



“Social Sciences”

“Supply Chain Management”

Postgraduate Dissertation

“Enablers and barriers of the implementation of sustainability in  
agri-food supply chain in Greece”

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## **Declaration**

I declare that, unless otherwise stated, all of the work I have done for this assignment is unique to me and that I have studied and understand the policies in my handbook about appropriate referencing, plagiarism, and cheating. I acknowledge that no appreciable amount of the work I have submitted here has been submitted for assessment in any previous or current degree courses, and if it has, appropriate credit will be deducted from any grade I may have otherwise received.

## **Abstract**

The twenty-first century has seen an increase in the demand for products to be more valuable, cost-effective, and waste-free due to factors like pollution, population growth, and limited resources. Due to the push for efficiency and sustainability, there is a growing awareness of the concept of a circular economy, which has many advantages including lowering waste and enhancing social well-being overall. However, because there is a lack of infrastructure, experience, and technology, implementing these ideas can be difficult, especially in emerging economies.

### **Keywords**

A-FSC: Agri-food supply chain

SC: Supply chain

SDGs: Sustainable Development Goals

CE: Circular Economy

CAP: Common Agricultural Policy

KPI: Key Performance Indicators

LE: Linear Economy

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### **Aims of this research**

The aim of this research is to investigate how the circular economy's drivers, obstacles, and enablers might affect the sustainability of the Greek agri-food industry.

This study aims to 1) to evaluate the current state of sustainability practices within Greece's agri-food supply chain. This involves understanding the existing systems, processes, and initiatives related to sustainability. 2) identify the enablers of sustainability in the agri-food supply chain. This could involve looking at policy support, technological advancements, or industry collaborations that promote sustainability. 3) analyze the barriers that hinder the implementation of sustainability practices. This might encompass issues like economic constraints, lack of awareness, or regulatory barriers, 4) assess the impacts (environmental, economic, and social impacts of sustainability initiatives within the agri-food supply chain). This includes evaluating how these initiatives affect various stakeholders, from farmers and producers to consumers and the environment. To achieve these goals, this research will evaluate concepts on literature reviews about the impact of enablers & barriers of sustainability implementation in Greece's agri-food supply chain, sustainability knowledge, personal and environmental values to determine sustainable behavior.

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## 1.Introduction

The purpose of this chapter is to give a summary of the information and resources included in the study. This section highlights current issues while providing past history and context for the study. We go into further detail about the goals, objectives, and research questions of the study.

### 1.1. Research background

To remain competitive, supply chain management has become essential for businesses. It guarantees cooperation between all parties involved, which raises a product's overall value and increases the effectiveness and efficiency of the business (Inda Sukatia, 2012). Sustainability is an important topic that has been examined in the literature from a variety of angles. The suggestion that "sustainability" means meeting present needs without sacrificing next generations' potential to fulfill their own requirements is among the most commonly accepted definitions of sustainability. (WCED, 1987).

The business of creating food through agriculture is referred to as "agri-food," and agri-food supply chains, or A-FSCs, are made up of all the operations involved in getting agricultural food output from producers/farmers to consumers. A typical "farm-to-the-fork" agri-food supply chain consists of a sequence of sequential steps, such as obtaining inputs, production, postharvest, storage, processing, marketing, distribution, offering food services, and consumption (Jaffee et al., 2010).

The global and local economies both depend on the agri-food sector. The food, beverage, and tobacco industries in Greece continue to lead the way in terms of the overall number of businesses operating in the processing sector (16,263 firms out of 57,014) and employ the greatest percentage of people working in domestic processing (39%). In addition, the agricultural industry employs over 400 thousand people, or more than 10% of the nation's employed human resources, and in 2020 it provided 4.7% of the nation's Gross Value Added (GVA). At the same time, the Greek agri-

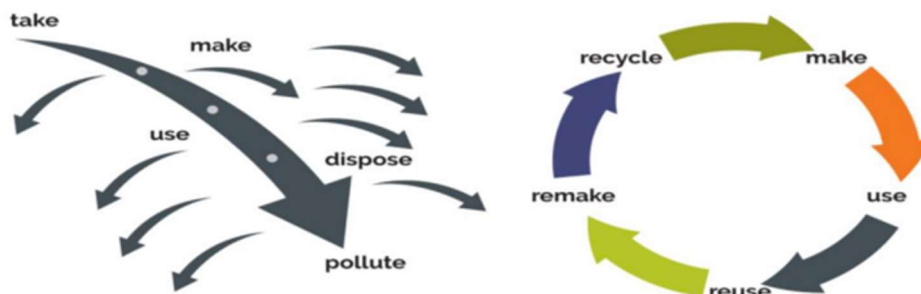


food industry makes a substantial contribution to exports; in 2020, the trade balance showed a surplus of € 207 million for the first time in a number of years.

For the past 150 years, the linear economy model has shaped the expansion of industry. (Arthur, 2015). The conventional linear economic model, according to Jawahir and Bradley (2016), is predicated on goods that are manufactured with raw resources, sold, and then thrown away as waste. Take-make-use-destroy is another name for this approach (Ghisellini, Cialani, and Ulgiati 2016).

Thus, implementing a circular economy will be the best way to address Greece's supply chain's sustainability-related issues (Gustavo Michelinia et al., 2017).

Companies will need to dispose of products as waste much less if they place more emphasis on concepts like reducing, recycling, and reusing. (Macarthur, 2020). These concepts are in charge of changing a product so that its value is granted even after it has been used. This would guarantee optimal resource utilization and lessen the requirement for raw materials. (Zink & Geyer, 2017). The circular economy, as shown in figure 1.1, aids in closing the loop by improving the environment and society in addition to raising commercial value, thus completing the cycle (Abdul et al., 2017; Despoudi & Dora, 2020).



*Figure 1 : comparison of linear and circular economy (Despoudi & Dora, 2020).*

One of the goals of the circular economy is to decrease the usage of hazardous materials, waste creation, greenhouse gas emissions, and natural resource use. Another goal is to move to suppliers of renewable and sustainable energy, which will ease the burden on these suppliers (Bastein et al. 2013). The ability of the circular

economy to distinguish between economic growth through the application of a new business model centered on services rather than natural resources is one of its benefits (Eijk 2015). According to Bastein et al. (2013), the circular economy can boost value creation at each link in the system and decrease the loss of value in the overall system. Recycling and product reuse are further ways that a circular economy can reduce waste, which benefits both the economy and the environment. Additionally, it may result in the development of new jobs and prolong the life of items (Ilić and Nikolić 2016).

The food processing sector has limited resources, mostly as a result of greenhouse gas emissions and the difficulty of reusing resources. Every stage of the chemical industry's life cycle includes the risk of having a negative environmental impact, and during the next years, it is anticipated that this industry will grow (Genovese et al. 2015).

## 1.2. Aim and objective

The central aim of this research is to define the enablers and barriers of the implementation of sustainable methods in Greece's agri-food. The significance of each component, as well as its difficulties and ideals, will become clear from an analysis of these components in this industry. Therefore, by analyzing the circular economy's implementation in Greece's agriculture and food sector, various opportunities and challenges can be understood, which significantly contributes to the circular economy's breakthrough. The research questions of this study are:

What are the implemented circular economy principles in Greek agri-food supply chain?

What are the enablers and barriers of circular economy principles implementation in the Greek agri-food sector?

Which are the drivers towards a sustainable Agri food supply chain?

What is the potential impact of the enablers, barriers and drivers of circular economy principles on sustainability performance in the Greek agri-food sector?

In order to ascertain the different facilitators and obstacles associated with the circular economy, this study begins by examining and cataloging every element found in the literature. This will serve as a foundation upon which additional assessment within the Greek context will be based. The aim of the research is to explore the potential impact of the enablers, barriers and drivers of circular economy principles on sustainability performance in the Greek agri-food sector.

## 2.Literature review

### 2.1. Introduction

The present investigation was introduced in the preceding chapter. The purpose of this chapter is to analyze the body of research on the circular economy in order to identify specific research topics for Greece's agri-food supply chain. Google Scholar and the university library database were used to find and assess the literature. The definition and guiding concepts of the circular economy are first covered in this section. The significance of the circular economy to Greece's agri-food industry is then examined. The key forces behind the circular economy are then identified and examined, along with its facilitators and obstacles. Lastly, a conceptual framework with research gaps and issues summarizes the findings.

### 2.2. The importance of the adoption of sustainable techniques in Agri food supply chain

As a balance between environmental effects and profitability is sought, supply chain networks development and management must take sustainability into account. (Linton et al., 2007; Neto et al., 2008; 2009; Hassini et al., 2012; Securing and Muller 2008). Stakeholders in the agri-food supply chain are urged to embrace a specific degree of dedication to sustainable practices within the framework of their Corporate Social Responsibility (CSR) initiatives. This is largely driven by the influence of governmental regulations, non-governmental organizations (NGOs), community advocates, and international competition. In their discussion of the growing significance of adopting CSR practices for exporting agri-food companies, Klerkx et al. (2012) draw the conclusion that the idea of corporate environmental friendliness has not been fully developed, particularly in emerging markets.

The majority of AFSC operations can account for a sizeable amount of the industry's overall energy consumption and environmental effects related to the agri-food sector, like traffic generation, vehicle emissions, vehicle noise, visual intrusion and health and safety of workers and the public. Such activities include fuel-powered harvesting using a variety of equipment, transportation involving numerous vehicle movements, long-term storage of perishable goods, and final production using environmentally friendly technologies. Van der Vorst et al. (2009) argue that the preservation of food quality and environmental sustainability should be the primary goals of investments in food supply chain design, in addition to enhancing logistics performance. In 2005, Mintcheva made the case that environmental concerns should not be addressed separately at every stage of the food supply chain. For supply chain networks of this kind, she also recommended a set of indicators for an integrated environment policy framework. The spatially distributed sources of agricultural products along with their often-bulky nature require the development of extensive logistical infrastructure and significant transport capacities for the design of eco-friendly agri-food supply chain networks. Given transportation is likely to have the biggest environmental impact, choices for vehicle selection, route, and scheduling should be made with consideration for the estimated total emissions that will be produced over the course of the network's lifetime. In addition to optimizing unloading processes, sustainable fleet management can also help reduce traffic and trip counts, improve the coordination of transport vehicles and site-specific accumulation of goods, and use machinery in a controlled manner to reduce energy costs (Auernhammer, 2001). According to Allen et al. (1998), the acceptance and future growth of an industrial or commercial activity are frequently greatly influenced by public perception, which also has an impact on the selection of locations and the planning of land use and transportation.

