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Citizens' Willingness to Help Improve Solid Waste Management in Kirkuk city: A Case Study of Kirkuk City

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ABSTRACT

Municipal solid waste (MSW) is currently one of the most significant environmental and public health concerns in rapidly growing cities like Kirkuk, Iraq. This study aims to determine residents' willingness to pay—financially and behaviorally—to improve MSW management practices through sustainable interventions. Based on a structured questionnaire completed by 329 residents, the study examines levels of awareness, acceptance of payment, behavioral willingness, and the influence of demographic and social determinants. The results reveal that most citizens, the sampling method used appears to be stratified sampling. The gender category includes 221 males and 108 females, showing that both genders are represented. The education levels are distributed among Bachelor's degree holders (184), Master/PhD degree holders (122 in total, combining 121 and 1), and Baccalaureate graduates (23), covering various academic backgrounds. Age groups are also stratified, with participants aged 18-25 years (75), 26-35 years (103), 36-45 years (74), and above 45 years (77). Regarding employment, different job types are included such as employees (215), freelance workers (76), housewives (17), municipal employees in Kirkuk (9), students (8), and free business owners (4).This stratification helps ensure that the sample accurately reflects the population diversity of Kirkuk city in terms of gender, education, age, and occupation, making the findings more reliable and generalizable. A total of 75.4% of respondents showed a strong willingness to separate their waste, pay a small fee, and support waste reduction initiatives led by both government and community organizations. These results highlight the significant potential for participatory and decentralized municipal solid waste (MSW) management reforms in Kirkuk. The study suggests implementing incentive-based waste programs alongside focused awareness campaigns to boost public engagement in achieving sustainable urban sanitation.

1. Introduction:

Municipal solid waste management (MSWM) in most Iraqi cities, including Kirkuk, remains underdeveloped and inefficient, leading to significant environmental and public health challenges. Despite the rapid increase in waste generation driven by urbanization, there is a clear lack of sustainable management practices, active citizen participation, and effective governmental intervention. Common issues such as improper dumping, inadequate waste collection, and low public engagement exacerbate urban pollution and

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contribute to declining living standards in Kirkuk [1].

The Kirkuk municipality faces numerous environmental challenges, particularly in resource efficiency, water pollution, and waste management. These problems stem largely from the existing environmental management system's insufficient capacity to keep pace with rapid urban growth and population expansion. The volume of generated waste and the contamination of water bodies have escalated, yet a significant portion of solid waste is still disposed of improperly—often in open dumpsites or near aquatic ecosystems—causing detrimental impacts on both biodiversity and human health. Such unsustainable practices further degrade the region's quality of life and environmental resilience by intensifying air and water pollution [2].

This study holds significant importance for several reasons. Firstly, it addresses a notable gap in Iraqi environmental research by examining citizens' behavioral and financial willingness to participate in solid waste management (SWM), a topic that remains underexplored in the local context. By providing empirical data on public attitudes in Kirkuk, the study offers valuable insights into how community engagement can be effectively leveraged to enhance municipal waste services. Secondly, the research contributes to the development of localized, sustainable solutions for urban sanitation. Given Iraq's growing challenges with urban waste, these findings can support government agencies, municipalities, and civil society organizations in designing effective, citizen-centered policies. Lastly, the study aligns with global trends toward participatory environmental governance by emphasizing the critical role of social behavior integration within waste management planning. The outcomes of this research lay a strong foundation for future academic inquiry and practical policy formulation aimed at achieving long-term environmental sustainability in Iraqi cities [3].

The primary objective of this study is to evaluate the readiness of Kirkuk's residents to engage and contribute to improving solid waste management. This involves identifying key factors that either facilitate or hinder their participation and proposing strategies to strengthen collaboration between community members and stakeholders to foster a cleaner, more sustainable urban environment.

