

Towards a more sustainable waste management in Qatar: Retrofitting mindsets and changing behaviours

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ABSTRACT

Historically, the peoples of Arabia have had a strong affinity with and respect for nature, recognising that their life depended on a mutually supportive relationship. The intertwined connections between people and nature included a reverence for camels that provide a dependable mode of transport across the harsh desert landscape; a deep affection for the majestic falcons that soared high above vast sand dunes in search of prey and a great pride in the saluki dog breed as a loyal and skilful hunting companion. Through the generations, nomadic and static tribes in the Gulf have learned to coexist with their hostile desert environment, following nature's path to water and fertile plains. And, while this bond endures, with the advent of oil wealth, which has brought with it unprecedented rates of development, it is a connection that at best is under strain and at worst on a catastrophic path as much desired rapid development brings with it demands on the environment and incursions into the landscape as never before: dredging, which destroys sea grass plains and their associated wildlife; agriculture, which requires ever more water, thereby depleting natural aquifers and necessitating higher levels of energy-consuming desalination and skyscraper cities, which demand increasing amounts of electricity for lighting, air-conditioning and residential comfort. Furthermore, an ever-growing mound of waste generated by a swelling population and increased consumerism do not seem favourable for the GCC region.

What will it take to restore the human–environment balance? What needs to be retrofitted? Is it simply a matter of technical fixes, add-ons or replacements? Or is a more fundamental change needed? Do we need to retrofit mindsets, both individual and organisational, with a new set of overarching socially and environmentally driven principles that will allow Qatar to continue along its developmental path while enhancing its historical ties with the environment? In short, is it possible to design or retrofit our way towards a sustainable Qatar?

It is argued in this paper that not only technological solutions and retrofits but also an associated change in mindsets and behaviours at all levels and in all communities will solve the waste management problems faced by Qatar. Drawing on examples from individual, organisational and community-driven initiatives in solid waste management in Qatar and a survey of attitudes towards waste, in this paper, we illustrate the complexity of the task ahead, the obstacles faced and the need for a “retrofit” of mindsets and behavioural change in order to achieve a transformation in solid waste management in Qatar.

Keywords: solid waste, waste management, recycling, behavioural change, Qatar

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1. INTRODUCTION

More than 25 years since the publication of the Brundtland Commission's Report *Our Common Future*,¹ establishing the principle of Sustainable Development as the *sine qua non* for the well-being of humankind and the earth, a plethora of commentary and literature has been directed at the meaning of sustainable development and its operationalisation at all levels of society – from resource management in sustainable economies, through the transformations needed in organisations and the products and services they provide, to the fundamental changes in individual behaviours and attitudes towards the environment. Running through much of this discourse is an implicit assumption that things need to be done differently in order to ensure sustainability and diversity of the communities and environments in which we live. With that, a requirement for new ways of thinking, learning and doing – the rethink, reframing and reimagining described by Elkington in his book *The Zeronauts*² – though opinion is divided on the direction, nature and degree of these changes.

Looking at the metropolitan areas of many of the Gulf Cooperation Council (GCC or Gulf) countries, we might think that, here at least, the fundamental way of urban development and living has remained unaddressed despite the phenomenal changes across the region from localised desert-dwelling communities to large urbanised conurbations. Most centres of economic activity in the Gulf have taken on an uncanny uniformity that closely resembles the skyscraper-clad skylines of modern metropolises worldwide, with less attention paid to the demands of the local and global environments or the Arabic culture underpinning them. An exception is the architectural embellishments that give an Arabic flavour to some developments, as explored by Alraouf and Clarke³ in an analysis of the characteristics of sustainable architecture in the Gulf.

In the case of Qatar, the country's national vision (Qatar National Vision 2030, QNV2030) outlines an unequivocal commitment to maintaining harmony between the three inter-dependent pillars of sustainable development: economic growth, social development and environmental management.⁴ Yet the country is set on a trajectory of unparalleled and rapid development that most commentators would recognise as unsustainable⁵ and which features many of the "errors" that have been made in other parts of the world, including, for example, a lack of developed recycling and waste management infrastructure, urban networks with cars as the main mode of transportation and precious water resources that are heavily subsidised and do not reflect the true cost of generation and distribution.

While there are forward thinking examples of the state-of-the-art sustainability in action across the GCC, for example, at the city level, Masdar City in Abu Dhabi; at the neighbourhood level Msheireb, the "Heart of Doha" and at the building level, the Bahrain World Trade Centre (BWTC) with its large wind turbines, only little attention has been paid to the robustness of the sustainability credentials within and between these levels or to the people who reside within them, with their diverse needs, desires and behaviours, which are not necessarily environmentally favourable. For example, the BWTC sits atop an exclusive shopping mall filled with designer brands, which implies a rift between the environmental sustainability that the building espouses and the culture of consumption it serves. In the case of the Heart of Doha phenomenon, it is unclear how the development will integrate with the less sustainably innovative structures surrounding it, where presumably people will lead their daily lives much as they did before.³

Thus, in assessing the credibility of the innovations in the built environment, we need to evaluate their economic, environmental and social sustainability across and between buildings, neighbourhoods and cities to ensure the quality of life of all members of their communities, including the large migrant workforces involved in creating much of the Gulf, without restricting the options of future generations or causing negative environmental impacts along the way.

The explosive transformation of the region from a relatively barren desert landscape into densely populated, multi-cultural cosmopolitan settings brings with it enormous challenges, not least that countries of the Gulf region hold the unenviable status of being the most affluent, resource-intensive and, consequently, waste-generating nations of the world. Estimates of the volume of solid waste generated in the Gulf Cooperation Council countries range from 80 million to 120 million tonnes per annum rising to 130 million tonnes in 2014 with the greater part ($\geq 50\%$) originating from construction and demolition activities, with municipal waste accounting for more than 30%.⁶ Indeed, per capita municipal waste generation rates rise above 1.5 kg per day in most countries of the region,⁶ ranking the Gulf States as some of the highest waste-generating countries globally. In this paper, we explore the attitudes, behaviours and institutional aspects of waste management in Qatar, in the context of sustainability issues in the wider Gulf region.

2. WASTE MANAGEMENT GENERATION AND BEHAVIOURS

Numerous studies have previously considered attitudes and behaviours in relation to waste management and recycling practices. A survey conducted in Spain with more than 1,000 participants found that the distance that people need to travel to reach refuse and recycling collection bins also influences their willingness to separate waste (for recycling in the home). Further, it noted that people who have the habit of recycling indicated their motivation to be their concern about their surrounding environment and considered this as a duty of every citizen.⁷

Several researchers note that the MSW generation rate and composition are influenced by a range of factors, including geographical and climatic conditions, population and socio-cultural factors.^{8–12} The economic status of a country is particularly related to its waste generation rate and composition.¹³ Chandrappa and Das¹¹ stated that low-income countries with an annual GDP below US \$5,000 per capita have the lowest MSW generation rates of 0.3–0.9 kg/capita/day. By contrast, the MSW generation rates of countries with a higher GDP reach 1.4–2.0 kg/capita/day or higher.

For the State of Kuwait, a GCC country with many cultural practices similar to Qatar, the waste generation was recently documented.¹² The results estimated an average daily municipal waste generation rate of 1.01 kg/person. The study included detailed waste stream surveys for more than 600 samples of municipal solid waste (MSW), including the categories of paper, corrugated fibres, PET bottles, film, organic matter, wood, metal, glass and others. It was also evident from the study that organic waste was dominant (44.4%), followed by film (11.2%) and corrugated fibres (8.6%).

In the GCC, an added dimension to the problem is the constant change in the expatriate population from year to year, which causes a significant flux in the waste stream composition. A significant percentage of the expatriate population in the region leaves the countries yearly with the termination of contracts. “These individuals are replaced by another group of expatriate workers mostly from the Philippines, India, Bangladesh and Sri Lanka. The generation and the mix of urban solid waste are therefore in a process of constant change. The solid waste information of only a few years back may no longer be valid to represent the picture of household solid waste at the present time” (p. 143).¹⁴

3. AIMS AND METHODS

The overall aim of this paper was to collect data for Qatar on an inherently complex question: Is it possible to design waste management strategies that overcome the idiosyncrasies of people by promoting actions that are inherently sustainable? In other words, is business-as-usual with a few technical adjustments and high-profile innovations sufficient or will something more fundamental and radical be required?

The paper begins with an overview of the scale of the problem of solid waste aggregation in Qatar and the steps taken for its management to date across domestic, construction and industrial waste streams, drawn in part from a study of domestic waste undertaken during 2011 and 2012.⁶ Additional data and information are taken from publically available documents and a number of focused interviews with environmental management practitioners based in Qatar held in 2014–2015. Finally, a survey was conducted to explore the attitudes of people towards municipal solid waste management in Qatar.

