tourists, but also for local residents. This implies that the method of direct weighting of food waste in a restaurant would be unable to separate the amounts of food wasted by tourists from wastage produced by the locals. This demonstrates the practical viability of the method of self-completion questionnaires and, hence, it was adopted in this study.

2.2 Participant recruitment

A stratified sampling method was used in the field survey to obtain sample tourists from August 25th, 2018 to September 4th, 2018. The survey was administered in popular tourist recreation spots in Lhasa such as the Potala Palace Square, the Jokhang Temple, the Sunshine Travel Bookstore, and the Zongjiao Lukang Park. Self-completion questionnaires were distributed by experienced researchers and college students trained in the given survey method. A total of 713 questionnaires were completed with an effective response rate of 93%. As a basic screening criterion, the survey targeted only those domestic tourists who had stayed in Lhasa for at least one day and consumed food. In the case of family tourists, only one family member was invited to partake in the survey.

2.3 Quantifying food waste and establishing its drivers

Microsoft Excel 2016 and *SATA* 14 software were used to analyze the food waste characteristics and the drivers behind wastage. First, the composition of food waste revealed in the survey was evaluated through statistical analysis. Second, the FWRE values among different tourist groups were identified through a one-way ANOVA. Lastly, multiple linear regression analysis was conducted to evaluate the drivers of food wastage. To this end, the Tobit regression model (Y. Y. Li, et al., 2019; Zhang, et

al., 2018) was employed to address the shortcomings of bias and inconsistency of parameter estimates (Bone, 1995). The analytical framework utilised to achieve the aims of this study is as follows:

The model built to establish the drivers of tourist food waste can be expressed as follows:

$$y_i = \alpha_0 + \alpha_1 x_{1i} + \alpha_2 x_{2i} + \alpha_3 x_{3i} + \ldots + \alpha_{27} x_{27i} + \varepsilon_i \quad (1)$$

where the dependent variable y_i denotes FWRE of tourist i (i = 1,2,3,…, 713) and the independent variables x_i denote various factors affecting food waste behavior. These factors can be grouped as follows: (i) socio-demographic characteristics: $x_{1\sim} x_8$; (ii) food consumption characteristics: $x_{9\sim} x_{13}$; (iii) past experience: $x_{14\sim} x_{15}$; (iv) tourism motivation factor: $x_{16\sim} x_{17}$; (v) other aspects of tourism: $x_{18\sim} x_{27}$. All model variables are explained in further detail in Table 1.

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253 Table 1. Model variables and their definitions
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Variable category	Variable	Variable symbol	Variable definition	References
	Dependent variable：			
	Food waste rate	*FWRE*	The proportion of uneaten food in total ordered food by tourist (%)	F. Li, et al. (2017) used FWRE to study food waste and its drivers
	Independent variables：			
	Gender (x_1)	*gender*	If the respondent is female, the value is equal to 1, otherwise is 0.	Painter, Thondhlana, & Kua (2016) claim that gender plays a role in food waste generation
	Age (x_2)	*age*	1: <18 years old; 2: 18~25 years old; 3: 26~40 years old; 4: 41~50 years old; 5: 51~60 years old; 6: > 60 years old	Zhang, et al. (2018) claim that age plays a role in food waste generation
	Family status (x_3)			Koivupuro, et al. (2012) claim that family status is a potential factor influencing food waste
Demographic characteristics	Married with children	*married_chr*	If the respondent married and has children, the value is equal to 1, otherwise is 0	
	Married without children	*married_nochr*	If the respondent married and has no children, the value is equal to 1, otherwise is 0	
	Unmarried	*unmarried*	If the respondent is not married, the value is equal to 1, otherwise is 0 (control group)	
	Education (x_4)	*education*	1: primary school or below; 2: junior high school; 3: high school/secondary school; 4: junior/high vocational school; 5: undergraduate; 6: postgraduate	Zhang, et al. (2018) claim that educational level plays a role in food waste generation

Career (x_5)			Koivupuro, et al. (2012) claim that career is a potential factor influencing food waste
Public officials	*public_officials*	If the respondent's career is a public official, the value is equal to 1, otherwise is 0	
State-owned enterprise employees	*employees*	If the respondent's career is a state-owned enterprise employee, the value is equal to 1, otherwise is 0	
Foreign company employees	*employees_for*	If the respondent's career is a foreign company-owned employee, the value is equal to 1, otherwise is 0	
Private enterprise, collective enterprise employees	*employees_pri*	If the respondent's career is a private enterprise or a collective enterprise employee, the value is equal to 1, otherwise is 0	
Self-employed persons	*self-employed*	If the respondent's career is a self-employed person, the value is equal to 1, otherwise is 0	
Famers	*famers*	If the respondent's career is a farmer, the value is equal to 1, otherwise is 0 (control group)	
Workers	*workers*	If the respondent's career is a worker, the value is equal to 1, otherwise is 0	
Retired or staffs without work	*retired*	If the respondent's career is retired or unemployed, the value is equal to 1, otherwise is 0	
Students	*students*	If the respondent's career is a student, the value is equal to 1, otherwise is 0	
Other careers	*career_other*	If the respondent's career is not included in the above mentioned, the value is equal to 1, otherwise is 0	
Income (x_6)	*income*	Monthly income: 1: <4000 RMB; 2: 4000~5999 RMB; 3: 6000~7999 RMB; 4: 8000~9999 RMB; 5: 10000~11999 RMB; 6: 12000~13999 RMB; 7: 14000-15999 RMB; 8: ≥16000 RMB	Zhang, et al. (2018) claim that the level of personal income plays a role in food waste generation

	Religion belief (x_7)	*religion*	If the respondent has religion, the value is equal to 1, otherwise is 0	Mak, Lumbers, Eves, & Chang (2012); Pettinger, Holdsworth, & Gerber (2004) and Suki & Suki (2015) claim that religion plays a role in food consumption behavior, including waste generation
	Local (x_8)	*local*	If the respondent is the local resident of Tibet, the value is equal to 1, otherwise is 0	L. E. Wang, et al., (2018) finds that tourists waste more food than the local residents of Lhasa
Food consumption characteristics	Food neophilia (x_9)	*neophilia*	If the respondent is prepared to taste unfamiliar food, the value is equal to 1, otherwise is 0	Mak, et al. (2012) and Mak, Lumbers, Eves, & Chang (2013) claim that food neophilia and neophobia affect tourist food consumption, including waste generation
	Importance of food (x_{10})	*importance_food*	The importance value (1~6) of "food" in six elements of tourism (food, accommodation, transportation, sightseeing, shopping, and entertainment)	Mak, et al. (2012) claim that motivational factors to try food affect tourist food consumption
	Most valued part of meals (x_{11})			Mak, et al. (2012) claim that sensory attributes (e.g., flavour, aroma, texture, appearance), price, value, and quality of food in the destination affect tourist food consumption
	Taste	*taste*	If the respondent most valued the taste of food on this tour, the value is equal to 1, otherwise is 0 (control group)	
	Appearance	*appearance*	If the respondent most valued the appearance matching of food on this tour, the value is equal to 1, otherwise is 0	
	Volume	*volume*	If the respondent most valued the amount of food on this tour, the value is equal to 1, otherwise is 0	
	Price	*price*	If the respondent most valued the price of food on this	

