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# Study of Communication-Media Strategies to Encourage Citizens to Segregate Waste at Source (Case Study: City of Tabriz)

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## Abstract

The present study was designed to investigate effective communication and media strategies to encourage citizens of Tabriz to segregate waste at the source. Employing a mixed-methods approach, the research explored various dimensions of behavior and awareness regarding waste management. A sample of 456 individuals over the age of 15 residing in the ten districts of Tabriz municipality was selected using a multistage cluster sampling method based on Cochran's formula. Initially, each city district was divided into neighborhoods, neighborhoods were randomly selected, and finally, participants voluntarily completed questionnaires. Quantitative results indicated a low level of awareness among citizens regarding the environmental and economic consequences of non-segregation, alongside a lack of social participation. These findings led the research towards a qualitative phase involving semi-structured interviews with 15 experts in media, urban management, and environmental fields. Qualitative data were coded through thematic analysis, extracting a network of primary and secondary themes of communication strategies. Effective strategies included continuous education, utilization of traditional and digital media, cultural campaigns, environmental advertising, and leveraging community networks. Based on the theoretical framework of the Theory of Planned Behavior and the Health Belief Model, a combination of local-social education and financial incentives emerged as key to enhancing citizen participation in Tabriz's waste management. The study provides practical solutions while emphasizing the pivotal role of media development and civic education in achieving sustainable urban waste management.

**Keywords:** Urban waste management, Source waste segregation, Environmental behavior, Communication media, Sustainable urban development.

## 1. Introduction

The rapid growth of urban populations, coupled with rising consumption patterns and industrial expansion, has made solid waste management one of the most pressing environmental challenges of modern urban life. Waste generation is an inevitable outcome of social and economic activity, yet its uncontrolled accumulation poses substantial risks to public health, ecosystems, and the sustainability of cities. In recent decades, municipal solid waste (MSW) management has evolved from a merely technical task of collection and disposal into a multidisciplinary and participatory process involving cultural, behavioral, and communicative dimensions. Within this context, the principle of *source separation*—the sorting of recyclable and non-recyclable materials at the point of origin—has emerged as a cornerstone of efficient waste management policies (Karahbar,



2023; Kaza et al., 2018). Effective implementation of this practice, however, depends not solely on infrastructure but on the environmental awareness, motivation, and participation of citizens. The present challenge for municipal authorities, especially in developing countries, lies in promoting behavioral change through appropriate communication and media strategies that inspire collective responsibility for sustainable urban living (Rashedi et al., 2024; Shirazi & Ramezani, 2014).

The global experience shows that environmental sustainability can only be achieved when citizens are empowered through continuous education and engaged communication. Media, as an intermediary between institutions and the public, plays a decisive role in shaping values and behaviors associated with environmental stewardship. According to studies, environmental advertising and targeted communication campaigns can enhance awareness of waste-related issues and positively influence citizens' willingness to adopt sustainable practices (Rashedi et al., 2024). Urban management institutions increasingly recognize that effective waste management requires integrating psychological and sociocultural mechanisms into technical solutions. In Iran, waste separation at the source is mandated in policy, yet participation remains inconsistent due to weak informational frameworks, low trust in local authorities, and insufficient public motivation (Razavian et al., 2015; Zare et al., 2018).

Research suggests that the mere availability of recycling infrastructure—bins, collection vehicles, and processing facilities—does not guarantee behavioral engagement unless citizens internalize the value of environmental action. In cities such as Tabriz, Tehran, and Shiraz, studies reveal that a majority of citizens are aware of environmental risks yet fail to translate this awareness into consistent behavioral patterns (Dastras & Khajehnoori, 2019; Shakerkhatibi et al., 2013). Such inconsistencies highlight the need for communication strategies that bridge the gap between knowledge and practice. Psychological frameworks such as the Theory of Planned Behavior (TPB) and the Health Belief Model (HBM) provide comprehensive explanatory models for understanding environmental actions, emphasizing that attitudes, subjective norms, perceived behavioral control, and health-related beliefs collectively determine behavioral intention (Glanz et al., 2015; Sonnenfeld, 2018). Applying these models to waste segregation behavior helps urban policymakers design communication interventions that target emotional, cognitive, and social dimensions simultaneously.

