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## **Circular Economy in Agriculture: Challenges and Opportunities in Central Finland**

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## **1. Circular Economy in Agriculture: Opportunities and Challenges in Central Finland**

The circular economy (CE) has increasingly been the target of policies because of its dual properties in tackling challenging global problems and providing opportunities for more sustainable economic action. While the CE concept is highly contested in academic debates, it provides an alternative economic system that circulates used materials in a closed loop. Finland, among other European Union (EU) countries, has concentrated its national efforts to leverage opportunities in the CE. In general, the CE industry in Finland has created innovations related to recycling, sustainable design, rental services, repair and sharing (Berg & Eskola, 2023). Despite these efforts, however, the material circularity rates in Finland are still lower than the average in the EU (Berg & Eskola, 2023).

Moreover, despite a growing research and policy focus on the CE, the agricultural sector, in Finland and beyond, has received less attention compared to other sectors (European Commission, 2020a). So far, only limited efforts have been made towards circularising agriculture, forestry, and the food sector, which are crucial sectors for addressing pressing global challenges such as increasing food demand and food insecurity, mitigating the environmental impacts of greenhouse gas emissions, and tackling biodiversity loss in agriculture (OECD, 2023). Here, the circular economy is proposed as one of the solutions.

Consequently, this study first aims to map the discussion in academia surrounding the definition of CE, and seeks to build an analytical framework of CE theories. The purpose of discussing and mapping CE definitions is to arrive at a common understanding of the aim and the means of CE. As a next step, the case study in Central Finland focuses on analysing the terminological and conceptual understanding of CE in the agricultural sector. This will be achieved through an empirical investigation of existing CE practices in agriculture, and the

opportunities and challenges faced in the sector. Through interviews, the research aims to fill knowledge gaps concerning farmers' perspectives on introducing CE in agriculture. To broaden understanding of the region's agriculture sector, other local stakeholders are interviewed as well, namely a representative of a large agrifood company and policy experts. It is argued that an in-depth understanding of the regional opportunities and challenges is crucial for successfully introducing a circular economy.

Combining insights from the academic literature with practical insights from the interviewees, the main research question that this study aims to address is: “*What are the key opportunities and challenges associated with implementing a circular economy in the agricultural sector in Central Finland?*” The study seeks to contribute valuable insights for the broader discourse on the theme of CE. The main objectives of this research are to: 1) identify existing frameworks, models, and theoretical foundations relevant to circular agriculture and 2) explore current practices, opportunities and challenges of implementing CE practices in the agricultural sector in Central Finland. Empirical data gleaned from expert and practitioner interviews provide further insights into the opportunities and the economic, political, and social challenges of implementing CE. The paper focuses especially the policy, societal and social implications of agriculture and circularity.

The study is structured as follows: The methodology section first introduces the key research methods and approach (section 2). The following then highlights the theoretical development of the CE concept, and establishes an analytical framework of common CE definitions, with regard to the existing literature on CE in the agricultural sector (section 3). Subsequently, the case study section introduces the local situation and summarises relevant findings derived from the stakeholder interviews (section 4). The discussion section proceeds by

analysing the significance of these findings for Finish CE policy while proposing two key recommendations for the region, together with an overview of the limitations (section 5). Finally, the conclusion section summarizes the main findings of the study, presents implications for the European Union level of policy-making, and outlines avenues for future research.

## 2. Methodology

This study aims to answer the following research question: *What are the key opportunities and challenges associated with implementing a circular economy (CE) in the agricultural sector in Central Finland?* A literature review and qualitative interviews are conducted to answer this question. The analytical framework, derived from the relevant academic literature, provides insights into the academic debate on circularity. This framework will be the starting point for conducting qualitative key informant interviews, which will shed light on the little-explored topic of perceived practical opportunities and challenges with circularity among key actors in the agricultural sector.

The literature review was carried out between January 2024 and May 2024. Traditional and narrative approaches were used for this research, and both peer-reviewed academic works as well as grey literature were reviewed. For CE definitions, the selection of literature was limited to the period from 2015 to 2024 in order to guarantee topical relevance. The literature search was conducted with WorldCat, GoogleScholar, and ResearchRabbit. The keywords used were “Circular Economy”, “definition”, “agriculture”, “European Union” and “rural”. In light of the literature review, an analytical framework is presented in the form of a table, outlining the complexity of the CE debate, and comparing key aspects of different CE definitions based on their stated scope, aim, and main principles. This analytical framework will serve as the basis for the interpretation of the empirical interview data.

For the interviews, a qualitative approach was used to complement the existing literature and provide insights into essential information from experts about the CE in the case study area. Qualitative research findings can not be generalised to other areas or groups, but they provide deeper insight into the interviewees' knowledge, thoughts, and beliefs. A total of 12 participants

were invited and seven 30-45-minute interviews were carried out as part of the study. Interviewees were selected based on their geographical location in the research area and their experience in the agricultural sector. Experience was defined as knowledge in the field of the CE, or as experience with working in agriculture. Two interviewees are policy experts representing public administration, four are farmers, and one interviewee is from an agrifood company. A diverse sample was selected to provide a comprehensive perspective on the research topic among various actors to get a cross-sectoral perspective on the systems around circular agriculture. The data processing phases will be presented and discussed in detail in section 4.

Participation in the study was voluntary and anonymous, while the safety of participants was ensured by handling data according to the General Data Protection Regulation (GDPR) rules of the University of Groningen. The ethical considerations, information sheet, and consent form are provided in Appendixes A, B, and C. Permission to use quotations from the interviews was requested after the interviews with each participant.

### 3. Literature Review

The following subsections seek to unveil the circular economy's theoretical development and perception in academic debates. The analytical framework illustrates and compares some of the main definitions of the circular economy (see Table 1). The final part of the literature review studies CE in the agricultural context and provides an overview of current European Union agrarian policies.

#### *3.1. Historical Development of the Circular Economy Concept*

Kenneth Boulding was the first to describe the CE with his idea of *Spaceship Earth*, which describes the Earth as a closed and limited system (Boulding, 1966). The prevalent thought of unlimited resources was dismissed based on limited extraction and pollution reservoirs, which then developed into a cyclical ecological system where humans must find their place. The wealth of tangible and intangible resources that contribute to the functioning and development of society is the essence of a prosperous economy (Boulding, 1966). Another seminal book in modern economics, *Limits to Growth*, followed these earlier considerations by stating that exponential growth in a finite world is impossible (Meadows et al., 1974). The authors also questioned the limits of pollution and how much the Earth's ecological balance could be disturbed before severe consequences emerge.

Another cornerstone of circularity was the emergence of sustainable development, as outlined in the United Nations' *Brundtland report* (Brundtland, 1987). According to the report, sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland, 1987). The



report establishes three pillars of sustainability: Economy, environment, and social equity, which are necessary for sustainable development.

The term circular economy was established by Pearce and Turner (1990) decades after the first notions of circularity became a topic of interest. The authors wrote about moving from a linear to a circular economic system, drawing from the first law of thermodynamics, which states that energy and material always remain within the system, and can not be destroyed. Used energy and materials can be converted and dissipated but must stay in the environmental system in one form or another. Drawing from Boulding's *Spaceship Earth* (1966), Pearce and Turner understood Earth to be a closed economic system, where the economy and environment have a circular relationship (Pearce & Turner, 1990). For example, the authors wrote about resources, such as burning fossil fuels, which cannot be recycled back into energy. The Earth's balance of finite materials can be achieved by reusing, recovering, and recycling. Accordingly, the entropy within the thermodynamic system creates a physical 'boundary' for redesigning the economy as a closed, sustainable, circular system (Pearce & Turner, 1990).

Research from Rockström et al. (2009) further defines the concept of planetary boundaries, which includes nine essential earth system processes that are crucial for humanity's ability to maintain a safe operating space. If the boundary limit values for climate change, ocean acidification, aerosol loading, ozone depletion, phosphorus and nitrogen cycles, land-system change, freshwater use, biodiversity loss, and chemical pollution are surpassed, uncertain and severe consequences are expected (Rockström et al., 2009).

The business and policy sectors also strongly influenced earlier phases of contemporary CE discourse (Friant et al., 2020). The cradle-to-cradle sustainable business strategy gained traction in early sustainability theories, advocating for the cyclic use of technical and biological

materials (McDonough & Braungart, 2002). China, in particular, was the first country to implement CE with the *Circular Economy Promotion Law* in 2008, which promotes the development of CE, improving resource efficiency, protecting the environment, and realising sustainable development (Geng et al., 2012). Indicators that operate on three levels: a) the micro-level concerning individual firms, b) the meso-level of networks among industries, and c) the macro-level concerning cities and provinces, are the basis of the regulation (Geng et al., 2012).

Notably, the Ellen MacArthur Foundation (EMF) played a pioneering role in shaping the conceptual framework of the circular economy. The MacArthur Foundation model emphasises replacing the “end-of-life” concept with a restorative and regenerative economic model (Ellen MacArthur Foundation, 2013). The Butterfly diagram of the circular economy (Figure 1.) aims to maintain technical and biological products and materials at their highest utility and value throughout their lifecycle (Ellen MacArthur Foundation, 2015). There are three guiding principles: Preserving and enhancing natural capital, optimising resource yields through the circulation of products and materials, and fostering system effectiveness by addressing negative externalities (Ellen MacArthur Foundation, 2015).

**Figure 1.**

*Butterfly Diagram: Outline of Circular Economy (Ellen MacArthur Foundation, 2015)*

## PRINCIPLE

## 1

Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows  
ReSOLVE levers: regenerate, virtualise, exchange



Regenerate    Substitute materials    Virtualise    Restore

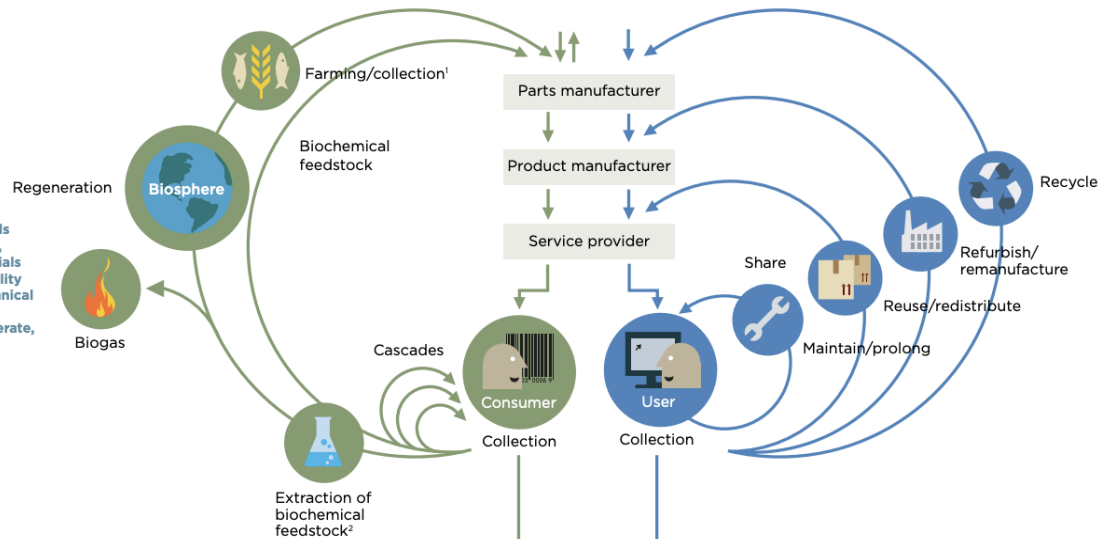
Renewables flow management

Stock management

## PRINCIPLE

## 2

Optimise resource yields by circulating products, components and materials in use at the highest utility at all times in both technical and biological cycles  
ReSOLVE levers: regenerate, share, optimise, loop



## PRINCIPLE

## 3

Foster system effectiveness by revealing and designing out negative externalities  
All ReSOLVE levers

Minimise systematic leakage and negative externalities

1. Hunting and fishing  
2. Can take both post-harvest and post-consumer waste as an input  
Source: Ellen MacArthur Foundation, SUN, and McKinsey Center for Business and Environment; Drawing from Braungart & McDonough, Cradle to Cradle (C2C).