The hypothesis of the survey is that *the current attitudes of individuals towards MSW generation and handling are leading to the large amount of MSW, and therefore, the behaviour of society is the key to reduce the waste generation from current levels*. The key components to study the attitude of a society towards the generation and management of waste are:

- the level of understanding of the population with regard to MSW;
- the common practices leading to large amounts of MSW;
- the willingness of people to change those practices;
- the motivating factors to reduce MSW.

An online survey was conducted to test the hypothesis. A total of 276 people responded to the survey, whose social classification is shown in Fig. 1. The discussion with regard to this paper will be limited to a few questions. However, a detailed questionnaire can be found in the Annexes.

The survey was developed starting from the organisation of the demands of the present study. The aim was to develop closed-ended questions to enable a quantitative and critical analysis of the data. A set of 31 questions was developed initially, drawing on the results of previous surveys. Experts in

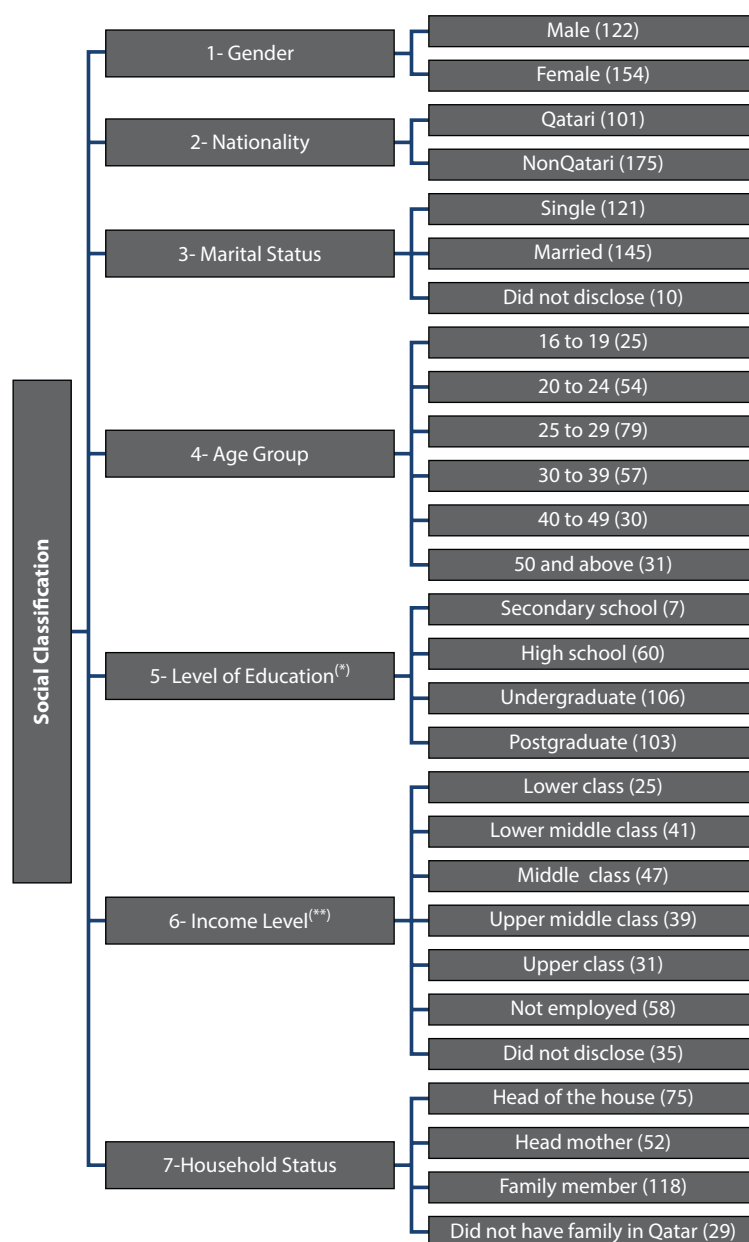


Figure 1. Social classification of the survey respondents and respective number of respondents. *Secondary school (7th, 8th and 9th grade), high school (10th, 11th and 12th grade), undergraduate (1st degree), postgraduate (additional degrees). **Lower class (less than 5,000 QAR), lower middle class (5,000–9,999 QAR), middle class (10,000–19,999 QAR), upper middle class (20,000–34,999), upper class (35,000 or above), not employed.

the field of MSW in the GCC helped to screen the questions to an appropriate number that adequately covers the scope of the study. As a result, the number of questions in the final survey was reduced to 18.

The survey was hosted in English and Arabic languages to target as large of an audience as possible. After hosting the survey online on Wufoo, the audience was reached through social media, e-mails, the Qatar Green Building Council's website and the Qatar Foundation's newsletter (Maktabi). The survey was hosted online for 2 weeks, after which the raw data were analysed using Microsoft Excel and IBM SPSS version 21.

Most researchers believe that environmental attitudes and social behaviours are closely linked.^{15–17} However, the methods to establish this link and the direct connections between social behaviours and the respective environmental attitudes remain to be developed.^{18–20} The present work is an effort to meet the shortcomings of the literature and provide survey-based results to develop a chain between social attitudes and MSW management in the State of Qatar.

4. REVIEW OF SOLID WASTE MANAGEMENT PRACTICES IN QATAR

Until relatively recently, with the exception of hazardous waste, a majority of solid waste – domestic, commercial, industrial and construction – in Qatar ended up in landfill with a fraction of the total recycled, 8% according to Qatar National Development Strategy 2011–2016.²¹ Furthermore, the former Ministry of Environment (the Ministry of Environment is now merged with the Ministry of Municipality and Urban Planning to form the Ministry of Municipality and Environment) showed that domestic waste rose from approximately 742,552 tonnes in 2008 to 931,662 tonnes in 2013, while the generation of total solid waste from all sectors over that period increased from 8.3 million tonnes to 12.1 million tonnes, an approximately 45% increase.²² Given that construction is racing towards the 2022 World Cup and beyond and that the population, currently nearly 2.5 million (June 2016), is projected to increase to support these activities, the upward trend in waste generation in Qatar will continue in the near future.

Recognising the need for a solution to the increasing waste generation, Qatar set out ambitious targets in its National Development Strategy (NDS) 2011–2016 across all waste-generating sectors with the goal of reaching a national recycling rate of 38% of solid waste by 2016, as well as improving material recovery and waste reduction at source. The stated aim was to minimise the disposal of all waste streams to landfill, this being the least-favoured waste management option on the waste hierarchy defined by United Nations Environment Programme – avoid, reduce, reuse, recycle, recover, treat, dispose – a principle adopted by many organisations and governments. To this end, the NDS calls for the elimination of waste at source; enhanced waste management techniques, know-how and education; improved recycling infrastructure and sophisticated material recovery facilities to move Qatar towards a more integrated waste management system. However, the strategy falls short of recommending a circular economy methodology, which would close the loop on all waste streams across the country. This approach has been adopted by the city of Borås, Sweden, where the waste recovery system is designed to convert all forms of waste into value-added products, such as biogas, electricity and heat, with the result that <1% of waste ends up in landfill.²³ In the same vein, Education City in Doha has a stated aim to be an exemplar of waste management by becoming a zero-waste location. It will do this through a two-pronged strategy of technological innovation and changing attitudes towards waste – from a material destined for landfill to a valuable resource.²⁴

4.1. Domestic solid waste management

Part of the approach in Qatar to domestic waste management was to close landfill sites to domestic waste while at the same time inaugurating a state-of-the-art Domestic Solid Waste Management (DSWM) facility, which features one of the largest compost plants in the world, at Mesaieed, south of Doha, together with five waste transfer stations designed to handle waste collected across the country by municipal vehicles and private contractors. The DSWM plant began accepting waste in December 2010. When operating at full capacity this plant is capable of processing 2,300 tonnes of commingled municipal solid waste per day, which can be separated into 627 tonnes for recycling, 857 tonnes for composting and 922 tonnes for input to a waste to energy plant.²⁴ Unfortunately, because of the burgeoning amount of waste from Qatar's development activities, the presence of few at-source recycling options for the general public and the absence of a comprehensive, countrywide education programme to encourage waste reduction, volumes of domestic waste have overwhelmed the new facility, and a landfill close to the Mesaieed Plant was opened in 2012 to cope with the overflow, pending either expansion of the plant or additional waste management facilities elsewhere.

