

ANALYSIS OF SKILLS AND ABILITIES REQUIRED BY THE LABOR MARKET FOR THE DEVELOPMENT OF CIRCULAR ECONOMY IN THE RURAL AREAS OF ROMANIA

Angelica MUȘAT¹, George Adrian MUȘAT², Constanta Laura ZUGRAVU¹,
Gheorghe Adrian ZUGRAVU¹

¹“Dunărea de Jos” University of Galați, 47, Domneasca Street, Galați, Romania, E-mails: angelica.musat@yahoo.com, zugravulaura@yahoo.com, zugravuadrian@yahoo.com

²National University of Science and Technology “Politehnica Bucharest”, România, E-mail: musatgeorge5@gmail.com

Corresponding author: zugravulaura@yahoo.com

Abstract

This paper proposes a forward-thinking approach to education management by identifying key emerging skills and capabilities that can drive innovative, cross-sector training programs. These efforts are designed to support the circular economy in rural regions and empower the creation of sustainable, future-ready business models based on the smart exploitation of resources and also using the knowledge and entrepreneurial skills needed by students to increase their employment and career opportunities, especially in the rural circular economy. The set of activities in the circular rural economy refers to all the economic activities of production, transformation and marketing of services, agricultural and forestry products and by-products and food, which are carried out by enterprises located in rural areas. The purpose of this questionnaire-based analysis is to identify new skills and personal abilities that students in rural areas need to acquire. Overall, the study concludes that fostering multidisciplinary, skills-based education is key to empowering rural populations and promoting sustainable economic growth through the circular economy.

Key words: education management, circular economy, rural areas

INTRODUCTION

The circular economy aim is to minimize environmental impact while maximizing resource efficiency [3]. In the rural area of Brăila, Romania, this model presents a valuable opportunity to revitalize the local economy, diversify income sources, and enhance environmental protection [23]. However, successfully implementing the circular economy in rural contexts demands a fundamental shift in how natural resources, agricultural production, and the consumption of goods and services are managed.

An essential part of this transition is the adaptation of farmers' and agricultural workers' knowledge and skills to meet the evolving demands of agriculture within a circular economy framework [9]. In this context, digitalization plays a crucial role in preparing the future workforce, providing tools for acquiring the competencies increasingly sought by employers [18].

To enable this shift in Brăila's rural areas, it is critical that the local workforce possesses a robust set of skills and abilities [13], [11]. These include not only technical knowledge in recycling and waste management [14], but also a solid understanding of ecological and economic processes, technological innovation, and sustainability education [13], [6], [7].

A comprehensive analysis of both short- and long-term skill requirements is necessary, one that reflects the regional context and its development potential [17], [5], [2]. This paper aims to identify the key competencies needed to support the implementation of the circular economy in Brăila's rural areas, considering current labor market needs and the existing landscape of vocational education and training. Additionally, we examine how local authorities and relevant organizations can adapt their strategies to facilitate this transition—placing a strong emphasis on continuous education and the development of human capital capable of addressing the

challenges and opportunities brought about by the circular economy.

MATERIALS AND METHODS

To identify the skills and abilities required by the labor market for the development of the circular economy in the rural areas of Brăila, Romania, a multidisciplinary approach combining theoretical research and field analysis will be used. The purpose of this research is to identify labor market requirements in the region, examine existing skills gaps and suggest directions for training and developing the human resources needed. A quantitative research approach was employed through the use of a structured survey questionnaire. The survey aimed to gather insights from key stakeholders actively involved in rural economic activities, including local employers, agricultural producers, vocational education providers, public authorities, and representatives of environmental organizations.

The questionnaire was designed to explore several key dimensions:

Awareness and understanding of the circular economy concept.

Current and anticipated skills gaps related to circular practices.

The perceived importance of specific technical and soft skills (e.g., digital literacy, sustainable resource management, entrepreneurship, problem-solving).

The role of education and training in preparing the rural workforce.

Opportunities and barriers to implementing circular economy practices.

The survey consisted of both closed-ended and Likert-scale questions, allowing for both statistical analysis and the identification of trends in stakeholder perceptions.

The questionnaire was distributed online and in person over a period of 2024, reaching a sample size of 100 respondents across the Brăila rural area.

The collected data was analyzed using descriptive statistics to identify the most in-demand competencies and to highlight the gaps between current workforce capabilities and future labor market needs. The findings were

then interpreted in the context of regional development strategies and the potential for sustainable transformation through the circular economy.

The questionnaire was developed using Google Forms and distributed via email to 100 managers in the agricultural sector in Brăila County, achieving a response rate of 90%.

