

THE FEASIBILITY OF WASTEWATER REUSE IN UZBEKISTAN

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Abstract: Water supply shortage is a pressing global issue, present even in traditionally water-rich regions. The study proposes a valuable solution to Uzbekistan's severe water troubles – adoption of wastewater reuse strategies already in practice. It examines wastewater management practices, focusing on Uzbekistan's unique climate and proposing policies, technological innovations, and public campaigns. A comprehensive literature review was administered, analysing case studies from Israel, Mediterranean basin, China, and South Africa. Challenges faced by every region were related with respect to the context of Uzbekistan. Findings reveal that robust regulatory frameworks and strategic goals are paramount for a nation's success in implementation of wastewater reclamation. Although study showed a positive public attitude towards wastewater reuse, establishing community campaigns and educating people about the benefits of wastewater treatment may bolster governmental efforts. Additionally, governmental funding and additional investments should be planned prior to the projects to maximize effectiveness. This underscores the need for Uzbekistan to integrate international practices that would suit Uzbekistan's climate and socio-economic condition the best. Also, to ensure sustainable water management techniques, the concept of wastewater reuse should be embraced in different sectors. Future researchers should explore the monetary side of wastewater management practices, focusing specifically on the financial feasibility of the project. By putting particular emphasis on wastewater reuse, Uzbekistan can manage its water shortage problems and ensure a sustainable water future.

Introduction

Water is a basic need for every living creature. Despite covering roughly 70% of our planet, only three percent of world water resources are appropriate for drinking. However, most of the freshwater is concentrated in glaciers and icecaps – sources not easily reached by humans. Therefore, more than 99% percent of all water resources are unusable by people for drinking[1]. Driven by climate change, water resources are minimised, and it leaves approximately two billion people without access to fresh water. Many countries, thus, are taking actions to mitigate water losses by embracing water reuse. Establishing sustainable wastewater reuse systems provides environmental as well economic merits, allowing adequate usage of valuable resources in problematic regions[2].

Uzbekistan – a region highly prone to droughts – is a landlocked country, with 80% percent of its land covered by deserts . In addition to this, water resources are not evenly distributed across the country's territory and are not sufficient[3]. In future, the number of droughts may increase due mainly to the diminish of the runoffs from Syr Darya and Amu Darya Rivers[4]. The fast growing

population of Uzbekistan is predicted to exacerbate water shortage problems in the region. "The population of Uzbekistan in the next three decades will grow dynamically and will exceed 41 million people in 2030, 46 million people in 2040, and 50 million people in 2050. Overall, for 2022-2050, the country's population will increase by 41 percent" states the Embassy of Uzbekistan in the United States[5]. Taking into account all these, implementing wastewater reuse is an essential step to place Uzbekistan in a better position in terms of fresh water availability.

Despite the worldwide success of wastewater treatment, It remains a largely underexplored topic in Uzbekistan and is practiced on a residential scale. Adopting wastewater reuse could lead to improvements in the agricultural sector and resolve water shortage problems in rural regions of the country. Israel – an arid country facing severe water supply problems – implemented wastewater reuse on a regional scale and has maintained a steady water supply throughout its territory.

This research aims to evaluate the feasibility of wastewater reuse by exploring other countries and polls. It begins with literature review which focuses on other country's success in adopting wastewater treatment, followed by methodology, government's interest, statistics and feasibility evaluation, and recommendations.

Literature Review

The following comprehensive review analyses insights from diverse sources to examine global practices, technological advancements, social and economic challenges, and the future potential of wastewater reuse in Uzbekistan. The goal is to illuminate effective pathways for integrating reclaimed water into existing water management systems, thereby resolving water scarcity issues.

Considering the existing regional initiatives and practices in wastewater reuse, these following regions have been exploiting wastewater reuse techniques: Europe, Mediterranean Basin, South Africa, and Beijing, China.

