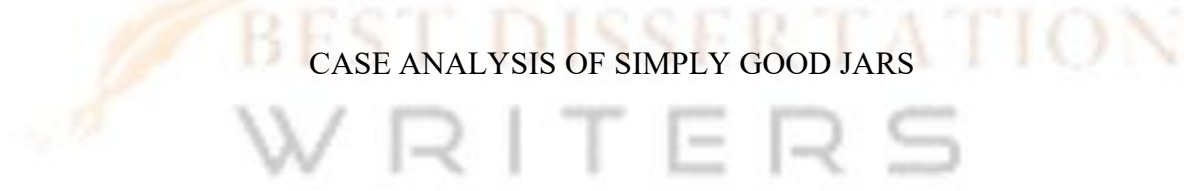


SUSTAINABLE SMART FOOD STORAGE SOLUTIONS: A SYSTEMATIC REVIEW AND  
CASE ANALYSIS OF SIMPLY GOOD JARS



Student Name

Instructor Name

Institution Name

Submission Date

## Executive Summary

Food wastes and plastic wastes are among the key contributors to environmental pollution. As a strategy of addressing this challenge, the Simply Good Jars (SGJ) developed smart containers focused on ensuring freshness of the stored foods for a long period of time. However, the company could not fully achieve this goal as the initially developed jars could only store foods for 3-5 days before they become unfit for human consumption. Therefore, there was need to develop more effective and environmentally sustainable food storage jars. In order to achieve this goal, the present study adopted a systematic literature review where evidence from the existing literature about the use of smart containers to achieve environmental sustainability were identified, selected and critically review. The analysis was further incorporated with the evidence from the SGJ case study. Results from the conducted analysis show that the SGJ can improve effectiveness of their smart jar food storage by incorporating bio-based sensors and Internet of Things.

## Introduction to the Case Study

### *1.1 Statement of the Problem*

Environmental pollution is among the key global challenges. Food wastes and plastics are some of the key environmental pollutants (Fan et al., 2020). As reported by Vanany, Wangsa and Jeremi (2023), food packaging and containers are among the key sources of plastic contamination in food waste streams which are collected for processing at compost and anaerobic digestion facilities. Large volumes of such wastes often originate from residential commercial and institutional sources. Simply Good Jars (SGJ) is the next-generation retail start-up which serves fresh food in zero-waste and reusable glass jars (Walser, 2022). The company offers ultimate convenience as it sells their jars in non-traditional locations such as workplaces and hospitals where there is little competition and most of the customers are looking for healthier options.

### *1.2 Research Aim and Objectives*

The primary aim of this report is to explore the impacts of SGJ initiative on environmental protection.

The objectives include;

- To assess the role of non-degradable food containers in the environmental pollution.
- To assess effectiveness of SGJ in reducing food wastes and environmental pollution.

### *1.3 Structure of the Rest of the Report*

This report is organised into five key chapters. The introduction chapter provides detailed description of the research problem, research aims as well as the objectives to be addressed.

Thereafter, the second chapter (case brief) describes the situation in the case. The third chapter (problem statement, plan of analysis) involves description of the problem statement to be addressed, a detailed presentation of the analysis approach as well as critical review of relevant literature. The analysis and findings chapter involve assessment of the current positions facing the chosen company as derived from applying the principles and practices of the concepts, models and theories included in the previous chapter. The last chapter is proposed solution to the problem which involves an integrated assessment of the analysis to generate ideas and alternative solutions to the problem and issues in the case study.

#### Case Brief: Description of the Situation

SGJ was a salad in a jar designed to meet expectations of consumers who wanted to eat fresh and healthy foods on the go (Walser, 2022). Therefore, the SGJ wanted to meet the needs of these customers by helping to feed others as well as enhancing sustainability in a number of ways. Precisely, the SGJ was created to provide different varieties of flavoured salads which could be easily taken on the go. As reported by Walser (2022), each jar contained a quick response (QR) code on the label which the target customers were to scan and pledge to repurpose the jar, hence allowing the SGJ to donate a meal to people who are in need. This approach made the SGJ company to be a certified B Corporation. During its initial stages of development, the SGJ was direct to the target customers offering them with a subscription opportunity for purchasing 5-8 meals per week, which were delivered to their addresses (Walser, 2022). The company further witnessed an increase in its customer base hence started to sell its products via vending machines in hotels, airports, learning institutions and other areas with high foot traffic. Unfortunately, most of the social amenities such as airports and commercial businesses were closed in 2020 because of the COVID19 pandemic, hence the leadership of SGJ had to change