The lack of municipally-operated recycling facilities across the country continues to be a great shortcoming despite the fact that a recent e-survey by the Qatar Green Building Council (QGBC) into attitudes towards green living in Qatar found an overwhelming support for recycling in the pursuit of greener communities and neighbourhoods in the country.^a Indeed, 90% of the 1,600 residents who participated in the survey indicated that their biggest motivator to recycle is their care and concern for more environmentally friendly behaviours, given the opportunity to do so.²⁴ However, there is no guarantee that these stated beliefs will translate into the desired recycling behaviour, particularly if recycling is not convenient, easy and fool proof. Clarke and Almanai reported the results of two small surveys of environmental and social work students in Qatar, which suggest that even the most

^aRefer to Qatar Green Building Council Attitudes to Sustainable Living Survey (<http://www.qf.org.qa/news/qatar-residents-ask-for-enhanced-recycling-facilities>).

environmentally aware individuals may not follow through (see QF Telegraph,²⁴ pp. 373–374). Low participation in kerb-side recycling is, according to Dresner and Ekins,²⁵ primarily due to problems of information, awareness, motivation and culture.

However, anecdotal evidence suggests that where members of the public are recycling in Qatar, it is often by use of schemes at their place of work or their children's school, which are managed by private contractors, rather than a municipality-run scheme. Indeed, some go to great lengths to recycle their waste thoughtfully, for example, by taking spent batteries back to their home countries for safe disposal. Unfortunately, a "Clean Qatar" drive – a waste recycling plan for households reported in local media in February 2015 – that would include the distribution of specially designed containers to families, mobile treatment plants and dedicated trucks for recycled material – has yet to materialise. It also remains to be seen whether individuals will be penalised for non-compliance with recycling rules and what impact the lack of a "waste tax"^b will have on the overall recycling rates. It may be an uphill struggle in the absence of a sea change in attitudes, in which people take individual responsibility for their waste. Indeed, Thomas *et al.*,²⁶ in a study of the Western Riverside Authority in London, identified three types of recyclers (high, medium and low/non), each with different attitudes, motivations and behaviours, which further complicate the mix and suggest the need for a multi-faceted education program to support the implementation of a recycling system.

4.2. Industrial solid waste management

The picture is more positive in relation to industrial solid waste. In the Oil and Gas sector, and in compliance with local and international legislation and regulations governing waste handling, treatment and disposal, the Health, Safety and Environment (HSE) Regulations and Enforcement Directorate (DG) of the Qatar Energy and Industry Sector reports good progress on waste management, including reductions in waste generated, increases in waste recycling and elimination of mishandling of waste.²⁷ The sector has achieved this through best practice workshops, capacity building, incentivising award schemes and multi-stakeholder engagement. In 2013, 218,694 tonnes of waste were recycled by the 26 companies reporting data to the DG, which corresponds to a recycling rate of approximately 36%, just short of the NDS target of 38%. While the report represents the activities of a small number of companies, it demonstrates what is possible given the right mix of know-how, legislation and incentives. For example, RasGas – an integrated Liquid Natural Gas supplier – launched a corporate waste management programme in 2009, which provides a cradle-to-grave framework for waste minimisation, collection, treatment, storage, reuse, recycling and disposal and has brought about recycling rates that largely exceed industry averages and national targets. In addition, it has enabled the company to enhance performance, transfer knowledge to contractors and develop innovative technological and human-led solutions to waste issues.

In the chemical industrial sector, Qatar Plastic Products Company (QPPC) – a manufacturer of flexible plastic packaging – has utilised a closed-loop production system, in which production waste and returned materials are recycled internally and transformed into recycled plastic products. This approach reduces waste from the factory to a minimum, saves the company money and generates a resource stream from waste. It demonstrates what can be achieved if waste minimisation is given high priority and is an integral part of business philosophy. In 2014, QPPC produced 277 tonnes of products made from recycled materials against a total production tonnage of approximately 12,600 tonnes of primary material.^c

These examples demonstrate the scope of waste management and what might be achieved in the domestic sector given the right incentives, behavioural changes, education and infrastructure.

4.3. Construction solid waste management

Phenomenal rates of development mean that construction companies in Qatar are grappling with enormous waste management issues. According to Ministry of Environment estimates, approximately 9.35 million tonnes of construction waste went to landfill in 2013, down from a high of 9.7 million in 2012.²⁷ This is composed primarily of excavated soil, concrete and mixed non-hazardous waste and is

^bThere is precedence for a waste tariff in the Gulf region; Abu Dhabi introduced a Waste Generation Tariff system in 2011 with the ambitious goal of reducing waste production from commercial, industrial, construction and demolition activities by 80% of its current volume by 2018.

^cPrivate email correspondence with Technical Manager QPPC, March 2015.

in addition to other common waste streams, such as tyres, used oil, plastic packaging, metal, paper and wood, which are recycled in line with each company's environmental policies. For example, Qatar Diar Vinci Construction (QDVC), a company with several thousand employees focussed on large-build projects, has a sustainable development policy on the environment, which states, "QDVC has implemented series of management strategies to reduce its environmental impact. These include efficient waste management, green procurement methods, monitoring of the environmental aspects and mitigation of their impacts, promoting clean technologies, best construction practices, investing in research, innovation and conserving of natural resources such as water".²⁸ This policy is applied to all projects and is managed by a small Head Office team and project teams of two or three depending on contractual requirements. In 2014, the company reused 643,398 cubic metres of excavated soil and concrete and recycled more than three million kilograms of scrap metal, paper and plastic, with the help of companies such as Al Suwaidi Paper Factory (paper/cardboard), Doha Plastic (packaging waste), Lucky Group (metal) and Al Haya Waste Management (electronic equipment).^d

Mega development projects such as the Qatar Rail development and Lusail City create massive waste management challenges, not least in relation to the removal, transport and reuse of excavated materials. In this regard, the Transport Research Laboratory (TRL) Qatar has recently completed a study of innovative uses of recycled aggregates in construction. With the colossal demand for aggregates in the run up to the 2022 World Cup, maximising the use of recycled aggregates is a priority and could potentially divert huge quantities of these materials from landfill and reduce the carbon footprint by up to 50% in relation to importing primary aggregates.^e As noted by Khalid Hassan, General Manager of TRL Qatar, overcoming the shortage of road-building materials, for example, by using recycled aggregates means that "instead of rotting in landfills, these old materials can be reused to supply the needs of the country's development".^f However, the use of recycled materials in construction not only requires technological and waste management know-how, but also entails changes in the regulations pertaining to, for example, the specification of allowable road materials. This necessitates collaboration between government, industry and academia, which has been a feature of this project.²⁸ It also requires a belief in and evidence that these recycled materials are as good as if not better in performance terms than the new materials they replace.

At the level of a city development, such as Lusail City, effective waste management by construction companies is encouraged through the implementation of an overarching environmental management plan, which covers the entire development and with which compliance is mandatory for all contractors. Through a weekly reporting mechanism, the 23 contractors on site in 2014 reported that 3,540 tonnes of waste (steel, plastic, timber and paper/cardboard) and 8,760 litres of waste oil were recycled.⁸ Each company makes its own arrangements with waste management providers to handle their various non-hazardous and hazardous waste streams (paper, plastic, metal, tyres, medical waste, oil, etc.), rather than through a centrally run system for the entire build. To encourage continuous improvements in environmental performance, contractors are invited to participate in the Lusail Green Award scheme. This helps to promote best practice and heightened awareness of the need for more sustainable behaviours.

In a similar manner to Lusail, at The Pearl-Qatar, an upmarket Riviera-style island development owned and developed by United Development Company (UDC), emphasis is placed on encouraging environmentally sensitive behaviours in staff, contractors and residents through voluntary incentive schemes and mandatory policies. In tower blocks, an ENVAC waste management system is designed to transport up to 3,720 tonnes of commingled waste per month through underground pipes to a dedicated waste transfer station on the Island from where it is shipped to the DSWM facility.⁶ The challenge is to expand at-source recycling opportunities on the Island for residents, the majority of whom live in high-rise buildings without inbuilt recycling facilities. In a bid to raise awareness about environmental challenges and encourage effective recycling and waste management, UDC has implemented a voluntary contractor incentive scheme, through which contractors report on their health, safety and environmental performance and waste management activities, and the best practice is rewarded. In addition, early in 2015, the company introduced a staff incentive program for UDC

^dEmail correspondence with QDVC Environmental Department, Qatar, February 2015.

^eRecycling in Qatar's Construction Industry. Downloaded from http://issuu.com/firefly-communications/docs/qcn_2_2_february2015_web/17?e=0

^fOutside the tarmac downloaded from <http://www.qatartodayonline.com/outside-the-tarmac/>

⁸E-mail correspondence with Environmental & Sustainability Manager, Lusail City, February 2015.

employees. It is interesting to note that, despite extensive and ongoing education and training, staff and contractors still make mistakes – for example, accidental contamination of the content of recycling bins – demonstrating how difficult it is to change ingrained behaviours.^h Residents are educated about environmental issues through practical events held throughout the year, including Earth Day activities.

