



Ministry of Foreign Affairs of the
Netherlands



Participatory Action Research

Water Scarcity and Contamination in Duhok City

Navy Group Project

Water Pollution in Duhok City and Its Environmental Impact

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Executive Summary

Water pollution in Duhok is a pressing environmental concern, primarily driven by plastic waste accumulation in water sources such as rivers, lakes, and dams. This report investigates the causes, impacts, and potential solutions to water pollution by plastic using a mixed-methods approach. The study collected data through 20 interviews with community leaders, educators, and healthcare workers; 2 focus group discussions in urban and rural areas; and surveys which, completed by 176 participants from diverse socioeconomic backgrounds. Key findings highlight significant gaps in public awareness about the environmental consequences of plastic waste. Over 75% of participants reported frequent use of disposable plastics, while logistical barriers and cultural resistance hinder recycling efforts. Additionally, weak enforcement of environmental policies worsens the issue, despite strong public support for stricter regulations. The study recommends setting up modern recycling facilities, launching targeted public awareness campaigns, and enforcing stricter waste management policies to mitigate pollution. Challenges such as incomplete data, logistical constraints, and systemic funding gaps were found but do not undermine the study's validity. This report emphasizes the importance of collaborative action between local communities, policymakers, and private stakeholders to address water pollution and ensure sustainable management of Duhok's water resources.

Introduction

Water pollution is an escalating global crisis with profound implications for ecosystems, human health, and economies. In Duhok, Kurdistan Region of Iraq, this issue is intensified by excessive plastic waste, poor waste management practices, and limited public awareness of the consequences of pollution. The region's reliance on single-use plastics has created a significant environmental challenge, one that demands immediate and sustained action. This report examines the root causes, impacts, and potential solutions to water pollution in Duhok, aiming to provide actionable recommendations for mitigating the problem.

Plastic waste, as found globally, is a dominant contributor to water pollution. Improper disposal and lack of recycling systems result in the accumulation of plastic debris in rivers, lakes, and reservoirs. These plastics, over time, break down into microplastics, which pose severe risks to aquatic life and humans who consume contaminated water or food. In Duhok, the improper disposal of plastics is compounded by a lack of public infrastructure for waste collection and recycling, leading to pollution hotspots near urban water bodies.

The implications of water pollution extend beyond the environment, affecting public health and economic activities. Polluted water sources threaten agriculture, an essential sector for Duhok's economy, and increase the prevalence of waterborne diseases, particularly among vulnerable populations. The issue also worsens socio-economic inequalities, as low-income communities often endure the most of limited access to clean water.

The research presented in this report adopts a mixed-methods approach, integrating surveys, interviews, and focus group discussions to explore the complex dimensions of water pollution in Duhok. Surveys captured public awareness and behavioral patterns, while interviews with key stakeholders provided insights into systemic and policy-level challenges. Focus groups explored community attitudes and cultural feelings, offering a comprehensive view of the problem.

Globally, integrated approaches that combine policy enforcement, public education, and technological innovation have proven effective in tackling water pollution. Case studies from countries like Rwanda and South Korea prove the importance of aligning government initiatives with community engagement. Duhok can draw on these examples to develop a tailored strategy that addresses its unique socio-economic and cultural context.



This report aims to shed light on the multifaceted nature of water pollution in Duhok, emphasizing the need for collaborative action among stakeholders, including government agencies, non-governmental organizations, and private sector entities. By fostering a culture of environmental stewardship and implementing sustainable policies, Duhok can mitigate the impact of water pollution and secure its water resources for future generations.

Data Collection Sample Sizing:

This study employed a mixed-methods research design to comprehensively analyze water pollution in Duhok. By integrating quantitative and qualitative approaches, the method ensured a robust exploration of public awareness, behavioral patterns, and systemic challenges while showing actionable solutions.

Research Design

The research focused on both exploratory and explanatory elements. The exploratory aspect aimed to uncover the root causes of water pollution, public attitudes, and systemic barriers. The explanatory part analyzed the interrelationships between pollution sources, policy gaps, and environmental impacts. This dual approach provided a holistic framework for addressing the issue.

Sampling Strategy

Purposive sampling was used to ensure a diverse participant pool. For surveys, participants were selected based on geographic distribution, socioeconomic status, and age. Interviewees were chosen for their ability and involvement in environmental management. FGDs included participants from various educational and professional backgrounds to capture a broad range of insights.

➤ Interviews:

- ❖ Number of interviews conducted: 20
- ❖ Interviewees: Adults aged 25-45, including community leaders, educators, and healthcare workers.
- ❖ Summary: Participants shared diverse perspectives, highlighting gaps in service delivery and suggesting actionable improvements. Recurring themes included the need for enhanced access to education and healthcare.
- ❖ Additional Note: Visits to several governmental offices were conducted, where employees were interviewed.



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➤ **Focus Group Discussions (FGDs):**

- ❖ Number of FGDs conducted: 15
- ❖ Locations: Local community centers in urban and rural settings, First Step group discussion center, and a university.
- ❖ Participants: Each FGD included 8-10 participants. The First Step group hosted locals from various age groups (all adults), while the university FGD involved university students.

- ❖ Summary: Participants emphasized cultural factors and logistical challenges, such as transportation to schools and limited awareness of available services.
- ❖ For the added FGDs, knowledge about waste and water pollution in Duhok city was assessed, and participants shared insights on potential solutions.



➤ **Questionnaires:**

- ❖ Number of questionnaires returned: 176
- ❖ Target population: Parents with children under 18, including diverse socioeconomic backgrounds.
- ❖ Summary: The questionnaires provided valuable data on parental attitudes toward education and healthcare services.
- ❖ High response rates showed strong community interest, with a majority reporting concerns about affordability and accessibility. Two types of surveys were conducted: one through Google Forms, distributed online to various demographic groups, and another as written survey distributed face-to-face in Duhok Dam and other locations. Both surveys focused on water pollution awareness and potential solutions for improving conditions in Duhok city.

Literature Review

Water pollution has been extensively studied as a pressing environmental issue with global and local dimensions. The interconnected nature of human activities, policy gaps, and inadequate waste management systems worsens the problem. This section synthesizes relevant literature to provide a framework for understanding water pollution in Duhok.

Globally, plastic waste has appeared as a leading pollutant. Studies, such as those by Jambeck et al. (2015), reveal that improper disposal of plastics leads to their accumulation in water bodies, where they degrade into microplastics. These microplastics contaminate aquatic ecosystems, threaten biodiversity, and enter the human food chain. Developing countries, including Iraq, face amplified challenges due to limited infrastructure and regulatory enforcement.

In the Middle East, water pollution is further complicated by the region's reliance on limited water resources and socio-political challenges. Agricultural runoff, industrial effluents, and insufficient waste management systems contribute significantly to water contamination. Research by Al-Mashhadani et al. (2019) highlights the role of excessive pesticide and fertilizer use in degrading water quality in Iraq. Similar studies emphasize the need for targeted interventions to address these sources of pollution.