The world may support more than 11 billion people in a few decades, so agricultural production methods now in use would need to change to help produce more food with fewer resources. ([www.fao.org](http://www.fao.org))

### 2.3. Circular economy definition

The "circular economy" is a paradigm of production and consumption that emphasizes renting, sharing, reusing, repairing, refurbishing, and recycling existing resources and products for as long as it is practical. According to the European Parliament, this extends the life cycle of items.

Supply chains originally developed in a linear way. The raw materials are gathered from suppliers at the beginning of the process, processed, and then sent to the distribution center. This is then supplied to final consumers (Gustavo Michelinia et al., 2017). After their shelf life, unused products usually ended up in the trash (Gustavo Michelinia et al., 2017). However, circular supply chains are welcomed by the community today as they aid in creating a system that unites the beginning to the end. This links the restoration of ecosystems, impacts society, generates value, and enhances human health (Abdul et al., 2017).

According to Macarthur (2020), it is a concept of an endless loop in which waste is minimized and resources lose very little value. Most people assume that the primary goal of this concept is to reduce waste. However, it also provokes ideas of reusing, recycling and re-innovating (Macarthur , 2020). Figure 2.1 depicts Zhang (2019) model of circular economy where the primary goal is not only to reduce waste but also to recycle waste materials and returned goods so they can be repaired and resold

while keeping sustainability as the primary focus.



*Figure 2 Source: Inicio | CDE Almería - Centro de Documentación Europea - Universidad de Almería (ual.es)*

### 2.3. Agri-food supply chains (AFSCs)

A-FSC encompasses all the operations involved in moving agricultural food produce from producers/farmers to consumers. The term "agri-food" refers to the agricultural food production industry. The provision of raw materials, production, postharvest, storage, distribution, services, etc. are crucial A-FSC operations. As cited in Kumari et al. (2015), Jaffee and Howard (2010), Ahumada and Villalobos (2009). In recent years, as production systems become more dependent on one another, the idea of sustainability has grown in significance in the agriculture sector. To maximize the benefits of any improvement, a system-wide perspective of sustainability must be taken. (Notarnicola et al., 2012).

AFSCs continue to evolve to keep up with the constantly shifting landscape of the agri-food industry. The main issues facing the world today are: increasing urbanization; expansion of national food markets; liberalization of national and international markets and factors; reduction in funding for the public sector; shifts in

income and demographics; shifts in consumer demand and preferences; and the rise of global supply chains. Consequently, to ensure the sustainability and efficacy of these complex, multitier supply chains, management demands that the most critical issues be identified and addressed by all AFSC stakeholders in order to facilitate an integrated decision-making process.

According to Kuik et al. (2010), in order to achieve social, economic, and environmental benefits, traditional supply networks should evolve into Sustainable Supply Chain Management (SSCM). “Integration of social, economic, and environmental practices within a global supply chain that provides green products, excellent services, and accurate information” (Xie and Allen, 2013) is the precise definition of supply chain management, or SSCM. “All employees, shareholders, business partners, and the wider community can share these benefits with each other,” the statement goes on.

#### 2.4. The need to move towards circular economy

Moving towards circular economy offers numerous environmental, economic, and social benefits. In a linear economy, resources are extracted, used, and frequently discarded which causes resource depletion and waste production. A circular economy aims to maximize resource efficiency by promoting the reuse, remanufacturing, and recycling of products and materials, thus lowering the requirement for fresh resource exploitation.

The pollution and the release of harmful substances into the environment are minimized as the reuse and the recycling of products establishes, since a circular economy reduces the burden on landfills and incinerators. Also, shifting to a circular economy can help lower emissions by reducing the need for new manufacturing processes and transportation of raw materials.

For businesses, adopting the circular economy's tenets can save a lot of money over time. Products that are durable and repairable can decrease the need for ongoing investments in new resources, lower disposal costs, and increase the lifespan of assets.

Businesses can reduce overall costs by reducing purchasing expenses by integrating the linear supply chain with the starting point. This gives them a competitive advantage over competitors. (Zink & Geyer, 2017).

Customers are becoming increasingly conscious of the good that they buy, informed about it, and worried about the conditions through which it is prepared and disposed of (Abdul et al., 2017). Their expectations have grown to the point where they wish to return any goods they regret purchasing or that they purchased in error. They occasionally wish to exchange their old items for new ones in order to avoid having to dispose of or recycle them (Farooque et al., 2019). Therefore, businesses that want to turn a profit in the future need to find methods to increase client satisfaction while cutting the cost of reverse logistics. It is crucial to implement the circular supply chain as a result (Turk, 2019).

## 2.5. Principles of circular economy

3R principle Circular economy is based primarily on three main principles or 3R's which consist of reduce, reuse and recycle (Reh, 2013).

According to the Ellen MacArthur Foundation (2019), the circular economy is founded on three principles: i) designing out waste and pollution; ii) keeping products and materials in use; and iii) regenerating natural systems. The 3R principle, also known as the "3Rs," stands for Reduce, Reuse, and Recycle. It is a framework for waste and resource management that promotes responsible and sustainable consumption and production practices. The 3R principle is closely aligned with the concept of a circular economy and serves as a foundation for waste reduction and environmental protection. Here's an explanation of each of the 3Rs.

**Reduce:** The first "R" encourages the reduction of waste and resource consumption. It involves minimizing the generation of waste in the first place by using resources more efficiently, producing less waste, and being mindful of the environmental impact of products and processes. This can be achieved through measures such as improving product design, increasing energy efficiency, and reducing unnecessary packaging.

**Reuse:** The second "R" promotes the reuse of products and materials to extend their lifespan and prevent them from becoming waste. Reusing items means finding new ways to use or repurpose them, rather than discarding them after initial use. Examples



include repairing and refurbishing products, using second-hand items, and encouraging the sharing of resources.

**Recycle:** The third "R" emphasizes the recycling of materials and products after they have reached the end of their useful life. Recycling involves processing materials to create new products or materials, reducing the need for the extraction and production of virgin resources. Commonly recycled materials include paper, glass, plastics, and metals.

The 3R principle encourages a holistic approach to waste management, with an emphasis on preventing waste generation (Reduce), making the most of existing resources (Reuse), and ensuring that materials are given a second life through recycling (Recycle). These practices are essential for conserving natural resources, reducing environmental impacts, and moving towards a more sustainable and circular economy.

The promotion of more sustainable and efficient practices can be achieved by implementing the 3Rs in the agri-food domain.

## 2.6. Principles of circular economy in the agri-food sector

### **Reduce in Agri-Food:**

The term “reduce” in Agri food, primarily means the reduction of food waste. Enhancing supply chain efficiency, educating consumers about minimizing food waste at home, and developing better harvesting and post-harvesting practices are all ways that agriculture and the food industry can reduce food waste. Secondly, it comes the reduction of the natural resources that are being used for farming practices. Supporting practices like precision agriculture, which involves using data and technology to optimize resource use, reduce inputs (such as water and fertilizers), and minimize environmental impact, will give a direction to sustainable farming practices.

Thirdly, there is the efficient packaging. The packaging of products plays a crucial role in facilitating, protecting, and preserving food during its transportation through the supply chain to the consumer. The primary function of packaging is to protect the

product and extend its shelf life. Despite its benefits, food plastic packaging is often produced and consumed in an unsustainable manner. Concerns are frequently raised about the sale of organic products in supermarkets wrapped in environmentally unfriendly packaging, including plastic and metal. Therefore, there is an urgent need for better alignment of food packaging solutions with the United Nations Sustainable Development Goals (SDGs).

Demands for greener packaging are evident as laws requiring organic products to be packaged to prevent mixing with non-organic items are being met.

Lastly, the “reduce” links with sustainable sourcing. In addition to supporting local economies, encouraging sustainable and local sourcing of agricultural products will result in a decrease in emissions associated with transportation.

### **Reuse in Agri-Food:**

The term “reuse” in Agri food links with the reusable of the packaging. Reusable container use for food product packaging and transportation can help cut down on the use of single-use packaging throughout the supply chain.

Next, there is the food processing byproducts, which means to explore opportunities to reuse byproducts and waste from food processing for other purposes, such as animal feed, compost, or bioenergy production.

Lastly, another way of “reuse” is the refurbished equipment. In the agricultural sector, consider the reuse of refurbished farming equipment to extend their lifespan and reduce the need for new machinery.

### **Recycle in Agri-Food:**

The term “recycle” in Agri food-most importantly is related to the recycling of the food packaging.

Also, there is the organic waste recycling. The implementation composting and anaerobic digestion systems to recycle organic waste from food processing and agriculture, will convert it into valuable compost or biogas.

Furthermore, the actualization of circular supply chains and circular agriculture. The composition of supply chains that emphasize the recycling and reuse of materials, such as returning packaging materials for reuse or recycling and the implementation of agricultural practices that recycle nutrients and organic matter back into the soil, promoting soil health and reducing the need for synthetic fertilizers, will accomplish the 3rd R that will lead to a more sustainable agriculture.

Interestingly, food waste is defined as food that is appropriate for human consumption but is thrown out during the retail, food service, or consumption stages. Food loss, on the other hand, is typically linked to the quantity lost during the production, post-harvest, and processing stages (Vilariño et al., 2017, FAO, 2019).

In the agri-food domain, the 3R principle can help reduce resource consumption, minimize food waste, and create a more sustainable and environmentally friendly food system. These principles align with the broader goals of promoting sustainable agriculture, reducing greenhouse gas emissions, and conserving natural resources.

Still, 6R concepts are applicable in the circular economy as a result of growing awareness of sustainable innovation in recent years.

## 2.7. Drivers of circular economy

A company's perspective on the drivers of the circular economy was obtained through the review of the literature analysis. These drivers include public health, knowledge, economic drivers, government support and regulations, customer awareness, leadership, and business status. In order to ascertain and appreciate what drives the adoption of the circular economy in a supply chain, it will first be necessary to examine the drivers.

### 2.7.1. Human drivers

The main cause of waste creation is human activity. Waste management was implemented in order to stop waste from piling up (Elmualim et al., 2012). To make sure that everyone has access to the needs at a sufficient level, sustainability is used in waste management. The production of garbage and human activity are closely related. (Agamuthu, 2009). The need for waste management increases along with the range of activities, which opened the door for the circular economy and sustainability.

