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FROM AWARENESS TO ACTION: TETOVO'S JOURNEY IN WASTE MANAGEMENT

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ABSTRACT

Waste is increasing worldwide, causing many adverse impacts to the environment, human health, as well as the global climate. The increasing global waste generation trend is also reflected in North Macedonia, including Tetovo, where lower sustainable waste management practices pose an ongoing challenge.

This research offers a comprehensive examination of the city of Tetovo's waste management practices, focusing on its residents' awareness levels and the undertaken strategies for sustainability. Building on existing research and new insights (especially those generated through the survey with Tetovo's citizens), it explores the historical evolution of waste management in Tetovo, highlighting past challenges and initiatives. With a focus on 'Municipal Public Services Co. (JPK) Tetova', the study navigates legislative hurdles, regional constraints, and potential for intermunicipal collaboration. Furthermore, it extracts Tetovo's community behaviors and awareness level through a conducted survey with citizens, which's insights

reveal a significant gap between awareness and active citizen participation, underscoring the need for actionable recommendations.

Drawing upon theoretical frameworks like Waste Management Theory (WMT) and the “Zero Waste” concepts, this research explores opportunities for enhancing sustainability in Tetovo's waste management approach. Additionally, it discusses the implications of waste management on climate change, emphasizing the need for alignment with international standards to mitigate environmental impacts. Based on the literature review findings and survey data, the research proposes practical steps for improving waste management practices in Tetovo. These include collaborative initiatives, awareness-raising campaigns, educational programs, and measures for incentivizing compliance, all centered around a citizen-centric approach. By implementing these recommendations, Tetovo can progress towards a more efficient, environmentally conscious waste management system, benefiting present and future generations. Furthermore, stakeholders are encouraged to leverage the insights from this study to collaboratively implement effective strategies for fostering sustainable waste management practices, thereby empowering citizens to contribute actively to environmental conservation efforts.

Keywords: Sustainable Waste Management, Zero Waste, Recycling, Circular Economy, Community Awareness, Greenhouse Gas Emissions Reduction, Climate Mitigation

INTRODUCTION

Evidence of publicly organized waste management systems exists as far back as the Roman Empire. Historically, the emphasis was on collecting and disposing of waste to protect the health of city inhabitants and improve the aesthetic appearance of territories. During the 19th century, with the expansion and industrialization of cities, there was a significant increase in waste generation, marked by a noteworthy shift in its composition. Notably, for the first time, a substantial non-putrescible component became part of the waste stream (World Bank Group, 2018). By the 20th century, waste was increasingly viewed as a resource to recover materials and energy.

In recent years, the escalating scale of waste production has become an alarming concern, transcending geographical boundaries. The world produces 2.01 billion tonnes of municipal solid waste annually, with approximately 33% of it not properly environmentally managed. On average, each person generates 0.74 kilograms of waste per day, ranging from 0.11 to 4.54 kilograms. Despite comprising 16% of the global population, high-income

countries contribute 34% (683 million tons) of the world's waste. Projected estimates suggest global waste will reach 3.40 billion tons by 2050 (Kaza et al., 2018).

Against this backdrop of evolving perspectives, the urgency of effective waste management becomes apparent. As the global population burgeons and urbanization accelerates, the sheer volume of waste generated has reached unprecedented levels. The repercussions of inadequate waste management are felt not only in environmental degradation but also in adverse effects on public health and well-being. In addition, greenhouse gas (GHG) emissions deriving from the waste sector further contribute to global warming. As such, the IPCC recommends enhanced action in overall waste (including food waste) prevention, minimization and management towards climate change mitigation as well as support of sustainable development, with particular synergies shown with several Sustainable Development Goals 1, 2, 3, 6, 7, 9, 11, 12, 14 and 15 (IPCC, 2022).

The problem of waste management is also common in North Macedonia. In the country, Municipal Solid Waste (MSW) generation remained stable between 2011 and 2017, ranging from 786,000 to 797,000 tons. Per capita waste generation fluctuated between 354 and 384 kilograms per capita. As of 2017, 87% of the total waste comprised mixed MSW, with households contributing 83% and commercial waste 17%. Despite a collection rate ranging from 70% to 81%, a significant portion of the population lacks access to waste collection services, particularly in rural areas. Municipalities, primarily through public communal companies, are responsible for MSW collection and disposal, with ownership being predominantly municipal and only a few operating as public-private partnerships with private investors (United Nations, 2019).

Tetovo, a city nestled in the Polog (Northwestern) Region of North Macedonia, captures a microcosm of this global dilemma. This paper aims to explore Tetovo's waste management thoroughly, covering its historical evolution, contemporary challenges, recent initiatives, and community perspectives (awareness and practices).

Tetovo's waste management history is marked by landfill reliance and informal dumping, with the 'Municipal Public Services Co. (JPK) Tetova' shouldering waste collection responsibilities. Recent challenges, including a human resources crisis and protests, have underscored the city's struggle (Gazeta Express, 2023). Exploring Tetovo's historical trajectory reveals significant milestones, such as the inauguration of a waste loading station and the

establishment of 'Deponia Rusino PP' leading to protests (Angelovski, 2021) and a cessation of waste disposal at Rusino.

Recent developments introduce a 15-year public-private partnership (PPP) between 'Saubermacher' and the Municipality of Tetovo (Saubermacher, 2023). 'Saubermacher Tetovo' aims to address littering and reloading issues, signaling a commitment to modernizing waste management. However, challenges persist, from legislative alignment to practical implementation. Tetovo faces issues of regional landfill absence, municipal constraints, and the need for better inter-municipal cooperation.

Waste Management Theory (WMT) and the "Zero Waste" concept provide theoretical frameworks, but their translation into action requires careful consideration. Creative activism by Tetovo's civil society organizations, from musical protests to unconventional demonstrations, reflects a collective commitment to addressing waste management challenges.

This paper concludes with a survey report, revealing a gap between awareness and active participation in sustainable waste management in Tetovo. Insights highlight the necessity of targeted awareness campaigns and transparent communication. In essence, this research navigates Tetovo's waste management journey, aiming to inspire sustainable practices and community-driven solutions for contributing to tackling global waste management challenges.

METHODOLOGY

This research is based on desk research as well as a specifically designed survey with residents of Tetovo. The reviewed documents include the Law on Environment, Law on Waste Management, National Strategy for Waste Management (2008-2020), National Plan for Waste Management (2009-2015), National Program for Waste Management, as well as different publications and information from the local media sources.

