ECONOMIC AND LEGAL ANALYSIS OF FOOD BIO-FRACTION MANAGEMENT IN THE CONTEXT OF CIRCULAR AGROECONOMY AND THE GREEN AGENDA FOR THE WESTERN BALKANS

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ABSTRACT

The paper conducts an economic and legal analysis of food bio-fraction management in the context of the transition towards a circular agroeconomy and the requirements of the Green Agenda for the Western Balkans. The research focuses on the role of consumers in a sustainable agri-food system and their willingness to separate and collect food bio-waste. The empirical research was carried out on a sample of 692 respondents, utilizing descriptive statistics and multiple linear regression. The findings indicate that financial reciprocity, accessible infrastructure, and greater institutional trust constitute prerequisites for transforming citizens from passive users into active participants in the circular agroeconomy and closing the nutrient loop in the food chain. This implies a need for local policies that combine economic incentives, clearly defined legal obligations, and programs for donating edible surpluses and food waste, in line with the principles of the Green Agenda.

Introduction

National legislation and EU regulations clearly mandate restrictions on landfilling biodegradable waste, aiming to reduce both waste volumes and greenhouse gas emissions generated by the decomposition of organic waste (Batinić, 2015). The degradation of

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biodegradable waste releases phytotoxins, carbon dioxide, salt, and heat, resulting in severe environmental and health consequences. Food loss encompasses edible food that is lost or damaged during production, storage, processing, and distribution before reaching the consumer, with a significant portion of these losses occurring in urban areas. The key to efficient food bio-fraction management lies in prioritizing the source-separation, collection, and treatment of household waste, particularly the food fraction. Proper treatment of food waste significantly contributes to reducing methane emissions generated by anaerobic decomposition in landfills, whereas composting represents a sustainable alternative that yields high-quality compost, supports resource conservation, and contributes to a sustainable agricultural system (Vukadinović, 2018) and agricultural land regeneration through the return of organic matter and nutrients.

The source-separation and treatment of biodegradable waste reduce the volume of waste ending up in landfills, extend their lifespan, and mitigate negative environmental impacts, while simultaneously creating resources from waste. Food bio-fraction separation and composting benefit numerous local communities on ecological, economic, and social levels. In this context, landfill capacity planning and the development of regional sanitary landfills and waste treatment facilities also entail the establishment of transfer stations to ensure the cost-effective transport of waste over longer distances.

The food bio-fraction management challenges have become more pronounced due to the increasing volume of waste and rising labor and system maintenance costs. In many developed countries, 50–70% of total waste management expenditures are attributed to collection and transport; therefore, even relatively small improvements in collection logistics can significantly reduce overall system costs (Pešević, 2022). Beyond technical and infrastructural solutions, cities can establish partnerships with local organizations, schools, and communities to develop food loss reduction initiatives tailored to local specificities. Particular attention should be directed toward preventing food waste and reducing losses through systems that donate surplus edible food to food banks, which subsequently distribute it to the population—thereby simultaneously reducing waste and supporting socially vulnerable groups. Additionally, local policies can facilitate food donation through tax incentives and other benefits for donors, while collaboration with retail chains can yield programs for distributing perfectly edible products that would otherwise end up as waste.

Gustavsson et al. (2011) state that approximately one-third of all food intended for human consumption is lost or wasted, amounting to a total of 1,3 billion tonnes of food annually. Since food production requires substantial resources, food loss and waste indirectly lead to various negative environmental impacts, including soil erosion, deforestation, water and air pollution, as well as the generation of greenhouse gases during production, storage, transport, and waste management processes (Mourad, 2016). It is precisely due to these growing ecological, social, and economic challenges that the issue of food waste is increasingly recognized as urgent and critical among governments, the business community, non-governmental organizations, researchers, and the general public.

Certain authors (Zadik & Katz, 2025; Ekström, Bjorvatn & Sjåstad, 2024; Đorić, 2022) are of the opinion that economic incentives and nudges can powerfully alter household behavior toward source-separation, recycling, and composting, whereas behavioral changes must be designed by respecting cognitive limitations and social norms, rather than relying solely on appeals to ecological awareness. Individuals are often unaware of externalities—specifically, the costs borne by society through the public budget—because these costs remain invisible and underestimated by citizens. Consequently, there is a need to raise awareness about the real costs of waste, as well as to reshape perceptions and habits, while public policy should engage households more actively (via pricing strategies, fees, pay-as-you-throw systems, vouchers, composting support, etc.).

Serbia faces significant challenges regarding landfilling as well as recycling and composting capacities, while its waste separation systems, billing mechanisms, and infrastructure remain under development (World Bank, 2024). Previous research has predominantly adopted a macro-analytical approach to system financing, focusing on waste volumes and composition, household food waste management and its behavioral shifts during the pandemic, waste generation, purchasing habits, willingness to reduce food waste, and the infrastructural and institutional aspects of waste management (such as waste quantities, landfills, system development plans, and service financing). However, there is a distinct lack of research in Serbia regarding household behavior in response to small financial incentives for source-separation, recycling, and composting, as well as the impact of normative messages, institutional trust, neighborhood cohesion, informal networks, and the willingness to pay (WTP) for enhanced waste management services.

