HALAL INDUSTRIAL FOOD WASTE MANAGEMENT: LESSON LEARNT FROM JAPAN

Nor Surilawana Sulaiman
Halalan Thayyiban Research Centre, Universiti Islam Sultan Sharif Ali, Brunei Darussalam.
surilawana.sulaiman@gmail.com

Abstract

One-third of all food produced for human use is wasted or discarded into the environment via landfilling. Currently, the only cheaper and easier option in Brunei is landfill. Dumping organic waste materials from industrial food waste into the environment contributes to harmful environmental effects. The value of food waste is being increasingly recognised, and Brunei Darussalam is among the highest in the area, with a solid waste output of 1.4 kg per capita per day. However, just 11.3% of food waste is estimated to have been recycled, with the remainder ending up in landfills. Through participation in the JENESYS Programme, the researcher virtually visited a company at Kobe Plant. The session was eye-opening and related to responsible consumption and production where the company implemented zero waste. In this context, this paper will highlight the waste reduction concept to enhance the current state of halal industrial food waste management. Through waste reduction or zero-waste implementation, these wastes can be converted into value-added products. This would strengthen the halal food sector and support the government's aspiration to achieve Brunei Vision 2035 Goal 3 – Dynamic and Sustainable Economy as well as SDG Goal 12 – Responsible Consumption and Production. This study also shows how effective waste reduction for a sustainable, healthy environment and circular economy may be achieved by handling industrial food waste.

Keywords: *Brunei, food waste management, halal companies, industrial food waste, Japan*

INTRODUCTION

Food waste was defined by the Food and Agriculture Organization (FAO) as the reduction in the quantity or quality of food brought on by the choices and actions of retailers, food services, and consumers (United Nations Economic Commission for Europe, 2020). With increased awareness of the issue's scope in recent years, food waste could be regarded as a problem of growing severity (FAO, 2011; FAO, 2012; FAO, 2013) including Brunei Darussalam (herein Brunei). Since food waste attracts vermin, emits toxic gases, and contaminates groundwater (Okareh, Oyewole, & Taiwo, 2014), it could be argued that it is a pure waste stream. Therefore, food waste poses a

serious environmental burden. Given the issues with production and consumption, food waste ranks among the most concerning situations.

Generally, the halalan thayyiban principle outlined in the al-Qur'an is the foundation of the halal food industry. The holistic idea includes shariah-compliant rules for food production and consumption. Additionally, Islam teaches some basic dietary manners, such as abstaining from overindulgence and showing charity to our neighbours and loved ones (Kadirov, Tjiptono, & Fam, 2020). Halalan thayyiban's existing approach, as seen in Brunei's current halal standard and requirements, may ignore some elements that ought to be incorporated, particularly in waste management. Nevertheless, Malaysia's MS1500:2019 and MMPHC (D) have included waste management as a prerequisite for Toyyiban Management in the guidelines (Jais, 2021).

To prevent food loss and waste, a thorough waste management program should be implemented in the halal business. The use of human resources, design, and production processes can all take waste elimination into account (Sang, Khairuzzaman, Abdul, Boon, & Yew, 2013; Kannan, Selladurai, & Karthi, 2013) and activities, distribution, and inventory sections (Manzouri, Ab-Rahman, Zain, & Jamsari, 2014). Therefore, the government must move quickly to handle industrial food waste effectively, particularly in light of the high value of organic fractions. This study attempts to demonstrate the benefits of handling waste properly while also generating value-added goods from industrial waste. By recycling industrial waste and creating value-added products, it is believed that the paper will assist the halal company in making the right choice regarding waste management.

LITERATURE REVIEW

Halal Food Industry

Livelihood depends on having access to food. Halal products must therefore include Halal meals as essential components. Halal regulations are good foundations for healthy living because they are not just concerned with the security, hygienic practices, and wholesomeness of foods. The location, tools, and methods used for butchering and keeping animals are also heavily influenced by Halal laws. Furthermore, consuming halal products is now considered to be a standard rather than just a religious need (Golnaz, Zainalabidin, Mad Nasir, & Eddie, 2010).