			trip, the value is equal to 1, otherwise is 0	
	Nutrition	*nutrition*	If the respondent most valued the nutrition of food on this trip, the value is equal to 1, otherwise is 0	
	Health	*health*	If the respondent most valued the health of food on this trip, the value is equal to 1, otherwise is 0	
	Other aspects	*food_other*	If the respondent most valued the other aspects of food other than above mentioned (e.g. smell, local cuisine characteristics) on this trip, the value is equal to 1, otherwise is 0	
	Proportion of Tibetan food (x_{12})	*proportion_local*	The proportion of consumption of Tibetan food on this trip (%)	Mak, et al. (2012) claim that food/cuisine type (e.g., national/regional/local cuisine) affect tourist food consumption
	Satisfaction of meals (x_{13})	*meal_satisfaction*	Personal satisfaction with the meals served on this trip: 1: very dissatisfied; 2: dissatisfied; 3: partially dissatisfied; 4: neutral; 5: partially satisfied; 6: satisfied; 7: very satisfied	Carvalho, Lima, & Rocha (2015) claim that high FWRE suggest customer's dissatisfaction with the meal
Past experience	Travel times to Lhasa (x_{14})	*times*	If the respondent traveled to Lhasa for the first time, the value is equal to 1, otherwise is 0	Zhang, et al. (2018) claim that frequency of meal consumption occasions plays a role in food wastage; Mak, et al. (2012) claim that past experience of food affects tourist food consumption
	Have eaten Tibetan food (x_{15})	*food_tib*	If the respondent has ever eaten a Tibetan meal before, the value is equal to 1, otherwise is 0	
Other tourism factors	Travel purpose (x_{16})			Mak, et al. (2012) claim that motivational factors to go on a holiday affect tourist food consumption
	Sightseeing	*sightseeing*	If the main purpose of this trip includes sightseeing, the value is equal to 1, otherwise is 0	
	Leisure vacation	*leisure_vac*	If the main purpose of this trip includes leisure vacation, the value is equal to 1, otherwise is 0	

	Experience local life, culture, and events	*culture_act*	If the main purpose of this trip includes experience local life, culture and events, the value is equal to 1, otherwise is 0	
	Religious worship	*religious_wor*	If the main purpose of this trip includes religious worship, the value is equal to 1, otherwise is 0	
	Meeting or exchange visit	*meeting*	If the main purpose of this trip includes meeting or exchange visit, the value is equal to 1, otherwise is 0	
	Scientific research or field trip	*research*	If the main purpose of this trip includes scientific research or field trip, the value is equal to 1, otherwise is 0	
	Other purposes	*purpose_other*	If the main purpose of this trip includes other purposes, the value is equal to 1, otherwise is 0	
	Perceived role of food on this trip (x_{17})			L. E. Wang, et al. (2017) claim the purpose of food consumption plays a role in food waste generation
	Satisfy hunger	*stomach*	If the role of food on this trip is to satisfy hunger, the value is equal to 1, otherwise is 0	
	Enjoy tasteful food	*food*	If the role of food on this trip is to enjoy tasteful food, the value is equal to 1, otherwise is 0	
	Experience culture	*culture*	If the role of food on this trip is to experience culture the value is equal to 1, otherwise is 0	
	Interpersonal communication	*communication*	If the role of the diet on this trip is interpersonal communication, the value is equal to 1, otherwise is 0 (control group)	
	Food knowledge	*knowledge*	If the role of the diet on this trip is to learn more about local cuisine, the value is equal to 1, otherwise is 0	
Other aspects	Duration of stay (x_{18})	*days*	The number of days stayed in Lhasa	Frisvoll, Forbord, & Blekesaune (2016)

of tourism				claim the length of stay at a destination affects tourist consumption of local food
	50-year-old tourist companion (x_{19})	*companion_50*	If there are companions over 50 years old on this trip in Lhasa, the value is equal to 1, otherwise is 0	Frisvoll, et al. (2016) claim that travelling companions affect tourist consumption of local food; Mak, et al. (2012) claim that contextual influences (e.g., time, place, companionship) affect tourist food consumption
	18-year-old tourist companion (x_{20})	*companion_18*	If there are companions under 18 years old on this trip in Lhasa, the value is equal to 1, otherwise is 0	
	Meal place (x_{21})			Mak, et al. (2012) claim that contextual influences (e.g., time, place, companionship) affect tourist food consumption; S. K. Cheng, et al. (2018) claim that a type of restaurants plays a role in food waste generation
	Specialty snack bar	*snack*	If the main meal place on this trip is specialty snack bar, the value is equal to 1, otherwise is 0	
	Ordinary restaurant	*ordinary*	If the main meal place on this trip is ordinary restaurant, the value is equal to 1, otherwise is 0	
	Restaurant specializing in catering for tourist groups	*fixed*	If the main meal place on this trip is restaurant specializing in catering for tourist groups, the value is equal to 1, otherwise is 0 (control group)	
	Star Hotels	*hotel*	If the main meal place on this trip is star hotels, the value is equal to 1, otherwise is 0	
	Relatives' or friends' home	*friends*	If the main meal place on this trip is relatives' or friends' home, the value is equal to 1, otherwise is 0	
	Other places	*location_other*	If the main meal place on this trip is other places, the value is equal to 1, otherwise is 0	
	Number of dining tourists (x_{22})	*number_tou*	The average number of people have meals together on this trip	Stancu, Haugaard, & Lahteenmaki (2016) claim that household food waste behavior significantly correlates with household