The Sofia Declaration on the Green Agenda for the Western Balkans emphasizes that this document is dedicated to the process of transitioning from a linear to a circular economy, while recognizing the need for research and innovation systems to support this transition. In order to contribute to environmental protection and minimize the volume of waste generated in the region, the Green Agenda promotes a plan to integrate the Western Balkans into EU industrial supply chains. This is to be achieved, inter alia, by developing circular economy strategies that consider the entire product lifecycle, waste prevention, modern waste management and recycling, reuse, repair, and remanufacturing, as well as through further progress in constructing and maintaining waste management infrastructure for cities and regions. In fact, from a legal standpoint, the core of the Green Agenda for the Western Balkans in the context of food waste rests on the obligation to align the national legislations of the region's countries with the European Union *acquis*, aiming for a full transition from a linear to a circular economic model. The Western Balkan countries have committed to transposing the provisions of the EU Waste Framework Directive (Directive 2008/98/EC) into their domestic legal frameworks governing waste management. Therefore, the objective of adopting a new—or amending the existing—legal framework regarding waste regulation is to transform waste from an environmental burden into an economic resource through strict statutory regulation and, among other things, to establish a sustainable bio-waste management system in line with European Union standards.

In 2025, Serbia adopted a new Waste Management Act. The structure of the new statutory text differs significantly from the previous law enacted in 2009. The key objectives of the new Act are deeper alignment with European Union directives, the digitalization of the system, and the strengthening of inspection oversight. As an example, and within the context of this paper's research scope, the new 2025 statutory text introduces and defines a new concept, namely "food waste"; furthermore, it permits the import of non-hazardous waste for energy recovery purposes, mandates electronic record-keeping and the digitalization of waste movement tracking documents, and significantly tightens extended producer responsibility (EPR) through clearer financial and legal provisions. Nevertheless, it remains evident that the new Waste Management Act is not fully aligned with European Union standards. Many provisions of the new Act, which acts as the *lex generalis* in waste management matter, require precise secondary legislation (decrees and rulebooks) to properly define and regulate this field in greater detail.

Due to the fact that prior research has not addressed the combination of economic and behavioral instruments, the research scope of this paper is to analyze the impact of economic, infrastructural, regulatory, and behavioral-cognitive factors, with the aim of investigating their influence on citizens' willingness to actively participate in food waste source-separation. In accordance with the research of Zadik & Katz (2025), Ekström et al. (2024), Thøgersen (2003), Thaler & Sunstein (2008), Fullerton & Kinnaman (1999), Prelez et al. (2023), Jalalipour et al. (2025), Herath & Meyler (2017), Krause et al. (2023), Omar & Rohani (2015), Qasim et al. (2020), Svensson & Karlsson (2024), Matzembacher et al. (2020), Al Habsi et al. (2026), Kosters & Van der Heijden (2015), Đorić (2022), Vukadinović (2018), Živković et al. (2021), Rai et al. (2025), Schanes et al. (2018), Russell et al. (2017), and the empirical findings of Berjan et al. (2022) for Serbia, the baseline hypothesis is formulated as follows: 1. Economic instruments, namely financial incentives (direct rewards — utility bill reductions; systemic inducements — vouchers and points; and personal economic benefits — budget savings); 2. Infrastructural and regulatory factors, namely the role of the system (infrastructural support — free dedicated bins/containers; punitive policies — the strictness of the law); 3. Behavioral-cognitive factors, namely awareness and knowledge (macroeconomic awareness — knowledge of landfill damages; circular value — understanding waste as a raw material), influence citizens' willingness to actively participate in food waste source-separation and collection.

Linking the Concept of Circular Economy with the Role of the Individual/ Household Behavioral Economics

Preventing food losses at the consumer level directly conserves the resources invested in primary agricultural production (land, water, energy, and mineral fertilizers), thereby establishing the principles of a circular agroeconomy. The food bio-fraction management can be addressed from technological, ecological, legal, and economic perspectives, as well as through the lens of human behavior and decision-making processes. Economic incentives and "nudges" (such as utility bill reductions, discounts on composting

equipment, or rewards for source-separation) can appeal to individual responsibility, acting as stimuli that redirect household behavior toward composting and recycling (Zadik & Katz, 2025; Ekström, Bjorvatn & Sjåstad, 2024). According to Đorić (2022), ecological incentives lead to a departure from the collective dimension of environmental protection, shifting collective responsibility onto individuals. Simultaneously, they appeal to rational self-interest (lower costs, financial gains) and leverage psychological mechanisms, behavioral patterns, and beliefs—collectively referred to as behavioral economics. In order to transition from traditional waste disposal to composting or recycling, the system must be designed in a way that highlights the correct decision as the easiest and most cost-effective option. Relying solely on social norms and environmental awareness is insufficient; rather, residents need to perceive the shortcuts and advantages of such behavior. Research by Cardadeiro, Laneiro & Roseta-Palma (2023) has demonstrated that messages framed around social norms in the form of descriptive norms yield positive results. According to Lima & Branco (2018), descriptive social norms are expected to influence behavior, with social identity moderating these associations. A promotional message phrased as "Join your neighbors..." proved to be more effective than a typical appeal to environmental protection or self-interest.