Behavioral factors play a critical role in perpetuating water pollution. Public awareness campaigns have shown measurable success in changing waste management practices in regions like India and Rwanda. However, in Duhok, surveys show significant gaps in awareness. Only 18% of respondents proved an understanding of the long-term consequences of improper waste disposal. Effective education programs tailored to local cultural contexts are essential to address these gaps.

Governance and policy enforcement are central to combating water pollution. Successful examples from countries like South Korea and Germany highlight the importance of strict regulations, public participation, and integrated waste management systems. In contrast, Iraq's fragmented regulatory framework and limited funding hinder effective waste

management efforts. This is particularly clear in Duhok, where stakeholders report insufficient coordination among municipal agencies.

Technological advancements offer promising solutions to water pollution. Innovations such as biodegradable plastics, advanced recycling systems, and water purification technologies are gaining traction globally. However, their implementation in regions like Duhok requires substantial investment and capacity-building. Studies emphasize the importance of public-private partnerships (PPPs) in bridging resource gaps and fostering innovation.

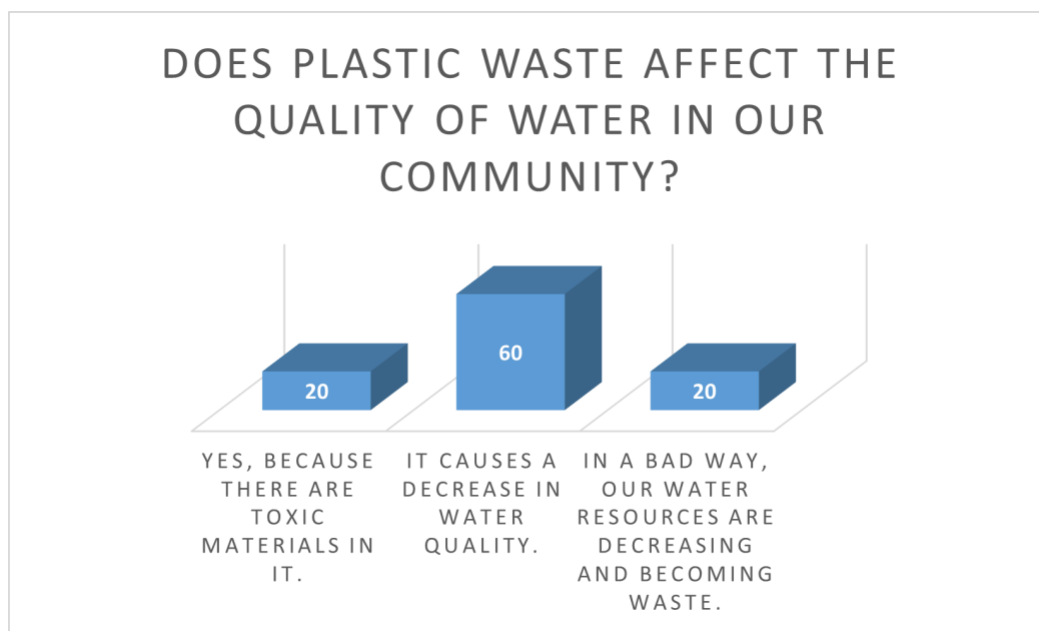
Case studies from comparable contexts provide valuable lessons for Duhok. For instance, Rwanda's ban on plastic bags and South Korea's comprehensive recycling programs proves how policy, technology, and community engagement can work synergistically. Applying these lessons to Duhok necessitates adapting best practices to local realities, such as addressing cultural feelings of waste and improving access to recycling facilities.

This literature review underscores the multifaceted nature of water pollution and the importance of integrated solutions. By synthesizing global and regional insights, it provides a foundation for understanding Duhok's challenges and opportunities in addressing water pollution effectively.

Results

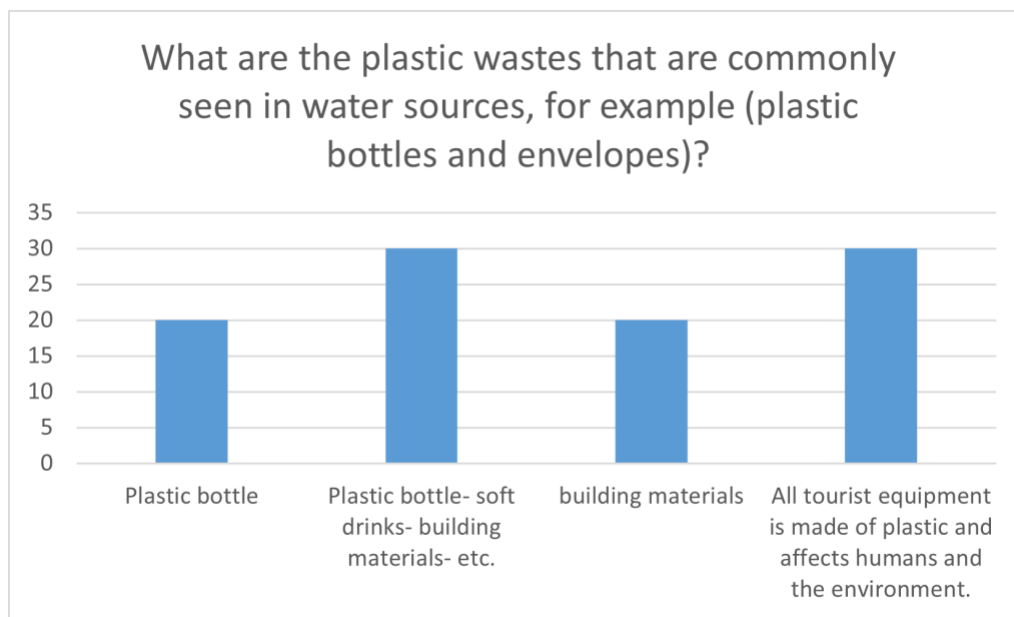
The results from the study offer valuable insights into the causes, impacts, and community beliefs of water pollution in Duhok. These findings are organized into key thematic areas based on survey, interview, and focus group data.

The bar chart below presents responses to a question about the impact of plastic waste on water quality. The majority of participants (60%) indicated that plastic waste causes a decrease in water quality, highlighting it as the most significant concern. A smaller but equally notable percentage (20%) associated the issue with the presence of toxic materials in plastic, emphasizing its harmful chemical properties. Another 20% identified the reduction and degradation of water resources as a critical consequence of plastic waste. This data underscores the multifaceted nature of water pollution caused by plastic waste, with implications for water quality, ecosystem health, and resource availability. The responses reflect a clear awareness of the detrimental effects of plastic waste, reinforcing the urgency for targeted interventions to address this issue.