In addition, a trilingual online survey was conducted from December 7th to 14th, 2023, using a user-friendly online form shared across various social media and networking platforms. The primary objective was to gather insights into waste management perspectives, practices, and opinions of the residents in the city of Tetovo. Therefore, some of the questions tackled the following aspects of citizens' familiarity with waste management practices in Tetovo, including their attitude towards waste management, awareness about environmental consequences of waste, and their engagement with waste management efforts.

The survey enlisted 285 participants aged 16 and above, comprising 60% Albanian language speakers, 31% Macedonian, and 9% English. The five-minute anonymous questionnaire consisted of 24 questions, out of which 23 were close-ended and one open-ended.

The obtained results were processed and analyzed using the STATA14 software. The primary methods employed included descriptive statistical analysis and chi-square statistical testing (with a confidence level of 95%) to examine associations with various demographic and socio-economic variables.

Furthermore, the Waste Management Theory (WMT), the European Union (EU)'s Waste Framework Directive and the "Zero Waste" concepts are explored in order to have a wider picture about the definitions of waste, its categories and their management. WMT is grounded in the imperative of preventing waste from harming human health and the environment (Pongrácz et al., 2004). While constructing a sustainable agenda of waste management it is important to not just regulate waste disposal, but to also minimize its generation. To design an effective waste management system, WMT emphasizes four key principles: preventing harm, conserving resources, prioritizing the creation of useful objects over waste, and transforming waste into non-waste.

The EU defines waste as any substance or object that the holder discards or is required to discard (Pongrácz et al., 2004). Its Waste Framework Directive defines waste aims to extract resources from waste, thus supporting a circular economy by improving waste management, stimulating innovation in recycling and limiting landfilling (EC, n.d.). It orients waste management, requiring it be managed without causing adverse impacts (including noise or odors) to humans, plants, animals, water, air, soil, places of special interest and the broader environment. In addition, it also introduces the "polluter pays principle" and the "extended producer responsibility", which mandate the responsible parties to pay for the caused damage considering the whole product's life cycle (EC, n.d.). The "Zero Waste" concept expands responsibility beyond producers, to politicians and the broader community. It refers to waste generation minimization through the 5 Rs: refuse, reduce, reuse, recycle and rot (WEF, 2020). Many countries worldwide are following this concept, and they are already showing results in the fight against waste management and sectoral GHG emissions reductions (Bennett, 2023). It is estimated that a zero-waste approach could contribute to an 84% reduction of sectoral emissions (Bennett, 2023).

Based on the desk review and survey findings, this research provides several recommendations for a more sustainable waste management in Tetovo that include creating collaborative collection and recycling points, organizing awareness raising campaigns, establishment of compost centers, developing educational programs, applying fines for non-compliance, and organizing community work for offenders.

RESULTS AND DISCUSSION

Findings from the desk review of the related legal framework in North Macedonia, responsive institutions and their competences in waste management in Tetovo, as well as past and current waste generation trends and management practices are presented in the first sub-section below. Furthermore, the GHG emissions trend in North Macedonia, especially that of the waste sector (including waste composition and expected trends) is further elaborated in the second sub-section. The third sub-section presents initiatives undertaken by the community as a response to the dire situation regarding waste management in the city, including conventional protests and other musical and artistic performances demanding a cleaner and healthier environment. In the end, the fourth sub-section presents the findings from the survey with the citizens of Tetovo (including 285 respondents), which provide valuable insights about the community awareness level, as well as their current practices and attitudes towards waste management.

1. Context and key challenges regarding waste management in Tetovo

Key legal framework related to environmental protection and waste management in North Macedonia includes the Law on Environment, the Law on Waste Management, as well as the National Strategy for Waste Management (2008-2020), the National Plan for Waste Management (2009-2015), and the National Program for Waste Management (Idrizi et al., 2019). Despite North Macedonia's work in aligning the legislation with respective European Union's requirements, practical implementation remains a key challenge around the whole country (Idrizi et al, 2019). Besides the Skopje region, almost all other planning regions are identical, lagging European practices.

Waste management in North Macedonia is a local government competence. Therefore, the Municipality of Tetovo is responsible for controlling waste management, while complying with the respective laws and aligning with relevant strategies and plans (including the National Plan for Waste Management, the National Strategy for Waste Management, and relevant spatial or sectoral plans). Practically, waste collection in Tetovo is conducted through the public

corporation 'Municipal Public Services Co. (JPK) Tetova', established in 1989. Its 'Municipal Hygiene' department manages the collection, transportation, and disposal of waste.

The global rise in waste generation is mirrored in Tetovo as well, signaling a concerning trend. The history of waste management in Tetovo reflects a system heavily reliant on landfill disposal and informal dumping, with low recycling rates and a lack of infrastructure for waste selection and recycling. Besides having no regional landfill, it also struggles with limited municipal resources and a lack of sufficient cooperation with other municipalities. Waste management challenges include overfilled waste containers, reloading issues, lack of approved sites for construction for waste disposal, random dumping, pollution, high transportation costs due to waste blockages, but also local protests (Idrizi et al., 2019; Gazeta Express, 2023). Overloaded landfills are also causing a negative impact on the adjacent fertile lands and drinking water sources (Alsat, 2023). Furthermore, open and green public spaces in the city, especially those around the sports hall and the 'Woman's Park' near the Bus Station, remain with a poor hygiene and maintenance level (Dimovski, 2023).

As of now, Tetovo lacks a comprehensive strategic plan to address this issue. Waste collection data is inconsistent but estimated from NWMP, CENSUS, and MAKStat. The breakdown shows 27% dry recyclables and 50% organic waste. Moreover, recent information reveals that within a day, **25** tons of waste have been collected in Tetovo, highlighting the ongoing challenges in waste management (CDPPR, 2020).