82.1% per cent of people in Brunei are Muslims, followed by 6.7% Christians, 6.3% Buddhists, and 4.9% who practice other religions or have no religious affiliation (Department of Economic Planning and Statistics, 2022). Therefore, a sizable portion of the nation's food sector offers halal food. The Halal Standard (PBD24:2007) was created by the Bruneian government to assist food businesses in halal procurement. This standard offers the food industry useful direction on how to prepare and handle halal food. Nevertheless, these guidelines assist us in fulfilling the prerequisites for a

halal food product, trade, or enterprise (Manzouri, Ab-Rahman, Zain, & Jamsari, 2014).

Due to concerns about the humane treatment of animals, non-Muslims are now familiar with halal food products. The State of Global Islamic Economy 2014 – 2015 Report (Thomson Reuters, 2014) also demonstrates that non-Muslim nations like Brazil, India, Australia, the United States of America (USA), and France are the top five exporters of halal food. It is clear that the halal sector has expanded significantly over the past few decades as a result of the growing concern among Muslim customers, consistent availability of halal products, and exports of halal food from non-Muslim nations (Mukherjee, 2014; Abdul-Talib & Abd-Razak, 2013; Lada, Tanakinjal, & Amin, 2009). Malaysia exports halal goods to nations like China, the USA, Indonesia, Singapore, and Japan. (Abdullah, Jaafar, & Abd Rashid, 2017).

The halal sector has also taken off and grown throughout the world among Muslim-majority nations, particularly in the East Asia region (Konety, Aditiany, & Nidatya, 2021), including developed Asian countries like South Korea, Japan, and Taiwan (Fazira, 2020). Many nations, both Muslim and non-Muslim, have increased their interest in the halal market because it is thought to be a lucrative industry (Omar, 2017). The halal market is being driven by the large and expanding Muslim population globally, as well as the expanding economies of Muslim countries and the emergence of prospective halal markets in non-Muslim countries. As a result, the halal markets have expanded to include non-Muslim countries as well as Muslim ones (Kurokawa, 2011).

Waste Management

Food waste is considered as food that has been thrown away which is fit for human consumption or edible but has beyond its expiration date, been retained after it has lost quality or been allowed to deteriorate or be eaten by bugs (Sun, Shahrajabain, & Chend, 2021). In turn, one-third of all food produced for human use is lost or dumped in landfills, polluting the environment. Additionally, a sizable portion of food waste is incorrectly handled before being dumped in landfills or burn, or it is illegally diverted into the unofficial system to produce cooking oil or feed cattle, which poses serious problems for food safety (Sun, Shahrajabain, & Chend, 2021). As one of the most crucial cornerstones of a sustainable and healthy society, food care at every stage of the supply chain is becoming increasingly relevant globally (Cappelletti, Papetti, Rossi, & Germani, 2022).

For this reason, a properly regulated system of reproducing waste into human use or as animal feed is needed to ensure the value-added product is secure and safe to consume. Without a question, reducing food waste is a significant task that involves numerous parties (Cappelletti, Papetti, Rossi, & Germani, 2022). More and more individuals are exploring employing environmental-friendly technology for treating and

preventing food waste to build more resilient food and waste systems globally (Thyberg & Tonjes, 2017).

From a life cycle perspective, the hierarchy is often closely followed by the environmental choice of waste management method in the case of food waste (Laurent, et al., 2013a) and is reliant on regional circumstances. For instance, the European Waste Framework Directive (WFD) establishes a waste hierarchy that prioritizes waste management and prevention (EC, 2008). The Moerman ladder in the Netherlands is another example of guidelines that are primarily related to food waste (Dutch Ministry of Economic Affairs, Agriculture and Innovation, 2014). Another example, the Food Recovery Hierarchy in the United States (United States Environmental Protection Agency, 2022), and the UK's Food Waste Pyramid were created by the Feeding the 5000 alliance to aid food businesses in reducing waste (Vision 2020) which have been tabulated in Table 1.