The questionnaire complies with the regulations of the Ethics Commission of the "Dunarea de Jos" University of Galati, and this interview was conducted with the consent of the interviewees.

The responses were reviewed for completeness and consistency, and only fully completed questionnaires were included in the final analysis.

The equation for calculating the sample size is presented below.

$$n = \frac{N}{1 + N(e)^2} \dots\dots\dots(1)$$

where:

- n is the sample size
- e is the margin of error
- N is the size of the number of agricultural firms in Brăila County.

To ensure data validity, duplicate or incomplete entries were excluded, and logical checks were applied to identify any inconsistencies in the responses.

For 824 agricultural firms from Braila county, the sample of 86 valid questionnaires, a confidence level of 90% was obtained (Table 1).

The analysis was conducted using Microsoft Excel, enabling the identification of key competencies required for the implementation of the circular economy in the local agricultural context.

The results were interpreted in relation to the current labor market needs and the specific characteristics of rural economic activities in Brăila County.

Table 1. Distribution of respondents by age

Variables	Category	No.	%
Sex	Male	40	46.51
	Female	46	53.49
	18–20	9	10.46
	21–30	15	20.2
	31–40	18	14.6
	41–50	23	30.3
	51–60	12	15.6
	>60	9	10.46
Place of birth	Rural	43	50.0
	Urban	43	50.0

Source: Results based on the questionnaires.

Comparing the data obtained from surveys and interviews with the labour market requirements can identify skills gaps and propose measures to close them through training and education.

RESULTS AND DISCUSSIONS

The participation of different age groups in the survey allows us to state that the most truthful answers to the questions in the questionnaire are expressed.

Investigating the number of people who know the concept of circular economy shows that 27.8% of respondents have not heard of this concept (Figure 1).

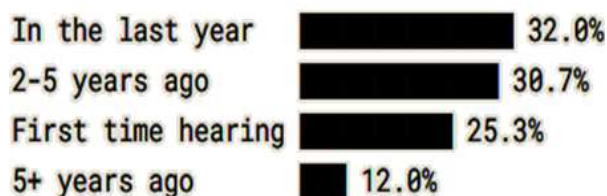


Fig. 1. Answers to the question: When did you first hear about the circular economy?

Source: Own processing based on the survey.

Regarding the need for specialization in the circular economy, the survey shows that over 72% of agricultural managers believe that the implementation of business models in the circular economy requires the training of specialists (Figure 2).

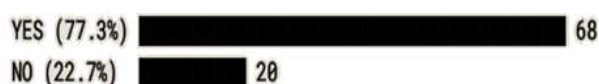


Fig. 2. Answers to the question: Do you think that business needs specialized professionals to implement innovative circular economy models in business?

Source: Own processing based on the survey.

In the last five years, it is noteworthy that new skills have been introduced into the business model regarding communication, IT (Figure 3).

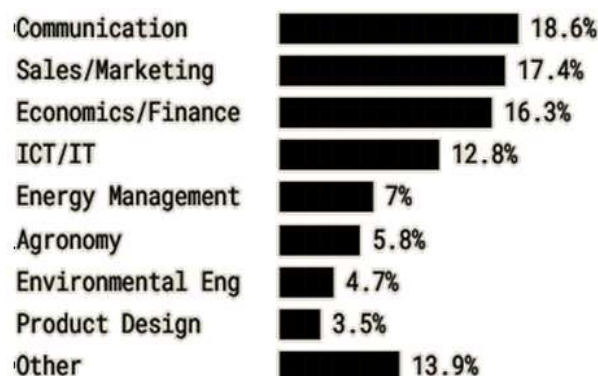


Fig. 3. Answers to the question: What skills have you added to your team (new employees or collaborators) in the last 5 years?

Source: Own processing based on the survey.

For the next five years, the interviewed managers believe that the main skills that will be needed are communication, marketing and environmental engineering (Figure 4).

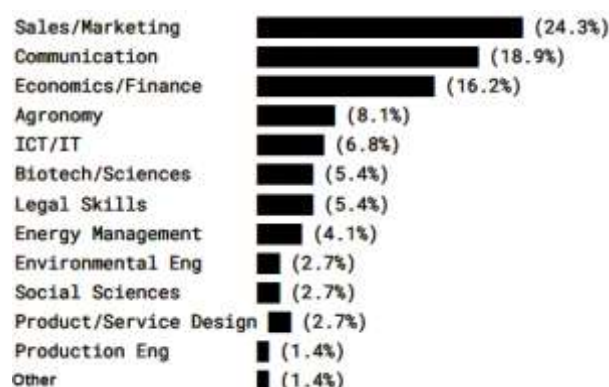


Fig. 4. Answers to the question: What skills have you added to your team (new employees or collaborators) in the next 5 years?

