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Food Waste Management Associated with Offshore Isalnds

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Abstract

Food waste is classified as a threat that causes a challenge in achieving the goal of sustainable development worldwide. Recently, food waste has tripled over the past 50 years due to the increase in population. Moreover, food waste is accountable for a third of all human-caused greenhouse gas emissions and it generates 8% of greenhouse gases annually. However, sustainability can be achieved when losses of resources, food waste and it is associated impacts are reduced. Food waste management systems might not yet be introduced in the offshore islands. Thus, this paper works in introducing the food waste management system to the offshore locations in UAE to prevent and minimize the volume of food waste generated. The paper provides calculations of the estimated food waste volume generated from offshore islands to determine the effective solution for food waste management. This study proposes methods that include specialized mechanisms and solutions that can help in reducing food waste and extract revenue from such practices.

Keywords
Food Waste Management System, Environmental pollution, GHG, Composting and Anaerobic Digestion.

1. Introduction
In the current and highly populated world, food waste is a growing global crisis that is affecting the physical health of the earth and the population inhabiting the entire planet. A big population requires big food production, which leads to more waste as it is more difficult to efficiently produce more food without increasing the waste. Food waste not only affects the environment by filling landfills and emitting greenhouse effect gases but also it wastes the valuable resources that have been used and consumed for its production: CO_2 emitted by the processes and transport, water used for irrigation and energy. In a modern society where every aspect of environmental protection is taken into consideration, food waste is another critical issue that cannot be ignored. By reducing the amount of food wasted and

treating that waste properly, not only can the effect of food waste be reduced, but the overall environmental footprint of human activity can be significantly lowered. This research focuses on identifying the generated food waste volumes associated with offshore islands. In this case, offshore locations do not tend to have their own landfills and they cannot dump the waste directly into the sea, they transfer it to onshore landfills. Based on the consequences of food waste, a proposed method discusses the ability to reuse the food waste in offshore islands and produce compost to use for their own food planting rather than buying it. Finally, this paper endorses proper recommendations to reduce the volume of food waste which will help in achieving a healthier environment.

1.1 Objectives

The purpose of this research paper is to provide a clear understanding of the impacts of food waste along with identifying the existing methods of food waste management. This report aims to propose a method to prevent food waste through the application of more sustainable practices to maintain almost zero waste. It has been intended to support the method with a circular economy concept for food waste management in the offshore locations.

2. Literature Review

Food waste has become an increasingly significant issue on a global level. According to FAO (Food and Agriculture Organization), approximately one-third of food produced for human consumption is lost or wasted worldwide. The amount of food waste is not only missing the opportunity to improve global food security, but it also contributes to increasing the environmental impact. Food wastage can also result in wasting all the resources that were used to produce food such as water, land, energy, labor, and capital. In addition, disposing of food waste in landfills leads to greenhouse gas emissions that can contribute to global warming and climate change (Chapagain and James, 2013).

When estimating the environmental impacts of food waste, the associated resources of food making should be accounted and considered. The food making system relays on freshwater in so many stages and functions, starting from irrigating crops to processing food products to preparing and cooking food. In many parts of the world, usable freshwater supplies are limited. Freshwater is one of the earth's most precious resources, and 70% of it is used for agricultural purposes including crop irrigation and drinking water for livestock. The production of one apple requires an average of 125 liters of water, which means throwing away a bruised apple is akin to pouring 125 liters of water down the drain. Meanwhile, the numbers with meat are even more staggering; 15,400 liters is considered to produce one kilogram of beef. According to FAO's food wastage footprint report, 250 cubic kilometers of water (three times the volume of Lake Geneva) is used each year to produce food that is ultimately lost or wasted (Chapagain and James 2013).

Land is a limited commodity integral to food production. Each year, 28% of the world's agricultural area is used to produce food that is ultimately wasted which results in the unnecessary degradation of land (Chapagain and James, 2013). Also, clearing lands for agricultural purposes can cause deforestation which eliminates wildlife habitats and wipes out greenhouse gas-absorbing trees as well as affects the hydrologic cycle and local climates (Parameshwari 2017).

