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Submission date: 21-Nov-2022 02:25PM (UTC+0000)
Submission ID: 189685304
File name: Chinedu_Jude_-_B00613259.pdf (1.73M)
Word count: 19838
Character count: 116006

THE UNIVERSITY OF THE WEST OF SCOTLAND (LONDON CAMPUS)

MBA IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT – LNDN11133 – BUSINESS RESEARCH PROJECT 202223 T1

CHALLENGES AND OPPORTUNITIES OF ADOPTING CIRCULAR ECONOMY PRACTICES TO DESIGN SUSTAINABLE FOOD SUPPLY CHAIN IN NIGERIA

By

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Declaration

I, [banner ID B00613259], the author of this dissertation, hereby declare that:

I have read and understood Regulations 3.49—3.55 of Chapter 3 of the Regulatory Framework of the University of the West of Scotland regarding cheating and plagiarism;

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Acknowledgment

Special thanks to my wife, Mrs. Uchenna Onwuachu for her support and for being by my side during this time. Without her, we could not have made this journey. Chimamanda Audrey, who would later understand and comprehend why her father was constantly working on his computer, deserves to be mentioned as well for her presence and inspiration. Thank you to my mother-in-law, Mrs. Ozemena Ibe, and my parents, Mr. and Mrs. Charles Onwuachu, for their unwavering encouragement, prayers, and faith. I want also to thank my sister Mrs. Queendarline A and in-law Mr. Akunebu for their tremendous help.

I want also to thank my lecturer and supervisor Dr. Md Mostain Belal for his encouragement and guidance throughout the stage of this research. I thank also all my lecturers throughout my journey at the University (UWS). My thank you to the University of the West of Scotland (London Campus) for the opportunity given to me to partake in this research MBA program. To all those who helped in the collection of data and information, I thank you all for the effect and help.

Acronyms

CE	Circular Economy
LE	Linear Economy
SC	Supply Chain
FLW	Food Loss & Waste
FSC	Food Supply Chain
SFSC	Sustainable Food Supply Chain
SDG	Sustainable Development Goal
UNEP	United Nations Environment Programme
SCP	sustainable consumption and production
SCM	supply chain management
ANP	Analytical Network Process
GHG	Greenhouse Gas
SFSCM	Sustainable Food Supply Chain Management
ROI	Return on investment
3Rs	Reducing waste, Reusing and Recycling resources

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Abstract

To enhance the economic, ecological, and social sustainability of supply chains, the food sector promotes the implementation of circular economy projects. Poor countries find it more difficult to adopt circular economies and sustainability-related principles than developed nations. Supply chain activities have detrimental effects on people, the environment, and company continuity due to poor sustainability implementation. One-third of the food produced each year for human consumption is lost or wasted somewhere along the food supply chain .The economic, social and environmental impacts across the globe has recently been paid significant attention by the practitioners, NGOs, government, politicians, economists and environmentalists. Though circular economy practices could significantly improve overall food sustainability, it is vital to understand the relevant challenges and opportunities faced by the industry to adopt such practices. Hence, this study aims to investigate the challenges and possibilities associated with implementing circular economy-driven sustainability concepts in food supply chains in developing countries, notably Nigeria. To gather the data, semi-structured interviews with nine practitioners with a minimum of three years of professional experience (in the food sector) were conducted using a purposive sampling strategy. The results suggest weak environmental regulations/enforcement, collaboration/support from supply chain actors lack of infrastructure, and lack of market preference/pressure as the key barriers. Moreover, lack of technology lack, poor infrastructure and Poor government policies and implementation emerges as the most prominent barriers. In Nigeria, supply chain sustainability in food sector is still in its infancy and there is potential for development.

CHAPTER ONE

1.0 Introduction

The chapter addresses the factors that led to the research's interest in the opportunities and problems associated with using circular economy principles to create a sustainable food supply chain in Nigeria. An outline of this research is then given, after which the research problems and concerns addressed in the study are further to formulate the key research questions.

1.1 Background of the Study

A network that links consumers, farmers, and manufacturers is known as a food supply chain (Antonucci et al, 2019). Agriculturalists, suppliers, wholesalers, storerooms, and traders, among others are working in the system of FSC with the aim of providing consumers with harmless, good and quality food (Dania et al, 2018). Many trashes (food waste) are associated with the transformation of fresh food (produced by growers) to the food that is processed and its distribution to clients (Gardas et al, 2018). With regards to UNEP (2021), food that was wasted in the year 2019 globally was around nine hundred and thirty one million tonnes, and domestic was 61%, food services was 26% while commerce is 13 %, and for a total of 17% of edible food waste globally. From social, environmental, and economic perspectives, food waste has significant repercussions. After establishing the 3Rs, FSC waste disposal must discard the smallest quantity of trash in landfills with either reuse, recycle or recovery. Therefore, a closed-loop system in the FSC reduces waste. Thus, a circular concept increases the usage of generated food and lowers general food waste.

Waste of food is linked to large emissions of greenhouse gases, damage to the environment, or disappearance of biological diversity, etc (Corrado et al., 2019), hence management of waste is essential (UNEP, 2021). Management of food waste is the greatest obstacle to maintainable growth due to inefficient food excess management (Ciccullo et al., 2021). In other to prevent food waste and loss, Papargyropoulou et al. (2014) present a sequence for the management of food waste, avoidance waste of food, reuse, recycling recovery, and throwing away. Though, there is a substantial space in

the food supply chain for controlling food waste. According to Vilario et al. (2017), food loss and waste minimization are crucial components of recycling and reuse and contribute to the achievement of sustainable development objectives (SDGs). Therefore, the use of CE in the food supply is required to reduce, recycle and recover waste. The CE notion is one such concept that has been used over time for food waste reduction in food supply chain (Kumar, Singh, and Kumar, 2021).

From a food supply chain viewpoint, circular economy (CE) has quickly become a strong driving factor behind SC sustainability in study and experimentation. Before the point of sale, the supply chain generates 75–90% of the carbon footprint of a typical food product (Tidy et al, 2016). The circular economy (CE) represents a new and enhanced sustainability limit for SC management (Nasir et al., 2017). Some global supply chain giants, like Apple, Coca-Cola, and Colgate-Palmolive, are embracing circular economy (CE) characteristics (Farooque et al., 2019). In a traditional supply chain, trash is promptly sent to garbage dump, while a CE aims for zero waste and little rubbish dump (Bressanelli et al., 2019). To effectively embrace CE practices in the food supply chain, businesses must recognize and overcome significant obstacles. CE adoption in FSC provides several benefits. It may maximize food value, decrease food waste, and eliminate land disposal. Therefore, the implementation of a CE in FSC is urgently needed to promote maintainable development goals such as sustainable consumption and production (SCP) and eradication of hunger.

CE implementation for sustainable development objectives has several benefits, but it still confronts hurdles and impediments in reality. By reusing, reprocessing, and recycling food items, the circular economy (CE) may minimize environmental impact and waste. Previous research and the United Nations Environment Programme (UNEP) (2021) indicated that FSC has great space for decreasing waste of food and that the CE plays a vital role in reducing waste and sustainable development. The World Bank estimates that 40 percent of all food produced in Nigeria is lost and that each year, Nigerians trash at least 189 kilogrammes of food, or a total of 37.9 million tonnes of food while the 2019 hunger rate in Nigeria was 14.60% out of a population of nearly 200million (Ripplesnigeria,2021).Consequently, this paper investigates the obstacles and potential

of applying a circular economy strategy in constructing a sustainable supply chain for food in Nigeria.

The vast bulk of research on the use of the circular economy has neglected developing economies such as Nigeria in favour of developed and rising economies. Food waste is a crucial problem for companies in developing nations that produce food. According to a large body of research, several factors contribute to food loss, including inadequate facilities and transportation, a lack of cooling, inadequate market services, inadequate packing, inadequate storage, inadequate quality control, etc. (see Table 2.1). To address the problems of food loss and waste in value chains, organizations should employ circular economy-driven, sustainability-oriented methods.

1.2 Statement of Problem

The needs for the adoption of CE practices stem from the increasing population and unsustainable food supply chain that are been undermined mostly in developing countries like Nigeria. Today, humanity is facing serious environmental problems ranging from climate changes, soil degradation and loss of biodiversity, basically due to rapid and dynamic technological advancement and the linear economy model cannot deliver a sustainable and maximum use of natural resources as it is prone to food wastes and environmental deterioration (Ionescu, 2020; Hodgkins, 2020). Therefore, given the level of food insecurity in developing countries which is caused by various factors including lack of government and various stakeholders commitment in developing a road map for food production, it becomes imperative to adopt CE practices to achieve workable use of food resources and recycling of waste to promote and execute maintainable production and consumption.

Food waste is believed to constitute a considerable fraction of total production waste (Borrello, Lombardi, Pascucci, & Cembalo, 2016). Food and Agricultural Organization (FAO, 2011) projected that one out of three of the global edible food supply chain (about 1.3 billion tonnes) is lost. Consequently, increased food waste has become a concern for the world's security and ecological governance, with important environmental, financial, and social consequences (Liu et al.,2021). In an exceptional issue on nature of CE,

Nigeria's use of the world's resources and trash production constitute a significant danger to the global food sustainability (Mathews and Tan, 2016).

About one out of six (35 million tonnes) of the total grain from Nigeria is lost each year during production, processing, and transport due to substandard equipment, inadequate knowledge and technology, and logistical problems that are made worse by a fragmented agricultural production system. (Liu et al., 2013; Cui and Shoemaker, 2018). Having these serious waste management and environmental difficulties (Geng et al., 2013), the Nigerian Government has undertaken several policies, laws, and financial measures to bolster its CE programme (Mathews & Tan, 2016). CE is an industrial system built on restorative and regenerative design principles, which is much more sustainable than the prevalent linear economic paradigm (make, use, dispose of). The circular economy practice provides a country with opportunities such as a large-scale, concentrated, and low-cost supply of food loss and waste feedstock, a consumer shift toward natural-based products, an increase in fertilizer supply to meet market demand, and the current trend of progressive advancement in energy-conversion technology to combat climate change.

Therefore, in both study and practice, CE has quickly emerged as a powerful factor supporting SC sustainability. (Genovese et al., 2017; Hobson, 2016; Nasir et al., 2017), presenting a new and advanced sustainability frontier in SC management (SCM). Existing literature refers to the integration of a CE into the SC as a circular supply chain (Farooque and Zhang, 2017). This well-known Gartner analysis asserts that "the future of the supply chain is circular, not linear" (Aronow et al., 2018). However, the adoption of a circular economy in the food supply chain faces several obstacles, including low technological readiness and reliability in estimating material potentials in terms of quantity and quality, high logistics costs associated with the collection of materials, safety concerns and low customer acceptance that create a marketing challenge, stricter regulations on animal feed production, and geographically dispersed supply locations (Shoemaker, 2018). This research focuses on the fact that Nigeria is the most populous country in Africa, with a population of over 200 million people, and that food insecurity has left many households hungry. Therefore, the research indicates the necessity for a study addressing Nigeria's perspective on CE practices.Koberg et al. (2019) analyze the problems and possibilities associated with creating a circular economy in this research. A comprehensive analysis

of sustainable SC management practices in worldwide supply chains for the development of a sustainable food supply chain in Nigeria is necessary.