				size (number of family members)
	Meal form (x_{23})			Juvan, Grun, & Dolnicar (2018) claim that tourists waste more food during buffet meals
	Table	*table*	If the main meal form on this trip is unified table meal, the value is equal to1, otherwise is 0	
	Buffet	*buffet*	If the main meal form on this trip is buffet, the value is equal to 1, otherwise is 0 (control group)	
	Order	*order*	If the main meal form on this trip is order meal, the value is equal to 1, otherwise is 0	
Tourism food waste perception	Hometown diet (x_{24})	*home_food*	The perception that "I am still more accustomed to the cuisine and eating habits of my hometown": 1: strongly disagree; 2: disagree; 3: partially disagree; 4: neutral; 5: partially agree; 6: agree; 7: strongly agree	Wu, Raab, Chang, & Krishen (2016) claim that attitudes to unfamiliar local foodstuffs play a role in tourist food consumption behavior towards local food
	Familiarity with Tibetan cuisine (x_{25})	*tibetan_food*	The perception that "I know Tibetan cuisine very well": 1: strongly disagree; 2: disagree; 3: partially disagree; 4: neutral; 5: partially agree; 6: agree; 7: strongly agree	Getlinger, Laughlin, Bell, Akre, & Arjmandi (1996) claim that familiarity with food correlates with the scale of food consumption
	Waste degree (x_{26})			L. E. Wang, et al. (2017) and Zhang, et al. (2018) claim that awareness of food waste problem (frugality) plays a role in food waste generation; Aschemann-Witzel et al. (2015) claim that consumers' lack of awareness and knowledge of food waste plays a role in food waste generation
	Understand	*understand*	If the respondent understands the problem of table (food) waste on the tour, the value is equal to 1, otherwise is 0 (control group)	
	Not serious	*not_serious*	If the respondent thinks the problem of table (food) waste on the tour is not serious, the value is equal to 1, otherwise is 0	
	Serious	*serious*	If the respondent thinks the problem of table (food) waste on the tour is serious and need to advocate conservation, the value is equal to 1, otherwise is 0	

Disinterest	*disinterest*	If the respondent does not pay much attention to the problem of table (food) waste on the tour, the value is equal to 1, otherwise is 0	
Waste responsibility (x_{27})			Aschemann-Witzel, et al. (2015) claim that consumers' lack of awareness and knowledge of food waste plays a role in food waste generation; Falasconi, et al. (2019) claim that consumers hardly recognize their responsibility for food waste generation when eating out; Parizeau, von Massow, & Martin (2015) claim that individuals bear the primary responsibility for food waste reduction
Government	*government*	If the respondent believes that the table (food) waste prevention is most related to the government, the value is equal to 1, otherwise is 0	
Restaurant	*restaurant*	If the respondent believes that the table (food) waste prevention is most related to the restaurant managers, the value is equal to 1, otherwise is 0	
Customer	*customer*	If the respondent believes that the table (food) waste prevention is most related to the customers, the value is equal to 1, otherwise is 0	
Others	*relationship_other*	If the respondent believes that the table (food) waste prevention is most related to the others (e.g. HORECA industry management departments and HORECA industry associations), the value is equal to 1, otherwise is 0	

The average FWRE/FWRO of a tourist in Lhasa is the arithmetic mean of FWRE/FWRO of all tourists, which can be expressed as:

$$AFWRE = \frac{\sum_{i=1}^{n} FWRE_i}{n} \quad (2)$$

$$AFWRO_j = \frac{\sum_{i=1}^{n} FWRO_{ij}}{n} \quad (3)$$

where $AFWRE$ is the average FWRE of a tourist in Lhasa, $FWRE_i$ is the FWRE of a tourist i (i = 1,2,3,…, 713); $AFWRO_j$ is the average FWRO of a food type j (j denotes grain, meat, vegetables, fruits, dairy products, aquatic products, and drinks, respectively) of a tourist; $FWRO_{ij}$ is the FWRO of a food type j of a tourist i (i = 1,2,3,…, 713); n is the total number of tourists.

3 Results

3.1 Tourist sample profile

The socio-demographic profile of study participants is presented in Table 2. The sample is dominated by males (59.89%) whose proportion is higher than that of the nation's average (51.13%) (National Bureau of Statistics of China, 2019). This can be partially explained by that males, as household heads, took responsibility for responding to a survey in the case of family tourists. More than half of study informants were aged 26~40 years old which is more than two times the proportion of the national population aged 25~39 years (23.41%) (National Bureau of Statistics of China, 2019). Popularity of Lhasa with business travelers (who are, in turn, are represented by young professionals) and students can partially explain this sample's deviation from the nation's average. Nearly 90% tourists are of Han nationality, which

is consistent with the nation's overall ethnic distribution (91.51%, (Population Census Office under the State Council of China & National Bureau of Statistics of China, 2012). A quarter of tourists have a monthly income between 6000 to 7999 RMB. The high consumption of tourism (Z. C. Wang & Li, 2006) determined that tourists' income is usually higher than that of the nation's average disposable income (2352 RMB in 2018) (National Bureau of Statistics, 2020). Most study participants represented employees of private enterprises and collective enterprises (23.42%), public officials (16.27%), and students (15.01%). Nearly half of respondents are educated to a bachelor's degree. More than half are unmarried tourists and 38.85% have children.

Table 2. Socio-demographic profile of study participants

Category	Classification	Number	Proportion %	Category	Classification	Number	Proportion %
Gender	Male	427	59.89	Career	Public officials	116	16.27
	Female	286	40.11		State-owned enterprise employees	55	7.71
Age	<18	6	0.84		Foreign company employees	44	6.17
	18-25	202	28.33		Private enterprise and collective enterprise employees	167	23.42
	26-40	395	55.40		Self-employed persons	104	14.59
	41-50	81	11.36		Famers	28	3.93
	51-60	19	2.66		Workers	44	6.17
	>60	10	1.40		Retired and staffs without work	36	5.05
Nationality	Han nationality	623	87.38		Students	107	15.01
	Minority	80	12.62		Other careers	12	1.68
Income (RMB)	<4000	168	23.56	Education	Elementary school or below	13	1.82
	4000-5999	164	23.00		Junior high school	56	7.85
	6000-7999	174	24.40		High school/secondary	104	14.59

				school		
8000-9999	80	11.22		College/higher vocational	140	19.64
10000-11999	44	6.17		Bachelor	335	46.98
12000-13999	20	2.81		Master's degree or above	65	9.12
14000-15999	14	1.96	Family	Married with children	277	38.85
≥16000	49	6.87	status	Married without children	104	14.59
				Unmarried	332	46.56

Descriptive statistics of the model variables are summarized in Table 3. The main points that can be derived from it are as follows:

Within the sample, the FWRE values range from 0 to 90%. Among the six elements of tourism (food, accommodation, transportation, sightseeing, shopping, entertainment), tourists tend to rank "food" as the third most important element of their visit to Lhasa (mean value of *importance_food* variable is 2.823). They had about 24% of meals from the Tibetan cuisine on average. On this tour, respondents expressed their partial satisfaction with their meals. On average, their trips to Lhasa lasted about 6.9 days and usually, when eating out, they had 3 meal companions. Respondents partially agree with the statement that "I am still more accustomed to the cuisine and eating habits of my hometown". In comparison, tourists in Lhasa think the table (food) waste problem in the tour is not serious and believe the prevention of food waste issue is mostly related to the customers (restaurant visitors). The common opinion is that restaurant guests should aim at reducing the amounts of food waste generated.