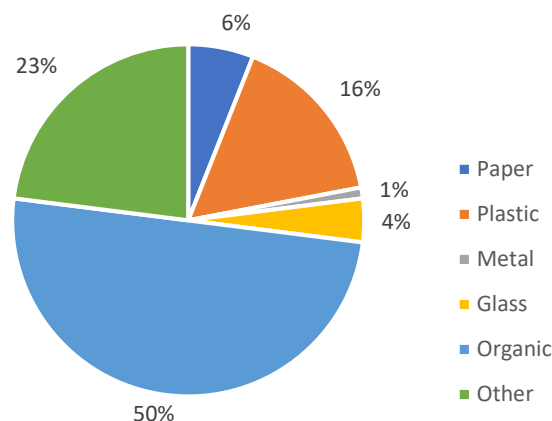


Figure 1. Waste collection (CDPPR, 2020)

A decade ago, waste disposal practices in Tetovo were centered around a location near the railway station and other illegal landfills. In 2017, Tetovo's Mayor, Teuta Arifi, took steps to address the waste management situation by inaugurating a waste loading station near the

village of Trebosh, just three kilometers from Tetovo city (Fol, 2023). The station should handle daily waste collection from households and then transport it to the 'Drisla' landfill in Skopje. According to European standards, Drisla landfill is the largest in the Balkans, serving over 600,000 families (Denkovska, 2019). During this time, residents faced challenges as 'JPK Tetova' delayed waste transportation to 'Drisla'. Concerns included damage to fruit trees and pollution affecting agriculture, leading to the community describing their village as a disaster (Denkovska, 2019). The municipality attributed difficulties to high transportation costs.

Since then, significant changes have been implemented in waste management processes, including increased efforts in maintaining old garbage bins, attempts to introduce underground bins for a cleaner city (though not yet implemented), separation of bins for glasses (through private investments), and relocation of the illegal dump site outside the city.

One notable development is the establishment of 'Deponia Rusino PP', a public inter-municipal enterprise founded by nine municipalities in the Pollog region, including the Municipality of Tetovo. The illegal waste dumping site 'Rusino' is situated above Gostivar in Banjicko Pole. This area, appreciated for its greenery and woodlands, has become a dumping ground for 120,000-140,000 tons of garbage daily from nine municipalities, and Tetovo was the major contributor (Angelovski, 2021).

In November 2023, the Municipality of Tetovo signed a 15-year public-private partnership (PPP) contract with an Austrian company 'Saubermacher' to enhance its waste management, cleanliness and hygiene. While the 'JPK Tetova' will be restructured, a new joint venture 'Saubermacher Tetovo' has been established, which will maintain regular waste collection services for its approximately 90,000 residents, but at the same time work on their and companies' awareness raising and education on the importance of proper waste disposal (Saubermacher, 2023).

As far as other countries are producing energy out of waste, Tetovo still has issues on whether to select waste or not. Environmentalists see a solution to the problem in the implementation of the "Zero Waste" concept, which is based on the principles of sustainable development and circular economy. As of 2022, this concept is applied by around 480 municipalities across different countries in Europe, which jointly on average separate collect 67% of their MSW, and at the same time contribute to waste reduction and increased recycling rate (Zero Waste Europe, 2022). This concept is also followed in Skopje, which can serve as a great model for increased environmental care and awareness raising.

2. Impact of waste on climate change

With the increased waste generation and its inadequate disposal and treatment, the GHG emissions from the waste sector as well as related air pollution are continuously increasing. According to the North Macedonia's GHG emissions inventory, emissions generated through the waste sector increased by 56% between 1990 and 2019, showing a linear growing trend (Obradovikj et. al., 2021).

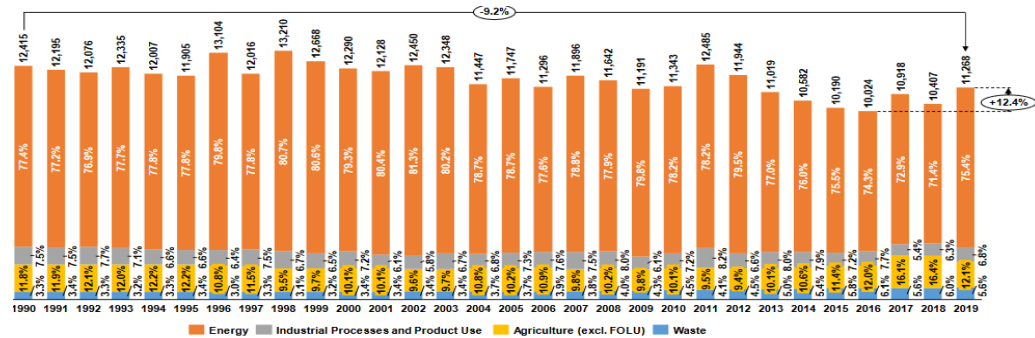


Figure 2: Total GHG emissions by sector (Obradovikj et. al., 2021)

In comparison to the increasing waste generation trend in North Macedonia, many other countries in the region have already stabilized or started decreasing the amount of waste per capita. For example, in Austria the quantity of waste during the period 2008-2017 remained, with a similar situation in Greece and Croatia, whereas in Bulgaria the amount of waste per capita was reduced by about 30% (MOEPP, 2020).

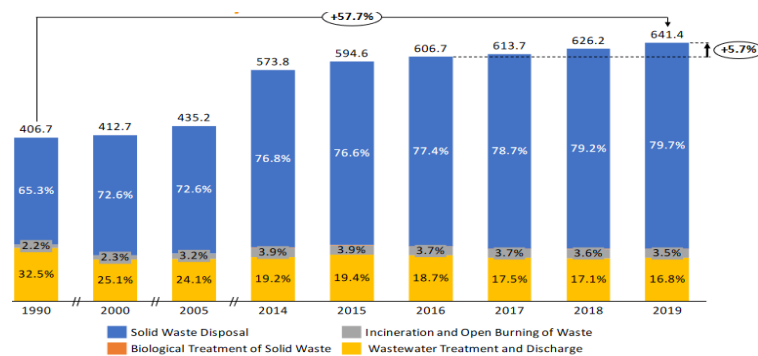


Figure 3: GHG emissions from the Waste sector, by category (Obradovikj et. al., 2021)

In North Macedonia, waste information is divided under four categories, including Solid Waste Disposal, Biological Treatment of Solid Waste, Incineration and Open Burning of Waste, and Wastewater Treatment (Obradovikj et. al., 2021). Solid Waste Disposal accounts for the highest GHG emissions, therefore, it should receive higher attention (Obradovikj et. al., 2021). In 2018, most of it comprised food waste (36.7%), garden waste (10.7%), paper (10.8%), wood (0.4%), textile (3.7%), nappies and plastic (5.0%), and other inert waste

(32.6%). With the increasing waste generation trend estimated to continue, it is assumed that the composition of waste will continue to be the same (MOEPP, 2020).