"Food is not only a form of energy but also a consumer of fossil energy in its production, transportation, and preparation" (Cuéllar and Webber, 2010). Energy is required in all food producing systems starting from fueling tractors and pumping and distributing irrigation water to running food processing equipment to powering refrigeration. A significant amount of energy consumption is embedded due to wasted food. The amount of energy lost in wasted food is more than the energy available for many popular operations in energy procurement strategies, such as the annual production of ethanol from grains and annual petroleum available from drilling in the outer continental shelf (Cuéllar and Webber 2010). Consequently, the embedded energy in food waste represents a critical target for decreasing energy consumption worldwide.

Greenhouse gases, including carbon dioxide, methane, nitrous oxide, and some synthetic chemicals, including chlorofluorocarbons, trap some of the Earth's outgoing energy, thus retaining heat in the atmosphere. Food waste is one of the contributing factors in increasing the concentrations of greenhouse gases in the atmosphere and it's considered one of the primary reasons of increasing 1 degree Celsius in global air surface temperature over the past 115 years (Parameshwari 2017). Moreover, food waste in landfills produces methane which is considered 25 times stronger greenhouse gas than carbon dioxide. The estimation of landfill emissions is made based on landfill volume and assumed rates of decay. In addition, landfill waste is responsible for 11% of global methane emissions. By 2050, global methane emission is expected to increase by about 70% as the world population continues to grow (Netro et

al. 2016). Global warming and climate change can result from the excess amounts of greenhouse gases such as methane, carbon dioxide and chlorofluorocarbons.

Managing food waste relies upon more than one method that is to be either landfilled or utilized to produce several types of resources. Mainly the food waste management methods are anaerobic digestion, landfill, composting or incineration. Anaerobic digestion is one of the waste management processes that rely mainly on microorganisms to break down and dissolve biodegradable materials that exist in the waste; this process is handled in the absence of oxygen, whereas the main purpose behind utilizing this method is to either process the waste of domestic or industrial uses or even producing several types of fuels. Companies that produce food and drink products often utilize this method to treat the residue of the fermentation and production methods. Besides, most factories rely upon anaerobic digestion as means of producing natural and renewable energy as the process of digesting products produces methane, carbon dioxide, and other gases that are considered as fuel. On other occasions, the same process is also utilized to produce nutrient-rich fertilizers that are beneficial for the soil, which serves in the cycle of sustainability of production (Al-Juhaz and Magesan 2004).

Another method of food waste management is the burning method used as means of managing waste. In Singapore, the government has been capable of managing waste by burning these materials in high-temperature ovens. While the emissions can bring about severe dangers to the environment, the same ovens utilize filters to neutralize these emissions and to turn the waste into dust that can be later buried underseas.

Meanwhile, composting is another means of waste management that is mainly utilized by food companies; this method relies upon transforming the waste fermentation output into fertilizers or even enriched soil that is full of nutrients (Jonathan and Wong, 2016). This process additionally serves in the better interest of the environment, where the waste is not going wasted but rather reused to enable nature to replenish. This method is cost-effective and, at the same time, brings about several revenues for these companies. On the other hand, the most popular method of food waste management is landfilled. However, Landfills cause a major harm to the environment and people. As the food rotting in landfills generates harmful gases like methane that affect the air quality.

Food waste is plentiful in carbon, natural nitrogen, phosphorous and mineral mixtures expected for the development of microorganisms. Therefore, the addition of food waste gives expected supplements to upgrade the biodegradation of oil hydrocarbon (Joo et al., 2001; Nakasaki et al. 1992). Treating the soil with food waste is a well-known treatment technique, and generally, late investigations have recommended that food waste treatment might be a valuable strategy for the bioremediation of sullied soil (Beaudin et al. 1996; van Gestel et al. 2003; Joo et al. 2007; Jorgensen et al., 2000; Kirchmanm and Ewnetu, 1998; Namkoong et al. 2002; Rojas-Avelizapa et al. 2007). New research, explained the adequacy of utilizing food waste for enhancing insufficient supplements of microbial fertilizing by 1% of oil hydrocarbon-tainted soil (Joo et al. 2007). The most widely recognized materials used for fertilizing the soil are biodegradable natural waste, for example, food waste (Joo et al. 2008) and yard waste (Tan et al. 2017) (Jiang et al., 2015). Among them, food waste has the most potential to be generally applied for composting processes from a possibly limitless supply from cafés, hotels, cafeterias, and family kitchens. The significant parts of food waste incorporate rice, meat, noodles, and products of soil waste, which can be created in the processes of gathering, transportation, processing, and merchandising (Shen et al. 2013; Zhang et al. 2018).