Table 3. Descriptive statistics of model variables

Variable	Obs	Mean	Std.Dev.	Min	Max
FWRE	713	14.64	13.965	0	90
gender	713	0.401	0.49	0	1
age	713	2.909	0.81	1	6

age_sq	713	9.116	5.501	1	36
married_chr	713	0.388	0.488	0	1
married_nochr	713	0.146	0.353	0	1
unmarried	713	0.466	0.499	0	1
educaton	713	4.295	1.172	1	6
educaton_sq	713	19.815	9.091	1	36
public_officials	713	0.163	0.369	0	1
employees	713	0.077	0.267	0	1
employees_for	713	0.062	0.241	0	1
employees_pri	713	0.234	0.424	0	1
self-employed	713	0.146	0.353	0	1
farmer	713	0.039	0.194	0	1
workers	713	0.062	0.241	0	1
retired	713	0.05	0.219	0	1
students	713	0.15	0.357	0	1
career_other	713	0.017	0.129	0	1
income	713	3.041	1.954	1	8
religion	713	0.196	0.398	0	1
ethnic	713	0.874	0.332	0	1
local	713	0.079	0.269	0	1
neophilia	713	0.741	0.439	0	1
importance_food	713	2.823	1.508	1	6
taste	713	0.324	0.468	0	1
appearance	713	0.021	0.144	0	1
volume	713	0.032	0.177	0	1
price	713	0.107	0.309	0	1
nutrition	713	0.087	0.282	0	1
health	713	0.426	0.495	0	1
food_other	713	0.003	0.053	0	1
proportion_local	713	24.165	19.859	0	100
meal_satisfation	713	4.976	1.017	1	7
times	713	0.541	0.499	0	1
sightseeing	713	0.663	0.473	0	1
leisure_vac	713	0.516	0.5	0	1
culture_act	713	0.39	0.488	0	1
religious_wor	713	0.08	0.271	0	1
meeting	713	0.062	0.241	0	1
research	713	0.029	0.169	0	1
purpose_other	713	0.024	0.153	0	1
food_tib	713	0.488	0.5	0	1
stomach	713	0.149	0.356	0	1
food	713	0.257	0.437	0	1
culture	713	0.509	0.5	0	1
communication	713	0.06	0.238	0	1

knowledge	713	0.025	0.157	0	1
days	713	6.914	7.183	1	90
companion_50	713	0.143	0.35	0	1
companion_18	713	0.107	0.309	0	1
number_tou	713	3.266	2.383	1	23
snack	713	0.321	0.467	0	1
ordinary	713	0.52	0.5	0	1
fixed	713	0.063	0.243	0	1
hotel	713	0.046	0.21	0	1
friends	713	0.036	0.188	0	1
location_other	713	0.013	0.112	0	1
table	713	0.222	0.416	0	1
order	713	0.717	0.451	0	1
buffet	713	0.062	0.241	0	1
home_food	713	5.08	1.494	1	7
tibetan_food	713	3.801	1.587	1	7
understand	713	0.126	0.332	0	1
not_serious	713	0.415	0.493	0	1
serious	713	0.342	0.475	0	1
disinterest	713	0.116	0.321	0	1
gevonerment	713	0.056	0.23	0	1
restarurant	713	0.261	0.439	0	1
customer	713	0.676	0.468	0	1
relationshop_other	713	0.007	0.084	0	1

3.2 Reliability and validity test

The reliability test returned the Cronbach α value of 0.944, indicating that the reliability of the scale and the consistency of measurement indicators are both high (Davenport, Davison, Liou, & Love, 2015); the KMO value was 0.952 and the results of the spherical test were significant (P=0.000), indicating the structural validity of the questionnaire was good (Sekaran, 2003; Vitasari, Wahab, Herawan, Othman, & Sinnadurai, 2011).

3.3 Tourist food waste characteristics

3.3.1 Food waste composition

On average, the tourist FWRE in Lhasa is 14.64%. Statistically, it is significantly (P<0.01, Table 4) higher than the tourist FWRE (8.43%) in the at-home context. Among 713 tourists, 10% stated they did not generate food waste on this trip; more than half wasted 1%~10% food; 20% tourists wasted food at the rate of 11%~20% and 15% wasted 21%~50%; only 2% respondents expressed that they wasted more than 50% (Fig. 2a). As to the food waste composition, the proportion of grain is the largest (30%), followed by meat (24%) and vegetables (16%); the wastage of fruits, drinks, dairy products, aquatic products and eggs is insignificant (Fig. 2b). Tourists' FWRO of grain is substantially lower than that in the at-home context, while the FWROs of meat and drinks are significantly higher (P<0.01, Table 4).

Table 4. Paired t-test of tourist FWRE and FWRO in the contexts of tourism and at home

Food type	Obs	Tourism Mean (Std.Dev)	At-home Mean (Std.Dev)	Difference of Tourism vs. At-home (Std.Err)
All food	713	14.64 (13.96)	8.43 (9.48)	6.21*** (0.53)
Grain	524	29.75 (23.14)	35.74 (26.14)	-6.01*** (1.15)
Meat	524	24.40 (21.86)	19.08 (17.52)	5.32*** (1.00)
Vegetables	524	15.84 (14.44)	16.89 (15.05)	-1.05 (0.77)
Fruits	524	6.20 (7.43)	5.96 (7.50)	0.24 (0.39)

Eggs	524	5.58 (9.63)	5.46 (6.93)	0.12 （0.45）
Milk	524	5.31 (7.59)	4.93 (7.12)	0.37 （0.35）
Aquatic products	524	5.61 (9.24)	6.16 (10.25)	-0.55 （0.48）
Drink	524	7.34 (11.95)	5.77 (9.24)	1.57*** （0.57）

