DOI: https://doi.org/10.55505/sa.2022.1.22
UDC: 338.45:664.85

ENTERPRISE-LEVEL ANALYSIS ON AWARENESS, PRACTICES AND BARRIERS OF CIRCULAR ECONOMY IN THE FRUIT PROCESSING SECTOR: IN ARMENIA

Davit MARKOSYAN

Abstract. The current production model in the agri-food industry is not environmentally conscious and as a result, we face the challenges of extensive and inefficient resource use along with a massive amount of waste. The major objective of this study is to analyze the awareness, practices, and corresponding barriers among the selected enterprises on the circular economy. Both quantitative and qualitative research methods have been used in this study. A survey-based questionnaire has been designed by the author and 40 companies operating in the fruit processing sector (dry fruit and jams production) have been asked to fill in the survey. The results show that although 80% of the respondents are aware of the circular economy, the practices are not intensively implemented and the barriers associated are very diverse including financial burdens such as access to agricultural credits, lack of practical knowledge, and the necessary infrastructure as well as small production volumes, which doesn't promote innovation and alternative production in the enterprises.

Key words: Circular economy; Circular businesses; Fruit processing; Sustainable production; Environmental protection.

INTRODUCTION

The concept of circular economy

The economic model of linear production is not sustainable anymore due to the irreversible impact it has on the planet. Not only the present generation suffers because of the current environmental crisis, but also the future generation may experience a significant decrease in life quality because of climate change, land degradation and biodiversity loss. It is noteworthy that the unprecedented growth in demand for various goods and products is accompanied by extensive resource use and improper practices of waste management.

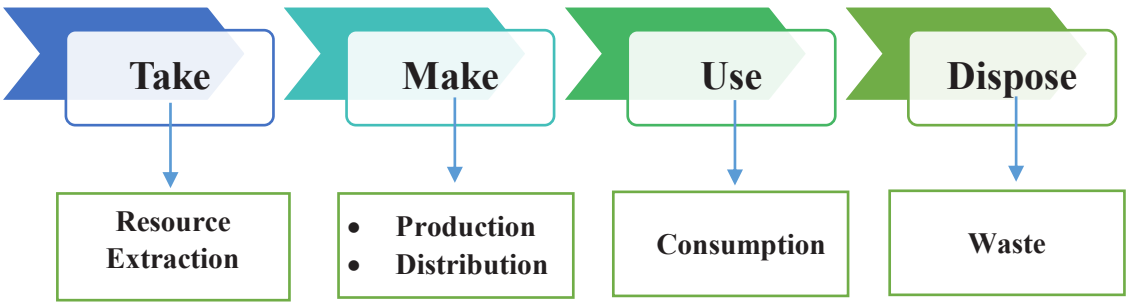


Figure 1. Model of Linear Production

Therefore, the transition to a new and circular model of production seems to be an imperative of the day. The circular economy has attained wide recognition in different countries due to the positive impact it brings to the society and environment. It is mainly governed by the 3Rs model, which is "Reduce-Reuse-Recycle". In this model, waste is minimized and practically, it can be used in production as a valuable resource. Other resources in the production can be reused multiple times and are manufactured in such a way that they can be recycled after certain stages. According to Bram Bet and Judith Kas (2018), a circular economy focuses on long-term ecological and social sustainability.

Nevertheless, practices in the circular economy are not widely applied in the world and more awareness and knowledge capacity should be built for extending its applicability in the business environment. According to Z. Ahmed et al., compared to the developed countries, the developing countries rarely apply the concept of the circular economy (Ahmed, Z. et al. 2022).

There are many barriers for the transition to the circular economy and there is a lack of information on circular practices and an enterprise-level analysis in the literature (Gedam, V. et al. 2021).

According to the Circularity Gap Report (2018), only 9.1% of the global resources are reused in the economy, which puts huge pressure on the planet to overshoot its capacity. It is striking to note that Earth is currently operating at 140% of its capacity and based on some estimations this number will reach up to 200% (Robertson, M. 2014).

Food Industry and Circular Economy

Currently, the food industry is responsible for the massive waste and inefficiency during production. Enterprises in this sector are mainly linear, thus a considerable number of resources are extracted and only a small amount of waste is reused (Ritchie, H., Roser, M. 2020).

