UDC: 628.4.042:502.14(496.5)
Professional paper

NATIONAL STRATEGIES FOR MONITORING FOOD WASTE IN ALBANIA IN LINE WITH THE EU GREEN AGENDA

Mamica.RUCI [2], Renata KONGOLI[1], Xhezair IDRIZI [3], Durim ALIJA[3], Kristi KARAJ[1]
[1*] *Department of Agro-food Technology, Faculty of Biotechnology and Food, Agricultural University of Tirana, Albania*
[2*] *Food Research Center, Faculty of Biotechnology and Food, Agricultural University of Tirana, Albania*
[3*] *Faculty of food and Food Technology, University of Tetovo, North Macedonia*
[*]*Corresponding Author: e-mail: rkongoli@ubt.edu.al*

Abstract

This study addresses a critical gap in Albanian environmental management, targeting food waste and the application of biotechnology under the EU's Green Agenda and SDGs. Through the analysis of national strategies and investigation of new biotechnological methods, the research offers beneficial data related to sustainable food waste reduction. The results seek to raise Albania's level of food waste reduction, combat climate change and meet EU standards, together with fundamental policy proposals. Albania has limited sustainable waste management, according to estimates of INSTAT, private homes waste 7-13 kg of food per person each year, totaling 18,000-37,000 tons on a nationwide scale. Only 86.9% of people in urban areas covered by urban management services by 2020, a 22.2% improvement over the previous year. A National Plan for Solid Waste Management issued on 1 January 2020 is designed to enhance waste management, recycling and protection of the environment. But there are still negative practices down the food chain and, the FAO estimates, a third of all edible food that is produced worldwide is lost or wasted. The research underlines the insufficiency of proper strategies in managing food waste in Albania that should be aligned with the EU Green Agenda and SDGs. It seeks to overcome this deficiency by evaluating the situation, researching biotechnological alternatives and coming up with practical strategies and policy suggestions. The general aims are to evaluate food waste, use biotechnological processes for waste degradation and suggest national strategies aligned with the EU Green Agenda. The results underscore the need for stronger policy measures to align with EU standards, reduce climate impact, and promote circular economy principles in Albania.

Keywords: *Food waste, biotechnology, circular economy, EU Green Agenda, Albania*

1. Introduction

Global food waste production has expanded significantly in recent decades. Municipal solid waste production already exceeds two billion metric tons per year and is expected to rise 3.8 billion tons by 2050. The increase in waste production presents considerable issues for waste management systems worldwide (Alves *et al*, 2024). According to the FAO (Food and Agriculture Organization), about one-third of all food produced for human use (1.3 billion tons) is lost or wasted along the supply chain. Organic waste is formed during production, post-harvest handling, storage, transportation, distribution, home processing, and consumption (Otles *et al.*, 2015, Ravindran *et al*, 2016; Stenmarck *et al*., 2016). Food waste can be defined as *"any food and inedible parts of food removed (lost or diverted) from the food supply chain, either by choice or as a result of spoilage or expiry due to negligence by the actor, primarily—but not exclusively—the end consumer at the household level"* (*FAO, 2014*). Food waste represents a critical global challenge with significant environmental, economic, and social impacts. In the European context, addressing food waste has become a key priority under the European Union's Green Agenda, which aims to promote sustainable resource use, climate neutrality, and circular economy principles. Albania, as a candidate country aspiring to align its policies with EU standards, is increasingly recognizing the importance of food waste reduction and resource valorization. The population and the economic growth trends increasing pressure