Table 1
Food Waste Hierarchy

Food waste hierarchy	European Waste Framework Directive	Food Waste Pyramid	Food Recovery Hierarchy	Moerman ladder
Highest	Prevention Re-use and preparation for re-use	Reduce Feed people in need	Source reduction Feed hungry people	Prevention Use for human food
	Recycle	Feed livestock	Feed animals Industrial use	Conversion to human food Use in animal feed Raw materials for industry
	Recovery	Compost & 100% renewable energy	Composting	Processing to make fertiliser for co-fermentation Processing to make fertiliser through composting Use for sustainable energy
Lowest	Disposal	Disposal	Incineration or Landfill	Burning as waste Dumping

Adapted from: (Eriksson, Strid, & Hansson, 2015)

Most prior studies on waste management techniques for organic or food waste describe and compare anaerobic digestion, landfilling, incineration, and composting (Bernstad & la Cour Jansen, 2012; Laurent, et al., 2013a; Laurent, et al., 2013b). In some research, the comparison also includes animal feed (Lee, Choi, Osako, & Dong,

2007; Menikpura, Sang-Arun, & Bengtsson, 2013; Vandermeersch, Alvarenga, Ragaert, & Dewulf, 2014). The advantages of food waste prevention for the environment are also discussed in some research. For instance, Gentil et al. (2011) estimated that a food waste stream might be reduced by 20%, but did not detail how this reduction could be achieved or how much it would cost to do so. Another preventive study, by Salhofer et al. (2008), equated prevention with a donation but did not assess the measure's potential. In addition, Schneider (2013) rated donated food based on its production-related emissions rather than the items that could be substituted.

In Brunei, the operational aspect of waste management involves the collection and disposal of waste generated which collection of wastes includes door-to-door pick-ups. The registered waste collectors are listed under the Department of Environment, Parks and Recreation (DEPR), Ministry of Development which can be found on their website. The public also has the option of utilising government-provided waste collection centres across the country which are managed by contractors appointed by the DEPR. The top four compositions of waste in Brunei consist of almost 32% of food waste, 29% plastic, 11% green and 10% paper which is disposed of at the Sungai Paku Engineered Landfill (Department of Environment, Parks and Recreation, 2021). While the nation is strongly encouraged to practise the 3Rs – Reduce, Reuse and Recycle – to deal with waste, most of the remaining waste (nonrecyclables and non-reusables) is still discarded at the Sungai Paku Engineered Landfill.

In Brunei, however, landfill is the sole option that is less expensive and simpler, as well as the most popular disposal method (Shams, Juani, & Guo, 2014). Dumping organic waste components from industrial food waste into the environment contributes to adverse environmental repercussions. With a population of only over 400,000, Brunei has one of the worst rates of food waste in the region, despite its still-relatively-small size. According to Shams, et al. (2014), Brunei produces 1.4kg of solid waste per capita each day, ranking second among the ASEAN countries. However, it is believed that just 11.3% of food waste has been recycled, with 2% of that material being used to manufacture compact, while the remaining 70% ends up in landfills (Borneo Bulletin, 2021).

On the other hand, Japan divides wastes into two groups: general (non-industrial) and industrial wastes (Honma & Hu, 2009). 19 different forms of waste generated by commercial activities are classified as industrial waste under the Waste Disposal and Public Cleansing Law, while other types of waste are classified as general waste (Hirota, 1986). Cinder, sludge, waste oil, waste acid, waste alkali, waste plastics, rubber scrap, metal scrap, glass and porcelain chips, vegetable and animal remnants, waste paper, waste rags, slags, construction waste materials, livestock excretions, livestock corpses, dust and treated waste are among the types of industrial waste (Hirota, 1986).

However, only 219 million tons of Japan's 422 million tons of industrial waste are recycled in 2005 (Honma & Hu, 2009). The rate of recycling has increased from 37.3% in 1995 to 51.3% in 2005, even though the amount of industrial waste has remained

steady over the past few years. However, in the case of general waste, 52 million tons were created in 2005, and 10 million tons were recycled. Since 2001, general waste production has decreased somewhat while recycling rates have improved from 9.9% in 1995 to 19.0% in 2005 (Honma & Hu, 2009).