*** $p<0.01$

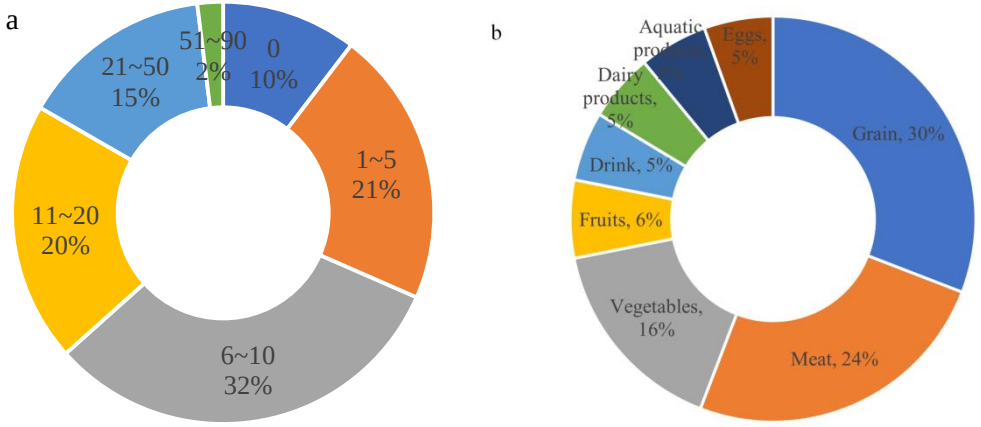

Fig. 2. (a) FWRE values stated by tourists (%) (b) Composition of wasted food

3.3.2 Food wastage among different tourist groups

The difference in food waste (FWRE or FWRO) can be seen among different tourist groups (Table 5): (i) for different gender groups, compared with males, FWRE of female tourists is significant higher (P<0.01) which is also the case for FWROs of grain, vegetables and eggs (P<0.05, P<0.05, P<0.01, respectively) for female tourists; (ii) for different age groups, FWRE and FWRO of grain of tourists aged under 18 years old or above 50 years old is significantly lower than for other age groups (P<0.1, P<0.1, respectively), while FWRO of fruits and aquatic products of tourists aged under 18 years old is significantly higher than that for other age groups (P<0.05,

346 $P<0.05$, respectively); (iii) FWRO of grain and aquatic products both have significant
347 differences among different career groups ($P<0.1$, $P<0.1$, respectively): workers have
348 the highest values of FWRO of grain and foreign company employees have the
349 highest values of FWRO of aquatic products; (iv) tourists with different education
350 levels have significant differences in FWRE and FWRO of vegetables ($P<0.05$,
351 $P<0.01$, respectively): tourists educated to a bachelor's degree level have the highest
352 values of FWRE and tourists with an educational level of junior high school
353 exemplify the highest values of FWRO for vegetables; (v) respondents with different
354 family statuses show significantly different FWROs of meat and aquatic products
355 ($P<0.05$, $P<0.1$, respectively): married without children tourists have the highest
356 values of FWRO for meat while unmarried tourists show the highest values of FWRO
357 for aquatic products.

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Table 5. FWRE and FWRO among different tourist groups

Category	Classification	FWRE		Grain		Meat		Vegetables		Fruits		Eggs		Milk		Aquatic products		Drinks	
		mean	F	mean	F	mean	F	mean	F	mean	F	mean	F	mean	F	mean	F	mean	F
Gender	Male	13.40	8.47***	28.93	6.45**	21.08	1.29	15.09	5.25**	5.45	0.01	4.05	7.51***	4.39	1.64	4.77	0.00	6.41	1.68
	Female	16.49		24.18		23.02		12.56		5.40		5.96		5.24		4.81		7.65	
Age	<18	7.67	2.11*	14.50	1.38	15.50	2.08*	10.00	1.15	13.33	2.43**	9.17	1.31	11.67	1.54	15.00	2.58**	10.83	1.56
	18-25	15.17		26.51		19.94		13.14		5.79		5.44		4.99		5.41		7.39	
	26-40	15.30		26.89		23.89		14.42		5.32		4.91		4.71		4.38		7.38	
	41-50	12.41		31.79		18.58		16.17		5.52		3.23		4.59		4.44		4.56	
	51-60	12.42		24.74		22.89		12.89		2.37		2.37		3.16		6.84		3.68	
	>60	4.50		16.00		9.00		7.00		3.00		3.00		0.00		1.00		1.00	
Income	<4000	14.24	0.97	26.41		20.21	0.76	13.93	1.18	5.51	0.79	4.59	1.23	4.51	0.87	4.83	1.31	5.74	1.29
	4000-5999	14.35		27.98		22.74		14.53		4.83		4.15		3.82		4.43		7.77	

	6000-7999	13.48		29.07		23.45		15.67		5.84		4.34		4.94		4.52		7.77	
	8000-9999	15.03		25.65		21.21		14.11		5.79		5.24		5.30		4.71		6.74	
	10000-11999	18.14		27.77		25.34		13.23		4.43		4.48		5.57		4.66		7.70	
	12000-13999	18.50		22.50		15.75		13.00		3.50		6.75		3.25		3.50		11.75	
	14000-15999	12.57		34.29		22.14		8.57		6.07		8.93		4.29		2.50		6.07	
	≥16000	16.33		20.00		19.29		10.10		6.63		7.14		6.78		8.22		9.59	
	Public officials	15.97	1.41	28.12	1.77*	18.08	1.19	13.32	0.51	4.98	0.74	5.02	1.61	4.88	0.91	5.28	1.71*	8.25	0.85
	State-owned enterprise employees	12.00		20.35		25.13		13.53		6.55		5.55		5.49		5.45		7.05	
Career	Foreign company employees	13.52		22.61		22.73		12.73		5.18		4.93		5.49		6.93		8.75	
	Private enterprise, collective enterprise employees	15.09		28.29		24.18		14.95		5.17		5.30		5.49		3.78		6.56	
	Self-employe	16.6		26.9		21.8		13.32		5.17		4.98		5.49		5.82		7.90	

	d persons	3		7	7											
	Farmers	12.00		28.84	16.38	16.30		5.17		4.73		5.63		4.38		6.16
	Workers	10.86		36.70	24.32	16.48		5.11		2.34		3.45		2.59		4.45
	Retired and staffs without work	12.22		22.78	21.11	14.44		3.75		1.67		1.94		1.94		4.58
	Students	14.83		25.32	22.02	13.07		6.06		4.63		4.34		5.79		6.64
	Other careers	20.00		34.17	12.50	17.08		3.75		11.25		7.50		2.92		2.50
Education	Elementary school or below	8.54	2.65**	25.96	10.58	7.50	3.93***	7.12	0.42	4.04	1.10	12.12		4.42	0.09	5.19	1.68
	Junior high school	11.54		31.52	18.68	18.46		5.71		3.30		3.66		4.38		7.14
	High school/secondary school	12.96		27.16	24.13	13.46		5.12		4.23		4.91		4.64		4.81
	College/higher vocational	15.51		28.43	22.50	16.85		4.90		4.29		5.12		4.56		5.49
	Bachelor	16.07		26.68	22.22	13.45		5.68		5.15		4.23		4.99		7.76
	Master's degree or	12.00		21.85	20.00	9.85		5.23		6.62		5.62		4.92		9.00

	above																	
Family status	Married with children	13.61	1.83	28.59	1.14	21.68	3.31**	14.75	0.52	5.78	1.09	4.41	0.58	4.55	0.15	4.84	2.55*	6.02	1.27
	Married without children	13.99		27.40		26.87		13.34		4.53		4.66		4.58		3.05		6.91	
	Unmarried	15.70		25.59		20.44		13.74		5.42		5.20		4.92		5.29		7.64	

**** p<0.01, ** p<0.05, * p<0.1*

3.4 Potential drivers of tourist food waste

The results of regression indicate that the variables of gender, age, family status, education, food neophilia, most valued part of meals, satisfaction with meals, travel purpose, dining place, familiarity with the Tibetan cuisine all have a significant effect on FWRE (Table 6). Most importantly, variables of food neophilia and satisfaction with meals exert the largest/most significant (negative) effect. Tourists prepared to taste unfamiliar food are more likely to consume the ordered Tibetan food. And tourists more satisfied with the food on the trip would left less food uneaten.