In fruit and vegetable industries, leaves, peel, pomace, rind, stem, seeds, spoiled fruits and vegetables are considered as waste (Narasimmalu, A. et al. 2020) and waste in food production is generated in almost all of the units of the supply chain starting from the production of raw materials (fruits and vegetables, milk, meat, etc.) to the storage and processing. Therefore, the implementation of the circular economy in the food industry can be a significant step towards more sustainable food production without intensely exploiting natural resources and jeopardizing the future of the upcoming generations.

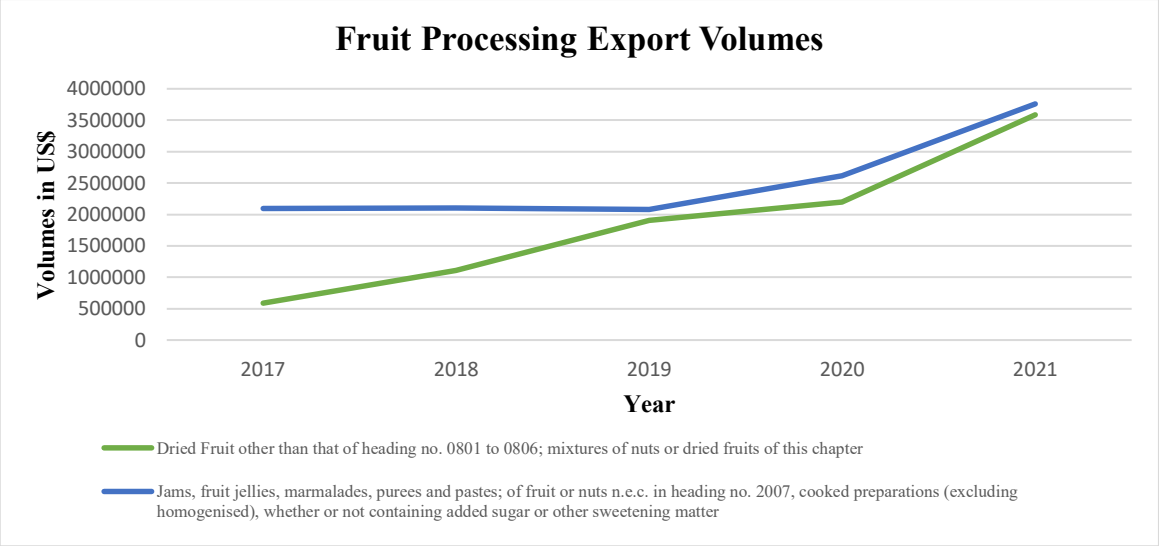


Figure 2. ***Export of processed fruit commodities***

The food processing sector, in particular, is one of the most strategic sectors in Armenia since it ensures employment in the rural areas being a major source of income. During the past 5 years, some organizations have also succeeded in the international market increasing the export volumes of processed fruit.

According to UN Comtrade (2022), which is a repository of official international trade statistics, the exports of the following commodities in fruit processing have been steadily increasing over the past few years. The amount of export has significantly slumped in 2020 due to the pandemic, that hit the trade all over the world.

According to the Ministry of Economy of Armenia (2020), a considerable amount of fruit products is acquired by the processing firms, which indicates that production volumes are increasing year by year. It is noteworthy that the assortment of the fruit products used in the processing is very diverse, however, the biggest share in the mix belongs to apples, peaches and apricots. To further develop the sector, the Government of Armenia has enacted various policies and programs providing farmers and businesses with incentives to increase production volumes. However, many enterprises process the raw materials with conventional methods of production and it generates a huge amount of waste, which in its turn causes a negative environmental impact.

Waste in food production can be a valuable resource in production due to the nutrients it contains. They can be used in manufacturing by-products, composting, making soil conditioners, etc.

MATERIALS AND METHODS

Quantitative and qualitative research methodologies were applied for this study. A survey-based questionnaire was used to gather primary data. The entire process was composed of three major phases: designing the survey, data collection and data analysis.

The questionnaire was divided into three parts: demographic data on the enterprises selected, awareness of the concept of circular economy and practices applied for the relevant barriers. After the literature review, the method applied by Masy Donato et al. (2018) was considered relevant also for this particular study with some alterations.