### 3.2. Contemporary Circular Economy Definitions and Their Application

The perception of the Earth as a closed and limited system where resources are finite and consequences of exponential growth and ecological boundaries are necessary to consider are the basis of circular economy theories in academia (Boulding, 1966; Meadows et al., 1974; Rockström et al., 2009). The emergence of sustainable development set a threshold for considering future generations through economic, environmental, and social aspects (Brundtland, 1987).

The following chapters explore the broader web of circular economy definitions, as the notion of CE is recognised to be ambiguous and often used as an umbrella concept for various circular processes (Kirchherr et al., 2023). The analytical framework applied in this study aims to

capture the essence of CE theories. As Kirchherr et al. (2023) point out, giving one definition of CE might not be possible or desirable, considering that our technologies, environment, and societies are constantly evolving. In the following section, key definitions of CE will be presented and summarised. Afterwards the framework is presented.

### **3.2.1. Key Circular Economy Definitions**

To begin with, the European Union (EU) utilises the CE definition of the European Parliament (2023):

*“A model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended, their use is optimised, and products and materials are maintained in their highest value function.”*

The key aim of CE, according to this definition, is to protect the environment, reduce raw material dependency, and create jobs (European Commission, 2020a). The EU defined the goal of CE as a regenerative model that keeps resource consumption within planetary boundaries by decoupling growth from resources and doubling its circular material use rate (European Commission, 2020a). A framework consisting of 5 thematic areas: (1) production and consumption, (2) waste management, (3) secondary raw materials, (4) competitiveness and innovation, and (5) global sustainability and resilience, are used to measure progress (Eurostat, 2023).

One of the most cited academic definitions of CE, by contrast, is provided by Kirchherr et al. (2017):

*“Economic system that replaces the ‘end-of-life’ concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes. It*

*operates at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations.”*

Kirchherr et al. (2017) highlight the need for a CE definition that goes beyond incremental improvements to deliver its potential, thus resulting in fundamental change. One possible solution would be the reduction of consumption and production in the CE definitions to go beyond business-as-usual, which might imply curbing consumption and economic growth. The definition implements waste hierarchy by suggesting that the first step is to reduce, reuse, recycle, and recover materials, later referred to as 4R's (Kirchherr et al., 2017).

Murray et al. (2017) recognised the need for an alternative model for managing finite resources and slowing or managing the fluxes of biochemical flows on Earth, such as water, atmosphere, or soil cycles. Additionally, the authors recognised a need to incorporate the social pillar of sustainability into CE (Murray et al., 2017). The authors define: “The Circular Economy is an economic model wherein planning, resourcing, procurement, production and reprocessing are designed and managed, as both process and output, to maximise ecosystem functioning and human well-being” (Murray et al., 2017).

A circular economy needs to be restorative, as it should prevent future harm and repair prior pollution damage by designing industrial systems better (Murray et al., 2017). The authors envision a circular economy with a central point in the three R's: Reduce, reuse and recycle. It is done by slowing down waste cycles, utilising waste for new purposes, and prolonging product lifetime. The authors call for system-based thinking to “race” humanity to a future that involves all three sustainability pillars: society, environment, and economics (Murray et al., 2017).

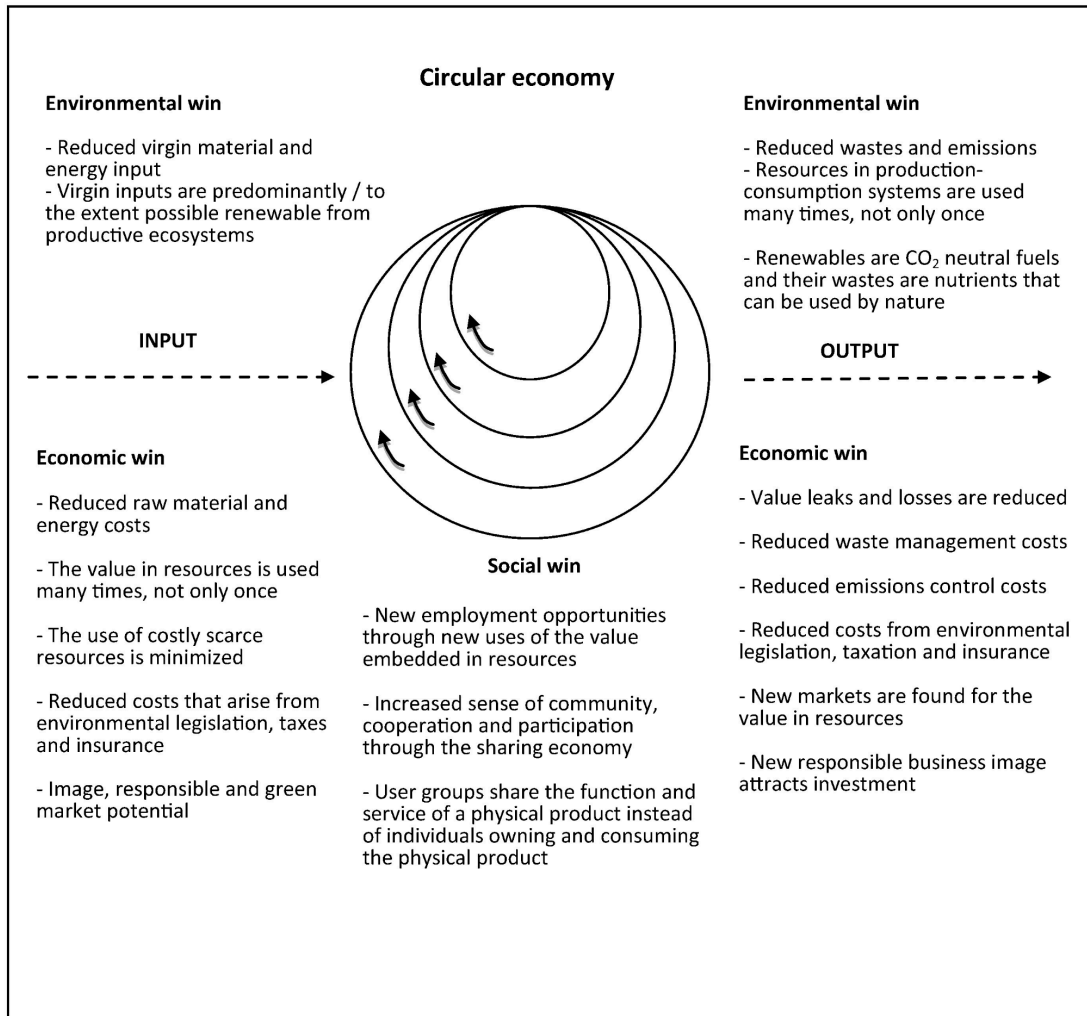
Korhonen et al. (2018), in turn, define the CE as follows:

*“Circular economy is an economy constructed from societal production-consumption systems that maximizes the service produced from the linear nature-society-nature material and energy throughput flow. This is done by using cyclical materials flows, renewable energy sources and cascading-type energy flows. Successful circular economy contributes to all the three dimensions of sustainable development. Circular economy limits the throughput flow to a level that nature tolerates and utilises ecosystem cycles in economic cycles by respecting their natural reproduction rates.”*

The authors envision a cyclical flow of materials and energy in a new consumption system where users and communities share product functions, services, and value, as visualised in Figure 2. (Korhonen et al., 2018). New business models may include leasing, renting, providing take-back strategies, reverse logistics, and concepts that enhance the sharing of products between users, bringing efficiency improvements to people's lifestyles. This circular economy would contribute to all three sustainability pillars. From an environmental aspect, environmental pressures are reduced when using less virgin materials and waste and emission outputs. The economies would benefit from the new business opportunities, innovation of new products, and lowered costs from less use of raw materials and energy costs. According to Korhonen et al. (2018), the social dimension will be considered the sharing economy, which would increase employment and create cooperative community use of existing material resources.

**Figure 2.**

*The Win-Win-Win Potential of Circular Economy (Korhonen et al., 2018)*



Friant et al. (2020) see an opportunity in CE to use it as a tool for transformative social change. Therefore, they establish the following definition: “Circular society defines discourses with a vision of circularity where not only resources are circulated in sustainable loops, but also wealth, knowledge, technology and power is circulated and redistributed throughout society.”

Circular society comprehensively includes the three pillars of sustainability and sees circularity as a holistic transition where political empowerment and social justice must also be addressed (Friant et al., 2020). The authors see two broad movements within the concept: Reformist circularity, which operates within the capitalist system, and transformational discourse of circularity, which seeks to transform the socioeconomic order (Friant et al., 2020). The

difference between the two is that one of the challenges the authors associate with CE is whether capitalism can overcome limited resources and decouple economic growth from ecological degradation. Therefore, the authors explore the concepts of reformist and transformational circular societies.

With the circular society concept, the authors aim to answer the gap of circular discourses that adequately examine the ecological, social and political implications of CE as they highlight the importance of systematic and holistic understanding. The regenerative and restorative production and consumption system ideally close the economy's input and output cycles. It contributes to resource scarcity, biochemical flow disruption and climate change while reviving local economies.

