

Strengthening Key Competences in Agriculture for Value Chain Knowledge “SKILLS”

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DIGITAL COURSE IN CIRCULAR AGRICULTURE

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CHAPTER 1

INTRODUCTION IN CIRCULAR AGRICULTURE

Chapter 1: Introduction in Circular Agriculture

The goal of this module is to explore an introduction to Circular agriculture (CA) at a HEI level. This digital course delves into the exciting and transformative world of Circular agriculture. As we navigate the challenges of our time, CA emerges as a powerful approach to build a more sustainable and resilient food system. This introductory chapter focuses on a comprehensive literature review, laying the foundation for your exploration of CA. SKILLS course in CA inspires students and teachers to learn not only circular agro-economy principles but also a policy-making tool to help achieve sustainability. Below we will explore our core points in CA and resources. It is important to familiarize yourself with each of these tools to better understand the thematic you will be working with.

1.1. Learning outcomes

By the end of this course, you will be able to:

- **Explain** why students and teachers should be educated about CA.
- **Describe** CA values for HEI.
- **Describe** CA core points and resources.
- **Identify** the key features of the CA.

Education about circular agriculture and food can present opportunities to students. Students bring their questions about food and circular agriculture to the classroom. However, circular agriculture is not recognized as a distinct subject in the SKILLS project HEI partner's curriculum, so few teachers have the expertise needed to share well-informed answers. If teachers or students search online sources for answers, they are likely to find conflicting, and possibly misleading, information. Circular agriculture is complex, so an informed consumer needs a thorough understanding of the perspectives and tradeoffs of agri-food practices. The education system, the circular agriculture and the agri-food industry owe students information about food and agriculture to fill a gap in food knowledge. When this gap is filled by myths about food and farming, those myths continually challenge the growth and progress of the agri-food industry. Educating students about food and circular agriculture can help dispel myths, create a deeper interest and connection to food, and promote local food. But education might do even more. The food and circular agriculture sector have real-world applications for university level subjects. For example, biology could lead to a specific application like plant or animal agriculture, followed by many career opportunities. We need to teach – because students are waiting to hear about the corresponding opportunities.

1.2. Target Audience

Our target audience is educators and their students, with an added focus on higher university level. We reach them using online resources, and we strive to have a meaningful and measurable impact. With this introductory course we remain committed to serving university educators by offering a carefully selected collection of state-of-the-art resources. Our goal is to have every teacher in at least the SKILLS partnership, but preferably beyond, to use one of our resources with this course. With the course in CA, SKILLS project needed to address the

gap at the university outreach to attract the interest of our future generation of customers and workforce. Our approach to higher education encourages critical thinking about food – where it comes from, how it is produced, and the facts about hot topics.

The CA course and its resources are available digitally. Educators are turning to technology for teaching and learning, so the education system has changed a lot in the last few decades. Students have changed their expectations too, as they are surrounded by technology in their home lives. Digital and online resources compete with blackboards and handouts. The course will be available from our project website but also via the partner's websites. The digital age has allowed us to track resource downloads and helps us monitor our impact on teachers and students.

1.3. Resource Library

Here, we will embark on a journey through research papers, articles, and reports about Circular economy, circular economy society and circular agriculture. The purpose for this review is to prove, that higher education students, academics, as well as agricultural producers and practitioners need green skills, which are relevant for circular economy society members and are represented in this learning material of digital course. The circular economy is defined as an economic system based on business models that replace the concept of "end-of-life" by reducing, alternatively reusing, recycling and recovering materials in production and/or distribution and consumption processes, thereby affecting the micro (products, companies, consumers), meso (eco-industrial parks) and macro (city, region, country, etc.) sectors of the economy. Levels to achieve sustainable development, which means creating environmental quality, economic prosperity and social justice for the benefit of present and future generations (Kirchherr, Reike, Hekkert, 2017). The circular economy is a socio-economic model that aims to minimise waste and resource depletion while maximising the durability and value of products, materials and resources. This concept contrasts with the traditional linear economy, where resources are extracted, converted into products, used and discarded as waste. In a circular economy, resources are continuously reused, renewed and recycled, creating a closed-loop system (Padilla-Rivera, A., Russo-Garrido, S., Merveille, N., 2020).

However, Padilla-Rivera, A., Russo-Garrido, S., Merveille, N. (2020) noted that while sustainability is highlighted as a key objective of the circular economy - to provide benefits to the environment, the economy and society at large - it currently appears that the main beneficiaries of the circular economy are the political and economic actors implementing the system.