According to Honma and Hu (2009), despite higher recycling rates, there are still challenges with waste, particularly with illegal dumping and improper waste disposal. In 2014, there were 13.2 years left in the life of current dump sites for general waste and 7.2 years left for industrial waste (Ministry of the Environment of Japan, 2007). It is vital to secure landfills, particularly for industrial waste. The scarcity of disposal facilities encourages improper and illegal disposal, which feeds a vicious cycle.

When Laurent et al. (2013a; 2013b) analyzed a substantial number of articles and reports, a pattern in studies contrasting various waste management options became apparent. A landfill was the least preferable choice, followed by composting and thermal treatment, while anaerobic digestion was the most preferable. Not all studies, nevertheless, followed this pattern. As a result, Laurent et al. (2013a) concluded that success depends on the local infrastructure.

A change in waste management is required for the sector to accomplish the goal of protecting the environment. What waste management approach from various waste management options should be used that could achieve environmental advantaged is the question. Therefore, the objective of this study was to understand the different food waste management scenarios available to the industry. The overall aim was to offer more in-depth information regarding waste reduction or zero-waste implementation which lead to the creation of value-added products.

Brunei Vision Goal 3 – Dynamic and Sustainable Economy

The goal of the country is to realize *Wawasan* Brunei 2035 (Brunei Vision 2035) by the year 2035. Brunei wants to be known for its highly educated and skilled workforce, which meets the highest international standards; its high standard of living, which ranks among the top 10 in the world; and its dynamic and sustainable economy, which has a Gross Domestic Product (GDP) that ranks among the top 10 in the world (Wawasan Brunei, 2019a).

The oil and gas industry currently provides the majority of Brunei's exports and revenue. Goal 3 of Wawasan Brunei 2035 aims to transform the nation into a developed nation with a high income, using knowledge and technology as the foundation of development and boosting private sector involvement while strengthening the public sector's role in realizing the nation's economic potential (Wawasan Brunei, 2019b). This is done to guarantee the economy is sustainable for future generations. Therefore, one of the top priorities for the country's economic development is to diversify its economy. Perhaps one of the possibilities for

diversifying the economy is to minimize food waste and reproduce it into value-added products.

SDG 12 – Responsible Consumption and Production

There are more people to feed with less water, farmland, and rural labour due to a growing global population, depleting natural resources and increased urbanization. Shifting to more sustainable production and consumption practices is necessary to meet the anticipated increases in water, energy, and food needs. Nearly 690 million people are undernourished in the globe today and a third of the food produced is wasted or lost. Growing more food while minimizing harmful environmental effects such as soil, water, and nutrient loss, greenhouse gas emissions, and ecosystem deterioration is necessary for farmers to feed the world sustainably. Encouragement is needed to get people to switch to safe, nutrient-dense meals that have a smaller impact on the environment.

The core causes of the triple global crises of climate change, biodiversity loss, and pollution are unsustainable patterns of consumption and production. The success of the SDGs as well as human well-being are threatened by these crises and the associated environmental deterioration. The Earth's limited capacity will not be able to support both the current and future generations' way of life if we continue on the current development trajectory. A sustainable future depends on changing how we interact with the environment. Governments and all citizens should take advantage of the chance to cooperate as the globe creates measures for sustainable recovery from the pandemic to increase resource efficiency, lessen waste and pollution, and create a new circular economy. (United Nations, 2023) The 11 goals listed in Table 2 are intended to spur action toward responsible consumption and production.

Table 2
11 goals of SDG 12 – Responsible Consumption and Production

LOGO	TARGET	EXPLANATION
	12.1 Implement the 10-year Sustainable Consumption and Production Framework	Developed countries should lead on sustainable consumption and production patterns.
	12.2 Sustainable Management and Use of Natural Resources	Sustainable management and efficient use of natural resources by 2030.