The Theory of Planned Behavior, as advanced by Ajzen, posits that an individual's behavior results from deliberate planning based on three key predictors: attitude toward the behavior, subjective norms, and perceived behavioral control. In the domain of waste management, citizens' attitudes are shaped by perceived environmental responsibility, subjective norms are influenced by family and community expectations, and perceived control is determined by the availability of supportive infrastructure (Sonnenfeld, 2018; Yilmaz & Ari, 2022). When individuals perceive social approval and practical ease, their intention to participate in waste separation increases. The Health Belief Model complements this perspective by explaining behavior through perceived susceptibility, severity, benefits, and barriers—essentially, how individuals evaluate the personal and collective consequences of waste mismanagement and their confidence in preventive actions (Glanz et al., 2015). The integration of TPB and HBM frameworks thus allows for a multi-layered understanding of why citizens may or may not engage in source separation practices.

Urban waste management in Iran, as in many developing contexts, faces several systemic and behavioral barriers. Research conducted in Tehran and Tabriz has demonstrated that despite the establishment of legal frameworks and municipal programs, participation levels remain low due to insufficient awareness campaigns, weak social marketing, and lack of trust between citizens and authorities (Karahbar, 2023; Naeema, 2014; Roshanaee, 2015). Furthermore, cultural factors and communication inefficiencies hinder the formation of social norms favoring separation. For example, social surveys indicate that many citizens perceive waste segregation as an additional burden rather than a civic responsibility. Overcoming this perception requires media-based persuasion and educational strategies that link environmental responsibility to tangible benefits—economic savings, community cleanliness, and health protection (Konehsalkhoob & Navah, 2024; Rashedi et al., 2024).

Globally, governments and environmental organizations have invested in awareness campaigns, but their success depends largely on localized communication design. In Delhi, for instance, behavioral interventions using simple messages and economic incentives significantly improved household waste segregation (Wadehra & Mishra, 2018). Similarly, studies in European and East Asian contexts show that effective communication tailored to community norms can transform recycling



from an occasional act into a habitual civic behavior (Knickmeyer, 2018; Wu et al., 2022). The growing influence of digital media adds another dimension to this field. Platforms like Facebook, Instagram, and Telegram enable real-time interaction and community mobilization, making them powerful tools for environmental education and social change (Muniandy, 2015; Nwafor & Okamgba, 2024). By amplifying citizen voices, showcasing good practices, and fostering dialogue, social media can bridge the gap between information and collective action.

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At the same time, traditional media—television, radio, newspapers, and outdoor advertising—remain critical in contexts where digital penetration is incomplete or uneven. For instance, public television programs and community billboards in Iranian cities have historically served as primary vehicles for civic education. They help disseminate messages about environmental protection, energy conservation, and waste reduction (Jahangiri & Emamifar, 2019; Shirazi & Ramezani, 2014). The educational potential of traditional media is particularly pronounced among older age groups, homemakers, and individuals with limited digital access. Integrating both traditional and digital platforms, therefore, creates a synergistic communication ecosystem capable of reaching diverse audiences across social and demographic strata (Bidehndi et al., 2018; Konehsalkhoob & Navah, 2024).

Behavioral research across developing countries underscores that the effectiveness of communication campaigns depends on cultural compatibility, message credibility, and interactivity. Campaigns that use culturally relevant symbols, community influencers, or religious values tend to have stronger behavioral impact (Dastras & Khajehpour, 2019; Roshanaee, 2015). In Iran, for instance, religious and local leaders often hold moral authority within neighborhoods and can serve as trusted mediators for environmental messages. Moreover, the inclusion of educational content in mosques, schools, and cultural centers has proven effective in promoting a sense of environmental citizenship (Shakerkhatibi et al., 2013). Such culturally embedded communication approaches contribute to sustainable changes in norms and values, encouraging individuals to internalize waste segregation as part of civic duty rather than external enforcement.

Recent studies in urban sociology highlight that waste management success relies not only on infrastructural capacity but also on social capital and trust in municipal institutions. When citizens perceive that their participation contributes to visible improvements, their motivation to engage intensifies (Karr et al., 2019; Zare et al., 2018). Conversely, lack of transparency or feedback mechanisms can lead to apathy or resistance. Therefore, municipalities must not only inform but also communicate results, showcasing the environmental and economic benefits achieved through citizens' cooperation. Participatory communication, two-way information exchange, and acknowledgment of citizen contributions are essential to building sustainable participation structures (Konehsalkhoob & Navah, 2024; Nwafor & Okamgba, 2024).