In order to ensure that the benefits of the circular economy go beyond the political and economic actors that shape its principles, according to Jaeger-Erben M., Jensen C., Hofmann F., Zwiers, J. (2021), the circular economy paradigm needs to be complemented by the concept of 'society' in order to create an alternative paradigm that goes beyond growth, technology and market solutions. The addition of a societal component to the circular economy paradigm is linked to the idea that the transition to a circular economy is not possible without the commitment and participation of all members of society. The concept of a circular economy society frames the transition to circularity as a profound socio-ecological-economic transformation to which society must not only contribute but also benefit.

1.4. Concepts and state of the art

Circular agriculture represents a transformative shift from the traditional linear agricultural model of 'take-produce-consume-discard' to a more sustainable and regenerative system. This approach prioritizes the avoidance of waste and losses, the reuse and recycling of by-products, and the efficient utilization of nutrients and biomass to feed humans (Hoogstra et al., 2024). By adopting circular practices, agriculture becomes more robust and sustainable, benefiting both farmers and the environment. This enhances household food security, reduces dependency on external inputs, and fosters a self-sustaining and productive farming approach (Kansah-Dwamena, 2023). To keep resources in use for longer, extract maximum value from them whilst in use, and recover and regenerate products or components when they reach their end of life help Circular business models. Piscicelli, L., & Ludden, G. (2016) determined product-service systems, hiring and leasing schemes, collaborative consumption, incentivised return and reuse and 4 business models by grouping them under the broad categories of 'product-based', 'service-based', 'sharingbased' and 'supply chain-based' circular business models. Product-based circular business models are built around high quality products designed to last. Service-based circular business models the manufacturer or retailer retains the ownership of the product and acts as a service provider. Sharing-based circular business models enable an increased utilisation rate of products by making possible their shared use, access or ownership. Supply chain-based circular business models reduce the quantity of raw materials required to meet the market demand by recovering useful resources or energy out of disposed products and byproducts. Circular agriculture, also known as closed-loop agriculture, promotes farming in harmony with nature, ensuring that nothing is wasted (Schouten, 2020; Toop et al., 2017).

Circular agriculture offers a compelling framework for transforming modern farming into a more sustainable and environmentally friendly practice. By moving away from the exploitative 'take-produce-consume-discard' model, circular agriculture promotes the efficient use of resources, minimizes waste, and fosters a regenerative approach to farming. This system not only enhances food security and reduces reliance on external inputs but also contributes significantly to the preservation of ecosystems and the mitigation of climate change. As scientific advances and new technologies continue to evolve, the implementation of circular agriculture will be crucial in ensuring that agricultural practices meet the needs of the present without compromising the ability of future generations to meet their own needs. The integration of circular economy principles into agriculture thus represents a vital step towards achieving a sustainable and resilient food system.

Farmers have a key role to play in the transition to a circular economy society, as according to Nordin et al. (2022), global agricultural production needs to increase by 70% in 2050 to meet food demand. But it is the challenges we face. The food supply system, on which we all rely, is threatened by climate change and biodiversity loss. Changing our food system to one based on the principles of the circular economy is one of the most powerful things we can do to tackle climate change and build biodiversity, provide healthy nutritious food for all. When implementing the principles of circular agriculture, it is very important to look for business models and strategies that meet the concept of sustainable development, as well as new ways of farming. Due to its various advantages, the circular economy is still the most

revolutionary concept in modern agriculture, with the potential to make agricultural practices more accessible and practical.

In circular agriculture, all steps of the food system from growing, harvesting, packing, processing, transporting, marketing, consuming and disposing food are designed with a view to promoting sustainable development. Primary agriculture and processing, agro services circular agriculture considerations in organizing the production and adaptation of the value chains. Farmers are rational business people. They farm according to the principles of the market, the dynamics of the market, which are created through the food system. Green competences, circular economy leadership could play a key role in this system, it could be achieved that more farmers can and want to farm more sustainably. Farmers help to regenerate nature by choosing regenerative farming's strategy. The chosen farming strategy helps create not only benefits for the farmer but also for society: climate; soil health; resource use efficiency; biodiversity; prosperity. Regenerative agriculture improves long-term farmer livelihood through reduced costs, improved crop yield and crop quality, and greater resilience to market volatility and extreme climate events. It also opens new green revenue streams for farmers, such as rewarding them for carbon capture and storage in the soil (World Economic Forum, 2023).