Education is essential because it can change people's attitudes and promote collaboration between businesses on waste management issues (Elmualim et al., 2012). As the public grows more aware of the situation, this can be started by providing them with regular informational updates. If people are properly educated and aware of the advantages of this model, the recycling process will increase by 20%. (Agamuthu, 2009). Individuals won't be driven to learn unless they receive compensation. Shopkeepers should, for instance, start charging for plastic bags, wraps, and tinfoil. Alternatively, they can establish a deposit scheme in which, should the consumer return the plastic item they purchased, they would refund the client's money (Flanagan, 2017).

### 2.7.2. Public health

The public's health has been negatively damaged by the government's and businesses' insufficient waste management initiatives. Public health can be safeguarded through the adoption of sustainable practices such as the circular economy, which can lessen the negative impacts of waste-related pollution (Geng et al., 2012). Waste is being handled inefficiently in the majority of developing nations, with only 30% to 70% of it being collected and the remainder discarded in open landfills. These have the potential to spread viruses and diseases that can result in respiratory illnesses, infections, and other health issues (Ezeah et al., 2013). Before collecting wastes, steps must be taken to ensure that they are separated at the source. Wastes must be separated into compostable and non-compostable categories to improve the overall quality of recycling. The development of the circular economy will be facilitated by this separation process (Ilić & Nikolić, 2016). Numerous benefits result from this, including decreased food insecurity, increased food safety, and improved occupational, social, and environmental health (Roni A. Neff et al., 2015).

### 2.7.3. Knowledge about circular economy

Acknowledging the circular economy is crucial because, as waste is avoided, these methods often raise awareness. Training and education are crucial for the transfer and expansion of this information (Siemieniuch M.A et al., 2015). It is vital to identify the material that already exists and to make it available through formal as well as informal learning. Employee suggestions will aid in industry knowledge acquisition since they have a deeper comprehension of the activities in which they are engaged.

(Diabat & Govinda, 2011). Therefore, employee engagement and passion have been a key factor in the creation of this approach. The exchange of knowledge among various supply chain sectors will be essential to the development of the circular economy. Various industries will have diverse approaches to waste prevention, and the advantages cannot be realized if the stakeholders do not share these ideas (Moktadir et al., 2018). In order for the government and private businesses to benefit from knowledge exchange, regulatory departments should promote it as well. To promote information sharing, the government should therefore take action by creating policies, offering incentives, and initiating awareness programs (Mittal & Sangwan, 2014).

#### 2.7.4. Economic drivers

The business must have the necessary resources, both financial and physical, in order to implement any waste management procedure (Wilson, 2007). The socioeconomic data of the nation is also crucial because it aids in determining the kind of waste materials produced and the appropriate course of action for dealing with them (Agamuthu, 2009). Recovered garbage might be able to be sold for more money in the future. These waste products are used as efficient sources of secondary raw materials by certain nations, such as China and India, and are occasionally traded with wealthy nations. In many Asian nations, the recovery of recyclable materials from garbage accounts for 2% of total employment (Wilson, 2007). Using this method enhances economic activity while also lowering the need for packaging, water, and a clearer understanding of food security and origin (MaCarthur & Foundation, 2018).

#### 3.7.5. Customer awareness

Consumer awareness of the part businesses play in safeguarding the economy is growing as economic concerns do as well. Customers have so been pressuring businesses to use circular processes constantly. Since they wish to address environmental challenges by creating eco-friendly products, working together with customers is essential (Elmualim et al., 2012). Two more reasons for starting this change are food scarcity and climate change. Businesses, communities, and the government are under constant pressure from consumers to implement green programs that safeguard the environment (Elmualim et al., 2012).

### 2.7.6. Leadership

The commitment of top management to make bold choices is crucial to maintaining a sustainable environment. They need to start working with other organizations to co-create. This will enable the company to exchange beneficial projects and strategies for developing a circular economy (Moktadir et al., 2018). Consequently, there will be an increase in the coordination and cooperation between various industries. Setting standards for their manufacturing and production procedures should be another duty of leaders (R. Nowosielski, 2007). They should embrace the concept of implementing green practices while emphasizing the company's corporate social responsibility. The CEO of AB InBev, Mr. Carlos Britto, is one of the clearest instances of this, having taken the initiative to join the Ellen MacArthur foundation. (Foundation, 2018). He has also implemented a process that reuses grains for brewing because they are nutritious and safe to consume. By doing this, a lot of grains won't be discarded or resold as animal feed (Inbev, 2020).

### 2.7.7. Government support and legislation

The government's established laws and regulations are a crucial factor in ensuring a circular economy. The government must move quickly to enforce sustainable practices due to the rising levels of emissions, pollution, and degradation. Government financing and subsidies will also encourage companies to convert from regular to environmentally friendly practices. (Moktadir et al., 2018). The government ought to introduce further legislation pertaining to the recycling and reprocessing of food and other items. Reusing materials will motivate companies to implement circular business models in the future and can be a crucial component of a sustainable manufacturing process (MaCarthur & Company, 2014). The government should also stress the need of strong supplier coordination since it fosters product stability. Consequently, when the government begins to finance the transition from conventional linear approach to the circular paradigm, both the producers and the sellers stand to gain (Moktadir et al., 2018). Both top-down and bottom-up approaches are occasionally used in nations like China (Mathews & Tan, 2011). The measures that the companies were taking up to adopt the circular economy because they thought that resource and energy prices had gone up were alluded to by the

bottom-up method. According to Mathews and Tan (2011), the circular model's implementation has undergone modifications as a result of the combination of these entrepreneurial endeavors and the state framework.

#### 2.7.8. Business status

Businesses need to protect the environment in order to maintain their reputation and earn the trust of customers who are becoming more environmentally conscious (Agamuthu, 2009). Maintaining the status quo is critical for the business as it provides customers with a sense of security and influences the attitudes of other stakeholders, such as sponsors, influencers, and workers. Agamuthu (2009) asserts that the manufacturing sector is beginning to transition away from conventional methods and toward environmentally friendly methods of production, which will increase satisfaction among consumers.

### 2.8. Enablers and Barriers

The circular economy has complimentary catalysts and constraints. Although they occasionally have a propensity to overlap, the major goal of introducers is to concentrate on improving and addressing many barriers. Occasionally the hurdles that are created by the enablers themselves become barriers (Harta et al., 2019). Among the many obstacles, the most important ones are sectoral, cultural, market, regulatory, technical, financial, and technological impediments. Similarly, the literature below delves deeper into enablers such as cultural, regulatory, financial, internal, and sectoral enablers.

#### 2.8.1. Barriers

Any barriers that arise can be found outside in the surrounding environment or inside the company.

##### **Policy and regulatory barriers**

Waste management recycling programs don't work to provide high-quality recycling. Uncertain national vision includes ambiguous goals, objectives, targets, and indicators when it comes to CE in supply chain regulations.

Despite the growth of EU in industrial applications, progress in many sectors is still limited; for instance, across the EU there are still high levels of electronic and food waste generation.

Regulatory frameworks do not always support the circular economy. Existing regulations may not be conducive to circular economy practices. In some cases, regulations may inadvertently favor linear economy models or lack the flexibility needed to accommodate circular approaches. Governments may need to review and update regulations in order to remove barriers and create a more supportive legal environment. Reuse-related legislation are deemed insufficient by a variety of stakeholders, including garbage operators and constructors, for the shift from a linear to a circular economy. It is unclear how waste streams should be categorized and how materials that are still useable but are legally categorized as waste can be reinserted into production operations. Legislative definitions of "waste" pose a major obstacle to the implementation of the circular economy.

Laws pertaining to the circular economy have not been adequately applied. There is currently no mechanism available to assess the efficacy of proposed regulations and laws, and the laws pertaining to the circular economy are weak. Rather than being derived from technical expertise, most laws are based on subjective opinions.

Then we have the inconsistent policies. There may be inconsistencies or contradictions between different government policies that affect the adoption of circular economy practices. Aligning policies across departments and levels of government is critical to providing a cohesive and supportive framework.

Thirdly, there is the lack of incentives. The lack of financial or regulatory incentives can discourage businesses from implementing circular practices. Governments can play a crucial role in providing incentives such as tax breaks, subsidies, or grants to encourage businesses to invest in circular economy initiatives.

Additional regulations pertain to the use of second-hand materials, land allocation, water reuse, and the reuse of demolition debris, particularly with regard to permitting pilot projects and experiments. Examples of barriers concern, for instance, the lack of clear rules for the use of sludge, reclaimed water and recycled waste (according to the type) in accordance with health and ecological standards. In Europe, the current eco-



design directive is heavily focused on energy-related areas, with a lesser emphasis on materials and product typology in a wider context.

### **Financial/ economic barriers**

The transition from a linear to a circular economy poses financial risks for economic actors. This is believed to have something to do with the critical magnitude of activity occurring in variously sized cities because of factors like population, market size, material flows, etc. A circular economy initiative's scale often does not match the complexity of the relationships between various domains, laws, and players. De-risking circular investment opportunities also calls for appropriate legislative frameworks as well as transparency in the planning and implementation of the project. Enhancing the participation of well-established major corporations is crucial in serving as drivers for the change. The UK city of Glasgow is attempting to encourage more well-established companies to incorporate the circular economy into their business plans. Leaders of certain major corporations might go a step further in embracing end-of-life principles by proposing concepts like remanufacturing, repurposing, and reusing. For instance, it has been noted that financing initiatives including the full product/value chain is necessary in Flanders, Belgium.

Transitioning to circular economy practices often requires significant upfront investments in new technologies, infrastructure, and processes. For example, setting up recycling facilities, implementing waste-to-energy systems, or adopting precision farming technologies can be financially demanding for businesses, particularly small and medium-sized enterprises (SMEs). Weak economic incentives make it difficult for enterprises to implement CE in SC.

The shop floor and production unit must be redesigned in order to implement the circular economy in the supply chain. This involves skilled labor, building, technology, and other elements. For SMEs and smaller industries, this first step appears to be a difficult undertaking.

Production costs are increasing in the circular economy. The high cost of environmentally friendly materials and packaging is a common challenge for

businesses and individuals looking to adopt more sustainable practices. Recycled materials in SC have high costs, so they are frequently more expensive than virgin materials on the market. Customers are frequently more concerned with price than with the product's full lifecycle because virgin products are typically less expensive than recycled ones.