1.3 Rationale of the study

The available literature indicates that the field of maintainable SC management has been explored from a variety of viewpoints in different settings and has gained pace over the years (Koberg and Longoni, 2019). Further research is required for each unique location, especially undeveloped and growing countries due to their constraints, as noted above, and the urgency of today's environmental and social challenges. Additionally, in the age of globalization, concerns relating to the environment, the economy, and society affect not only one nation, but also the whole area and the entire globe (Koberg and Longoni, 2019).

Contextual considerations are critical for the sustainability of the food supply chain in the context of the food industry (Toussaint et al., 2021). The available research reveals that empirical studies focusing on the variables influencing sustainable food value chains in developing and emerging countries are few. One of the top producers of fresh food in the world, Nigeria's smallholder farmers is responsible for the majority of the country's agricultural output. After harvest, more than forty per cent of this fresh product is wasted, which results in a loss of revenue for smallholders of more than thirty per cent (Ripplesnigeria, 2021). Therefore, there is a need for a study that explores the challenges and opportunities of adopting circular economy practices in designing a sustainable food supply chain in Nigeria.

1.4 Objectives of the Study

The main objective of this study is to investigate the challenges and opportunities of adopting circular CE in designing sustainable food supply chains in Nigeria. The specific objectives of this study include to:

i. to explore the significance of sustainable food supply chain design in Nigeria
ii. to investigate the key challenges of adopting circular economy practices in designing a sustainable food supply chain in Nigeria

iii. to explore key opportunities for adopting circular economy practices in designing a sustainable food supply chain in Nigeria.

1.5 Research Questions

The following questions will be addressed by this study:

i. What are the key challenges of adopting the CE practice in designing a sustainable food SC?

ii. What are the key opportunities for adopting the CE practice in designing a sustainable FSC?

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1.6 Scope of the Study

This study focuses on investigating the challenges and opportunities in adopting the circular economy practice in designing a sustainable food supply chain in developing countries a case of the Nigerian food supply chain Market. Therefore, the study cover farmer, food supplier, and food processing firm in Nigeria. The study deploys literature review and interview techniques as the main approach to achieving the study objectives.

1.7 Organization of the Study

This research work is organized in five chapters. Chapter one covers the introduction which includes the background of the study, a statement of the problem, the objectives of the study, research questions, and the significance of the study. Chapter two concentrates on the literature review while chapter three emphasizes on the methodology and philosophy adopted in the study. Chapter four looks at analysis and discussion while chapter five summaries the findings, conclusion and recommendations.

1.8 Chapter Summary

In conclusion, this chapter provides a brief overview of the motivation, the research problem, and the importance of this research in recognizing the opportunities and

limitations of adopting circular economy practices in designing a sustainable food supply chain in Nigeria. This chapter's goal is to explain the justifications behind the research questions, the setting of the study, and its significance. This also included a summary of the research organizational structure so that readers could easily move between its many chapters. The topic of the following chapter will be a review of the literature with a specific focus on the study's objectives and relevant research gaps.

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual Review

This section concentrates on the review of the previous study on basic concepts and theories relevant to the study. The review adds to the writing by giving new bits of knowledge about the proceeding difficulties that SSC faces in emerging nations like Nigeria.

2.1.1 The Concept of Circular Economy

As a method of sustainable economics, CE lessens the extraction of raw materials and permits resource recirculation, resulting in favorable settings for both societies and industry (Ada et al,2021). However, putting CE into practice necessitates both radical alternative economic solutions and innovative resource management while resource utilization, waste, and emissions issues along the supply chain are the primary goals of CE (Ada et al, 2021). The take-make-waste linear economy is thought to be replaced by a circular economy (CE). CE operates under the tenets of preserving resources and renewing natural systems while minimizing waste and pollution and in this economic system, the concepts of end-of-life and reduce, reuse, recover, and recycle are used instead (Do, Q et al, 2022).

2.1.2 Circular Economy Practices

CE is defined through specific actions and practices such as eco-design, reuse, refurbishment, remanufacturing (e.g., Nasr and Thurston 2006), repair, product sharing, and industrial symbiosis (IS) (Chertow and Ehrenfeld 2012).

- **Recycling**

This is a process of disassembling discarded products into their constituent parts and turning them into new products. The raw materials in this instance would then only need to be extracted once, saving time, energy, and labour, and they would be continuously cycled and recycled. Raw resources must first be mined, processed into something more usable, and then put together into components, and eventually into goods, before they can be sold. When a product is thrown away at the end of its useful life, all the work and value that went into it are also lost. Every recycling method is an effort to keep some of the embodied value. According to Defra, 2008, a million tonnes of textiles are produced in the UK estimated to be valued £238 million yearly disposed of in landfills, which, given limited resources capacity of a landfill would occupy the available area suppose these numbers persist in ten years.

According to Kim and Kim 2016 findings, due to these challenges and the depletion of raw material the culture of throwaway clothing has slowly spread around the world especially in the UK , and the amount of textile waste generated as a result has increased the negative social, economic, and environmental repercussions. Reviewing the UK case for the textile recycling process, management demonstrates competence in the management of charitable organizations and recycling businesses for trash distribution and collection. As charities and recycling businesses run their operations in this kind of collaboration under government control and supervision, the waste collection and distribution channels are built in an efficient and effective process regarding the high recycling rates of the waste and social contribution from its sales and profit with over 380 members joining the charity companies with more than 7,800 outlets stores that resell donated used clothing to the population and the excess inventory sold to recycling companies (Kim and Kim, 2016). This minimizes the waste on the textile industries in the UK.

- **Reuse**

Reusing items or materials helps to lessen the environmental harm caused by pollution by keeping them from becoming waste. When waste is disposed of in landfills, it harms

the ecosystem by lowering the quality of the air and water, as well as having an impact on the local species and biodiversity (Radhakrishnan 2016).

A review on the research of reuse of the waste water in Germany for irrigation on crop material according to Maab, and Grundmann (2018), observed that governance structure's alignment with irrigation's unique characteristics and the associations of farmers' interdependence with one another support the reuse program's efficient functioning. Pooling of resources with distinct ownership and decision-making powers characterizes the governance structure designed to match the irrigation's characteristics. Growing interest has been shown in the use of wastewater reuse in agriculture as a means of assisting the water and agricultural industries' transition to the circular economy in Gemany according to this study. Reusing wastewater gives a chance to lessen the demands on natural water resources and the discharge of pollutants to surface water bodies when done safely based on this review.

- **Remanufacturing**

Remanufacturing is a procedure where the used product goes through a series of procedures such disassembly, sorting and cleaning, scanning, refurbishing or replacement, reassembly, and quality testing before being put on the market and is a crucial part of the circular economy because it helps to extend the life cycle of goods that are no longer needed or in use, which helps to harness the advantages for the environment, the economy, and society (Singhal et al, 2020).

The United States is the largest remanufacturer in the world, producing remanufactured goods worth $43 billion and providing 180000 jobs while the largest remanufacturers in Europe are in Germany, the United Kingdom, the Netherlands, and France (USITC, 2012). There are environmental advantages, such as reduced energy and material consumption and carbon footprint in remanufacturing (Wang et al., 2016). For instance, the energy needed to produce the same number of remanufactured products uses 85% less energy than the production of new products (Hazen et al., 2017). Additionally, the remanufacturing of engines results in a decrease of 55 kg of steel and 565 kg of CO2 (Zhang et al., 2011). With the same amount of energy and materials used in

manufacturing, 7–11 more units can be produced (Steinhilper, 2001). Remanufactured goods are typically sold for as little as 60% of the price of brand-new goods (Rathore et al., 2011)..

- **Reverse Logistics**

According to Guide and Van Wassenhove (2009), the movement of products from consumers back to manufacturers is referred to as reverse logistics which is one element of a CE and without reverse logistics, a product flow often ends with customers disposing of products in landfills. Returned merchandise from customers, product recalls, excess inventory, or just a product that has outlived its usefulness can all trigger the reverse logistics process.

According to Wilson et al (2022) findings is that although the numerous reverse logistics functions and duties each rely on a different type of Artificial intelligent which has considerable benefits across all functions and tasks in the process.

2.1.3 Sustainable Food Supply Chain

According to the UN Global Compact, the goal of supply chain sustainability is to "produce, protect, and grow long-term environmental, social, and economic value for all stakeholders involved in bringing goods and services to market. A food supply chain consists of the businesses in charge of producing and distributing goods made from either plants or animals. Food supply chains are distinct from those for other products. In reference to Figure 2.1, which consist of supplier, manufacturer, distribution, return and waste will be evaluated on the sustainable approach on food supply chain in there various activities

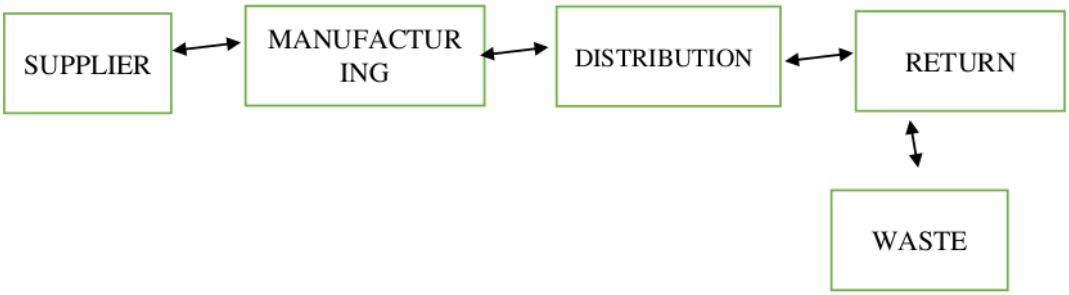

Figure 2.1 – Supply Chain Diagram - Source Researcher

Supplier

In other to maintain sustainability of the supply to manufacturing Stage, Companies need evaluation to qualify suppliers as well as solve other issues like choosing, rating, categorizing, and/or sorting providers. Sorting and classification are two distinct issues in the multicriteria approach. According on Tidy et al (2016), greenhouse gas emissions are greatly impacted by the food supply chain. Tidy et al (2016) noted that in the food retailing industry in the United Kingdom (UK), supermarkets are the dominant players and responsible retailers must change supplier behaviour to lower emissions because 75–90% of the carbon footprint of a typical food product is created in the supply chain before the point of sale.