Source: Own processing based on the survey.

Managers from rural areas believe that the main skills needed in the circular economy for a career in the economic field are the ability to develop strategies and communication techniques (Figure 5).

The main skills that managers consider essential for a career in industrial production within the circular economy are represented by the ability to maximize the value of by-products obtained, waste management and technological innovations (Figure 6).



Fig. 5. Answers to the question: What are the skills needed on the labor market for a career in the circular economy in rural areas in the economic field?
Source: Own processing based on the survey.

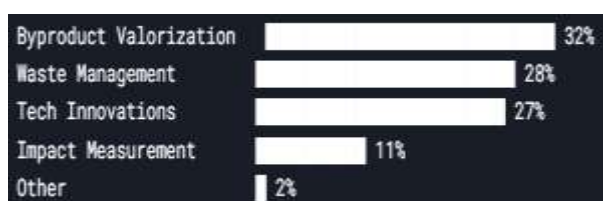


Fig. 6. Answers to the question: What are the skills needed on the labor market for a career in the circular economy in rural areas in the field of industrial production?
Source: Own processing based on the survey.

The main skills that managers consider essential for a career in resources management within the circular economy are represented by the ability to sustainably manage the potential of natural resources (Figure 7).

The main skills that managers consider essential for a career in business management within the circular economy are represented by business management strategies for the circular economy (Figure 8).



Fig. 7. Answers to the question: What are the skills needed on the labor market for a career in the circular economy in rural areas in the field of resource management?
Source: Own processing based on the survey.

Following an in-depth analysis of the labor market in Brăila, along with a thorough review of the relevant academic literature, a series of key skills and competencies essential for the development of the circular economy in the county's rural areas have been identified [8], [4]. These competencies are not only fundamental to supporting the transition toward a sustainable economic model, but also

to enhancing regional competitiveness and attracting investment.



Fig. 8. Answers to the question: What are the skills needed on the job market for a career in the circular economy in rural areas in the field of business management?
Source: Own processing based on the survey.

Within rural contexts, waste management emerges as a core component of the circular economy. Professionals operating in this sector must demonstrate a comprehensive understanding of recycling mechanisms, waste separation techniques, and material reuse strategies.

Also, waste management skills in agriculture are essential to minimize losses and valorize agricultural by-products (eg composting) [12], [1], [15].

Increasing interest in renewable energy sources (eg solar panels, wind turbines) and in technologies that reduce resource consumption requires the vocational training of workers in rural areas.

Implementation of agricultural practices that minimize environmental impact and capitalize on circular processes (eg use of organic fertilizers, crop rotation, efficient water management).

Within the circular economy, farmers and entrepreneurs in rural areas must adopt innovative technologies to reduce waste and increase efficiency in production. This requires knowledge of technologies such as 3D printing, robotics, the use of sensors to monitor the environment and resources.

Digital skills are essential to track material flows and implement smart resource management solutions. These competencies play a critical role in facilitating the transition toward a circular production system [20], [19], [21]. The emergence and growth of businesses grounded in circular economy principles represent a sector with significant potential for innovation and sustainable development.

Farmers and entrepreneurs need to be educated about the economic opportunities of recycling, reusing and reusing materials.

Circular economy business planning and management skills are fundamental to ensure long-term sustainability and profitability. These skills include resource management, green accounting, and knowledge of environmental regulations.

As the circular economy involves multiple sectors (agriculture, industry, recycling), collaboration skills between various entities (companies, local authorities, non-governmental organizations) are essential.

It is essential that workers in rural areas participate in continuing training programs to acquire the new skills required by the circular economy. Education and training play a central role in preparing the workforce for the future.

In many rural areas of Brăila, the infrastructure for recycling and waste management is not sufficiently developed. This is a major obstacle to the implementation of the circular economy, as it requires significant investment in recycling facilities and waste collection centres.

Many farmers and entrepreneurs in rural areas may be reluctant to adopt new technologies and business models.

A key challenge in advancing the circular economy is shifting mindsets and raising awareness about its long-term benefits. In Brăila, as in many other rural regions of Romania, there is a notable lack of specialized vocational training in areas closely tied to the circular economy, including waste management, green technologies, and agricultural innovation.

Romania has access to European funding aimed at supporting the transition toward a sustainable economy. These resources can be strategically invested in infrastructure development, training initiatives, and innovation projects that drive circular practices forward.