In the global technological landscape, e-waste management has introduced new challenges and opportunities. The rise of electronic waste demands targeted communication strategies to educate citizens about recycling and safe disposal methods. Research demonstrates that institutions adopting digital communication and reverse logistics systems can enhance recycling efficiency while reducing environmental harm (Saeedzadeh, 2025; Singh et al., 2025). Similarly, communication media in higher education have shown to play a pivotal role in increasing awareness about e-waste and sustainability (Nanath & Kumar, 2021). These insights affirm that educational communication must evolve alongside technological change, integrating digital literacy and ecological awareness into the broader waste management discourse.

From a policy perspective, the transition from traditional waste disposal to sustainable management necessitates multi-level coordination among governments, media institutions, NGOs, and citizens. Studies in Iran and abroad converge on the idea that environmental behavior change is most effective when supported by consistent policies, visible municipal support, and community-driven initiatives (Dastras & Khajehpour, 2019; Karahbar, 2023; Kaza et al., 2018). The synergy between local government actions and media engagement creates a framework within which individual responsibility and institutional accountability reinforce each other. Furthermore, media campaigns must emphasize the link between personal behavior and collective outcomes, demonstrating how small acts of separation contribute to macro-level environmental improvements (Rashedi et al., 2024; Wu et al., 2022).

Digital transformation has also expanded the means through which environmental education can be delivered. Interactive platforms, gamification, and mobile applications can be used to remind citizens about waste collection schedules, encourage



sustainable habits, and reward environmentally friendly behaviors. Studies indicate that introducing technological incentives, such as smart recycling programs or digital reward systems, can significantly increase participation in waste segregation schemes (Bidehndi et al., 2018; Singh et al., 2025). In addition, partnerships between municipalities and private tech companies can facilitate innovation in waste monitoring and communication infrastructures, ensuring that citizens remain informed and motivated.

Nevertheless, communication strategies must go beyond mere dissemination of information. To sustain behavioral change, messages must evoke emotional engagement, moral responsibility, and a sense of community belonging. This can be achieved through storytelling, local success narratives, and visual representations of pollution's consequences. Artistic interventions and creative advertising—such as recycling art or public exhibitions made from waste materials—can transform abstract concepts into tangible experiences that provoke reflection and inspire action (Jahangiri & Emamifar, 2019). Such experiential learning aligns with the broader principles of environmental psychology and education, wherein knowledge acquisition and emotional engagement jointly foster sustainable behavior.

Ultimately, the success of source separation initiatives depends on aligning psychological motivation, cultural context, and communicative innovation. Combining the insights of the Theory of Planned Behavior and the Health Belief Model with empirical findings on communication effectiveness can guide policymakers and media strategists in designing evidence-based interventions. The literature demonstrates that citizens' environmental awareness, perceived efficacy, and trust in municipal systems form the triad of determinants for participatory waste management (Konehsalkhoob & Navah, 2024; Wu et al., 2022; Yilmaz & Ari, 2022). In the case of Tabriz, where social participation levels remain below average, the challenge lies in constructing integrated media strategies that blend traditional mass communication with modern digital engagement, fostering both knowledge and accountability.

This study aims to identify and analyze effective communication-media strategies to encourage citizens of Tabriz to segregate waste at the source, thereby enhancing public participation in sustainable urban waste management.

## 2. Methods and Materials

The research employed a mixed-methods approach, combining both quantitative and qualitative methods. In terms of objective, it is classified as Applied Research. Following extensive library studies and the comprehensive compilation of the theoretical literature and research background, the study utilized statistics from the Waste Management Center of Tabriz Metropolis Municipality. These statistics were used to analyze the rate of waste generation and the percentage of source separation, thereby quantifying the level of public participation in source recycling.

The statistical population for the quantitative phase comprised all citizens aged over 15 years residing in the 10 municipal districts of Tabriz, amounting to 1,799,093 individuals according to the 2019 census. Based on Cochran's formula, a sample size of 456 participants was selected using a cluster sampling method, and questionnaires were subsequently distributed.

The sampling process involved dividing the ten municipal districts of Tabriz into several areas, which were further subdivided into neighborhoods. Neighborhoods were then selected cluster-wise, followed by a non-probability voluntary selection of individuals to complete the questionnaires.

Tables 1 and 2 present the frequency distribution of participants based on gender, education, age, and municipal district.

