CZU: 005:658.567:332.142.6(450:478) **https://doi.org/10.59295/std2024.11**

ITALY'S EXPERIENCE - VEGETAL WASTE, BEST PRACTICES FOR THE REPUBLIC OF MOLDOVA

Natalia ANTOCI
Moldova State University, Chisinau, Republic of Moldova
antocinatalia57@gmail.com
ORCID ID: 0000-0002-7433-106X

Romita TULLIO
University of Calabria, Italy

Abstract

The management of vegetal waste has emerged as a critical global issue, with significant implications for environmental sustainability, food security, and economic development. Italy's experience demonstrates how innovative legislative frameworks, advanced recycling technologies, and public-private partnerships can effectively address the challenges of vegetal waste, transforming it into a valuable resource. This paper analyzes Italy's best practices and explores their applicability to the Republic of Moldova, a country with substantial agricultural potential but lacking comprehensive waste management strategies. The study emphasizes the importance of adopting progressive legislation, enhancing public awareness, and leveraging technological innovations to reduce waste and promote circular economy principles. The findings provide actionable insights for policymakers and stakeholders aiming to achieve sustainable development goals.

Keywords: *Vegetal waste management, food security, circular economy, sustainable development, public-private partnerships, composting, biogas*

Introduction

The vegetal waste economy represents a critical frontier in sustainable development, addressing pressing global challenges such as resource scarcity, environmental degradation, and food security. This innovative economic model emphasizes the transformation of vegetal waste—leaves, stems, fruit peels, and other plant residues—into valuable products and resources, promoting circular economy principles and reducing environmental impact. The importance of this economy extends across environmental, social, and economic dimensions, making it a cornerstone of sustainable practices worldwide.

In the context of global challenges related to food loss and waste, Italy offers a relevant example of best practices in managing vegetal waste and reducing its impact. Through the implementation of coherent policies, innovative projects, and community initiatives, Italy has demonstrated that an integrated behavioral approach and the use of modern technologies can transform vegetal waste from a problem into a valuable resource. This analysis explores the lessons provided by Italy's experience, focusing on their applicability to the Republic of Moldova, a country with considerable agricultural potential but significant challenges in waste management.

Results and Discussions

The mismanagement of vegetal waste leads to significant environmental issues, including greenhouse gas emissions, soil degradation, and water contamination. When improperly disposed of in landfills, vegetal waste decomposes anaerobically, releasing methane, a potent greenhouse gas that contributes to climate change. According to the United Nations Environment Programme (UNEP), over 8% of global greenhouse gas emissions are associated with food waste, which includes vegetal residues.

The vegetal waste economy mitigates these effects by converting organic matter into environmentally friendly products such as compost, bioenergy, and biodegradable packaging.

Composting, for instance, enriches soil health, reducing reliance on chemical fertilizers and enhancing carbon sequestration. Similarly, biogas plants transform vegetal residues into renewable energy, providing an alternative to fossil fuels and reducing carbon footprints. By closing the loop on waste, the vegetal waste economy fosters environmental sustainability and resource efficiency.

Economic Opportunities

The transformation of vegetal waste into marketable products generates substantial economic benefits. By valorizing plant residues, industries can create new revenue streams while reducing disposal costs. Examples of economic opportunities within the vegetal waste economy include:

1. Composting and Soil Amendments: Farmers and agricultural businesses can produce and sell high-quality organic fertilizers from vegetal waste, improving soil productivity while reducing input costs.
2. Bioenergy Production: Biogas and bioethanol derived from vegetal waste serve as renewable energy sources, offering an alternative to conventional fuels and enhancing energy security.
3. Innovation in Biodegradable Materials: Vegetal waste is increasingly being used to develop biodegradable packaging, textiles, and even bio-based plastics, tapping into growing consumer demand for sustainable products.
4. Job Creation: The development of waste management infrastructure, recycling facilities, and research initiatives creates employment opportunities across multiple sectors, from engineering to agriculture and technology.

The vegetal waste economy also holds significant social implications. It empowers communities by providing affordable and sustainable solutions to waste management and energy production. Localized composting initiatives, for instance, enable rural and urban communities to manage organic waste effectively, reducing public health risks associated with improper disposal.