Another factor that creates a barrier is the lack of access to capital. Many businesses, especially smaller ones, may face challenges in accessing the necessary capital to invest in circular economy initiatives. Limited access to loans, grants, and other financial instruments may impede the adoption of sustainable practices in the agri-food sector.

Moreover, the cost competitiveness, the ability of a company or a product to offer goods or services in the marketplace at prices that are attractive to customers while maintaining profitability, is challenging when combined with the adoption of circular economy. Circular economy practices may not always be immediately cost-competitive with traditional linear practices. Businesses may be hesitant to adopt circular models if they assume they are more expensive, or the payback period is too long. Governments and financial institutions can play a role in providing incentives or subsidies to bridge this gap.

Also, there is market uncertainty. Businesses may face uncertainties regarding the market demand for circular products or services. If customers are unwilling to pay a premium for products bearing the circular economy label, businesses may be hesitant to invest in circular practices. Effective communication and marketing strategies are needed to convey the value of circular products to consumers.

Another barrier is the fluctuations of commodity price. Agriculture is often subject to commodity price fluctuations influenced by factors such as weather conditions, global demand, and geopolitical events. These uncertainties can make it challenging for farmers and agri-food businesses to plan and invest in circular practices with confidence.

Then there is supply chain complexity. Implementing circular practices may require changes throughout the entire supply chain, from production to distribution. Coordinating and integrating these changes can be economically challenging, particularly in complex and globally dispersed supply chains.

Finally, there are the economies of scale, that constitute a barrier. Circular economy initiatives often benefit from economies of scale. Small-scale farmers or businesses may find it more difficult to achieve cost efficiencies associated with circular practices. Collaborative efforts and support mechanisms are needed to help smaller entities participate in circular initiatives.

### **Technological Barriers**

Applications of a CE in Industry 4.0 (I4.0) will be vital to sustainable food supply chains (SFSCs). To increase the circularity and sustainability of FSCs, I4.0 applications can be utilized for traceability, tracking, inspection and quality monitoring, environmental monitoring, precision agriculture, farm input optimization, process automation, etc. The elements combining I4.0 and CE adoption in SFSC are still poorly understood, nevertheless. Moreover, there are a number of obstacles to I4.0 adoption even with its enormous potential.

The first barrier is the data and information systems. Effective circular practice implementation frequently necessitates the use of robust data and information systems for monitoring and optimizing resource flows. Inadequate technological infrastructure for data management can be challenging.

The company's vision and plan for digital operations are poor. Industry 4.0 refers to a novel approach to company operations, particularly in industrial firms, through digital transformation, necessitating a distinct vision and goal for digital operations.

Organizations seem to be struggling to articulate their Industry 4.0 strategy and goal during this transition. Organizations seem to be having difficulty converting the visionary concepts of Industry 4.0 into practical levels of supply chain sustainability improvement thus far (Erol and associates, 2016).

Complexity issues are a frequent type of performance issues. In order for the workforce to accept digitalization in the manufacturing environment, they should be trained in the fundamental processes, their relationships, and data interpretation. Business personnel typically lack the skills necessary to effectively manage the complex difficulties surrounding data analysis, scheduling, and the use of instructions in relation to Industry 4.0 adoption. "Industry 4.0" is not appropriate for attaining

supply chain sustainability due to its high complexity and absence of roadmaps and guidelines to facilitate its adoption (Ras and colleagues, 2017; Erošl et al., 2016).

Then, the lack of adequate expertise in how to use the technology and the type of skills to be adopted are issues that must be addressed. (Amsterdam, 2013). Some linear technologies are already well established in the economy, making it even more difficult to introduce new circular systems. (Amsterdam, 2013).

Finally, the lack of infrastructure and internet-based networks constitute a severe barrier. High-tech facilities and solutions based on information technology are essential for the successful implementation of Industry 4.0 concepts. Inadequate internet access is a crucial obstacle to Industry 4.0 projects. In addition, Internet-based technology in Greece is not acknowledged to the same extent in rural and urban areas, which could hinder the expansion of businesses in the long run.

### **Cultural and Behavioral Barriers**

Cultural barriers are obstacles and challenges that arise from differences in culture, customs, traditions, and values among individuals or groups. These barriers can hinder effective communication, understanding, and collaboration, particularly in multicultural or diverse settings.

Food waste-related losses in developing nations are primarily concentrated at the consumer level. As a result, in order to help the shift from LE to CE, suppliers and customers are essential. Furthermore, their understanding of and familiarity with material recycling are very important for SC's adoption of CE (Xue et al. (2010); Ellen MacArthur Foundation, 2016; Borrello et al. (2017); FICCI, 2018; Farooque et al. (2019a); Sharma et al. (2019).) Consumer preferences and behaviors may favor traditional linear consumption patterns. Encouraging consumers to embrace circular products, adopt sustainable diets, and reduce food waste can be a difficult task. In order to fully embrace CE, suppliers and customers must take an active role in the process. However, because of increased costs or concerns about quality, neither is eager to offer circular goods and services. The advancement of booths is critical for improving the supply, use, and purchase of more sustainable products. As a result, having CE initiatives requires the involvement and support of these external stakeholders.

The lack of interest and awareness among consumers is the second obstacle. This is a challenging barrier that requires a concerted effort from businesses, governments, and advocacy groups to educate consumers, enhance product availability, and create a cultural shift towards sustainable consumption habits. Many consumers have a limited understanding of the concept of the circular economy. The principles of reduce, reuse, and recycle are not universally grasped, leading to challenges in promoting sustainable consumption habits. The circular economy can be perceived as a complex and abstract concept. Consumers may find it challenging to relate these principles to their daily lives, leading to a lack of interest and engagement. Convenient goods and services are frequently preferred, even if they don't follow the guidelines of the circular economy.

There may be cultural resistance to change within the industry and among stakeholders. It might be necessary to change ingrained behaviors and perspectives in order to adopt circular economy ideas.

Moreover, there is the hesitant company culture. It could be difficult for companies used to traditional, linear supply chain models to switch to circular ones. Change resistance may arise from a lack of familiarity with circular strategies.

Despite the advantages for the economy and environment, consumers still do not readily adhere to items based on CE standards. Moreover, the barrier to the dissemination of CE arises from CE-based business models' inability to satisfy the cultural, social, and psychological needs of consumers. Adoption of CE is hampered even by consumers' unfavorable attitudes and actions about circular products (Borrello et al. (2016); Borrello et al. (2017); Kirchherr et al. (2018); Singh and Giacosa (2019).

### **Market barriers**

The market comprises supply and demand patterns, which can be very erratic and limit new business endeavors (Jesus & Mendonça, 2018). Due to its low cost of virgin materials, the market forces are considered as significant barriers to the transition from traditional practices to the circular model. As a result, alternative linear products will be forced to outperform circular products in the marketplace (Mont et al., 2017).

This conversion process can only be successful if the business has a stable source of funding.

According to Jesus and Mendonça (2018), there are three main reasons why markets fail: poor information flow, poor communication, and accessible investment costs. Market barriers are thought to be the second most significant impediments when weighed against other obstacles (Mont et al., 2017). For instance, some believe that banning plastic from food packaging will have the opposite effect of intended one—that is, increase total costs of packaging as businesses are forced to turn to more expensive alternatives like cardboard, which also contributes to deforestation (Gaukroger, 2018; Gray, 2018).

### 2.8.2. Enablers

Certainly, sustainability in the agri-food supply chain is crucial for meeting the growing demand for food while minimizing environmental impact and ensuring social responsibility. Enablers aim to establish a conducive atmosphere that promotes the adoption of sustainable and circular practices in the agri-food supply chain, with the goal of implementing a circular economy. These facilitators are essential for overcoming obstacles and promoting the shift from resource-intensive, linear models to more circular, sustainable ones.

#### **Cultural enablers**

It is recommended to employ a top-down approach in which decision makers and other team members are conversant with the theory. Establishing the circular model rules in the supply chain requires the support of a company's leaders. Thus, it is believed that leadership is a major motivator (Charlson & Dunwoody, 2017). It is advisable to collaborate with the company's members and management to integrate social and financial goals. To stay in touch with clients and work together with other businesses, industry customer workshops could be implemented (Hart et al., 2019).

When suppliers and customers realize that the circular model will benefit the economy, their perceptions of it will both greatly improve. This gives the business a chance to strengthen its relationships with suppliers and be more socially conscious. (Martin Agyemang 2019). Because system thinking integrates procurement and uses contemporary methods to create a model inside the purchasing structure, value chain

activities and system thinking are viewed as important drivers (ARUP & foundation, 2018). Businesses should learn how to avoid chasing after short-term gains and work together by collaborating with other stakeholders on long-term projects (ARUP & foundation, 2018).

### **Regulatory enablers**

Government policy support can be used to foster the innovation and experience that are critical to enabling the circular economy. Policies and rewards are beneficial since it is unrealistic to expect businesses to create this model on their own (Hill, 2014). For instance, the C40 organization has made major cities sign and make rules regarding the reduction of waste up to 15% by 2030 and the avoidance of burying waste in landfills up to 50% by 2030. Their other aim is to improve treatment of food waste and carbon offset (Ellen MacArthur foundation, 2019) (C40, 2020).

Developed countries are expected to increase their agri-cultural production and effectiveness in the agri-food supply chain (AFSC) operations in order to respond to the anticipated rise of 70% on the global food demand by 2050 (FAO, 2006; FAO, 2009; Nelson et al., 2010). At the same time, as one of the most regulated and protected sectors in the European Union (EU), AFS has significant implications for sustainability, such as meeting human needs, supporting employment and economic prosperity through export-led growth, the environmental impact, eradicating poverty, and creating new markets, as mandated by the United Nations Industrial Development Organization (Humphrey and Memedovic, 2006). Furthermore, the European Commission (EC) is promoting significant reforms to its Common Agricultural Policy (CAP) in order to address the plethora of globally emerging AFS challenges (EC, 2010).

### **Internal enablers**

Companies may implement the circular model if they take the steps required to cultivate the company's fundamental values and incorporate circularity into its goals and KPIs (Key Performance Indicators) (Pheifer, 2017). For the shift to go smoothly, the advantages must be made evident. Effective communication within the organization can foster a comprehensive environment that encourages internal stakeholders to contribute concepts and tactics (Pheifer, 2017). Developing training programs is necessary to guarantee that organization personnel possess the skills and

information needed to implement the circular economy model. In order to find vulnerabilities and increase value, assessment tools ought to be set up (Pheifer, 2017). In addition, this will provide a competitive edge to the companies implementing this idea. Food sellers argue that a company's dedication to sustainability—not wasting food—will enhance client happiness (Mirza, 2016).