Manufacturing

According to estimates, the entire food system in developed countries produces between 15 and 28% of the total GHG emissions, with all supply chain phases from agricultural production to processing contributing to approximately half of the GHG emissions connected to food in affluent nations and more (relatively) in developing regions with less developed post-harvest supply chains (Smith et al, 2007). In other words, green food processing is vital to the sustenance of food production in the future. Green food processing is centered on the innovation of method that will utilize less

water and energy, allow the recycling of waste products through bio-refineries, and provide food that is both safe and of a high standard (Chemat et al, 2017). Lack of technical know how, funding, infrastructure, government policies and collaboration of supply chain are some of the challenges in adopting green method on food processing especially in the developing nations (See Table 2.1)

Distribution

There are multiple activities involved in distribution, such as packaging and shipping, and this have a significant environmental impact. Carbon dioxide (CO_2), a greenhouse gas that contributes to global warming, is reduced using sustainable distribution techniques (USEPA, 2022). Almost every firm is a contributor to ecological overrun and its occurs when the ecosystem's capacity to engage our carbon dioxide emissions and replace the resources we have depleted at a rate that keeps up with our consumption surpasses our collective demand on the ecosystem (Agility, 2021).
Green distribution methods put efficiency first to avoid wasting energy that could entail anything from more effective use of shipping containers or vehicles for packing to attaining the best fuel efficiency possible for ground transportation (Agility, 2021). All of it translates into huge energy savings and a decrease in carbon emissions. More importantly, though, a smoothly operating company typically has a happier staff, better customer outcomes, and fewer resources squandered. Consider this as a win-win situation for you and the environment since most organizations aim to increase operational effectiveness.

There are also lots of benefit economically. It goes without saying that using less energy will increase organization’s profits and the business might save a lot of money by making even very little adjustments, like remembering to turn off exterior floodlights during the day. For instance, a 2018 energy assessment by academics revealed that a Zimbabwean industrial site could save over $50,000 annually on electricity costs just by upgrading its lighting equipment (USEPA, 2022). When you take into account how sustainable distribution optimizes numerous processes throughout your supply chain, it's simple to see how quickly the savings can up from the business.

Waste

Any city's zero waste strategy must include effective handling of food and organic waste. Food waste accounts for about 8% of the world's greenhouse gas (GHG) emissions and a third of the food produced worldwide is lost or wasted.

The appropriate use of biogas produced from waste can be promoted as a means of accomplishing the objective of sustainable renewable energy. The production of biogas is influenced by waste management for sustainability (Aziz and Hanafiah, 2020). Sustainable bioenergy can take the place of non-sustainable energy sources (Rincon et al., 2019). A need for alternate energy sources is favoured by increasing fuel consumption due to a growing population. Finding a viable renewable energy source that is environmentally sustainable is of global significance. To create bioenergy, waste water from the paper, pulp, and food sectors is used (Goud et al., 2014; Vaez and Zilouei, 2020).

400 million tonnes of paper are produced annually by the 5000 paper and pulp factories that exist worldwide and in other to address the effluent problem sustainably, biomethane and biohydrogen are created from the effluents of paper mills (Gottumukkala et al., 2016; Vaez and Zilouei, 2020).With the help of the anaerobic digestion (AD) process, the palm oil mill is one of the potential sources of organic waste that may be converted to biogas, thereby trapping the methane that can be used productively (Xu et al., 2019).Food waste is converted into bioenergy by biological processes such as aerobic composting, feed fermentation, AD, and bioethanol production (Kiran et al., 2014).

2.1.4 Key component of designing a sustainable Food Supply Chain

All forward processes in the food chain, such as material acquisition, production, and distribution, as well as the backward processes to gather and process, returned used or unused goods and/or parts of products, are referred to as sustainable food supply chain management (SFSCM) to ensure a socioeconomically and environmentally sustainable recovery (Bloemhof and van Nunen 2008). Food consumption has greatly grown owing to population expansion, changes in nutritional requirements generally, and increasing

income levels. The CE paradigm aims for sustainability by reversing environmental degradation and preserving the economic and social health of the present. The need for food production and delivery has grown due to this rise in consumption, creating serious global economic, societal, and environmental issues (Tilman et al. 2002). According to the Food and Agriculture Organization of the United Nations (FAO), food sectors must simultaneously boost productivity and reduce the negative effects of production and distribution (FAO 2012).

Any company must take into account the following components to develop a sustainable food supply chain, as shown in Figure 2.1. They consist of:

Senior Leadership's Commitment:

Starting at the top of the firm, a corporate culture where environmental, sociological, and economic implications are given equal weight must be developed. Because the shift in business procedures and employee behaviour represents a major deviation from accepted norms, senior management involvement is necessary. Resistance to the necessary adjustments in methods, measures, and behaviours is nearly a given in any change management approach. For instance, our farmers' and input service providers' "get it done" mentality—often sensible given Mother Nature's time constraints—might need to adapt when taking into account considerations like employee safety, environmental effects from drift, runoff, volatilization, etc. Common fertiliser application procedures in the autumn may need to be balanced against their effects on water quality, and innovations may need to be developed to strike a balance between the need for fall application and the need to lessen the workload in the spring. Although these kinds of changes are difficult to implement, projects cannot succeed without the support of senior management (Bloemhof and van Nunen 2008).

Engaging important Supply Chain Participants

Agriculture-related individuals and businesses have a reputation for being fiercely independent. Throughout the value chain, they have depended on free markets and arm's-length transactions. The food sector of the economy has likewise tended to stay out of agriculture and let markets decide how raw materials are exchanged for food

products. Food and agribusiness firms throughout the chain must grow increasingly reliant on one another as demand for more sustainable food supply chains rises. To enable sustainable metrics to be monitored and traced across the system, players in sustainable food supply chains must cooperate, take responsibility for their activities, and exchange information transparently. The participants on the food supply chains in the developing nations like the farmers ,the food processing companies, the logistics companies and the distributors should engage each other in information sharing etc. in other to attain food supply chain sustainability. For instance according to Maab, and Grundmann (2018) research, the successful use of waste water for crop irrigation in Germany was due to government alignment with farmers associations which supports the reuse program's efficiently.

Supply Chain Members Participating in the Strategy

The players in the food and supply chains will need to collaborate to have significant sustainability benefits, and they will also need to be willing to publicly communicate how the chain's strategies are being developed and align those goals with their own companies. Due to misaligned incentives and/or pressure from individual actors to avoid responsibility, a sustainable food supply chain plan that is not in line with the objectives of the individual enterprises is likewise destined to fail. Chain and company strategy alignment is a collaborative effort. To enable chain players outside of the specific business to become more acquainted with and involved with the individual company's strategy, the alignment must be flexible and open. Hence, the success of the strategy's development will depend on the establishment of close bonds and trust among the supply chain's participants (Sadraei et al, 2022).

Technical Capabilities Development

To fulfil consumer demands, the food and agriculture supply chain involves a tangled combination of hard sciences and social sciences, which may clash. Human talent must be able to comprehend, communicate, and act on this confluence of sciences in innovative ways as the chain adjusts to meet future sustainability needs. It is necessary to create talent with the ability to monitor and trace operations both inside and across

organizations. It is also necessary to train personnel with the interpersonal skills necessary to forge bonds of trust and establish interdependencies among businesses so that sustainable food supply chain strategies may be implemented successfully. To continually increase the effects of sustainable food supply chain policies, people that can drive innovation must be created (Barua, 2022).

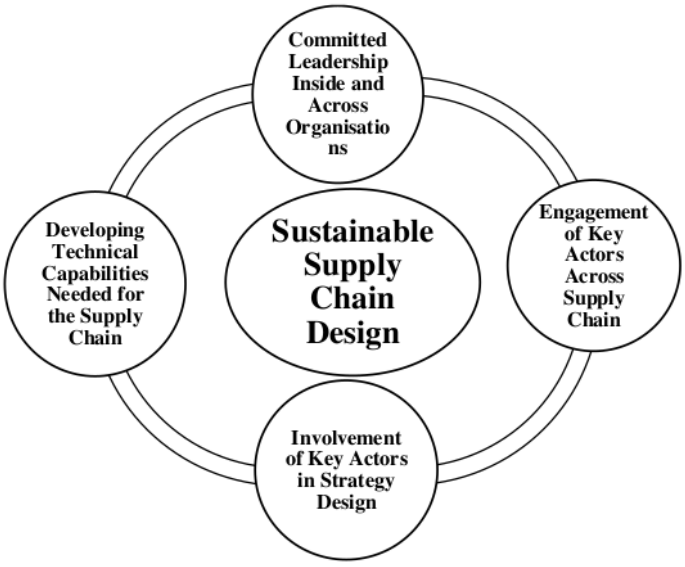

Figure 2.2 Sustainable Supply Chain Design (Source – Author)

2.1.5 The Importance of Circular Economy Practice to achieve sustainability.

FSC goods are designed for extensive recycling, restoration, reuse, and circular production. In addition, the collection of high-quality biological nutrients (e.g., organic materials) in this manner contributes directly or indirectly to natural resources (De Angelis et al., 2018). Several academics (Lehtokunnas et al., 2020) have already reduced significant amounts of garbage using CE methods, indicating a connection between the FSC and waste minimization.

Genovese et al. (2017) conducted a life cycle study and found that CE practices boost the FSC's sustainability and benefit the environment. Meherishi et al. (2019) found that sustainable packaging in supply chain management facilitates CE practices. Jurgilevich et al. (2016) examined the barriers to using the concept of CE in the FSC. Principato et al. (2019) offered a case study on CE processes in the pasta production industry. They found that pasta manufacturing is the most exemplary example of CE since it contributes to just 2% of food loss and waste across its whole life cycle. Given that almost 0.8 billion people globally suffer from chronic hunger and that the majority of developing countries score low on the hunger index, minimizing food waste is one of the food industry's most critical sustainability problems (FAO, 2014).

Packaging is considered a vital element of sustainable food consumption and a great way to reduce food waste by preserving food fit for human consumption and viably reducing carbon footprints as well (Guillard et al., 2018)

According to a statistic published in 2014, the world manufactured three hundred and eleven metric tons of plastic in a one year, using up 6% of the oil used for manufacturing plastic , only 5% of the total amount of plastic was recycled for later use, resulting in a loss in productivity of 26% by volume, or £62–92 billion and by 2050, it is predicted that annual plastic manufacturing would have increased to one hundred and twenty four metric tons, using 20% of the world's oil supply (World Economic Forum, 2016).