Since the practices of the circular economy are many, a literature review has been performed and the selected practices have been distributed among three categories: resource and energy use, waste management and product design. In order to extract specific practices from the literature, the following keywords have been used "circular economy" AND "practices", "circular design", "waste management", "resource efficiency" and the barriers were identified with the same logic using the keywords "circular economy" AND "practices" AND "barriers".

The interviewees were asked about the practices they apply and the answer section was composed of the following options: "Yes", "No" and "Planning to implement". As for assessing the awareness of the circular economy among the enterprises, the interviewees were asked to list a few practices of the circular economy and also make a self-assessment of their knowledge on a scale from 1(not aware) to 5 (perfectly aware).

According to the Ministry of Economy (2020), there are about 69 enterprises in the fruit and vegetable processing sector and eight of them are relatively large. On the other hand, there are about 350 individuals and legal entities in the production of dried food products and spices, out of which six are medium-sized enterprises (Chir LLC, Aveliats LLC, Gyughi Tatik LLC, Armen Manukyan and Hasmik Mirzoyan private entrepreneurs, Vayk Group CJSC), while the rest are microenterprises.

For this study, 40 small and medium enterprises operating in the fruit processing sector (dry fruit and jams production) were selected. Different web resources were used to find their contacts including the list that is uploaded on the website of the Ministry of Economy.

RESULTS AND DISCUSSIONS

Descriptive Data and Awareness Analysis

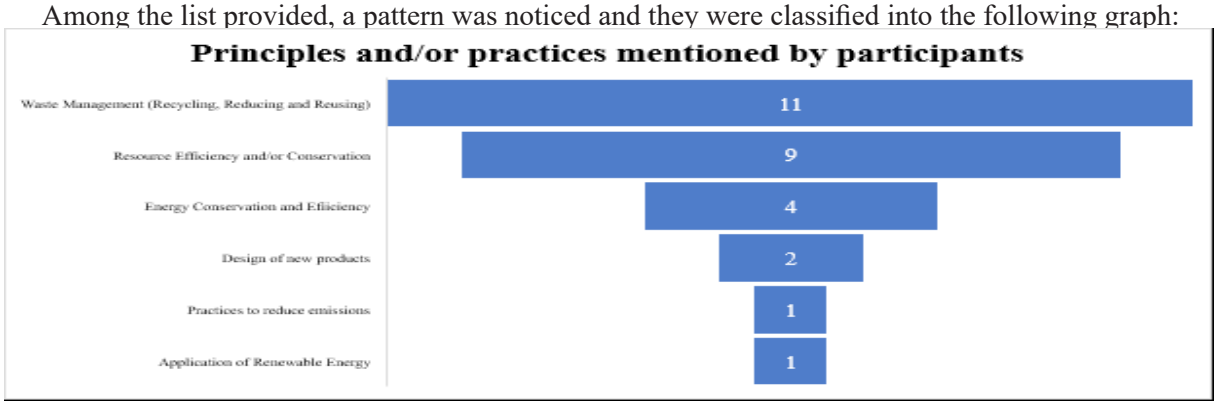
The majority of the respondents from the selected companies were founders (58%), executive directors (19%), managers (9%) and 14% represented other categories such as quality assurance specialists, technologists and specialists in marketing.

64% of the respondents mentioned that the number of employees in their enterprises is of 1-10 employees, 24% mentioned 11-50 employees and 12% had more than 50 employees.

The respondents were asked whether they are aware of the circular economy and the majority of them, which is 76%, answered that they have heard of the practices in the circular economy. Then, the respondents were required to assess their knowledge from 1(not aware) to 5 (perfectly aware). It is noteworthy that for those of the respondents who were informed of the practices in the circular economy, the average of score as 2.7 (awareness slightly above the average).

The respondents were asked to list some principles or practices of the circular economy, that helped to understand how realistic they were regarding their response to the awareness.

Among the list provided, a pattern was noticed and they were classified into the following graph:



It is striking to mention that the principles mentioned by the participants are mainly an integer part of the circular economy.

The respondents were also asked if they used any principle of the circular economy in their enterprises and 30 respondents mentioned that they apply at least one principle of the circular economy. The main practices mentioned are renewable energy (solar energy), composting, animal feed production, waste management, energy efficiency/conservation and reduced use of plastic.

