

Food Losses and Waste

Subjects: **Others**

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Food losses and waste (FLW) refers to "a decrease, at all stages of the food chain, from harvest to consumption in mass, of food that was originally intended for human consumption, regardless of the cause". Food waste (FW) is a critical challenge in the Gulf Cooperation Council (GCC). This paper analyzes research dealing with food waste in the GCC countries (viz. Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates). It draws upon a systematic review performed on Scopus in January 2020. The paper covers both bibliometrics (e.g., authors, affiliations, journals) and research topics (e.g., causes, food supply chain stages, extent and quantity, food security, economic impacts, environmental implications, management strategies). A main finding of the review is the scarcity of data on FW in the GCC in general and in Kuwait, Oman, and Bahrain in particular. Most of the selected articles address FW reuse and recycling (e.g., waste-to-energy conversion, compost production). Indeed, other FW management strategies, such as reduction/prevention and redistribution, are overlooked. The systematic review highlights that further research on FW in the GCC is highly needed with a focus on the identified research gaps such as causes and drivers, trends, magnitude and extent, environmental and economic impacts, along with implications of food wastage in terms of food security. Since food wastage is a common issue for all GCC countries, these research gaps should be addressed in a shared regional research agenda.

food losses and waste

food security

Gulf Cooperation Council

1. Definition

Food losses and waste (FLW) refers to "a decrease, at all stages of the food chain, from harvest to consumption in mass, of food that was originally intended for human consumption, regardless of the cause" ^[1]. FLW occurs between when an agri-food product is harvested and when it is consumed or discarded. Indeed, FLW occurs along the whole food supply chain from harvesting, transportation, storage, processing/packaging, distribution to consumption. Food waste may be considered as "food loss" when occurring in the initial stages of the food supply chain (e.g., harvesting, transport, storage), and as "food waste" when incurred within later stages e.g., retail and consumption ^{[1][2][3]}. There are significant differences among countries and from a commodity and season to another ^{[1][2][3][4][5][6]}. In particular, losses occurring in the initial part of the food supply chain (mainly caused by poor harvesting, transport and storage infrastructure, and facilities) are high in the developing world, whereas in developed countries, food waste mainly occurs within later stages i.e., in distribution and at consumer level ^{[1][2][3]}.

FLW is an emerging issue with massive environmental, economic, and social implications ^{[1][3][7][8][9]}. Food wastage is also an ethical scandal ^[10] in times when more than 820 million people are still hungry worldwide ^[11]. Indeed, some scholars associate overconsumption and obesity to food waste ^[12]. Today, it is assessed that 1.2–2 billion

tons (about a third of food produced worldwide for human consumption) is lost or wasted ^{[1][2]}. FLW undermines the foundation of food security ^{[1][3][13][14][15]}. When converted into calories, FLW amounts to about a quarter of all food produced at the global level ^{[15][16][17]}. FLW also represents a loss of valuable nutrients (including micro-nutrients) ^[18]. The reduction of FLW is also considered crucial to decrease the food-related environmental footprints ^{[1][2][15][19][20][21]}. Indeed, food waste amounts to a major depletion of resources (e.g., both natural resources, such land and water, and other economic resources, such as labor, energy, and capital) at global and local levels ^{[2][15][22]}. FLW represents, on the one hand, a waste of the resources utilized to produce wasted food and, on the other hand, a major source of negative environmental impacts including the emissions of greenhouse gas (GHG) that cause climate change ^[20].

2. Bibliographical Metrics of Research on Food Wastage in Gulf Cooperation Council (GCC) Countries

One of the main results of this systematic review is the marginality of research on FW in the GCC countries (viz. Saudi Arabia, UAE, Kuwait, Oman, Qatar, Bahrain). It is, in fact, surprising that only 32 documents resulted dealing with food wastage in the GCC given the magnitude and extent of the problem in the region and its tight link to food security. Indeed, the 31st regional conference of FAO in the Near East recommended to "[...] assist member countries in addressing the key challenges of reducing food waste and losses by conducting comprehensive studies on the impact of food losses and waste on food security in the region and in establishing a plan to reduce food losses and waste in the region by 50% within 10 years" (p. V) ^[23]. Most likely, it is for the awareness of the lack of data and studies on this issue that the Regional Strategic Framework on "Reducing Food Losses and Waste in the Near East and North Africa Region" devoted one out of its four components to "Data gathering, analytical research, and knowledge generation" (p. 4,5) ^[23]. The need for further research on food wastage issue in the region was also highlighted by many scholars ^{[24][25][26][27]}.