Through local actions (e.g., introducing discounts or providing free composting equipment, training, and technical support), the state can lower adoption barriers and encourage the desirable and expected behavior of individuals, targeting issues such as equipment costs, lack of knowledge, and process uncertainty (Jalalipour et al., 2025). Research by Chernet, Sema, Gebeyehu & Wogayehu (2024) indicates a willingness among households to pay for improved solid waste management. They conclude that municipalities should leverage this willingness by establishing enhanced waste management systems, which can help alleviate budgetary constraints through active household participation in financing these services.

Empirical research by Zadik & Katz (2025) indicates that small rewards doubled the amount of source-separated waste, meaning that monetary incentives—even in small amounts—stimulate higher household participation in waste separation (Svensson & Karlsson, 2024). A similar effect is observed with pay-as-you-throw (PAYT) systems and recycling rewards. In addition to increasing the volume of recycled waste, this approach alters the motivational structure, thereby reshaping how waste is perceived (Thøgersen, 2003). While a segment of households responds directly to financial incentives (Al Habsi, Huang & Liu, 2026), another develops a sense of personal environmental responsibility. In an extensive field study, Ekström, Bjorvatn & Sjåstad (2024) compared small price-stimuli with normative nudges and concluded that small pricing incentives exert a large, lasting positive effect on both the quantity and quality of recycling, whereas the normative nudge alone shows no statistically significant effect. A study by Prelez, Wang & Shreedhar (2023) demonstrated that small monetary factors have a stronger and more sustained effect; consequently, individuals no longer perceive recycling as a burden or an extra chore, but rather as a contribution to the household budget. This bridges the intention-action gap, transforming waste separation, recycling, and/or composting into financial

savings, where every unutilized liter or kilogram is perceived as a cost. Since waste management costs are covered by the public budget, any expenditure that could have been prevented through recycling or separation represents a loss that could have otherwise financed public goods consumption. Therefore, economic incentives (e.g., reduced utility bills for those who compost) are particularly significant. Thaler & Sunstein (2008) state that nudges steer people's behavior in a predictable direction without forbidding any options or significantly changing their financial incentives. Although nudging has become popular in public policies aimed at reducing energy, water, and paper consumption, as well as mitigating food waste, it has faced criticism due to potential manipulation and a lack of long-term evaluations (Kosters & Van der Heijden, 2015).

The theory of externalities indicates that certain costs impact a third party—that is, a participant who did not choose to be involved in the process. These include landfilling costs, greenhouse gas emissions, and infrastructure and health burdens, which are borne by the city through the public budget rather than by individual households. Krause, Kenny, Stephenson & Singleton (2023) point to the first in a cascade of costs associated with food waste that ends up in a landfill instead of a composter. During the decomposition of food in landfills, methane is released—a gas that is over 25 times more potent than CO2 at trapping heat, consequently driving climate change. In the EU, more than 58 million tonnes of food waste are generated annually, with an estimated market value of 132 billion euros (UBQ Materials, 2024). Toxic liquid (leachate) contaminates water resources, forcing municipalities to invest millions into wastewater treatment facilities and soil protection (Omar & Rohani, 2015). Food waste is heavy, thereby requiring more trucks, higher fuel consumption, and the rapid depreciation of road infrastructure, ultimately leading to the necessity of constructing new, prohibitively expensive landfill cells. Organic waste landfills attract rodents and insects that act as disease vectors, increasing the incidence of respiratory and infectious diseases in nearby areas, which directly strains the public healthcare system (Qasim et al., 2020; Maheshwari, Gupta & Das, 2015). The transport of municipal waste is also linked to negative effects on property values, community image, and aesthetics, while causing noise, unpleasant odors, and traffic congestion (U.S. EPA, 1997).

One of the objectives of waste management policy is to inform individuals about the real costs of waste, thereby prompting them to change their habits (Fullerton & Kinnaman, 1999). According to the theory, externalities are often hidden and thus underestimated costs, yet they are associated with massive social costs. In order to make acceptable political decisions regarding food waste management, it is essential to properly identify, understand, and assess such externalities (Herath & Meyler, 2017).

In promoting pro-environmental behavior (Sörqvist, 2016), environmental psychology begins by studying and explaining the complex relationships between people and their natural or built environments. Four key stages have been identified: identifying the behavior to be changed; examining the main factors underlying that behavior; designing the behavioral intervention; and evaluating the effects of implementation (Steg & Vlek, 2009). Kahneman (2003) points out that humans possess limited cognitive capacities,

imperfect willpower, and bounded self-interest; therefore, a thorough understanding of cognitive shortcuts (heuristics), information framing, and loss aversion can significantly improve the design of public policies.

Materials and methods

The empirical research was conducted on a sample of urban consumers in the territory of the city of Novi Sad, aiming to understand the role and behavior of end consumers in the agri-food chain and food waste management. This empirical segment investigated the perspective of citizens, specifically focusing on the role of individuals in managing food waste. The research sample consists of 692 randomly selected respondents whose answers were included in the subsequent analysis. The survey was designed using Google Forms, and the questionnaire link was distributed utilizing the snowball sampling method. A total of 822 invitations were sent out, yielding responses from 692 participants, which represents an 84.18% response rate. A list of specially formulated questions was prepared for the survey, strictly aligned with the established research objectives.