https://doi.org/10.62792/ut.jftn.v8.i15-16.p2978

on natural resources (Kaza *et al.,* 2018). Due to rapid urbanization and industrial development worldwide, the continuous increase in waste generation has placed growing pressure on governments to address the complex and diverse nature of waste. In recent decades, European Union (EU) member states have begun integrating policies to address environmental challenges, including those related to food waste. Food waste management is integrated to both the EU Green Agenda and the SDGs, as it directly impacts environmental, economic, and social goals. The EU Green Agenda focuses on transitioning to a climate-neutral, circular, and resource-efficient economy. In the context of food waste, the key objectives include preventing food loss and waste across the supply chain and promoting circular economy models that repurpose organic waste into bioenergy, compost, or secondary raw materials. For Albania aligning national waste strategies with these frameworks is essential for sustainable development. Therefore, waste prevention has received increasing attention in recent years. However, given the inevitability of some waste generation, sustainable methods of recycling must also be prioritized within waste management systems Food waste monitoring is considered a priority action, particularly as new policy priorities emerge and governments adopt novel approaches aimed at achieving these goals. Albania is introducing Circular Economy and Green Growth actions, contributing to the creation of a cleaner and more competitive Europe in collaboration with economic actors, consumers, citizens, and civil society organizations. National strategies provide policy statements and some initiatives in renewable energy, energy efficiency, and tourism. These strategies must be managed within a unified framework aligned with the principles of the green and circular economy and should define incentives or barriers that could facilitate the implementation of the Green Agenda. Identifying effective strategies to food waste management through biotechnology processes conversion has become a significant focus area, as it aligns with the principles of a circular bioeconomy (Nget *et al.,* 2020; Areniello *et al.,* 2023). Biotechnology plays a vital role in enabling sustainable solutions for food waste management. It offers innovative approaches for converting waste into valuable products such as biofuels, enzymes, compost, and nutraceuticals, contributing to a circular economy. Despite its potential, the integration of biotechnology and circular practices in Albania remains at an early stage This study analyzes Albania's current state of food waste, national strategies and the potential applications of biotechnological approaches in this issue and the policy alignment with the EU Green Agenda to strengthen Albania's transition toward a circular bio economy.

2. Literature review

Food waste is a major concern because it poses threats to environmental sustainability. Its environmental impact includes GHG emissions, land and water waste, and biodiversity loss (Gustavsson, 2011). Addressing food waste supports SDG 12.3 and aligns with EU directives on resource efficiency and sustainable food systems **Food waste** includes both the edible and inedible parts of food that are removed from the food supply chain and must be managed through recycling or disposal (Östergren *et al.,* 2014). It can also be interpreted as the loss of edible food at various stages of the food supply chain, including harvesting, production, processing, distribution, and consumption (Ivert *et al*., 2015). Food waste is typically categorized into two types based on its origin:

- **Unavoidable food waste**: expired or spoiled ingredients, food remnants such as meat trimmings (e.g., ends of cooked ham, meat scraps after cutting), and vegetable waste (e.g., tomato ends, outer lettuce leaves, potato peels, vegetable stems); and
- **Avoidable food waste**: meal leftovers resulting from improper food handling (e.g., inefficient peeling or cutting), overproduction for banquets or catering services, poor ordering procedures, inadequate food rotation practices leading to spoilage, and flawed inventory systems that result in both plate and kitchen waste such as uneaten pasta.