There are enormous differences among the GCC countries in terms of research dealing with food wastage. It seems that research on food waste is mainly performed in Saudi Arabia ([Table 1](#)). This is quite normal considering that the country is the largest and the most populous one in the GCC. In fact, it is important to take into consideration the sizes of countries and their research systems (e.g., country research performance is assessed on Elsevier's SciVal using the number of scientific articles per million inhabitants as an indicator). However, also Qatar and, to a lesser extent, UAE are active in the research field on food waste. On the other hand, such research field is marginalized in Kuwait and Oman, while there was no paper dealing with food wastage in Bahrain. Surprisingly, although food wastage is a common issue for all GCC countries, there is no single study that addresses this issue in a comprehensive way in the whole region.

Table 1. GCC countries where research on food waste was performed.

GCC Country (Number of Articles)	References
Kuwait (2)	Aljamal and Bagnied [28] ; Natour [29]
Oman (1)	Baawain et al. [30]
Qatar (8)	Abdelaal et al. [31] ; Aktas et al. [32] ; Bennbaia et al. [33] ; Bennbaia et al. [34] ; Elkhailifa et al. [35] ; Irani et al. [36] ; Al-Ali Mustafa [37] ; Seed [38]
Saudi Arabia (16)	Alhajhoj [39] ; Al-Othman and Hewedy [40] ; Alruqai [41] ; Al-Shoshan [42] ; Al-Zahrani and Baig [43] ; Amara et al. [44] ; Khan and Kaneesamkandi [45] ; Mu'azu et al. [46] ; Nizami et al. [47] ; Ouda et al. [48] ; Rehan et al. [49] ; Rehan et al. [50] ; Shahzad et al. [51] ; Waqas et al. [52] ; Waqas et al. [53] ; Waqas et al. [54]
UAE (4)	Abdallah et al. [55] ; Abu Qdais et al. [56] ; Pirani and Arafat [57] ; Seguela et al. [58]

3. Topics Addressed in Research on Food Waste in the Gulf Countries

The following sub-sections describe and analyze the findings on food waste in the GCC countries from the reviewed literature with a particular focus on the causes of food wastage (4.1), stages of the food supply chain (4.2), extent and quantity of food waste (4.3), food wastage and food and nutrition security (4.4), food waste prevention and management strategies (4.5), economic impacts of food wastage (4.6), and environmental implications of food waste (4.7). Each sub-section includes an evaluation of the whole selected literature to see whether or not it addresses each specific topic (and to what extent) as well as an analysis of how the topic was addressed by comparing and discussing data from the different selected papers.

3.1. Causes of Food Wastage

FAO [\[59\]](#) suggests that the causes of FLW vary across the NENA region and include inadequate and weak infrastructure (e.g., cold chain, markets), inappropriate regulatory and policy frameworks, and institutional weaknesses. Likewise, FAO [\[23\]](#) argues that poor farming systems, inappropriate postharvest practices (e.g., cold storage, handling, drying), and deficient infrastructure are among the main causes of food wastage in the region.

While there is no paper that analyzes the causes of FLW along the whole food supply chain in the GCC countries, some papers address the drivers of food wastage in specific stages of the food chain (mainly consumption) and/or in determined settings (e.g., university and hospital canteens, households).