The definition from Schröder et al. (2020) aims to contribute to the under-discovered social aspect of the circular economy. The authors define CE as:

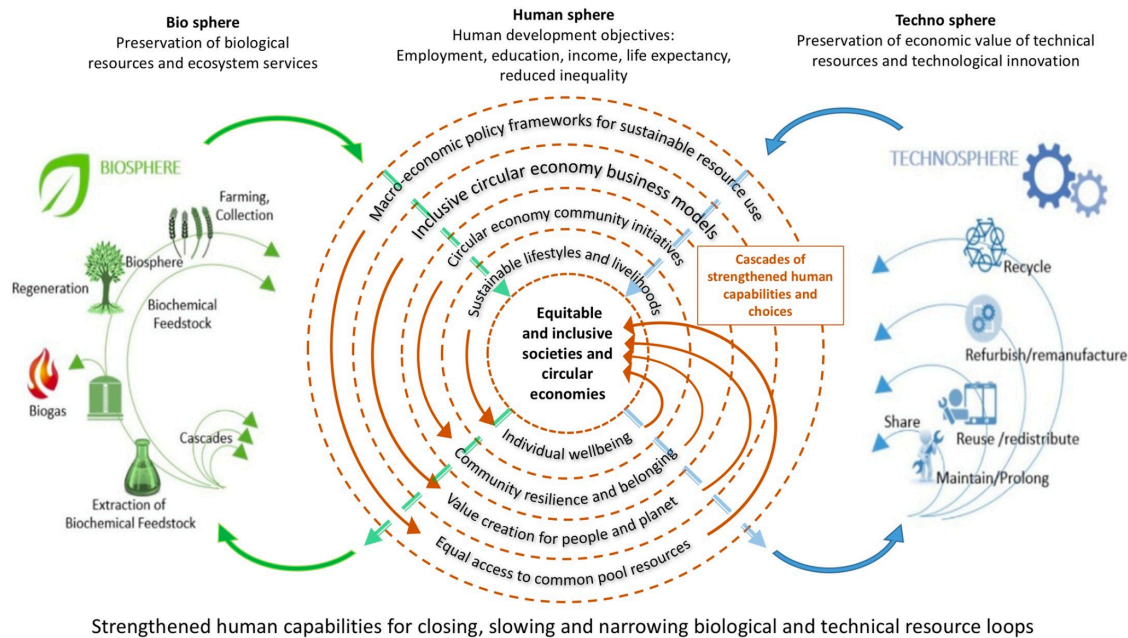
*“A human-centred regenerative and restorative socio-economic system which increases human choices and builds human capabilities by recapturing value of materials and waste for people through slowing, closing, and narrowing material and energy loops that minimise resource inputs and waste, emissions, and energy leakage. This can be achieved by empowering workers, enabling social inclusion and fostering sustainable lifestyles through applying practices and policies for long-lasting human-centred design, maintenance, ensuring rights to repair, reusing and sharing, remanufacturing, refurbishing, and recycling.”*

This definition extends the Ellen MacArthur Foundations Butterfly diagram with the human development aspect, as the authors describe that people can have other roles in CE besides being consumers or users, as illustrated in Figure 3. (Schröder et al., 2020).



**Figure 3.**

*Framework for a Human Development-Focused Circular Economy (Schröder et al., 2020)*



### 3.2.2. Analytical Framework

These seven introduced circular economy theories are compared in **Table 1**. Derived from the early literature on CE, the analytical framework compares the thematic pillars on which the definitions rest, namely the economic-technical, institutional-political, socio-cultural, and environmental aspects of CE. Secondly, the framework examines whether specific definitions of CE are potentially too narrow and only focus on a single aspect, industry, or phase of circularity, or whether they imply a more extensive societal transition. Thirdly, the framework examines the principles and terms that specific CE definitions use. Lastly, the CE definition's aims will be compared. Different CE theories are categorised by emphasising the short definitions made by

the authors. However, since a short definition has limitations in illuminating complex models, the categorisations consider further explanations the authors had made in the research articles.

**Table 1.**

*Analytical Framework: Characterisation of Circular Economy Definitions*

<b>Author</b>	<b>Year</b>	<b>Focus aspect</b>	<b>Level of detail</b>	<b>Key principles</b>	<b>Aim</b>
European Parliament	2023	Technical-Economic	Narrow	Production and consumption model, 4R's	Protect the environment, job generation
Kirchherr et al.	2017	Technical-economic	Narrow	Economic system for business models, 4R's	Sustainable development
Murray et al.	2017	Technical-economic	Narrow	Design and management of inputs and outputs, 3R's	Ecosystem functioning, well-being
Korhonen et al.	2018	All	Narrow	Societal production-consumption systems	Sustainable development
Friant et. al.	2020	All	Broad	Circular Society	Sustainable development, political empowerment, social justice
Schröder et al.	2020	Socio-cultural	Broad	Socio-economic system, 5R's	Increase and build human choices and capabilities, human-centred design

### ***3.3. Circular Economy and Agriculture***

This section expands on the previous discussion of CE definitions by examining existing knowledge on CE in agriculture through studies by Barros et al. (2020) and Rótolo et al. (2020). Barros et al. (2020) explored CE practises in agriculture through a systematic literature review, looking at it with a CE model that “aims to maintain components, materials, and products at their

highest utility to eliminate waste from a system” to increase environmental gains and avoid additional costs (Barros et al., 2020). The authors remarked that the concept of CE in the agricultural sector is not new, as material and waste loop-closing has already been used in practices such as using animal manure as a crop fertiliser. Similar ideas around circularity have been described in various ways, including “industrial ecology”, although the field has developed new practices recently (Barros et al., 2020).

One of the most advantageous agricultural practices is bioenergy, which uses biodigester technology to generate different types of energy (Barros et al., 2020). Another essential practice is improving phosphorus efficiency, which is crucial for plants as fertiliser, although excessive amounts can cause the eutrophication of water. Barros et al. (2020) found that such agricultural practices add value to agriculture through environmental and economic sustainability. CE in agriculture can bring strategic, operational and competitive advantages to actors and reduce greenhouse gas (GHG) emissions through circulation of materials, waste, and manure. Top management can create CE practices by facilitating the exchange of materials among different actors, such as animal manure recycling between livestock and crop farmers.

While circular initiatives in agriculture have positive impacts, they might nevertheless raise concerns over related impacts such as GHG emissions, ecotoxicity, eutrophication, biodiversity, and land use changes. Life-cycle assessment is a tool that can support evaluating the environmental effects throughout the agricultural chain (Barros et al., 2020).

Rótolo et al. (2020) researched the perception and awareness of CE among the actors in the agricultural sectors of Argentina. They conducted an online survey with 504 respondents in different agriculture-related sectors. The authors found a common understanding of CE “as a more sustainable production and consumption model” (Rótolo et al., 2020). Similarly to Barros

et al. (2020), the research found that CE contributes to emissions and waste reduction through sustainable design and supply chains. Additionally, the respondents saw a possibility to create new job opportunities.

As obstacles to circularity, Rótolo et al. (2020) mention the lack of a coherent national approach and a lack of coordination between different agricultural subsectors. Actors in agriculture have various roles, from managing and processing products to contributing with know-how, innovation, and appropriate policies. Concerning such policies, the respondents pointed out more support for investments, as there are high upfront costs for planning, implementing, and using advanced technologies or legislation that encourages using recycled materials. Lastly, promoting on-site renewable energy generation and training professionals, technicians, and farmers would incentivise the introduction of CE practices.

### ***3.3.1. Agricultural Policies in the European Union***

The most central European Union policies regarding agriculture and circular economy are CAP, Farm-to-Fork and CEAP. The most critical regulation guiding agriculture in the European Union is the Common Agricultural Policy (CAP). The most recent version for 2023-2027, Regulation 2021/2115 aims to support farming in the region, provide food security and contribute to sustainable development, among other objectives. The tools to enforce the objectives are financial support through direct payments, income support, schemes for the climate, the environment and animal welfare, interventions in specific sectors and rural development (Regulation 2021/2115). At the member state level, particular strategic plans are enforced, and monitoring, reporting, and evaluation take place to follow the implementation. Compared to the previous version of the policy, the key targets are currently environmental and

climate action in agriculture, supporting social aspects and competitiveness (European Commission, 2022).

The Farm-to-Fork strategy, adopted in 2020, is crucial to achieving the United Nations Sustainable Development Goals and the European Green Deal, which aims to make Europe the first climate-neutral continent by 2050 (European Commission, 2020b). The strategy promotes a fair, healthy, and environmentally friendly food system for producers and consumers throughout the whole food chain. There has been a need to reduce dependence on pesticides, antimicrobials and fertilisers, increase organic farming, improve animal welfare and reverse biodiversity loss (European Commission, 2020b). The transition has been enabled so far by increased efforts in research innovation and knowledge sharing (European Commission, 2020b).

The European Union Circular Economy Action Plan (CEAP) creates an agenda for a clean and competitive Europe through transformational change with various actors (European Commission, 2020a). The EU set the CEAP to accelerate the transition towards a regenerative growth model, which returns resource consumption within planetary boundaries by decoupling economic growth. The plan discusses various points about different materials, such as batteries and plastics, but also remarks on food, water, and nutrients, mainly from the single-use packaging perspective (European Commission, 2020a). These three policies are central to how the circular economy in the agricultural sector in Europe develops.

#### **4. Circular Economy in Agriculture: A Case Study in Central Finland**

Agriculture is a crucial sector in Finland. While Finland is one of the northernmost agricultural countries, it produces most of the food consumed by the 5,6 million citizens (Finnish Ministry of Agriculture and Forestry, n.d.; Tilastokeskus, 2024). In 2023, there were 42,271 farms, of which 72 percent cultivated crops, 20 percent livestock, and the rest a mix of the two (Natural Resources Institute Finland, 2024). Central Finland has about 2,300 farms, which, together with other provinces, had faced restructuring in the agriculture sector over the past few years (Natural Resources Institute Finland, 2024). According to the Ministry of Economic Affairs and Employment, the number of producers has decreased, and the production is concentrated regionally (Työ- ja elinkeinoministeriö, 2024). The national security of maintenance often arises in discussions of the viability and profitability of agriculture. The changing natural conditions create a challenge, while the producer prices have been low (Työ- ja elinkeinoministeriö, 2024). The agriculture income per labour unit in Central Finland is lower than in other parts of the country, while Finland is behind Sweden, Denmark and Western Europe (European Commission, 2024).

Concurrently, another important challenge arises. Over the last decade, biodiversity has been declining mainly due to pressures caused by agriculture and forestry (Valtioneuvosto, 2020). Forslund et al. (2022) report that changing to the CE model in the food and agriculture sectors could revive 73 percent of biodiversity. Finland is at the top in Europe regarding eco-innovations, but falls behind other European countries with regard to other targets, such as in recycling rate and material circularity rate (Kaariaho & Pirtonen, 2022). Therefore, the country provides an interesting case study to examine the state of agriculture regarding CE, how it is

perceived, and what kind of opportunities and challenges are seen. The focus is on agriculture in Central Finland to have a detailed case in a province facing many challenges and opportunities.