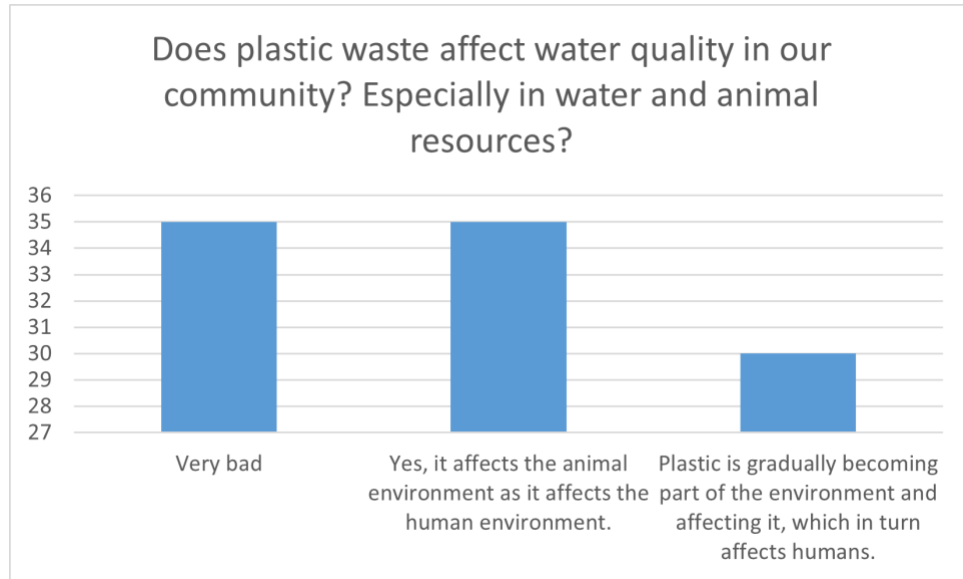


The chart highlights the types of plastic waste commonly found in water sources, such as plastic bottles and envelopes. The most frequently reported category, with approximately 35 respondents,

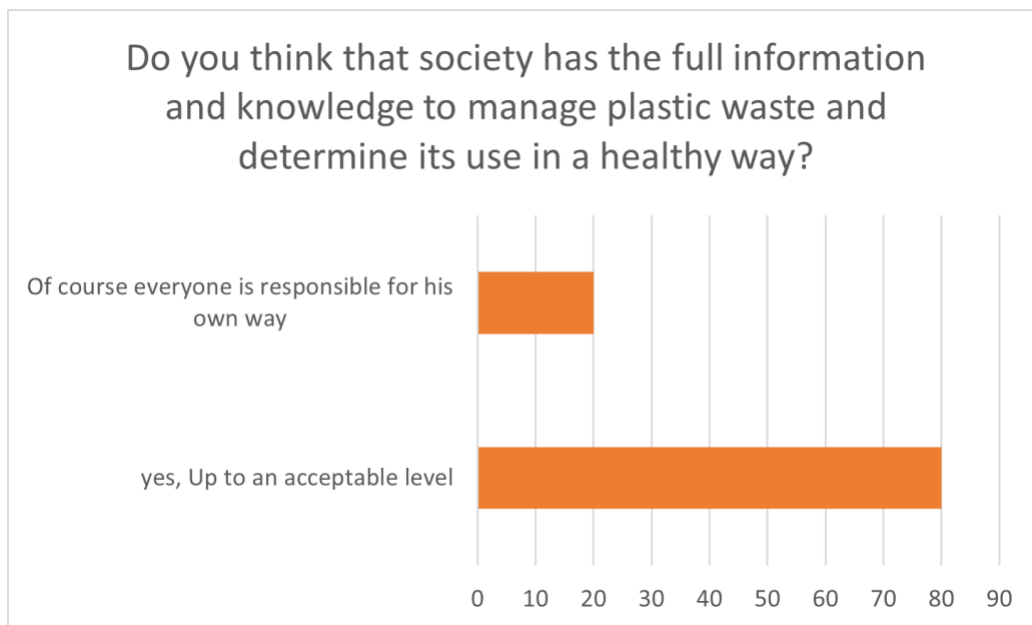
includes a broad range of plastic waste, such as soft drink bottles, building materials, and other items. This suggests a significant contribution of miscellaneous plastic products to water pollution. Additionally, tourist equipment made of plastic, which impacts both humans and the environment, was also reported by around 30 respondents, underlining the role of tourism in exacerbating plastic waste issues. Basic plastic bottles and building materials were equally mentioned by about 20 respondents each, indicating their prevalence in water pollution. This data points to the diverse sources of plastic waste contaminating water bodies, necessitating targeted interventions in both consumer behavior and waste management systems to address these challenges effectively.



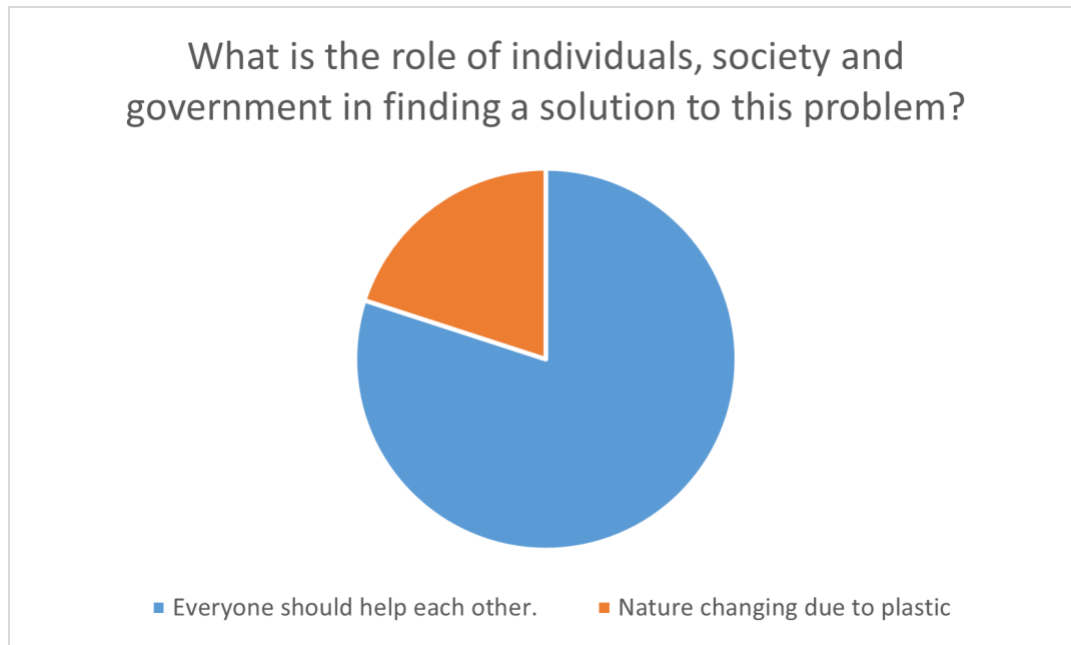
The chart shows that the majority of respondents perceive plastic waste as having a highly detrimental impact on water quality in their community. Approximately 35 individuals rated the effects as "very bad," indicating a clear concern about the degradation caused by plastic waste. Another 35 respondents emphasized that plastic waste not only affects water quality but also harms animal environments, indirectly impacting humans. A smaller proportion, around 27 respondents, highlighted that plastic is gradually integrating into the environment, leading to cumulative long-term effects. This data underscores the awareness of plastic waste's severe environmental consequences, particularly on water and animal resources.