5. SURVEY RESULTS

In order to gauge the level of awareness of the respondents about MSW handling practices in Qatar, Question 1 of the survey is, “What happens to the waste you generate?” In reality, about 3% of the solid waste in Qatar is recycled, 4% is incinerated and the rest (93%) is disposed in the landfills.²⁹ In comparison, the percentage of respondents who think that MSW is recycled, incinerated and landfilled are 21, 24 and 30%, respectively, as shown in Fig. 2.

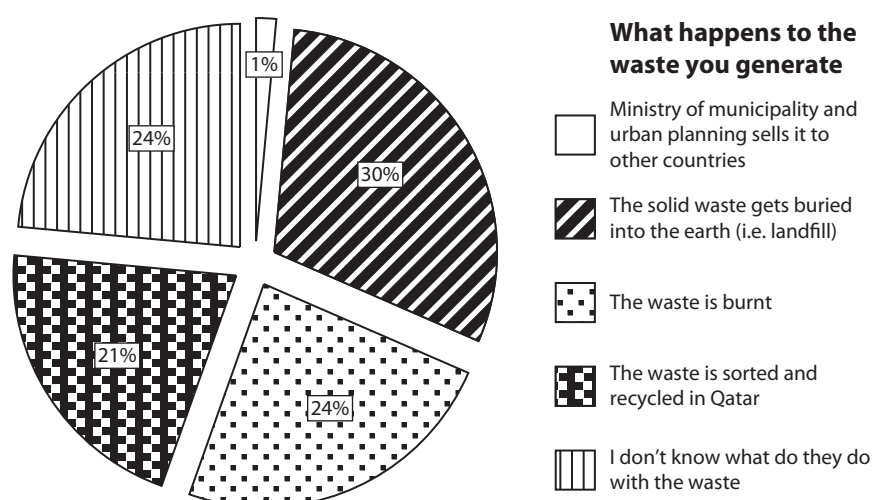


Figure 2. Perception of waste-handling practices among the respondents.

On the contrary, about 24% of the respondents did not know what happens to the waste, and a very small percentage (< 1%) believed that the Ministry of Municipality and Urban Planning (now MME) sells it to other countries. These numbers imply that a large portion of the population in Qatar is either uninformed or misinformed, having the viewpoint that more solid waste is being incinerated or recycled than landfilled. The results are not surprising given that similar findings have been reported in the past for other countries, for example, China, India, Sri Lanka and Thailand.³⁰

In the state of Kuwait, researchers have reported that nationalities and waste generation behaviour have a significant relationship with each other.³¹ Elaborating on this result, the same question – “What happens to the waste you generate?” – has been analysed with respect to the nationality of the respondents in Qatar. The nationality was categorised into two groups: Qataris and non-Qataris. The result of the analysis, shown in Fig. 3, suggests that more non-Qataris tend to have a better understanding of MSW-handling practices, that is, largely landfilling, than the Qataris who primarily believe that the household waste is recycled.

To seek the statistical significance between nationality and awareness of waste-handling practices, a Chi-square test has been carried out using SPSS, testing at a 5% level of significance.^{32,33} The results of the test (Chi-square = 9.41, df = 4, $p = 0.052$), detailed in Table A.1 of Appendix A, suggest that there is a borderline statistical significance between these two categories.³⁴ This lack of statistical support does not make the results inconclusive. One of the obvious reasons for the borderline statistical significance is the high levels of the variables, 5×2 matrix in this case, compared to the number of responses.³⁵ A further analysis of the probability of statistical errors, that is, type I (or α) and type II (or β) errors, can provide a better insight into the statistical significance of the result;³⁶ however, such an analysis does not lie in the scope of the present work.

^hDiscussion with UDC Environmental Department, November 2014.

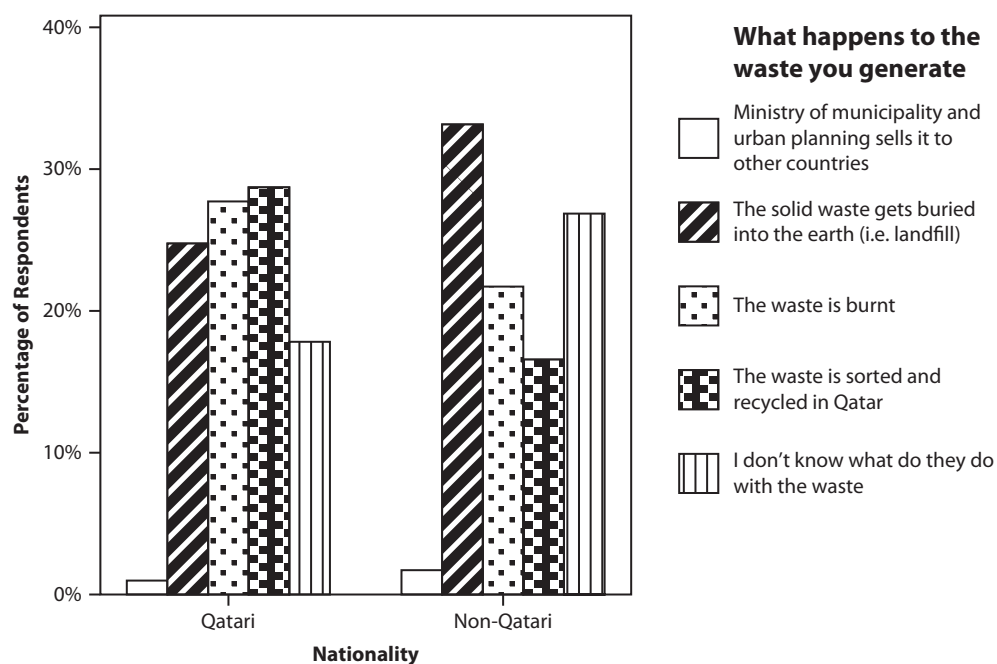


Figure 3. Perception of waste-handling practices based on nationalities.

Corral-Verdugo³⁷ highlighted that gender can also be a crucial demographic determinant in recycling and waste generation in a society. Therefore, additional investigation has been carried out to examine the waste-handling awareness among the Qatari males and females. The results show that Qatari women tend to have a better insight into waste disposal practices than Qatari males, as shown in Fig. 4. About 29% of Qatari females believe that the household waste is landfilled compared with 16% of Qatari males. However, a large proportion of respondents, both males and females, equally believe that the MSW is either recycled or incinerated, whereas, in reality, recycling and incineration represent less than 10% of the overall waste disposal in Qatar.

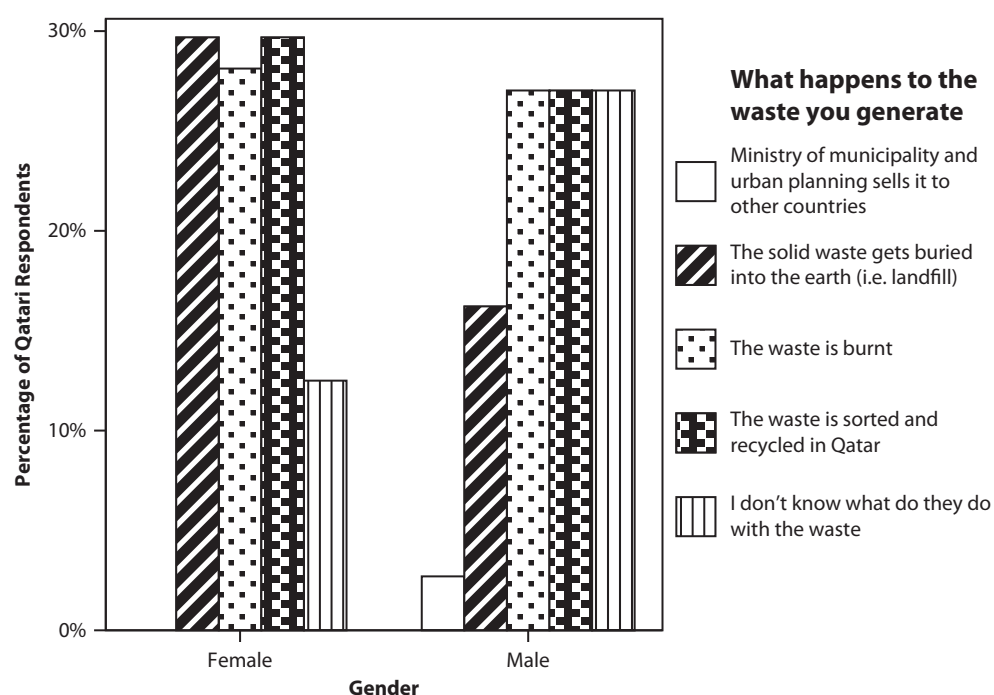


Figure 4. Perception of waste-handling practices among the Qatari respondents with respect to gender.