Table 2.1 Literature Review Table on the aim, opportunities and Challenges of CE food supply chain

AUTHOR /YEAR	METHODOLOGY	COUNTRY	AIM OF THE STUDY	KEY FINDING	KEY CHALLENGES	KEY OPPORTUNITY
Do et al (2021)	Mixed	UK, Italy,	Customer readiness in a Circular Economy	Excessive food modification may pose a risk to the health of customers	(1) Low level of technological readiness (2) expensive collection-related logistics costs (3) Government policies and implimentation	(1) New commercial opportunities by industry practitioners (2) The abundant, focused, and inexpensive supply of FLW feedstock
Ada et al (2021)	Qualitative 65%: Quantitative 25%,mixed 10%-	EUROPEAN UNION	Explore the barriers of Circular Economy in FSC	Industry 4.0 can help CE solve its issues.Tools for processing data on the blockchain can deliver the transparency necessary for taxes and incentive systems, which is a key concern.	(1)Lack of knowledge and skills(2) Lack of blockchian Technology. access to resources for investments and infrastructure. (3)Weak regulations,	Decreases the exploitation of raw materials and allows for resource recirculation. Creating products in accordance with customer specifications
Farooque, M et al (2019)	Qualitative: Quantitative	CHINA	To systematically analyse the causal-effect relationships	lack of public commitment to and support for the government's CE aspiration	lack of market preference or pressure.Weak environmental regulations	possible collaboration opportunity with neighbouring businesses and also promotes the creation and upkeep of a formal

			among the barriers		and enforcement collaboration/support from supply chain actors.	regional eco-industrial network
Kumar et al(2022)	Qualitative	INDIA	To investigate the difficulties of CE adoption in India	To have a profound understanding, it is necessary to analyse the indicated components.	Lack of Government policymaking and offering incentives. Strictly enforcing environmental regulations.	It is possible to engage in corporate social responsibility (CSR).
Sadraei et al (2022)	Qualitative: Quantitative & Mixed	Italy , USA, UK , China Brazil Australia Spain Austria Turkey Malaysia	to investigate bibliometric factors relating to waste in the food business	Lots of Pollution caused by food production. To reduce food waste, businesses should adjust their circular business models and provide themselves with cutting-edge production facilities; Customers should demand from businesses waste reduction strategies and partnerships with organizations that distribute food to the underprivileged. More evidence should be provided regarding pollution.	Lack of technology. Lack of collaboration between supply chain. Cultural implications. Government regulations and enforcement	Using effective collection methods, treated food waste can be used again.
Zhang et al(2021)	Qualitative, Quantitative/ Mixed	EUROPEAN UNION	How to encourage participants at various levels of a food supply	The key issue that needs to be how to successfully apply CE concepts to the management of the	Lack of policies and legislation enforcement-	Eradication of poverty and hunger

			chain to follow sustainable practises	food supply chain, particularly CE-based food waste management.	transition challenges.	
Suhartini et al (2021)	Mixed	Indonesia	investigating the production of energy from food waste	processes pose a risk to the natural environment if not managed correctly	Low Technology	The fuel for domestic cooking can be made from briquettes made from food waste.
Saurabh Ardra1 ; Mukesh Kumar Barua (2022)	Qualitative: Quantitative/ mixed	INDIA	Identification of barriers/factors to implementing circular practices in the food supply chain	Government policy , Culture	Information mechanisms to monitor recycled goods are lacking. Lack of production technique.	The CE economic model seeks to maximise resource productivity while avoiding waste.
Zahir Irani and Amir M. Sharif (2017)	Qualitative	Italy	explore the use, applicability and relevance of strategic planning in FSC	usage of strategic planning tools capable of comprehensively capturing a multitude of interrelated factors	Lack of preparation of food products, processing, storage, transportation, consumption and disposal	Food with the highest nutritional value, the least amount of trash, and no land-based disposal
Howard et al (2022)	Qualitative	UK	Examine tools and techniques for small- to medium-sized businesses to adopt the circular economy.	Make production more efficient by maximising the value of the materials.	insufficient ambient culture or support system to facilitate the adoption of CE	Cost-cutting and its effect on the bottom line
Krishnan et al (2019)	Qualitative	India	Intends to use environmental impact assessment to find operational and resource inefficiencies in FSC.	natural resource depletion hazardous gas emissions into the environment, energy usage drinking water	Low technology. Government policy	Lessen the number of virgin input resources needed throughout the FSC's cultivation stage.
Sadhukhan et al (2020)	Qualitative	India	Examine the following global challenges for a sustainable 21st century: a plant-	Cultural issues, lack of collaboation	Technology.. Government policy	Zero hunger, zero poverty through biorefinery and bioeconomy; biosurfactant and

			based diet, avoidable food waste, biorefining, and a circular economy.			chemical manufacturing from bioresources
Sharma et al (2019)	Mixed	India	Examining the different obstacles to the successful implementation of circular economy-led sustainability in FSC is the goal of the current investigation.	Poor government policies. Lack of tools and technology, and farmers' ignorance .Lack of understanding	.transportation and infrastructure caused by bad government policy. tractability problems Issues with packaging and a weak cold chain. Lack of farming knowledge and awareness, lower production, a lack of technology	CE assist administrators and decision-makers in the efficient management of natural resources in the food industry
Sarker et al (2022)	Qualitative, Mixed	Bangladi sh	Aim investigate the challenges in sustainable food supply chian	While FW is not managed separately, some typical waste management techniques are used.	Cultural issues, Givernment policies . Techonolgy	Conversion of waste to energy. Integrated Biorefinary. Waste to value added product
Hamam et al (2021)	Qualitative	Australia	Understanding its primary traits and viewpoints, as well as reviewing and debating the literature CE area.	implementation of cleaner production methods, a corresponding rise in stakeholder accountability and consciousness on the part of both producers and consumers. implementation of suitable tools and regulations.	Lack of tight coordination amongst all parties involved. Government policies	A promising approach to promoting regenerative, restorative, and sustainable agriculture

Yoong et al (2021)	Quantitative	Malaysia	Investigate how resource recovery from food waste might be useful.	Implementing resource recovery from food waste can make a direct or indirect contribution.	Changing the consumer buying behaviour; food consumption behaviour. Technology, Regulation policies	Good health and wellbeing; absence of poverty; Sanitation and clean water; Cost-effective and clean energy, decent employment, and economic expansion; Healthy Communities and Cities
Taghavi, Fallahpour, Wong, and Hoseini (2021)	Quantitative	Iran	Aim to determine and rank the elements that affect the GSCM's implementation	External factors	Lack o government polices, Consumer and supplier's behaviour	reduce the negative environmental impact
Kayikci et al (2022)	Qualitative	Holland	Examines if blockchain technology is suitable for addressing significant issues in the food business, such as traceability, trust, and accountability.	Robust tools to be available in the Industry 4.0. Blockchain consortium are the widely accepted and appropriate models for use in business	Consumer's behaviour. Lack of transparency. expensive solution to implement. Capacity to trace lots backward and forward.	Developing the financial identities of smallholder farmers. Public safety, reducing fraud and transparency, and reining in financial waste
Al-Saidi et al (2021)	Qualitative	Qatar	Dissect the circular economy concept in the context of the water and food sectors, as well as other fundamental supply sectors.	utilising by-products of desalination,raising household engagement and understanding in waste management. promoting low-hanging fruit based on the reduction and reuse principles	Government polices and implementation	Using treated wastewater as a different resource to produce food. Using both organic and inorganic substances, producing biomass as feedstock. Conversion and recycling of food waste is creating potential for capturing resources for biorefineries and renewable energy production.
Boon, E.K. and Anuga,	Qualitative	Ghana	The adopted macroregional strategy will enhance	.Insufficient involvement of the stakeholders	Lack of training, capacity building,	Agriculture products have cheap production and marketing costs. Farm waste could be

S.W., (2020)			prospects for regional food hubs to be established in Ghana and will facilitate cooperation and coordination.		knowledge and technology transfer, human resources, and policy reforms and adjustments	utilised to make organic fertiliser to help agriculture become more intensive. use of natural resources that is efficient and effective. food and nutrition security, and the reduction of poverty

2.1.6 key challenges in designing a sustainable food supply chain using circular economy concepts.

In addition to the benefits of switching to CE from the linear approach in FSC, there are certain difficulties in actually putting it into effect. The key findings of earlier, more current research on the identification and analysis of CE adoption problems in FSC are shown in Table 2.1.Sharma et al. (2019) in the research observed that the poor government policy and implementation is the main challenge in food supply chain sustainability in countries like India, Bangladesh, and Pakistan. Ineffective recycling and waste management initiatives, a lack of environmental legislation, and a lack of sustainable policies are all challenges (Kumar, Singh, and Kumar,2021). In reference to Table 2.1 on the literature review, there are several challenges on the implementation of the sustainable food supply chain. Lack of Technology, Government policy and implementation.Lack of infrastructure, supply chain collaboration, lack of technical skill, customer awareness

Technology utilization should attempt to enhance corporate operations' sustainability as well as efficiency and with this, Industry 4.0 and the circular economy are contenders to be complementary concepts (Garcia-Muia et al., 2019). Industry 4.0 is a set of concepts

that aim to enable firms to modify their manufacturing processes and analyses enormous amounts of data in real-time, which will improve strategic and operational decision-making (Kagermann et al, 2013). This will enhance sustainability of the food supply chain especially in the developing economy

Additionally, developing economies lacked digital logistic infrastructure and support for information technology (IT) (Mangla et al., 2018). According Sharma et al (2019), the reaseach on the Indian food industries suggested that poor and outdated infrastructure for support the sustainability in the food industries is one of the challenges. From observation, poor facilities is one of the major challenges in the developing nation and the government should organize the stakeholders in investing the critical areas to support agricultural and food production.

Supply chain collaboration among the various stakeholders is another challenges faced with food sustainability in Ghana (Boon, E.K. and Anuga, S.W, 2020). Their research article, it is observed the various stakeholders including the government whose polices are inconsistent and poor implementation of the existing one to support food sustainability is one of the major issues. Organization alignment with other partakers in the FS chain network is also observed by this article as another the issue. Government especially in the emerging economy should lead the way in aligning with various stack holders on the proper policies and proper enforcement with strict supervision. Awareness is also to be created by the government on the need for the sustainable food polices with proper highlight on the benefits to the environment, social and the economy.

The consumer behavior is another challenges faced with the food sustainability implementation in Holland according to Kayikci et al (2022). The end product user may not really understand the implication on the change or traditional product design and may not be willing to commit his resources in the purchase of the product. Awareness needs to be created in other to prevent consumer's misunderstanding of the situation.

Lack of technical skill is one of the difficulties FSC encountered in effectively implementing CE practice in the current Industry 4.0 age. For CE adoption in FSC, an efficient traceability system is needed to track the waste produced (Nandi et al., 2021). Since it keeps track of food waste, food quality and safety, and transparency, the FSC traceability is essential. But it's difficult to set up a traceability system (Sharma et al., 2019). Challenges are interconnected, with some serving as a cause or driver and others as an effect or drive, it has been discovered. To find new chances, it is crucial to examine and evaluate difficulties to comprehend their significance and role in growing CE practice.

Poor funding with high interest rate is another challenges faced with the implementation of the sustainable food supply chain in Ghana according to Boon, E.K. and Anuga, S.W, 2020. This is very peculiar to the emerging nations with double digit interest rate on loan. The stakeholders in the sectors should encourage loans to food production companies, farmers and the food network with low interest rate to enable the implementation of circular food supply chain in the emerging nations.

2.1.7 Key opportunities of Using Circular Economy Techniques When Creating a Sustainable Food Supply Chain

Industry-wide adoption of the circular economy has lot of advantages based on the previous literature and the review above(See Table 2.1) These opportunities ranging from low cost, low carbon emission to the atmosphere, cheap production of agricultural products and marketing costs. Farm waste could be utilized to make organic fertilizer to help agriculture become more intensive, food and nutrition security, and the reduction of poverty. Convertion of waste to Biofuels is also another advantage in adopting sustainable practices

Quynh et al (2021) on of food sustainability in the UK and Italy discovered that with the abundant of focus and proper reverse logistics there is an opportunity in reducing the cost of feeding of livestock with the adoption of Circular practice in the food supply chain industries , According to the research, the food waste in converted to feeds for livestock which creates additional job, and value to the process.