Natural food waste composting is a kind of normal food waste process under controlled circumstances by which food waste is separated into various parts by microorganisms. Composting will need further development; it will need surface and air circulation to decompose. The least complex parts would then be transformed into humus which is known as fertilizer. During composting the volume of the collected waste diminishes over the long run to create a high supplement because of the change of crude natural materials through microbiological change. This natural and rich manure is utilized as a characteristic compost in farming areas as it benefits the soil since it is rich in fiber and organic supplements. There are two phases in composting: 1) Microbial action and 2) Transformation of natural material. General waste disposed of in the kitchen would hold roughly 60-80% dampness, 3-5% debris, 40-60% starch, 18-30% volatiles, 10-30% protein, 15-40% fat and 45-65% carbon. (Palaniveloo et al. 2022)

According to a report by the Regular Assets Safeguard Chamber 2012 (Gundersn 2012), landfills have turned into the third biggest wellspring of methane CH_4 emanations in the US and have represented 18% of the complete methane discharges there (US EPA 2015). Specialists have proposed redirecting food waste from landfills as compost. In the composting system, organics decompose and balance out in a high-impact condition. The final result is natural manure, which can be used to develop soil surface, and richness, and subsequently decreases the utilization of manufactured composts (US EPA 2009). Notwithstanding the use of manure as a compost, applying fertilizer to the dirt might

expand the carbon limit inside the dirt, which reduces GHG emanations into the environment (Saer et al. 2013). Composting is likewise better than other food waste reusing innovations, like anaerobic processing and burning, since it is more straightforward to make (US EPA 2009), has better financial execution at a limited scale (Murphy and Power 2006), produces more secure side-effects, and less GHG outflows (Andersen et al. 2011). The use of food waste composting stays low, i.e., just 8.3% of 36 million tons of food waste produced were reused in 2011 (US EPA 2014b). Food waste composting is even uncommon in the U.S. Moreover, it is confronted with many difficulties, including (1) the food waste is made consistently and simply to become foul, which expands family's and waste administration organizations' responsibility on food wastes assortment and arranging; (2) composting offices find it hard to find end clients to use that will supply food waste. (Murphy and Power 2006); (3) other composting innovations, like Windrow, feedstock and working circumstances shift significantly in seasons and climate accordingly the item quality is challenging to control; (4) food composting has an unpleasant scent that can raise objections in neighborhoods.

3. Methods

There is an intimidating need for effective food waste management in the UAE as 3.2 million Tonnes of food waste is generated annually. UAE has a great scope to reduce the adverse per capita environmental impact of cities by paying attention to food waste management. This study focuses on providing methods for food waste management offshore location. To take advantage of food waste, composting provides a means of accomplishing the reduction of the amount of garbage sent to the landfill, reuse the organic matter rather than dumped, and recycling it into a useful soil amendment. Apart from that, the food waste generated from X and Y islands is sent to an onshore recycling company which handle all responsibilities for waste disposal. The proposed method is to construct a service area for composting process to handle all related food waste management activities at X island and Y islands. The service area of food waste management consists of the loading dock, food waste storage warehouse, grinder, and trash compactors. The service area is recommended to be located near kitchens and cafeterias to minimize the need for transportation. Besides, this proposed method requires hiring contractors specialized in composting food waste. The development of a service area for food waste composting is a source of a significant amount of revenue generation. The food waste conversion into compost can be used for agricultural purposes as it ends up as a product. The circular concept of a product or a material influences the economy directly and indirectly. The proposed food waste management method using the circular economy concept is shown in Figure 1.