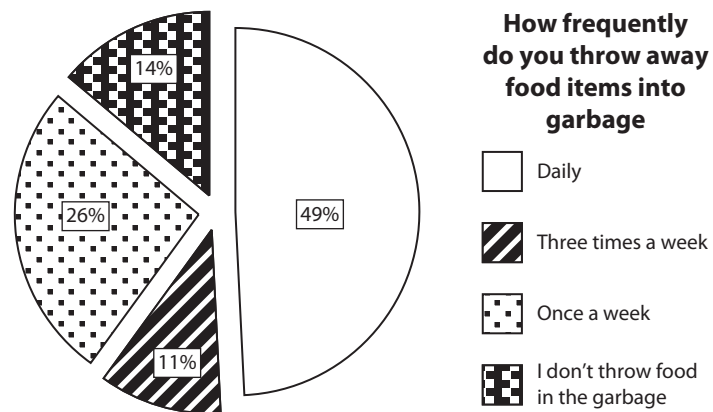


Figure 5. Frequency of wasting food among the individuals who do not know how household waste is disposed.

To determine the statistical significance between the gender of Qatari population and awareness of waste handling in Qatar, a Chi-square test has been carried out at a 5% level of significance. The results of the test (Chi-square value = 6.293, $df = 4$, $p = 0.178$), shown in Table A.2 of Appendix A, suggest that there is no statistical significance between these two categories. A similar study has been carried out in Nigeria to seek the level of understanding of waste generation and disposal with respect to gender.³⁸ In the Nigerian study females are reported to have better understanding of waste handling and disposal compared with the males.

It has been advocated in the literature that individuals respond to waste problems only when they perceive it as a threat to their well-being.^{39,40} In connection with this, it is important to determine if only the awareness of waste-handling processes is enough for people to reduce waste generation, or if there has to be another level of awareness of the consequences of waste problem. Because a considerable percentage of respondents do not know how household waste is handled in Qatar, it will be interesting to analyse their waste generation frequency, particularly food waste, in contrast to the waste generation frequency of the individuals who are aware that a large proportion of waste is landfilled.

The results presented in Fig. 5 suggest that, of all the individuals who do not know what happens to the waste generated, 49% waste food items every day. On the contrary, 55% of the individuals aware of the waste-handling practices throw away food items daily, as shown in Fig. 6. This consistency in results implies that the awareness of waste-handling processes alone may not be sufficient to inspire people to reduce waste generation. This phenomenon has been referred to as a “psychological variable” in the literature and can be explained as the individual’s adaptive capacity to defend against only those environmental problems that they perceive as a high-level tangible threat to the environment and well-being of society.⁴¹ Hence, even though people are aware of the waste disposal practices, they appear to lack an understanding of the long-term detrimental consequences of excessive landfilling.

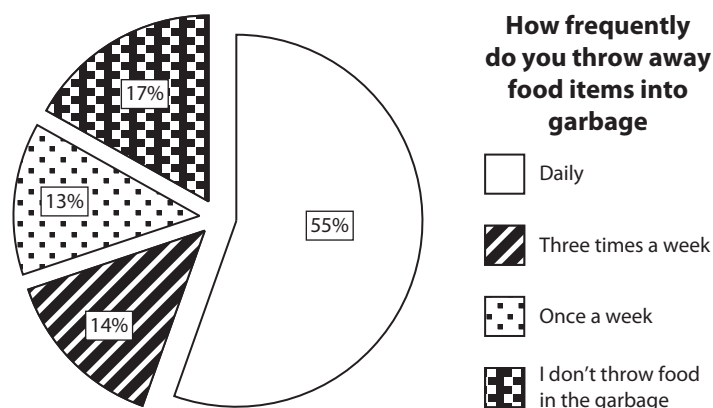


Figure 6. Frequency of wasting food among the individuals who are aware that most of the household waste is landfilled.

The attitude of survey respondents towards managing household waste in Qatar has been weighed against their opinion that the responsibility for improvement should be held by themselves, communities, companies and/or government. Similar to the results of a study conducted in the United Kingdom,⁴² the majority of respondents, as shown in Fig. 7, feel that individuals have a certain responsibility for improvements in MSW management in Qatar. This is in addition to the community's responsibility as a whole, as well as companies and government. This result is remarkable for a country where most of the people look only towards the government to address social challenges.⁴³ It demonstrates a growing sense of responsibility among the Qatari people and residents of Qatar for environmental concerns and the realisation of the importance of collaboration among different institutions to develop sustainable societies.

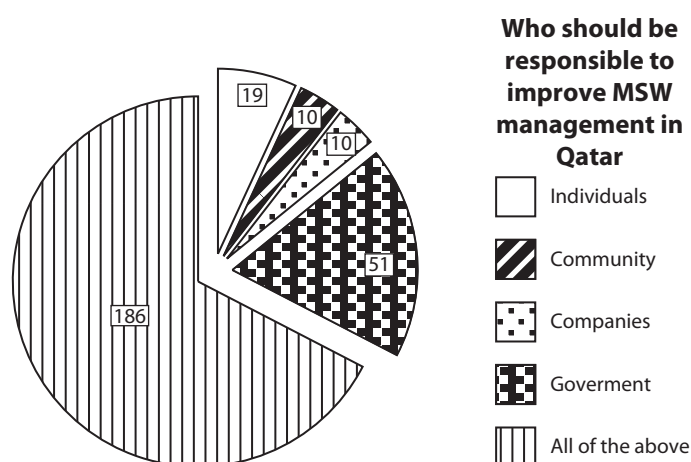


Figure 7. Perception of the responsibility for the improvement of MSW management in Qatar.

A total of 186 respondents placed the responsibility of improvement of MSW management on both institutions and individuals compared with the 51 respondents who held only the government in charge for the betterment. Of these, 59% ($N = 31$) throw away food items. This provides an opportunity to educate people about the shared responsibility that is needed to achieve a net social benefit. No single institution will be able to completely eradicate the waste problem until all other institutions and individuals play their part in reducing waste generation.

Food waste constitutes a large portion of the household waste in developing and under-developed countries.^{44–48} According to a report of Food and Agriculture Organization of the United Nations (FAO), about 1.3 billion tons of food is wasted each year, which represents about one-third of annual food production, and costs around US \$1 trillion.^{49–51} The problem is more serious in the Near East and North Africa Region (NENA),ⁱ comprising most of the Arab world, where every local resident, on an average estimate, had wasted 250 kg of food in 2014, compared with 70 kg per person in other parts of the world.⁵² In light of these statistics, the perspective of survey respondents in Qatar, on food waste, was determined through their frequency of discarding food items. A staggering 50% ($N = 138$) of survey respondents reported to throw away food items daily, as shown in Fig. 8. Wasting food daily is alarming, especially in a country, as small as 11,586 sq. km,⁵³ where over 90% of MSW is landfilled.²⁹ Such a practice will not only require more land in the near future, but also produce large quantities of landfill gases associated with organic waste, which can have severe adverse effects on public health and safety.^{54,55}

This result was explored further to see how the level of education could influence the food-wasting rate. For that purpose, 138 respondents who reported to waste food daily have been analysed over their level of education. The results, as shown in Fig. 9, revealed that a high level of education does not reduce the food-wasting tendency of an individual, as 38% of postgraduates throw away food items daily, followed by 36% of undergraduates and 22% with high school education. It should be noted that the lower number of responses with secondary school education, only 3%, is mainly due to the lower participation of individuals in this category.

ⁱAlgeria, Bahrain, Egypt, the Islam Republic of Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, the United Arab Emirates and Yemen.

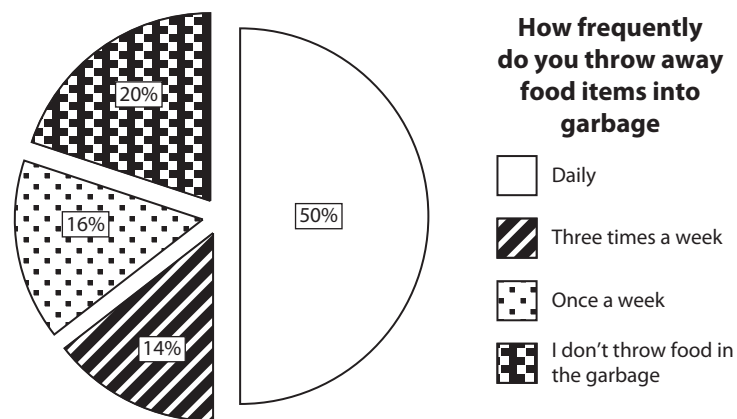


Figure 8. Frequency of wasting food items.