Researchers argue that different factors contribute to food waste at each stage, thus requiring tailored mitigation strategies. Comprehensive diagnostics of food waste across these stages are crucial for effective waste management. Previous research has highlighted the negative consequences of food waste, including threats to food security, contributions to climate change, greenhouse gas emissions, and financial losses (Hennchen, 2019). Regarding food waste generation, studies have shown that a significant portion occurs at the consumption stage, including both in-home and out-of-home settings. Households represent in-home consumption, while the food service sector represents out-of-home consumption. The food service sector includes both commercial and non-commercial institutions such as restaurants, hotels, healthcare facilities, educational institutions, and staff catering services. One notable sub-sector is educational institutions, where food is consumed on-site. In Europe, households are the largest contributors, responsible for 54% of total food waste, followed by industrial processing at 19%. The remaining 27% are distributed among food service (11%), production (8%), and wholesale and retail sectors (8%) (Stenmarck et al., 2016). Agri-food waste primarily originates from plant sources, including peels, leaves, seeds, pomace, and from animal products such as meat derivatives, feather or egg products to a lesser extent (Berenguer et al., 2023). The fruit and vegetable sectors are significant contributors to food waste, as an estimated 45% of products are lost during production and/or as leftovers (Bank the world, 2024). However, in developing countries, over 40% of these losses take place during post-harvest and processing stages, whereas in industrialized countries, over 40% occur at the retail and consumer stages (Gustavsson *et al.,* 2011). However, the United Nations 2021 report suggests that using byproducts can improve nutritional value, reduce waste and GHG emissions, and improve global food supply security (UNEP United Nations Environment Programme, 2021). Agricultural and livestock production are among the most polluting and resource-intensive practices, responsible for several ecological issues. In recent decades, food production has consistently increased to meet the growing demand for food. Simultaneously, food waste has also risen considerably, associated with the loss of all inputs used in production throughout the food supply chain (FSC), generating unnecessary emissions and other environmental impacts (Bond *et al.,* 2013). Some studies have examined the environmental impact of food waste by exploring its water and carbon footprints, as well as its impact on other natural resources. The global carbon footprint of food waste was estimated to be around 4.4 Gt CO_2 equivalents per year, representing 8% of total human-induced GHG emissions (FAO, 2015). It exacerbates social injustice: nearly 1 billion people suffer from chronic malnutrition globally (Skaf *et al.,* 2020), while global food demand is projected to increase between 70% and 110% by 2050 (Lemaire *et al.*, 2019). The United Nations has proposed a 50% reduction in food waste by 2030 in its Sustainable Development Goal 12.3 (United Nations, 2020). Meanwhile, in lower-income countries, greater economic losses from food waste are observed during the primary production phases. Additionally, food waste implies the loss of economic investments needed to support the production process. In other words, reducing food waste can lower environmental impacts and preserve resources that belong to the most vulnerable and marginalized populations, while saving economic costs and improving their nutrition and health (FAO, 2014) Currently, Agri food waste are landfilled, or utilized for animal feed or biofuel production (biogas, biohydrogen, bioethanol, biodiesel) and commercial chemicals (Dahiya *et al.,* 2018). Some waste are also receiving interest as a source of bioactive compounds for the cosmetic and pharmaceutical industries as a sustainable and natural supply of colors, fragrances, and antioxidants (Saini *et al.*, 2019; Genkinger *et al*, 2004). However the implementation of biotechnologies principles in waste management remains in its early stages due to the complexity and the substantial financial resources required.

3. Overview of Food Waste management in Albania

The central issue addressed in this study is the lack of effective strategies and monitoring systems for food waste management in Albania—an essential requirement for alignment with the European Union's Green Agenda, given the country's aspirations for EU membership. This research seeks to address this gap by assessing the current state of food waste management, exploring biotechnological solutions, and proposing actionable strategies and policy recommendations. Negative practices occur throughout the entire food supply chain, from production to consumption. According to INSTAT, 2023 Albania generates about 311 kg of municipal waste per capita annually, below the EU average of 530 kg per capita (European Parliament, 2023).Similarly, in the EU, households generate more than half of the total food waste (54%) in the EU with 70% of food waste arising in households, food services and retail (Eurostat, 2023). The EU is committed to meeting the Sustainable Development Goal of halving global per capita food waste at retail and consumer level by 2030 and reducing food losses along food production and supply chains. The main categories of managed urban waste, organic waste continues to dominate urban waste management. This category occupies the largest share of managed urban waste, with a weight that has remained relatively stable at 57-58% over the last three years. The disposal in landfills and waste fields, approved as temporary deposits by the respective municipalities, continues to be the most used method for waste management in Albania According to INSTAT, 2023 waste treatment relies heavily on landfilling (77%), with limited recycling (19%) and minimal incineration or composting.