The first section of the questionnaire covers the socio-demographic characteristics of the respondents. The second section focuses on the specific food-related behavior of the respondents (9 questions) and the relationship between motivation and knowledge (4 questions). The third section addresses: environmental awareness and attitudes toward food waste (5 questions); intentions and willingness to participate (5 questions); the role of social norms and networks (7 questions); perceptions of the institutional and regulatory framework (7 questions); and the assessment of responsibility and reasons for non-compliance in food waste management (3 questions). Thus, the research objective was to construct a profile of the individual handling food waste, understand their specific behaviors, and thereby formulate recommendations, promotional messages, and regulatory measures regarding food waste.

Given that the Google Forms questionnaire was configured to ensure that no questions could be skipped and that all fields required precise completion in compliance with the prompts and instructions, data cleaning or the exclusion of incomplete questionnaires was unnecessary. Furthermore, preliminary manual data sorting and tabulation were not required, as Google Forms enabled the automatic export of data into a unified Excel spreadsheet, which facilitated the seamless integration of the SPSS software for statistical data processing.

For the in-depth data analysis, descriptive statistics and multiple linear regression were employed. Descriptive statistics were used to describe the sample and identify trends, quantitatively presenting the research results through frequencies, percentages, and mean values. Multiple linear regression was applied to determine the prediction of habit changes in food waste management. In this manner, the impact of seven independent variables on citizens' willingness was examined; specifically, the analysis identified the influence of economic incentives, infrastructural and regulatory factors, as well as the significance of behavioral-cognitive drivers on changing habits in food waste management.

Results

Results The research results indicate that the sample is predominantly female, accounting for 61.6%, while the age structure is evenly distributed, with a slight dominance of the population aged 51 to 70 (36.8%). In terms of education, 76.9% of the respondents hold a higher education degree.

Table 1. Socio-demographic structure of respondents

		Frequency	Percent			Frequency	Percent
Gender	Female	426	61.6	Education	Master's/PhD	139	20.1
	Male	266	38.4		Secondary School (SSS)	160	23.1
Age	19-30	137	19.8		Higher Education (VS)	393	56.8
	31-50	138	19.9	Income	120 – 150 in 000 RSD	132	19.1
	51-70	255	36.8		50 – 80 in 000 RSD	135	19.5
	71+	136	19.7		80 – 120 in 000 RSD	258	37.3
	under 18	26	3.8		under 50 in 000 RSD	160	23.1
Residence	House	275	39.7		over 150 in 000 RSD	7	1
	Apartment	417	60.3				

Source: Authors' calculations

The high education level of the respondents corresponds to a high level of environmental awareness, as evidenced by the attitudes that: food bio-fraction separation is crucial for the environment (M=4.22; std. dev. 0.629), food waste constitutes a serious environmental problem (M=4.33; std. dev. 0.472), it is linked to climate change (M=3.78; std. dev. 0.415), and it represents an important segment of the circular economy (M=4.33; std. dev. 0.472). This high environmental awareness reflects emancipated citizens who demand public services from the state, given that they pay taxes and other levies. Their critical stance toward infrastructure in buildings or neighborhoods is associated with the perception that the level of living standards does not necessarily align with the level of environmental awareness.

An increase in consumption is linked to income growth; thus, higher purchasing power generates a larger ecological footprint. The respondents predominantly reside in apartments (60.3%) and possess solid incomes (37.3% have incomes ranging from 80k to 120k RSD). Consequently, there is greater "pressure" on the waste disposal system, given the generation of larger volumes of potentially recyclable waste, particularly the organic food bio-fraction (food deliveries, online shopping, cosmetics). Unlike respondents living in houses, who have easier access to composting, those residing in apartments are highly dependent on municipal infrastructure. As a result, the lack of source-separation containers challenges their environmental awareness and breeds frustration. The attitudes of respondents aged 51 to 70 (36.8%) hold particular significance and play a key role in interpreting the findings. Their views on waste disposal, separation, and recycling are linked to memories of a time when the collection system for secondary raw materials (glass packaging, waste paper in schools) was organized differently. Due to these comparisons with the past, they emerge as the most demanding segment of respondents.

Table 2. Specific household behavior regarding the food bio-fraction

	Mean	**Std.dev.**
In my household, we frequently discard cooked food leftovers.	2.08	.846
We often throw away fruits and vegetables because they spoil before we can use them.	2.38	1,08
When shopping, I frequently purchase more food than we actually need.	2.42	1,12
I usually save uneaten food and use it for the next meal.	4.20	.633

Source: Authors' calculations

The respondents expressed a high level of agreement regarding food preservation (M=4.20; std. dev. 0.633), indicating a tradition of minimizing food waste, reuse, and meal repurposing. Moderate incomes are associated with respondent responsibility; thus, the low mean values for statements concerning the discarding of cooked food leftovers (M=2.08; std. dev. 0.846) and throwing away spoiled fruits and vegetables due to underutilization (M=2.38; std. dev. 1.08) demonstrate that citizens in Serbia, according to this study, value the effort and resources invested in food preparation. On the other hand, discarding spoiled food or purchasing larger quantities constitutes a direct impact on the household budget, requiring planning and attention—particularly given the high participation rate of respondents with incomes up to 80k RSD.