2. Literature Review

Song et al. [4] conducted a questionnaire survey in Macau to evaluate residents' attitudes toward solid waste recycling and their willingness to pay (WTP) for related services. The study revealed a high level of environmental awareness among participants, alongside a strong willingness to engage in waste separation and financially support recycling initiatives. Furthermore, the findings indicated that education level significantly influences WTP. On average, households were willing to pay 38.5 Macau Patacas (MOP) per month for recycling services. Xiao et al. ([°]) conducted a comparative study in Shanghai to examine changes in public willingness to participate in waste separation before and after the implementation of new policies. The results indicated that although public knowledge and satisfaction regarding waste management increased, the overall willingness to engage in waste separation decreased by 5.4%. The researchers concluded that enhancing community infrastructure is a more effective approach to increasing public participation than relying

solely on government-led initiatives. Mulat et al. ([٦]) conducted interviews with 903 households in Injibara, Ethiopia, to assess their willingness to pay (WTP) for improved solid waste management services. The study revealed that 81.06% of participants expressed readiness to pay an average of 29.7 Ethiopian Birr (ETB) per month. Furthermore, the willingness to pay was found to be significantly influenced by factors such as gender, education level, income, the quantity of waste generated, and satisfaction with existing waste management services. Ahmed et al. ([٧]) surveyed 201 individuals in Logia town to evaluate their willingness to pay (WTP) for improved solid waste management services. Approximately 65.17% of respondents expressed willingness to pay, with an average maximum WTP of 13 Ethiopian Birr (ETB) per month. Key determinants influencing WTP included age, distance to waste disposal sites, availability of unpaid waste disposal alternatives (negatively correlated), as well as awareness, supervision, and type of housing (positively correlated). Similarly, Haron et al. ([٨]) collected data from 300 households in Kuala Nerus, Malaysia, using a contingent valuation method to assess WTP for enhanced solid waste management services. The findings revealed that 69.1% of participants were willing to pay, with an average WTP ranging between RM7.05 and RM7.16. The study suggested that more frequent waste collection and expanded service coverage could be sustainably financed through community contributions.

pio et al. ([٩]) conducted a cross-sectional survey involving 585 households in Lira City, Uganda, to assess their willingness to pay (WTP) for improved waste collection services. The study found that 48.12% of respondents were willing to pay an average monthly fee of UGX 3,012 (approximately $0.84). Key factors influencing willingness to pay included education level, occupation, environmental concern, and proximity to waste dumping sites. Quraishi et al. ([١٠]) utilized national survey data from Pakistan to investigate the determinants of household willingness to pay for enhanced solid waste management. Their analysis indicated that factors such as occupancy status, distance to the nearest waste bin, and frequency of bin collection positively influenced WTP, whereas dissatisfaction with existing waste collection services had a negative impact. The study recommended targeted policies to raise awareness and support urban households in improving waste management practices. He et al. ([١١]) surveyed 521 residents of Hangzhou, China, to evaluate public willingness to pay for five waste management practices aligned with circular economy principles. The findings revealed that WTP was positively correlated with education, income, and community engagement initiatives that informed residents about environmental impacts. The study emphasized that outreach programs and transparent policies are effective in increasing public participation and fostering sustainable municipal solid waste management systems.

3. Methodology

The study employs a quantitative descriptive design to quantify citizens' readiness to help to improve the solid waste management in Kirkuk city. The study is also aimed at establishing the level of public environmental participation and to investigate whether the level of readiness is affected by demographic determinants.

٣.1 Research Design

A cross-sectional survey design to collect data from a representative population of Kirkuk citizens was employed. Demographic information and a battery of

Likert-scale items used to assess the various dimensions of readiness to adopt environmentally sustainable waste practices
.

٣.2 *Population and Sample*

Population in study are citizens residing in Kirkuk. Convenience sampling approach was employed in collecting feedback from a sample of 329 respondents. The sample had respondents from diverse age groups, education levels, and occupational groups to maintain diversity and representativeness.