**Table 1. Frequency Distribution of Participants**

Gender	Frequency	Percent	Cumulative Percent
Female	272	59.6	59.6
Male	184	40.4	100.0
Total	456	100.0	
Age Group	Frequency	Percent	Cumulative Percent
15 to 25	108	23.7	23.7
26 to 35	153	33.6	57.2
36 to 45	131	28.7	86.0
46 to 55	48	10.5	96.5
56 to 65	13	2.9	99.3
66 to 75	3	0.7	100.0
Total	456	100.0	



Education	Frequency	Percent	Cumulative Percent
Below Diploma	45	9.9	9.9
Diploma	139	30.5	40.4
Bachelor's	186	40.8	81.1
Master's	67	14.7	95.8
Doctoral and Higher	19	4.2	100.0
Total	456	100.0	

**Table 2. Frequency Distribution of Respondents by Municipal District**

Municipal District	Frequency	Percent	Cumulative Percent
1	63	13.8	15.2
2	69	15.1	31.9
3	63	13.8	47.1
4	72	15.8	64.5
5	52	11.4	77.1
6	26	5.7	83.3
7	26	5.7	89.6
8	10	2.2	92.0
9	9	2.0	94.2
10	24	5.3	100.0
Total (Response)	414	90.8	
No Response	42	9.2	
Total	456	100.0	

The qualitative phase of the research focused on "Investigating Communicative-Media Strategies to Encourage Citizen Source Separation of Waste." The Thematic Analysis method, based on the approach by Braun and Clarke, was utilized. This method involves identifying recurring patterns in the data, initial coding, extracting sub-themes and main themes, and finally creating a thematic network.

Qualitative data were collected through semi-structured interviews with 15 experts and specialists in the fields of media, communication, urban management, and environment, continuing until theoretical saturation was reached. The interviews were conducted either in-person or online (via Zoom), with each session lasting approximately 30–45 minutes. The interview questions were designed based on the main research question (the most effective communicative-media strategies proposed for encouraging Tabrizi citizens) and included aspects such as the role of media in awareness, challenges, and practical strategies.

### 3. Findings and Results

To test the first three hypotheses, a One-Sample T-Test was used. This test compares the mean response for each question against a theoretical mean (test value). Since the measurement scale for the questions was a 5-point Likert scale, the theoretical mean was set at 3.

**Table 3. One-Sample T-Test for Waste Separation Extent**

Item	Mean	Standard Deviation	t	df	Significance (P-value)	Mean Difference
H1: To what extent do you separate dry and wet waste into separate bags at home?	3.0022	1.14738	.041	455	.967	.00219
H2: To what extent do you encourage friends, acquaintances, and relatives to separate waste at the source?	2.7544	1.14305	-4.588	455	.000	-.24561
H3: To what extent do your neighbors separate dry and wet waste into separate bags?	2.2807	.99898	-15.376	455	.000	-.71930

Hypothesis 1 (Individual Inclination to Separate): "The average inclination of Tabrizi citizens toward source separation of waste significantly differs from the mean level."

The mean response to the question ("To what extent do you separate dry and wet waste...") was 3.0022.

The T-test result ( $t(455) = .041$ ;  $P > .05$ ) is not statistically significant ( $P = .967$ ).

Conclusion: This indicates that the respondents' self-reported level of waste separation is at the theoretical average (3). Therefore, Hypothesis 1 is rejected (no significant difference from the mean).



Hypothesis 2 (Awareness/Encouragement of Relatives): "The average awareness of Tabrizi citizens regarding the economic and environmental consequences of not separating waste is significantly lower than the mean level."

Note: The narrative text frames the test for H2 as the question regarding "encouraging friends/relatives," which serves as an indirect measure of surrounding social norms or perceived lower action/awareness.

The mean response to the question ("To what extent do you encourage friends, acquaintances, and relatives...") was 2.75.

The T-test result ( $t(455) = -4.588$ ;  $P < .05$ ) is statistically significant and negative ( $P = .000$ ).

Conclusion: Since the mean is significantly lower than the theoretical mean (3), respondents rate the level of encouragement or engagement in source separation by their relatives/acquaintances as below average. Hypothesis 2 is accepted/proven (confirming a perception of below-average engagement in the social circle).

Hypothesis 3 (Role of Neighbor/Kinship Factor): "The average role of the neighborhood and kinship factor in encouraging Tabrizi citizens to separate waste is significantly lower than the mean level."

Note: The narrative frames the test for H3 as the question regarding "neighbors' separation behavior," which serves as a measure of neighborhood social norms.

The mean response to the question ("To what extent do your neighbors separate dry and wet waste...") was 2.28.

The T-test result ( $t(455) = -15.376$ ;  $P < .05$ ) is statistically significant and negative ( $P = .000$ ).

Conclusion: As the mean is significantly lower than the theoretical mean (3), respondents perceive the level of wet and dry waste separation by their neighbors as below average and unfavorable. Hypothesis 3 is accepted/proven.