their business model by partnering with retailers such as groceries and convenience stores. The SGJ realised that the jars had potential risks due to short shelf life of its contents (about 3-5 days) and potential contamination over time despite being great for conveniently containing food products (Walser, 2022). Therefore, SGJ were motivated to develop a new technology for the jar with improved food and consumer safety known as the SmartJar technology which kept foods naturally fresher for longer periods of time compared to their traditional containers.

### Problem Statement and Plan of Analysis

#### *Statement of Problem in the Case*

The primary focus on SGJ was to ensure sustainability of its operations by reducing negative environmental impacts which resulted from their previous operations. Precisely, Walser (2022) reported that the jars produced by the company before COVID19 pandemic carried potential risks because of the reduced shelf life of the stored foods as well as possible contamination over time. This implied that both the containers and foods stored in them could be disposed to the environment in 3-5-day time, hence contributing to environmental pollution through food and plastic wastes. According to Jeswani, Figueroa-Torres and Azapagic (2021) and Scherhauser et al. (2018), the use of non-biodegradable materials in food packaging and storage has raised a lot of environmental pollution concerns. Food waste accounts for at least 30% of the human-caused greenhouse gas emissions as well as being involved in the generation of 8% of greenhouse gases annually (Tonini, Albizzati and Astrup, 2018). Therefore, there is a need to reduce the environmental footprint caused by the food wastes. Initially, the SGJ was not able to fully achieve its sustainability goal of promoting healthy storage of foods for a long period of time as the jars could not store the food for more than 5 days. This implied that after 5 days, both the food and jar could be disposed to the environment leading to environmental pollution.

Consistent with the evidence reported in the studies by Hanaysha et al. (2022) and Tilt et al. (2021), businesses can improve their sustainability status by reducing carbon footprints and abandoning their wasteful practices. Innovation and implementation of the SmartJar technology by the SGJ helped in addressing this challenge as the company was able to produce smart jars that could store foods for longer periods of time, making the foods safe for human consumption and reducing the amount of food wastes released to the environment.

### *Proposed Plan of Analysis*

The present report adopted a systematic literature review approach to collect and analysis evidence from the existing literature about business sustainability approach from the perspective of the SGJ. According to Xiao and Watson (2019), systematic literature review involves identification, selection and critical appraisal of evidence from the existing literature in order to answer a clearly formulated research question. The literature search was conducted on three business databases such as Business Source Complete, Academic Search and ABI/INFORM Global. The selected studies were then reviewed in order to generate new knowledge that was used to address the research aim and objectives.

### *Relevant Literature Review*

Over-exploitation of natural resources, increased incidences of consumerism as well as excess of existing products and respective waste and pollution have important global impacts on the environment as well as human life. Precisely, evidence from the studies by Currало et al. (2022) and Mendes et al. (2021) shows that plastic pollution has long-term ecological, economic, and eco-toxicological impacts on the environment. Therefore, information and changes in the mindset are key for ensuring sustainable future. Extensive research has been conducted to assess effectiveness of different sustainable designs in reducing food wastes, plastic wastes and

environmental pollution. For example, the study by Groß-Vogt (2020) has reported that the innovation of sustainable designs has greatly impacts on the eco-literacy and environmental sustainability. Consistently, Currало et al. (2022) and Rodrigues et al. (2021) have established that sustainable design involves integration of environmentally friendly approach as well as making good use of planet-friendly materials to develop new innovations for reducing wastes and protecting natural environment from pollution. Therefore, sustainable designs allow companies to effectively meet the needs of their target customers without compromising the ability of future generations, and that the principle integrates sustainable design and technological innovation so as to promote new models of behaviours while generating ecological awareness, action, and economic results.