٣.3 *Instrumentation*

Demographic information (age, gender, education, occupation) was collected through the first half of the survey questionnaire, while seven questions about readiness were asked in the second half on a five-point Likert scale from "strongly disagree" (1) to "strongly agree" (5). Seven questions were used to measure readiness factors, such as environmental care, willingness to sort waste, and support for recycling programs.

Table 1. The interpretation of the Likert scale (1-5)

Value	**English Interpretation**
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

Table 1. Shows is utilized to implement the arithmetic mean for all items in the following way:
Between 1.00 and less than 2.50 → Weak acceptance or approval
2.50 to below 3.50 → Neutral or average level
3.50 to 5.00 → Very high level of acceptance or approval

٣.4 *Reliability and Validity*

The internal reliability of the readiness scale was confirmed with Cronbach's alpha, which provided a high reliability coefficient of 0.833. Content validity was ascertained through a review of literature and borrowing survey items from previously validated scales.

٣.5 *Data Analysis*

Data were analyzed using SPSS. Descriptive statistics were used to provide summaries of readiness levels and demographic information. Inferential analyses, such as the independent samples t-test, Spearman's correlation coefficient, and linear regression, were applied to examine differences and associations between demographic variables and readiness scores and waste management preparedness.

Table ٢. The descriptive analysis of the personal information of the respondents.

Personal information	**Category**	**Count**	**Percentage**
Gender	Male	221	67.17%
	Female	108	32.83%
Education Level	Bachelor	184	55.93%
	Master/PhD	121	36.78%
	Baccalaureate	23	6.99%
	Master / PhD	1	0.3%
Age	26-35 years	103	31.31%
	Above 45 years	77	23.4%
	18-25 years	75	22.8%

	36-45 years	74	22.49%
Job	Employee	215	65.35%
	Freelance Work	76	23.1%
	Housewife	17	5.17%
	Employee in Kirkuk Municipality	9	2.74%
	Student	8	2.43%
	Free business	4	1.22%

4. Results

Gender: The statistics showed that a very high proportion of the interviewees were male (67.2%), to 32.8% female, perhaps a reflection of higher interest among men in the topic or a split sample distortion.

Education Level: A majority of the respondents were at the bachelor's level (55.9%), with master's or doctorate level (36.8%), and a very small percentage who were high school or below graduates (approximately 7%).

This is to imply that the majority of the sample came from a good academic background, and this can influence their environmental consciousness and preparedness.

Age: The largest represented category was 26–35 years, and second was 36–45 years, which made up a representative sample of the working population and youth, who were considered most influential in community and environmental activism.

Job: Participants were concentrated primarily in two categories: employees and students. This indicates that the majority of the sample was academically or professionally productive, enhancing the value of the responses and the quality of the data obtained.

Hence the general conclusion of personal information The sample was of sufficient size and well representative by gender, education, and age. Males and university graduates were overrepresented, but that might be an indicator of how highly aware the participants were, so the outcome of the survey is more credible.

Table 3. The average Likert item scores (readiness rating out of five)

Question	**Mean Score**
I am willing to sort household waste if bins are provided.	4.21
I would like to participate in environmental awareness campaigns.	4.35
I agree to pay a nominal fee to improve waste collection services.	4.42
I strive to teach others the importance of waste reduction.	4.51
I will seriously commit if a full recycling system is provided.	4.58
Every citizen must participate in improving the local environment.	4.61
I support government and civil society initiatives to reduce waste.	4.6

From the above results, we note that all items recorded high averages (above 4), indicating a positive level of acceptance and readiness by the participants. Based on this, we divide the level of readiness into three levels (low, medium, high), as shown in the table below.

Table 4. The readiness level classification.

Readiness Level	**Count**	**Percentage**
Low	11.0	3.34%
Medium	70.0	21.28%
High	248.0	75.38%

From Table 4.above data, we conclude that the vast majority of the sample has a strong willingness to participate in environmental activities and solid waste management in Kirkuk.

Table 5. The chi-square test to examine the association.