Initiating with Europe, over the past two decades it has faced continuously intensifying water stress due to not only quantitative scarcity but also qualitative deterioration. As highlighted in Wastewater reuse in Europe - ScienceDirect, advanced reclamation techniques have been largely used to address these challenges[6]. Southern European nations, heavily dependent on agriculture and tourism, are maintaining a leadership in promoting wastewater reuse projects. The absence of unified institutional frameworks, economic investment, and standardized guidelines impede the full potential of wastewater reuse throughout the region. Therefore, with the help of integrated policies and financial investments, the full potential of wastewater treatment could be achieved.

Continuing the review with the Mediterranean Basin, the region's uneven precipitation and water distribution pose unique challenges for water resource management. Reclaimed wastewater is indispensable for agricultural irrigation, as It reduces the reliance on expensive tertiary treatments, according to the status of wastewater reuse practice in the Mediterranean basin - ScienceDirect [7]. Leading countries like Israel and Tunisia have pioneered innovative applications of treated wastewater, particularly in agriculture. However, fragmented regulatory frameworks prevent through regional collaboration. Consolidating these policies, likewise, could present significant economic and environmental benefits. Moreover, natural fertilizers in reused wastewater can lighten the reliance on chemical use in agriculture.

Next in analysis comes South Africa; a severe lack of potable water supplies emphasizes the need for alternative water sources. As noted in Treated wastewater reuse in South Africa: Overview, potential and challenges - ScienceDirect [8], wastewater reuse has significant potential for non-potable applications, including industrial processes and landscape irrigation. The success of these initiatives relies upon public trust, strict regulations, and financial feasibility. By addressing these factors, long-term sustainability in regions where water is in short supply is guaranteed. Additionally, geographical differences in access to reclaimed water highlight the need for interventions focusing on infrastructure and education.

Ultimately, the increasing scarcity of freshwater resources in Beijing acted as a catalyst for the integration of recycled wastewater as an alternative supply. Research in Analysis of wastewater reuse potential in Beijing - ScienceDirect emphasizes that centralized wastewater treatment plants are more monetary efficient than decentralized systems [9]. These facilities primarily serve agricultural and urban recreational purposes, offering a competitive advantage when integrated into a comprehensive water management strategy.

The afterward analysis touched upon the technological aspects. Technological innovation plays a huge role in effective wastewater reuse. The conventional activated sludge treatment technique, as described in Wastewater treatment and water reuse - ScienceDirect, has been the global standard for a long time[10]. However, advanced methods such as membrane filtration, reverse osmosis, and ultraviolet disinfection have certainly revolutionized water reclamation, giving a rise to the production of high-quality outputs suitable for various applications. These advancements not only enhance the quality of treated water but also expand its potential uses across various sectors.

Newly developed soft technologies, such as nutrient recovery systems, offer dual benefits of environmental sustainability and economic efficiency. The method involves the recovery of nutrients, and by doing so these systems reduce dependency on chemical fertilizers, making the financial side of wastewater reuse more appealing in agriculture. These advancements are particularly crucial for regions like the Mediterranean, where stringent treatment levels are required to address health and environmental concerns effectively and immediately. Moreover, energy-efficient systems are gaining attraction, ensuring that wastewater treatment satisfies broader sustainability goals.

Leaving from the discussion of technology, we need to enunciate the attention to necessarily the development of robust regulatory frameworks for scaling wastewater reuse. As noted in Wastewater reuse and risk: definition of key objectives - ScienceDirect, the proper division into tailored categories—such as irrigation, industrial use, or aquifer recharge—is essential for ensuring microbial and chemical safety[11]. Thorough assessment of existing risk frameworks are of paramount importance when it comes to addressing emerging pollutants and ensuring the long-term sustainability of reuse systems. Additionally, these frameworks must be adaptable to ever-changing scientific knowledge and technological innovations.

In regions like the Mediterranean, incomplete regulations are very likely to pose significant challenges to transnational collaboration. Minimizing the issues in relation to current guidelines could facilitate a large-scale adoption and drive economic exchanges. Similarly, South Africa's efforts highlight the importance of region-specific regulations that address public health concerns and boost public confidence in wastewater reuse systems. Improved cooperation between

regulatory bodies, stakeholders, and communities is valuable to addressing these challenges effectively.