Table 1. Different definitions of circular agriculture

Definitions of circular agriculture	Key objects
Circular agriculture is a closed-loop system in which nothing is wasted (Toop et al., 2017).	a closed-loop system, nothing is wasted
Circular agriculture is known as closed-loop agriculture, a method of farming with nature, rather than against it (Schouten, 2020).	closed-loop agriculture, a method of farming with nature
Circular agriculture is defined as a facet of the circular economy that targets the challenges of the farm-based rural economy and environmental issues (Atinkut et al., 2020).	aspect of the circular economy, to solve economic and environmental problems
Circular agriculture is a shift away from the current exploitative ways of growing food that destroy soil fertility, contribute largely to greenhouse gas emissions and leave little space for wilderness to a model that regenerates and cares for nature (Marinova, Bugaeva 2020).	a model that regenerates and cares for nature
Circular agriculture is an effective approach for the management of soil organic inputs that improves soil fertility and cropping system sustainability (El Janati et al., 2021).	an effective approach, improves soil fertility and cropping system sustainability
Circular agriculture is a way to farm sustainably, while making use of scientific advances, innovations, and new technologies (Helgason, Iversen, Julca, 2021).	a way to farm sustainably, scientific advances, innovations, and new technologies
Circular agriculture contributes to a more robust and sustainable food system, benefiting both farmers and the environment. The adoption of circular practices enhances household food security, diminishes external input dependency, and fosters a self-sustaining and productive farming approach (Kansah-Dwamena, 2023).	more robust and sustainable food system, a self-sustaining and productive farming approach
Circular agriculture is to move from the current ‘take-produce-consume-discard’ model to one in which waste and losses are avoided, where by-products are reused and recycled and nutrients and biomass are used more efficiently to feed humans (Hoogstra et.al., 2024).	waste and losses are avoided, products are reused and recycled, more efficiently

1.4. The need for CA in HEI

This Digital Course in Circular Agriculture equips higher education students, academics, as well as agricultural producers and practitioners with the green skills needed to thrive in a circular economy society. This course is for circular society members who are passionate about circular agriculture – and provides the knowledge to transition towards a more sustainable future. Using innovative content and tailored materials, learners will explore ways to enhance resource efficiency, profitability, and environmental responsibility in agricultural production, how to implement the principles of circular agriculture. Also, this course empowers stakeholders within the agricultural sector to embrace circularity and become drivers of positive change. By equipping the green skills needed to implement circular agriculture practices effectively, society can significantly reduce their environmental impact, improve the economic viability of farms, other business organizations, institutions and even create new jobs. Furthermore, the course will catalyze innovation and collaboration across agricultural value chains, paving the way for a widespread adoption of circular economy principles in our food system. The survey conducted in the partner countries of the project showed that their universities have curricula or at least separate courses that teach the basics of circular agriculture, and the educational materials and tasks created in this course can be easily integrated into existing courses.

For example, in the Faculty of Bioeconomy Development in Agriculture Academy of Vytautas Magnus University in Lithuania organize and implement several study programs related to the circular economy and circular agriculture. There are first cycle study program “Sustainable Bio-Business Management”, the second cycle (master) study program “Agricultural economics”, the broader master's degree program "Rural Development Administration". These study programs aim to provide knowledge, skills about circular economy and circular agriculture, sustainability and related decisions. In the study program descriptions note that in order to develop the bioeconomy as a separate sector of the economy, sustainable bio-business management specialists are needed who are able to perform management functions, who have the knowledge and abilities necessary to manage and develop organizations, who are familiar with management processes, technologies for the production, sustainably processing and conversion of biological resources, who understand the economic, political, legal and social context in global society, able to evaluate it and make management decisions in business and public organizations operating in the bioeconomy sector and government institutions responsible for the sustainable development of the bioeconomy sector striving to implement circular economy. Are study subjects taught at the University, which are closely related to the development of circular agriculture. For example, “Fundamentals of Circular Economy”, “Sustainable food systems”, “Sustainable project management”, “Strategic management of rural development”, “Analysis of Agriculture and Rural Development Policy” and others.

The Romania state-of-art of current ag-programs offered at the faculties of agriculture in moving towards circular agriculture. Outstanding study programmes and faculties in Romania: “Agroalimentary Economics” Sapientia Hungarian University of Transilvania. Faculty of Technical and Human Science study programme “Agricultural Engineering”. In Agricultural Economics students’ study “Sustainable Economic Development”, “Circular Economy”. There

students can learn about the history of the circular economy, local good practices and the sharing economy. The master study program of “Management and Organisation”. Students in the first year, first semester, in the subject “Sustainable and Regional”, have a lecture on the circular economy and the indicators of the circular economy, more specifically, how to measure the circular economy.

The curricula of Greek Agricultural Universities have (plus University of the Aegean, School of the Environment, Department of Food Science and Nutrition) many courses, related with Circular economy. Agricultural University of Athens, Department of Plant Production Science “Environmental management and protection”, Department of Forestry and Natural Environment “Climate Change & Forest Ecosystems” and “Citizen education for the natural environment”, Department of Animal Production Science, “Environmental Management and Protection option”, Department of Natural Resources Utilization & Agricultural Engineering” Soil environmental Physics – Reuse of Treated Liquid Waste” and “Waste Treatment and Management”.