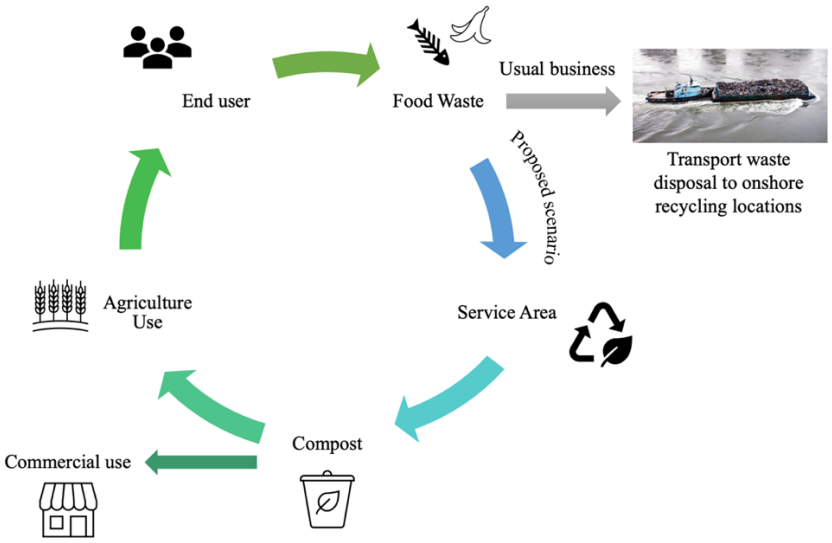

Figure 1. The proposed circular economy concept for food waste management in offshore islands

4. Data Collection

One of the most serious issues in the region is food waste. The UAE is one of the top countries in the world for food waste per capita waste generation, according to Dubai Carbon, 2019. About 38% of the food that is prepared each day

is wasted in UAE. According to recent estimates, each person's waste in the UAE is 2.7 kilos per day, which is among the highest food waste in the world. This section will refelct the caulcation of Isalnds X and Y. Considering that Island's X population is about 6,000 and island Y inhabited by 5,000.

5. Results and Discussion

Food wastage is an issue because it drains billions of dollars each year and it affects the environment by contributing to global warming and greenhouse methane gas emissions when it is added to landfills. This report focuses on food waste associated with offshore islands to manage the volume of food waste and use it for their own benefit or for commercial purposes. To address the issue of food waste, calculations have been made to estimate the volume of food and cost wasted in the UAE, discussing reducing the impact of food waste in fault tree and bowtie diagram.

5.1 Numerical Results

The food waste in both islands can be estimated by taking the average food waste per person in the UAE. For X and Y islands, the food waste is approximately 16,200 kg/day and 13,500 kg/day, respectively. Additionally, the total amount of food waste for both islands each year is almost 11 million kg/year which is about 10,840.5 Tonnes/year. According to the Dubai Carbon Centre of Excellence, the volume of food wastage is estimated to be 3.2 million Tonnes annually and it costs $3.5 billion according to the UAE Ministry of Climate Change and Environment, 2022. Therefore, the total cost of food wastage in X and Y islands is about $12 million annually, it includes all resources to make the wasted food, land, labor, water, energy, producing contributions, processing, transporting, preparing, storing, and disposing of the food. Tables 1 and 2 explain the calculations made to get the data.

Table 1. Recent food waste data in UAE

Average food waste in UAE per person/day	Food waste volume in UAE annually	Cost of food waste in UAE annually
2.7 kg/day	3.2 million Tonnes	$3.5 billion

Table 2. Estimated food waste data in X Island and Y island in UAE

	Population	Food waste kg/day (1)	Food waste kg/year (2)	Food waste Tonnes/year (3)	Cost of food waste annually (4)
X Island	6,000	16,200 kg/day	5,913,000 kg/year	5,913 Tonnes/year	$6,467,344
Y Island	5,000	13,500 kg/day	4,927,500 kg/year	4,927.5 Tonnes/year	$5,389,453
Total	11,000	29,700 kg/day	10,840,500 kg/year	10,840.5 Tonnes/year	$ 11,856,797

The volume of food waste kg/day was calculated by:

(1) $2.7 \times Population$

The volume of food waste kg/year was calculated by:

(2) $Food\ waste \frac{kg}{day} \times 365$

The volume of food waste Tonnes/year was calculated by:

(3) $\frac{Food\ waste\ kg/yaer}{1000}$

The cost of food waste was calculated by:

(4) $\frac{\$\ Cost\ of\ food\ waste\ annually}{Food\ waste\ volume\ Tonnes/year} \times Food\ waste\ Tonnes/year$

5.2 Graphical Results

Food waste results in severe damage to the environment. It often ends up in landfills and releases methane, a greenhouse gas. 11 percent of greenhouse gas emissions are caused by food waste, according to studies. Food waste contributes to other resources, it wastes land, natural resources, and water, and it harms biodiversity. This section will discuss first the bowtie diagram that explains the environmental food waste impacts.