	12.3 Halve Global Per Capita Food Waste	Reduce food losses along the production and supply chains, including post-harvest losses, and cut down on global per capita food waste at the retail and consumer levels by 2030.
	12.4 Responsible Management of Chemicals and Waste	To lessen the amount of waste released into the environment and lessen its detrimental impacts on both human health and the environment, an international framework needs to be put in place.
	12.5 Substantially Reduce Waste Generation	Reduce waste production by a significant amount by 2030 by practising prevention, reduction, recycling, and reuse.
	12.6 Encourage Companies to Adopt Sustainable Practices and Sustainability Reporting	Companies should adopt sustainable practices and integrate sustainability information into their reporting cycle.
	12.7 Promote Sustainable Public Procurement Practices	In the public procurement process, promote sustainability and adherence to national aims and policies.
	12.8 Promote Universal Understanding of Sustainable Lifestyles	Ensure that everyone has access to the necessary knowledge and awareness of sustainable development and environmentally friendly lifestyles by the year 2030.
	12.9 Support Developing Countries' Scientific and Technological Capacity for Sustainable Consumption and Production	Encourage developing nations to improve their scientific and technological capabilities so they can transition to more environmentally friendly patterns of production and consumption.
	12. A Develop and Implement Tools to Monitor Sustainable Tourism	Develop and implement mechanisms to track the effects of sustainable tourism on the local economy, jobs and products.

	12. B Remove Market Distortions that Encourage Wasteful Consumption	Rationalize inefficient fossil-fuel subsidies to reflect environmental impacts and protect the poor and affected communities.

Adapted: (The Global Goals, n.d.)

RESEARCH METHODOLOGY

Given the delicate nature of the topic, the majority of the data gathered in this study come from sources in the grey literature that were already available, like government documents (i.e. Department of Environment, Parks and Recreation, Ministry of Development), media stories (i.e. the Brunei Times, the Scoop and Borneo Bulletin), and related authority websites (i.e. Ministry of Development), particularly for Brunei-specific information. Additionally, information from pertinent documents, journals, and proceedings was obtained for this paper from the white literature on the issue. This research aims to add to the body of knowledge by combining and analyzing the data that is already available.

In addition, the researcher participated in JENESYS – Japanese Food and Food Safety of Batch 33 on 18 – 24 January 2023 online. Through the programme, the researcher visited the company at Kobe Plant in Japan virtually. The researcher finds it eye-opening to observe the zero-waste being implemented in their company. All enterprises, including those in the food industry in Brunei, must adhere to it as one of the fundamental principles. Thus, it is envisaged that the results of this study would enable relevant stakeholders to develop strategies for putting this approach into practice and raising environmental consciousness. As a result, this study considers the significance of the halal sector as well as Brunei's distinctive contribution to the management of industrial waste.

Less research has been done on how to adopt zero waste, waste reduction, or waste management in the halal industry, especially in Brunei. This study decides to demonstrate the advantages of handling waste management effectively. The majority of businesses worry that undertaking waste reduction will be expensive and ineffective (Nordin, Deros, Wahab, & Ab-Rahman, 2011). Understanding these benefits might therefore make waste management easier to implement.

RESULTS AND DISCUSSION

Kewpie Corporation, Kobe Plant, Japan

Tochiro Nakashima, the founder, aspired to create a brand everyone loves and named the nourishing condiment "Kewpie mayonnaise". Ever since Kewpie Corporation was established in 1919, its product manufacturing from one era to the next has adhered to an unwavering insistence that good products begin with good ingredients. "Kewpie mayonnaise" is Kewpie's flagship product which has been cherished by consumers across Jaosn since 1925 (Kewpie Corporation, 2019). Now, Kewpie has become a standard condiment in every Japanese home.

In addition to standard mayonnaise with Japanese taste, Kewpie has product lines for overseas markets catering to the regional taste and consumer demand, for instance, China, Thailand, Malaysia, Indonesia, Vietnam, Europe, and the USA. Kewpie also established manufacturing factories in other countries such as Beijing Kewpie in 1993, Hangzhou Kewpie Corporation in 2002, Kewpie (Thailand) Co. Ltd. in 2009, Kewpie Malaysia Sdn Bhd in 2009, Kewpie Vietnam Co. Ltd in 2010 and PT. Kewpie Indonesia in 2013 (Kewpie Corporation, 2019).