A review on the research of reuse of the waste water in Germany for irrigation on agricultural crop farms according to Maab, and Grundmann (2018), observed that governance structure's alignment with irrigation's unique characteristics and the associations of farmers' interdependence with one another support the reuse program's efficient functioning. Reusing wastewater gives a chance to lessen the demands on natural water resources and the discharge of pollutants to surface water bodies when done safely based on this review. This should be encouraged by supporting the developing nations on the need to adopt this method in reducing consumption of raw material and safety of the environment.

According to Ada et al (2021) on research review in the European country observed that opportunities of decreasing the exploitation of raw material and allows resources circulation, creating products in accordance with customers satisfaction if sustainable practice is adopted.

Suhartini et al (2021) after the research in Indonesia observed that the use of food waste for domestic cooking by converting the waste to fuel. The fuel will be made from briquettes made from food waste which is far more affordable when it comes to price. Also will reduce the effect of waste disposal on the environment

2.2 Conceptual Framework of the Study

A conceptual framework assists in first identifying and then explaining the important components of a study that are understood, valued, and desired to relate to other characteristics and forces that have an impact on the research (Ravitch & Riggan, 2016). This is mostly used in qualitative research as an inductive method (Ngulube, Mathiapa, & Gumbo, 2015). According to Ravitch and Carl (2016), it is a fundamental source of reflective thinking and behavior throughout the research process. On the figure 2.2 below

illustrates all the key variables in moving from the formal (Linear Economy) of the aspect of the food supply chain to CE based on some of the finding in the literature review (see Table 2.1)

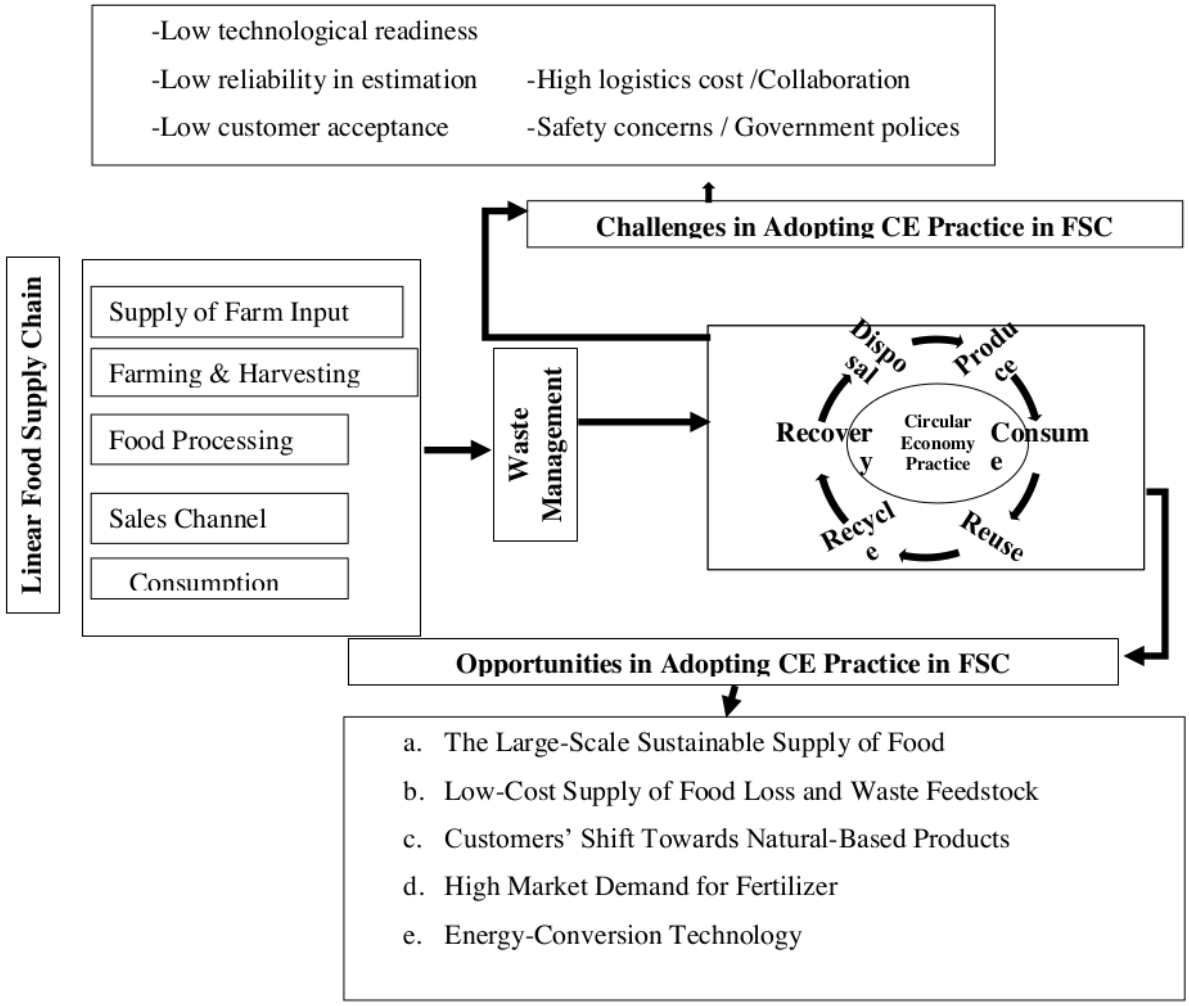

Figure 2.3 Framework of the literature Review. Source – Literature Review (Aurthor)

2.3 Summary

The assessment of the literature on the food supply chain management's role in food sustainability revealed that numerous authors have investigated the subject using diverse methodological stances, including quantitative, qualitative, and mixed methodologies. How to attain food supply chain profitability through sustainable strategies and network optimization has been the subject of 20 research studies on various developing and developed countries. Diverse authors individually explored the dimensions of sustainability in relation to food supply chain management in the research on the topic of sustainable supply chain management.

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The next chapter will be on the research methodology, approach, design, and population of study, data presentation, data collection, and analysis.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This qualitative study's goal was to investigate the difficulties and possibilities associated with implementing the circular economy in Nigerian food supply chain design. This entails exposing the activities that take place throughout the entire food supply chain and comprehending the opportunities and obstacles they encounter when implementing sustainability in Nigeria.

This chapter focuses on establishing the methodology and philosophy that the researcher deployed in this study. It enables the readers to understand what was done and how it was done to arrives at the conclusion. This chapter examines the research design, data collection methods and methods of data analysis. The justification of the chosen design in light of other potential designs as well as the function of the researcher will be discussed.

3.2 Research Philosophy

The research philosophy relates to the investigator's beliefs towards the study in which data is obtained, investigated, analyzed, and evaluated (Moon et al., 2019; Junjie and Yingxin, 2022). It revealed research assumptions about the study that reflected the approaches that had been applied to the objectives, as well as research design and research methodology to analyze and interpret the research's findings (Ryan, 2018).

There are four philosophical perspectives on research: Realism, Pragmatism, Positivism, and Interpretivism (Singh et al., 2019; Al-Ababneh, 2020):

Pragmatism describes the movement that comprises the claimant who gives a theory or ideology as accurate and if it functions well, that the pragmatic effect of adopting a statement defines its meaning, and that impractical concepts should be abandoned. Similarly,Mauthner (2020) defines realism as the perspective that accords things an independent essence of existence regardless of whether or not someone is considered viewing them.

Interpretivism was adopted due to the subjectively assessed and evaluated study of social reality and the focus of interpretivism is to convey people's experiences via analyses and interpretations of the research (Iovino and Tsitsianis, 2020). Based on the current study objectives, this study adapted interpretivism as its research philosophy. Additionally, interpretivism studies frequently emphasize meaning and may use a variety of techniques to represent various facets of the problem (Saunders et al .2012)

Another reason this research adopted interpretivism is because it is socially constructed, has multiple goals of understanding, weak predictions with specific interest that is unique, and deviant, and has an interactive, cooperative, participatory subject/researcher relationship (Pizam and Mansfeld ,2009). It also sought information on what some people think and do, what kinds of problems they face, and how they deal with those problems (Pizam and Mansfeld ,2009). The interpretivist method of data collecting is based on realistic approaches like interviews and observations and the theory is very mutual with secondary data research Collins, H. (2010), which means that in this studies typically become apparent at the end of the investigation.

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3.3 Research Approach

This study employed inductive approaches. According to Opie (2019), the research approach is a strategy that includes a series of steps that contain larger presumptions for method description, including data collection, analysis, and interpretation. The domain and kind of study that is being addressed determine the research methodologies. The inductive research method is described as beginning with the acquisition of facts pertinent to the researcher's area of interest (Rott, 2021). The inductive strategy focuses on the

creation of the theory, whereas the deductive approach determines and tests a hypothesis using an existing theory. However, using inductive approach in this study offers a thorough and deep grasp of the issue studied. The inductive approach was used to condense interview data into a concise, summary format and establish distinct relations among the research objectives and the summary findings derived from the interview data, and develop a framework of the underlying structure of experiences that are evident in the interview data (Thomas, 2016). Another reason for using the inductive approach is because it is a method that offers a simple, systematic set for examining qualitative data that can result in accurate and true conclusions(Thomas, 2016)..

3.4. Research Design

According to Mello (2022), the qualitative method is a kind of natural science inquiry that seeks a deeper comprehension of phenomena. Therefore, the current study is a descriptive research design. The descriptive research designs help provide answers to the questions of who, what, when, where, and how associated with a particular research problem. Descriptive research is used to obtain information concerning the current status of the phenomena and to describe "what exists" concerning variables or conditions in a situation.

A realistic and explanatory method of studying many phenomena in the universe is provided by qualitative research (Denzin & Lincoln, 2013). In qualitative research, the goal is to identify, characterize, and recount how people behave in particular situations in relation to the phenomena being studied (Erickson, 2011). The qualitative tradition includes various philosophical viewpoints, cultures, knowledge eras, and methodologies with historical roots in anthropology, philosophy, and sociology and traces to Herodotus and Aristotle (Erickson, 2011; Merriam & Tisdell, 2016; Patton, 2015).

The qualitative method enables for participant involvement to gain insights into their experiences and wider attitudes (Merriam & Tisdell, 2016; Yin, 2016). In qualitative

research, people's opinions and interests in their unique and natural contexts are discovered and described (Erickson, 2011). By using qualitative research, one can better understand how people perceive various situations and capture the richness of the setting (Yin, 2016). The goal of qualitative content analysis is to classify enormous amounts of text into an effective number of categories that represent related meanings and it goes beyond simply counting words (Weber, 1990).The purpose of content analysis is to provide information and comprehension of the phenomenon being studied (Downe-Wamboldt, 1992).As a result, the qualitative technique was better suited for this study to provide a thorough grasp of the sustainability phenomena in the participants' everyday environments and to comprehend their experiences in the context of their particular environments.