#### ***4.1. Local Circular Economy Targets***

To implement a CE, Finland has set a goal of achieving a carbon-neutral CE society by 2035 (Finnish Government, 2021). The key goals are to reduce the consumption of non-renewable resources, make sustainable use of renewable resources, and double resource productivity and material circulation. The CE planning does not include climate, food or the bioeconomy, the use of renewable biological resources, and related issues, but instead has separate targets and measures (Finnish Government, 2021).

The system is scattered as various ministries and institutes share responsibilities. For example, the Finnish Food Authority is responsible for agricultural investment subsidies (Finnish Food Authority, 2024). These subsidies, starting from 3.000 EUR to 7.000 EUR, can be given to investments that improve 1) the farm's competitiveness and modernise it, 2) promote the state of the environment and sustainable production methods, 3) energy investments, and 4) animal welfare and biosecurity (Finnish Food Authority, 2024).

#### ***4.2. Data Collection Process***

This research aims to map the existing knowledge of CE among different stakeholders in Central Finland's agricultural sector to understand the current state of affairs regarding implementation. The earlier section identified numerous frameworks and models academics have used to define the vast concept of CE. The following chapters proceed by looking into the perception of CE through current agricultural circular practices, stakeholders' definitions,

opportunities, and challenges. In the participant selection, both purposive sampling and a snowball method were used to contact interviewees based on their location and role. A total of seven semi-structured in-depth interviews were conducted in Finnish in April and May 2024, both online and in-person. Interviewees were asked specific questions to identify perceptions regarding the circular economy, together with opportunities and challenges.

This semi-structured interview method enabled participants to share their knowledge beyond the scope of the designed questions, thus reducing the possibility of biases in question design. Interview guides can be seen in Appendix D. Interview recordings were transcribed using Microsoft Word and data was analysed and coded thematically into the following categories: Defining CE, thoughts and attitudes towards CE, opportunities seen in CE, and challenges faced or seen in CE. The results will be presented in three main sections: Definitions, opportunities, and challenges. Answers were grouped into those given by farmers, an employee in the agrifood industry, and policy experts.

### ***4.3. Participants***

The interviewed farmers from the Central Finland region represented different sectors and businesses of different sizes. Two of them were organic farmers, and two were regular farmers. The interviewed farms had cattle, dairy cattle, strawberry farming, and beekeeping as main businesses. Many also had other side businesses, such as wild fish products, producing seedlings, forestry, and growing grain and grass. One farmer had started about ten years ago; the rest had been farming for some decades. Two farmers mentioned direct sales for consumers, most produced for supermarkets directly or through manufacturers. Many farmers aimed or were self-sufficient in producing most of the necessities needed within the farm.



The employee interviewed represented a large agrifood company, a retailer between farmers, commerce, and consumers in the area. One of the policy experts was from a local legislative body responsible for services for rural businesses, including funding and assigning permits. The second policy expert represented an agricultural advocacy organisation that advocates for farmers.

When asked what type of CE practises the interviewees had implemented, one of the farms had invented a new product that uses ingredients considered waste. Another farmer mentioned recycling tractor oil with a company that reuses it for new purposes. Some farmers use fertilisers from waste ingredients and have changed to cultivation practices that improve nutrients in the field's natural cycle. One had installed solar panels. Farmers mentioned recycling waste as a regular practice.

The agrifood company, in turn, had started to consider collaborations utilising circular opportunities, improving the materials of packages, educating farmers on sustainability, and paying responsibility bonuses to farmers who implement sustainable practices.

The policy experts did not mention any specific practices in the region, but generally discussed the state of CE in agriculture. They described CE as being in the beginning phase, and discussion increased as the world economy had raised fertiliser prices, making farmers and businesses search for alternative solutions. The experts noted that while new companies focusing on circularity are arising, they had noticed Finland stagnating in the CE process compared to European countries. The agriculture sector was noted to be important as food production is an important basic need, yet it is also a challenging sector to circularise.

#### ***4.4. Defining Circular Economy***

The received definitions are analysed in groups to summarise how different individuals understood the circular economy. The interview questions asked for a definition of the circular economy, the concept's perceived aim, and its main principles. Individuals' verbatim quotes can be seen in Appendix E. Overall, the interviewees had positive feelings about the CE concept, while the perception varied between different stakeholders.

In general, the farmers found it difficult to define a circular economy and had a narrow view. When the farmers' answers were combined, CE was described as recycling or reusing materials and side streams of production and consumption. One also mentioned recovering harmful substances from pollution, and another reduced the need for new materials. The aim of a circular economy varied among all farmers, ranging from bringing benefits to industries, having sufficient resources and preserving nature to the efficient cycle of materials. The main principles for achieving CE were cooperation, research and development, political and consumer pressure, attitude change and solutions that are easy to implement and affordable for the user. One farmer could not know what to answer when asked about the principles.

The agrifood company defined CE as a sustainable operation model that utilises side streams by finding solutions that compete economically with using virgin materials. The aims were resource efficiency, responsibility, environmental sustainability, and finding economically profitable action. The main principle was establishing stakeholder cooperation to find solutions that compete with the current linear economy.

The policy experts had more elaborate views, although partly conflicting definitions. Both defined the concept as using as few raw materials as possible and utilising existing resources thoroughly. One of the experts added that CE would support and preserve nature's

existing circular flow with minimal interference. One expert saw its aim as a founding principle of the Finnish economy, while the other expert as consuming the planet's resources in a way that maximises humans' and other species' well-being. On the principles, the experts agreed upon needing an attitude change, but had different views on what this might entail. One expert highlighted attitude change towards materials used, the other one towards behaviour and thinking about lifestyle, needs and consumption, prompting people to live a more satisfied life with less. The experts had opposing views on the basis of circularity. One of them mentioned that circular agriculture needs to be market-based, whereas the other one highlighted that the goal of businesses needs to change, which no longer can be to achieve maximum profits. While one of the experts highlighted suitable market conditions to unite CE with the existing system, the other expert talked about the political will to achieve CE.

#### ***4.5. Opportunities in the Agricultural Sector***

All of the farmers said that they see some or considerable opportunities in the circular economy in the agricultural sector. Nearly all of the farmers saw opportunities in CE for improved soil conditions and productivity. An increase in organic materials would benefit the soil and environment, as the soil could bind more water and nutrients, and erosion would be lessened. One farmer also highlighted the role of soil in carbon sequestration. Improved soil conditions were seen to benefit society in general.

Another topic that arose in two of the conversations is benefits for manufacturing and related industries, where sidestreams can be utilised. Some farmers experienced that recycling practices, for example, mean extra work for the farmer, but the benefits arise elsewhere, such as in the recycling centres or the firms utilising the waste:

*“By recycling plastics, I do not gain anything. On the contrary, it takes me 4 hours with the tractor to drive them to the recycling centre and back. It is a little thing, and the best thing about it is to get rid of it from my corners ... However, some people will always benefit from recycled plastics. For example, when I take them to get burned in the waste incineration plant, somebody benefits from it, not the farmer itself.”*

The topics of recycling, composting, and saving materials also arose in other contexts, as these practices were considered to be universally reasonable. One farmer mentioned feeding leftover and out-of-date vegetables to the cattle, but also referred to constraints, since an organic farm can not utilise the same products as an ordinary farm because of strict organic farming regulations.

New opportunities were seen in underutilised resources, such as wild fish, which play a role in the eutrophication of lakes but are not that common to use because of unpopular attitudes towards their use and taste. Biogas was also mentioned as an opportunity for new energy production in cattle farms. Additionally, even small-scale honey farming was seen as useful, as resources would be utilised while pollination would be taken care of. One farmer highlighted appreciation of small-scale activities, which would provide flexibility for the farmer.

When asked how CE impacts the farmers' businesses, one saw opportunities in general, one saw new business opportunities on their farm, and two did not see any opportunities on their farms:

*“Well, it is not so easy to turn them into a finished product, but there are many ideas for utilizing waste or side streams and producing food from them.”*

*“We have been thinking about what would be a reasonable solution, but I do not see anything as everything we produce is utilised within the farm, there is nothing more that we could sell to others.”*

However, one of the farmers also mentioned that CE opportunities might increase self-sufficiency within the country by not having to import everything, which would be valuable for society.

The agrifood company said it sees much potential in CE, but acknowledged that all of the opportunities have yet to reach general awareness. Recognition was seen as key, which the company had done by searching for ways to introduce new solutions, such as biogas production. In the biogas process, manure's energy potential would be utilised while the rest of the biomass would be returned to the fields in a better form for the plants. Bioenergy production holds the possibility of being a new source of livelihood for farmers. It would improve the financial profitability of the farm while reducing greenhouse gas emissions and realising other environmental benefits. For society at large, the agrifood company saw opportunities for self-sufficiency in fertilisers and energy. This would create new jobs, as someone would collect plastics and take them back to the recycling centres. The environment in Finland was seen as an enabler of opportunities, as there are biomasses, forests, water, and a favourable climate, which people want to make an effort to maintain.

Both policy experts mentioned the opportunities to reach environmental targets through circular agriculture. One expert specified that less earth-shaping agriculture impacts nutrient circles, carbon sequestration in reaching carbon emission targets, less water stress, and improved biodiversity.

One expert raised a concern that opportunities are related to whether CE products will bring additional value to customers, for which people or businesses are willing to pay more. The other expert thought about the economic side from the perspective of how acceptable the farm practices are, as currently, they saw some contradiction there. With fewer animals produced, the well-being of animals would be increased. People could appreciate the resources of raising an animal, increase their appreciation towards farmers, and live more harmoniously with the current resources. Economic benefits were also seen in farmers producing their energy.

Additionally, underutilised side streams were seen as a possibility to replace fossil raw materials and improve packaging, which would also increase self-sufficiency. New industries have started in the area, such as the mill industry, where synthetic materials are already being replaced with materials such as oat husk. Forest-based products were also seen as an opportunity.

From a cultural perspective, there was an opportunity to improve the vitality of the countryside by renewing aid policies. This would also allow compensation to the farmers accordingly so that they would receive what they deserve and get along with their work. The last opportunity was seen in people working more in cooperation networks, which would bring people overall well-being and increase the community spirit in the countryside.

#### ***4.6. Challenges Faced in the Agricultural Sector***

When looking at the number of different remarks made, more challenges were seen than opportunities. One of the challenges seen by most of the farmers was funding. Inexpensive solutions were seen to lower the threshold of trying new products or services as they could be competitively priced compared to traditional practices. Some farmers saw that redirecting public funds could encourage innovation, and some others thought about farmers getting the smallest

share of the produced foods and how consumers could appreciate the food and be willing to pay more.

Another common challenge was the introduction of circular practices. Circular practices were seen as adding work and requiring farmers to be active in seeking solutions that suit their farms. The current solutions are not yet seen as ready-made systems, which require the farmers to work with the bureaucracy or cooperate with others. Small-scale farms saw a challenge in finding cost-effective solutions.