Waste Management in Kewpie Corporation

Without considering the involvement of the industry actors, the problem of industrial waste cannot be solved. Due to this, the current methodology, which is based on a literature review and a virtual visit to one of the companies in Japan, places the industry at the centre of the development of waste management. According to Black (2015), food waste can happen at any point along the supply chain, including during agricultural production, post-harvest handling and trade, processing, the food service sector, retailers, and households. The methodology is designed to be iterated to guarantee that people are aware of the value and advantages of waste management in the industry. The main goal is to motivate the industry to reduce industrial waste.

Kewpie mayonnaise is a form of mayonnaise that uses egg yolks rather than entire eggs as the main ingredients (Kewpie Corporation, n.d.). Therefore, Kewpie mayonnaise contains 4 egg yolks per 500g, which is crucial to the savoury and pleasant flavour of Kewpie since egg yolks produce amino acids. The remaining egg white, egg shells, and egg membranes were recycled and converted into value-added products following the 3R policy; reduce the generation of waste, reuse, and recycle resources and products, recommended by Japan's Ministry of the Environment. The super eco-town project's goal is to reduce industrial waste by breaking down wasted goods into their parts and recyclable raw materials and then turning the residual waste into energy (Tokyo Metropolitan Government, 2005).

As mentioned on the Kewpie website, the creation of mayonnaise and other products results in the production of 28000 tons of egg shells annually. To preserve the environment, Kewpie began recycling in the 1950s and has now achieved recycling

100% of eggshells. The calcium-rich eggshells are utilized in fertilizers, soil conditioners, and calcium-fortified meals. In the meantime, the inside of the thin 0.07 mm eggshell membrane is used as a raw material for cosmetics and food. Whereas, egg white is used for sweets, kamaboko and ham. It seems to me that, Kewpie has implemented the lean production "zero-waste" application to reduce or minimize waste. It appears that reducing waste during the production process is made possible by this method.

Similar to industrial ecology, Japanese lean production is focused on reducing waste. Industrial ecology's "waste equals food" dictum is based on nature, but lean production's "zero waste" precept emphasizes the various relationships between design, engineering, manufacturing, marketing, and distribution. Through collaborative relationships between planners, designers, engineers, plant workers, suppliers, and distributors, lean production aims to integrate all linkages in the product cycle, from raw materials to final goods (Womack, Jones, & Roos, 1990).

The goal of lean production is to find and remove waste in resources, energy, inventories, spaces, labour hours, and products. By changing product design, technologies, and work methods, lean producers aim to permanently eliminate flaws and waste, at the same time, enhance profitability. Tokyo had the highest firm share of 10% among all cities in the world as of 2004, making up 20% of all businesses worldwide that had attained ISO 14001, an industrial standard for businesses looking to reduce their negative environmental effects and continuously improve their environmental performance. Tokyo Metropolitan Government (TMG) is also promoting urban environmental industries, advising businesses on the use of biodegradable and recyclable materials, to persuade Tokyo residents to buy waste-free products to further its environmental policy objectives.

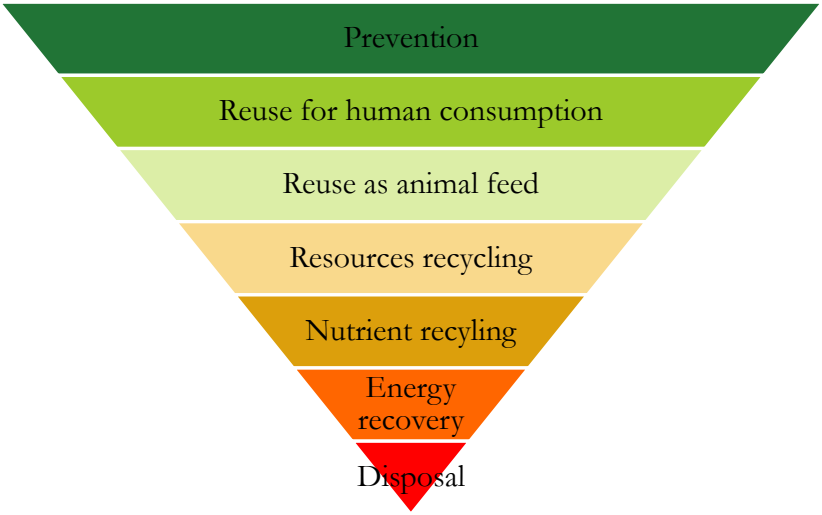
Lesson Learnt and Further Considerations