This chart reveals that the majority of respondents, approximately 80 individuals, believe that society has an "acceptable level" of knowledge to manage plastic waste and use it in a healthy way. However, this suggests room for improvement in public understanding and practices. A smaller group, around 20 respondents, expressed the opinion that responsibility for managing plastic waste lies with individuals rather than society as a whole. The responses highlight a moderate level of confidence in society's awareness while emphasizing the need for further education and collective responsibility to enhance waste management practices.



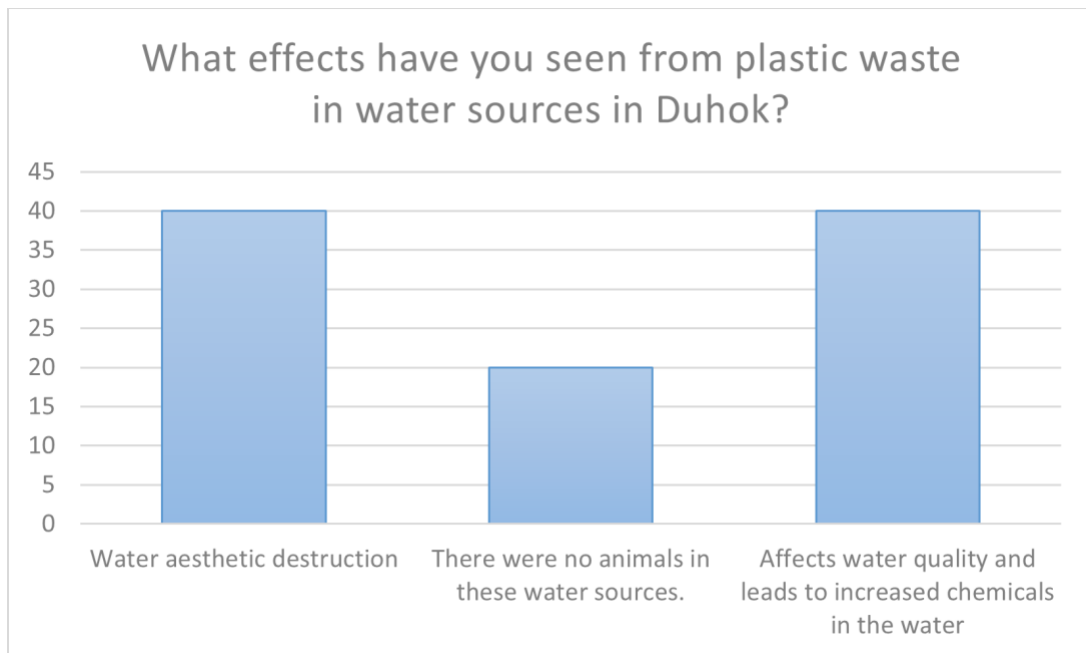
The majority of respondents agree that "everyone should help each other" in addressing the issue of plastic waste, as represented by the larger portion of the pie chart. This suggests a strong preference for collective action and shared responsibility among individuals, society, and government. A smaller segment points out that "nature is changing due to plastic," emphasizing the visible environmental consequences of inaction. The data highlights the importance of a collaborative approach where all parties work together to tackle plastic pollution effectively.



The chart indicates that increasing taxes on plastic waste is the most favored measure, with around 35 respondents supporting it. Other significant measures include the use of recycled plastic equipment and establishing plastic collection and recycling industries, each with approximately 25 respondents. Community development and raising awareness about the harm caused by plastic were less popular but still notable. These responses underline the need for both regulatory and infrastructural changes to effectively reduce plastic waste.



The most commonly reported effect is the "destruction of water aesthetics," highlighted by about 40 respondents. An equal number of respondents observed that plastic waste "affects water quality and leads to increased chemicals in the water," indicating its harmful impact on ecosystems and human health. A smaller group noted the absence of animals in these water sources, reflecting the ecological consequences of plastic pollution. This data emphasizes the multifaceted impact of plastic waste on water bodies.



A significant majority of respondents believe the city's efforts in managing plastic waste are "very little," as represented by approximately 80 respondents. A smaller portion, around 20 respondents, think the city has made some progress but "not enough." This sentiment reflects dissatisfaction with current waste management strategies and underscores the urgent need for stronger and more effective interventions to reduce plastic pollution in water resources.



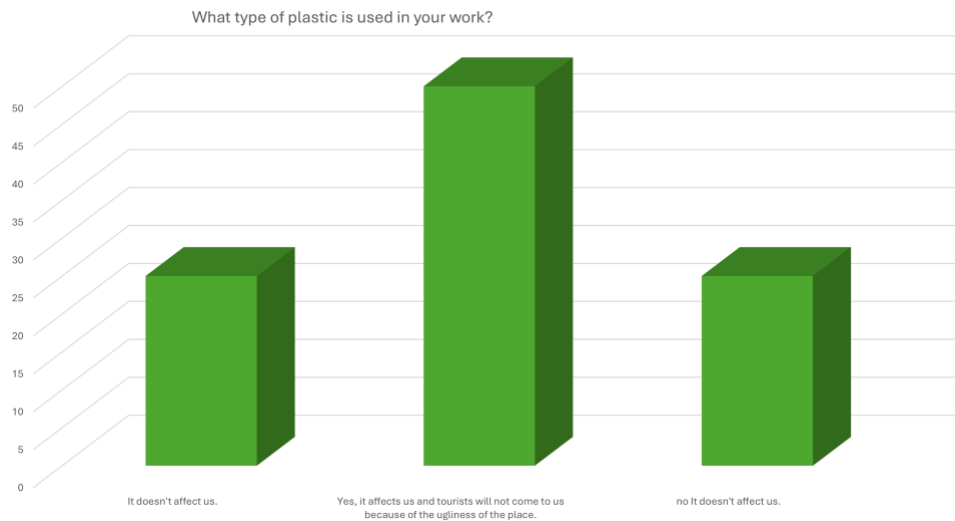
The chart highlights a balanced distribution of responses, with each suggestion receiving similar levels of support. Key suggestions include following instructions, individual responsibility, modern guidelines, drivers' roles, and introducing taxes to discourage plastic waste disposal. This even distribution indicates that participants view effective participation as a multifaceted effort requiring collective action from all sectors.