Bureaucracy was generally considered a challenge. The EU and national regulations were seen to have helped increase general knowledge, but the amount of regulation was considered to have increased and challenged farmers.

*“All regulations and requirements are quite strict, the same rules for everyone make it challenging for small operators. It is easy for the authorities to have the same rules for everyone, but it makes it more rigid. And then maybe such political decisions would be a bit along the lines of encouraging experimentation and starting activities, not immediately demanding that everything should be perfect. Rigid bureaucracy leads to only a few people wanting to start. It makes me a bit cautious, I feel like it is illegal to try new experiments. At least such experimentation and development should be encouraged more.”*

There were some prejudices about how the solutions would work, the impact of the product, and how to use the products. One farmer mentioned the hygiene in circular products, another one the rigid requirements of organic products, and a third farmer considered that their area is so special that there should be experts to develop solutions for this specific type of cultivation. Logistics bring challenges as the farms are far from each other in the region. Fields are small and dispersed, and the distances for transporting products are generally long.

Lastly, some technical challenges were seen in spreading new fertilisers, which would require different machines for spreading products than the farm currently had—seasons also constrained fertilising the ground at other times of the year than in the growing season. The farmers saw some challenges on the industry's side with inventing new products or processes, and the collection of agricultural waste, such as plastics, had not been working out.

The employee of the agrifood company listed many challenges the company sees in CE. Firstly, agriculture is low-profitable and incurs additional costs in CE, like recycling fees. The side streams of agriculture, such as plastics, are difficult to reuse or recycle, as new facilities need to be still created, and the waste is scattered around the regions requiring transportation. As political challenges, the company experienced instability in the political environment that strained planning. For example, the profitability of biogas production depends on demand, which is related to the government's biofuel distribution obligation. Some of the responsibilities were seen to be on the consumers, who might demand sustainability but prefer to choose cheaper and less sustainable products.

When asked about business culture, the employee saw that companies want something out of operating more sustainably, at least positive publicity. Additionally, they thought CE should be seen as a cross-cutting goal for the company instead of having only a dedicated team working on improving sustainability.

Similarly to the farmers and the agrifood company, the policy experts mentioned the expensiveness of circular solutions compared to current materials or solutions, bureaucracy, risks in trying and advancing practices and possible technical challenges. Furthermore, challenges were also seen in the possible costliness of CE practices for the consumer prices of products while taking care of affordability. One of the experts says that enforcing such practices needs to



be market-based, implying that as soon as consumers demand and pay more for their products to be circularly produced, these practices will become more common in agriculture. At the same time, investments from the municipalities towards infrastructure that supports circularity are required.

In addition to the aforementioned points, there were also political challenges, such as a lack of political enforcement by being at the “celebration speech level” in the EU and some national politicians “holding on to the past”. The EU agricultural policies and financial aid are not seen as supporting the development of the agricultural sector towards CE. Nationally, one of the experts suggests that the different ministries operate in isolated spheres, which leads to poor operationalisation of actions. The bureaucratic and legislative processes are seen to be partially missing, possibly because of little expertise, experience, historical background and information on how CE should have been developed.

*“In my opinion, however, the circular economy market is such a developing market that it still lacks a lot of rules of the game, lacks processes, and that is why we are in such a difficult situation bureaucratically, financially and in terms of expertise.”*

In a political context and also regarding individuals, both of the experts mentioned how the meaning of circular economy is not clear to everyone. One of them had experienced that the terminology is not even clear in the EU’s discussions as many similar terms with different meanings are being used simultaneously. From a socio-cultural perspective, a lack of awareness in agriculture and consumers was considered a challenge. One of the experts said that an attitude change is crucial in the agricultural sector and, more broadly, in society to see alternatives to milk- and meat-heavy food production and consumption, to dare to go towards more circularity

and see humans as a smaller part of life. The last challenge was the perception that CE had been thought to be important for over 20 years, and the expert would have expected to have positive results in such a time so that it is not just considered to be some tinkering.

*“It would be so nice if all people could somehow understand [the importance of circular economy] without such a hard requirement like some legislation, but that might not be possible.”*

## 5. Discussion

To summarise the findings, the stakeholders had various perceptions of the circular economy. The farmers had a more narrow view of CE compared to policy experts and the agrifood company. Among the farmers, a persistent view of the concept was recycling or reusing materials or side streams of production and consumption, which aims for environmental preservation. The policy experts and agrifood company had more elaborate views, acknowledging the variety of the aims but different views on the principles. As showcased in Appendix E., the agrifood company envisioned CE as competition to the linear economy, the experts as an economic system or a broader societal way of restructuring our lives.

Farmers saw opportunities in CE for environmental benefits, such as improved soil condition, carbon sequestration and recycling. Additionally, farmers saw benefits in energy production, manufacturing, and using underutilised resources. There was polarisation on whether farmers' businesses would benefit from a circular economy. The agrifood company and policy experts saw great potential in the circular economy through economic benefits, reduced greenhouse gas emissions, self-sufficiency and improved biodiversity. Additionally, the policy experts highlighted the opportunities to replace scarce materials, create new industries, increase animal welfare, and revitalise the countryside through increased community spirit.

The challenges faced in implementing CE among all stakeholders included lack of funding, bureaucracy, finding suitable solutions and some prejudices towards the usability of new practices. Inexpensive solutions could lower the threshold for trying new practices, while some practices require cooperation and cost-effective solutions for smaller farms. Technical challenges in using the practices and recycling waste also pose challenges for farmers. The agrifood company and the policy experts see challenges in the circular economy market,

including the high cost of solutions, bureaucracy, technical challenges and political issues. Enforcing circular practices requires market-based investments and societal support. Political problems arise from a lack of political enforcement, isolated ministries and unclear terminology. Socio-cultural awareness also challenges the further adoption of the circular economy.

### ***5.1. Findings***

This research aimed to explore the opportunities and challenges faced by the agricultural sector of Central Finland in the circular economy. The in-depth interviews provided rich and nuanced insights into the current state of implementation. Based on the results, three insights are summarised: a narrow view of the circular economy, first-hand challenges in implementation, and political support.

The first finding is that while all interviewees had some knowledge of the concept, there is a narrow view of the circular economy in the agriculture sector, as seen both in the literature and the case study. Like the study by Rótolo et al. (2020), farmers especially saw CE as a narrow sustainable production and consumption model concept. Various perceptions of the concept were expected, as academia has yet to settle on one definition of CE. Having a narrow definition enables one to have a more concrete view of the circular economy, a clear view of the possibilities, and increased usability.

In turn, the narrow perception of CE also has a constraint of not seeing the variety of social opportunities. The interviews showed a narrow perception, as the farmers highlighted the environmental opportunities, while the economic or social opportunities were less identified. Connecting this finding back to the studies by Barros et al. (2020) and Rotolo et al. (2020), there is a gap in the literature on the social aspects of CE in agriculture. The gap is in balance with the

growth in academic CE theories, as studies defining the concept have only recently started highlighting the importance of social aspects. In the literature, social opportunities lie in the sharing economy, an increased sense of community and cooperation, together with the recognition of humans' roles other than those of consumers or producers (Korhonen et al., 2018; Friant et al., 2020; Schröder et al., 2020). One of the seven interviewees also mentioned the opportunity for increased community spirit.

The narrow view of CE was also seen in the understanding of the concept, as none of the interviewees or previous researchers identified practices in agriculture that involve some of the R's, such as reducing, reusing, sharing, leasing, and refurbishing. For example, only one of the seven interviewees mentioned reducing consumption or production in the context of a need for lessened consumption of animal products. In the literature, however, the reduction of consumption and production was noted as the first principle in two CE definitions (Kirchherr et al., 2017; Murray et al., 2017). Nevertheless, the reduction of production and consumption is not part of the European Union definition (2023), which influences the most crucial policies. While interviewees had varying understandings of CE, there was a consensus that change is necessary.

The second key finding is that the case study confirmed what data has shown with regard to the challenges faced by the agricultural sector in recent years. Structural challenges constrain the implementation of circular practices, which would need to be overcome first, as some of the mentioned challenges relate more to the viability of agriculture than challenges in implementing CE. In the interviews, it was mentioned that farmers face the challenge of low profitability, and that the opportunities of CE are not seen as sufficient to improve this condition. All interviewees mentioned economic concerns and that CE practices must be cost-effective as they bring more work for the farmers. Rótolo et al. (2020) also found that some CE investments have high

upfront investment costs, which require incentives to introduce CE practices. Three of the farmers did not see the same new opportunities for improved livelihoods as the interviewed experts and many of the previous studies envisioned.

The means for incentivising CE divided opinions among interviewees. While one expert and some farmers highlighted the need for political decisions to drive CE forward, the agrifood company and other experts highlighted the importance of the market economy to provide suitable conditions for investing. Some noted the behaviour of individuals on purchasing power, while some also admitted that while CE is necessary to work towards, people do not have adequate knowledge or means to act. From the interviews, no consensus can be reached on the necessary conditions for enabling a circular economy in agriculture.

Another inherent challenge in the agricultural sector is the high burden on the environment and weakening biodiversity (Sitra, 2022). All of the interviewees mentioned the opportunities for the environment, but through the interviews, the how can be understood to be through optimising current processes. The conclusion was prompted by interviewees seeing CE as more organic fertilisers and pesticides rather than looking at restorative or regenerative practices, as mentioned by Friant et al. (2020). One of the policy experts showcased a broader view of the CE theory, seeing it as a more holistic transition of changing the narrative of how people live within the Earth's limits. The expert noted rethinking agriculture based on how animal husbandry is perceived and how agriculture is valued. This reformist view, also elaborated by Friant et al. (2020), would require more knowledge and debates as the main view of CE in this and previous agriculture studies is a narrow transition towards a circular production and consumption system. The studies from Barros et al. (2020) and Rotolo et al. (2020) did not include critical views on attitudes towards agriculture and food production.

Regarding the first finding, a narrow understanding of the concept, it can be concluded that examples of suitable solutions and more cooperation in finding farm-specific solutions would help solve the structural challenges. Increased knowledge would benefit finding solutions and creating cooperation networks to unveil opportunities further.

Thirdly, a challenge experienced by all participants was that upcoming policies need to support the implementation of CE in agriculture. It was seen that even though increased CE action plans and goals have made the topic more recognised, its meaning needs to be made clear and provided the tools for the agricultural sector to renew. New policies have increased bureaucracy, which has been experienced as making operations more rigid and disincentive circularity. The political system was experienced as scattered and lacking investments, which was also acknowledged by Rótolo et al. (2020), yet other political challenges had not been recognised in the existing literature.