Table 3. Environmental Intention and Actual Behavior

Do you source-separate your waste and dispose of it in the designated bins?	**Frequency**	**Percent**	**If you source-separate your waste, what is your primary motivation for doing so?**	**Frequency**	**Percent**
Yes, I do so every day.	118	17	I care about the environment.	119	17.2
No, because I lack the necessary infrastructure.	476	68,8	I care about the future.	60	8.7
I have never disposed of waste this way, even though I have access to a designated bin.	98	14.2	I do not source-separate.	394	56.9
			It makes me feel better.	60	8.7
			It gives me a sense of satisfaction.	59	8.5

Source: Authors' calculations

When examining the link between the respondents' awareness and their actual behavior, it is crucial to highlight that a high percentage of participants—specifically 68.8% (476 individuals)—do not source-separate waste because they lack the necessary infrastructure. When combined with the small proportion of those who do so every day (17%), it can be concluded that strong environmental intentions are hindered by an inadequate system. An analysis of the respondents' motivational structure indicates the presence of environmental concern as an ecocentric motive (17.2%), along with emotional satisfaction ("it makes me feel better" – 8.7% and "it gives me a sense of satisfaction" – 8.5%). Thus, the results indicate that for a small segment of the population, recycling has become embedded in their personal identity and moral

integrity rather than being perceived merely as a technical chore. Furthermore, the data reveals that 14.2% of the respondents represent the actual proportion of the population that is resistant to habit changes.

Table 4. Relationship between motivation and knowledge

		Frequency	**Percent**
Do you compost at home?	Yes	173	25
	No	346	50
	I would like to, but I do not know how.	173	25
Are you aware that developed countries collect coffee grounds from households and restaurants?	Da	58	8.4
	Ne	634	91.6
Are you aware that some countries collect used cooking oil?	Ne	576	83.2
	Da	116	16.8
If you had the opportunity, would you collect and hand over coffee grounds or used cooking oil?	Da	429	62
	Ne	263	38

Source: Authors' calculations

There is a visible gap between the respondents' knowledge, awareness, and motivation to adopt new environmental practices regarding coffee grounds and used cooking oil. According to the study, the collection of coffee waste and used cooking oil in Serbia is still in its infancy or is inadequately promoted. Nevertheless, the respondents demonstrated a strong willingness to collect these secondary raw materials, confirming their openness to new ecological concepts once the necessary conditions are established.

Table 5. Disposal Methods for Specific Raw Materials and Collection Models

		Frequency	Percent
In your estimation, how much used cooking oil waste does your household generate?	0 liters	174	25.1
	1 - 5 liters	518	74.9
In your estimation, how much coffee waste does your household generate?	0 -1 kg Monthly	480	69.4
	1 - 5 kg Monthly.	133	19.2
	0 kg Monthly	79	11.4
The most efficient method for collecting used cooking oil	By organizing annual, scheduled collection drives directly from households	232	33.5
	By placing specialized containers at recycling centers/ waste collection islands	460	66.5

Source: Authors' calculations

By examining the quantities of secondary raw materials (oil, coffee, and food) that are effectively lost from the system, it can be concluded that inadequate disposal occurs, leading to negative environmental impacts. Used cooking oil waste (with 74.9% of respondents generating between 1 and 5 liters monthly) and coffee waste (69.4% generating 0–1 kg per month) represents a clear environmental challenge

and underscore the necessity for a systemic solution. Regarding logistical solutions and preferred collection models, the respondents' feedback is highly significant for designing guidelines for local governments and public utility companies. The majority of respondents (66.5%) prefer the placement of specialized containers in the immediate vicinity of their residence, whereas the model of periodic campaigns (such as "eco-days") is supported by 33.5% of the participants.

Table 6. Environmental awareness, attitudes, intention, and willingness to participate in food bio-fraction separation

Environmental awareness and attitudes toward food bio-fraction separation	**Mean**	**Std. Dev.**
I believe that waste separation is important for the household budget (economic benefit).	3.95	.94
I believe that food waste represents a serious environmental problem (landfill economic damage / macroeconomic awareness).	4.41	.72
I am aware of the impact of food waste on the environment and climate change.	3.78	.415
I view food waste reduction as an important part of the circular economy – waste is a valuable raw material.	4.28	.81
Individuals are adequately sanctioned for improper disposal of waste and food waste?	1.50	.686
Intention and willingness to participate		
I am willing to separate food waste if a dedicated bin is provided near my home (infrastructural reward).	4.58	.065
I am willing to change my habits and separate food waste.	4,51	.68
Over the next year, I plan to pay more attention to the amount of food I waste.	3.56	.500
I am willing to participate in a local composting or food waste separation program in exchange for a reduced utility bill (direct reward).	4.62	.61
I am willing to support food surplus donation programs (e.g., through separation and awareness sharing).	4.67	.472

Source: Authors' calculations

The results presented in the table indicate a high level of awareness and environmental literacy, where food waste is recognized as a key element of the circular economy (M=4.28). Respondents identified a systemic deficiency, specifically the inadequacy of the penal policy and the absence of institutional control in this area (M=1.50). On the other hand, the respondents' willingness to participate is very high (M=4.58), provided that accessible infrastructure (bins near the home) is available. We are of the opinion that respondents are ready to change their personal habits (M=4.51), demonstrating a readiness to adapt, but they demand that the public utility system takes full initiative.