### **Financial enablers**

By implementing concepts like lifetime costing, which can promote greater energy efficiency, value of assets can be prioritized (Harta et al., 2019). Businesses don't necessarily need to make large early investments. To determine the end result, they can begin by applying straightforward techniques like temporary workspaces, cost-saving solutions, and the use of reused and second-hand materials (Tingley et al., 2018). The production process's decreased costs provide financial benefits. The business can improve margins and recoup costs by selling secondary materials in new markets by utilizing them efficiently. This has the power to draw in new clients and strengthen the ties that already bind them (Mont et al., 2017). Combining various projects together with scaling can help reduce expenses and turn roadblocks into potential opportunities. Additionally, scaling increases flexibility, which facilitates navigating regulatory obstacles (Harta et al., 2019). Merchants in the food industry stand to gain greatly from this because it makes them more resource-efficient. By reusing food products, businesses can reduce their expenditure on raw materials and natural resources, further enhancing their efficiency (Mirza, 2016).

### **Market enablers**

Customers now hold businesses that supply them with food to higher standards of quality in addition to the food itself. More and more consumers are seeking products at affordable prices and with easy accessibility, which, at the same time, have been produced in an ethical and sustainable manner. Additionally, they are increasingly demanding higher quality service, with the ability to place orders at any time, from anywhere and through any means, whether by visiting the store, by phone, or through an e-commerce application. The last method has developed rapidly in the last two years due to the pandemic. Therefore, there is a strong shift towards LATTE products



(Local, Authentic, Traceable, Transparent, and Ethical). At the same time, a large number of consumers are seeking personalized nutrition.

The most significant consumer trends that will impact the industry are consumers' demands for product traceability/recognition, high nutritional value, personalized nutrition, reduced environmental footprint, and increased e-commerce. (Dr. Papadopoulos Filippos)

### 3. Research methodology

#### 3.1. Introduction

This section describes the research philosophies chosen to conduct the study. The research methodology and the principles of the thesis are then described. First, the five research methodologies are identified and the most appropriate for the purpose of this research is selected. This determined the type of research and then a method of data collection and analysis was developed to enable the conclusions to be conducted.

#### 3.2. Research philosophies

A study's primary goal is to increase knowledge and understanding in a particular field. A particular field of knowledge can be developed by applying a variety of theories and principles. The approaches used to ascertain it are known as research philosophies. (Saunders, 2019). There is an interdependent relationship between research theories, opinions, and expectations. Every time someone chooses to identify which philosophy best fits their needs, they frequently face a conflict between their personal values and the ideal philosophy. When it comes to research philosophies, Mkansi & Acheampong (2012) claim that there are several explanations, classifications, and divisions that differ depending on the individual.

There are five distinct research philosophies: postmodernism, pragmatism, interpretivism, realism, and positivism. According to Saunders (2019), positivism is centered on the available information and deals with facts and numbers that are established by scientific methods independent of the individual's perspective or bias. On the other hand, Interpretivism claims that reality is subjective and context dependent. It focuses on comprehending and interpreting meanings from the

participants' perspectives (Burrell & Morgan, 1979) -and that is why it is often used in qualitative research methods, such as interviews-. Critical realism acknowledges an objective reality but recognizes that our understanding is mediated by our perceptions and experiences. It seeks to uncover the underlying structures that influence phenomena. Thus, in critical realism, the truth is deemed to be the most crucial element (Fleetwood, 2005). Pragmatism focuses on the practical aspects of study. It implies that researchers should employ whichever methodologies and approaches work best for answering a specific research topic, regardless of philosophical constraints. (Saunders, 2019). Postmodernism focuses more on the objects and language that dominate reality. It serves to identify the ideas that are disregarded and concentrates more on the current idea. (Fleetwood, 2005).

Regarding this research, interpretivism will be primarily used. Because the primary goal of this research is to investigate the possible impact of the enablers, barriers, and drivers of circular economy principles on sustainability performance in the Greek agri-food industry, the ideas remain undiscovered in this division, and it is necessary to understand how these are interpreted in the specific context. As a result, interpretivism will be most appropriate for determining the circular economy principles, enablers, and barriers in the Greek agri-food sector, where different people have diverse perspectives. Philosophy as personal logic and significance that extends beyond social activity is justified, and social interaction is essential for understanding different people's perspectives, with a greater emphasis on the human sense than the dependent or independent factors.

### 3.3. Research type

Research can be classified under two types namely inductive and deductive. Inductive research involves deriving a general conclusion from a set of specific studies as showed in figure 3.4. On the other hand, involves gathering general data in order to arrive at precise conclusions as mentioned in figure 3.5 (SIMON, 1996)

Deductive research, therefore, begins with an analysis of the body of current literature in which a particular problem is recognized. Conversely, inductive research emphasizes less structured approaches where the observer is willing to accept any

outcome (Sutrisna, 2009).



*Figure 3 represents deductive approach (Saleem & Burney, 2008)*



*Figure 4 represents inductive approach (Saleem & Burney, 2008)*

Given that the interpretivism philosophy underpins this research, an inductive approach would be more appropriate. The inductive approach has no limitations when it comes to making projections based on predetermined outcomes, which makes it especially helpful for finding new sequences. Consequently, a more qualitative method may be applied (Woo et al., 2017). Experiential learning accounts for a large amount of the learning. Based on the studies, consistencies, similarities, and patterns, a number of hypotheses will be taken into consideration and generated from the qualitative data (Saunders, 2019).

### 3.4. Research strategy

The kind of research strategy used for the dissertation should be decided upon based on the goals and research questions. Research strategy will clarify the foundations from which data will be collected and the various methods employed for collecting this data (Saunders, 2019).

The various sorts of methods are displayed in Figure 5. There are four types of research: case studies, qualitative interviews, quantitative surveys, and action-oriented research. Rodrigo (2017).



*Figure 5 signifies the different types of research strategies (rodrigo, 2017)*

A case study is the ideal choice in situations where research is conducted using a workstation or only a few organizations. Case studies are more concerned with depicting a situation than with proving causation and effect (Rodrigo, 2017). When compared to other methods, this one's main shortcomings include a lack of impartiality and rigor. Conversely, it offers a wealth of information that is very helpful during the research's exploratory and explanatory phases (Rowley, 2002).

One of the most widely used techniques, quantitative surveys come in very handy when there are a lot of participants. To ascertain the characteristics of a population, sampling and questionnaires are used to attain statistical precision. It may be able to offer evaluations that apply to the entire population (Sukamolson, 2007). It is quite adaptable because it can be completed over the phone, in person, or online. Finding the traits of a sizable population and guaranteeing high consistency are the key benefits (Boru, 2018).

Qualitative interviews: this approach involves researchers and participants in various conversations and exchanges where the subject is recorded and analyzed (Crouch & McKenzie, 2006). Finding out about someone else's comprehension, beliefs, goals,

position, and challenges can be useful. Thru conducting interviews, the researcher learns about various perspectives and experiences in addition to observing group dynamics (Hummelvoll, 2008). Structured, semi-structured, and unstructured interviews are all possible. The formulation of planned questions makes a difference (Rodrigo, 2017).

Research that is action-oriented can be used to improve practices and environments where social processes are the main focus (Rodrigo, 2017). This approach makes use of a variety of informational resources that are beneficial for applying collaborative and participatory approaches to solve actual administrative problems. Developing and changing an organization's ethos is one of the major ramifications (Saunders, 2019).

According to the above techniques, the qualitative approach is the most practical choice for examining the circular economy's facilitators and obstacles in nations like Greece since it gives the researcher the ability to pose various queries and follow up on responses. Thus, the researcher will be able to obtain comprehensive information, high response rates, and a deep understanding of the problem by using qualitative interviews. Interviews are used to gather information and knowledge from a variety of perspectives, and by speaking with a large number of participants, the results will also be accurate.

### 3.5. Data collection

Data gleaned by others whose primary goal may not be directly related to the research question is referred to as secondary data. According to Cowton (1998), it differs from regulatory agencies, businesses, the press, journals, books, and case studies. In order to obtain a thorough understanding of the circular economy, the literature review will analyze these currently available data.

Since there are no secondary data accessible, primary data will be gathered to learn about the uses of circular economy in Greece. Greece was selected for this study because it is where the idea of a circular economy is beginning to emerge. Interviews with employees of businesses involved in the agriculture and food industries will be used to get this data. Because the interview questions are flexible, allow for the open exchange of new questions, and enable the interviewer to go deeper into the subject, a semi-structured format will be used (Kajornboon, 2005). When it comes to collecting data both primary and secondary data will be collected and used for this research.

### 3.6. Sampling

The number of participants to be interviewed will be decided in this section. Pragmatic and theoretical factors are considered when choosing the sample size (Robinson, 2014). It will not be feasible to proceed with further planning or to estimate the resources needed without determining the number of participants. Consequently, it would be possible to have a maximum and minimum range rather than being strict and having a set number of participants (Robinson, 2014). Idiographic projects often involve a modest number of participants (Robinson, 2014). Given that this study also aims to gather idiographic data, it is appropriate to interview 8–12 people; the exact number will depend on the saturation rate and the information provided by the participants (Robinson, 2014). The primary objective is to identify the factors that promote and hinder the circular economy. To this end, the researcher will be able to obtain the information they need by conducting interviews on this topic. There will be in-person, phone, and Skype interviews. Companies that supply food, vegetables, frozen food, and fertilizers are among the contestants in an effort to gather opinions from various sectors.

### 3.7. Design of questions for the interview

A list of questions is prepared in advance of the interview process in order to gather information about the subject. Because of the questions' great flexibility, the scope of the investigation can be expanded and modified in response to the interviewees' evolving answers to the material (Crouch & McKenzie, 2006). These inquiries are in charge of advancing current understanding and offering perceptions into the interviewee's viewpoints (Crouch & McKenzie, 2006). A list of all the interview questions is given in Table 1, along with the intended answers and the relevant references.