The CE definitions by Friant et al. (2020) and Schröder et al. (2020) cover the topics of political empowerment, increased human capabilities and human-centred design, which also imply creating a system in the agricultural context that empowers farmers. As one of the participants described, the rigid bureaucracy makes experimenting feel “illegal”; it diminishes the feeling of creativity and flexibility to find solutions to mutual challenges. The definition of CE by Friant et al. (2020) envisions societal circularity, in which power circulates and redistributes throughout society, which is enabled by political changes. The active role of farmers in transforming society into a circular economy is a topic of further research.

Here, a connection can be seen to the second finding, an initial challenge with agriculture's profitability. Even though there are economic incentives for farmers, adequate political measures are needed to address the structural challenge of financial profitability in

agriculture. However, the root causes of agriculture's low profitability are beyond the scope of this research and require further studies to find the right political means.

To summarise the findings, in the agriculture sector of Central Finland, the focus of circular economy opportunities mainly was in the environmental and technical-economical aspects. Only one participant mentioned some socio-cultural opportunities. In contrast, in the challenges the participants experienced challenges in three thematic aspects; economic-technical, institutional-political and socio-cultural. Only a few challenges related to the environment. The stakeholders mainly had a narrow view of circularity, as among most participants it was seen changes in practices rather than as a more extensive societal transition. Narrow perception was also implied by mostly seeing CE as a production and consumption model, where not all R's such as reduce, reuse, share, lease, and refurbish were identified. The aim varied, but mainly there were similarities to the definition by the EU, to protect the environment and create jobs by the use of materials. One expert saw well-being as one of the aims.

## ***5.2. Recommendations***

Two recommendations will be made based on the research on circular agriculture in Central Finland. As the interviews revealed, the agriculture sector has a positive attitude towards a circular economy, but a number of challenges constrain the introduction of circular practices.

To combat the challenge of CE knowledge falling short, the agricultural sector would benefit from increased research and development among various stakeholders and the spread of awareness of the broad scope of the concept. Increased knowledge in topics such as what CE is, how it is advanced and implemented, what solutions there are for farmers that are feasible to implement, and what opportunities there are in agriculture would be beneficial to the



advancement of the practices. As there is much knowledge already in organisations and companies, this knowledge would benefit farmers and individuals. However, the study recognised that only some of the practices for farmers had been identified so far. Thus, further research on the practices and implementation processes in the agriculture sector is essential.

Secondly, it is recommended that agriculture-specific policies, aid policies, and legislation be reviewed to address the challenges of bureaucracy and lack of enforcement. Legislation and regulations should enable the transition towards the circular economy by incentivising and deterring actions. Aid policies should be targeted towards incentivising circular activities. Lastly, bureaucratic processes should be reviewed to ease the burden on farmers to seek support and new possibilities. Increased circular practices would support the opportunities for a cleaner environment and profitability of the agriculture sector.

### ***5.3. Limitations***

Some limitations impacted the research. Firstly, the research had a small sample size of stakeholders in a specific region. The sample and region were narrowed to have a more in-depth view of all of the aspects influencing the implementation. Focusing on a particular region enabled the research to gain some depth in relevant local policies, of which only a fraction is introduced. Meanwhile, it also impedes the generalisation of the results to other regions. In future studies, the sample size could be extended to a wider variety of companies contributing to the agricultural sector, such as other agrarian businesses, fertiliser producers, or other administrative bodies such as the waste collection plant. Additionally, the experts and the agrifood company interviewed in the study specialised in environmental or circular economy questions, for which their views can not be generalised to all public servants or company

representatives. Lastly, the research question was broad, which did not allow for going into detail with the rich data gained. More in-depth follow-up questions arose in the analysis phase of research, which could not be included in the study.

## 6. Conclusion

The aim of the present research was to identify the circular economy's theoretical foundations and examine the practices, opportunities and challenges in implementing the concept in the agriculture sector. The research was motivated by the question: *What are the key opportunities and challenges associated with implementing a circular economy (CE) in the agricultural sector in Central Finland?*. The research first established an analytical framework of circular economy, deriving the categorisation from the historical notions of circular economy and recent academic definitions. Later, the framework was used to analyse the case study results. Seven stakeholders in the agricultural sector in Central Finland, including farmers, policy experts and an agrifood company, were interviewed on their perceptions.

Three main findings of the research were identified to answer the research question. Firstly, in the literature and in practice, the circular economy was perceived narrowly. The opportunities were mainly seen in the environmental and economic benefits, while the socio-cultural aspects were less identified. Secondly, the agricultural sector faces structural challenges, which might impede the introduction of CE, while CE might also provide solutions to the challenges. The third finding was that the current CE and agricultural policies and increased bureaucracy are not sufficiently supporting the transition.

The European Union's (EU) narrow definition of the circular economy impedes progress across various sectors, particularly in agriculture. The EU plays a significant role in setting goals and shaping the narrative for the transition to a circular economy. However, it is currently not facilitating sufficient progress in the agricultural sector. The EU's focus remains predominantly on materials and devices, despite the potential for the circular economy to encompass all sectors influenced by the EU in member countries.

This research shed some light in the perceptions within the agricultural sector in Central Finland to adopt circular economy practices. Despite a strong inclination towards change, implementation efforts lag behind. To facilitate this transition, policies, financial incentives and further research must be directed towards actions that advance the circular economy, rather than perpetuating unsustainable or unsuitable practices.

Future research focus could be in specific agricultural sectors or particular circular economy (CE) practices and processes within the agricultural chain. More research and development, including impact assessments, are necessary to uncover circular solutions for the agricultural sector. Notably, practices and collaborations with social implications are currently under-researched within the broader context.

Another pertinent research topic is the role of farmers in contemporary society. Questions to explore include how empowered farmers feel in decision-making regarding their farming practices, whether they are adequately represented and valued in society, and what role they play in the transition to a circular economy. Furthermore, research could investigate what a circular society would look like, especially in the agricultural sector, and how broader perspectives might influence this transition. Lastly, more profound policy review could evaluate the impacts of existing policies on promoting the circular economy within agriculture. Specifically, research could explore which policies facilitate implementation and which types succeed in advancing the circular economy.

## 7. Reference list

- Barros, M. V., Salvador, R., De Francisco, A. C., & Piekarski, C. M. (2020). *Mapping of research lines on circular economy practices in agriculture: From waste to energy*. *Renewable & Sustainable Energy Reviews*, 131, 109958.  
<https://doi.org/10.1016/j.rser.2020.109958>
- Berg, A., & Eskola, P. (2023). *Kiertotalouden tilannekatsaus*. Kiertotalous-Suomi.  
<https://kiertotaloussuomi.fi/tieto/kiertotalouden-tilannekatsaus/>
- Boulding, K. (1966). *The Economics of the Coming Spaceship Earth*. Jarrett, H. Ed. 1966  
 Environmental Quality in a Growing Economy, Resources for the Future/John Hopkins University Press, Baltimore, pp.3–14.
- Brundtland, G.H. (1987). *Our Common Future: Report of the World Commission on Environment and Development*. Geneva, UN-Document A/42/427.
- Ellen MacArthur Foundation. (2015). *Growth within: A circular economy vision for a competitive Europe*.  
<https://www.ellenmacarthurfoundation.org/growth-within-a-circular-economy-vision-for-a-competitive-europe>
- Ellen MacArthur Foundation. (2013). *Towards the circular economy Vol. 1: An economic and business rationale for an accelerated transition*.
- European Commission. (2022). *Common Agricultural Policy For 2023-2027, 28 Cap Strategic Plans At A Glance*.  
[https://agriculture.ec.europa.eu/document/download/a435881e-d02b-4b98-b718-104b5a30d1cf\\_en?filename=csp-at-a-glance-eu-countries\\_en.pdf](https://agriculture.ec.europa.eu/document/download/a435881e-d02b-4b98-b718-104b5a30d1cf_en?filename=csp-at-a-glance-eu-countries_en.pdf)
- European Commission, Directorate-General for Environment. (2023). *Circular economy: New tool for measuring progress*, Publications Office of the European Union.  
<https://data.europa.eu/doi/10.2779/1618>
- European Commission. (2015, December 2). *Commission adopts ambitious new Circular Economy Package*. IP/15/6203. European Commission.  
[https://ec.europa.eu/commission/presscorner/detail/en/IP\\_15\\_6203](https://ec.europa.eu/commission/presscorner/detail/en/IP_15_6203)

European Commission. (2020a, March 11). *A new Circular Economy Action Plan For a cleaner and more competitive Europe*. COM/2020/98 final. EUR-lex.

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2020:98:FIN>

European Commission. (2020b, May 20). *A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system*. COM(2020) 381 final. EUR-lex.

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0381>

European Commission. (2024). *Farm Economy focus*. Agridata.

<https://agridata.ec.europa.eu/extensions/DashboardFarmEconomyFocus/DashboardFarmEconomyFocus.html>

European Parliament. (2023). *Circular Economy: Definition, importance and benefits*. Topics | European Parliament.

<https://www.europarl.europa.eu/topics/en/article/20151201STO05603/circular-economy-definition-importance-and-benefits>

Eurostat. (2023, May 15). *Improved circular economy monitoring framework now live*. Eurostat.

<https://ec.europa.eu/eurostat/web/products-eurostat-news/w/wdn-20230515-1>

Finnish Food Authority. (2024, March 21). *Maatalouden investointituet*. Ruokavirasto.fi.

<https://www.ruokavirasto.fi/tuet/maatalous/investoinnit/maatalouden-investointituet/#4.-elainten-hyvinvointia-ja-bioturvallisuutta-edistavat-investoinnit>

Finnish Government. (2021). *Uusi suunta: Ehdotus kiertotalouden strategiseksi ohjelmaksi*. In julkaisut.valtioneuvosto.fi (YM010:00/2020).

<http://urn.fi/URN:ISBN:978-952-383-658-7>

Finnish Ministry of Agriculture and Forestry. (n.d.). *Tietoa Suomesta - Maa- ja metsätalousministeriö*. Maa- Ja Metsätalousministeriö. Retrieved May 14, 2024, from

<https://mmm.fi/eu2019fi/tietoa-suomesta>

Forslund, T., Gorst, A., Briggs, C., Azevedo, D., & Smale, R. (2022). *Tackling root causes - Halting biodiversity loss through the circular economy*. Sitra.