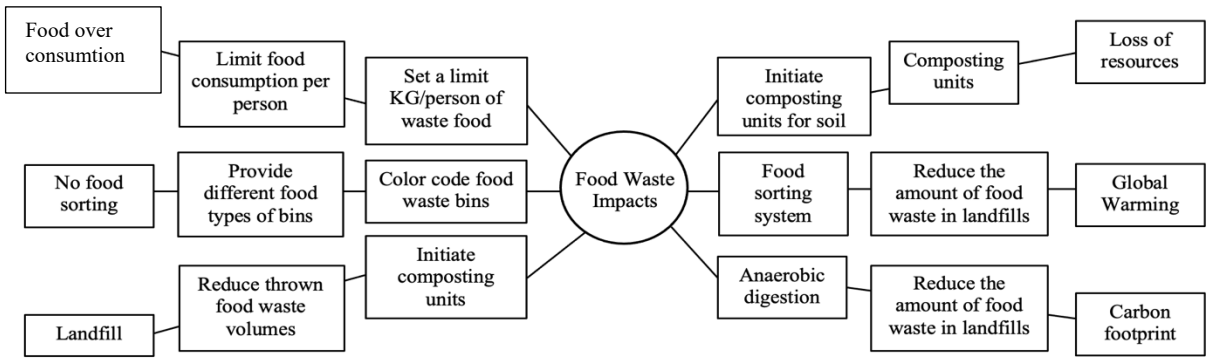

Figure 2. Food waste impacts the bowtie diagram

The bowtie diagram in Figure 2 shows the threats that can cause food waste with its later impacts and barriers that can be taken to mitigate its consequences. Threats such as over food consumption, no sorting of food waste and landfills with no alleviating techniques will defiantly cause an impact on the environment such as loss of resources, global warming, and carbon footprint. According to the US Department of Agriculture in 2022, 30% of food waste is from over food consumption. To overcome this habit, limiting food consumption per person can reduce the generated food waste by providing guidelines and awareness to people and setting limits on food waste per person. To mitigate the impacts of this habit, initiating composting units for the soil can reduce the loss of resources such as land, water, energy, and others. Besides, the unavailability of a food sorting system can help in increasing the volume of food waste and it will be hard to use it in the composting process since it will need huge effort and time. Providing different food types of bins like color coded bins and specifying each color to a specific type of protein for example. Reducing the amount of food waste in landfills can make a difference in reducing and limiting environmental impacts. In landfills, food wastage starts to decompose and mix with soil and air which can affect the environment. Reducing thrown food waste volumes in landfills can lower the impacts. Initiating composting units to reuse the food waste in treating the soil can reduce the volumes of food waste in landfills. To lower its impacts, anaerobic digestion can be used. It uses bacteria to break down food waste with the absence of oxygen to produce biogas which can be used as natural gas to offer heat, electricity, and power cooling systems. This process can reduce the amount of food waste in landfills as well as the emissions of landfills into the atmosphere which will reduce the carbon footprint.

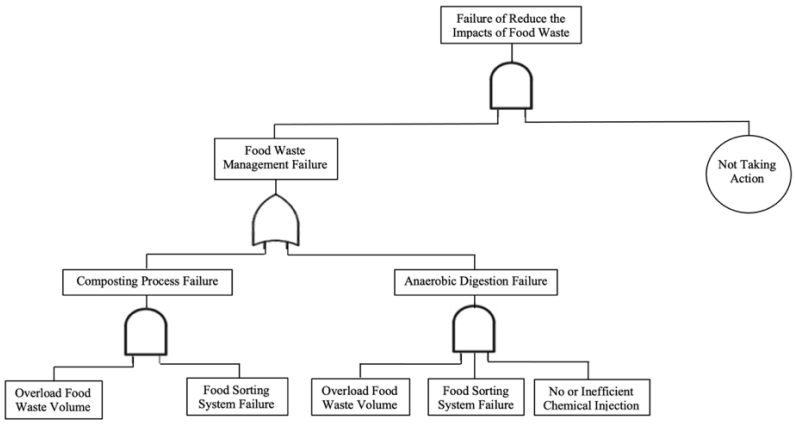

Figure 3. Failure to reduce the impacts of food waste fault tree analysis diagram