*Table 1: the topics of the interview and their objectives (Source: author)*

Topics	Questions	References	Objective
Implementation of circular	1. How do you define circular economy?	(Hart et al., 2019)	These questions are designed to gain information

economy principles	2. Which principles of circular economy has your company implemented		about the company's current practices of circular economy
	3. What are the drivers of circular economy implementation in the Greek agri-food sector?		
The enablers and barriers of implementing circular economy	4. What enablers and barriers that businesses face when attempting to implement circular economy practices in the agri-food domain?	(Hart et al., 2019)	These questions are designed to gain information about the enablers and barriers of each company's current practices of circular economy
	5. Based on Greece, which of the above enablers and barriers will have the biggest impact and why?		

Demographics	6. How long have you been part of this company?		These questions are engaged to gaining information regarding the interviewee and their background
	7. In which part of the supply chain does your company operate?		
The impact of the sustainability initiatives on environmental, social, and economic performance & the on overall sustainability profile of every organization	8. What is the impact of [your company name]'s sustainability initiatives on its environmental, social, and economic performance, and how do these aspects contribute to the overall sustainability profile of the organization?		These questions are incorporated to investigate the opinion that individual have regarding the implemented sustainable practices on the significant domains that their company operates

### 3.8. Data analysis

The process of applying theme analysis to data collected through qualitative methods allows for the identification of a theme (Muir-Cochrane & Fereday, 2006). According to Muir-Cochrane and Fereday (2006), thematic analysis is a method used to analyze qualitative data, such as interview transcripts derived from people's perspectives, understandings, and ideas. Accordingly, the information that is gathered is typically assessed by looking through and documenting data patterns (Boru, 2018).



Documentation is the initial stage of the data analysis process. It is important to save and register all of the notes you take, the data you gather, and any text you create from audio recordings.

This makes information tracking easier and facilitates additional analysis (Schutt, 2018). Subsequently, coding occurs, wherein copious amounts of raw data are categorized and divided into a logical order that can be employed to discern patterns. These themes are assigned to particular types of data (Wong, 2008). The researcher should later compile the shared features of the data after determining the themes. After that, suitable illustrations are given to prevent misunderstandings (Kawulich, 2004). The final step is to look at these relationships to determine why those people experienced those things in that setting (Schutt, 2018). For data analysis, thematic analysis will be employed.

### 3.9. Quality of research

Reliability and validity are crucial parts of high-quality research. In comparison to casual laws, qualitative researchers are more interested in the various viewpoints that people have about their experiences (Golafshani, 2003). Therefore, the accuracy and veracity of their findings will be key factors in determining the validity of this study. However, consistency and repeatability in the researcher's ability to gather reliable and accurate data have an impact on reliability (Brink, 1993; Golafshani, 2003).

Sampling bias is the risk that comes with doing qualitative research. Either overrepresentation or underrepresentation can accomplish this (Brink, 1993). The primary goal of a qualitative study is to prevent inaccurate data, and the researcher must choose the subjects based on their judgment (Brink, 1993). A similar risk is that participants may be biased, making certain things appear healthier or less healthy. They occasionally adjust their responses to suit the researcher's needs in an effort to please them. Similarly, they won't feel comfortable sharing specific information on purpose, which could have an impact on the study's findings (Brink, 1993). There are occasionally additional problems associated with cultural differences (Saunders, 2019). However, there won't be any problems because the research participants come from similar cultural backgrounds.

The core of this research is gathering data on the application of circular economy in the Greek agri-food sector, where the settings are quite personal and conducive to

interviews. The researcher will give background data on each participant chosen through purposive sampling in order to guarantee validity and reliability. In accordance with the guidelines in the participant information leaflet, the researcher will give participants 24 hours' notice before the interviews start in order to obtain their consent to participate in the study. Because then they can abandon at any moment if it makes them uncomfortable, this will boost trust. Only questions directly related to the subject will be asked during the interview; no information not needed for the study will be acquired. As a result, the research's validity and dependability will be assured.

### 3.10. Ethical implications

Ethics are the morals that a researcher upholds that are related to doing good deeds and refraining from bad and unpleasant deeds. Research participants will be protected through the adoption of ethical practices (Angelica Orb, 2001). Recognizing the participant's right to privacy, dignity, discretion, and concealment is one of the most important duties to be followed. The primary purpose of the data gathered for this study is to determine how adaptable the circular economy is in developed nations like Greece; no further personal information or details about the supplier's business will be gathered in any way. The investigator should exercise caution by obtaining the required consent from the subjects prior to starting the interview. To avoid any confusion or potential conflicts, the researcher will give specific proof in advance about the kind of data that needs to be gathered. Furthermore, the information gathered will be kept confidential and used only for research, with no public display.

The appendix's ethical approval form ensures that the researcher complies with the Hellenic Open University's ethical standards.

### 3.11. Conclusion

The research methodology facilitates the identification of the information gathered and the organization of the analysis by the researcher. First, the type of research to be conducted is determined, followed by the research paradigm that is most appropriate for the study. The researcher then goes on to detail the data collection procedures and research strategy. The researcher will later decide which analytical techniques to use when analyzing the data. Lastly, a thorough discussion of all ethical issues is provided

because this study complies with the standards set forth by the Hellenic Open University of Warwick and other ethical authorities.

## 4. Data Analysis

The goal of this chapter is to present an extensive examination of the information gathered from the interviews. For this study, eight individuals with varying backgrounds from the agri-food industry participated in semi-structured interviews. Before the analysis, background information on the individuals interviewed is provided, along with other fundamental details regarding the circular economy.

### 4.1. Information about the participant

Eight people were interviewed to find out the main factors and barriers to the implementation of the circular economy in the agri-food sector. Table 2 includes comprehensive details about the participants, such as their background and the kinds of items they use. In order to generate a variety of viewpoints on the subject, interviews were carried out with individuals in a variety of roles, with experience spanning from six months to ten years, as Table 2 illustrates.

*Table 2 Participants information (Source: author).*

Interviewee	Position	Experience	Product
1	Logistics Manager	10 years	Fertilizers and Animal feed
2	Supply chain supervisor	7 years	Fertilizers and Animal feed
3	Brand Manager	6 months	Dairy Products
4	Supply Chain Assistant	2 years	Frozen vegetables
5	Researcher and PhD student (Agricultural	1,5 years	Water

	university of Athens)		
6	International Trade Marketing and Training Assistant	5 months	Plant-based Cosmetics
7	Harvest Analyst	3 years	Fish
8	Logistics Associate	9 months	Coffee

## 4.2. The implementation of circular economy principles in the Greek agri-food domain

Reduction, recycling, and reuse are the three primary categories into which the circular economy's tenets are divided, per the literature. The purpose of the questions was to find out how the participants understood the circular economy and what these principles meant. They suggested that:

” A linear economy, in my opinion, is one in which production, consumption, and waste occur simultaneously. The idea behind the circular economy, on the other hand, is to recycle waste and repurpose it for manufacturing.”- **Interview 1**

“Circular economy promotes sustainability, efficiency on resources and waste reduction. It is an economic model which has lots of benefits in each organization.” – **Interview 2**

“The bog picture of circular economy as we define it is to ensure the longevity of local communities and of the environmental ecosystem. The idea in our industry is to create a loop through which most resources & raw materials ideally flow continually and being reused. For us in the food industry circular economy, simply put, is becoming more environmentally responsible. We try to develop more sustainable products, meaning that we try to collect our raw materials (eg. Milk) from producers that follow sustainable practices, support the local economy. And all the above, to try and prolong the product’s life in order to minimize the waste of resources.” –

**Interview 3**

“A circular economy is a regenerative system with the least amount of waste, resource input, and environmental effect possible. It entails building a closed-loop system to prolong the life cycle of materials, encouraging recycling, and designing products with durability in mind.” – **Interview 4**

“Circular economy is an economic model that promotes the regenerative use of resources by minimizing waste, maximizing product lifespan, and fostering sustainable practices throughout the entire product life cycle.” – **Interview 5**

“Circular economy entails creating a sustainable system where resources are efficiently used, products are designed for longevity, and waste is minimized through recycling and repurposing.” - **Interview 6**

“At Avramar, circular economy in the context of responsible aquaculture involves a holistic approach to minimize waste, optimize resource utilization, and promote the sustainable production of fish. It encompasses practices that ensure the long-term health of aquatic ecosystems while meeting the demand for high-quality seafood.” - Interview 7

“In my opinion, the circular economy can be characterized as a procedure that reduces waste and increases the material's overall value." One company's profits are used as a source of raw materials by another. In the end, this procedure maximizes resource utilization, guaranteeing optimal use, and lessens environmental impact.” - **Interview 8**

From the responses of the participants, it appears that they have a very clear understanding of the meaning of the circular economy. When asked about the implementation of these principles, 2 said that the company he works for has not implemented any principles, while 5 mentioned only recycling. Regarding product reuse, participants 1, 3, 4, 6 and 7 gave examples of different ways in which they had dealt with it.

“In our company the products that are considered defective are shipped for re-packaging and in this way we can restore them to the market. Thus, cost reduction is achieved and the product can be sold without problems and we do not have to undertake destruction operations which would be very expensive.” - **Interview 1**

“At this point we don’t implement any recycling methods or other principles.” -

**Interview 2**

“More precisely, we procure milk from local farms with whom we have long term collaborations and we have agreed in some quality standards, which include the well-being of cows and environmentally friendly farming practices. In addition, the company I am currently at, recently established a super modern biogas and cogeneration of electricity & heat production facility, to cover their needs in energy. The production of biogas uses exclusively as raw material the liquid waste of the ice cream and dairy plant, as well as the whey resulting from the straining of yogurt. The production of biogas is very important because it transforms materials that damage the environment into an absolutely "clean energy" and contributes to sustainable development and the fight against climate change.” -- **Interview 3**

“Barba Stathis has integrated the concepts of the circular economy by emphasizing waste reduction through enhanced production procedures, utilizing environmentally friendly packaging, and ethically obtaining raw materials. We strive to reduce our environmental impact and place a strong emphasis on products that can be reprocessed.” – **Interview 4**

“The university has not implemented any principles, other than recycling, of course, as far as I know. But the employees and students are trying to reduce water consumption.”. – **Interview 5**

“While we continuously explore opportunities, current initiatives at Korres emphasize sustainable sourcing, eco-friendly packaging, and promoting the recyclability of our products.” -**Interview 6**

“Avramar has implemented circular economy principles by adopting responsible aquaculture practices. This includes minimizing environmental impact, ensuring the efficient use of resources in fish farming, and utilizing eco-friendly approaches in fish processing and packaging.” -**Interview 7**

“We certainly implement the 4 Rs, that is Reduce, Reuse, Recycle and Remove. We implement slow cycles, so as the products and materials can be used for an extended period. We care about the natural system and that is why we restore or regenerate them.” - **Interview 8**

Concerning the driving forces for the implementation of the circular economy in the Greek agri-food sector, all participants expressed similar concerns and opinions on the ways of action of the companies. Participants 2,4,5,6 and 7 argued that environmental concerns, regulatory requirements (European union), and growing consumer demand for sustainable and locally sourced products are driving forces, while participants 1,3 and 8 added the concept of cost as a key parameter.