It is estimated that the total GHG emissions from the waste sector will increase by 50% in 2040. The subcategory with the largest share of emissions (81% in 2040) will remain Solid Waste Disposal for the whole period, followed by the subcategory Industrial Wastewater (10% in 2040) and Domestic Wastewater (6% in 2040). Concerning the emissions by greenhouse gases, by far the largest amount is from CH₄, with a share of 96% in 2040 (MOEPP, 2020). Only after 2030, North Macedonia will start seeing a decreasing trend on some gases, including N₂O. However, local data for Tetovo regarding its waste sector's contribution to the GHG emissions and respective shares is not available.



Figure 4. Estimated GHG emissions in the waste sector by gasses (MOEPP, 2020)

3. Community response and creative activism

Grappling with many waste management challenges, the city of Tetovo has witnessed the convergence of artistic expression and civic action in response to its environmental concerns. For example, in 2016, the NGO 'Eco Guerilla Tetovo' orchestrated a unique form of creative activism, using the melodies of Johann Sebastian Bach's "Air" to draw attention to the hazardous "wild dump" at the city's entrance (Evrosimoski, 2016). The musicians' performance, set against a backdrop of garbage heaps, symbolized a powerful call for authorities to address the environmental and health threats posed by uncontrolled waste.



Figure 5. Waste activism (radiomof.mk)

In 2018, the citizens of Tetovo creatively expressed their dissatisfaction with the city's cleanliness through an unconventional protest. The central square's New Year's tree, adorned with plastic bags and garbage boxes, became a symbol of protest prevalent litter issues. Slogans and messages highlighting the environmental impact of plastic adorning the tree, transforming a festive tradition into a visual representation of Tetovo's waste challenges (Andonov, 2018).



Figure 6. Map underground containers in Tetovo (Mak Press, 2021)

In 2021, civic activists took a proactive stance, installing a "Map with Underground Containers" at key locations across Tetovo. This initiative aimed to emphasize the need for a long-term solution to transform waste management practices in the city. The strategic placement of the map in the city center, supported by the non-governmental organization "Multikultura", not only showcased potential improvements to waste management infrastructure but also served as a call to action for citizens to actively contribute to a cleaner and more sustainable urban environment (Mak Press, 2021).



Figure 7. Community activism (Gostivar-Infoteka)

In 2021, residents protested under the slogan “STOP RUSINO”. The issue gained attention when residents of Gostivar were investigating the types of garbage being dumped there, during which they observed constant smoke, and significant air quality deterioration (Angelovski, 2021).

These instances of creative activism highlight the community's commitment to addressing Tetovo's waste management issues through innovative and impactful means. Their (and others' communities in overall North Macedonia) demand for a better and healthier living environment should be considered a priority by the local and central government authorities, whereas their willingness to contribute should be utilized in achieving the aimed results jointly.

4. Community practices and awareness level

The survey conducted through this research with 285 respondents provides valuable insights into Tetovo's community awareness, practices, and attitudes towards waste management. While there is a high perceived importance of waste reduction, a significant gap exists between awareness and active participation.

The survey respondents displayed diversity, with 89% falling within the 18-50 age range, 9% aged 50 and above, and a modest 2% under the age of 18. Female participants dominated, constituting 64% of the surveyed population (Figure 8).

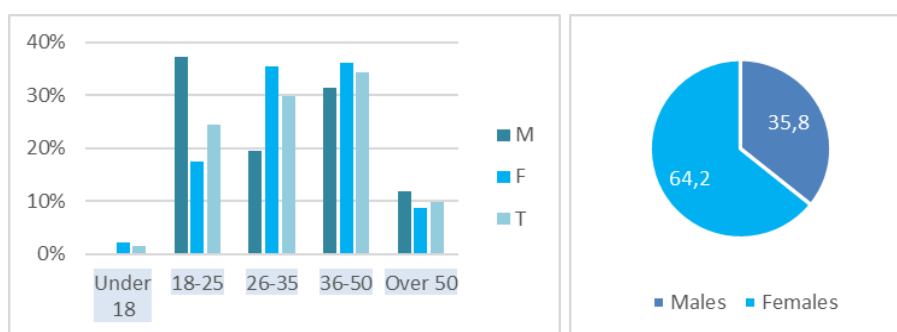


Figure 8. Respondents by age (%) (left) and by gender (%) (right) (authors)

A significant 79% reported having higher or advanced education, while 19% had secondary education. Regarding income, 77% indicated an average household income, 15% reported high income, and 8% reported low income. In terms of employment, 66% identified as employed or self-employed, 21% as pupils or students, 6% as unemployed, and the remaining 7% fell into other categories (Figure 9).

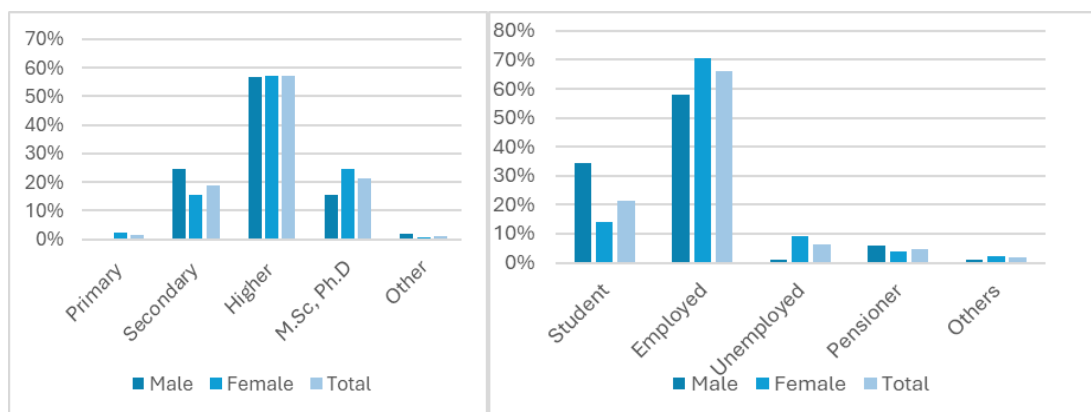


Figure 9. Respondents by education level (%) (left) and by economic status (%) (right) (authors)

Respondents exhibited diverse self-assessments of their awareness of waste management practices, with 28% considering themselves very aware, 49% rating their awareness as somewhat aware, and 14% indicating not very aware. Chi-square tests revealed no significant associations of rate of the awareness of waste management with age, gender, working status, education, or household income. This suggests a consistent level of awareness across different demographic and socio-economic factors, including gender, work status, household income, and education levels.