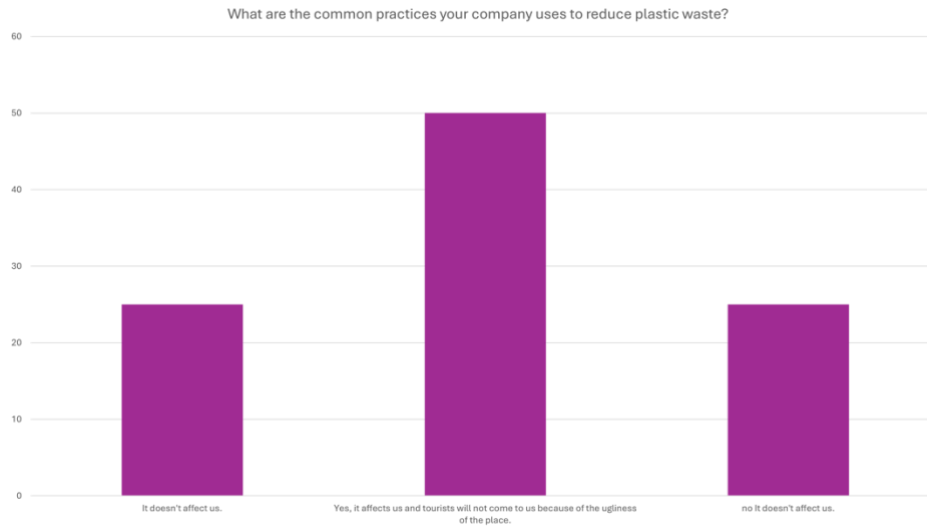
The pie chart shows a majority of respondents are motivated by health concerns, as represented by the larger orange segment. This indicates that personal well-being is a strong driver for reducing plastic waste. A smaller group emphasizes the importance of expert-prepared instructions on waste damage, showing some reliance on structured guidance for action.



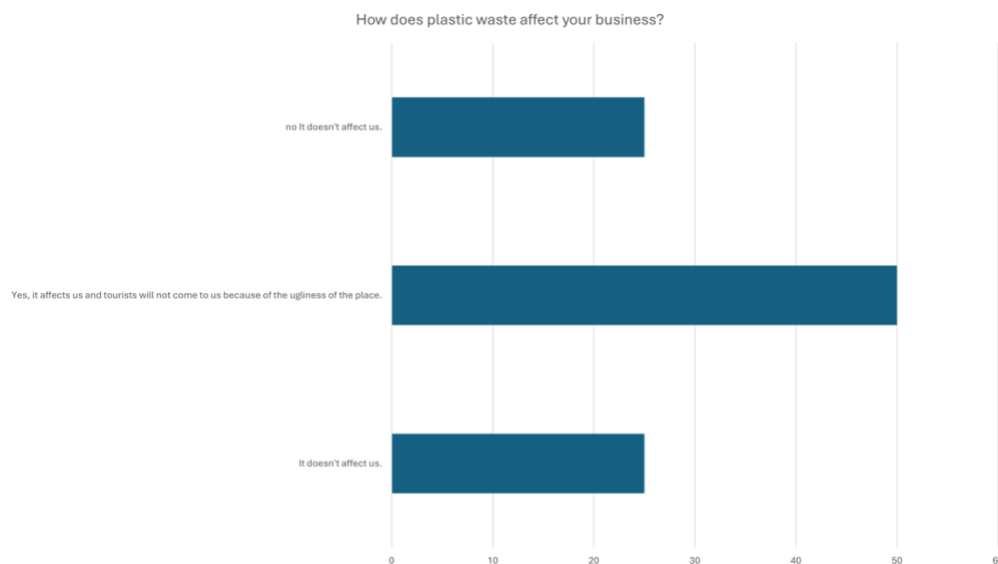
The bar chart reveals that most respondents encounter plastics linked to utility and tourism due to the lightweight and widespread use of these materials. Moderate numbers report non-relevant plastics, while fewer indicate no relation between their work and plastic usage. This shows the pervasive presence of plastics in occupational activities and highlights areas for targeted intervention.



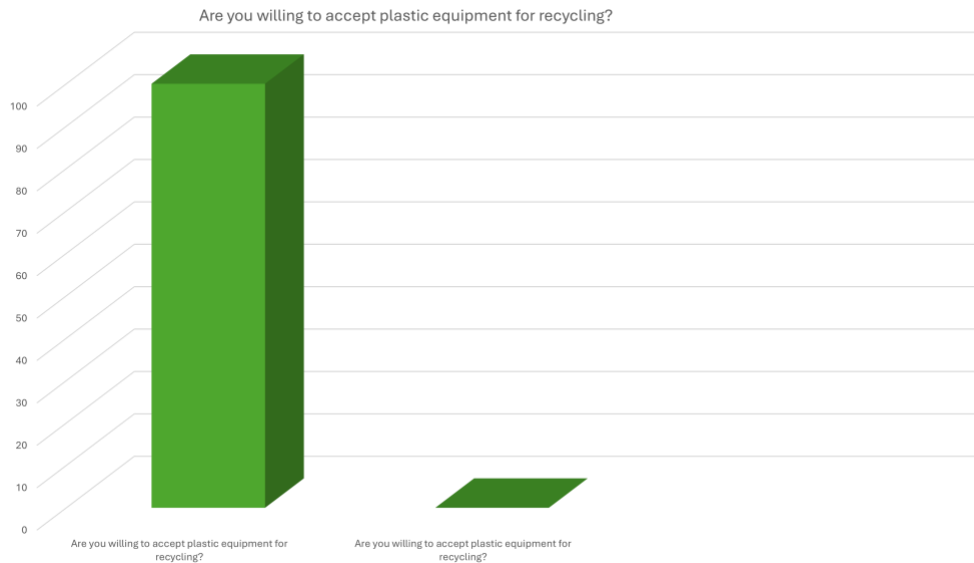
The chart highlights that nearly half of the respondents report their companies take effective measures, such as limiting plastic usage in business operations. Smaller proportions note a lack of initiatives or practices that indirectly impact their operations. This illustrates that while efforts are being made, there is significant room for improvement in corporate responsibility.