The fault tree diagram in Figure 3 shows the different paths that can be taken to understand the failure of reducing the impact on the environment caused by food waste. The first path explains how composting process can be failed. If there is a huge volume of food waste and a failure in the food sorting system, it will result in a failure of the composting process. In this process, the food waste must be separated into several types based on their category so it can be used

in the composting process. The second path is anaerobic digestion failure, it can be developed if there is a food waste volume, food waste sorting failure, and inefficient chemical injection. However, composting process or anaerobic digestion both can help in managing food waste. Tacking action by organizations regarding limiting the volume of food waste per person and the emotions of gases released into the atmosphere, will force companies to follow the regulations and standards. By acting and managing food waste we can achieve a noticeable reduction in the impacts of food waste.

6. Recommendation

As per the finding, the volume of food waste is estimated as 10,840,500 kg/year in offshore locations. The following recommendations are suggested to be implemented in the offshore location to reduce food waste along with the associated impacts. As the suggestions cover three different levels of food waste management before food preparation, educating end-users by campaign or introducing the food sorting system and after consumption to utilize the food waste.

1. Before food preparation companies must endorse a meal preference survey. In order, to understand consumer preference and prepare the cuisine upon end-user recommendations. Thus, a clear estimation of the dish quantity will be considered, especially in the buffet to minimize the probability of excess food. Therefore, the survey outcome will eliminate the unpreferred dishes that will end up as waste.
2. the waste of food is highly essential as they are the consumers. Offshore companies must prompt for measurable food consumption through campaigns and marathons. To enhance individuals' knowledge of the consequences of food waste. Such an initiative will support the UAE's vision for zeros waste.
3. The food sorting system can be applied as a practice to be implemented in canteens and cafeterias. Basically, 4-6 compartments and divided trays must be provided for each user. The different compartments in the trays are divided based on the type of food such as fruits, vegetables, meats, or carbs. Each food waste category is associated with a specific trash bin for leftovers. Organizations must provide guidelines and procedures for their employees. These procedures will raise awareness of food waste management and help acknowledge the required food consumption for individuals among employees. Additionally, the trash bins for food waste can be sent to composting unit for composting process.
4. As per the data, the cost of food waste is 11,856,797 $ in offshore locations. Thus, it is highly recommended to establish a service area in the offshore islands to utilize the food waste. The installment of such a machine will make revenue from waste as it will be converted to organic soil for plantation. Consequently, this will reduce the amount of food waste in landfills, and it will limit the associated impacts such as greenhouse gas emissions and wasted resources. Introducing the soil-making machine in offshore islands will support in achieving the goal of sustainability.
5. A food sorting system can be applied to limit food waste in canteens and cafeterias. This method helps to reduce time in sorting food waste before composting process. To implement this food sorting system in canteens and cafeterias, 4-6 compartments and divided trays must be provided for each user. The different compartments in the trays are divided based on the type of food such as fruits, vegetables, meats, or carbs. Each food waste category is associated with a specific trash bin for leftovers. The trash bins for food waste must be approachable for all canteens users to dump leftovers. The organizations must provide guidelines and procedures along with food sorting systems to their employees. This practice will raise awareness of food waste management and help acknowledge the required food consumption for individuals among employees.