According to the data gathered, the respondents highlighted the role of waste management in the circular economy and it is the most frequently appeared response both in the awareness checking list and among the practices they apply in the enterprises. The next section of the questionnaire was committed to the practices that are currently implemented by the enterprises and they are categorized into three broad categories:

- Energy use and efficiency;
- Waste management and
- Eco-Design of products.

Based on the answers provided, the frequency was calculated per practices with the following scale, which are colored with specific shadow (Donato, M. et al. 2018).

Table 2. Frequency of the practices

PRACTICES	IMPLEMENTATION		
ENERGY USE AND EFFICIENCY	Yes	No	Planning to Implement
Energy Conservation			
Regularly implemented energy audit			
Thermal insulation for doors, windows and roof of the production facility			
Utilization of energy efficient doors and windows			
Improvement of the internal thermal distribution			
Application of bioenergy			
Solar energy for water heating			
Application of solar PVs			
Automated monitoring of electricity			
Sales of the electricity from solar			
Application of other renewable sources of energy			
WASTE MANAGEMENT			
Animal Feed from Waste			
Bioenergy/Biofuel generation from waste			
Byproducts Design (Oil, Cosmetics)			
Composting			
Waste sorting			
Multicycle Packaging			
Soil Conditioner			
Other biotechnological solutions			
RESOURCE USE AND PRODUCT DESIGN			
Use of reusable raw materials (e.g. packaging)			
Minimal use of plastic materials			
Use of biologically based plastics			
Application of recycled plastic			
Innovative delivery approach to reduce environmental impact			
Eco-labeling			
Digitized product information			
Organic processing			

Frequency more than 70% of respondents (29 and more)	
Frequency between 30-70% of the respondents (12-28)	
Frequency less than 30% of the respondents (up to 11 enterprises)	

Table 3. Barriers associated with the practice categories

BARRIERS	PRACTICES		
	ENERGY USE AND EFFICIENCY	WASTE MAN-AGEMENT	RESOURCE USE AND PRODUCT DESIGN
Lack of knowledge of appropriate management methods and practices	32.50%	25%	30%
Lack of awareness and its exchange	42.50%	17.50%	30%
Lack of necessary infrastructure	60%	35%	45%
Economic viability of traditional business models	2%	15%	5%
Lack of state support	27.50%	17.50%	15%
Inaccessibility of necessary equipment	22.50%	22.50%	17.50%
Insufficient/low quality consultancy	10%	10%	12.50%
Low volume of production	40%	47.50%	37.50%
Lack of financial resources, including barriers to agricultural credits	62.50%	50%	60%
Not applicable to business	2.50%	10%	2.50%
Lack of recycled raw materials	N/A	13%	15%

Energy Use and Efficiency

According to the survey results, the three most frequently applied practices in the category of energy use and efficiency are energy conservation (75%), installation of energy-efficient doors and windows (60%), as well as thermal insulation (55%). Those three practices are not costly options to cut the use of energy, which is beneficial for the environment.

On the other hand, the least applied practices in this category are the application of biofuel and other renewables, thus some of the derivative actions depend on the application of renewable energy (automatic electricity control and sales of additional electricity). It is noteworthy that the energy audit is not frequently done by enterprises. This simple yet powerful tool allows people to monitor energy use, system drawbacks, and other issues. 62.50% of the participants mentioned that the major barrier to not applying more energy-efficient technologies is the lack of financial resources, including barriers to agricultural credits and 60% mentioned the lack of the necessary infrastructure. Additionally, 42.5% of the respondents mentioned that it is purely because of the lack of awareness and experience exchange. The lack of knowledge of appropriate management methods and practices and the small production volumes are also among the frequently-mentioned barriers of implementing the practices included in this category.

Waste Management

Based on the survey results, the following practices are among the top three: waste sorting (70%), animal feed processing from waste (67.5%), byproducts design (47.5%), which includes oil, cosmetics and some other pharmaceutical materials. The least applied practices chosen are biomass processing (95%), soil conditioner (95%) and composting (52%). It is noteworthy that even though composting is not a complicated process, more than half of the organizations are not applying this practice.