“In Greece, the circular economy, as a potential factor of productive reconstruction and strengthening of entrepreneurship, is perfectly compatible with the structural characteristics of the economy, the quantities and quality characteristics of the produced waste and the need to protect natural resources from increased anthropogenic pressures, mainly from agricultural activity and tourism. It is noted that in the primary sector, there are great possibilities for modernization, with a reduction in production costs as it is characterized by low indicators in the productivity of resources and energy. Finally, Greece has the appropriate scientific potential and know-how to implement the adjustments required for the transition to a circular economy, while being supported by the EU through the proposed strategic directions and the availability of financial tools.” – **Interview 1**

“The agri-food sector has a lot of impact in all principles of circular economy. The population grows exponentially and there is an increasing need to protect the environment, reduce waste and find viable resources that can be reused and recycled. In Greece, at this point there are some policies implemented by the government and there is an increasing demand by consumers to follow green practices.” – **Interview 2**

“The key drivers in Greece seem to be financial, the European policy & legal framework that stimulate the implementation of circular economy for Greek companies.” – **Interview 3**

“Environmental concerns, regulatory compliance, and the need to meet consumer expectations for eco-friendly products are the driving forces behind the need for sustainable practices in the Greek agri-food sector. The industry understands that adopting the principles of the circular economy is critical to its long-term survival.” –

**Interview 4**

“Core factors in Greece include environmental concerns, resource efficiency, regulatory requirements, and growing consumer demand for sustainable and locally sourced products.” – **Interview 5**

“In Greece, factors such as environmental consciousness, demand for locally sourced ingredients, and adherence to regulatory standards are driving the adoption of circular economy practices in the agri-food sector.” - **Interview 6**

“In the Greek agri-food sector, the drivers for circular economy implementation in responsible aquaculture include the need for sustainable seafood production, compliance with environmental regulations, and the rising consumer demand for ethically sourced fish. Avramar recognizes the importance of aligning with these drivers.” - **Interview 7**

“Increase of raw materials. It is cheaper to reuse the same materials rather than create new ones. Then there are European and Greek motives for circular economy. There is also the rise of the standards set by industries and consumers, since it is also a current marketing strategy to go green.” - **Interview 8**

Regarding the enablers for businesses when trying to implement circular economy practices in the target sector, all mentioned environmental concerns of society as well as the reduction of production costs. For barriers, all argued that existing economic structures promote linear models of production and consumption and thus while the technology exists, many markets do not support investment.

“There are many obstacles that do not allow in businesses, especially the small businesses, to adopt business models of the circular economy. They concern the organizational culture and management towards environmental issues. The lack of



funds is another big one barrier, for the supporting sustainable activities and innovation. Also, the high level of bureaucracy in monitoring and supporting collection of performance data of small and medium enterprises in circular economy sector. As for the enablers it seems to be mainly environmental factors and the current market trending.” - **Interview 1**

“Starting with enablers I would say saving money on packaging costs by reusing materials, improving brand reputation, and using less energy which leads to reduce of costs. I believe that important barriers are first and foremost, lack of awareness and lack of knowledge which leads to resistance and reluctance of investment. Moreover, time constraints and operational burden of the organizations.” - **Interview 2**

“Certainly financial, technological and consumption-related are the top three barriers in implementing a circular economy in the agrifood sector in Greece. On the other hand, financial reasons may also be a huge enabler, as well as environmental concerns.” - **Interview 3**

“Government policies that seem to be helpful, developments in environmentally friendly technologies, and industry cooperation examples of enablers. The initial expenses of putting circular practices into practice, the absence of uniform laws, and the requirement for industry-wide collaboration could all be obstacles.” - **Interview 4**

“I strongly believe that enablers encompass supportive policies, collaboration within the supply chain, and technological advancements. Barriers include initial implementation costs, lack of awareness, and regulatory challenges. The challenge lies in the fact that existing economic and regulatory structures promote linear production and consumption models, creating obstacles for the adoption of circular approaches.” - **Interview 5**

“As I have seen from my position, enablers include consumer awareness, supportive policies, and innovative technologies. As for the barriers, they involve initial investment costs and the need for widespread industry collaboration.” - **Interview 6**

“I will speak for my field because I don’t have experience in any other market. I think that enablers for responsible aquaculture businesses involve supportive regulations promoting sustainable aquaculture, access to eco-friendly technologies, and collaboration with stakeholders across the supply chain. For us, barriers include

investment costs in sustainable aquaculture practices and potential resistance to new methodologies.” - **Interview 7**

“The reduction of any cost in the supply chain is always a constant enabler. Also, during the last years, there are many motives by European and Greek legislation regarding farm to fork. In order for a company to gain a competitive advantage among the components they seem to choose keeping up with the ecological and environmental trends. As for barriers, circular economy is a new trend and many businesses are not sure for its benefits and the positive impact or profit it might bring them.” -**Interview 8**

In the next question, the participants seem to agree that cost is a driving force for all business models. However, some mention it as an enabler and others, perhaps considering the initial investment cost, classify it as a constraint. They also seem to agree that the lack of knowledge of both the consumer community and the management of each company can be a barrier to the integration of sustainable products.

“One of the main barriers to the circular economy's adoption is a lack of funding. Making the switch from a linear to a circular business activity involves tasks that demand a significant time and financial commitment from the organization. Particularly significant factors are the extent of advance costs, the indirect cost (time and human potential), and the anticipated payback period.” -**Interview 1**

“In Greece saving costs is the most important enabler which will help all involved parties increase their incentives on circular economy. Accordingly, lack of knowledge and limited awareness prevents the development of such practices, resulting in staying behind evolving advancements.” -**Interview 2**

“Technological and financial because the technology & the investment required in Greece in order to participate in a circular economy model, is huge and complicated. It requires complex technological systems, the expertise of which requires often an immense amount of budget to be allocated by the companies to this purpose. The consumers in Greece, are not educated enough and environmentally aware of the benefits of circular economy, rather they are looking constantly for cheap/ affordable

food solutions, since the economic crisis and financial insecurity that they live under. Often, environmentally friendly products come higher at the price and this is an important barrier for the final consumer. Therefore, durable, reusable, “green” etc products are not often chosen, a factor that does not give the stimulus to companies to invest towards them. As for the enablers, environmental & financial seem to be the top ones.

Companies that view circularity as an economic opportunity, can in fact generate substantial net material cost savings in their budgets. In addition, in a highly competitive environment, companies try to look out for unique propositions and competitive advantage, in order to gain market share and increase their profits. Applying this kind of transformation, in a business world that becomes more & more transparent and with consumers that are more and more environmentally aware on sustainability matters, companies could differentiate and give added value to their products.” -**Interview 3**

“In Greece, growing consumer awareness and government aid are likely the biggest facilitators. However, potential barriers could arise from the diversity of the agri-food industry, necessitating specific strategies for different subsectors.” -**Interview 4**

“In Greece, supportive policies and collaboration within the supply chain are likely to have the biggest impact. The close-knit nature of the agricultural sector in Greece can facilitate effective collaboration, while supportive policies can provide the necessary framework for circular practices.” -**Interview 5**

“Given Greece's strong emphasis on tradition and local sourcing, enablers like consumer demand for sustainable products and collaboration within the industry would have a significant impact. Barriers related to initial costs might be mitigated by emphasizing the long-term benefits of circular practices” -**Interview 6**

“In Greece, the biggest enabler for responsible aquaculture businesses like Avramar is likely the increasing consumer awareness and demand for sustainably sourced fish. However, a potential barrier could be the need for significant investments in advanced aquaculture technologies.” - **Interview 7**

“I think that most significant enablers for Greece would be financial motives by EU and Greek government. In that way, the business not only will have a new circular system which saves them money, but they will also have funding or better taxation. The most important barrier is the change of the current linear system, for the reasons I mentioned above.” **Interview 8**

Concerning the last question, for which a combined approach is needed, the social responsibility is the first thing that came to mind of every participant. Also, along with the social responsibility all of the participants believe that the constant trying of saving the environment is an unchangeable factor of 2024. From these facts, it becomes clear that circular economy and sustainability is aligned with the social responsibility that every human has to act in ways that are not harmful to the environment. The second most common answer has to do with the financial benefits, which is the main concern of each business. Participants 2,3,4,6,7 & 8 mentioned that the financial gains are directly linked with the green strategy. Lastly, only a few

“Our company, which is part of the French multinational group Roullier and has been active in Greece since 1998 under the name Timac Agro-LYDA S.A. The company collects plastic packaging and pallets from its customers after the use of its products and reuses them. By doing so, we recycle packaging materials and reduce the cost of packaging our products. The social impact is that we inspire customers and producers to reduce waste themselves.” - **Interview 1**

“TIMAC AGRO Southeast Europe which is involved in trading fertilizers has significant impacts in all mentioned fields. Adopting circular economy principles, gas emissions are reduced, water pollution is minimized improving the climate change impact. At the same time brand reputation is enhanced which leads to customer loyalty and generates more revenue and profit. The company is part of a Group which has already taken measures in ESG frameworks so the contribution to the overall sustainability profile is in absolute alignment.” - **Interview 2**

“KRI-KRI takes social responsibility seriously. For four years the company supports the area of Kerkini lake, along with the environmental management body of the lake.