Unlike the quantitative research method that uses statistical techniques to analyse the data and focuses on using numbers to portray the data (Dietz & Kalof, 2009). The quantitative paradigm, which has positivist epistemological foundations in the natural sciences, places a strong emphasis on data quantification and adopts grounding theory's deductive methodology for developing and evaluating hypotheses. (Babbie, 2017) Despite the provisional and unpredictable nature of the results, statistical techniques, which are the primary drivers of quantitative analysis, aid in better decision-making (Leon-Guerrero, 2015). But the quantitative method, which emphasizes measurements and causality, offers less depth and richness (Babbie, 2017; Denzin & Lincoln, 2013). This study's qualitative technique was compatible with its goal of examining the challenges and advantages in adapting circular economy practice in designing a sustainable food supply chain in Nigeria from the viewpoints of supply chain professionals based on their actual working experience.

In order to fully comprehend the context-specific dynamics at play, this study's qualitative methodology was useful. The qualitative approach complies with recommendations for greater research into supply chain sustainability to offer information that quantitative studies might miss (Pagell & Shevchenko, 2014). A

strategy for learning about supply chain operations was to conduct qualitative interviews with supply chain experts (Reefke & Sundaram, 2017). Additionally, interviews provided a deeper understanding of the sustainability sensations (Gualandris & Kalchschmidt, 2014). In order to promote research and practise, interviews with food supply chain and sustainable development managers may be used (Ahmad et al., 2016).

3.4.1 Population of the Study

The target population for this study is the entire Nigerian economy particularly the food supply chain market which includes: farmers, farmer inputs suppliers, food production and distribution channels as well as the consumers. The study's scope should be consistent with its title and address the relevant population or the target group. According to the objectives of the study, the researcher is free to choose these boundaries (Simon & Goes, 2013). In order to do this, the study's scope was constrained to Nigeria, an emerging economy.

12 participants were approached for the interview but only 9 accepted to partake. The position of the nine (9) participant cuts across senior and midlevel staff of the food supply chain in Nigeria which includes large food retail shops, food processing companies, raw food distribution company, government food and drug agency. The participant positions includes Managers/deputy, executive, supervisors, consultants and coordinators. The range of the ages of the participants are between 40 to 65 years. All the interview were conducted in English language and no translations. 8 out of the 9 participant had university bachelor's degree from various filed, 2 out of the 9 participant had Master's degree while one (1) out of the 9 participant whom is an executive director of the executive food retail had a PHD as shown in Figure 3.1 below

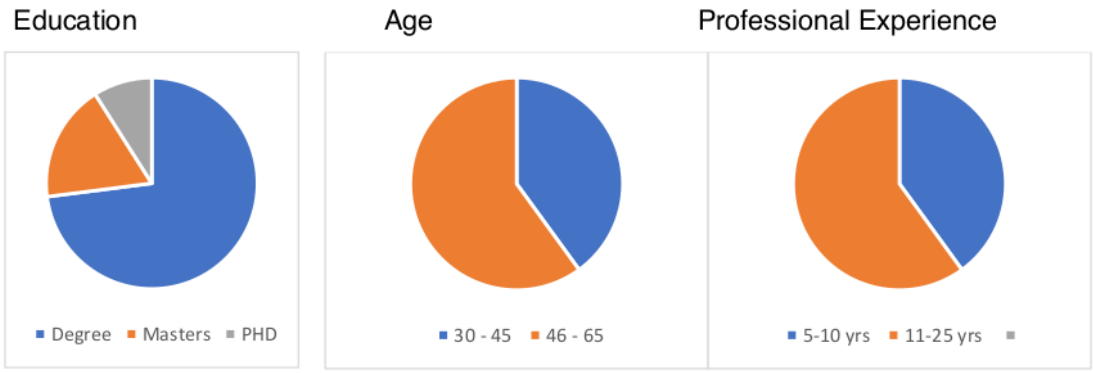

Figure 3 Demographics

3.5 Sampling Technique

The sampling procedures are the methods and strategies used to collect data from the population. Employing particular sampling strategies for the target audiences aids the researcher in conducting a better evaluation of the research study. As a result, the sampling technique offers data from the intended audience (Queirós et al., 2017).

Purposive sampling was adopted in this study so that the section that is believed to be representative of the entire food supply chain in Nigeria are contacted in order to produce more accurate insights to the findings of this study. Age, geography, desire to participate, and relevant experiences of possible participants were all taken into account as part of the sampling plan for this study. Participants had to be at least 18 years old and had worked in Nigeria's food consumer products/ manufacturing sector for at least three years as supply chain practitioners. This sampling method is more accurate since it relies on the opinion of people who are acquainted with the fundamental challenges and opportunities in the food supply chain in Nigeria.

The qualitative methodology made it possible to connect with participants in their distinct natural setting and gain insights into their experiences and wider perspectives (Merriam & Tisdell, 2016; Yin, 2016). This study's main goal was to examine the opportunities and challenges associated with adopting a circular economy approach when constructing the food supply chain from a developing economy position. This study was qualitative in nature.

The purposive sampling utilized the important experts' group characteristics technique (Bloor & Wood, 2006; Patton, 2015). These are the people who are highly knowledgeable about a subject. In order to gather pertinent data for addressing the research questions, participants were chosen from the desired food sector using the key knowledgeable technique who had relevant experiences with the issue being studied (Ravitch & Carl, 2016).

3.6 Data collection method

Data collection methods are described as systematic strategies for gathering and correctly collecting information and data from various sources to convey the insights and responses of the research hypothesis testing and assessment of study outcomes. According to Nanna (2022), there are two types of data collecting methods: primary data collection and secondary data collection. Primary data collection refers to gathering

information directly from the source, while secondary data collection involves gathering information from other sources (Taherdoost, 2022).

The interview process was created by myself specifically for this study and to address the main research topic. The interview questions should be detailed enough to elicit from participants information that is pertinent to the study's objectives (Rubin & Rubin, 2012). As a result, open-ended interview questions were created with the intention of enabling a thorough examination of participants' experiences in order to gather rich data (Turner, 2010)

I conducted the semi-structured interview technique as the lead researcher for this study and research tool to get data from participants. The interview questions is designed to be read to the respondent via his preferred means of communication. In order to find those eager to participate in the research based on the study's objectives, participant selection is essential (Creswell & Poth, 2018).Access to participants was taken into account as part of the research objectives for this study. I gained access to site porters through my social network and was able to ask for authorization to send invitations to research participants to food supply chain participants. The main objective of this study was to investigate on the challenges and advantages adopting Circular Economy in designing food supply chain experts in the consumer products have integrated sustainability principles into their supply networks. This query provided insight into the difficulties or implementing sustainable supply chain management. Insights into the viewpoints of food supply chain professionals regarding sustainable supply chain management were also made clear by this research question.

The purposive sampling utilized the important experts' group characteristics technique (Patton, 2015).In order to gather pertinent data for addressing the research questions, participants from the desired population who had experiences similar to the phenomenon under study were chosen using the key knowledgeable technique (Ravitch & Carl, 2016). There are semi-structured interviews which include 3 sections based on the research question (see Appendix A). In Lagos, Rivers, Nigeria, I conducted data collection as the researcher via phone network. The interview took place in less than a week at a time that worked for the participants. The interview sessions took 20 to 30 minutes to complete.

3.6.1 Data Collection instrument

Any tools or procedures that help researchers obtain information and proof from participants in research operations are considered instruments for data collection. Additionally, they provide a sense of how the researchers collect knowledge and data to arrive at the study's conclusions (Clark et al., 2018).Semi structured interview was used in collection of the primary data.

I conducted participant interviews while keeping track of any observed behaviours and environmental clues as the principal data collector for my MBA research project. I respectfully questioned the contributors as they discussed their experiences and made sure that my note-taking did not take their attention away from them. There was absolutely no conflict of interest because this study (interview) was carried outside the UK (in Nigeria). The interview was done via phone call and recording

3.7 Data analysis method

The data analysis method assists researchers to communicate their findings using a variety of strategies to provide accurate and precise conclusions (Pandey & Pandey, 2021). This study deployed content analysis and interview methods. The content analysis approaches are useful for identifying the key variables that affect the participants' behavior through a rigorous literature review while the interview avenue collected directly from the expatriates.

The interview provides bases for the analysis of respondents' ideas and thoughts (Riger & Sigurvinsdotti, 2016; Nawaz 2018). The interview is recorded on a device to ensure that no vital information is missing. The researcher transcribed the interviews which have taken a long time but are necessary to obtain useful information. The data obtained were analysed in subsection according to questions in the interview questionnaire above. In

qualitative research, several basic methods for organising and evaluating data must be taken into account as part of the overall analysis plan. The issue of developing meanings for the enormous volume of the aforementioned data acquired is a hindrance to the qualitative analysis, which includes the processes a researcher takes in reviewing data collected to produce logical responses to the research questions (Rubin and Rubin, 2012).

Researchers will need to think about the structure of the acquired data, the main research topic, the analysis approach to apply, how to handle outliers, and the usage of computer-assisted tools. The information gathered for this study directly answered the main research question. The examination of the data revealed detailed comments from food supply chain experts in the manufacturing of consumer goods about their experiences integrating sustainability principles into their food supply networks.

3.8 Instrument Validity

Validity is the extent to which a measuring device measures what it is intended to measure. The purpose of content validity is to guarantee that the scale's contents are broad enough to encompass the entire scope of the topic.

Researchers serve as the main data gathering tool in qualitative research (Ravitch & Carl, 2016). Data collecting plays a vital role in the research process as part of the overall research plan. Data are the foundation of a research investigation since research is about data (Yin, 2016).A semi-structured interview guide was used as the primary data gathering tool (see Appendix A). A researcher could utilize the interview guide's written questions to start or continue an interview and elicit further information about the subject at hand (Rubin & Rubin, 2012) .This interview guide ensured that the questions were the same for all participants, which improved rationality (Patton, 2015).

On the plus side, interpretivism's acceptance has made it possible to study qualitative research areas like cross-cultural variations in companies, ethical dilemmas, leadership and the examination of factors influencing leadership, etc. in great detail and because the

information used in these research tends to be reliable and honest, primary data produced through interpretivism studies may have a high level of validity (Collins, H. 2010).

3.9 Instrument Reliability

Additionally, construct validity examined the precise measurement of the many occurrences linked with the construct. The items in the research instrument will be validated and approved by the project manager, who will make any required modifications to the question. And guarantee that the instrument consistently with a high degree of reliability measures for what it is intended to measure.

In order to show the calibre and rigour of the procedures, decisions, and conclusions, the research's reliability is essential. Reliability includes the research's design, methodology, data, analysis, and conclusions (Toma, 2011). The research must accurately reflect the data gathered from participants on the ground while also taking into account competing and alternative interpretations (Patton, 2015; Ravitch & Carl, 2016; Toma, 2011) To demonstrate the accuracy of the research beyond a reasonable question, reliability is crucial in qualitative studies. The research was made more reliable by the aggressive pursuit of anomalous or unfavorable patterns during the iterative data gathering and analysis phase, as well as by the use of detailed explanations when presenting the results.