Thus far, we have talked about the understanding and attitude of people in Qatar, in the context of MSW. This section examines the willingness of people to change their behaviour and practices and their motivation to do so. Conventionally, people from all parts of the world express their willingness to change waste-generating practices to avoid undue environmental burden.^{42,56,57} Similar results were anticipated from both the local Qatari population and foreign residents of Qatar. To observe the willingness of people to change, the survey asked the question, “Are you willing to switch to reusable cloth bags instead of plastic bags for shopping?” As expected, both Qataris and non-Qataris have shown a positive response (Fig. 10). Interestingly, the constraint of this change is different between Qataris and non-Qataris. The former have agreed to make this switch provided they are given some time to get used to the practice (43% Qataris), whereas the latter expressed their interest conditioned on the low-cost and easy availability of cloth bags (39% non-Qataris).

The results of the Chi-square test (Chi-square value = 6.297, df = 4, $p = 0.178$), as shown in Table A.3 of Appendix A, support the null hypothesis that no significant relationship exists between the nationality and the willingness of people to switch from plastic to cloth bags. Hence, people of Qatar, regardless of the nationality, have shown interest in changing their behaviour to reuse cloth bags for shopping.

To further examine the willingness of respondents to change, their opinion on recycling has been analysed. In this context, respondents were asked, “If a recycling program was set up to collect materials such as plastic, paper, metals, etc., would you be willing to segregate these materials into separate bags for collection purposes?” Results shown in Fig. 11 highlight that the respondents are equally willing to participate in the recycling program as they were to reuse cloth bags for shopping – 93% of the respondents have given an affirmative answer, whereas only about 3% rejected the idea and the remaining 3% have asked for further information on the recycling program. The consent of the residents of Qatar to the “change for betterment” is remarkable. People are willing to participate in initiatives aimed at waste minimisation.

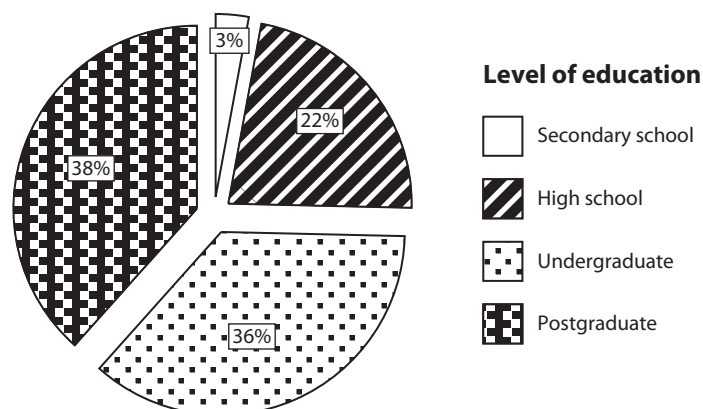


Figure 9. Education level of the respondents who waste food items daily.

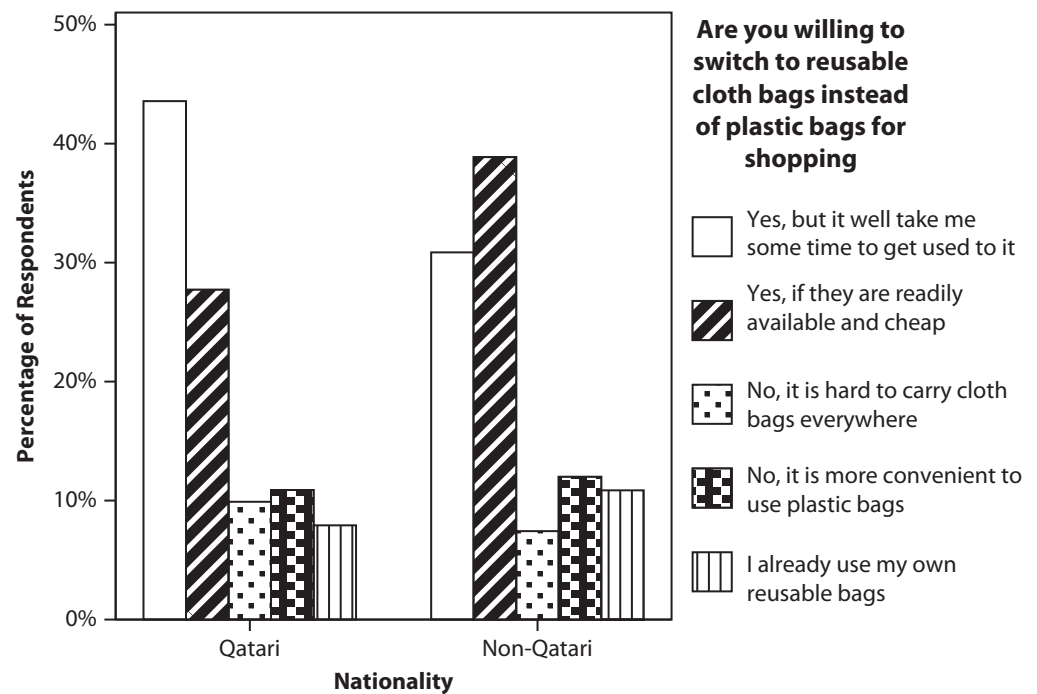


Figure 10. Readiness of people to switch from plastic bags to reusable cloth bags based on their nationality.

While the majority of respondents have agreed to participate in a recycling program, it is important to recognise the barriers to the success of such programs. Respondents were asked, “What do you think is the biggest barrier in a program to reduce waste and encourage recycling?” As shown in Fig. 12, the top three hurdles identified by the respondents are deficiencies in the training of people (47%), lack of

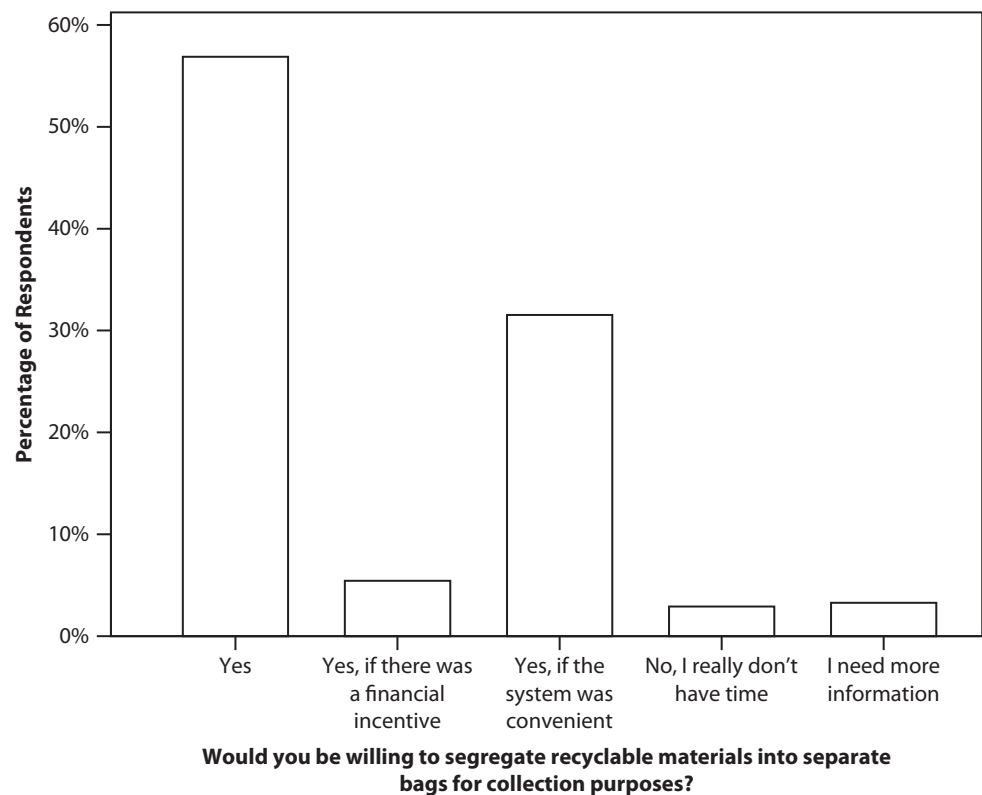


Figure 11. Willingness of people to segregate waste for recycling program.