Brăila County, with its strong agricultural heritage, stands to gain a considerable competitive advantage by embracing circular economy principles in agriculture. Through more efficient resource management, reduction of waste, and the valorization of agricultural

by-products, local farmers can enhance productivity and sustainability.

Strengthening collaboration between local authorities, the private sector, and non-governmental organizations is essential for the successful implementation of circular economy initiatives. Potential projects include the development of recycling centers, digital education platforms, and networks for sharing best practices.

To address the skills gap, it is imperative that public authorities and vocational training providers design educational programs tailored to the needs of the local labor market. These programs should cover critical areas such as waste management, innovation in agricultural practices, and circular entrepreneurship.

Establishing partnerships between local government, businesses, and educational institutions can further support workforce development and accelerate the adoption of circular economy models.

Following the analysis of labor market demands and the skills required to foster the circular economy in Brăila's rural areas, several essential conclusions emerge. The competencies necessary for this transition are both diverse and interdisciplinary, spanning technical and soft skills.

Successful implementation of circular economy practices in Brăila's rural context calls for expertise in waste management and recycling, innovation in agricultural systems, proficiency in green and digital technologies, and strong entrepreneurial and sustainable management capabilities. At the core of these competencies lies the ability to manage resources efficiently and to apply innovative solutions that minimize environmental impact. Lack of infrastructure and specialized education are significant barriers.

In many rural areas of Brăila, the necessary infrastructure for waste management and recycling is insufficiently developed. This deficit represents a major barrier to implementing the circular economy on a large scale, as resources are not properly harnessed. Moreover, the absence of targeted professional training programs in the field of circular economy significantly contributes to the skills gap within the local workforce.

There is a significant gap between labor market requirements and available skills, which requires the development of continuous education and training programs adapted to the new economic and ecological realities.

Brăila's agricultural potential represents a strategic advantage in advancing the circular economy. With a well-established tradition in agriculture, the county is well-positioned to integrate circular economy principles into farming practices, generating both economic and environmental benefits. The adoption of sustainable methods—such as composting, water reuse, and efficient resource management—can play a pivotal role in supporting the transition toward a circular agricultural model.

The integration of circular economy practices within the agricultural sector can enhance production efficiency, lower operational costs, and generate new economic opportunities. Access to funding and support from the European Union plays a crucial role in this process. European funds serve as a vital resource for advancing circular economy initiatives in the rural areas of Brăila, enabling investments in sustainable technologies, infrastructure, and training programs.

These funds can be used to develop recycling infrastructure, support technological innovation and implement training and vocational education projects.

Local authorities and businesses can benefit from these funds to develop innovative solutions and encourage the transition to a greener and more sustainable economy.

Continuing education and training are crucial. One of the key findings of this analysis is the pressing need for continuous training. To ensure the workforce can meet the evolving demands of the circular economy, it is essential for public authorities, educational institutions, and vocational training providers to collaborate in developing and delivering specialized education and training programs tailored to this sector.

These programs should address not only technical competencies, but also essential skills in management and entrepreneurship. A comprehensive skillset is critical for fostering

innovation and ensuring the sustainability of circular economy initiatives.

Effective implementation of the circular economy relies heavily on robust collaboration between the public and private sectors. Creating a supportive framework for its development requires the active engagement of local authorities, private enterprises, and non-governmental organizations. This multi-stakeholder collaboration can drive the implementation of joint projects, the formulation of favorable public policies, and the development of innovative economic solutions.

Moreover, public-private partnerships play a key role in facilitating access to financial resources, advanced technologies, and specialized expertise, thereby accelerating the transition to a circular economy [22], [16], [10].

Strategic Recommendations for the Future:

- Development of a Local Strategic Plan for the Implementation of the Circular Economy in Brăila – This plan should outline clear objectives, priority areas for action, and mechanisms for stakeholder coordination to ensure an integrated and effective transition to a sustainable economic model, which includes investments in infrastructure, professional training and the promotion of collaboration between sectors.

- Creation of continuing education and training centres offering courses and specializations in areas such as waste management, green technologies and agricultural innovation.

- Supporting rural entrepreneurship through financing and advisory programs.

- The utilization of European funds to support projects focused on the development of ecological infrastructure and the promotion of technological innovation within the agricultural and industrial sectors.

CONCLUSIONS

For Brăila, the transition to a circular economy presents a major opportunity for both economic growth and environmental sustainability. However, realizing this potential requires strategic investments in the development of key sectors, ensuring a smooth

and successful shift towards a sustainable economic model of workforce skills, in infrastructure and in the formation of sustainable partnerships between local authorities, the private sector and other relevant entities. Through an integrated and strategic approach, the circular economy can become an engine of sustainable development in the rural areas of Brăila.

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