<https://media.sitra.fi/app/uploads/2022/05/sitra-tackling-root-causes-2.pdf>

Friant, M. C., Vermeulen, W. J., & Salomone, R. (2020). *A typology of circular economy discourses: Navigating the diverse visions of a contested paradigm*. Resources,

- Conservation and Recycling, 161, 104917.  
<https://doi.org/10.1016/j.resconrec.2020.104917>
- Geng, Y., Jia, F., Sarkis, J., & Xue, B. (2012). *Towards a national circular economy indicator system in China: an evaluation and critical analysis*. Journal of Cleaner Production, 23(1), 216–224. <https://doi.org/10.1016/j.jclepro.2011.07.005>
- Kaariaho, T., & Pirtonen, H. (2022, December). *Kiertotalous edistyy Suomessa hitaasti – merkittävimmät askeleet kohti asetettuja tavoitteita ovat vielä ottamatta*. stat.fi. <https://stat.fi/tietotrendit/artikkelit/2022/kiertotalous-edistyy-suomessa-hitaasti-merkittavimmat-askeleet-kohti-asetettuja-tavoitteita-ovat-viela-ottamatta/>
- Kirchherr, J., Reike, D., & Hekkert, M. P. (2017). *Conceptualizing the Circular Economy: An analysis of 114 definitions*. Social Science Research Network. <https://doi.org/10.2139/ssrn.3037579>
- Kirchherr, J., Yang, N. N., Schulze-Spüntrup, F., Heerink, M. J., & Hartley, K. (2023). *Conceptualizing the Circular Economy (Revisited): An analysis of 221 definitions*. Resources, Conservation and Recycling, 194, 107001. <https://doi.org/10.1016/j.resconrec.2023.107001>
- Korhonen, J., Honkasalo, A., Seppälä, J. (2018). *Circular Economy: The Concept and its Limitations*. Ecological Economics, Volume 143, 2018, Pages 37-46, ISSN 0921-8009, <https://doi.org/10.1016/j.ecolecon.2017.06.041>.
- McDonough W. & Braungart M. (2002). *Cradle to cradle: Remaking the way we make things* (1st ed.). North Point Press.
- Meadows, D. H., Rome, C. O., & Associates, P. (1974). *The limits to growth: A Report for the Club of Rome's Project on the Predicament of Mankind*. New York : Universe Books.
- Murray, A., Skene, K., & Haynes, K. (2017). *The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context*. Journal of Business Ethics, 140(3), 369–380. <http://www.jstor.org/stable/44164300>
- Natural Resources Institute Finland. (2024, April 24). *Maatalous- ja puutarhayritysten rakenne 2023*. <https://www.luke.fi/fi/tilastot/maatalous-ja-puutarhayritysten-rakenne/maatalous-ja-puutarhayritysten-rakenne-2023>
- OECD. (2023). *Measuring the environmental performance of agriculture across OECD countries*. <https://doi.org/10.1787/4edcd747-en>

- Pearce, D. & R. Turner (1990). *Economics of Natural Resources and the Environment*, Harvester. Wheatsheaf, Hemel Hempstead, Herts., UK
- Regulation 2021/2115. *Regulation (EU) 2021/2115 of the European Parliament and of the Council of 2 December 2021 establishing rules on support for strategic plans to be drawn up by Member States under the common agricultural policy (CAP Strategic Plans) and financed by the European Agricultural Guarantee Fund (EAGF) and by the European Agricultural Fund for Rural Development (EAFRD) and repealing Regulations (EU)*. <http://data.europa.eu/eli/reg/2021/2115/oj>
- Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., III, Lambin, E., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., De Wit, C. A., Hughes, T., Van Der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P. K., Costanza, R., Svedin, U., . . . Foley, J. (2009). *Planetary Boundaries: Exploring the safe operating space for humanity*. *Ecology and Society*, 14(2). <https://www.jstor.org/stable/26268316>
- Rótolo, G., Vassillo, C., Rodriguez, A., Magnano, L., Vaccaro, M. M., Civit, B., Covacevich, Arena, A., & Ulgiati, S. (2022). *Perception and awareness of circular economy options within sectors related to agriculture in Argentina*. *Journal of Cleaner Production*, 373, 133805. <https://doi.org/10.1016/j.jclepro.2022.133805>
- Schröder, P., Lemille, A., & Desmond, P. (2020). *Making the circular economy work for human development*. *Resources, Conservation and Recycling*, 156, 104686. <https://doi.org/10.1016/j.resconrec.2020.104686>
- Tilastokeskus. (2024, April 25). *Väestön ennakkotilasto*. Tilastokeskus. <https://stat.fi/tilasto/vamuu>
- Työ- ja elinkeinoministeriö. (2024). *Alueelliset kehitysnäkymät keväällä 2024*. <https://tem.fi/julkaisu?pubid=URN:ISBN:978-952-327-913-1>
- Valtioneuvosto. (2020, August 26). *Raportti: Luontokadon pysäyttäminen edellyttää ekologista siirtymää*. Valtioneuvosto. <https://valtioneuvosto.fi/-/10616/raportti-luontokadon-pysayttaminen-edellyttaa-ekologista-siirtymaa>



## Appendix A.

### *Ethical considerations*

#### 1. Participants

What is the (estimated) number of participants? How did you determine the number of participants (e.g., power analysis)?

- Estimated number of participants is 6. It was decided by getting a comprehensive qualitative analysis from participants. It is also enough to have a comprehensive qualitative look at different actors.

Does the study involve participants who are unable to give informed consent (e.g., people with learning disabilities)? If yes: Explain why and what measures you will take to avoid or minimize harm.

- No.

Does the research involve potentially vulnerable groups (e.g., children, people with cognitive impairment, or those in dependent relationships)? If yes: Explain why and what measures you will take to avoid or minimize harm.

- No.

Will the study require the cooperation of a gatekeeper for initial access to the groups or individuals to be recruited? (e.g., students at school, members of a selfhelp group, residents of a nursing home)? If yes: Who is the gatekeeper? What agreements have you made, and which expectations regarding the research project do you share?

- No.

Will it be necessary for participants to take part in the study without their knowledge and consent at the time (e.g., covert observation of people in nonpublic places)? If yes: Explain why and how, and provide a risk analysis if applicable.

- No.

Will any relationships exist between anyone involved in the recruitment pool of potential participants? If yes: Explain why and how, and provide a risk analysis, and explain how you will deal with this.

- No.

How is the researcher or the team of researchers positioned in the project (e.g., relationships/affinity/encounters with the participants, attitudes/opinions/assumptions towards the research subject). Describe the positionalities and reflect on the potential consequences and how you adjust/minimize the influences in the research project and/or plan to deal with these throughout the research process?

- My education, beliefs, and opinions might have influenced the research and questions framing and interpreting the results. The interviewees were contacted as their information was found on the internet, which may have influenced the participant pool.

The influence will be minimised by communicating the research's purpose, goals, and potential impact to participants. The research questions will be developed to be open-ended so that participants have more freedom to answer. I will also engage in continuous reflexivity, acknowledging personal biases, and consistently reflecting on how my positionality may shape the research. Also, feedback will be asked to minimize individual biases and enhance the study's credibility.

## **2. Research design and data collection**

Will the study involve the discussion of sensitive topics (e.g., sexual activity, drug use, politics)? If yes: Which topics will be discussed or investigated, and what risk is involved? What measures have you taken to minimize any risk, if applicable?

- No.

Will drugs, placebos, or other substances (e.g., food substances, vitamins) be administered to the study participants? If yes: Explain the procedure and provide a brief cost benefit analysis. What measures have you taken to minimise any risk, if applicable?

- No.

Will the study involve invasive, intrusive, or potentially harmful procedures of any kind? If yes: Explain the procedure and provide a brief cost benefit analysis. What measures have you taken to minimize any risk, if applicable?

- No.

Could the study induce psychological stress, discomfort, anxiety, cause harm, or have negative consequences beyond the risks encountered in everyday life? If yes: Clarify the procedure and explain

why no alternative method could be used. Provide a brief cost benefit analysis if necessary. What measures have you taken to minimize any risk, if applicable?

- No.

Will the study involve prolonged or repetitive testing? If yes: Explain the procedure and clarify how the interests of the participants are safeguarded.

- No.

Is there any form of deception (misinformation about the goal of the study) involved? If yes: Explain the procedure and provide a rationale for its use.

- No.

Will you be using methods that allow visual and/or vocal identification of respondents? If so: What will you do to guarantee anonymity and confidentiality?

- No.

Will you be collecting information through a third party? If yes: Who is that party? Provide a brief outline of the procedure.

- No.

Will the research involve respondents on the internet? If yes: How do you plan to anonymize the participants?

- No.

Will you guarantee anonymity and/or confidentiality? Outline your procedure and give an estimate of the risk of a breach of confidentiality.

- I will guarantee anonymity and confidentiality by ensuring that interviews are done in a safe space, where the participants can answer our questions in full privacy. The interviews will be recorded to ensure the information is accurate. I will make sure that no one else has access to the recordings. In the transcripts, I will use non-recognisable acronyms instead of any personal identifiers, like interviewee 1, to keep the anonymity of participants. In writing the final paper, we will make sure that the answers can not be connected to any individual and we have removed all personal information and other specific things that might jeopardize anonymity and confidentiality. Even with strong security precautions, there are always risks associated with any

system. Because of the strong privacy policies and the protective procedures in place, the likelihood of a breach is thought to be minimal.

What information in the informed consent will participants be given about the research? Please consult the template for information sheets and informed consent sheets for further guidance.

- The information sheet and consent form as attached.

Provide a brief summary or upload the consent form. Which procedures are in place in case participants wish to file a complaint? The template is available on Brightspace.

- The consent form is shared along with this checklist. During the informed consent process, participants will be provided with information regarding the complaint mechanisms. I will explicitly give participants my contact information, which includes my email address and the institutional contact information, so they can address any issues.

Will financial compensation be offered to participants? Provide a short account of any compensation being offered.

- No.

If your research changes, how will consent be renegotiated?

- If the research is changed, the participants will be asked to fill in an updated consent form to ensure their safety and confidentiality.

### **3. Analysis and interpretation**

What is the expected outcome of your research? What would you consider a significant result?

- The expected outcome of the research is to gain insight from the participants on the research question and achieve research objectives. Significant results would be new insights, that have not been discussed in the literature, or gain reassurance for the information found from the literature.

During the course of research, how will unforeseen or adverse events be managed (e.g., do you have procedures in place to deal with concerning disclosures from vulnerable participants)?

- The careful consideration of the participant pool and research questions minimises unforeseen situations. Participant's safety and well-being will be ensured.

### **4. Dissemination**

How do you plan to share your research findings? Which audience do you intend to target? What are ethical issues to consider in the dissemination of your findings?

- The research data will be used for the bachelor thesis. Findings are shared within the University of Groningen and also the different stakeholders interviewed for the research. The audience will be interdisciplinary, from businesses to governance actors. Informed consent, confidentiality and anonymity are important factors I will ensure for the dissemination of the findings.

## **5. Data storage**

Where will your data be stored? Which measures have you taken to make sure it is secure?

- The data will be only stored in personal devices, to which no one else has access and are safeguarded by a password. Upon completion of the research, the recordings and other personal data will be deleted from the personal device. Additionally, our research output will be stored in the Y-drive of the University of Groningen server for 5 years, in correspondence with the university GDPR legislation.

Which safety precautions have you arranged for in the case of data leakage?

- The study will comply with legal and ethical obligations regarding data protection and confidentiality. Any data leakage will be reported to the appropriate regulatory bodies and participants as required by law.