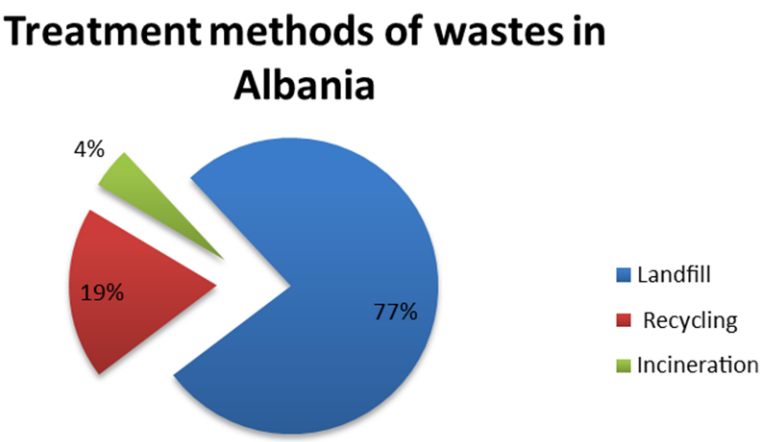


Figure 1. The treatment methods of urban wastes in Albania

In Europe according EUROSTAT the treatment methods of urban solid wastes in 2021 are: 23% landfill, **32% recycling**, **25% incineration**, 17% composting

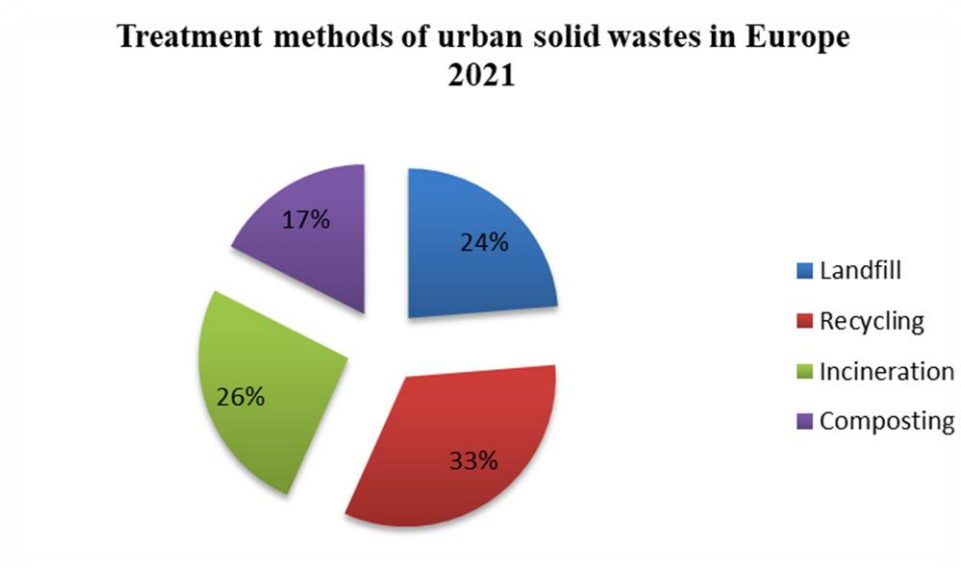
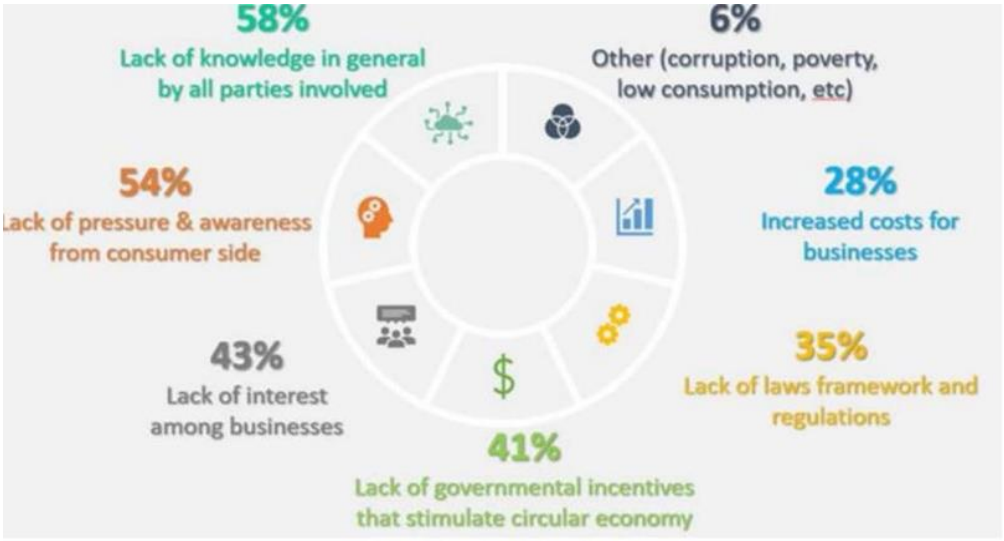