Some of the difficulties faced by waste management in Brunei include the lack of guidelines, policies and legislation on industrial food waste management. As a result, according to a Brunei Times, the Sungai Paku Landfill, which is often utilized is expected to be full by 2025 if appropriate recycling procedures are not done, received rotten goods and vegetables from retailers in Brunei. Additionally, retailers in Brunei produced up to BND 1000 worth of spoiled goods, including fruits, every month, including imports from other nations. Hua Ho, one of Brunei's biggest supermarkets, discards 2 to 3 kilograms of rotten products every two days, amounting to 45 kilograms of waste monthly (Dariah, Abdullah, Hidayat, & Matahir, 2022).

Municipal solid waste, which includes waste from domestic, agricultural and commercial sectors have become a major concern over the past years as the the amount generated has increased tremendously. Hence, the concerns about industrial waste management in Brunei have prompted the researcher to come up with studies for halal companies to practice waste reduction and implement zero waste. In

Brunei, there are only acts on Hazardous Waste (Control of Export and Transit) Order 2013 and Guideline on Health Care Waste Management, but, no specific legislation on industrial waste management. Therefore, appropriate and specific policy or regulatory frameworks, particularly regarding industrial food waste, require attainable targets and efficient enforcement. The study has identified seven general clusters of waste hierarchy based on the literature review on waste management, including (i) prevention, (ii) reuse for human consumption, (iii) reuse for animal feed, (iv) resources recycling, (v) nutrient recycling, (vi) energy and fuel recovery, and (vii) disposal/landfill. The hierarchy is depicted in Figure 1 below.

Figure 1. Food Waste Hierarchy



Source: Developed by Author

Natural resources abound on our globe, but we have not used them wisely, and our current consumption far exceeds what our earth can support. Therefore, it is essential to learn how to utilize and produce in sustainable ways to undo the damage that people have done to the environment. Consequently, production processes should use resources, labour, and capital more efficiently and produce less pollution and waste to promote sustainable growth (Honma & Hu, 2009). Hence, recycling waste or producing value-added products from it is a wise decision that promotes the circulation of the economy. A circular economy is a strategy that modifies how resources are used in the economy (Ghosh, 2020). For instance, industrial waste will be valuable input for other processes, and products can be reproduced into value-added products to be mended, reused, or improved rather than discarded (Ghosh, 2020). Value-added refers to any type of processing that modifies the appearance or personality of a product (Thürer, Tomašević, & Stevenson, 2017).

CONCLUSION

The current research contributes by providing a concept to this topic in a setting where the industry is urgently challenged to minimize waste or waste minimization to lessen environmental difficulties. The major lesson learnt from this study is to reproduce or recycle waste into value-added products for human or animal use. The idea of recycling waste into value-added products is advantageous for both the environment and the economy. Therefore, the industry needs to vigorously push waste recycling and implement zero-waste applications.

To reach SDG Goal 12 of halving waste production per capita, the government must also develop policies like the European Waste Hierarchy, Food Waste Pyramid in the UK, Food Recovery Hierarchy in the USA, and Moerman Ladder in the Netherlands. The policies should consider a variety of actions and causes. Consideration, research, and action are needed to address the issue of industrial food waste, particularly methods for reducing food waste generation. Simultaneously, by reproducing the waste, the government would be able to accomplish *Wawasan* Brunei 2035 of having a dynamic and resilient economy while also diversifying the economy's income.

To look more closely at the issue, provide the industry players with more precise information, and develop a waste management strategy, a more in-depth research is required for industrial waste management in Brunei. The results demonstrate the waste minimization application's enormous potential from an environmental and financial standpoint in terms of waste management. Through an industrial case study, which involves observing industrial waste management, quantifying trash, and tracking costs, more precise data can be gathered.

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