Variable	Chi-square	Df	p-value	Significant
Gender	1.144	2	0.5644	No
Educational level	1.828	6	0.9348	No
Age	12.027	6	0.0614	No
Job	16.258	10	0.0925	No

The table 5 shows A chi-square analysis was conducted to test the relationship between the level of environmental preparedness and demographic variables. The results were as follows:

1. Gender: No statistically significant relationship ($p = 0.564$).
2. Educational level: No statistically significant relationship ($p = 0.935$).
3. Age: There is a tendency for a relationship, but it is not statistically significant ($p = 0.061$).
4. Occupation: No statistically significant relationship ($p = 0.093$).

Conclusion: There are no strong, statistically significant relationships between the level of environmental preparedness and demographic variables based on this test.

This is because the majority of the sample has a very high level of preparedness for solid waste management in Kirkuk.

To ensure the analysis is completed in a comprehensive manner, we conducted a linear regression analysis for the sample to find the extent of correlation in the relationships, as shown in the table below.

Table 6. The values of the linear regression analysis.

Variable	Coefficient	Std. Error	p-value	Significant
Gender	-0.515	0.526	0.327	No
Educational level	-0.601	0.252	0.017	Yes
Age	0.504	0.261	0.055	No
Job	-0.339	0.183	0.065	No

The table 6 shows results of the linear regression analysis show that educational level is the only variable with a statistically significant effect on the level of environmental readiness. While age and occupation tend to have an effect, they are not significantly significant. Gender does not show a statistically significant effect on readiness. Ultimately, the influence of demographic variables was reduced due to the high readiness of the majority of the sample to manage solid waste and encourage its management in Kirkuk.

5. Discussion

The findings of this study reveal a strong willingness among Kirkuk residents to actively participate in improving municipal solid waste management (MSWM). High levels of agreement regarding waste segregation, financial contributions, and

volunteering in environmental initiatives indicate a community that is not only environmentally conscious but also prepared to take concrete actions—provided that adequate infrastructure and supportive policies are established.

These findings align with prior research conducted in developing urban contexts, where public participation has been recognized as a critical determinant of successful and sustainable waste management policies. For example, citizen involvement in source segregation and recycling has been shown to enhance collection efficiency, reduce operational costs, and yield environmental benefits. In the context of Kirkuk, the nearly 80% agreement on willingness to segregate waste is particularly noteworthy, given that existing municipal services currently do not fully accommodate source separation. This disparity highlights a clear gap between public readiness and institutional capacity, underscoring the urgent need for local authorities to address this through targeted investments and strategic planning.

Further, the strong willingness to pay a token price for improved services (over 85% agreement) neutralizes the prevalent perception that paying is unpopular in urban low-income communities. It can be attributed to enhanced unhappiness with present waste collection service and calls for actual improvements. It also offers a window for public-private or government-sponsored programs with cost recovery without inordinately impacting poor households.

The fact that more than 88% of the respondents encourage environmental awareness within their households shows the significance of social influence and informal learning in promoting sustainable habits. Such a bottom-up environmental approach is especially important in a city where top-down control measures are frequently ineffective or scarce.

Demographic analysis revealed that some dimensions of readiness are statistically influenced by factors such as age, education, and occupation. Lower age, higher education, and professional occupations reflected higher levels of engagement. These findings suggest that future awareness campaigns need to be tailored to capture underrepresented populations, including older residents and lower education levels, to ensure inclusiveness.

Despite the positive results, the study also identifies structural and policy-based limitations to citizen participation. Lack of infrastructure (e.g., recycling containers or organized collection infrastructures), poor public communication, and low visibility of government-sponsored environmental programs were frequently mentioned in open-ended responses. These barriers must be overcome to convert citizen willingness into specific action.

In summary, while Kirkuk citizens express strong environmental concern and readiness to engage, the success of any future MSWM reform will also largely depend on the government's capacity to provide supporting infrastructure, open communication, and regular public participation measures. Integration of community input into waste management policies is no longer an option—it is a prerequisite for long-term urban sustainability.