Figure 2. The treatment methods of urban solid wastes in Europe 2021

There are significant differences in the methods used for treating urban waste, and Albania faces considerable challenges in implementing key approaches such as recycling, incineration, and composting, which remain underutilized or, in some cases, entirely absent. Municipal Solid Waste (MSW) management in Albania is organized into 10 waste management zones based on economies of scale and connectivity. Municipalities are responsible for organizing integrated waste management, from collection to final treatment, and for reporting data to relevant government bodies, such as the Ministry of Tourism and Environment (MTE) and the National Environment Agency (NEA). Currently, four regional waste management facilities are operational: the Maliq Landfill and Transfer Station (Korça Waste Zone), the Bajkaj Landfill and Himara Transfer Station (Vlora-Gjirokastra Waste Zone), Bushat (Shkodër-Lezhë Waste Zone), and the Sharra Landfill (Tirana-Durrës Waste Zone), along with the Elbasan Incinerator (Elbasan Waste Zone). However, complex waste treatment facilities remain in the process of infrastructure development to manage waste in an environmentally friendly manner by reducing, reusing, and separately collecting waste materials and recycling, considered the most ecological practices defined in the waste hierarchy pyramid. The circular economy model in the agri-food sector aims to minimize waste and maximize resource efficiency by closing nutrient and material loops. This involves shifting from the traditional linear model of 'take-make-dispose' to a regenerative system where food waste, by-products, and residues are valorized into useful outputs. Core principles include reducing input resources, designing for reuse and recycling, and promoting systemic innovations that enhance sustainability throughout the food value chain (European Commission, 2020). Circular economy strategies are increasingly integrated into sustainable agricultural practices. Examples include composting organic farm waste to enrich soil, using anaerobic digesters to generate biogas, and applying precision farming technologies to reduce resource consumption. Agroecological practices, crop rotation, and the use of biofertilizers are further aligned with circular principles, promoting soil health and resilience while reducing environmental impacts (FAO, 2022; EEA, 2020). In Albania, the principles of the circular economy are referenced in key national documents such as the National Strategy for Integrated Waste Management (2018–2023) and the Strategic Policy and National Plan for Integrated Waste Management (2020–2035). These strategies aim to support the transition from a linear to a circular economy by promoting waste reduction, resource efficiency, and sustainable consumption patterns. Although there has been progress compared to previous years by private business companies to move their activity towards the circular

economy through the waste management stages and resource losses stages, there is still much to be done by the central government or local municipalities to embrace the circular economy approach and establish strict regulations for waste management. According Study Report on Circular Economy Awareness & Sensitivity among General Public and Businesses (2020), the perceptions of citizens and entities on the main barriers of circular economy implementation in Albanian to be lack of knowledge (58%); lack of pressure and awareness from consumer side (54%); lack of interest among businesses (43%); lack of government incentives (41%); lack of laws framework and regulations (35%); increased costs for businesses (28%); corruption, poverty, low consumption (6%)



*Source: Study Report on Circular Economy Awareness & Sensitivity among General Public and Businesses (2020)