Although there are university and other study programmes in the partner countries that focus on circular agriculture, the research carried out in the first and subsequent phases of this project shows that there is still a lack of in-depth knowledge and green skills in circular agriculture among the public. So, this digital course material is not only intended for self-learning by those interested, but also as a complement to formal study programs.

1.5. Personal Benefits

The need for professional circular economy specialists is based on the provisions of the 2030 Agenda for Sustainable Development (2015), adopted by the United Nations (UN), the European Union (EU) Growth Strategy “European Green Deal” and other strategies require a fair transition to national, regional and local public administration systems, focusing on the integrated/inclusive development of the territory, bringing together local resources without leaving anyone behind. The overarching aim of the European Green Deal is for the European Union to become the world's first “climate-neutral bloc” by 2050. The European Green Deal of the EU's strategy for sustainable and inclusive growth is at the heart of the link between healthy people, healthy societies and a healthy planet's sustainable food system. The green course in the transition to circular agriculture is intended to stimulate the economy, improve people's health and quality of life, and nurture nature. The management of these processes and activities requires professional, proactive circular agriculture development specialists who assume leadership based on evidence, experience, and knowledge. In order to participate effectively in and benefit from the circular economy, its members need to have a high level of green skills (knowledge, values, behavior and abilities that enable them to integrate into green jobs. Thus, promoting the inclusion of society in the circular economy requires action not only by business organizations but also by government and educational institutions, to ensure that members of society receive the necessary training and acquire the knowledge and skills to perform the jobs that are relevant to the needs of the circular economy (Padilla-Rivera, A., Russo-Garrido, S., Merveille, N., 2020).

a) Develop skills

You will be able to develop your own CA literacy skills which will allow you to carry the subject matter expertise in agriculture throughout your career. You are also now equip to answer important questions that students are curious about.

b) Network

The SKILLS CA course allows you to build a network with teachers and teacher candidates from SKILLS partner countries. Through participating in discussion boards located within the modules, you will be able to build your teaching and agricultural tool kit by sharing and learning from their colleagues.

c) Become informed

There are benefits to your personal life too. What you learn about circular agriculture can help you become an informed consumer. If you have ever struggled with terms like sustainability of food security, value chain for minimizing waste resources, megatrends, concepts and factors of CA you will have the chance to learn the facts. You might develop an informed opinion that can give you confidence in your teaching decisions.

1.7. Activity: Develop an elevator pitch

SCENARIO: You are leading a lesson with your students around circular agriculture. You start to speak, remember key terms, and then pause. Where do you start?

MAKING A PITCH: An elevator pitch is a 20-30 second, compelling speech. You will use it to describe how you will hook students into understanding the importance of circular agriculture. It should be interesting and sound natural in conversation. The speech should be prepared in advance, so it is a clear and succinct explanation. In this activity, you will develop your own elevator pitch.

To do so, follow these steps:

a) *Identify your goal*

Describe the goal of circular agriculture – with a focus on how it relates to your students.

b) *Be engaging*

Communicate what you want your audience to remember most about you. A great pitch shows your enthusiasm and attracts your listener's attention.

c) *Communicate uniqueness*

Identify what makes circular agriculture a unique sector that is filled with potential.

Consider the messages from this list:

Every 1 in 8 jobs in Europe is in the agriculture sector.

Over 2.1 million people directly or indirectly interact with your food from farm to table.

By 2050, there will be over 9 billion people on planet Earth.

Food travels on average 4500 km to reach our plates.

Every 1 in 8 households in Europe are experiencing food insecurity.

1.8. Conclusion

In conclusion, the advancement of circular agriculture is intrinsically linked to the broader goals of a circular economy society and the cultivation of green skills among its members. This integrated approach not only ensures the sustainability and resilience of agricultural systems but also contributes to the overall sustainability of our economy and environment. Through the adoption of circular practices and the development of green skills, circular economy society members, were farmers and other stakeholders of the agricultural sector, have a key role and can play a pivotal role in creating a sustainable future for all. This digital course analyses and introduces learners to topics relevant to the transition to circular farming:

1. Objectives and potentials of CA
2. Sustainability of food security in CA
3. Value chain for minimizing waste resources in CA
4. Megatrends, concepts and factors of CA
5. Case studies of CA and Best practices implied in CA

The topics analyzed and presented in this digital course will provide learners with the necessary knowledge and green skills to successfully transition their operations and farms to the topic of circular farming. Each topic is given its own chapter with a detailed overview of the concepts, explanation, practical examples and, where possible, related exercises.

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