It is a concern that a mere one in five participants (20%) demonstrated awareness of local recycling programs in Tetovo. Chi-square tests confirmed no significant associations of awareness of local recycling programs in Tetovo with age, gender, working status, education, or household income. The in-depth analysis exposed interesting insights into the perception of access to recycling bins (shown in Figure A in Appendices). Younger individuals (less than 25 years) exhibited a more positive perception of access to recycling bins, with 43% acknowledging access compared to 33% among the overall respondents. Additionally, participants with secondary and less education reported a higher awareness level (36% and 33%, respectively) compared to persons with higher education.

The survey uncovered a significant knowledge gap regarding Tetovo's waste management regulations and laws, with a majority of 75% lacking familiarity (Figure B in

Appendices). Notably, the 26-35 age group and individuals with higher education displayed a considerable lack of knowledge, registering at 82% and 77%, respectively.

Concerns about waste management did not translate into active participation, as only 8% of respondents reported engaging 'frequently' or 'always' in local initiatives. Notably, a significant gap in engagement was observed, with 76% of individuals with secondary education or less and 89% of unemployed individuals indicating minimal participation (Table 1). Additionally, among the youth and students, awareness stood at 8% and 11%, indicating a lower interest and participation level in this local activity in the common community.

Table 1. Frequencies of participation in local waste reduction and recycling initiatives

Frequency	Tot.	Economic status				Education			
		Student	Employed	Unemployed	Pensioner	Others	Second. and less	Higher ed.	M.Sc., Ph.D.
<i>Never</i>	30%	33%	28%	39%	31%	40%	40%	29%	25%
<i>Rarely</i>	36%	31%	35%	50%	54%	20%	36%	36%	36%
<i>Occasionally</i>	26%	28%	28%	11%	8%	40%	22%	26%	30%
<i>Frequently</i>	7%	8%	7%	0%	8%	0%	2%	8%	8%
<i>Always</i>	1%	0%	2%	0%	0%	0%	0%	1%	2%
<i>Total</i>	100%	100%	100%	100%	100%	100%	100%	100%	100%

While respondents expressed a high level of importance in reducing waste, with 83% indicating it as extremely important or important, a contradiction emerged between perceived importance and actual engagement. This suggests opportunities for community-driven initiatives and policy improvements to bridge this gap.

In terms of disposal methods, respondents had the multi-choice possibility to answer. The majority 93% selected "garbage bin collection," followed by 11% using "recycling programs, 5% opting for "composting", and another 5% disposing of waste in unmarked places. Additionally, nearly half, or 54% of respondents implemented measures to minimize household waste, with 35% engaging in recycling activities like paper, plastic, or glass on a daily, weekly, or monthly basis (Figure C in Appendices). Students younger in age (18-25) are more engaged (52% and 43%) than the whole population (35%).

A substantial 78% of respondents expressed very/extreme concern about the environmental impact of improper waste disposal. The highest concern is expressed by

respondents over the age of 50 (93%) and persons with the highest education level (M.Sc. and Ph.D.) (85%) (Figure 10).

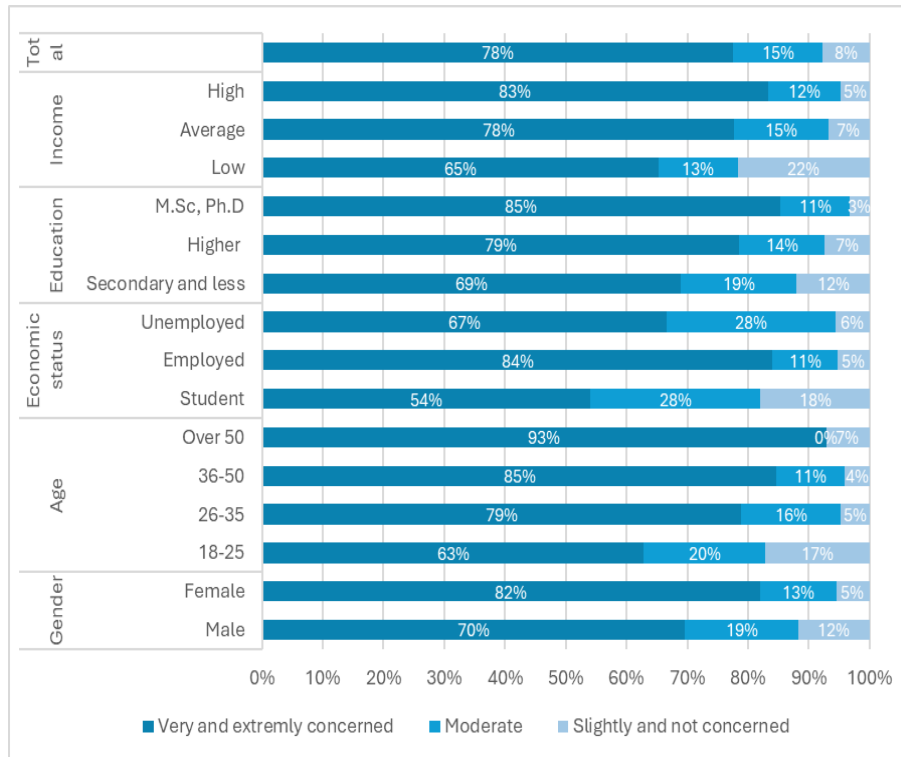


Figure 10. The level of concern about the environmental impact of improper waste disposal in Tetovo (authors)

When asked about the factors influencing their waste disposal habits, 28% identified the "environmental impact" as the primary factor, followed closely by 29% who cited "convenience". Additionally, 26% considered their disposal habits based on "knowledge of recycling options", while 17% were influenced by "community influence".

Approximately half of the respondents (49%) expressed optimism or were very optimistic about the new public-private partnership for waste management. However, 30% reported being uninformed about this initiative, and 20% were not optimistic. Despite this, a significant 91% of respondents expressed a high likelihood of adopting new waste management practices if introduced, demonstrating a positive attitude towards potential changes. Furthermore, 94% of participants indicated interest in receiving tips to reduce household waste. Thus, the findings suggest the need for targeted awareness campaigns, educational initiatives, and transparent communication to bridge this gap.

The open-ended responses shed light on specific challenges, including perceived municipal support, infrastructure deficiencies, financial concerns, and potential impropriety in

JKP Tetovo's management. Addressing these concerns is crucial for building trust, improving operational efficiency, and ensuring that waste management initiatives meet the needs and expectations of the community.