To evaluate Hypothesis 4 ("The level of Tabrizi citizens' awareness of the various aspects of waste collection and disposal costs is significantly low"), three questions were designed. The Chi-Square Test ( $\chi^2$ ) was used to analyze the difference in the frequency of responses given to each question, particularly focusing on the "I don't know" category.

**Table 4. Chi-Square Test for Comparing Response Frequencies**

Item	Response	Frequency	Percent	$\chi^2$	P-value
Number of Personnel Responsible for Waste Collection	I don't know	397	87.1	$\chi^2(3) = 937.71$	$P < .05$
	1300	11	2.4		
	1500	23	5.0		
	1750	25	5.5		
	Total	456	100.0		
Cost of Waste Collection and Disposal	I don't know	397	87.1	$\chi^2(3) = 937.26$	$P < .05$
	10 Billion Tomans	17	3.7		
	30 Billion Tomans	26	5.7		
	80 Billion Tomans	16	3.5		
	Total	456	100.0		
Financial Damages from Waste Collection and Disposal	I don't know	344	75.4	$\chi^2(3) = 619.98$	$P < .05$
	5 Billion Tomans	32	7.0		
	10 Billion Tomans	40	8.8		
	20 Billion Tomans	40	8.8		
	Total	456	100.0		

Awareness of Personnel: 87.1% of participants answered "I don't know" regarding the number of personnel responsible for waste collection in Tabriz. The Chi-Square test ( $\chi^2(3)=937.71$ ;  $P<.05$ ) indicates that this frequency difference is statistically significant. Conclusion: It can be statistically asserted that Tabrizi respondents have no mental estimation of the number of waste collection personnel.

Awareness of Collection/Disposal Cost: 397 individuals (87.1%) selected "I don't know" for the cost of waste collection and disposal. The Chi-Square test ( $\chi^2(3)=937.26$ ;  $P<.05$ ) confirms the statistical significance of the responses. Conclusion: Respondents have no estimate of the cost of waste collection and disposal.

Awareness of Financial Damages: 344 individuals (75.4%) answered "I don't know" regarding the financial damages resulting from waste collection and disposal. The statistically significant Chi-Square test ( $\chi^2(3)=619.98$ ;  $P<.05$ ) indicates that respondents lack an accurate estimate of these financial damages.

Overall Conclusion for Hypothesis 4: Across all three measures, a statistically significant majority of respondents chose "I don't know." Thus, Hypothesis 4 is accepted/proven, confirming that the level of awareness among Tabrizi citizens regarding the various dimensions of waste collection and disposal costs is significantly low.



The findings from the quantitative phase indicated a low overall level of citizen awareness regarding the various aspects of waste separation. The most critical factor identified was the lack of effective communication and reception of appropriate communicative messages through the media.

Therefore, the second part of the research involved consulting experts and media academics in the social field to investigate communicative and media strategies for encouraging citizens toward source separation. Data from the semi-structured interviews were recorded, transcribed, and coded.

In the initial coding stage, over 200 initial codes were extracted, which were then grouped into sub-themes and main themes. The analysis approach was inductive (moving from data to theory) and focused specifically on communicative-media solutions. The thematic network was constructed based on the relationships between the main themes (e.g., the overlap between traditional and digital media).

Table 5 provides a structured presentation of the thematic network, showing the relationships between the themes.

**Table 5. Thematic Network for Communicative-Media Strategies**

Basic Themes (Operational Activities)	Organizing Themes (Mid-Level Categories)	Global Themes (Overarching Strategies)
Use of educational TV programs for broadcasting separation content	Focus on Traditional Visual Media	Optimal Utilization of Traditional Media
Broadcasting local TV news reports on the benefits of separation		
Producing short environmental documentaries to show consequences of non-separation		
Broadcasting promotional teasers in local cinemas	Focus on Traditional Auditory Media	
Daily radio advertisements to remind citizens of separation importance		
Expert-led dialogue radio programs with environmental specialists		
Specialized radio programs for homemakers on household waste management	Focus on Traditional Print Media	
Use of local newspapers for educational articles on waste management		
Printing educational posters in the press to encourage citizens		
Analytical articles in local magazines about waste policies	Utilization of Traditional Outdoor Advertising	
Urban billboards with persuasive messages on economic savings		
Installing promotional banners in streets showing environmental pollution		
Using digital urban displays to show waste generation statistics		
Advertising on city buses with environmental messages		
Instagram campaigns with relevant hashtags for sharing citizen experiences		
Educational posts on Telegram channels about environmental benefits	Focus on Digital Social Networks	Optimal Utilization of Digital Media
Twitter (X) campaigns with environmental content for public discussion		
Facebook campaigns for local Tabriz groups		
LinkedIn campaigns for environmental professionals	Use of Digital Video Platforms	
Producing short video content on TikTok for teaching separation methods		
Using YouTube for longer educational videos on waste management		
Developing a mobile application for separation reminders and collection day notifications	Utilization of Mobile Digital Tools	
Sending in-app notifications to inform about waste collection		
Developing educational mobile games for learning waste separation		
Using SMS for separation day reminders	Use of Digital Web Tools	
Creating dedicated websites for online waste education		
Online educational webinars on waste management		