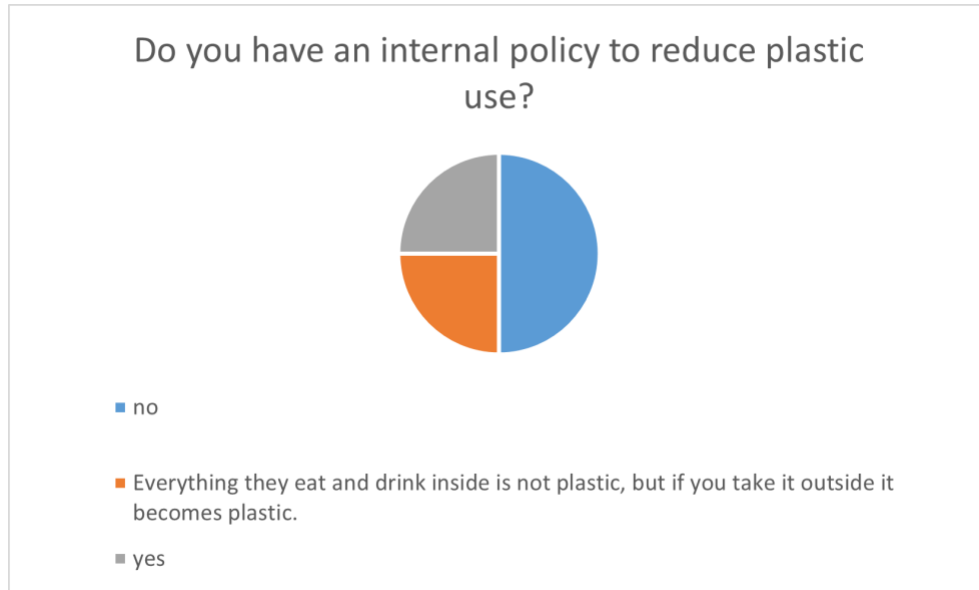
A majority of respondents note significant impacts on their businesses due to plastic waste, especially in terms of reduced tourism appeal. Moderate numbers report no direct effects, while a smaller group highlights its relevance only in specific contexts. This demonstrates the economic implications of plastic waste for local businesses and emphasizes the need for strategic management.



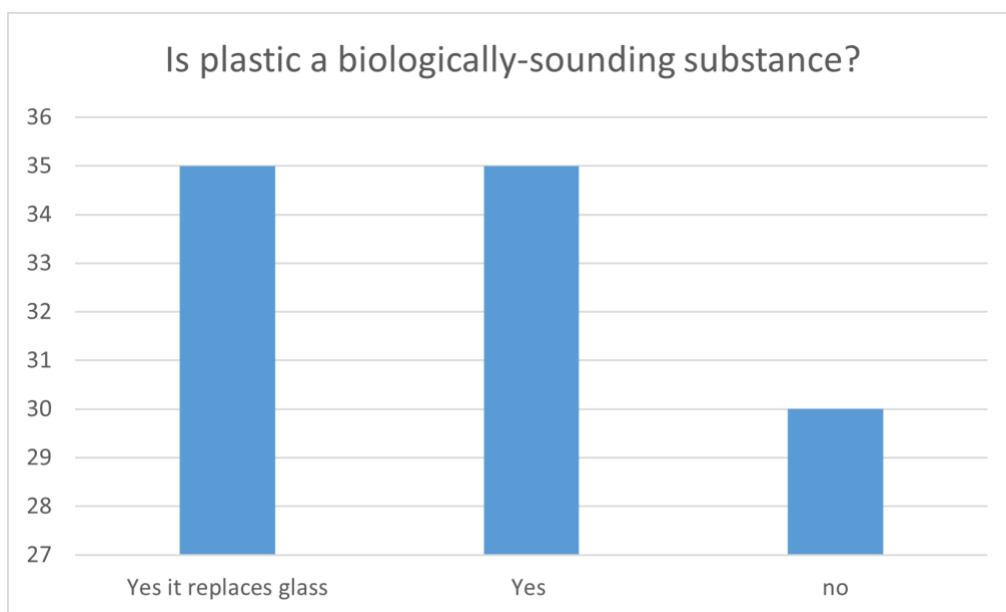
The chart indicates overwhelming support for recycling initiatives, with nearly all respondents expressing willingness to accept plastic equipment for recycling. This finding underscores a strong public readiness to engage in sustainable waste management practices and highlights the potential for implementing effective recycling systems.



The pie chart shows a fairly balanced distribution among the responses. A significant portion of respondents indicated "no" to having an internal policy, reflecting a lack of structured efforts to reduce plastic use within organizations. Another group highlighted a unique condition where items consumed inside are not plastic but become plastic when taken outside, showcasing partial and conditional measures. A smaller segment indicated "yes," showing that only a minority have clear internal policies for reducing plastic use. This suggests that while awareness exists, comprehensive and consistent internal policies are still lacking.



The chart reveals that most respondents, divided between two categories, believe plastic is biologically relevant, either because it replaces glass or due to general acknowledgment of its biological implications. A smaller group disagreed, indicating that some skepticism or lack of understanding about plastic's biological compatibility remains. This data underscores the complex perceptions surrounding plastic's material properties and its role in replacing traditional materials like glass.



The data from the charts provides valuable insights into the perceptions, challenges, and solutions surrounding plastic waste management in the community. A recurring theme across the findings is the significant awareness of the negative impacts of plastic waste on the environment, water resources, and human health. Respondents consistently highlighted the harmful effects of plastic, such as the destruction of water aesthetics, increased chemical contamination, and harm to animal and human ecosystems.

Despite this awareness, the findings show gaps in action and policy implementation. Many individuals and businesses lack internal policies to reduce plastic use, and only a minority report comprehensive practices to manage or recycle plastic waste. At the same time, there is a strong willingness among respondents to engage in recycling initiatives and support measures such as increased taxes on plastic waste, promoting recycled materials, and establishing recycling infrastructure.

Collaboration between individuals, businesses, society, and the government was repeatedly emphasized as essential for addressing the plastic waste problem. Collective responsibility, modern guidelines, and incentives like taxation were identified as key strategies to encourage participation and accountability. However, the perception of insufficient action by local authorities and businesses reflects a need for stronger enforcement, education, and support for sustainable practices.

In conclusion, the charts underscore the urgent need for comprehensive and coordinated efforts to address plastic waste. While awareness and willingness to act are evident, success will require a combination of policy enforcement, infrastructure development, and community engagement to reduce plastic's environmental footprint and foster sustainable practices.

Discussion

Behavioral Patterns and Public Awareness

The findings reveal significant gaps in public awareness regarding water pollution and its long-term consequences. While 75% of respondents reported frequent use of single-use plastics, only 18% recognized the harmful effects of improper disposal. Younger participants exhibited greater awareness, likely influenced by education and global environmental narratives. These trends suggest that awareness alone is insufficient without effective behavior change. This gap reflects challenges common in developing regions, where limited environmental education perpetuates unsustainable practices (Jambeck et al., 2015).

The study also revealed a willingness among respondents to adopt sustainable practices if provided with the right information and tools. Focus group discussions underscored the importance of localized awareness campaigns tailored to Duhok's cultural and socio-economic realities. Successful global examples, such as community-led initiatives in India and Rwanda, provide evidence of the potential for behavior-driven change in reducing plastic waste.