7. Conclusion

Food waste is classified as a potential hazard that affects the environment as food waste emits greenhouse gasses. Unfortunately, food waste shows a significant increase worldwide due to the increase in population. While UAE trying to reduce food waste, they still report a high food waste volume of 3.2 million tonnes annually. Per the estimation, the food waste in the offshore locations is 10,840,500 kg/year. This amount of waste cost 11,856,797 $ which consider huge. Therefore, this issue should be addressed to achieve sustainable development and to meet the UAE zero waste vision. Thus, a food waste management system must be introduced to offshore locations to minimize food waste and its associated impacts. In this research, a proposed method and recommendations were introduced to reduce the amount of waste. Offshore companies must endorse guidelines and provide procedures to be followed by individual and kitchen staff. Additionally, they must utilize advanced solutions to start making use of food waste. Food waste become a significant issue that should be treated and reduced to prevent any future consequences.

References

AL-Juhasz, G., & Magesan, R., Waste Management. New York: CRC Press, 2004.

Chang, J., J.J.Tsai, & K.H.Wu. (2005, June 28). Thermophilic composting of food waste. Available: https://www.sciencedirect.com/science/article/abs/pii/S0960852405001082?via%3Dihub,Oct 12, 22

Chapagain, A., and James, K. Accounting for the impact of food waste on water resources and climate change. *Food Industry Wastes: Assessment and Recuperation of Commodities,* pp. 217-36, San Diego, United states, 2013.

Cuéllar, A. and Webber, M., Wasted food, wasted energy: the embedded energy in food waste in the United States, *Environmental science & technology,* pp. 6464-6469, United states, July 21, 2010

Hosetti, B., Prospects and Perspectives of Solid Waste Management. New York: Delta Publications,2006.

Jonathan, W., & Wong, R., Sustainable Waste Management, London: Harvard Press, 2006.

Kreith, F.,Handbook of solid Waste Management. London: Harvard Press, 2002.

Netro, Z., Álvarez, J., Carrillo, A., and Flores, R. Solid waste management in Mexico's offshore platform construction: determining potential supply for a reverse logistics process. *NETNOMICS: Economic Research and Electronic Networking*, pp. 71-94, Newyork, United States, 2016.

Our food is damaging the environment. (2019, February 28). Available: https://dcce.ae/press_releases/our-food-is-damaging-the-environment/, Oct 13, 22

Palaniveloo, K., Amran, M., Norhashim, N., Mohamad-Fauzi, N., Peng-Hui, F., Hui-Wen, L., Kai-Lin, Y., Jaile, L., Chain-Yee, M., Jing-Yi, L., Gunasekaran, B., Razak, S. (2020, June 22). Food Waste Composting and microbial community structure profiling. Available: https://www.mdpi.com/2227-9717/8/6/723, Oct 12, 2022.

Parameshwari, S. Impact of food waste and its effect on environment, *International Journal of Food Science and Nutrition*, pp. 184-187, Tamil Nadu, India, July 2017.

Poplin, J. (2022, May 16). How to reduce food waste and stop over-buying on groceries. Available: https://www.thesimplicityhabit.com/stop-over-buying-on-groceries/, Dec 4, 22

Saera, A., Lansing, S., H.Davittc, N., & E.Gravesd, R. (2013, March 29). Life cycle assessment of a food waste composting system: Environmental impact hotspots. Available: https://www.sciencedirect.com/science/article/abs/pii/S095965261300156X?via%3Dihub,Ctb 10, 2022

Sankar, A. (2022, October 03). Food Waste has an impact on climate change in the region, warn UN officials. Available: https://www.thenationalnews.com/uae/2022/09/30/staggering-food-waste-impacts-climate-change-in-the-region-says-un-official/#:~:text="Recent%20estimates%20indicate%20that%20the,event%20at%20Atlantis%2C%20The%20Palm, Dec 1, 22

UAE plans new Food Waste Programme following successful Expo 2020 run. (2022, May 24). Available: https://foodmatterslive.com/article/uae-national-food-waste-reduction-initiative-expo-2020/#:~:text=Food%20waste%20costs%20the%20UAE,the%20world%2C%20according%20to%20Replate, Dec 1, 22

Biography

Jwahir Albreiki graduated from Khalifa University with a bachelor's degree in Electrical Engineering, United Arab Emirate. Currently, she is pursuing her master's degree in health, Safety and Environmental Engineering program. She is working as an instrument and control engineer. Her research interests include process safety, industrial hazard, sustainability, occupational health, and operational efficiencies. Jwahir is a member of IEOM.

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