3.10 Summary

The goal of this study was to look into the opportunities and difficulties associated with implementing the circular economy while creating a sustainable food supply chain in Nigeria. The research questions centered on getting detailed feelings from experts in the food supply chain in the consumer products in food industry on challenges they've encountered when applying sustainability principles in their manufacturing/food supply procedure.

An industry background of at least five years in the production or supply of food, as well as a willingness to participate, were requirements for participation. As saturation was reached, interviews with a purposive sample size of 9 people were conducted. The interview process took place online (phone call).

The test process, setting-specific contextual elements, data collection, analysis, issues of reliability, and findings will all be highlighted in detail in the next chapter.

CHAPTER FOUR

DATA PRESENTATION AND DISCUSSION ON THE RESULT

4.1 Introduction

This chapter focuses on presentation and discussion on the key findings of the research. The study explored the challenges and opportunities in adapting circular economy practice in designing a sustainable food supply chain in Nigeria.

4.2 Data Presentation

The finding of this study are met by a thorough analysis of the literature and telephone interviews with significant figures in the Nigerian food supply chain business. As a result, the final participants in this study are divided into four groups: food processors (food processing/manufacturing companies), sales and distribution channels (supermarkets, import/export companies, e-retailers and wholesalers), clients (buyers/consumers of the final product), and government officials (external supply chain stakeholder). These participants were chosen based on their various experience in the food sector and the interview conducted through phone call to respondents. 12 respondents were contacted

out of which 9 responded to the call and their responses recorded on a paper and summarized to answer the questions raised in the study. A total of 16 research questions were raised. The participants are classified into A,B,C,D,E,F,G,H and I (representing 9 participant in the interview).This is for easy identification when analyzing the findings. The interview questions was developed based on the objectives of this study, literature review and a thorough investigation covering the situations uncovered during the pilot study.

Table 4.1 Highlight of key findings:

Research Objective	Most Important findings
Significance of adopting CE practices	Majority of the respondents identified CE practices as source of competitive advantages as well as a solution to contemporary environmental issues. Majority of the respondent mentioned increase in profit, customer satisfaction Employment opportunities, preservation of raw material
Key challenges of adopting CE	- **Top level challenge**: Government policies and implementation, Lack of technology, Poor infrastructure - **Medium level challenge**: Collaboration with stakeholders, customer awareness, funding/ high interest rate, corruption

	- **Low level challenge**: management decision
Key opportunities of adopting CE	- Competitive advantage , Profit maximization, Cost reduction, Environmental safety, job creation

Source – Interview Data

Significance in adopting CE Practice

Competitive advantage- Majority of the respondents identified sustainable practices as source of competitive advantages as well as a solution to contemporary environmental issues

Participant A - said that sustainability will always attract more clients to the company's business.

Participant F – (Logistics manager for food distribution Company). Mentioned that they have a reverse logistics system that ensure that their customers send back items in relation to the terms and conditions. '' Of course, yes . we retain our customers due to this additional services''

Environmental Practices - All the respondents said that they understand the need and implication of the sustainable environmental practices but 7 out of the 9 respondent said they have some related environmental practice.

Participant C - ''Yes, yes. We have a solar panel powered batteries of which the company uses for at least 30 to 40 hours a week especially during the down times to reduce the cost of using generating sets to power electricity and as well reducing the carbon emission. yeah''

Participant D (Retail outlet Supervisor) Said the company have reverse logistics that ensures the backload of good from the client when required.

Participant G (Coordinator - food distribution company) - said ''Yes, you do not have to complicate issues with you host community'', We have a system where our food waste is managed by the government agency.

Participant I (Government agency for Food) – Said that all the food outlets are mandated by the agency to compile with the food waste management regulation. He said that on a yearly basis, the retail outlets are given approval called GHP (while the food processing company are given Certificate renewably 5 years wi th the agreement to complie with all the food safety procedure including management of waste via Local waste mangemnen

Reduction of Cost - 7 out of 9 participant said that sustainability practice will reduce the cost of doing business at the long run.

Respondent A – (Food manager processing company) said that the company do not recycle but have a system where by the state government agency (LAWMA) manages the food waste for them and is cheaper. 'We pay LAWMA on a monthly basis to evacuate our food waste.''

Participant E (Supervisor food outlet). Mention that the company have a vendor that supplies them with recycled food packing items which is cheaper.

Risk management – All the respondent said that there are a lots of risk associated with the sustainable practice**.**

Respondent A – said there is a lot of risk that needs to be managed when trying to adopt food sustainability.

Respondent C - Said, ''there are risk management in all we do here in the company. Before we do anything including changing from one procedure to another. Yes, in all we do''

Respondent G – Mentioned that the risk management is an issue but said is mostly case by case basis. He said the most area that the company considers most risk is the case of import. Because government agencies are usually involved in the process and is one of the most difficult issues working the external stakeholder including the banks.

Respondent I (Government agency for Food) – Yes , we have a procedure on inspection of the food for importation. The agency do a source impaction of the factory of manufacturing both in country or outside the country and then a NAFDAC number will be allocated go the product which will be on the body of the product for identification at all time. A regular routine check on the food processing and retailing facilities is done on a monthly basis or so will (depending). Any company found violating these procedure will be sealed. This is how to avoid the production and consumption of substandard food in the country.

Key challenges of adopting of CE practices

All the participant identified various challenges they face implementing the CE practice in food supply chain in their various organizations. There are different barriers mentioned by various participant which includes poor infrastructure, Government policies and implementation, lack of funding, Lack of Technology, collaboration with other food supply chain organization, customer awareness,

Cost implication. 6 out of the 9 participant mentioned cost as one of the limitation in attending food sustainability

Participant B (Deputy manager Retail food outlet) said that there are cost implication if the objective in being sustainable is considered .You might have a situation where companies choose not to expand in certain areas, are not to throw certain parts of their portfolio because they can't meet the sustainability targets for the area due to high cost

Participant D (Retail outlet Supervisor) – Said on cost implication 'Yes, if you are going to have food sustainability, you have to get serious as a company''

Participant F (Logistics coordinator) said that there is always cost increase when a company wants. ''Yes, our company is thinking towards repacking of our outdoor delivery plastics for recycling'' but will come with additional cost.

Government policies and implementation– 8 out of the 9 participants said that unclear policies and lack of policy implementation of government and its agencies is one of the main hindrances in attending food sustainability.

Participant A - Mentioned that ''As far as he is aware, there is no clear polices from the Government of Nigeria or its regulatory bodies on the direction of food sustainability procedure''

Participant C (Manager food retail outlet) - Said that ''Government is the number one problem on the food sustainability in Nigeria. Their policies are not clear especially when it comes to food sustainability''.

Participant H (Executive Director) - Mentioned lack of consistency in the policies of government from one political regime to another as one of the main issues on sustainability in food sector.

Participant G (Coordinator of food distribution company) said – '' Lack of political will from the Nigeria politicians in Government is the main factor hindering food sustainability''

Participant I (Government agency for Food and drugs) – Mentioned lots of bottleneck in the process of food company applying for inspection and food analysis report. According to him '' yes you know my brother. Is always an issue with government at Local, State and federal level. Correct there is form of delays in the process''

Collaboration with stakeholders - 6 out of the 9 participant said that collaboration inefficiencies like transparency, capabilities and uncertainties of various stakeholders especially the external is one of the issue faced with food sustainability. The collaboration between the food supply chain stakeholders is still one of the factors.

Participant B – Said ''some suppliers are not meeting up the criteria regarding deliveries''

Participant D (Retail outlet Supervisor) – mentioned that the some of the suppliers are not really transparent in their transaction that they pull a lot of surprises when it comes to supply delivery.

Participant C (Manager food retail outlet)– said '' Government and its agencies are very very difficult to engage with. Many at times. Yes ''

Participant G – engaging the external stakeholder like the government agencies is very difficult most of the time.

Participant I (Government agency for food and drugs) - mentioned that they have procedures

Context. Of the 9 participants,8 discussed different contextual factors, such as challenging economic conditions that influence consumer decisions and encouraging the purchase of inferior goods, as well as ignorance, High interest rate and funding , lack of infrastructure, , lack of technology, and expertise

Participant B (Deputy manager Retail food outlet)– mention '' lack of customer awareness'' as one of the factors affecting food sustainability. ''When people do not know what the massage is all about of the product change in price and packaging''

Participant C - mentioned lack of infrastructure as one of the problems. ''Poor road facilities for the movement of perishable raw food from the Northern parts of Nigeria down to south,and the on transit cold storage is still not enough. Yes, there is no train transportation facilities as well, for easy movement of food items. it have increased our cost as well''

Participant D (Retail outlet Supervisor)– mentioned lack of technology in recycling waste food item. ''We do not involve in recycling due to lack of technology. That is a no, no. We have some livestock farmers whom collect our food waste on daily bases in order to convert it and make feeds for their livestock''. Also he mentioned the Council government agencies (LAWMA) is responsible for collecting the food waste and managing it . ''We pay them on a monthly basis for the services''

Participant H - mentioned the use of generator to provide electricity which is very common in the food processing due to lack of electric power in Nigeria. ''This is harmful to the atmosphere especially now that we are worried about climate change. Oh yes, lots of rainfall had just destroyed most of the farmers land products in Nigeria ''

Key opportunities of adopting CE Practices

Environment – All the 9 respondent understood the benefit of environment as regards food sustainability. However 6 out the 9 respondent said that they have practice in their various organization that is environmental friendly.

Participant A - said that the company do not recycle but have a vendor who supplies some of the recycled material used for food packaging and processing.

Participant B- Said ''Yes, oh yes, we have a reverse logistics that collects back our product based on customers request/ agreement or we refund if the customer returns by himself. Sure, it is only for our big clients"

Participant D (Retail outlet Supervisor)– said the his organization have solar powered energy with batteries which they used on average of 38 hours in a week to reduce the cost of powering the electricity with generating set.

Participant H – Mentioned that they have sort of an agreement with the livestock farmers who collects the food waste on a daily bases in other to convert to feeds for their livestock.

Economy All the participants said that they have understanding of the benefits associated with the sustainable practice in the organization.

Participant B - said his organization have created a big competitive advantage in their reverse logistics activities by gaining the trust of their client.

Participant D – '' we have save a lot of revenue using solar energy at the long run''

Participant H – said that the company made more income in disposing the excess food on a daily basis. The livestock farmers collects it to convert it to feeds

Participant G - mentioned that it creates additional avenues for profit making for the organization.

4.3 Discussion

This section of the study concentrates in discussion of significance of adoption of circular economy practice in designing sustainable food supply chain, examines key challenges and opportunities for food supply chain in Nigeria.

4.3.1 The Significance of Sustainable Food Supply Chain Design in Nigeria.

Nigeria with a population of over 200 million people need to ensure that food production boosted to reduce the level poverty in the country. Protecting human rights, halting

environmental deterioration, and accounting for value and cost were some of the strategies for attaining food sustainability. All the participant understood the importance of food sustainability which are for social, economy and environment. Most of the participants mentioned that the sustainability approach will have a competitive advantage to the organization, Safety of the environment is one of the issues mentioned by the participants. Preservation of the natural resources is one of the advantages mentioned by the participant.