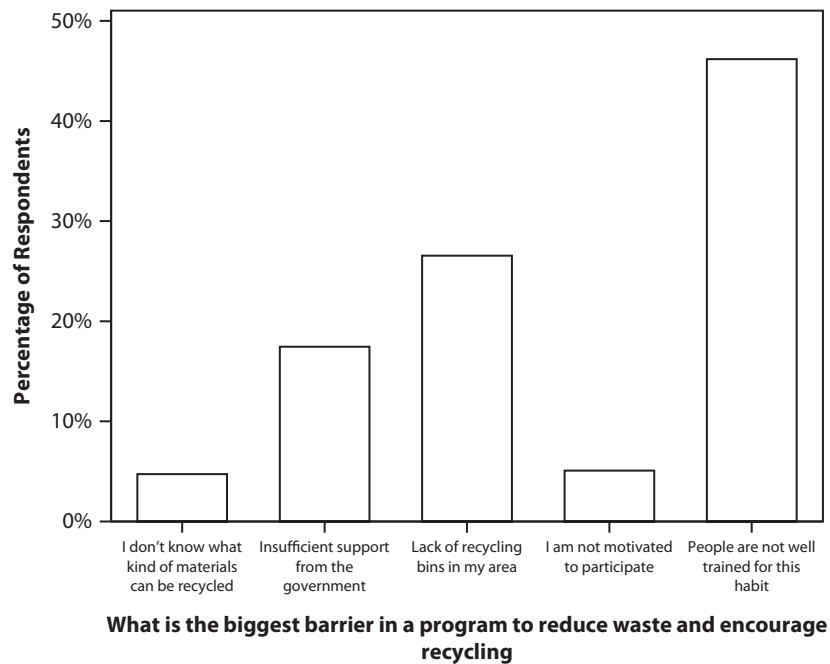


Figure 12. Respondents' perception of barriers to the success of waste reduction and recycling programs.

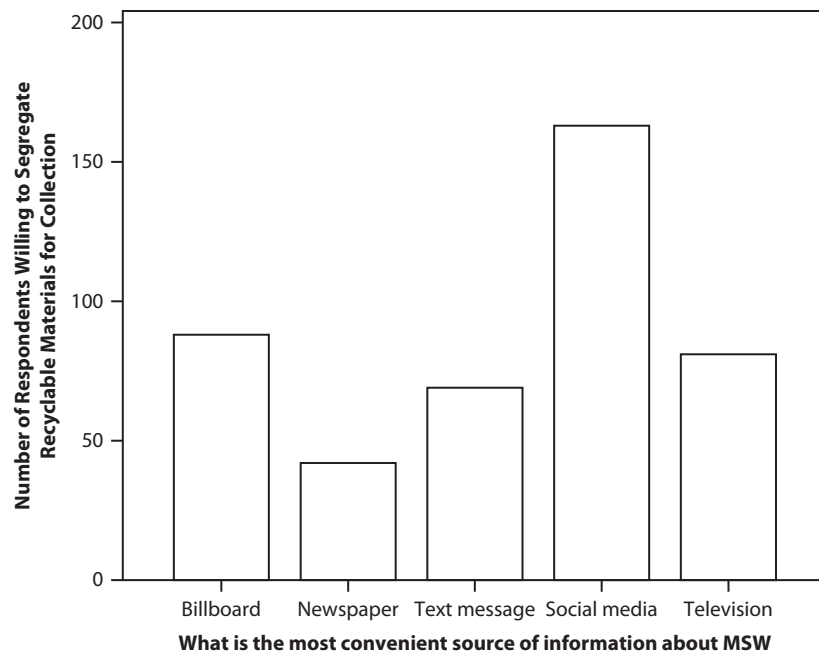


Figure 13. Convenient sources of information about MSW.

recycling bins (27%) and insufficient support from the government (18%). It has been demonstrated that training and education can effectively improve the recycling culture in societies.⁵⁸ As such, this represents an opportunity for the concerned authorities to increase the recycling rate of MSW from 3% (present) to the targeted 38%.^{29,59}

Finally, respondents who showed willingness to participate in recycling programs were asked to identify the most convenient source of information about MSW.^j It can be seen in Fig. 13 that social media is the most preferred channel to engage people in recycling initiatives. Other popular options are

^jIt was the only question in the questionnaire where respondents could chose multiple options.

billboards, television and text messages. Social media has the benefit of not only targeting the intended audience but also triggering the interest of others. It could be used to help people understand the consequences of ignoring the waste problem, which allegedly in some cases has led to the transfer of large quantities of municipal waste from developed countries to developing countries,⁵⁰ without good reason.

We have seen through this survey that the people of Qatar have shown an apparent willingness to change their waste generation practices. However, training these individuals about household waste management could further reduce waste and encourage recycling.

6. DISCUSSION

Less than a generation ago, desert-dwelling families in the Gulf Region cherished, respected and lived in harmony with their immediate environment, recognising its fragility and importance to their ongoing well-being,⁶⁰ with date stones, palm fronds and camel manure being the main waste streams. Today, with a desire for all the technological, economic and cultural sophistication that the 21st century can offer, waste is far down on personal “To-Do” lists and more likely than not to be viewed as someone else’s responsibility as shown by the results of the survey reported in this paper. While the survey suggests a willingness among Qatar’s residents to act in environmentally friendly ways, it is not unusual in Qatar to witness trash thrown out of car windows, garbage left on beaches, plastic bags floating in the wind and an army of street cleaners and volunteer beachcombers picking up after the remainder of the population. With the attitude that it is the responsibility of government or others, and in the absence of fully enforced waste management policies, the desire for rapid development appears to champion all. This reality may be due in part to the need to fulfil development promises in ever-shortening timescales leading up to World Cup 2022 as well as a function of different concepts of personal space and the public good: so long as my yard is clean and tidy, I need not be concerned with what goes on the other side of my wall as that is someone else’s (i.e. the municipality’s) responsibility. Moreover, in a country where many households have hired help – cleaners, drivers, nannies – and where a vast migrant worker population has different waste generation patterns and a lower stake in long-term outcomes, an added dimension is the need to educate, incentivise and empower all residents to ensure the successful implementation of waste minimisation and recycling initiatives.

What is demonstrated by the range of waste management examples described above and the survey is that in and among the growing waste mountain in Qatar, there are encouraging instances of effective waste management underpinned by a waste avoidance approach. Yet conspicuous by their absence are the modern day “gold prospectors” that might be expected to be clamouring to grab a share of the revenue to be made from waste. Part of the problem lies in the economics of many of these initiatives; while companies such as Averda, Al Haya Waste Management, Al Suwaidi Paper Factory, Doha Plastics and Lucky Group cater to some of Qatar’s waste management needs, often the business case for projects is lacking. Without government support, including the revision of legislative and regulatory frameworks, or viable markets for products made from recycled materials and the waste itself, incentives may not exist for dealing with waste in innovative ways. Companies offering integrated waste management services for recycling often operate on a relatively small, localised scale without municipal infrastructure and on a case-by-case, contract-by-contract basis with individual companies or organisations. For example, Averda provided a recycling service for paper/cardboard, plastic and cans at the former Ministry of Environment at their 24-storey headquarters building in West Bay, Doha, one of the first ministries in Qatar to embrace recycling wholeheartedly. The introduction of the scheme required careful planning to ensure that all staff received training as well as to manage the logistics of emptying the large outside storage container, which occupies much sought-after parking spaces and has to be emptied outside working hours.^k This latter issue demonstrates the reality of retrofitting recycling services into existing building stock. Often, tower blocks do not have space for collection points on every floor or temporary storage facilities at ground level for accumulated recycled materials. Furthermore, in cases where building owners and occupiers do not welcome the extra manpower and time needed to manage the system, an argument can be made for a hi-tech solution that removes the need for individual decisions about which recyclable product to put where and takes commingled trash from existing receptacles to a place where it can be sorted safely and effectively, in a similar

^kInterview with PR manager at Averda, February 2015.

manner to the DSWM facility. However, this does nothing to minimise the scale of the problem or change mindsets and points to the need for a multi-pronged approach.

A common element of many of the solid waste activities described in this paper, such as that at QPPC and QDVC, is the presence of highly motivated individuals who stand out as the environmentally forward-thinking innovator within their organisation. These individuals are often inspired by a deeply held belief in the need for environmental stewardship as “the right thing to do”, despite all the uncertainties and complexities that environmental, social and economic sustainability entails, and at the personal risk of being labelled as “unconventional”, in a local culture where conformity to social norms is expected. This type of multi- and inter-disciplinary, conventional-wisdom-shattering project is urgently required to tackle Qatar’s waste woes – not only to design out waste from the system, but also to tackle the wasteful attitudes, thought processes and mindsets that generate the waste in the first place and to replace them with a view of, “How can we do this differently?”. This implies that (futuristic) solid waste technologies need to go hand in hand with imaginative programmes to encourage innovative solid waste elimination at source. To this end, as evidenced in the results, social media platforms should be fully utilised in Qatar to propel waste to the top of the public agenda and get the subject of waste “trending”. The recently formed grassroots environmental organisation Doha Oasis^l is one vehicle through which to promote these ideas and innovations.