3.2. Stages of the Food Supply Chain

Most of the selected articles address food wastage at the consumption stage, while no or little attention was devoted to remaining stages of the food supply chain, such as production and harvesting, storage, transport, and/or processing. This might be because most of food wastage in the rich GCC countries takes place at the consumer level. Indeed, Baig et al. [60] suggest that food is mainly wasted at the consumer level in Saudi Arabia; "food is wasted at restaurants, caterers, cafeterias and, especially, by households such that food waste is the single-largest component of the landfills" (p. 1743). Moreover, even at the consumption level, studies on behavioral and attitudinal aspects relating to food wastage are lacking; the only exception is Aktas et al. [32] who use TPB (theory of planned behavior) to investigate food waste behavior of Qatari consumers. The selected papers deal with food waste at consumption in different settings such as food outlets of university campuses [31][40], hospitals [58][42], hotels [57][61], as well as households [34][33][43][28][56].

3.3. Extent and Quantity of Food Waste

The selected articles do not encompass any comprehensive analysis of the quantity and magnitude of food wastage in the GCC countries. Moreover, the few presented figures do not make any distinction between edible and inedible (cf. unavoidable) parts of food. However, many studies show that the countries of the GCC are amongst the top world food wasters. Baig et al. [27] point out that the KSA might have one of the highest rates of food waste in the world and put that "estimates of annual per capita waste of food ranged from 165 kg to 511 kg" (p. 1633). Meanwhile, referring to data from the Food Sustainability Index [62], Baig et al. [60] argue that "with 427 kg of food wasted per capita per year, the country ranks among the top food wasters" (p. 1743). Shahzad et al. [51] highlight that FW is the largest stream in the municipal solid waste (MSW) in Makkah (Saudi Arabia) and represents slightly more than a half of MSW in the city. Bennbaia et al. [34] suggest that "Qatar is one of the top 10 countries in the world in terms of per capita food waste; which ranges from 584 to 657 kg per year" (p. 2495).

3.4. Food Wastage and Food and Nutrition Security

The relationship between food waste and food security is particularly relevant in the NENA region [25]. Indeed, the region has a huge food deficit and depends heavily on food imports to satisfy the total food requirements of its population [23][63][64][65]. Hence, it is intolerable that the NENA region wastes each year up to 250 kg per capita, which is even more than the global food waste average [23]. Despite that, the relation between food wastage and food security is not explicitly addressed in the selected documents. However, many authors refer to food security to justify the need to reduce food wastage.

Referring to the Kingdom of Saudi Arabia (KSA), Baig et al. [27] put that "the KSA has limited arable lands and scarce water and thus relies on extensive imports and food subsidies to meet food demand. Accordingly, waste

and loss of food are a significant concern for food security" (p. 1633). This argument is valid for all the other five countries of the GCC. In addition, Baig et al. ^[60] highlight that food waste is one of the main issues that threaten long-term food security in Saudi Arabia.

3.5. Economic Impacts of Food Wastage

The economic impacts of food wastage depend on the amount of money spent on food. As for 2018, the yearly expenditure on food (including non-alcoholic beverages) per capita in the GCC countries ranged from 1951.9 US\$ (13.71% of total expenditure) in UAE to 1910.5 US\$ (19.22%) in Kuwait, 1755.7 US\$ (12.27%) in Qatar, 1689.6 US\$ (20.62%) in Saudi Arabia, 1674.1 US\$ (13.24%) in Bahrain, and 1329.1 US\$ (22.65%) in Oman ^[66].

The analysis of the literature included in the systematic review shows that no document examines the impacts of food wastage on the prices of agri-food products in the GCC countries and how such changes in prices affect producers and consumers. Nevertheless, some papers estimate the financial value of food wasted in different settings (e.g., hospitals) as well as the economic benefits of recycling food waste (cf. energy, compost).

Al-Shoshan ^[42] estimates the monetary value of food waste over 2 days (i.e., six meals served to 759 persons among patients and attendants) in 18 general hospitals in Saudi Arabia and puts that the "average plate waste represented approximately 40% of the meal cost/participant/day, and the estimated annual monetary loss for the 5.625 million regular meals to be served to patients and attendants will be around 35 million Saudi Riyals" (p. 7), so about 9.3 million USD (as of February 1992).

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