Sources of Pollution and Systemic Barriers

Plastic waste is identified as the dominant pollutant in Duhok, with improper disposal near water bodies exacerbating the problem. This is consistent with global patterns attributing water pollution primarily to single-use plastics and inadequate recycling systems (Plastics Europe, 2020). In Duhok, additional contributors include industrial and agricultural runoff, compounded by weak enforcement of waste management regulations.

Systemic challenges, such as insufficient infrastructure and limited governmental coordination, further hinder efforts to address water pollution. Stakeholders emphasized the need for stricter monitoring and enforcement of industrial waste disposal and the importance of adopting tailored waste management strategies, similar to reforms successfully implemented in other Middle Eastern countries.

Policy and Governance

While there is strong public support for stricter regulations, such as fines for improper disposal and bans on single-use plastics, governance challenges persist. Fragmented responsibilities among governmental agencies and inadequate funding hinder effective implementation. Interviews with stakeholders highlighted that inconsistent enforcement diminishes the impact of existing policies.

Case studies from South Korea and Germany demonstrate the effectiveness of integrating strict enforcement with community participation in waste management. These examples provide a framework for Duhok to develop coordinated policies that engage government agencies, private companies, and local communities.

Technological Solutions

Innovative technologies offer promising opportunities to mitigate water pollution in Duhok. Biodegradable plastics, chemical recycling, and water purification systems have been successful in other regions but face financial and technical barriers in Duhok. Stakeholders suggested leveraging international partnerships to introduce these technologies while addressing resource constraints.

Technologies such as GIS-based monitoring tools could improve the identification and management of pollution sources. Global examples from countries like China and the United States demonstrate how integrating technology into waste management systems enhances efficiency and outcomes.

Social and Environmental Impacts

Water pollution in Duhok has significant social and environmental consequences, disproportionately affecting low-income communities reliant on untreated water. Contaminated water sources reduce agricultural productivity, harm biodiversity, and pose severe public health risks due to the presence of microplastics. These impacts reflect global trends of environmental degradation exacerbating socio-economic inequalities. Addressing these disparities will require coordinated efforts to improve infrastructure and enhance community resilience.

Recommendations and Solutions

1 Awareness Campaigns:

- Develop localized public education programs focusing on the dangers of water pollution and practical recycling practices.
- Use community-led initiatives and partnerships with local influencers to promote sustainable behaviors, drawing lessons from successful global examples like Rwanda.

2 Policy and Governance:

- Introduce stricter regulations, such as fines for improper waste disposal and bans on single-use plastics.
- Establish a unified governance framework to streamline responsibilities and improve enforcement across agencies.
- Provide incentives, such as tax breaks, for businesses adopting sustainable waste management practices.

3 Infrastructure Development:

- Build accessible and efficient waste collection systems to manage plastic pollution effectively.
- Establish recycling facilities and encourage the use of recycled plastic in manufacturing and construction.

4 Technological Integration:

- Invest in modern recycling technologies, biodegradable plastics, and water purification systems.
- Use GIS-based tools to monitor and address pollution sources systematically.
- Partner with international organizations to gain access to expertise and funding for implementing advanced technologies.

5 Public-Private Partnerships (PPPs):

- Encourage collaboration between government, businesses, and international organizations to develop innovative waste management solutions.
- Provide subsidies or tax breaks to local businesses participating in recycling initiatives.
- Promote knowledge transfer and capacity building through partnerships with global environmental organizations.

6 Targeted Interventions for Vulnerable Communities:

- Subsidize access to clean water for low-income populations.
- Integrate environmental education into school curricula to foster a culture of sustainability from an early age.

Conclusion

The research conducted on water pollution in Duhok highlights the urgent need for targeted interventions to address the city's environmental challenges. The study emphasizes the multifaceted nature of the issue, which stems from behavioral patterns, systemic inefficiencies, and policy gaps. By analyzing public awareness levels, infrastructure deficits, and governance challenges, the findings provide a roadmap for mitigating water pollution and ensuring sustainable resource management.

The prevalence of plastic waste as a primary pollutant underscores the necessity of addressing public behaviors and cultural feelings about waste disposal. With 75% of survey respondents often using single-use plastics, public awareness campaigns are critical. Targeted education programs, particularly for older demographics and rural communities, could foster a culture of environmental responsibility and reduce the reliance on disposable plastics.

Systemic challenges, including the lack of adequate recycling facilities and inconsistencies in waste management services, further worsen the problem. Addressing these issues requires robust investments in infrastructure and the development of efficient waste collection systems. Interviews with stakeholders revealed strong public support for stricter regulations, which could serve as a foundation for implementing bans on single-use plastics and incentivizing sustainable practices.

The environmental and social impacts of water pollution in Duhok are profound, affecting biodiversity, public health, and agricultural productivity. The contamination of water sources with plastics and chemical pollutants poses long-term risks, particularly for low-income communities that already face limited access to clean water. These disparities highlight the need for inclusive policies that prioritize vulnerable populations and ensure fair access to resources.

Global examples provide valuable lessons for Duhok, proving the effectiveness of integrated approaches that combine policy enforcement, community engagement, and technological innovation. Case studies from Rwanda, South Korea, and Brazil illustrate how coordinated efforts among governments, businesses, and communities can drive significant improvements in waste management and water quality. Duhok has the potential to adapt these models, using its unique strengths and addressing its specific challenges.

Technological advancements, such as chemical recycling and water purification systems, offer promising solutions for mitigating water pollution. However, adopting these innovations requires overcoming financial and technical barriers. International partnerships and public-private collaborations can play a pivotal role in bridging resource gaps and offering the ability needed to implement these technologies effectively.

The study also highlights the importance of fostering public-private partnerships to enhance waste management systems. Engaging local businesses in environmental initiatives through tax incentives and subsidies can create a collaborative framework for sustainable development. Additionally, partnerships with international organizations could bring much-needed funding and technical ability to the region.

In conclusion, tackling water pollution in Duhok demands a comprehensive approach that integrates public awareness, infrastructure development, policy enforcement, and technological innovation. By fostering collaboration among stakeholders and drawing on global best practices, Duhok can address its water pollution challenges and secure a sustainable future for its water resources. The findings of this research underscore the need for immediate action and provide a foundation for designing effective strategies to protect the environment and improve the quality of life for the city's residents.

If everything aligns with your expectations, I can now create the accompanying graphs and ensure all sections are polished. Let me know if you would like me to go ahead with visualizations or further refinements!

Challenges and Limitations:

- The biggest challenge we faced was the timing. We were all students with midterms and finals.
- The study faced several challenges, including incomplete data due to logistical barriers in accessing remote areas and reliance on self-reported surveys, which introduced potential biases.
- Cultural resistance to discussing environmental issues and habitual use of single-use plastics hindered immediate behavioral change.
- Systemic issues, such as weak enforcement of environmental policies, fragmented governmental responsibilities, and limited funding, constrained progress.
- Additionally, technical barriers, including insufficient local expertise and financial limitations, restricted the adoption of advanced waste management technologies.
- Despite these challenges, the findings underscore the need for improved resource allocation, stakeholder collaboration, and targeted interventions to address water pollution effectively.