The next aspect to consider is public perception, which plays a crucial role in determining the success of wastewater reuse projects. As emphasized in Obstacles to wastewater reuse: an overview - Duong - 2015 - WIREs Water, people's psychology, often labeled as the "yuck factor," remains a significant barrier[12]. Overcoming this challenge requires targeted public awareness campaigns and transparent communication about the safety and benefits of reclaimed water. Educational initiatives that address misconceptions can play a pivotal role in shifting public opinion and fostering acceptance.

Economic factors also significantly influence the adoption of wastewater reuse. In Beijing, competitive pricing strategies and institutional support have facilitated widespread adoption, as demonstrated in Analysis of wastewater reuse potential in Beijing - ScienceDirect [9]. Conversely, in South Africa, gaps in public education and trust have been a nuisance to progress. Connecting these socio-economic divides through stakeholder engagement and community involvement can prove highly beneficial for achieving widespread acceptance and long-term success. Furthermore, integrating economic incentives, such as subsidies and tax benefits, could help to accelerate the adoption of reclaimed water systems.

Unfortunately, issues concerning health risks, economic viability, institutional and policy gaps are present and need to be properly addressed. Starting from health concerns, the presence of pathogens, heavy metals, and emerging pollutants in reclaimed water poses substantial health and environmental risks. Strict monitoring systems and advanced treatment technologies are necessary to mitigate these risks, as outlined in Wastewater reuse and risk: definition of key objectives - ScienceDirect [11]. However, the high costs associated with these technologies is a barrier for widespread implementation, particularly in developing regions. Collaborative research and funding mechanisms could help fill these gaps and ensure equitable access to advanced treatment systems.

Next in line are economic challenges, including the costs of retrofitting infrastructure and deploying advanced treatment technologies; they limit the scalability of wastewater reuse initiatives. Centralized treatment plants, as evidenced in Analysis of wastewater reuse potential in Beijing - ScienceDirect [9], offer a cost-effective solution. Financial incentives, subsidies, and innovative pricing mechanisms could further enhance the economic viability of wastewater reuse projects, particularly in resource-limited regions. Long-term cost-benefit analyses are crucial for demonstrating the projected value of reclaimed water systems.

The absence of rational policies and institutional support also often undermines wastewater reuse initiatives. Europe and the Mediterranean illustrate the importance of harmonized guidelines and dedicated economic instruments for driving large-scale implementation (Wastewater reuse in Europe - ScienceDirect) [6]. Addressing these gaps is critical for unlocking the full potential of reclaimed wastewater as a sustainable resource. Strengthening institutional capacities and fostering international collaboration are vital steps toward addressing these challenges effectively.

To be able to derive the full potential of wastewater reuse, following areas should be prioritized:

- **Technological Innovation:** Investing in cost-effective and energy-efficient treatment systems to enhance the quality and reliability of reclaimed water.

- **Policy Development:** Establishing stringent, sector-specific guidelines that align with local socio-economic and environmental contexts.
- **Public Engagement:** Leveling public awareness and trust up through education campaigns, stakeholder engagement, and transparent communication.
- **Research Expansion:** Building a vigorous evidence base to evaluate the long-term efficacy, safety, and socio-economic impacts of wastewater reuse systems.

Additionally, supporting collaborations between academic institutions, industries, and governments could be a great driver of innovations and ensure the successful integration of reclaimed water systems into broader water management strategies.

To summarize the findings of this review, wastewater reuse represents a revolutionary solution to the growing global water scarcity crisis. While regions such as Europe, the Mediterranean, and Beijing have achieved significant progress, challenges are still present in public acceptance, economic feasibility, and regulatory coherence. By advancing technologies, fostering public trust, and establishing cohesive policies, wastewater reuse can become a cornerstone of sustainable water management. This review lays a solid groundwork for advancing research, shaping effective policies, and setting up practical solutions in wastewater reuse. Building on these efforts is essential to addressing water scarcity and ensuring secure and sustainable water resources for future generations.