Moreover, educational campaigns around vegetal waste management raise awareness about sustainability and responsible consumption, fostering a culture of environmental stewardship. When communities are actively involved in managing vegetal waste, they contribute to a cleaner environment, improved public health, and enhanced food security.

The vegetal waste economy is poised for significant growth as governments, businesses, and consumers increasingly prioritize sustainability. Advances in technology, such as AI-driven waste sorting and bioengineering, are expected to enhance waste valorization processes, making them more efficient and cost-effective. Policies supporting the circular economy, carbon neutrality, and renewable energy will further drive investment in the vegetal waste sector.

Globally, approximately 14% of all food produced is lost or wasted before reaching consumers, representing losses of $400 billion (FAO, 2019). In 2019, 931 million tons of food waste were recorded, 61% originating from households, 26% from food services, and 13% from retail (UNEP, 2021). These losses undermine food security, generate greenhouse gas emissions, and contribute to environmental degradation.

Italy, a country with diversified agriculture, has implemented solutions that include legislative policies, awareness campaigns, and the use of recycling technologies. These approaches have significantly reduced food waste and transformed vegetal waste into renewable resources.

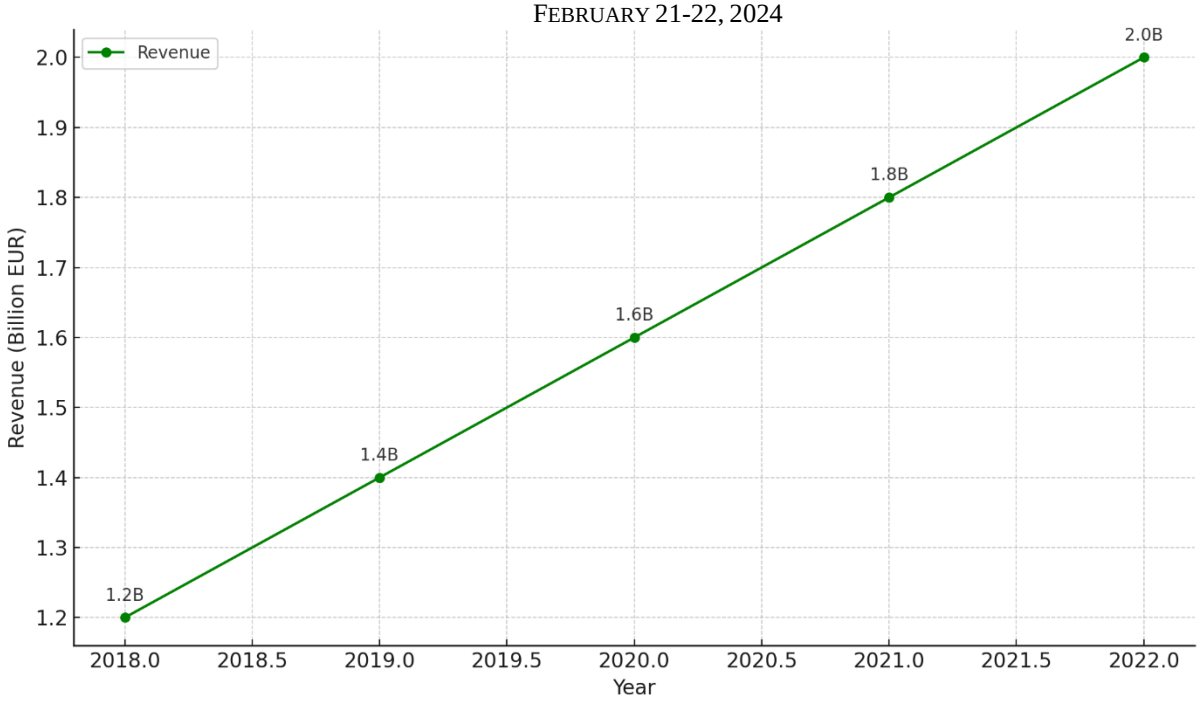


Figure 1. The management of vegetal waste in Italy (2018-2022)

The chart illustrates the revenue generated from the management of vegetal waste in Italy over the last five years (2018-2022). It shows a steady increase, rising from €1.2 billion in 2018 to €2.0 billion in 2022, highlighting the economic benefits of sustainable waste management practices.