As Wals notes, increasing environmental knowledge will not necessarily bring about a more environmentally responsible behaviour. People’s environmental behaviours are far too complex and contextual to be captured by a simple cause-and-effect model, not least because of the uncertainty regarding what the most environmentally sensitive behaviours are and the recognition that there may be no universal answers; what is sustainable behaviour today may turn out to be unsustainable later in time.⁶¹ This suggests that while putting out recycling bins, for example, may result in more recycling, mountains of paper, plastic, glass and metal waste may still be produced by a wasteful society if the underlying principles governing it remain unchanged and the population does not have the critical thinking skills to analyse problems and propose cutting-edge solutions.

Thus, to move people and organisations along the waste hierarchy from reduce–reuse–recycle–recover to waste avoidance and prevention, they must be encouraged to take responsibility for their waste and then to re-define how things are done.⁶² This will have the effect of minimising waste and potentially closing the loop through an exchange system, for example, in which one organisation’s waste becomes a resource for the next, as in the circular economy approach highlighted earlier. The Arab Recycling Initiative spearheaded by UNESCO features elements of this philosophy. It is a Web-based platform to improve the waste management capacity of the Middle East by advancing the availability and visibility of information related to waste management in the region and features a simple Waste Exchange through which companies can post information about their recycling capabilities or materials they wish to recycle. However, it does not actively promote collaborative waste minimisation projects that might be designed to bring people together to develop out-of-the-box solutions to waste problems, from recycling upwards. At the country level, the Qatar Sustainability Network, an NGO partnership between academic, private and public sectors in Qatar to advance the culture of research, science and sustainability, launched with great aplomb on 24 October 2012, appears to have stalled in its infancy.^m However, if rejuvenated, it has the potential to create a platform for research and action about alternative solid waste management solutions and be a vehicle for the transformational change required. In addition, Estedama,ⁿ Qatar’s national programme for sustainable development initiated by and under the official patronage of the Ministry of Environment in 2013 after COP18, is a platform for raising awareness about sustainability issues in Qatar and for encouraging action through workshops, events and exhibitions. It has a key role to play in engaging individuals and organisations in a discussion about solid waste.

On the face of it, recycling and waste minimisation ought to be relatively straight forward and require little by way of external input or direction; for example, at collection points, recycling does not require state-of-the-art technology, unless, that is, the receptacles are smart bins that alert the depositor when a mistake has been made and/or notify the collection company that the bin is ready to be emptied. Nevertheless, the basic principle of putting the right thing in the right place is quite straightforward.

^lRefer to www.dohaoasis.org

^mRefer to Qatar Sustainability Network: <http://qsnetwork.org/>

ⁿRefer to Estedama: <https://www.estedama.qa>

However, doing things differently is more of a challenge because even a minor change can be a major hurdle; for example, using a jug of water and glasses instead of throw-away plastic bottles of water at a meeting or remembering to take a reusable bag to the supermarket for the weekly shop. Yet the survey results indicate a willingness to change and try new behaviours.

Could personal “ownership” of and responsibility for waste be promoted in a similar manner to a number of practical education-based programmes aimed at children, such as UNESCO’s Eco Schools, Mseheireb Properties’ Green Programme for Schools (GPS) and the Friends of the Environment Centre’s Award for Schools? What may be required are a set of big, bold, hands-on projects that can be used as a vehicle to raise awareness and change mindsets. What is lacking in Qatar is a mechanism to capitalise on the momentum that projects like Doha Oasis and Estedama generate. With an absence of any follow through, there is a danger that the participants in these schemes will become disillusioned and cynical. There is a sense that residents of Qatar are holding their collective breath, waiting for a solution, be it comprehensive curb recycling, a state of the art material recovery facility or a new waste management centre, which will enable the country to design and retrofit itself out of its waste woes.

7. CONCLUSIONS

Solid waste, and how to manage it, is a global problem. This study illustrated how Qatar is tackling it, both the successes and failures. What the discussion and the survey results demonstrate is that simply designing in waste management options may not be sufficient to achieve NDS targets, let alone anything near a zero-waste philosophy. What seems to be required is a retrofitting of mindsets and mechanisms to encourage changes in behaviours that complement the physical retrofitting of the built environment. This will enable the emergence of a shared vision of effective waste management for Qatar together with an implementation strategy. Undoubtedly, a forward-thinking country with a desire to lead the world also needs an excellent approach to solid waste management. This may be achieved by:

- taking responsibility for waste and redefining our relationship with it;
- unravelling the rules and re-thinking how things are done to find innovative ways of eliminating waste, whatever its source;
- exploring the “impossible” and aiming for zero; we might not get there but the target is a great motivator;
- looking for the catalysts and their networks; celebrate their achievements and use them to energise and engage others;
- educating with big, brave out-of-the-box projects that spark people’s imaginations and encourage others to join in; and
- investing in practical research projects to determine what works in Qatar; a uniquely Arabic approach to waste management may be waiting to be uncovered.

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Appendix A

Table A.1. Awareness of waste handling practices in Qatar based on nationalities.

			Nationality		
			Qatari	Non-Qatari	Total
What happens to the waste you generate?	Ministry of municipality and urban planning sells it to other countries	Count	1	3	4
		Expected count	1.5	2.5	4.0
	The solid waste gets buried into the earth (i.e. landfill)	Count	25	58	83
		Expected count	30.4	52.6	83.0
	The waste is burnt	Count	28	38	66
		Expected count	24.2	41.8	66.0
	The waste is sorted and recycled in Qatar	Count	29	29	58
		Expected count	21.2	36.8	58.0
	I don't know what do they do with the waste	Count	18	47	65
		Expected count	23.8	41.2	65.0
Total			Count	101	175
			Expected count	101.0	175.0

Chi-square tests	Value	df	Asymp. Sig. (two-sided)
Pearson's chi-square	9.410 ^a	4	0.052
Likelihood ratio	9.378	4	0.052
Linear-by-linear association	0.070	1	0.791
No. of valid cases	276		

^a 2 cells (20.0%) have expected count less than 5. The minimum expected count is 1.46.

Table A.2. Understanding of waste handling among the Qatari population with respect to gender.

What happens to the waste you generate (Qatari)?											
Ministry of municipality and urban planning sells it to other countries		The solid waste gets buried into the earth (i.e. landfill)		The waste is burnt		The waste is sorted and recycled in Qatar		I don't know what do they do with the waste		Total	
Gender (Qatari)	Female	Count	0	19	18	19	8	64			
	Male	Expected count	0.6	15.8	17.7	18.4	11.4	64.0			
Total		Count	1	6	10	10	10	37			
		Expected count	0.4	9.2	10.3	10.6	6.6	37.0			
		Count	1	25	28	29	18	101			
		Expected count	1.0	25.0	28.0	29.0	18.0	101.0			
Chi-square tests											
		Value			df	Asymp. Sig. (two-sided)					
Pearson's chi-square		6.293 ^a			4	0.178					
Likelihood ratio		6.564			4	0.161					
Linear-by-linear association		2.406			1	0.121					
No. of valid cases		101									

^a 2 cells (20.0%) have expected count less than 5. The minimum expected count is 0.37.

Table A.3. Willingness of people to switch from plastic to cloth bags based on their nationality.

			Nationality		Total
			Qatari	Non-Qatari	
Are you willing to switch to reusable cloth bag instead of plastic bag?	Yes, but it will take me some time to get used to it	Count	44	54	98
		Expected count	35.9	62.1	98.0
	Yes, if they are readily available and cheap	Count	28	68	96
		Expected count	35.1	60.9	96.0
	No, it is hard to carry cloth bags everywhere	Count	10	13	23
		Expected count	8.4	14.6	23.0
	No, it is more convenient to use plastic bags	Count	11	21	32
		Expected count	11.7	20.3	32.0
	I already use my own reusable bags	Count	8	19	27
		Expected count	9.9	17.1	27.0
Total		Count	101	175	276
		Expected count	101.0	175.0	276.0

Chi-square tests	Value	df	Asymp. Sig. (two-sided)
Pearson's chi-square	6.297 ^a	4	0.178
Likelihood ratio	6.308	4	0.177
Linear-by-linear association	1.679	1	0.195
No. of valid cases	276		

^a 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.42.