Methodology

As stated earlier in the introduction, this study attempts to investigate the potential use of wastewater reuse in Uzbekistan and prove its feasibility. To ensure most valuableness, regional obstacles, technology considerations, and the perception of a public is absolutely critical. The robust analysis showed that a systematic approach would be effective and essential to get accurate understanding and insights into current existing practices, limitations, and prospective opportunities to grasp which are related to wastewater reuse in the study-region. The following section of the research sets out to detail the design of a study, methods that were utilized when collecting data, specific strategies used for comprehensive analysis, and some of the ethical considerations.

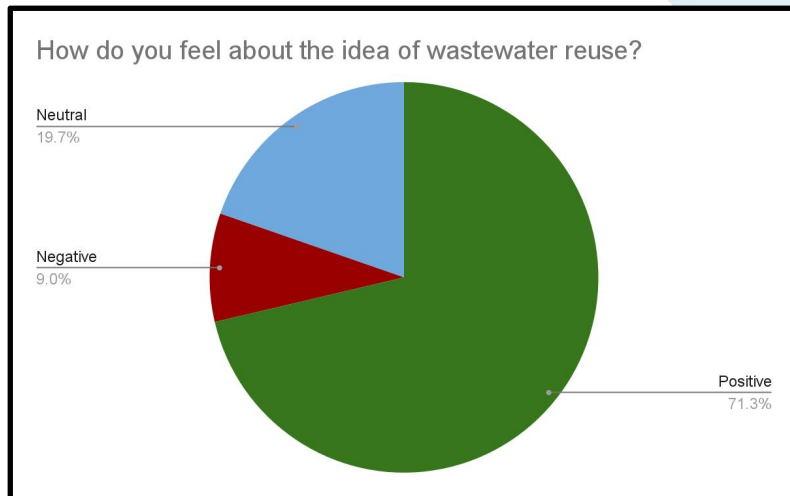
The study is based on a mixed approach, focusing on both qualitative and quantitative data. Thereby, it concentrates on public attitude and addresses subjective questions to set a context. By analysing already existing scholarly sources, the research wants to underscore the feasibility of wastewater treatment. Numerous examples of countries that adopted various ways of wastewater treatment allow an implementation of the technologies and regulatory frameworks that suit Uzbekistan's climate and policies. Polls and surveys, on the other hand, deliver public attitude towards a potential wastewater management strategy and a general possibility of implementing wastewater reuse. The research is guided by key principles of sustainability, feasibility of the wastewater reuse, community attitude and socio-economic benefits. These ideas will serve as foundation while collecting qualitative data or surveying the public. The public perception, existing barriers, feasible technologies, and strategies already in practice will be observed throughout the study, and necessary questions will be addressed.

Primary numerical data were gathered through online surveys in “Telegram,” enabling more people to participate in the poll. As Telegram is a leading messenger in Uzbekistan – 18 million users registered in Uzbekistan in 2022 – the reach of the survey was not restricted to particular groups of people or regions[13]. Furthermore, before responding, participants were provided with all necessary information to set a context and prevent bias. Google forms documents with a survey were forwarded to numerous telegram channels. Language barriers were also taken into account and addressed, with questions presented in three languages: Russian, Uzbek, and English. Therefore, the audience of respondents was expanded. At the end of the online survey, participants were given an opportunity to leave questions that will be enlightened later in the study. The survey included 4 closed-ended questions about adoption of wastewater treatment in Uzbekistan. First, participants were asked about their take on wastewater reuse and its implementation in Uzbekistan. Two other questions asked their opinion about investments into STP (Sewage Treatment Plants) and applications of treated wastewater. Background information was also given for clarity reasons.