Also, the company uses biodegradable waste as raw material for biogas production, as I mentioned earlier. Regarding, recycling, we recycle the cardboards for 2 years now, and this initiative has a huge environmental impact. That is to say, water, energy and trees are being saved, not to mention that our costumers are now familiar with the concept of recycling, in order to sustain the country healthy. It is clear that brands that are socially and environmentally conscious are gaining popularity among consumers, that's a reason-among others-why KRI-KRI has improved its market reputation.” -

### **Interview 3**

“Barba Stathis's sustainability initiatives have improved our environmental performance while lowering waste and promoting ethical sourcing. Our commitment has enhanced social relations with stakeholders, and increased efficiency boosts the organization's overall sustainability and competitiveness financially.” - **Interview 4**

“The impact of the Agricultural University of Athens' ongoing sustainability research initiatives, though not yet implemented, holds promise across environmental, social, and economic dimensions. Our dedicated research, focused on innovative solutions for sustainable water management in agriculture, aims to deliver tangible benefits: Anticipated advancements in sustainable water practices have the potential to reduce environmental impact, enhancing conservation efforts and fostering biodiversity within agricultural ecosystems. By developing knowledge-sharing programs and contributing to the scientific community, our research endeavors not only aim to improve social awareness but also empower farmers and communities with sustainable water management practices. The envisioned precision irrigation models and strategies, born out of our research, are poised to optimize resource use, reducing costs for farmers, and promoting economic viability in agriculture. Although these initiatives are still in the research phase, the Agricultural University of Athens aspires to strengthen its position as a hub for sustainability in agriculture. The intention is to contribute valuable insights and solutions to the broader scientific community, ultimately shaping a more sustainable future for agriculture.” - **Interview 5**

“Regarding the social impact, is widely known that in korres the 3Rs take place, so every customer becomes familiar with our ecofriendly concept. We are merely going full circle—from the seed to the extract to the formulation to the water purification to

the final product to the repurposing of each and every one of its constituent parts—following our conscience. So, as time passes, we get more and more customers that are extremely selective of the products they decide to buy as well as their production.”

**- Interview 6**

“Avramar is involved in all aspects of the sustainable aquaculture supply chain, from the harvesting and distribution of our sustainably sourced fish to the use of ethical fish farming techniques. By lowering the ecological footprint of fish farming, Avramar's sustainability initiatives in responsible aquaculture have improved our environmental performance. Socially, our dedication has improved our connections with customers who appreciate seafood that is sourced ethically. Economically speaking, the increases in efficiency result in cost savings, which supports Avramar's dedication to aquaculture's long-term sustainability.” - **Interview 7**

“First, we have a better ecological footprint to the environment. On the social domain, we have better connection and collaboration with the local community, awareness of customers and increase of our sales, contribution to the effort of local ecological NGOs, participation in environmental initiatives, support from local community. Lastly, the impact on the company's economic performance is the increase of sales, due to the “green” campaigns. All these encourage us to continue this effort, enhancing it gradually even more in the future, aiming at the optimization of the circular economy in favor of the environment, the society and our company results. We want to strengthen our position as a company who cares for all and set the example for other companies, no matter the sector they operate” - **Interview 8**

### 4.3. Summery and Conclusion

#### 4.3.1. Summery

Initially, the participants' jobs, experiences, and general backgrounds were reported, along with their products. From that point on, four main themes were examined, including: how circular economy principles are being applied in the Greek agri-food sector; what supports and hinders this application; Based on the assessment, it is evident that every participant has implemented at least one circular economy principle

in their operations. Specifically, four of the eight participants have also included the reduction and reuse principle in their recycling methods. It was established that the most well-known promoters and obstacles of the circular economy were those related to the market and finances, whereas the financial and regulatory barriers were less well-known.

#### 4.3.2. Conclusion

This chapter's primary goal is to review and assess the data gathered from the semi-structured interviews. The aforementioned analysis has examined the different factors that will impact the circular economy's implementation.

### 5. Final conclusions, limitations, and future research

#### 5.1. Introduction

This chapter's primary goal is to provide an overview of the research findings with respect to its purpose, goals, and inquiries. In order to reach a final conclusion, this chapter will, overall, give an overview of the various findings from the literature review and interpret the findings from the data that was previously analyzed.

The aim of this study is to investigate the relationship between the implementation of circular economy principles, as well as the barriers and enablers of these principles in the Indian fruit and vegetable sector.

The aim of the research is to investigate how the circular economy's drivers, obstacles, and enablers might affect the sustainability of the Greek agri-food industry. The two primary axes are the adoption of circular economy principles in the Greek agri-food sector and the factors that facilitate or hinder the application of these principles in this sector.

To gather basic data for the study at the onset, the literature review examined previously published works and research papers. After that, data was gathered through semi-structured interviews with eight individuals who are now employed in the Greek agri-food industry. After then, a thorough analysis of this data was conducted to draw conclusions.

When it comes to the production of agricultural products in Greece, agriculture contributes 4.1 percent of GDP. This one remains an important sector of economic activity and employment for Greece, with exports of agricultural products accounting for one third of total exports in Greece.

Greek businesses' unwillingness to follow green business strategies is one of the biggest problems the nation is currently facing, despite the fact that output and exports are booming. Thus, the nation may improve sustainable practices and cut waste by implementing circular economy concepts in the supply chain.

## 5.2. The implementation of circular economy principles in the Greek agri-food sector

The three pillars of the circular economy are reduction, reuse, and recycling (Reh, 2013). Recycling is the process of recovering products so they can be used again after being used, as opposed to throwing them away (COUNCIL, 2008). Comparably, the principle of reuse makes sure that goods aren't thrown away and used again for the same reason (Prendeville & Sherry, 2014). Conversely, reduction is the process of boosting production efficiency by maximizing resource utilization and avoiding products that are detrimental to society (Figge et al., 2014). Upon examining these principles considering Greece's circular economy implementation, it was found through the participant interviews that each of them had at least one of these principles implemented in their supply chain, indicating that Greece has already seen some degree of these practices. Recycling was the one that participants embraced the most frequently among these.

## 5.3. Enablers and barriers of circular economy principles implementation in the Greek agri-food sector

Upon closer examination of the circular economy implementation process in the literature, a number of enablers and barriers were found. Cultural, market, regulatory, technical, financial, technological, and sectoral barriers are among the obstacles facing the circular economy (Pheifer, 2017; Mont et al., 2017; Kirchherr et al., 2018; Harta et al., 2019; Despoudi, 2019; ARUP & foundation, 2018). However, a number of facilitators were also discovered, including those that were sectoral, financial,



internal, cultural, regulatory, and hart et al. (ARUP & foundation, 2018; Martin Agyemang, 2019; Hart et al., 2019; Montag et al., 2017; Mirza, 2016; Tingley et al., 2018). The participants recognized barriers mentioned each of the aforementioned because they believed it could have a major impact on the implementation process as well. Further investigation revealed that, given the importance of the financial investments mentioned by multiple participants, the biggest barrier to the widespread adoption of the circular economy is financial risk. Ultimately, it was discovered that the largest obstacles to the adoption of the circular economy in Greece are financial and sectoral ones, while the largest facilitators are still financial and market forces. Nonetheless, the people will be able to overcome financial, sectoral, and market barriers with the assistance of financial aid and the rules and regulations already established by the government. Similar to this, cultural barriers can be overcome if people are made to realize the advantages of circularity.

#### 5.4. Impact of circular economy applications on the implementation of sustainability principles in the Greek agri-food sector

The exploration of circular economy applications within the Greek agri-food sector unveils a transformative potential that resonates with the core principles of sustainability. As our study has illuminated, the adoption of circular economy practices in this sector holds the promise of mitigating environmental impact, promoting social responsibility, and bolstering economic resilience. The participants are reconciled to the terms of circular economy and sustainability and seem to have understood the benefits to both society and the environment.

The reduction of waste, the optimization of resources, and the overall carbon footprint related to agri-food production demonstrate the positive environmental impact. By putting circular economy models into practice, the industry can move toward a more resource-efficient and regenerative system. Socially, integrating circular practices promotes responsible consumption, strengthens local economies, and encourages community involvement. The Greek agri-food industry can support the health of the communities it serves as well as the environment by adopting sustainability principles.

Applications of the circular economy offer financial prospects for lower costs, more productivity, and the creation of new revenue streams. Circular practices are cyclical, which is consistent with the ideas of economic sustainability.

### 5.5. Conclusion

To conclude, it's clear that businesses want to stay ahead of the curve in the market by having the newest technology and being more environmentally friendly. They will assist in putting the circular economy into practice by closing the loop on the linear economy.

This study examined the various circular economy tenets as well as the facilitators and impediments to its implementation. It also examined the various ways that the circular economy has been applied to various agri-food enterprises. Additionally, the different barriers and enablers for the adoption of sustainable practices. Eight distinct people were interviewed in order to ascertain the implementation in Greece, and from these interviews, the key facilitators and obstacles of the circular economy were identified. In summary, it was found that since Greece has already adopted a number of circular economy supply chain principles, the country can effectively adopt these principles as well.

Essentially, by adopting circular economy applications, the Greek agri-food industry not only tackles current environmental issues but also lays the groundwork for a robust, socially conscious, and commercially sustainable future. Greece's agricultural and food industries are moving closer to a more sustainable and prosperous future as a result of the sector's commitment to circular economy principles. However, the journey towards a sustainable agri-food system is still ongoing.

### 5.6. Limitations and future research

This study offers a comprehensive overview of the circular economy's application in the Greek agri-food industry. Nonetheless, there may be limitations to this study that will inform further research. The first limitation relates to the industry selected; while the Greek agri-food sector was the focus of this research, each sector must be examined separately in order to implement a circular economy because different products have different needs. Therefore, future research can concentrate on different areas like the

dairy, cereal, and protein industries. Similarly, because research has only used qualitative data collection techniques, little is known about sustainability despite the fact that information was gathered from 8 people. To produce thorough and accurate data, this issue could be addressed by gathering information from a variety of participants and utilizing additional research techniques like experiments, surveys, and file analysis.

Moreover, the Greek agri-food industry is well-positioned in the international market thanks to its dedication to sustainability principles, which are supported by the implementation of circular economy applications. Products that are socially and environmentally conscious are becoming more and more popular, and businesses that follow the circular economy's tenets are more competitive in the market.

Even though our study highlights the advantages, it's important to recognize that cooperation between stakeholders, supportive legislation, and continuous innovation are necessary for the effective application of circular economy applications in the Greek agri-food sector. Sustaining the positive effects of circular economy applications on sustainability in the industry will require ongoing research and a dedication to best practices.

Essentially, by adopting circular economy applications, the Greek agri-food industry not only tackles current environmental issues but also lays the groundwork for a robust, socially conscious, and commercially sustainable future. Greece's agricultural and food industries are moving closer to a more sustainable and prosperous future as a result of the sector's commitment to circular economy principles. However, the journey towards a sustainable agri-food system is still ongoing.

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