The theory of sustainable design has been widely used by different scholars to explain effectiveness of different sustainable practices adopted by the contemporary companies to promote consumer satisfaction and environmental protection. With reference to the explanations by Cabot et al. (2019), the theory of sustainable design explains effectiveness of business sustainability programmes in reducing negative impacts on the environment, wellbeing and health of target consumers, hence improving the overall business performance. Furthermore, Groß-Vogt (2020) and Mendes et al. (2021) have reported that the primary objective of sustainability in business is to reduce overreliance to non-renewable resources, waste minimisation as well as creation of healthy, productive environments. The need for effective food and plastic waste management programmes has been motivated by an increase in the volumes of food wastes together with the recent Sustainable Development Goals of food security, the need to protect environment as well as material and energy efficiency (Shariff, Gurubasavanna and Byrareddy, 2019). Some of the conventional food waste management

practices reported in the existing literature, such as Tyagi et al. (2021) and Rodrigues et al. (2021), include composting, anaerobic digestion and animal feed. However, these approaches are mainly used in ensuring sustainable elimination of food wastes from the landfills and not to reduce the rate of food waste generation and release to the environment.

The intelligent packaging systems widely used in the food containers often rely on three key technologies such as indicators, data carriers and sensors. As reported by Cabot et al. (2019) and Tyagi et al. (2021), the indicators have a primary role of informing the consumers about the current status of their food quality. These indicators are often developed using coulometric dyes and fluorescent dyes. Information provided by these systems are often associated with the presence or absence or at times concentration of the target chemicals in the stored foods (Shariff, Gurubasavanna and Byrareddy, 2019). A comparative assessment of evidence from the existing literature shows that smart containers for food storage often have different forms of indicators, such as temperature indicators and freshness indicators. Despite the benefits associated with these innovations, the intelligent packaging and storage technologies are still underexplored in the food market applications (Groß-Vogt, 2020). Low public awareness regarding effectiveness of these technologies in reducing food wastes and protecting the environment is among the major factors which have influenced their low adoption and use in the contemporary market.

### Analysis and Findings

#### *Incorporation of Bio-Based Sensors*

A major finding from the conducted analysis is the need for the SGJ to incorporate bio-based sensors in their SmartJar technology in order to make their product more effective and appropriate for the target customers. According to Cabot et al. (2019) and Tyagi et al. (2021), microbial growth is among the key causes of food degradation leading to freshness loss through

production of metabolites. However, the presence of these metabolites can be easily detected by bio-based sensors that are incorporated into the packaging and storage containers. The studies by Curralo et al. (2022) and Rodrigues et al. (2021) reported that the presence of metabolites such as carbon dioxide, volatile nitrogen compounds, ethanol, biogenic amines or sulphurous compounds can be easily detected using freshness indicators. Currently, the SGJ are mainly focused on the storage of salads. However, results from the conducted analysis shows that the incorporation of bio-based sensors into the SmartJar technology will enable the SGJ to effectively store a wide range of food products such as meat, fish, seafood, fruits, and vegetables which are often highly perishable products. Consistent with the arguments by Groß-Vogt (2020) and Mendes et al. (2021), bio-based sensors offer protection to the food products stored in the containers hence protecting the customers from hazardous metabolites which are often produced during the degradation process.

Evidence reported in the study by Curralo et al. (2022) shows that the freshness of meat often decreases following the microbial growth leading to the formation of different forms of compounds such as acetic acid, n-butyrate, and biogenic amines. Precisely, these compounds often compromise overall quality of meat (Shariff, Gurubasavanna and Byrareddy, 2019). Therefore, bio-based indicators can be used to detect them at their early stages of development for effective elimination and ensuring enhanced freshness of food products. Prior to the innovation of SmartJar technology, the foods stored in SGJ had an average shelf life of 5 days, which was very short hence most of the food products stored in such containers were disposed after sometime because they were not fit for human consumption. Consistent with the evidence reported in the study by Mendes et al. (2021), the SGJ can use bio-based sensors to monitor and determine spoilage of fish and seafood based on the amount of total volatile basic nitrogen

(TVB-N) in addition to the presence of biogenic amines which are often generated from the decarboxylation of amino acids because of the microbiological action. Based on the conducted analysis, the SGJ can improve efficiency of their smart containers by incorporating bio-based sensors using natural compounds in intelligent food packaging.