Some of the key concerns extracted through the open-ended responses include:

1. *Lack of municipal support:*

Respondent's answer: *"Despite the desire for awareness, when there is no organization from the municipality that supports you, efforts are in vain. Placing recycling bins next to ordinary ones that are never collected feels like attempting to extinguish a house fire with buckets of water"*. This open-ended response emphasizes a perceived lack of municipal support, rendering individual efforts in waste management futile. The metaphor of attempting to extinguish a house fire with buckets of water conveys a sense of frustration and ineffectiveness. The respondent specifically points out the issue of irregular trash collection, suggesting that addressing this fundamental problem should be the municipality's priority before implementing recycling programs. This insight underscores the importance of basic waste management infrastructure and services as a prerequisite for successful and meaningful recycling initiatives. It also highlights the need for the municipality to enhance its operational efficiency and responsiveness to citizens' concerns.

2. *Infrastructure deficiencies and financial impact:*

Respondent's answer: *"The city's not having proper infrastructure makes it hard to do the new project. Plus, the new partner might make the monthly payments more expensive, which could seriously affect family budgets"*. The respondent raises concerns about the lack of proper infrastructure in the city, making it challenging to implement new waste management projects. Additionally, they express apprehension about potential financial implications, anticipating that a new partner might increase monthly payments, impacting family budgets. The analysis underscores the importance of addressing both practical and financial considerations in waste management initiatives. It emphasizes the need for thorough planning, transparent communication about potential costs, and ensuring that any proposed projects align with the city's infrastructure capabilities and residents' financial capacities. This insight highlights the significance of holistic and sustainable waste management solutions that consider the broader impact on the community.

3. *Call for convenient disposal:*

Respondent's answer: *"Having a phone number available would be useful to call and arrange for a small truck to pick up items like a mattress or other furniture, when needed"*. This answer highlights the importance of convenient and accessible waste disposal methods. The suggestion indicates a practical approach to address specific waste disposal needs, emphasizing the significance of responsive and user-friendly waste management services. This insight supports the idea that incorporating convenient solutions can enhance citizen satisfaction and participation in waste management initiatives.

4. JPK Tetova management efficiency and potential impropriety

Respondent's answer: *"In the past, JPK Tetova thrived with 100 garbage collectors and only 20 people in administration, fostering a clean city with conscious citizens. The current shift to 100 administrative staff and a mere 20 garbage collectors has eroded our city's cleanliness and people are the ones without consciousness. Despite consistent payments for years, garbage remains uncollected, exposing flaws in JKP's management and raising concerns about inefficiency and potential impropriety. This issue extends beyond a lack of awareness, highlighting systemic problems and mindless theft"*. The respondent reflects on the historical shift in JPK Tetova's operations, noting a decline in the number of garbage collectors and a rise in administrative staff. The analysis underscores concern about the impact on city cleanliness and raises issues related to management efficiency and potential impropriety. The respondent expresses suspicions of corruption and embezzlement within the management, emphasizing the need for transparency and improved governance in waste management services. This response highlights broader concerns beyond individual awareness, pointing towards systemic challenges that need addressing for effective waste management.

These and more open-ended responses shed light on specific challenges, including perceived municipal support, infrastructure deficiencies, financial concerns, and potential impropriety in JKP Tetovo's management. Addressing these concerns is crucial for building trust, improving operational efficiency, and ensuring that waste management initiatives meet the needs and expectations of the community. Therefore, municipality should consider these insights for a comprehensive and sustainable waste management strategy in Tetovo.

Despite valuable insights gained from the survey, several limitations must be acknowledged. The survey sample may not fully represent Tetovo's diverse demographics, introducing potential biases. Subjectivity in survey responses and a limited time frame for data collection may impact the findings' generalizability and relevance to different temporal

contexts. The lack of participation from NGOs in the survey and limited insights from the communal sector underscores the need for broader collaboration and diverse perspectives in future research endeavors. Yet, the obtained results still provide space for concern and potential avenues for exploring in terms of improving the waste management practices and knowledge in Tetovo.

RECOMMENDATIONS

Based on the research findings presented in the sections above, the following steps are recommended:

1. **Creating a collaborative collection and recycling point:** Creation of a collaborative effort with any of the local recycling companies (e.g. *Agro Pall Kompani*, *Aid Asko Komerc*, *Eko-Flor Plus*, *HasPlast*) or even with the new company *Saubermacher Tetovo* to create one or more collection points. The collaboration should estimate the monetary value of the materials from the community (*glass, plastic, and paper*) that will be recycled. The earned income besides other related improvements or environmental concerns, could also be distributed to serious health projects being implemented in the area, e.g. support for local children suffering from different lung diseases. This initiative, in addition to being ecological, is also humanitarian because it encourages the involvement of the entire community in supporting a joint cause. Other initiatives, such as the collection of plastic bottle caps with the purpose of supporting children in wheelchairs, also implemented at the South East European University campus through its “Max van der Stoel” library can also be followed (Xhelili, 2023).
2. **Establishing a compost center:** Drawing insights from waste collection data provided by PKMM, CENSUS, and MAKStat, with an estimated 50% constituting organic waste, this research proposes the establishment of a compost center. Taking inspiration from the recently completed composting center in the Municipality of Prishtina in Kosovo, a pilot project supported by the Slovenian Government (through the Center for Development and International Cooperation) and the German Government (through GIZ) and implemented through the NGO Fondacioni Jeshil, which is composting all waste generated by the maintenance of green spaces in the city parks (waste from pruning trees), Tetovo could build similar facilities to tackle its organic waste. The center's focus would primarily be on green waste from ‘JPK Tetova’, supplemented with other materials essential for composting. This

initiative presents a sustainable, long-term solution for waste management. The output from this composting center would yield a high-quality product beneficial for farmers and agriculturists, promoting environmentally friendly agriculture practices. Additionally, cooperation with the municipality and NGOs would be crucial for educational initiatives associated with the composting process, ensuring community engagement, and understanding.