Table 7. Social norms and networks (norms, networks)

	Mean	Std. Dev.
Most people I know try hard not to waste food.	3.41	.492
People in my social circle separate waste (including food waste).	2.00	.674
It is important to me what others think about my attitude toward environmental protection.	2.96	.564
My family members encourage me to pay attention to the amount of food we waste.	3.68	.466
Through my social networks (relatives, friends, neighbors), I receive information on ways to reduce food waste.	2.50	.500
I feel a personal responsibility to reduce food waste in my household.	4.41	.492
I believe that a "good citizen" should separate food waste.	4.32	.465

Source: Authors' calculations

The respondents demonstrated a clear distinction between internal moral norms and the actual situation within their social networks. It is an established fact that the social environment shapes an individual's environmental behavior, and that social pressure or support influences waste management. The results indicate a high level of personal responsibility (M=4.41) and a strong belief that a "good citizen" should separate waste (M=4.32). Driven by an internal sense of proper behavior, respondents strive toward the ideal of a "good citizen" despite the absence of widespread waste separation, composting, and recycling. The role of the family (M=3.68) indicates that environmental awareness is primarily transmitted and sustained within the household; thus, regarding food waste, the family serves as a corrective factor to a greater extent than formal institutions do. The results further reveal that respondents do not receive sufficient information about waste reduction from their friends and neighbors (M=2.00), pointing to an existing social isolation in terms of environmental behavior. Since individuals lack information suggesting that their friends, relatives, and neighbors behave in this manner, they become isolated in their decision-making and may eventually abandon these practices over the long term. Although there is an acknowledged stance that the opinions of others matter (M=2.96), respondents do not recycle or conserve food for the sake of others or for public recognition, but rather due to their own sense of responsibility and household economics.

Table 8. Perception of the institutional and regulatory framework

	Mean	Std. Dev.
There are enough containers/bins for separate waste collection in my neighborhood.	2,34	1,16
The waste sorting system in my city is well-organized.	2.18	1,04
I believe that the competent institutions actually recycle the waste sorted by citizens.	2.00	.952
I believe that the introduction of a stricter penal policy is necessary for those who do not comply with waste disposal rules (penal policy).	3,82	1,22

	Mean	Std. Dev.
I believe that financial incentives (e.g., lower bills, rewards) would motivate citizens to separate food waste (systemic incentives).	4.35	.78
I support the introduction of local food waste composting programs.	4.49	.500
I support the introduction of a food surplus donation system (food banks) by grocery stores and restaurants.	4.85	.454

Source: Authors' calculations

The analysis of the institutional and regulatory framework highlights a gap between the current provision of public utility services and citizen expectations. Respondents rate the current infrastructure very poorly in terms of container availability (M=2.34) and the general organization of the system (M=2.18). Of particular concern is the skepticism and distrust among citizens regarding the recycling process (M=2.00), which undermines the effort invested and keeps primary source-separation at a low level. Implementing stricter penalties (M=3.82) received a lower score compared to the support for financial incentives (M=4.35), suggesting that while penalties are deemed necessary to establish order in public spaces, respondents view positive reinforcement (e.g., lower bills or rewards) as the true motivator. The highest scores were attributed to the support for establishing food banks and donating food surpluses (M=4.85), as well as introducing local composting programs (M=4.49), indicating that citizens are ready for the most ecologically advanced waste management models.

Table 9. Responsibility and Food Waste Management Measures

		Frequency	Percent
In your opinion, who bears the primary responsibility for food waste management?	State	373	53.9
	Everyone	319	46.1
In your opinion, which state-level measures yield the best results in waste management, particularly regarding food waste?	Vouchers and points	104	15
	Penalties	206	29.8
	Monetary compensations	303	43.8
	Discounts upon waste drop-off	79	11.4
What prevents you from sorting waste?	I always sort waste.	118	17
	I lack the necessary conditions for waste sorting at home.	151	21.8
	I am not interested in waste sorting.	112	16.2
	There are no waste sorting facilities where I live, so my efforts would be pointless.	311	45

Source: Authors' calculations

Regarding institutional responsibility, the respondents were divided between those who believe that the burden of waste and food waste management should be borne by the State (53.9%), and those who perceive that this responsibility lies with everyone (46.1%). This result highlights the respondents' expectation that shifts in environmental awareness must be driven by clear regulations and infrastructural development. Citizens demonstrate high awareness and perceive sustainable waste management as a

process requiring active synergy among all stakeholders, albeit with the State playing the primary role. When it comes to the barriers preventing proactive behavior, the study detected infrastructural pessimism; specifically, as many as 45% of the respondents emphasized that there are no conditions for waste sorting where they live. The share of citizens who are essentially uninterested in sorting waste is only 16.2%, indicating that environmental activism is not deactivated by citizen attitudes, but rather by the lack of, or distrust in, public utility logistics. Respondents prefer incentive-based economic instruments (70%) over punitive ones (29.8%), specifically: monetary compensations (43.8%) combined with a voucher system (15%) and reduced utility bills (11.4%). This finding confirms the hypothesis that a highly educated population with moderate income reacts to environmental challenges as an economic actor, favoring rewards for responsible behavior and other incentives as contributions to the household budget.