Table 6. Tobit model regression results of tourist food waste in Lhasa

Variable symbol	Coef.	St.Err.	t-value	p-value
gender	2.466	1.159	2.13	0.034**
age	5.772	3.786	1.52	0.128
age_sq	-1.020	0.537	-1.90	0.058*
married_chr	-1.805	1.533	-1.18	0.239
married_nochr	-3.136	1.759	-1.78	0.075*
educaton	6.984	2.847	2.45	0.014**
educaton_sq	-0.872	0.365	-2.39	0.017**
public_officials	3.347	3.314	1.01	0.313
employees	-0.474	3.651	-0.13	0.897
employees_for	-0.911	3.888	-0.23	0.815
employees_pri	1.754	3.211	0.55	0.585
self-employed	3.870	3.253	1.19	0.235
workers	1.162	3.469	0.34	0.738
retired	1.524	3.865	0.39	0.693
students	2.389	3.543	0.67	0.500
career_other	7.621	5.032	1.51	0.130
income	0.405	0.347	1.17	0.244
religion	1.698	1.601	1.06	0.289
local	-1.870	2.682	-0.70	0.486
neophilia	-3.374	1.291	-2.61	0.009***
importance_food	0.265	0.356	0.75	0.457
appearence	2.553	3.777	0.68	0.499
volume	-3.922	3.118	-1.26	0.209
price	-2.594	1.910	-1.36	0.175

nutrition	-2.211	2.004	-1.10	0.270
health	-2.102	1.271	-1.65	0.099*
food_other	-0.268	10.158	-0.03	0.979
proportion_local	0.024	0.028	0.84	0.399
meal_satisfaction	-1.675	0.563	-2.98	0.003***
times	0.941	1.147	0.82	0.412
sightseeing	-0.523	1.243	-0.42	0.674
leisure_vac	-2.156	1.096	-1.97	0.050*
culture_act	0.063	1.102	0.06	0.954
religious_wor	3.203	2.215	1.45	0.149
meeting	-1.067	2.414	-0.44	0.659
research	-2.319	3.251	-0.71	0.476
purpose_other	-7.453	3.607	-2.07	0.039**
food_tib	-0.512	1.134	-0.45	0.652
stomach	-3.052	2.679	-1.14	0.255
food	-2.273	2.502	-0.91	0.364
culture	0.035	2.373	0.01	0.988
knowledge	-0.522	3.950	-0.13	0.895
days	0.013	0.077	0.17	0.869
companion_50	1.653	1.683	0.98	0.326
companion_18	2.787	1.818	1.53	0.126
number_tou	0.101	0.249	0.40	0.687
snack	5.828	2.464	2.37	0.018**
ordinary	4.501	2.377	1.89	0.059*
hotel	7.679	3.387	2.27	0.024**
friends	4.525	3.653	1.24	0.216
location_other	12.052	5.368	2.25	0.025**
table	1.953	2.445	0.80	0.425
order	-1.753	2.273	-0.77	0.441
home_food	-0.360	0.370	-0.97	0.331
tibetan_food	-0.883	0.362	-2.44	0.015**
not_serious	-1.314	1.698	-0.77	0.439
serious	0.095	1.787	0.05	0.958
disinterest	-2.372	2.208	-1.07	0.283
gevonerment	1.742	2.311	0.75	0.451
restarurant	0.713	1.249	0.57	0.568
relationship_other	-9.765	6.374	-1.53	0.126
Constant	5.086	10.472	0.49	0.627

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4 Discussion

4.1 Food waste composition and patterns of wasteful behaviour among tourists

Tourists generated circa 15% of the total food waste in the HORECA sector of Lhasa, Compared to food wastage at home, they produced about 1.7 times more food waste when on travel. Moreover, the food waste level is higher than the published food wastage level of Chinese rural households (2.4%) in 2013 (F. Li, et al., 2017), household's FWRE established in China Health and Nutrition Survey (CHNS) during 1999~2009 (3.25%~4.78%) (Xiong & Wang, 2017), FWRE in Chinese college canteens (12.13%) in 2018 (Qian, Li, & QIian, 2019) and solid waste rate (which includes food) of the Hawaian tourism industry (Saito, 2013). Past evidence reinforced with the results of this study suggests that the magnitude of food wastage in tourism is higher than the magnitude of food wastage at home, both when cooking in households and when eating out.

As for the causes of food waste, nearly half (42%) of tourists stated they wasted food because of unsuitable taste; 28% of them indicated altitude sickness affected their appetite and 18% of them did not consume all food because they did not know the size of ordered portion size. It can therefore be concluded that taste preferences of tourists to Lhasa represent a major driver of food wastage which is in line with findings reported by Beretta, Stoessel, Baier, & Hellweg (2013) in the context of food waste generation in the foodservice sector, by Blondin, Djang, Metayer, Anzman-Frasca, & Economos (2015) in schools and by Lanfranchi, Calabrò, Pascale, Fazio, & Giannetto (2016) in households. Food wastage from tourism to Lhasa is not only determined by poor familiarity of domestic tourists with the Tibetian cuisine, but also with their unawareness of a 'typical' Tibetian meal size. Portion size is a well-established driver of food wastage (Massow & McAdams, 2015) and, as it increases, so does the amount of wasted food (Freedman & Brochado, 2010; Ofei, Holst, Rasmussen, & Mikkelsen, 2015). Careful portion size control is considered a

meaningful measure to mitigate food waste occurence on consumer plates (Kallbekken & Sælen, 2013).

There is evidence to suggest that tourists tend to consume more food on holiday than at home (Gossling, 2015), spending almost a third of their travel budget on food (Torres, 2003). The results of this study indicate that excessive food consumption by tourists may not necessarily mean that more food is consumed when on holiday, but that more food is wasted instead. Tourists like trying unfamiliar food, especially locally distinctive foodstuffs in exotic locations, which is to gain a better experience of different cultures (Scarpato, 2002). Some new, unfamiliar dishes may not always meet the taste preferences of every tourist, thus driving food wastage. In this regard, the experience economy is usually seen positively as tourists seek new, authentic experiences, thus benefiting the locals. This quest may however have a dark side to it, for example when the (food) experience is not to someone's personal taste, then this brings about excessive (food) wastage. Personal well-being is another reason for tourists wasting food in Lhasa. The average altitude of Lhasa is above 3600 meters; tourists feeling uncomfortable, may have a poor appetite meaning higher amounts of food left on their plates.