3. **Increasing awareness-raising campaigns:** The research findings showed a high need for increased awareness-raising campaigns for the broader population, targeting all groups of society. These campaigns should use various mediums, such as social media, television commercials, radio broadcasts and other non-polluting communication materials to reach a broader audience. Targeted campaigns should be developed, centered on waste management practices, the advantages of recycling, associated health and economic benefits out of the reduced waste or their upcycling, but also potential philanthropic contributions through increased community collaboration for greater social and humanitarian causes. Universities in collaboration with local environmental civil society, could play a key role in starting to implement waste separation and recycling initiatives and at the same time in developing creative awareness raising campaigns and finding ways for a broader information distribution.
4. **Developing targeted educational programs:** Recognizing the pivotal role of educational institutions in fostering genuine environmental awareness, authors advocate for the implementation of targeted educational programs in kindergartens, schools at all levels, and universities. These initiatives should prioritize middle scholars and individuals in leadership positions who play a key role in instilling responsible waste management practices. Enabling such educational programs and initiatives would further inform on the importance of waste reduction, separation, recycling and proper disposal as well as the associated benefits to human and environmental health, economy and climate. By focusing on the younger generation and decision-makers within educational institutions, these efforts can lay the groundwork for a culture of sustainability, ensuring that environmentally responsible practices become integral to the educational experience.
5. **Employing fines for non-compliance:** Fines, when properly applied, serve as more than just punitive measures for institutions. Besides supporting the achievement of visible impact and tangible results, this action can also play a crucial role in

educating and raising awareness on proper waste disposal. This approach contributes not only to accountability but also to fostering a culture of responsible waste disposal and compliance with established guidelines. In 2013, the Municipality of Tearca imposed fines ranging 50-150 Euros for littering, resulting in four individuals receiving penalties, which can serve as an example to be followed in Tetovo too.

- 6. Establishing community work programs:** The establishment of a community work program for offenders, with a specific emphasis on environmental conservation and waste reduction, represents an innovative and socially responsible approach to rehabilitation. Implementation of this initiative would not only serve as a form of restitution but would also contribute to community well-being and environmental sustainability. Through such programs, offenders would be able to actively participate in initiatives that directly address the environmental impact of improper waste disposal, fostering a sense of responsibility and community engagement, but also upskilling for the future green jobs market.

CONCLUSION

To conclude, the exploration of Tetovo's waste management journey reveals a rich narrative of many challenges and potential opportunities, echoing the complexities faced by many communities around the world. From historic support in landfill disposal to recent efforts in public-private partnerships, Tetovo's story reflects both the struggle and the potential for transformative change. Against the backdrop of increased waste production and the imperative for effective management strategies, Tetovo faces a spectrum of obstacles, from infrastructural constraints to regulatory barriers. Yet amid these challenges lies a beacon of hope, illuminated by the city's recent strides toward modernization and sustainability.

This research highlights the key role of community engagement and activism in catalyzing change. Creative protests and grassroots initiatives not only raise awareness but also mobilize action, amplifying the collective voice advocating sustainable practices. However, there is a significant gap between awareness and action, as evidenced by modest participation in local initiatives, despite widespread acceptance of the importance of waste reduction. This disconnect underscores the need for targeted awareness campaigns, transparent communication and inclusive policies that empower individuals to embrace their role in environmental stewardship.

Looking forward, Tetovo's journey serves as a guiding light for fostering collaboration, harnessing innovation and empowering communities to lead the charge in waste management. Initiatives such as shared collection points, composting centers, education programs and enforcement measures present tangible pathways to a more sustainable future.

In essence, Tetovo's waste management journey transcends its local context, resonating as a testament to the global imperative for sustainable development. By turning awareness into action and embracing community-driven solutions, Tetovo not only charts a course toward a cleaner and healthier environment, but also inspires others to join in the collective pursuit of a brighter future.

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APPENDICES

I. Community practices and awareness level

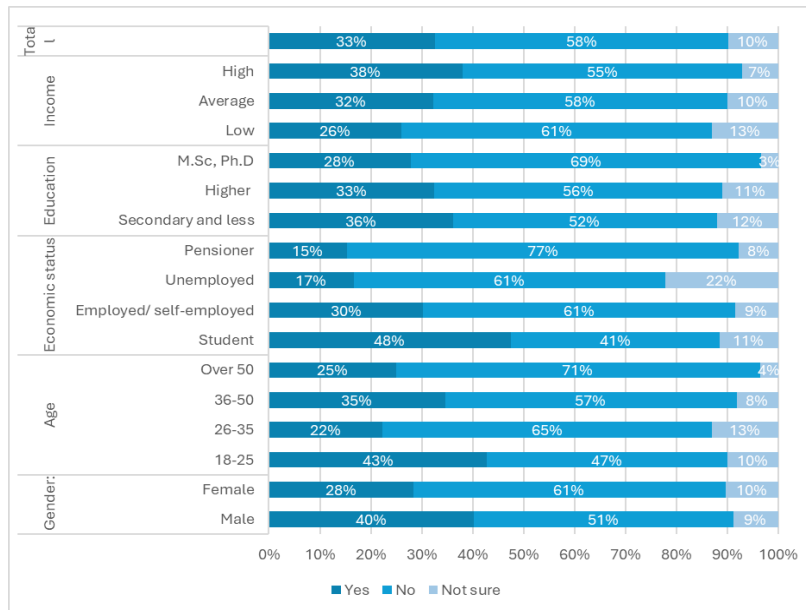


Figure A. Access to recycling bins or recycling facilities near the home (authors)

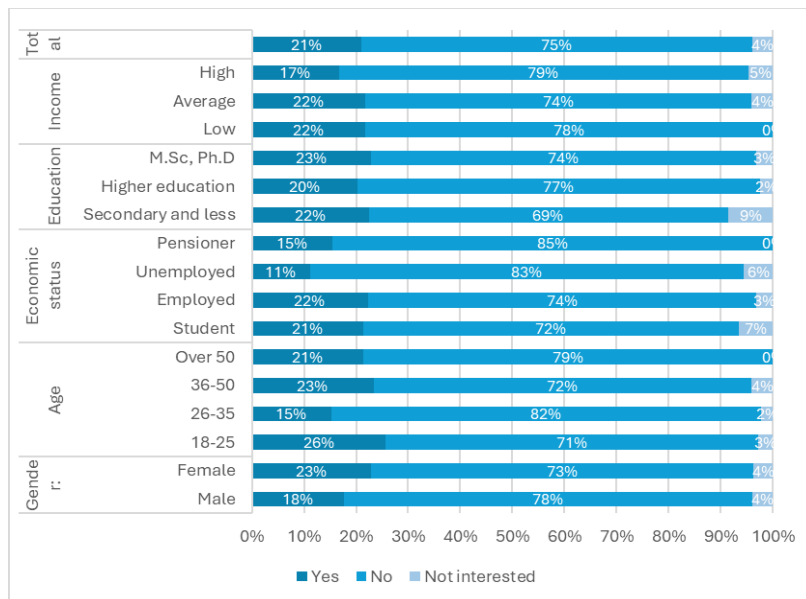


Figure B. Familiarity with the waste management regulations and laws in Tetovo (authors)