Producing online educational podcasts about consequences of non-separation	Utilization of Digital Audio Platforms	
Podcast interviews with environmental experts		
Collaborating with local YouTubers to produce green content	Collaboration with Digital Influencers	
Using digital influencers to promote green behaviors		
Producing engaging animations for children about waste separation	Production of Creative Educational Content	Adoption of Educational and Awareness Strategies
Motion graphics to explain the consequences of non-separation		
Short environmental narrative films for emotional persuasion		
Producing humorous clips to encourage waste separation		
Cultural programs in cultural centers for discussion on waste	Focus on General Citizen Education	Development of Social Cooperation and Participation via Media
Education in mosques and religious centers focusing on religious responsibility		
Workshop programs in parks for practicing waste separation		
Highlighting the financial costs of non-separation in campaigns	Economic Awareness	
Demonstrating family economic savings through separation		
Emphasizing environmental pollution in educational content	Environmental Awareness	
Visual reports on river pollution caused by waste		
Collaborating with local trustees to promote waste separation	Development of Local Community Participation via Media	
Word-of-mouth campaigns in neighborhoods for experience sharing		
Using the role of neighbors in local advertisements		
Education through local group games in neighborhoods		
Financial incentives like prizes for participating in separation	Financial and Reward-Based Motivation	
Virtual prizes in apps for active participants		

#### 4. Discussion and Conclusion

The findings of this study provided a comprehensive understanding of citizens' participation in waste segregation at the source and the role of communication-media strategies in shaping such behavior. Quantitative results indicated that the overall level of individual participation among citizens of Tabriz was moderate, but social engagement through neighborhood networks and kinship encouragement remained significantly below average. Furthermore, the level of awareness about the economic and environmental consequences of non-segregation was notably low, with more than three-quarters of participants unable to estimate even the basic costs of waste collection and disposal. These results reflect a fundamental gap in environmental literacy and the effectiveness of current public communication strategies in motivating behavioral change. The qualitative phase complemented these insights by identifying four global themes—optimal utilization of traditional media, optimal utilization of digital media, adoption of educational and awareness strategies, and development of social cooperation and participation via media—each contributing to a holistic framework for enhancing waste segregation participation.

The pattern of findings aligns with prior studies emphasizing that insufficient environmental communication and public education are among the leading causes of weak participation in municipal waste management systems (Karahbar, 2023; Razavian et al., 2015; Zare et al., 2018). The low awareness levels observed among Tabriz residents confirm what previous research in Tehran and Shiraz also revealed: although citizens may conceptually understand the importance of recycling, they lack accurate, localized, and emotionally engaging information to sustain regular participation (Dastras & Khajehnouri, 2019; Naeema, 2014). The results therefore substantiate the hypothesis that behavioral change requires consistent communication rather than sporadic campaigns. Indeed, the scarcity of clear, trustworthy information channels between municipal authorities and citizens has perpetuated misconceptions about the cost-efficiency and collective impact of segregation programs.

Furthermore, the results demonstrated that personal participation in waste separation does not necessarily translate into social influence. Respondents reported neutral levels of individual engagement (mean  $\approx$  3.0) but significantly low perception



of neighbors' and relatives' participation. This indicates that although some citizens perform waste segregation individually, the behavior has not yet transformed into a shared social norm. This outcome supports the theoretical expectations of the Theory of Planned Behavior, which suggests that behavioral intentions are strongly moderated by subjective norms—citizens' perception of social approval or disapproval regarding their actions (Sonnenfeld, 2018; Wu et al., 2022). When community norms are weak or ambiguous, even individuals with positive attitudes toward recycling are less likely to exert social influence.

Page | 9 Hence, the lack of neighborhood-based reinforcement appears to be a key factor suppressing the diffusion of waste segregation behavior among Tabriz residents.