The three major barriers to implementing the practices included in this category are the lack of financial resources (50%), small production volume (47.5%) and the lack of knowledge of appropriate management methods and practices (25%).

Resource Use and Energy Use

Data show that the respondents of the survey apply the following practices: use of reusable raw materials (eco-packaging) (75%), minimum use of plastics (70%) and digitalized information on the products (50%). It is noteworthy that organic production is also widely used among the producers, which counts for about 45% of the respondents. The majority of the respondents don't use bio-plastics (85%), because of the lack of knowledge of appropriate management methods and practices.

Apart from the lack of financial resources as a major barrier to implementing the practices in this category, inefficient infrastructure and production volumes are also in the top three barriers to switching to the circular economy. The results show that the lack of knowledge and awareness of the practices are mentioned by 30% of the respondents.

CONCLUSIONS

The anthropogenic activities have already overshot the capacity of the planet, thus more environmentally-conscious steps are required to maintain sustainability and the intertemporal justice between current and future generations.

This paper contributes to the existing knowledge and literature on the circular economy in the food industry given the limited number of the studies in the Republic of Armenia.

It provides a comprehensive review on the Circular Economy practices which are currently implemented in the fruit processing sector and the associated barriers per each category.

According to the study, many companies apply the Circular Economy practices only when they are cheap to implement and don't require extensive capital investment. Those activities are mainly related to the waste management and product design. On the other hand, the barriers chosen by the enterprises are very diverse including financial burdens and lack of knowledge and capacity.

The paper can also be of a great interest to the enterprises, as they can attain more detailed information on the existing practices and apply those in production.

This study has also some limitations. The sample size selected for the study is not big, thus further research studies should extend the selection of the sample size for more explanatory results. In addition, it is recommended to extend the set of the practices and barriers mentioned in the table above including other categories.

REFERENCES

1. AHMED, Z., MAHMUD, S., & ACET, H. (2022). Circular economy model for developing countries: evidence from Bangladesh. Heliyon [online]. In: Heliyon, vol. 8, pp. 1-12. Available: https://www.cell.com/heliyon/pdf/S2405-8440(22)00818-0.pdf
2. BET, Bram et al. (2018). Barriers and best practices for the circular economy. SMO Promovendi – Circular Minds 2017/2018. 41 p.
3. GEDAM, V. et al (2021). Circular economy practices in a developing economy: Barriers to be defeated. Journal of Cleaner Production. In: Journal of cleaner production, v. 311. ISSN 0959-6526.
4. MASI, Donato et al. (2018). Towards a more circular economy: exploring the awareness, practices, and barriers from a focal firm perspective. In: Production Planning & Control, vol. 29(6), pp. 539-550.
5. MINISTRY of Economy of the Republic of Armenia (2022). [online]. [viewed March 25 2022]. Available: https://www.mineconomy.am/en/page/1327
6. NARASIMMALU, A., RAMASAMY, R. (2020). Food Processing Industry Waste and Circular Economy. In: IOP Conference Series: Materials Science and Engineering, vol. 955, No. 1, p. 012089). Available: DOI:10.1088/1757-899X/955/1/012089
7. RITCHIE, H., ROSER, M. (2020). Environmental impacts of food production. In: Our World in Data. https://ourworldindata.org/environmental-impacts-of-food
8. ROBERTSON, M. (2014). Sustainability Principles and Practice. 1st ed. London: Routledge, 392 p. ISBN 9780203768747. Available: https://doi.org/10.4324/9780203768747
9. UN Comtrade Database [online]. Available: https://comtrade.un.org/data/
10. De WIT, M. et al. (2018). The Circularity Gap Report: Our World is only 9% Circular-Circle Economy: An analysis of the circular state of the global economy, January 2018. 36 p. Available: https://pacecircular.org/sites/default/files/2020-01/Circularity%20Gap%20Report%202018_0.pdf

INFORMATION ABOUT AUTHOR

MARKOSYAN Davit https://orcid.org/0000-0002-3388-9366

PhD student, Department of Agribusiness and Economics, Armenian National Agrarian University, Armenia

E-mail: davitzmarkosyan@gmail.com

Data prezentării articolului: 27.04.2022

Data acceptării articolului: 02.06.2022