Variables of gender, age, family status, education, food neophilia, most valued part of meals, satisfaction of meals, travel purpose, dining place, familiarity with Tibetan food have a significant effect on FWRE:

Female tourists waste significantly more food. This finding is consistent with research on household food waste (Koivupuro, et al., 2012; Silvennoinen, et al., 2014) and school food waste (Buzby & Guthrie, 2002; Kuo & Shih, 2016; Painter, et al., 2016). Dietary pursuits by females may, at least partially, explain the difference in food wastage in comparison with males which is in line with findings reported in Filimonau, Lemmer, Marshall, & Bejjani (2017). Concurrently, evidence shows that females are more willing to taste the unknown food (Mak, et al., 2012), thus

suggesting that females are more likely to order food which they do not subsequently like and, therefore, waste.

The effect of age on FWRE presents an "inverted U-shaped" feature which means that, within a certain age range, the effect of age on the FWRE is positive; after reaching a certain limit age, the impact on food waste is negative. This confirms the findings of Zhang, et al. (2018) and can be explained by the fact that the middle-aged (26~40) consumers usually eat more than youngsters but the elderly consumers tend to restrict food intakes because of heath and/or financial reasons (Visschers, Wickli, & Siegrist, 2016). Similar findings are reported for food wastage in the context of households where the explicit impact of (older) age has been recorded (Quested, Marsh, Stunell, & Parry, 2013). This study shows that the younger tourists waste a higher proportion of fruits and aquatic products. This may be attributed to health considerations in food consumption that are of particular relevance to the younger demographics (Wansink & Johnson, 2015).

The FWRE values of married tourists without children are significantly lower than those of unmarried tourists. This finding partially supports Derqui, Fernandez, & Fayos (2018) who highlight excessive food wastage generated by children in the context of school canteens. It can further be assumed that families are more concerned with the impact of food on health and might, therefore, order less food or order smaller meal portions. High food wastage among single consumers is confirmed by Koivupuro, et al. (2012) and can, at least partly, be explained by the desire of singletons to enjoy holiday, and the food consumed on holiday, in absence of any household obligations.

Education has a significant "inverted U-shaped" impact on FWRE of tourists. This implies the limitation of educating consumers on reducing food waste which is in line with Zhang, et al. (2018). Highly educated people have a better awareness of the impact of food waste on the environment (D. Y. Qi & Roe, 2016). Therefore, they pay

more attention to their food consumption behaviors and avoid wastage (Abdelradi, 2018; Mattar, Abiad, Chalak, Diab, & Hassan, 2018; Song, Li, Semakula, & Zhang, 2015). Secondi, et al. (2015) indicate that people who have a lower level of education also waste low amounts of food but attribute this to lower incomes of this category of consumers and higher personal values they subsequently assign to food.

Tourists willing to try unfamiliar food have a significantly lower FWRE. As one important motivation for tourism (Mak, et al., 2013), food neophilia encourages tourists to consume food representative of aspecific destination, such as Tibetan meals in Lhasa, and waste less of that food even if taste is not always 'right'. Conversely, if tourists have food neophobia, it will influence their willingness to taste the unknown food and thereby their preferences to novel foods (Tsimitri, et al., 2018; Tuorila, Lahteenmaki, Pohjalainen, & Lotti, 2001). This study shows that, when more Tibetan specialty was ordered (by tourists and/or their companions), food waste was easily generated.

Personal satisfaction with the meals served is significantly negatively correlated with tourist FWRE. As an index of foodservice quality, food waste could reflect consumer satisfaction (Aminuddin, Vijayakumaran, & Razak, 2018; Ferreira, Martins, & Rocha, 2013). Satisfaction of meals is also the most intuitive embodiment of whether the food can satisfy tourist appetite and can directly determine whether the food is likely to be wasted. Higher rates of food waste are well correlated with customer dissatisfaction with meals (Carvalho, et al., 2015).

Tourists on leisure vacation demonstrate significantly lower values of FWRE. This category of tourists may assign more value to the natural scenery and activities and pay less attention to food, considering it a functional, rather than experiential, attribute of their holiday. Thus, their diet structure and consumption are closer to that in the at-home context. They are less likely to consume unknown food and, therefore, generate waste. In contrast, more food waste produced by tourists on a business and/or

study trip can be attributed to the high frequency of food consumption occasions, but also to the social pressure element which can influence food wastage (Papargyropoulou, et al., 2016; F. Qi, Sun, Ge, & Cui, 2014; Zeng, 2015).

Compared to dining at the restaurants that cater for tour groups, the FWRE values of tourists dining at specialty snack bars, ordinary restaurants, and star-rated hotels were higher. Fixed menus operated by many tourist restaurants are normally less wasteful than traditional, long menus adopted by many regular, a la carte, restaurants. This is assigned to limited food choice which implies less wastage generated in restaurant kitchens (Huang, He, & Li, 2018; Papargyropoulou, et al., 2019).

Regarding the perception of food consumption, better tourist familiarity with the Tibetan food implies lower FWRE. As an important form of tourism cultural experience, tasting the specialties of a destination is a common consumption behavior of tourists (Frisvoll, et al., 2016). However, tourists' "known" or "safe" experiences could affect their food consumption. Knowing what to expect implies limited scope for (unpleasant) surprises in the form of unliken food and, consequently, waste (Fenton, Eves, Kipps, & Odonnell, 1995).

4.2 Mitigation strategies and actions

Building (more) sustainable food systems by facilitating food waste reduction has become a priority for many national and international stakeholders (Derqui, et al., 2018; Mourad, 2016). This signifies the need for policy and industry designed interventions to reduce food waste occurrence in the different sectors of economic activity (S. K. Cheng, et al., 2017). Such interventions should be underpinned by systematic, empirical research (S. K. Cheng, et al., 2017). Given the larger magnitude of food wastage in the tourism context compared to the household and 'dining out' contexts, urgent food waste reduction interventions are required in China. Considering the multifaceted impacts of food waste, its reduction campaigns should involve

multiple stakeholders, such as the national government of China, the HORECA industry association, the HORECA providers, and the customers (tourists).

A number of grassroot initiatives have been launched around the world to aid in food waste minimization within the tourism industry. Examples include the "Zero Waste tourism" campaign in Slovenia (Oblak & Meia, 2017), the EU LIFE FOSTER Project in Malta (Maltachamber, 2019), the BUFFET (Building an Understanding For Food Excess in Tourism) campaign in Asia Pacific (Pawson, 2018) and the Food Bank project in the UAE (Stepfeed, 2017). Given the above initiatives are rather recent, their impact on consumer (tourist) behaviour is yet unknown. This notwithstanding, it is argued that all these projects can provide a useful insight into the challenge of combating food waste in the tourism industry in China, subject to their adaptation to the local food consumption context.