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Our special thanks go to UNICEF for their support, ability, and shared commitment to addressing the environmental challenges caused by waste plastics and their impact on water resources.

We also thank Artist Company for their valuable cooperation and for offering key insights into the environmental effects of waste plastics.

We would like to express our heartfelt gratitude to our research supervisor, Dr. Hussein Ali, for their invaluable guidance, insightful feedback, and encouragement throughout the course of this project. Their support has been instrumental in shaping the quality and direction of our work.

Finally, we acknowledge the Duhok Dam Directorate for granting us access to essential data and research opportunities in this vital area, enabling us to focus on understanding and mitigating the impact of water pollution.

This project would not have been possible without the collective efforts and unwavering support of all these entities. Thank you for your dedication to environmental sustainability and the protection of our natural resources.

Appendices

• Appendix A: Copies of questionnaires and interview guides.

1. How familiar are you with the plastic pollution problem in Duhok City?
 - A. Familiar
 - B. In between
 - C. Unfamiliar
2. Where did you learn about plastic pollution in the Duhok City?
Your Answer: _____
3. How often do you use plastic items (bottles, bags, containers) daily?
 - A. Frequently
 - B. Sometimes
 - C. Rarely
 - D. Never
4. When you visit tourist places, how often do you notice plastic waste (e.g., bottles, bags) around the water?
 - A. Very Often
 - B. Often
 - C. Occasionally
 - D. Never
5. How concerned are you about your community's water pollution caused by plastic waste?
 - A. Concerned
 - B. Somewhat concerned
 - C. Not concerned
 - D. Not concerned
 - E. Unsure
6. Who do you believe is most responsible for addressing plastic pollution in Duhok City?
 - A. Government
 - B. Local Community
 - C. Tourists
 - D. Businesses
- E. Other
7. Would you be interested in volunteering for a cleanup event at Duhok City?
 - A. Yes
 - B. No
8. Would you support daily recycling of single-use plastics (like bags and bottles)?
 - A. Yes
 - B. No
9. How often do you bring reusable items (such as water bottles and bags) when you are having an outdoor meal?

- A. Very Often
- B. Often
- C. Occasionally
- D. Rarely
- E. Never

10. What actions do you think would be most effective in reducing plastic pollution in Duhok City?

Your Answer: _____

11. Which areas around the Duhok City contribute most to plastic waste?

Your Answer: _____

12. Do you believe plastic pollution in Duhok City affects nearby communities drinking water quality?

- A. Yes
- B. No

13. Would you take part in educational sessions or workshops about plastic pollution if they were available?

- A. Yes
- B. No

12. Are you aware of the environmental impacts of plastic waste on water sources?

- A. Yes
- B. No
- C. Somewhat

13. do you notice plastic waste near water sources (rivers, lakes, and dams) in Duhok City?

- A. Yes
- B. No

14. Would you support stricter plastic use and waste management regulations to protect water sources?A. Yes

- B. No
- C. Unsure

Objective: Foster open discussion among residents, tourists, business owners, and local authorities

on challenges, solutions, and collective actions for plastic waste management.

- Demographic Information:

1. Age:
2. Gender:
3. Occupation:
4. Education level:
5. Length of residence in Duhok City

- Discussion Prompts

1. How do you feel plastic waste affects the water quality in our community?
 2. What kinds of plastic waste do you commonly see around water sources? (E.g., plastic bottles, bags)
 3. How do you think plastic waste affects the local environment, including water bodies, plants, and animals?
 4. Do you think the community has enough knowledge and resources to manage and reduce plastic waste properly?
 5. What measures, if any, would you like to see implemented to reduce plastic waste pollution?
 6. What role should individuals, the community, and the government play in tackling this issue?
 7. What impacts have you saw from plastic waste on water sources in Duhok?
 8. How well do you think the city currently manages plastic waste, especially water pollution?9.
- How can each group (residents, tourists, businesses, authorities) contribute more effectively to this effort?
10. What would motivate or help your group to actively take part in reducing plastic waste?

Main Objectives:

- Assess community awareness and attitudes toward plastic pollution.
- Understand how plastic pollution affects local water sources and ecosystems.
- Find barriers to proper plastic disposal and waste management practices.
- Gather suggestions from the community for reducing plastic pollution

Questionnaire Objective: Understand public feeling, behavior, and awareness regarding plastic waste and its effects on water pollution in Duhok City.

- ❖ Demographic Information

- Age:
- Gender:
- Occupation:

- Education level:

- Length of residence in Duhok City:

1. Interview Guide for Environmental Experts and Government Officials.

Objective: Gather in-depth insights into the causes, challenges, and policies related to plastic waste and water pollution in Duhok City.

- Questions

1. How would you describe the current state of water pollution in Duhok City, specifically in relation to plastic waste?

2. What are the primary sources of plastic waste contributing to water pollution in the area?

3. Can you discuss any specific challenges faced by the city in managing plastic waste and its impact on water bodies?

4. How effective are current waste management and pollution control policies in addressing plastic waste issues in Duhok City?

5. What is the role of environmental education in reducing the use of plastic and encouraging society to switch to environmentally friendly alternatives?

6. Are there specific government programs or initiatives aimed at reducing plastic waste or protecting water sources in Duhok?

7. Is the government implementing awareness campaigns aimed at reducing the use of plastic and educating citizens about its environmental impact?

8. In your opinion, what actions could be taken to reduce the impact of plastic waste on water pollution in Duhok?

9. Are there innovative technological solutions that help remove plastic from the environment and water effectively?

10. How can the community and local organizations contribute to reducing plastic waste pollution?

2. Interview Guide for Business Owners

Objective: Explore business practices, challenges, and willingness to adopt eco-friendly measures about plastic use and waste management.

- Questions

1. What kinds of plastic materials are most used in your business operations?

2. Are there any practices your business has implemented to reduce plastic waste?

3. How does plastic waste management impact your business's operations?

4. Would you be willing to adopt alternatives to plastic if incentives were provided?

5. Do you have an environmental policy within the company to reduce the use of plastic?

6. Do you feel there is enough support from local authorities to help businesses reduce plastic waste?

7. Do you consider replacing plastic with biodegradable components an economical choice in

- your business? 8. How can your company contribute to reducing plastic pollution in local communities or in the supply chain?
9. How does your business currently dispose of plastic waste, and are you aware of local recycling facilities?
10. What role do you think businesses in Duhok should play in reducing plastic pollution?
11. How do you assess the impact of your business on the environment in relation to plastic pollution?