The results of the conducted linear regression analysis indicate that as much as 51.4% of the model's variance is explained by the influence of the selected factors ($R2 = 0.514$), while the high correlation coefficient value ($R=0.717$) indicates that economic stimulation, infrastructural and regulatory factors, as well as behavioral-cognitive factors, are the key drivers of habit change in food waste management. The ANOVA test results show that the model is statistically significant, $F(7, 79) = 11.973$; $p < 0.001$, leading to the conclusion that the independent variables statistically significantly predict the citizens' willingness to change their habits regarding food waste management.

Table 10. Motivational Factors for Active Citizen Participation in Waste Management

Model / Variable	Unstandardized B	Std. Error	Standardized Beta (β)	t	Sig. (p)
(Constant)	0.412	0.315	-	1.308	0.195
X1: Direct rewards (utility bill reduction)	0.345	0.118	0.312	2.923	0.004
X2: Infrastructural support (provided bin)	0.298	0.116	0.285	2.568	0.012
X3: Macroeconomic awareness (knowledge of landfill damages)	0.256	0.110	0.241	2.327	0.022
X4: Systemic incentives (vouchers and points)	0.205	0.101	0.198	2.030	0.045
X5: Penal policy (strictness of law)	0.041	0.74	0.042	0.554	0.058
X6: Circular value (knowledge of waste as a raw material)	0.025	0.98	0.023	0.255	0.079
X7: Personal economic benefit (household budget savings)	-0.018	0.85	-0.017	-0.212	0.083

Source: Authors' calculations

The analysis of individual coefficients in the regression model indicates that economic and infrastructural factors play a primary role. The largest standardized beta coefficient is observed in the Direct Reward variable ($\beta = 0.312$; $p = 0.004$). The obtained value indicates that financial reciprocity, in the form of reduced utility bills, is the strongest motivational driver for changing citizen habits. The results confirmed the existence of a

hierarchy in the order of motives, followed by infrastructural accessibility (β = 0.298), macroeconomic awareness of losses (β = 0.256), and systemic incentives such as vouchers (β = 0.205), which exert a similar but slightly weaker statistically relevant influence.

Conversely, for variables advocating external coercion—namely, the penal policy (p = 0.058) and the recognition of the circular value of waste (p = 0.079)—there is no statistically significant effect on the dependent variable. This result indicates that repression does not have a long-term effective impact; rather, individuals prefer direct benefits. Ultimately, the transformation of individual readiness should progress from passive users to active participants, driven by economic and financial incentive models along with infrastructural support.

Discussion

The research results indicate that as many as 68.8% of the respondents cite the lack of waste separation containers as the primary reason for their hesitation, i.e., inactivity. These findings align with the study by Krause et al. (2023), which emphasizes that the physical accessibility of disposal and waste separation sites is crucial, whereas their absence—combined with a lack of information—passivizes the public. The expressed high willingness to participate (e.g., 66% for collecting used oil and coffee grounds) confirms a high level of awareness and readiness to act, provided that dedicated bins are placed within neighborhoods. On the other hand, a low score was observed for composting (3.39), which does not indicate a lack of awareness but is rather a consequence of an urban lifestyle (60% of the sample resides in apartments). A viable solution could involve introducing innovative models, such as subsidies for household composters or offering shared community-based utility solutions.

A significant number of respondents (over 91% are open to composting given an incentive) suggest that lower utility bills, vouchers, and/or points would help address the food waste issue. This thesis is consistent with the views of Thaler and Sunstein (2008) regarding the impact of the nudge theory, stating that financial incentives (vouchers and points) yield greater results than punitive measures. While some authors have highlighted the positive role of strict enforcement measures (Qasim et al., 2020) or, conversely, the limited impact of repression (Al Habsi et al., 2026), the results of this study demonstrate that penalties “do not work” in Serbia. This points to the need for developing an alternative approach to waste disposal management, rather than relying solely on inspection supervision.

The high willingness of citizens to donate surplus food (M=4.75) and engage in composting (M=4.28) indicates a significant potential for reducing food supply chain losses and diverting bio-waste into organic agricultural production, as confirmed by the study of Berjan et al. (2022) on specific motives in Serbia.

The fact remains that 51.3% of the respondents perceive the State as the primary bearer of responsibility, while 46.1% display high awareness on this matter and emphasize the necessity of collective action. The solution lies in enhancing the institutional framework,

where collaborative efforts—specifically through the targeted involvement of SMEs—would educate users, offer tangible benefits, and ultimately transform citizens from passive consumers into "prosumers" (producers-consumers of raw materials).