The qualitative findings further confirmed that the city's media landscape remains underutilized in promoting environmental responsibility. Although local television, radio, and newspapers occasionally broadcast environmental content, these messages are often fragmented and lack continuity. Participants emphasized the need for creative, localized storytelling, collaboration with community influencers, and integration of educational material across multiple platforms. Such recommendations resonate with the findings of (Rashedi et al., 2024), who demonstrated that environmental advertising can significantly improve citizens' environmental performance when designed with attention to psychological and cultural factors. In Tabriz, as in many Iranian cities, the messages delivered through media have not yet reached the necessary frequency, clarity, or cultural resonance to induce long-term behavioral change.

The results also corroborate international studies highlighting that behavioral and psychological dimensions are pivotal in determining the success of waste management systems. The low awareness among participants mirrors the findings of (Wadehra & Mishra, 2018), who observed that Indian households showed limited initial interest in segregation until exposed to low-cost interventions emphasizing practical and economic benefits. Similarly, (Knickmeyer, 2018) and (Wu et al., 2022) both reported that citizens' attitudes toward recycling improve substantially when communication programs emphasize personal relevance and convenience. Thus, behavioral activation through media requires both cognitive and emotional engagement—providing factual information about the consequences of non-segregation and simultaneously appealing to individual values and community pride.

Another critical interpretation from this research concerns the gap between environmental knowledge and perceived behavioral control. According to the Theory of Planned Behavior, individuals are more likely to act when they believe they have the ability and resources to perform the behavior. The findings revealed that respondents often lacked confidence in their capacity to contribute meaningfully to waste segregation, citing inadequate municipal infrastructure and limited neighborhood participation. This observation aligns with studies conducted in other Iranian cities, which showed that infrastructural deficiencies—such as lack of color-coded bins and irregular waste collection—directly reduce perceived control (Konehsalkhoob & Navah, 2024; Zare et al., 2018). When citizens feel powerless or unsupported, they are less likely to maintain environmentally responsible practices even if they understand their importance.

At the same time, qualitative interviews underscored the importance of combining traditional and digital communication channels to reach all demographic groups. Older citizens, homemakers, and individuals with limited digital access still rely on television and radio, while younger populations prefer social media platforms such as Instagram, Telegram, and TikTok for environmental content. The experts interviewed emphasized that campaigns combining both traditional and modern communication tools yield greater engagement, particularly when they include participatory elements such as user-generated content, local contests, or storytelling initiatives. This mixed-media approach finds strong support in prior research. (Nwafor & Okamgba, 2024) demonstrated how Facebook messages from broadcasting services successfully disseminated waste management information in Nigeria, while (Muniandy, 2015) confirmed the influential role of social media in motivating recycling behavior through social norms and peer influence.

The current study also discovered that educational content must be presented in forms that resonate emotionally and socially. Interviewees noted that creative media forms—such as environmental art, documentaries, and animations—could attract attention and inspire empathy. These insights are consistent with the work of (Jahangiri & Emamifar, 2019), who emphasized the transformative potential of recycling art in promoting ecological awareness through visual culture. Additionally, financial incentives and digital reward systems emerged as complementary motivators, especially when integrated into communication campaigns or mobile applications. This aligns with the recommendations of (Bidehndi et al., 2018) and (Singh et al., 2025),



who advocated for the use of intelligent platforms and reverse logistics systems to enhance engagement in recycling programs. Together, these findings affirm that successful waste segregation strategies require a balance between external incentives and internal motivation, both reinforced through strategic communication.

Furthermore, the study's results highlight the necessity of embedding cultural and religious values into environmental campaigns. Interviewees and participants frequently mentioned that messages delivered through mosques, religious centers, and community leaders could exert stronger moral influence than those communicated solely by municipal authorities. This observation corroborates earlier Iranian research demonstrating that culturally grounded education fosters collective responsibility and trust (Roshanaee, 2015; Shakerkhatibi et al., 2013; Shirazi & Ramezani, 2014). Hence, religious and community institutions should not be viewed merely as audiences but as partners in the dissemination of environmental values.

The results also provide empirical evidence for integrating psychological models such as the Health Belief Model into communication strategy design. The low awareness and motivation levels among Tabriz citizens indicate that perceived susceptibility and severity—core constructs of the HBM—remain underdeveloped. Many participants underestimated the environmental hazards of improper waste management, indicating a weak perception of threat. Educational interventions must therefore focus on highlighting the tangible consequences of non-segregation, including air and water pollution, public health risks, and municipal financial losses. This insight is consistent with (Glanz et al., 2015) and (Nanath & Kumar, 2021), who found that well-designed communication can modify beliefs about environmental susceptibility and efficacy, thereby reinforcing preventive behavior.