4.3.2 Challenges in Designing a Sustainable Food Supply Chain with Circular Economy Practices.

Previous studies and the interview data have numerous factors challenging transition to circular food supply chain. The interview participants also mentioned the issues of financial resources, poor infrastructure, collaboration with some stake holders, lack of Technology/ Technical know - how , organizational culture and management, customer awareness, uncertainty about benefit/Risk management, cost implication, Weak government policies and implementation, lack of market preference,

Lack of financial resources is one of the challenges indicated on the literature review (see Table 2.1) and interview with the participant. According participant A (Manager food Processing company) who mentioned high interest rate and strict conditions on loan facilities to organizations in Nigeria as one of the major issue in food sustainability .The participant said that the mark up on the loan (interest rate) is very high with the condition attached well.

Limited expertise, technology Lack of design, process, and supply chain expertise, technology, and/or technical support. Lack of information about the available technologies and best practices

Lack of management commitment, and inadequate management capacity.

Poor infrastructure is also reflected on the literature review, the participants mention poor road for transportation, lack of electricity, and alternative means of transportation of good especially from the northern part of the country to the south.

Uncertainty about benefits is aspect in unknown profit with risk management was one of the factors affecting food sustainability .Participant mentioned that feasibility planning and strategy are important to the execution of food sustainability practice. In all these factors management role in the implementation is very important since they are the leading hierarchy in the organization's decision making. Environmental uncertainties is also another factor, like one of the participant mentioned in an interview on the recent flood in Nigeria which destroys some of the farmers agricultural product due to rain fall (Climate Change).

Weak environmental regulations and enforcement to support CE implementation of the sustainable practices was mention by one of the participant. Participant 1 (Government agency on food and drugs) mention the overall government procedure that is very slow

Lack of market preference and pressure from both customers and consumers

Supply chain actors are reluctant to collaborate/support CE initiatives. The collection and processing of the waste streams could be quite challenging at supply chain level. This is especially the external stakeholders like government agencies.

4.3.3 Opportunities to Use Circular Economy Principles When Creating a Sustainable Food Supply Chain

Majority of the participants mentioned the opportunities of sustainable food practices on the interview which includes, food security, increase profitability for food supply chain firms, job creation, competitive advantage and environmental safety. Participant I who mentioned that the government ensures that the food waste is managed with the State government agency who collects the waste and dispose of it.

4.4 Summary

This chapter discuss how the data were analyzed and how the conclusions related to the study's main research question. The results demonstrate that food supply chain professionals understand sustainability strategies that take into account social, environmental, and economic factors. The results also demonstrate that for sustainable

performance in the food supply chain, internal and external stakeholders must work together and coordinate.

The results will be interpreted in the following chapter within the framework of the body of information as mentioned in Chapter 2 of the literature review. Also provided will be an examination of the results in light of the theoretical and conceptual framework. In addition, I'll go over the study's conduct's limitations, conclusions, and implications for practice and societal change. The chapter will end with a summary of the main point.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter presents summary of findings, draw conclusion and suggest possible ways forward for the adoption of circular economy in designing food supply chain in Nigeria.

5.2 Summary of Findings

This research provided a multi-stakeholder perspective on challenges to circular food supply chains. The results offer insights for all stakeholders, irrespective of how direct or indirect their involvement is. This subsection summarizes new insights that were not reported in the extant literature and discusses important research directions for further studies.

Nigeria, being the most populous black nation country in the world have poor legislation to push CE implementation. However, weak enforcement of such environmental regulations was found to be a key cause barrier in the food sector. This is ironic and thought-provoking, given the Nigerian Government's stance on circular economy.

The other key cause barrier is that most Nigerian consumers and businesses care little about environmental protection; hence, there is a lack of public commitment to and support for the government's CE aspiration. These findings have serious implications for the importance of policy makers in Nigeria addressing issues in bureaucracy, governance, corruption and environmental education.

From extant literature review challenges to adoption of food circular economy to design sustainable food supply chain include:

Lack of financial resources available to implement CE. Lack of design, process, and supply chain expertise, technology, and/or technical support. Lack of information about the available technologies and best practices. Organizational culture hinders the adoption of CE. Lack of management commitment, and inadequate management capacity. Food supply chain actors' resistance to change. Uncertainty about the potential environmental and economic benefits of CE including subsidies/tax benefits. Lack of economies of scale in implementing CE. High cost of implementing CE and the possible adverse effect on scale economy. Weak environmental regulations and enforcement to support CE

implementation. Lack of market preference and pressure from both customers and consumers. Lack of collaboration/support from supply chain actors.

Further, this study reveals that their adoption of circular economy in the design of sustainable food supply chain comes with inherent opportunities which include: Competitive advantage, food security, increase profitability for food supply chain firms, job creation and environmental safety.

5.3 Conclusion

The rate of Nigeria's consumption of global resources and the production of solid waste poses a severe threat to the national sustainability. To overcome the challenges associated with recirculation of waste materials, the Nigerian Government has to heavily invest in implementing circular. This study identifies and analyses the specific barriers to integrating circular economy practice in the context of food supply chains in Nigeria. The severity of adverse environmental impacts of food supply chains and scarcity of research in Nigeria on their sustainability practices make this issue worth investigating.

The first original contribution of this research is in conceptualizing circular food supply chains, in the context of integrating circular economy philosophy in food supply chain management, a new frontier in supply chain sustainability research and practice.

This study systematically investigate and prioritize the barriers to circular food supply chains in Nigeria. Viewpoints from four evaluating groups (food processors, sales and distribution channels and government officials) were explored. The results suggest weak environmental regulations and enforcement and lack of collaboration/support from supply chain actors as the key cause barriers. Moreover, lack of technology and poor infrastructure emerges as the most prominent barrier.

Finally, this study discusses theoretical and practical implications for overcoming/circumventing the barriers. It offers new insights for future research directions in supply chain sustainability.

5.4 Recommendations

Based on the large and rigorous body of literature reviewed and the interview data in this study, there are inherent barrier in adoption of circular economy in designing sustainable food supply chain in Nigeria. These recommendations are based on the on the established barrier in this study:

Nigeria has taken the backward lead in adopting and promoting circular economy practice in the agricultural sector as a national policy, enforcement of such environmental regulations has been more problematic than their promulgation, plagued by low bureaucratic status and prevalent corruption.

The government needs to develop an effective enforcement mechanism to implement circular economy at the micro, meso and macro levels of organization in the food supply chain. However, to ensure CE implementation at the all level, it is imperative to develop relevant indicators. The government may consider broad standards and indicators that can be adapted or tailored by firms to reflect their specific characteristics, conditions and problems. These indicators should include detailed descriptions, industry-specific goals and standardized procedures for collecting, measuring and submitting the required data. More stringent regulatory mechanisms need to be in place for monitoring and enforcing the indicator system. The food industry, along with other industries, should be made acquainted with these indicators to ensure maximum compliance.

In Nigeria, most of the policies surrounding environmental initiatives do not involve any public consultation. The absence of any formal institutional structure for this in the Nigerian political system further weakens the public interest in and awareness of environmental initiatives such as circular economy practice. Hence, this study recommends an extensive promotion campaign using media such as internet, social media, TV, radio and newsletters besides interactive platforms like exhibitions, conferences and workshops. To sustain the public interest and awareness over the long-term circular economy practice, it is essential to incorporate CE and environmental education in schools.

Further, from a strategic viewpoint, this study suggests systemic sustainability collaboration among key food supply chain players (food processors, sales and

distribution channels and customer) in Nigeria with an explicit focus on improving economic and environmental impact outcomes.

5.5 Limitation of the Study

Despite several contributions, this study has its limitations. First, the list of barriers identified in the study was far from exhaustive, although it was enough to meet the research objectives. Future studies may expand the list of barriers under the most relevant theoretical lenses identified in this study to suit their research objectives. Second, the study analyzed responses from multiple food supply chain stakeholders in Nigeria. However, farmers, who are among the important food supply chain stakeholders, could not be included in the analysis due to data quality issues. Last but not the least, one of the agencies that manages waste in Lagos Nigeria could not be reached to confirm how they manage the overall food waste collected from all the food outlets and households.

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Appendix 1 Ethics form Approval (see Attached)

Date: 29th Oct 2022

Dear Chinedu Onwuachu

Following a review of your ethical application for your project titled ***(Investigating the challenges and opportunities of adopting circular economy practices in designing sustainable food supply chain in Nigeria)*** *on* LNDN11133, I am pleased to grant you ethics approval for Business Research Project.

Yours sincerely
Md Mostain Belal

(**Supervisor Name and signature**)

Date: 29/10/2022

Appendix 2 Research question and Interview question

RESEARCH QUESTION	INTERVIEW QUESTION
To explore the significance of sustainable food supply chain design in Nigeria	(1) Can you explain the importance of considering sustainability practices within your operations? (2) What effects do you think sustainable practices operations will have on the environment, society, and the economy? (3) Can you explain the key environmental practice you have adopted in your organization? (3.1)What are the challenges faced while adopting these practices?
To investigate the key challenges of adopting circular economy practices in designing a sustainable food supply chain in Nigeria	(1) Does your organization recycle or redesign products? If so, what difficulties does this procedure present for your operations? (2) Does your organization have reserve logistics in place, and how does it operate?

	(2.1) Can you describe the difficulties your organization is having putting these strategies into practice? (3) Can you explain the process in your organization that derives value from waste and product design, and what challenges arise while implementing it? (4) Can you describe the operation procedure for recycling, reusing, and remanufacturing in your organization? Do these procedures fall under any regulations? (5) What green practices has your organization adopted? (5.1) Can you describe the difficulties in putting these principles into practice?
To explore key opportunities for adopting circular economy practices in designing a sustainable food supply chain in Nigeria.	(1) What economic, social, and environmental benefits can you expect from implementing green practices in your organization's processes? (2) What are the social and environmental advantages of recycling and reusing products? (3)Could you explain how lessening the use of raw materials will enable resource recirculation? (4) Can you describe the economic and social advantages of implementing reverse logistics in your organization? (5) Can you explain how adopting sustainable practices would allow business professionals in the industry to take advantage of new commercial opportunities?

Appendix 3 Consent form Template

Consent Form

Title of Project:

INVESTIGATING CHALLENGES AND OPPORTUNITIES OF ADOPTING CIRCULAR ECONOMY PRACTICES IN DESIGNING SUSTAINABLE FOOD SUPPLY CHAIN IN NIGERIA

Please initial box:

1	I confirm that I have read and understand the information sheet dated ——— for the above study with the relevant information and have had the opportunity to ask questions.	☐
2	I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.	☐
3	I understand that my responses will be anonymised (unless I state otherwise) and that confidentiality will be ensured.	☐
4	I agree to take part in the above study.	☐

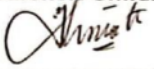
Your signature will certify that you have voluntarily decided to take part in this research study having read and understood the information in the sheet for participants. It will also certify that you have had adequate opportunity to discuss the study with the researcher and that all questions have been answered to your satisfaction.

Name of Participant:

Signature:

Date:

Name of researcher: Onwuachu Chinedu Jude

Signature: 

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