The study established a high, statistically significant impact of direct rewards and financial reciprocities on citizen readiness, which aligns with the conclusions of Fullerton and Kinnaman (1999) regarding economic instruments. Vouchers and points act as positive motivators, consistent with the research by Kosters & Van der Heijden (2015), Thaler and Sunstein (2008) on subtle incentives (nudges), and Omar & Rohani (2015). Although Zadik and Katz (2025) emphasize the importance of incentives for the transition, the research results (for Serbia) indicate that utility bill reductions are more effective than any potential benefits, meaning that citizens in Serbia respond to direct price incentives, which creates opportunities for designing sustainable economic models within the circular agroeconomy (Đorić, 2022).

A good infrastructure, treated as a convenience in waste disposal, has a highly statistically significant impact, which aligns with the views of Krause et al. (2023). High environmental awareness among citizens, in the absence of convenience, is not a sufficient driver, which amplifies the importance of the technical aspects of waste management (Vukadinović, 2018; Svensson & Karlsson, 2024). A comprehension of the broader macro-aspect of waste disposal is present among the respondents, and the study established its statistically significant impact, as confirmed by Schanes et al. (2018). High consensus was reached with the stance of Berjan et al. (2022) regarding the specific sensitivity of citizens toward food chain losses; thus, the existence of internal pressure among respondents due to awareness of state-level losses (landfills, resources) was proven.

Although Rai et al. (2025) emphasize the importance of understanding waste as a resource, the conducted research demonstrates that knowledge alone is not a sufficient motivator. In practice, there is a prominent knowledge-action gap (Thøgersen, 2003); knowledge remains largely passive, which is consistent with the findings of Matzembacher et al. (2020). Respondents are not sufficiently prepared to conserve food, resulting in significant quantities being wasted; thus, household savings alone do not provide a sufficient motive to alter habits or to foster a readiness to separate and collect food waste (Prelez et al., 2023). These conclusions underscore the necessity of identifying new models to stimulate citizens to transform their awareness regarding food waste disposal.

Conclusion

The essence of the Green Agenda for the Western Balkans in the context of food bio-fraction management rests upon the obligation to harmonize the national legislations of the region's countries with the European Union acquis, aiming for a complete transition from a linear to a circular economic model. Accordingly, the Western Balkan states have committed to transposing the provisions of the EU Waste Framework Directive

into their national legal frameworks governing waste matter. In 2025, Serbia adopted a new Waste Management Law, the key objectives of which are deeper alignment with EU directives, system digitalization, and the strengthening of inspection supervision. Nevertheless, it is evident that the new Waste Management Law is not fully harmonized with European Union standards. Many provisions of this new law, which serves as the lex generalis in waste management matter, require precise secondary legislation (decrees and rulebooks) to properly define and regulate this field.

The research results point to obstacles in food waste separation, with 68.8% of respondents citing the lack of specialized containers as a key factor. The high readiness to act (66% for collecting oil and coffee) indicates a latent motivation, conditional upon accessibility, while the low score for composting (M=3.39) stems from urban living conditions (60% of respondents reside in apartments), suggesting a need for subsidized household systems or shared community utility options. Over 91% support financial rewards such as lower bills or vouchers, in line with nudge principles that favor incentives over penalties, as enforcement demonstrates limited effectiveness in the domestic context.

High scores for food donation (M=4.75) and food banks (M=4.28) signal solidarity, confirmed by regional studies on motivations within the Western Balkans. The State is viewed as the primary bearer of responsibility (51.3%), yet there is strong backing for collective engagement (46.1%), highlighting the role of SMEs in education and the transformation of citizens into active prosumers. Financial reciprocity and rewards carry a statistically significant impact, countering passivity despite an awareness of macroeconomic costs, where infrastructure transcends pure knowledge as a driver.

Based on empirically confirmed hypotheses and identified barriers in food waste management, the following set of targeted measures, tailored to urban living conditions, is proposed:

The creation of an “Incentivized Recycling” model should introduce direct financial incentives through personalized access cards for smart containers. These would log the submitted food bio-fraction and automatically reduce the monthly utility bill or generate shopping vouchers redeemable with partners within the small and medium enterprise (SME) sector.

Due to living conditions in urban environments, infrastructural adaptation is required; solutions must be technically feasible within constrained spaces. The subsidized procurement of small household composters is proposed, alongside the placement of dedicated containers for used oil and coffee grounds in the immediate vicinity of residential buildings (within a 50–100 meters radius).

The lack of citizen awareness can be overcome through cooperation with the private sector. It is necessary to develop mobile applications that display container locations in real-time, while simultaneously providing education on proper waste separation and individual resource savings (e.g., reducing CO2 and methane emissions). Educational

campaigns should be rebranded to place the focus on concrete macroeconomic losses rather than abstract messages about a "clean planet."

The expressed willingness to donate food requires a legally and logistically defined process. Tax incentives are proposed for retail chains and SMEs that donate surplus food near its expiration date to food banks, accompanied by the construction of a logistical network for rapid distribution.

The proposed measures, grounded in the research findings, enable the transformation of passive awareness into active waste management. Implementation requires coordination between local authorities, the private sector, and citizens, with effects measured through indicators such as separation rates and waste reduction, thereby achieving sustainable economic and environmental progress while establishing a stable and circular agri-food system in line with the principles of the Green Agenda.

Conflict of interests

The authors declare no conflict of interest.

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