For the government, the major task is to streamline food quality standards in the national HORECA sector. The Chinese government has already implemented a series of policies and taken relevant measures to reduce food waste (Zhang, Bai, Liu, & Cheng, 2019) but, whilst being useful, the above initiatives focus on food consumption occasions when people go to eat out in their leisure time and do not encapsulate the very special and large consumer group of tourists. The institutions in charge should pay more attention to the policy guidance and supervision of HORECA providers in China. This can be done by, for example, introducing relevant guidelines or by standardizing the approaches to preparing food dishes and designing menus. The special/unusual foods should be clearly marked to avoid blind ordering which may cause unnecessary food wastage in the destinations with unique cuisines that distinctly different from the more 'mainstream' cuisines of China.

Education has a significant impact on tourist FWRE within a certain range; hence, strengthening education of tourists on food consumption and nutrition represents a

necessary means to reduce food waste in tourism. Considering the importance of education in adolescents in terms of personal growth, character formation, and values, as well as the effective impact of nutrition education on eating habits and, consequently, on food waste reduction (Kim, Choi, Lee, & Kwak, 2007), it is necessary for the Chinese government to mobilise its education department and focus on strengthening food waste related education for young(er) people. The government should also consider supporting the non-profit companies or industry organizations to run food waste reduction campaigns in schools, colleges and universities. Successful examples can be learnt from the "Do Good: Save Food!" campaign in France (FAO, 2019; FAO & International Food Waste Coalition, 2018) and the "Love Food Hate Waste" (www.lovefoodhatewaste.com) campaign in the UK. Also the "Gourmet Bag" project launched by the French government and the "Source Reduction" efforts shared by the United States Environmental Protection Agency (EPA) can provide useful insights into food waste reduction in restaurants (futureofwaste, 2018).

For professional/industry associations, these should standardize corporate behavior, strengthen publicity and education, and promote responsible food consumption among tourists. As social intermediaries, the national HORECA industry associations in China should publicize and implement the national food waste reduction policies and regulations, timely reflect the food waste problems and offer possible solutions to their members. They should further organize staff and management training on how to achieve food waste reduction in HORECA enterprises in popular tourists destinations in China.

Foodservice provides should combine efforts to reduce food waste in their operations, paying more attention to the optimization of kitchen processes, work with suppliers, staff training and consumer choice architecture (Filimonau & De Coteau, 2019). As a special form of eating out, similar measures should be applied by HORECA providers to address the challenge of tourist food waste. As taste preferences drive tourist food

waste in Lhasa, the HORECA providers should strive to improve the quality of dishes they cook to meet tourist satisfaction. Adopting menus to meet tourist preferences, developing strategies to improve meal acceptance and customer satisfaction (Carvalho, et al., 2015), and requesting feedback from clients as a regular assessment of the food waste reduction measures (for instance, conduct customer satisfaction surveys and interviews) are necessary. Portion size control should also be adopted and the HORECA operators providing tourists with a choice of meal sizes, especially when serving unfamiliar dishes. Moreover, a customer reminder service (for example, about the weight and approximate taste of the dishes) is also essential to avoid food waste caused by blind ordering for tourists who may be unfamiliar with a local cuisine.

It has been emphasized that consumer behavior represents an important challenge to HORECA food waste mitigation (Filimonau, Fidan, et al., 2019; Filimonau, Krivcova, et al., 2019; Ge, Almanza, Behnke, & Tang, 2018; Radwan, Jones, & Minoli, 2010). Under the national culture of China (mianzi), Chinese consumers tend to order more food than they really need (L. E. Wang, et al., 2017). In the domestic tourism context, the same situation is equally inevitable. Tourists usually leave some food on the plate due to shyness or in order to show generosity, especially when eating with non-family members. To better understand the local diet to reduce food waste, tourists should learn about local food culture in advance and proactively request the dishes' details before ordering. However, as tourists with higher-level education waste less food, it is necessary for tourists to educate themselves to acquire knowledge of the detrimental societal and environmental effects of food waste (Filimonau, Matute, et al., 2019). This study demonstrated that most domestic tourists in China believed that food waste prevention was a prime responsibility of consumers (tourists). Awareness building represents a fundamental step to let tourists to realize their importance in food waste reduction.

5 Conclusion

Being a cornerstone of a holiday experience, food consumption in tourism represents a topic of growing academic interest. However, extant scholarly research has mostly considered food consumption as a 'pleasurable' element of holiday. This study has shown the 'dark' side of food consumption on holidays by establishing the magnitude of food wastage among tourists in Lhasa, a popular tourist destination in China, and by revealing the main determinants of wasteful behaviour, including the effect of various socio-demographic characteristics. We found that tourists waste more food when on travel than when cooking at home and when eating out at home. The main drivers include food preference, portion size, educational level, food neophilia, meal satisfaction and such socio-demographic characteristics as gender, age, family status and educational level.

Constrained by time and funding, this project obtained the data on tourist FWRE and the FWRO of particular foodstuffs by using a self-completion questionnaire rather than by the method of direct weighting of wasted food. In the survey, 10% of tourists stated they did not waste food on this trip. This may signify the effect of social desirability bias. However, by comparing the FWRE and the FWRO of particular food in the tourism and at-home contexts for the same consumer, as well as by conducting a comprehensive analysis of the main drivers of tourist food waste in a popular tourist destination, we believe our research can contribute to a comparative study of out-home and at-home food consumption in the tourism field and food field, and the policy/measures taken for tourist food waste reduction.

Future research should strive to procure more accurate food waste data by tourists by the method of direct weighting. The analytical framework developed in this study to measure food waste generated by tourists can be replicated in other tourism contexts. Future research can also aim at adopting a mixed method approach to investigation,

i.e. by, supplementing the quantitative element of research (a consumer survey) with the qualitative element (in-depth tourist interviews) to better understand the drivers of wasteful tourist behaviour. Exploring food wastage by international tourists to China and by comparing it with food wastage by domestic tourists represents another promising research opportunity. Lastly, interviews with local HORECA providers and Chinese policy-makers on how tourist behaviour can be modified to make it less wasteful should also be conducted.

Declaration of competing interest

The authors declare no competing conflict of interest.

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***Declaration of Interest Statement**

The authors declare no competing conflict of interest.

Credit Author Statement

Wang Ling-en: Investigation, Conceptualization, Methodology, Writing- Reviewing and Editing, Project administration

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Supplementary File

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