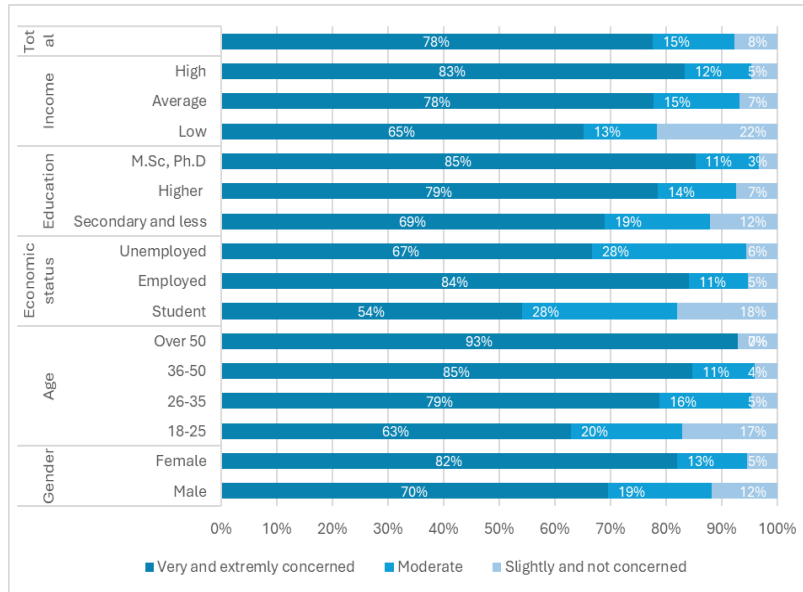


Figure C. Frequencies of selecting the recycle items like paper, plastic, glass (authors)

II. Questionnaire

Hello,

We are a group of students in the Master's program in Green Economy and Sustainable Development at SEE University. As part of our research on the subject of Climate change, we are conducting a survey to understand the perspectives and practices related to waste management in Tetovo. Your valuable insights will contribute significantly to our efforts to address environmental challenges, identify potential areas for improvement and promote sustainable living.

Your responses are completely private and will be used solely for academic and learning purposes. This survey will take approximately 5 minutes of your time.

Section 1: Demographics

1.1. Age:

- ☐ Under 18
- ☐ 18-25
- ☐ 26-35
- ☐ 36-50
- ☐ Over 50

1.2. Gender:

- ☐ Male
- ☐ Female

1.3. Work Status:

- ☐ Student
- ☐ Employed/self-employed
- ☐ Unemployed
- ☐ Pensioner
- ☐ Housewife
- ☐ Other

1.4. Residential Area:

[List of Tetovo neighborhoods or districts]

1.5. Socio-economic status of the household in terms of income

- ☐ Low income
- ☐ Average income
- ☐ High income

1.6. Education (highest level of completed formal education):

- ☐ No education or incomplete primary education
- ☐ Basic education
- ☐ Secondary education
- ☐ Higher education (Bachelor's degree)
- ☐ Greater than High (M.Sc., Ph.D.)

Section 2: Waste Management Awareness

2.1. How would you rate your awareness of waste management practices in Tetovo?

- ☐ Very Aware
- ☐ Somewhat Aware
- ☐ Neutral
- ☐ Not Very Aware
- ☐ Not Aware at All

2.2. Are you aware of local recycling programs in Tetovo?

- ☐ Yes
- ☐ No

2.3. Do you have access to recycling bins or recycling facilities near your home?

- ☐ Yes
- ☐ No
- ☐ Not sure

2.4. How often do you participate in local waste reduction or recycling initiatives?

- ☐ Never
- ☐ Rarely
- ☐ Occasionally
- ☐ Frequently
- ☐ Always

2.5. Are you familiar with the waste management regulations and laws in Tetovo?

- ☐ Yes
- ☐ No
- ☐ Not interested

Section 3: Attitudes Towards Waste Management

3.1. What is your opinion on the importance of reducing waste in everyday life? Rate from 1 to not important, to 6 extremely important.

- ☐ It doesn't matter
- ☐ Slightly important
- ☐ Moderately important
- ☐ Very important
- ☐ Extremely important

3.2. Are you familiar with the concept of reducing waste by purchasing products with less packaging, reusing, or repairing items?

- ☐ Yes
- ☐ No

3.3. Do you believe that individual actions, such as recycling, can make a positive impact on the environment?

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Partially agree
- ☐ Agree
- ☐ Strongly agree

3.4. How do you dispose of your household waste? (Select all that apply)

- ☐ Garbage bin collection
- ☐ Recycling programs
- ☐ Composting
- ☐ In an unmarked disposal site
- ☐ Other

3.5. Have you implemented any measures to minimize waste in your household?

- ☐ Yes
- ☐ No

3.6. On average, how often do you select for recycle items like paper, plastic, or glass?

- ☐ Daily
- ☐ Weekly
- ☐ Monthly

- o Rarely
- o Never

Section 4: Environmental Awareness

4.1. How concerned are you about the environmental impact of improper waste disposal in Tetovo?

- o Not concerned at all
- o Slightly concerned
- o Moderately concerned
- o Very concerned
- o Extremely concerned

4.2. What factors influence your waste disposal habits the most? (Select up to three)

- o Environmental impact
- o Convenience
- o Community influence
- o Knowledge of recycling options
- o Government regulations
- o Other

Section 5: Recommendations and Future Initiatives

5.1. What improvements or initiatives do you believe could enhance waste management awareness in Tetovo?

You can select more than one.

- o Improved recycling facilities
- o Educational programs
- o Community engagement initiatives
- o Stricter waste disposal regulations/fees.
- o Other

5.2. How likely are you to adopt new waste management practices if introduced in Tetovo?

- o Very Likely
- o Likely
- o Neutral
- o Unlikely
- o Very Unlikely

5.3. How optimistic are you about the effectiveness of the new public-private partnership for waste management in addressing the waste issue in the municipality of Tetovo?

- o Very optimistic
- o Somewhat optimistic
- o Not familiar with the topic
- o Somewhat pessimistic
- o Very pessimistic

5.4. Are you interested in tips to reduce household waste?

- o Definitely
- o Probably
- o Probably not
- o Definitely not

Section 6: Additional Comments

6.1. Please share any additional thoughts, suggestions, or comments regarding waste management in Tetovo.

Thank you for taking the time to participate in our survey!

Your thoughtful responses are invaluable to our research and contribute significantly to our understanding of waste management in Tetovo. Together, we are making strides towards a more sustainable and environmentally conscious community.