#### *Incorporation of Internet of Things*

Another important improvement that the SGJ should incorporate into its SmartJar technology is the Internet of Things (IoT) to facilitate remote monitoring of the food stored in the containers. Even though the SmartJar technology by SGJ helped in increasing shelf life of the stored products, effective temperature management of such products was still reported as a major problem. Results from the conducted analysis show that incorporation of temperature indicators on the smart containers helps in improving efficiency of such containers in promoting food freshness and prolonged shelf life. Precisely, the studies by Cabot et al. (2019) and Tyagi et al. (2021) have reported that most of the smart containers for food storage are incorporating the IoT in order to provide consumers with easy access and monitoring of the stored foods. Incorporation of Internet of Things into the SmartJar technology will allow the SGJ customers to easily collect information and make it convenient for them to keep track of the foods stored in the containers. An important innovation which is similar to that of SGJ is the Smart Tupperware which are plastic food containers that are fixed with IoT to allow for effective remote monitoring of the stored contents.

Based on the success of Smart Tupperware in ensuring freshness of stored foods for a long period of time, the SGJ should also centre their SmartJar technology around a microcontroller with the ability to collect key data from the sensors and easily communicates with the mobile apps installed in the customers' phones or personal computers through Bluetooth

wireless network. As reported in the study by Mendes et al. (2021), many customers are seeking to use kitchen appliances with low power consumption rates. Consistent with the explanations by Rodrigues et al. (2021), smart kitchen food containers can minimise consumption of power by controlling active and sleeping modes in order to make the microcontroller effectively control power flow. Therefore, the SGJ should redesign their SGJ products to minimise power consumption as a strategy for attracting more customers to use the product.

### Proposed Solutions to the Problem

#### *Recommendations*

Results from the conducted analysis show that there are key improvements that SGJ should incorporate into its SmartJar technology to make it more effective in ensuring freshness of the stored foods. The first recommendation is the incorporation of bio-based sensors. Currently, the SGJ primarily focuses on ensuring proper storage of salads. However, incorporation of bio-based sensors will enable the company to produce more containers that can be used for storage of a wide range of food products such as meat, fish, seafood, fruits, and vegetables. Furthermore, the incorporation of bio-based sensors will allow for easy detection and elimination of metabolites such as carbon dioxide, volatile nitrogen compounds, ethanol, biogenic amines or sulphurous compounds which often lead to food spoilage. Currently, the SGJ have an average shelf life of 5 days, a duration of time which is relatively short based on the fact that some of the consumers would like to store their foods for a long period of time. Therefore, incorporation of bio-based sensors will allow for a prolonged storage of foods in such containers.

Another important recommendation for the SGJ based on the results from the conducted analysis is the incorporation of IoT into their containers. Evidence from the reviewed literature shows that most of the customers are currently looking for products which are can remotely

control because of the recent advancements in technology. With the incorporation of IoT, the SGJ customers will be able to assess the quality of stored foods remotely through their phones without necessarily doing the physical or manual assessment of the containers. Furthermore, the IoT will also help in minimisation of power consumption rate, a key development which will attract more people to use the product.

#### *Study Limitations and Action Plan*

The first limitation of this study is that it based its analysis on the secondary data which were published more than 2 years ago. Precisely, this study assessed the responses provided by SGJ founder and general manager in different interviews. However, it has failed to include data on the most recent developments within the SGJ. Another important limitation of this study is that large portion of the analysis was based on the evidence reported in the previous studies on business sustainability, specifically innovation of smart containers for use in the kitchen. Even though the initial literature search was focused on assessing and identifying studies which had assessed sustainability programmes of SGJ, this goal was not achieved as there was no such studies which had been established. In this context, most of the analysed studies were about smart food storage containers but not specifically regarding the sustainability approach adopted by the SGJ.

#### *Scope for Further Research*

The present study has led to the identification of key gaps in knowledge which can be researched and reported by future research. For example, there is need for most recent research on the current developments carried out by the SGJ on their SmartJar technology. Results from such studies would allow for the generation of more comprehensive evidence about the effectiveness of SGJ as a sustainable business project. Furthermore, the current study generally

based its analysis on the interview responses provided by the SGJ general manager more than 2 years ago. Therefore, there is need for additional research in this context to include recent perceptions, thoughts and lived experiences of not only the general manager of SGJ but also consumers who have purchased and used the products for food storage. Precisely, primary qualitative research will be appropriate in this context where both the SGJ employees and customers are interviewed in order to understand their thoughts, feelings and lived experiences about this sustainable innovation.