Figure 3. Main Barriers to the Circular Economy in Albania

4. The Role of Biotechnology in Food Waste Valorization

Biotechnology offers transformative solutions for the valorization of food waste, enabling its conversion into high-value products. Key applications include the production of bioenergy through anaerobic digestion and fermentation, the generation of compost through microbial decomposition, and the development of bio-based materials such as biodegradable plastics and biosurfactants. These processes not only reduce landfill dependency but also promote circular economy principles by recovering nutrients and energy from organic waste streams (Saini *et al.*, 2015; Li *et al.*, 2020). Several countries have successfully implemented biotechnology-based waste valorization systems. For instance, in Sweden and Germany, anaerobic digestion facilities convert household food waste into biogas and digestate used for electricity generation and agricultural fertilizer. In Italy, food industry by-products are used to produce biodegradable packaging. The United States has also pioneered bioethanol production from lignocellulosic agricultural waste, integrating carbon capture technologies to reduce emissions. These models demonstrate the economic and environmental viability of biotech approaches and provide valuable lessons for Albania's transition (Fiorentino *et al.*, 2017; Hu *et al.*, 2021). Albania holds significant potential to adopt biotechnological solutions for food waste valorization, particularly in the agro-food sector. However, several challenges persist, including low technological readiness, limited public and private investment, and lack of specialized infrastructure. Research in microbial and enzymatic treatment remains underdeveloped, and there is a shortage of innovation hubs that connect academia, industry, and government. To close these gaps, Albania must invest in pilot projects, research and development (R&D), and public-private

partnerships to scale sustainable biotechnology applications (World Bank, 2021; UNEP, 2024). Numerous circular initiatives are emerging across Europe and the Western Balkans. These include food banks, surplus redistribution programs, farm-to-fork networks, and industrial symbiosis models whereby food industry by-products are used in other sectors. Active stakeholder engagement—including farmers, policymakers, NGOs, and consumers—is critical to these efforts. Collaborative platforms, such as the EU's Farm to Fork Strategy and Horizon Europe projects, support innovation and policy development in circular food systems (European Commission, 2021; UNEP, 2024). Although there has been progress compared to previous years on the part of private businesses to move their operations toward a circular economy through waste and loss management at the resource stage, much remains to be done by the central government and local municipalities to adopt the circular economy approach and establish strict waste management regulations. Unfortunately, based on the most recent waste management plan, the government lacks the capacity to reduce the amount of waste in accordance with the steps of the waste hierarchy, as most of the budget is allocated to incinerators and landfills. Ensuring a successful transition to a circular economy, however, requires efforts on multiple fronts; the circular economy goes beyond waste management. In order to prioritize the implementation of circular economy practices in the Albanian market, a series of processes must involve all stakeholders, particularly the main actor—the Albanian government

5. *Policy Framework: Albania and the EU Green Agenda*

The European Union (EU) has placed a strong emphasis on sustainable development, particularly through the Green Deal and the 2030 Agenda. Directive 2008/98/EC on waste, amended by Directive (EU) 2018/851, establishes a waste hierarchy prioritizing prevention, reuse, recycling, recovery, and disposal. The Green Agenda for the Western Balkans aims to support environmental protection, climate action, and the transition to a circular economy. Reducing food waste is a central element of these policies, directly contributing to Sustainable Development Goal 12.3: halving per capita global food waste by 2030 (European Commission, 2020; UNEP, 2024). Albania has undertaken several steps to align its national policies with EU directives. The National Strategy for Integrated Waste Management (2018–2023) and the National Plan for Integrated Waste Management (2020–2035) highlight the transition toward a circular economy and emphasize waste minimization. These strategies incorporate EU principles by promoting reduction at the source, improved waste separation, and enhanced recycling infrastructure (Republic of Albania, 2020). Moreover, Albania's progress is closely monitored through its EU accession negotiations, particularly Chapter 27 on Environment and Climate Change. Despite policy progress, Albania faces significant barriers to effective implementation. These include limited infrastructure, poor public awareness, inadequate data collection systems, and fragmented institutional responsibilities. Recycling and composting rates remain low, and incineration is underdeveloped or controversial. Additionally, a lack of enforcement and regulatory clarity hinders the operationalization of circular economy practices. Bridging these gaps will require substantial investments, capacity building, and a stronger alignment between national legislation and EU standards (EEA, 2020; World Bank, 2021). To align effectively with the EU Green Agenda and the Sustainable Development Goals, Albania must invest in institutional and human resource development. This includes training programs for government officials, waste management professionals, and environmental inspectors to enhance knowledge of circular economy principles and food waste reduction. Moreover, increasing funding for academic research and pilot projects in biotechnology and sustainable waste treatment will provide Albania with the scientific foundation needed to develop context-specific solutions (World Bank, 2021; UNEP, 2024).