Will your data be disposed of? If yes: When (date)? If not: Why not?

- Yes, as soon as the research has been finalised, so the 6th of June 2024.

Will your research involve the sharing of data or confidential information beyond the initial consent given (such as with other parties)? What specific arrangement have you made and with whom?

- No, the data will not be shared with anyone.

## **Appendix B.**

### *Information sheet*

Dear participant,

Thank you for your interest in participating in this research. This letter explains what the research entails and how the research will be conducted. Please take time to read the following information carefully. If any information is not clear, kindly ask questions using the contact details of the researchers provided at the end of this letter.

### **WHAT IS THIS STUDY ABOUT?**

The research will look into the concept of circular economy in the context of the agricultural sector. The aim of the research is to answer the question: What are the key opportunities and challenges associated with implementing a circular economy (CE) in the agricultural sector in Central Finland? The qualitative research aims to understand perceptions of the circular economy and what kind of opportunities and challenges are to be seen in it. The research will interview 6 individuals to share their knowledge and perspectives.

You have been included to participate in the study, as you might have relevant experience on the question due to your job position in the area.

The research will be conducted by Jonna Könkkölä for the University of Groningen, faculty of Campus Fryslan.

### **WHAT DOES PARTICIPATION INVOLVE?**

Participation involves one 30-45 minute interview organised in person or via online call during the spring of 2024. The interview will be held in a preferred language (Finnish/English).

### **DO YOU HAVE TO PARTICIPATE?**

Participating in this research project is entirely voluntary. Withdrawal from participation can be done at any time, without consequences or further reasoning. Furthermore, you can choose to not answer questions without consequences and or provision of reason.

### **ARE THERE ANY RISKS IN PARTICIPATING?**

There are no risks in participating in the research, as your anonymity and confidentiality will be ensured. We will do this by anonymizing your identity in the transcript and in the research output.

**ARE THERE ANY BENEFITS IN PARTICIPATING?**

There are no direct benefits to participating in the research, but by participating you may contribute to the further knowledge of the topic.

**HOW WILL THE INFORMATION YOU PROVIDE BE RECORDED, STORED AND PROTECTED?**

Your information will be guaranteed to be fully confidential and anonymous. During the process, in the data, you will be referred anonymously. During the interviews, an audio recording will be taken to accurately relate back to your answers. The transcript will not be accessed by anyone other than the researcher and limited academic staff of the faculty. The transcript will be deleted in 5 years after the finished project is realized. In the final outcome there will be no personal information from what you could be identified. The recording and transcription of the recording will be handled according with the EU's General Data Protection Regulation (GDPR).

**WHAT WILL HAPPEN TO THE RESULTS OF THE STUDY?**

The results of the study will be published on the University of Groningen website where it is publicly visible.

**ETHICAL APPROVAL**

This research has obtained ethical approval from the Campus Fryslân Ethics Committee, the faculty of the University of Groningen, where it is conducted. The researcher is upheld to relevant ethical standards.

**INFORMED CONSENT FORM**

This informed consent form is asked to be signed to agree to the objectives of the study. However, even after signing this informed consent form, you are still able to withdraw from the research at any time. This informed consent will serve solely to ensure the protection of your rights as a participant.

**WHO SHOULD YOU CONTACT FOR FURTHER INFORMATION?**

Jonna Könkkölä

## Appendix C.

### *Consent form*

#### **INFORMED CONSENT FORM**

**Title study:** Circular economy in the Agriculture sector in Central Finland

**Name of participant:**

#### **Assessment**

- I have read the information sheet and was able to ask any additional question to the researcher.
- I understand I may ask questions about the study at any time.
- I understand I have the right to withdraw from the study at any time without giving a reason.
- I understand that at any time I can refuse to answer any question without any consequences.
- I understand that I will not benefit directly from participating in this research.

#### **Confidentiality and Data Use**

- I understand that none of my individual information will be disclosed to anyone outside the research team and my name will not be published.
- I understand that the information provided will be used only for this research.
- I understand that data (consent forms, recordings, interview transcripts) will be retained on the Y-drive of the University of Groningen server for 5 years, in correspondence with the university GDPR legislation.

#### **Future involvement**

- I wish to receive a copy of the scientific output of the project.
- I consent to be re-contacted for participating in future studies.

**Having read and understood all the above, I agree to participate in the research: yes / no**

**Date**

**Signature**

---

To be filled in by the researcher:

- I declare that I have thoroughly informed the research participant about the research study and answered any remaining questions to the best of my knowledge.
- I agree that this person participates in the research study.

**Date**

**Signature**



## **Appendix D.**

### *Interview guides*

#### **Farmers**

- Tell about the farm and its operations
- How long have you practised agriculture and how has the farm changed over the years?
- What tasks do you do at the farm?
- How has sustainable development been taken into account?

#### Definition

- How do you define circular economy?
- What is the aim of circular economy? What is going to be achieved with it?
- How circular economy is going to be achieved? What are the central principles?
- What circular economy practices do you know there to be for the agricultural sector?
- What circular practices have been implemented at the farm or are being planned?

#### Challenges

- What challenges do you see in implementing and introducing circular practices in agriculture?
  - Any economic or technical?
  - Institutional or political?
  - Societal or cultural?
  - Environmental?
- How do you see circular economy opportunities to respond to the growing need for food production while reducing environmental impacts?

#### Opportunities

- What opportunities do you see in implementing a circular economy in the agricultural sector? For the farmers? For the society?
- How could farmers be supported in implementing a circular economy?

- How do you see the role of government and the EU in promoting a circular economy in the agricultural sector?
- What national or EU laws or policies do you know that enforce or restrain implementing circular practices?
- What do you think about new solutions, like circular economy, that change the habitual ways of farming?
- How do you see circular economy to impact your farm's business model?
- What new business opportunities do you see in enforcing circular economy in agriculture?

### **Policy experts**

- Tell me about your role in the organisation
- What is the role of the organisation?
- What is the role of the organisation in supporting farmers?
- What is the role of the organisation in advancing circular economy?

### Definition

- How do you define circular economy?
- What is the aim of circular economy? What is going to be achieved with it?
- How circular economy is going to be achieved? What are the central principles?
- How circular economy has developed in recent years? What is the current state?
- Is the circular economy a good way to achieve sustainable development in agriculture?

### Challenges

- What challenges do you see in implementing a circular economy in agriculture?
  - Any economic or technical?
  - Institutional or political?
  - Societal or cultural?
  - Environmental?

- How do you see circular economy opportunities to respond to the growing need for food production while reducing environmental impacts?

### Opportunities

- What opportunities do you see in implementing a circular economy in the agricultural sector? For the farmers? For the society?
- How can a circular economy be supported and incentivised in the agricultural sector?

### Practises

- What policies, initiatives or legislation are there that improve circular economy practices in the agricultural sector?
- How do you see that these policies respond to the challenges faced by the agriculture sector in implementing a circular economy? How about the opportunities?
- How do you believe circular economy impacts the business model of the farmers?

### Companies

- Tell me about your role in the company
- What does the company do? What is its role in the agriculture sector?
- What kind of connection does the company have with the farmers?
- What is the role of the company in advancing circular economy?

### Definition

- How do you define circular economy?
- What is the aim of circular economy? What is going to be achieved with it?
- How circular economy is going to be achieved? What are the central principles?
- How circular economy has developed in recent years? What is the current state?
- Is the circular economy a good way to achieve sustainable development in agriculture?

### Challenges

- What challenges does the company see in implementing a circular economy in agriculture?
  - Any economic or technical?
  - Institutional or political?
  - Societal or cultural?
  - Environmental?
- How do you see circular economy opportunities to respond to the growing need for food production while reducing environmental impacts?

#### Opportunities

- What opportunities do you see in implementing a circular economy in the agricultural sector? For the company? For the society?

#### Practises

- What policies, initiatives or legislation are there that improve circular economy practices in the agricultural sector?
- How do you see that these policies respond to the challenges the company faces in implementing them? How about the opportunities?
- How do you believe circular economy impacts the business model of the company?

## Appendix E.

### *Participants definitions of circular economy*

Farmer 1	Well, I understand that it is kind of a side stream coming from industries, agriculture and human consumption, like extras that can be recycled or utilised in other areas. [The aim is to] be able to make use of [the extra] and that it would be bringing positive things to someone else's operations. To reach the goal, cooperation and favourable political decisions [are needed]. I could believe that authoritative demands are expensive and time consuming in terms of action. More research and development. In the economic side, it should not become too expensive for the end user to utilise final products.
Farmer 2	I find it difficult to define, but I would believe that the resources would circulate and make use of them. If you think about fishing, we remove [excess] nutrients from the waters and then return [the remains of the fish] to the crop rotation. Overall, the aim is that the resources will suffice, as there is only limited stock, and we do not have other options. In many sectors, like the business world, the pressure comes from the consumers. Politically, decisions should put pressure into action. Also, an attitude change is needed to not idealise so to speak everything new and shiny, and accept that sometimes it is a bit more difficult.
Farmer 3	Well, it is probably something that we use things many times, like cow manure or some fertilisers, and it is probably also something that we take to recover the harmful substances, like plastics for example that we do not waste there [in nature]. [The aim is] to save nature or resources. I do not know [how to reach circularity].
Farmer 4	Using industrial or agricultural side streams and possibly utilising everything that is a waste to one, could be beneficial for another. Existing nutrients would be recycled efficiently, so that as little as possible new artificial fertilisers would be needed. From the user's perspective, the products should be easy to use.

*Participants definitions of circular economy*

Agrifood company	Utilising the side streams in some other products. It should not be a cost, but solutions should be found that make it economically profitable and competitive compared to virgin materials. So, a sustainable operation model that is economically profitable and utilises sidestreams. The aims are resource efficiency, responsibility, environmental sustainability and economically profitable new action. Essential is cooperation to find partners who to find solutions together with, and think about how to solve the bottlenecks to compete with the linear economy.
Policy expert 1	Using as few new raw materials as possible and aiming to utilise existing organic bio-derived or inorganic materials without risking for example food safety. It would be one of the founding principles of the Finnish economy. It would require a change in people's minds to utilise existing resources instead of constantly leaning toward new materials. CE would unite with the existing system, which requires a change in mindset and suitable market conditions to move CE forward.
Policy expert 2	Coming along as well as possible with the existing resources that we have, and using as few virgin raw materials. Additionally, we could support and preserve nature's circular flows and disturb it as little as possible. We would consume the planet in a way that everyone, including humans and all other species, could be as good as possible. It requires political will, which is related to the opinions of the voters, and therefore there is the dilemma of who should first change their behaviour and opinions. We need a lot more skills and an overall understanding of what the CE is and technical solutions. But also the change in ordinary people's behaviour and figuring out how we live, what we need, where our well-being comes from and how much we consume. With much less, we could live a much more satisfactory life than now.