## References

- Cabot, M.I., Luque, A., De Las Heras, A. and Aguayo, F., 2019. Aspects of sustainability and design engineering for the production of interconnected smart food packaging. *PLoS one*, **14**(5), pp.1-9.
- Currало, A.F., Lopes, S.I., Mendes, J. and Curado, A., 2022. Joining sustainable design and internet of things technologies on campus: the IPVC smartbottle practical case. *Sustainability*, **14**(10), p.5922.
- Fan, H., Zhang, M., Bhandari, B. and Yang, C.H., 2020. Food waste as a carbon source in carbon quantum dots technology and their applications in food safety detection. *Trends in Food Science & Technology*, **95**(4), pp.86-96.
- Groß-Vogt, K., 2020, September. The drinking reminder: prototype of a smart jar. In *Proceedings of the 15th International Audio Mostly Conference*, **17**(4), pp. 257-260.
- Hanaysha, J.R., Al-Shaikh, M.E., Joghee, S. and Alzoubi, H.M., 2022. Impact of innovation capabilities on business sustainability in small and medium enterprises. *FIIB Business Review*, **11**(1), pp.67-78.
- Jeswani, H.K., Figueroa-Torres, G. and Azapagic, A., 2021. The extent of food waste generation in the UK and its environmental impacts. *Sustainable Production and Consumption*, **26**(4), pp.532-547.
- Mendes, J., Currало, A., Curado, A. and Lopes, S.I., 2021. Fostering Sustainability on Campus: Design of an IoT-Enabled Smartbottle for Plastic Reduction in the Academic Environment. In *Advances in Human Dynamics for the Development of Contemporary Societies: Proceedings of the AHFE 2021 Virtual Conference on Human Dynamics for*

- the Development of Contemporary Societies, July 25-29, 2021, USA* (pp. 18-25). Springer International Publishing.
- Rodrigues, C., Souza, V.G.L., Coelho, I. and Fernando, A.L., 2021. Bio-based sensors for smart food packaging—Current applications and future trends. *Sensors*, **21**(6), pp.21-29.
- Scherhauser, S., Moates, G., Hartikainen, H., Waldron, K. and Obersteiner, G., 2018. Environmental impacts of food waste in Europe. *Waste management*, **77**(16), pp.98-113.
- Shariff, S.U., Gurubasavanna, M.G. and Byrareddy, C.R., 2019. IoT-based smart food storage monitoring and safety system. In *International Conference on Computer Networks and Communication Technologies: ICCNCT 2018* (pp. 623-638). Springer Singapore.
- Tilt, C.A., Qian, W., Kuruppu, S. and Dissanayake, D., 2021. The state of business sustainability reporting in sub-Saharan Africa: an agenda for policy and practice. *Sustainability Accounting, Management and Policy Journal*, **12**(2), pp.267-296.
- Tonini, D., Albizzati, P.F. and Astrup, T.F., 2018. Environmental impacts of food waste: Learnings and challenges from a case study on UK. *Waste Management*, **76**(5), pp.744-766.
- Tyagi, P., Salem, K.S., Hubbe, M.A. and Pal, L., 2021. Advances in barrier coatings and film technologies for achieving sustainable packaging of food products—a review. *Trends in Food Science & Technology*, **115**(31), pp.461-485.
- Vanany, I., Wangsa, I.D. and Jeremi, N.A., 2023. A Multi-objective Mixed-Integer Linear Model for Sustainable Dairy Supply Chain with Food Waste and Environmental Pollutants. *Process Integration and Optimization for Sustainability*, **18**(3), pp.1-18.
- Walser, A., 2022. Sustainability through Simply Good Jars. *Ivey Business School Foundation*, pp.1-12.

Xiao, Y. and Watson, M., 2019. Guidance on conducting a systematic literature review. *Journal of planning education and research*, **39**(1), pp.93-112.