Establishing collaborative platforms between the public sector, private enterprises, and academia can drive innovation in food waste management. Albania should promote the creation of innovation hubs focused on circular economy technologies, providing incentives such as tax benefits, grants, or co-financing models. Such partnerships can accelerate the commercialization of sustainable technologies, create green jobs, and enhance the implementation of waste-to-value strategies (European Commission, 2020). Reliable data collection systems are critical for evidence-based policymaking. Albania must improve its national waste statistics, adopting EU methodologies for tracking food loss and waste across the supply chain. At the same time, nationwide public awareness campaigns can foster behavioral change, encouraging households and businesses to adopt more sustainable practices. Increased transparency, digital tools for monitoring, and regular public reporting will support accountability and civic engagement (EEA, 2020; FAO, 2019).

6. *Conclusions*

Food waste management is a critical issue in Albania with significant social, economic, and environmental implications. Despite growing awareness, structured national monitoring systems are still underdeveloped. However, alignment with the EU Green Agenda provides both a framework and an opportunity for Albania to modernize its approach to food waste monitoring, integrating sustainability targets with concrete, measurable actions. There is a lack of consistent data on food waste generation across the value chain—from production to consumption—making it difficult to design effective, evidence-based policies. Institutional coordination is limited, and roles and responsibilities among government bodies, municipalities, and stakeholders in the agri-food sector are not clearly defined. Biotechnology offers significant potential for the valorization of food waste in Albania, enabling the transformation of organic residues into valuable products such as biofuels, bioplastics, enzymes, compost, and animal feed. Albania currently lacks an integrated strategy for biotechnological valorization of food waste, and existing efforts remain fragmented and largely pilot-based. Existing infrastructure for waste management is not optimized for segregation and collection of food waste suitable for bioconversion, leading to missed opportunities for resource recovery.

7. Recommendations

Develop and implement a national food waste monitoring system that aligns with the EU's measurement methodology (e.g., as per the EU Delegated Decision 2019/1597), ensuring data comparability and policy coherence. Establish clear institutional roles and responsibilities, particularly involving the Ministry of Agriculture, Ministry of Environment, and the National Statistics Institute, in designing and managing monitoring frameworks. Strengthen data collection capacities at the local and regional levels, including pilot projects in key sectors such as retail, food processing, and hospitality. Engage stakeholders across the food chain, including farmers, businesses, civil society, and consumers, through awareness campaigns, training, and voluntary agreements. Leverage digital technologies for traceability, data reporting, and analytics to enable real-time tracking and targeted interventions. Seek technical and financial support from EU pre-accession funds and international donors to build institutional capacities and infrastructure for food waste monitoring and prevention. Promote circular economy models, such as food donations, composting, and food by-product valorization, as part of a broader strategy to reduce the environmental impact of food systems. Develop a national roadmap for food waste valorization, with biotechnology as a core component, aligning with EU circular economy principles and Albania's environmental sustainability goals. Promote cross-sector collaboration between universities, research institutes, agri-food businesses, and municipalities

to pilot and scale up biotechnology-based solutions such as anaerobic digestion, microbial fermentation, and enzyme production. Incorporate biotechnology and circular economy principles into higher education curricula and vocational training programs to build the next generation of specialists in bioresource management. Monitor and evaluate pilot projects, documenting best practices and challenges to inform scalable policy recommendations and attract investment in sustainable waste valorization.