Another aspect revealed by the findings is the underutilization of e-waste communication and management systems. Although e-waste constitutes a growing share of urban waste, awareness about its recycling remains minimal. The results align with the conclusions of (Saeedzadeh, 2025), who emphasized that electronic waste management requires targeted campaigns and educational initiatives focused on safe disposal methods. Integrating e-waste awareness into broader waste communication policies could ensure that citizens view recycling as a comprehensive environmental duty rather than a fragmented task.

In comparing the present findings with international research, a notable consistency emerges: behavioral change in waste management is most effective when communication strategies combine education, motivation, and community participation. Studies in diverse settings—from India to Turkey and China—have repeatedly confirmed that attitudes, subjective norms, and perceived behavioral control are reliable predictors of recycling behavior (Wu et al., 2022; Yilmaz & Ari, 2022). The results of the Tabriz case study reinforce this theoretical proposition by demonstrating that positive individual attitudes are insufficient without strong social norms and perceived ease of action. Therefore, environmental policymakers should design communication that not only educates individuals but also creates visible social expectations around waste segregation.

The thematic analysis further underscored that citizens' trust in municipal institutions plays a decisive role in participation. Interviews revealed that skepticism regarding the actual recycling of collected materials discourages some residents from separating waste. This finding corresponds to the observations of (Karr et al., 2019) and (Konehsalkhoob & Navah, 2024), who noted that citizens' trust in municipal efficiency directly predicts sustained participation. Consequently, transparent reporting and public demonstration of waste processing outcomes are vital for maintaining engagement. By sharing measurable achievements—such as reductions in landfill waste or increases in recycling revenue—municipalities can reinforce citizens' sense of collective efficacy.

Overall, the discussion highlights that the behavioral and communicative dimensions of waste management are intertwined. The low awareness and limited participation observed in Tabriz are not merely a reflection of infrastructural shortcomings but also of insufficient social communication and community mobilization. The integration of traditional and digital media, combined with culturally sensitive educational content and financial incentives, represents a pathway toward sustainable change. As (Kaza et al., 2018) argued, waste management is not only a technical process but a social system requiring participatory governance and citizen empowerment. The present study contributes to this understanding by empirically confirming that communication-media strategies are central to transforming environmental values into collective practice.

Despite its comprehensive mixed-methods design, the study encountered several limitations. The quantitative phase relied on self-reported data, which may be influenced by social desirability bias, leading participants to overestimate their actual engagement in waste segregation. The sampling was limited to urban residents of Tabriz, and therefore, the results may not generalize to rural or smaller urban areas where infrastructural and cultural conditions differ. Additionally, the cross-sectional



nature of the data prevents establishing causal relationships between communication strategies and behavioral outcomes. In the qualitative phase, the number of expert participants, though sufficient for thematic saturation, might not fully capture the diversity of opinions across all relevant sectors, including private recycling companies and local NGOs. Lastly, rapid technological changes and the evolving media environment may alter communication patterns faster than the study's design can accommodate.

Future research should adopt longitudinal designs to track behavioral change over time following specific media interventions. Experimental or quasi-experimental approaches could be employed to assess the causal effects of communication campaigns on citizens' waste segregation behaviors. Comparative studies across multiple Iranian cities or cross-national analyses in similar socio-cultural contexts would provide deeper insights into how cultural, economic, and infrastructural variables mediate communication effectiveness. Further exploration of digital engagement, including gamification, mobile applications, and AI-driven environmental education, could expand understanding of how technology facilitates behavioral transformation. Moreover, future studies should consider integrating psychological assessments to evaluate the mediating roles of environmental self-efficacy, perceived control, and trust in municipal governance.

Municipal authorities should institutionalize continuous environmental education programs that employ both traditional and digital media in a complementary manner. Collaboration between urban management departments, educational institutions, religious centers, and local influencers can enhance message credibility and cultural resonance. Campaigns should employ visual storytelling, public recognition of active citizens, and transparent communication of results to build trust. Digital tools such as reminder applications, interactive games, and online contests can be used to maintain motivation, especially among youth. Finally, municipal managers should integrate communication-media strategies into broader urban sustainability plans, ensuring that citizen participation in waste segregation becomes an enduring element of environmental governance in Tabriz.

### Ethical Considerations

All procedures performed in this study were under the ethical standards.

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### Conflict of Interest

The authors report no conflict of interest.

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