Italy has positioned itself among European leaders in reducing food waste through progressive legislation. The Gadda Law (2016) promotes the reuse of unused food and simplifies donations to charitable organizations. This law established a clear framework for recovering food surplus from the agricultural, retail, and HoReCa sectors, thus reducing food losses and supporting vulnerable groups.

The Republic of Moldova could benefit from similar legislation encouraging food donations and the recycling of vegetal waste. Collaboration between the public and private sectors could facilitate the creation of a normative framework adapted to local contexts.

Technological Innovations in Managing Vegetal Waste

Italy has invested significantly in technologies for valorizing vegetal waste. These include:

1. Composting and Biogas - Modern composting technologies transform vegetal waste into organic fertilizers. Additionally, biogas plants convert waste into renewable energy, reducing dependence on fossil fuels. Notable examples include the Emilia-Romagna region, where vegetal waste is utilized for large-scale biogas production.
2. State-of-the-Art Recycling Plants - Recycling stations, such as those in Lombardy, employ advanced separation and processing methods to maximize resource recovery from vegetal waste.

Relevance for the Republic of Moldova - As an agricultural country, Moldova generates a considerable volume of vegetal waste. Developing composting and biogas infrastructure could transform this waste into energy and fertilizers, supporting local farmers and reducing environmental impact.

Public Awareness and Behavioral Change

Public awareness is a central pillar of Italy's success. National campaigns, such as "Sustainability Week," and educational programs for schools have shifted perceptions regarding food waste. Italy's behavioral perspective involves analyzing psychological and social barriers to waste reduction and designing targeted interventions.

Relevance for the Republic of Moldova. Similar educational programs and public campaigns could raise awareness among Moldovans about the impact of food and vegetal waste. Such initiatives could involve NGOs, schools, and the private sector to promote sustainable practices.

Public-Private Partnerships (PPP)

Italy has successfully mobilized the private sector to support vegetal waste management. Public-private partnerships (PPPs) in waste recycling and renewable energy production have proven efficient in financing and implementation. For instance, projects in Tuscany have engaged private companies in building the necessary infrastructure.

PPPs can play a crucial role in developing vegetal waste management infrastructure in Moldova. Policies incentivizing private investments in sustainable solutions could accelerate progress.

Recommendations for the Republic of Moldova

1. Adopting a Progressive Legislative Framework - Moldova could introduce laws similar to the Gadda Law, encouraging the recovery and reuse of food and promoting the recycling of vegetal waste.
2. Developing Infrastructure for Composting and Biogas - Establishing regional composting and biogas stations could valorize vegetal waste, generating economic and environmental benefits.
3. Education and Awareness - Implementing national awareness campaigns in collaboration with schools and local organizations can drive behavioral change across the population.
4. Supporting Technological Innovations - Investments in research and development for recycling and waste valorization technologies can create economic opportunities and ecological solutions.
5. Promoting Public-Private Partnerships - Engaging the private sector in waste management projects can bring financial resources and technological expertise.

Conclusion

Italy's experience in managing vegetal waste offers a robust model for the Republic of Moldova, demonstrating that a combination of effective policies, advanced technologies, and public awareness can transform waste into a valuable resource. By adapting Italian best practices, Moldova can make significant strides toward a sustainable development model that supports the local economy, reduces waste, and protects the environment.

The vegetal waste economy is more than a waste management strategy—it is a pathway to a sustainable future. By converting waste into resources, it addresses environmental challenges, creates economic value, and strengthens community resilience. As global awareness of sustainability grows, investing in and developing this economy will be essential for achieving climate goals, fostering innovation, and building a circular economy that benefits both people and the planet.

Bibliography

1. Food and Agriculture Organization of the United Nations. (2019). *The state of food and agriculture 2019: Moving forward on food loss and waste reduction*. FAO. http://www.fao.org
2. United Nations Environment Programme. (2021). *Food waste index report 2021*. UNEP. https://www.unep.org
3. Italian Parliament. (2016). *Gadda Law: Legislation on food waste reduction and reuse*. https://www.camera.it
4. European Environment Agency. (2020). *Circular economy in Europe: Italian case studies*. https://www.eea.europa.eu