References

[1]. Preka, R., Berjan, S., Capone, R., El Bilali, H., Allahyari, M. S., Debs, P., & Mrdalj, V. (2020). Household food wastage in Albania: Causes, extent and implications.

[2]. Lagioia, G. (n.d.). The importance of waste management: Some observations on Albania. Economicus, (23), 56.

[3]. Dudi, V. A. (2020). Solid waste management in Albania: Does accountability matter. A Journey in Social and Environmental Accounting, Accountability and Society, 17–48.

[4]. Oncioiu, I., Căpuşneanu, S., Topor, D. I., Petrescu, M., Petrescu, A. G., & Toader, M. I. (2020). The effective management of organic waste policy in Albania. Energies, 13(16), 4217.

[5]. Alcani, M., Dorri, A., & Hoxha, A. (2015). Some issues of municipal solid waste management in Albania and especially Tirana City. International Journal of Science Technology & Management, 4(1), 16.

[6]. Kambo, A., Keco, R., & Tomorri, I. (2017). Pre-shopping activities and their influence on amount of food waste generated at household level in urban area of Albania: An econometric approach. International Journal of Economics, Commerce and Management, 5(6), 440–453.

[7]. Osmani, M., & Kambo, A. (2018). Food waste factors of urban Albanian consumers: A multinomial econometric approach. European Scientific Journal, 14(3), 11–30.

[8]. Saini, J. K., Saini, R., & Tewari, L. (2015). Lignocellulosic agriculture wastes as feedstocks for second-generation bioethanol production. Renewable Energy, 78, 19–28.

[9]. Li, Y., Wang, C., & Zhang, X. (2020). Carbon and energy balance of food waste conversion technologies. Journal of Cleaner Production, 250, 119478.

[10]. Fiorentino, G., et al. (2017). Environmental impact assessment of bio-based packaging from food industry residues. Resources, Conservation and Recycling, 125, 170–180.

[11]. Hu, X., et al. (2021). Dynamic LCA of enzyme-based valorization of food waste. ACS Sustainable Chemistry & Engineering, 9(10), 3904–3913.

[12]. World Bank. (2021). Western Balkans: Green transition and innovation.

[13]. UNEP. (2024). Food Waste Index Report 2024. United Nations Environment Programme.

[14]. European Environment Agency. (2020). Food systems and resource use: Towards a circular approach.

[15]. UNEP. (2024). Circularity in food systems: Policy and innovation for the future. United Nations Environment Programme.

[16]. Alves, B. (2024). Global waste generation – statistics and facts. Statista. https://www.statista.com/topics/4983/waste-generation-worldwide/

[17]. Gustavsson, J., Cederberg, C., & Sonesson, U. (2011). Global food losses and food waste: Extent, causes and prevention. Food and Agriculture Organization of the United Nations.

[18]. Bayon-Vicente, G., Toubeau, L., Gilson, M., Gégo, G., Landgey, N., Krings, S., & Leroy, B. (2025). Metabolic pathways to sustainability: Review of purple non-sulfur bacteria potential in agrifood waste valorization. Frontiers in Bioengineering and Biotechnology, 13, 1529032. https://doi.org/10.3389/fbioe.2025.1529032

[19]. Stenmarck, Å., Jensen, C., Quested, T., & Moates, G. (2016). Estimates of European food waste levels (Report No. D1.8). https://doi.org/10.13140/RG.2.1.4658.4721

[20]. Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk, R., & Meybeck, A. (2011). Global food losses and food waste. Food and Agriculture Organization of the United Nations.

[21]. European Commission. (2020). A new circular economy action plan for a cleaner and more competitive Europe.

[22]. Republic of Albania. (2020). National Strategy and Action Plan on Waste Management 2020–2035.

[23]. European Environment Agency. (2020). Environmental Implementation Review 2020: Albania.

[24]. World Bank. (2021). Western Balkans: Scaling up environmental performance through green growth.