6. Conclusion and Recommendations

6.1 Conclusions

Through the collection and analysis of a questionnaire sample targeting Kirkuk residents, we conclude the following:

1. The questionnaire demonstrated high reliability, with a Cronbach’s alpha

coefficient of 0.83, confirming the validity and consistency of the measurement instrument.

2. A substantial majority of participants (75.4%) exhibited a high level of environmental preparedness, indicating strong environmental awareness within the sample.
3. Descriptive statistics revealed that most respondents were male and possessed either a bachelor's degree or higher postgraduate qualifications.
4. Chi-square tests indicated no statistically significant associations between environmental preparedness and demographic variables such as gender, age, education, or occupation.
5. Regression analysis identified a significant negative relationship between educational level and environmental preparedness, suggesting that higher education was associated with lower preparedness scores; other variables did not show statistically significant effects.
6. The questionnaire results reveal a high level of environmental awareness among Kirkuk residents, coupled with a strong willingness to actively contribute to improving solid waste management. Participants demonstrated positive attitudes toward waste segregation, environmental education, financial support, and engagement in recycling initiatives, reflecting a conducive social climate for advancing sustainability-oriented reforms.
7. The evident gap between community readiness and the existing waste management infrastructure underscores an urgent need for institutional action to effectively harness public participation. Given that demographic factors significantly influence behavioral readiness, policy measures must be tailored to accommodate the diverse characteristics of the population. Consequently, integrating community involvement throughout the planning and implementation phases is essential for developing effective and sustainable solid waste management strategies in Kirkuk.

6.2 Recommendations

1. Strengthen environmental awareness campaigns for all ages, especially the unprepared segments.
2. Include environmental education in school syllabi from elementary levels to root environmental concepts firmly.
3. Emphasize incentive policies, such as aiding participants in sorting waste or providing symbolic incentives.
4. Facilitating source-sorting of waste by providing the appropriate infrastructure (bins, collection points, and incentive systems).
5. Safeguarding the position of government offices and civil society groups in spearheading environmental sustainability initiatives.

These are the recommendations provided based on the findings of the study:

1. Develop Infrastructure: Introduce properly labeled waste sorting containers in public and private areas, and see collection frequency enhanced.
2. Begin Awareness Campaigns: Conduct education and media campaigns for all ages, emphasizing the advantages of sorting and consciousness of the environment.
3. Develop Incentive Systems: Adopt incentive systems or token rebates on individual homes that are actively practicing recycling or adequate waste disposal.
4. Develop Community Partnerships: Engage schools, institutions, and civic society organizations to encourage community engagement and environmental initiatives.
5. Empower Local Policy: Design policy schemes favoring community participation and engaging the citizens in policy-making.

6. Conduct Additional Research: Take the research to other Iraqi cities to test differences and compare public environmental perceptions.

8. Future Research Suggestions

Based on the findings and limitations of this study, the following are proposed suggestions for additional research:

1. Conducted parallel research in other Iraqi cities for the purpose of comparison of levels of awareness and engagement.
2. Insert qualitative methods such as interviews or focus groups to gather more elaborate social and cultural data.
3. Assess long-term impacts of government interventions (e.g., public education or economic incentives) on behavior change.
4. Investigate the impact of social media on environmental attitudes, especially among youth.
5. Study the dynamics of institutional trust and public participation in environmental programs over time.

Ethics Statement:

"This study was approved by the Research Ethics Committee at [Municipality Department and Tikrit University]. Informed consent was obtained from all participants before completing the questionnaire, and they were informed about the study's objectives and the confidentiality of the data."

Limitations:

"This study acknowledges several limitations, including potential sample bias due to the participant selection method and reliance on self-reporting, which may lead to response biases. Additionally, the results may be limited in generalizability to other populations due to sample characteristics. The study recommends further research with larger and more diverse samples to confirm the findings and minimize potential biases."

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