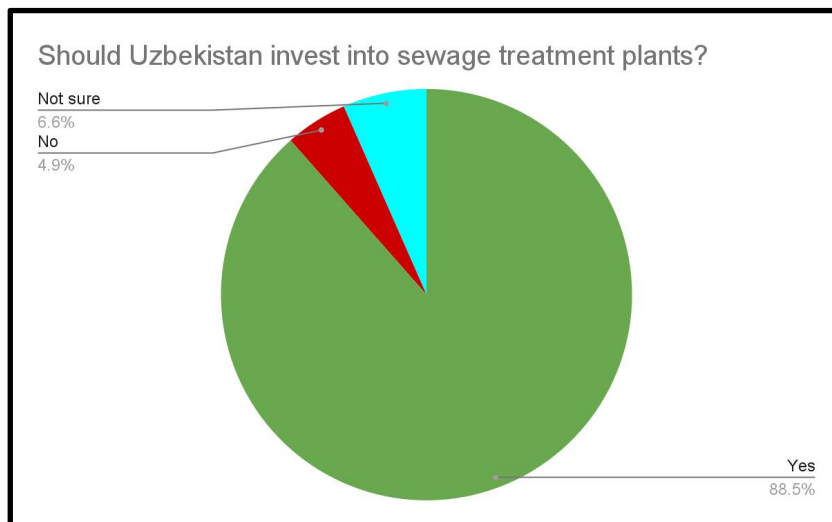
Secondary data collection was derived from authentic scholarly sources, government reports and international studies. Both qualitative and quantitative data were proof-checked for credibility before inclusion to this study. To guarantee an unbiased approach, multiple sources on the same theme were thoroughly analysed. Moreover, conclusions were driven only according to relevant cases from similarly arid regions that succeeded in wastewater reuse.

Given the amount of knowledge and current understanding of the very idea of reusing wastewater possessed by all layers of population in Uzbekistan, the predictions were that the majority will prefer to stay on the fence, choosing neutrality; in regards to the investments, the projections were highly positive because they are foundational in any project.

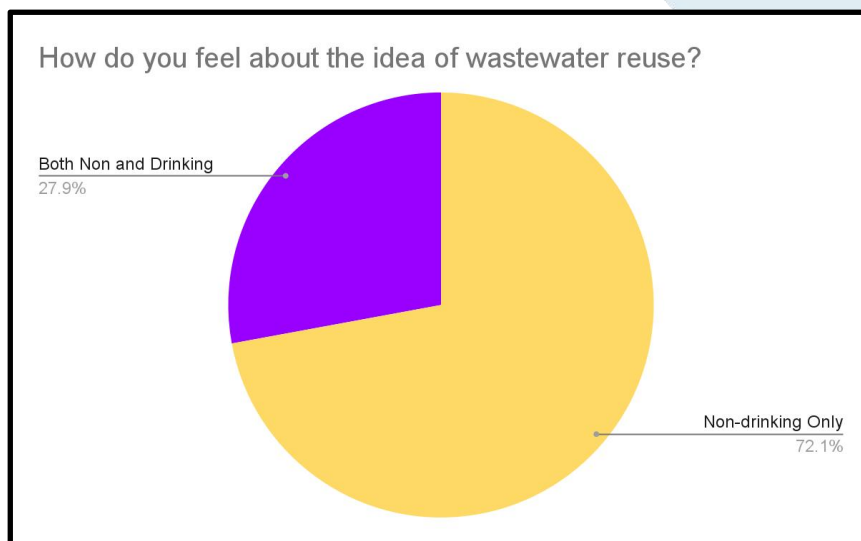
Moving to the tangible statistics, the team handpicked four most important questions to have answers for. To better understand these perspectives, I organized the responses into statistical categories, such as percentages of agreement, neutral responses, and disagreement with specific statements. Let's start from the first one: How do you feel about the idea of wastewater reuse? It is important to understand the public's perception, and what they feel about this idea. For instance, 72.4% of respondents expressed a positive attitude towards wastewater reuse, while 8.6% showed their safety concerns (being negative to this idea). Generally speaking, we can derive that the vast majority of respondents are for implementing this idea into reality, which can prove to be highly beneficial when proposing this project since more than 80% of the people supported the idea that Uzbekistan should adopt it[14].



Next, the survey was also concerned about adoption of sewage treatment plants and whether treated wastewater be used for drinking and non-drinking purposes. As it turned out, almost 90% of respondents showcased a support in case for sewage treatment plants adoption, with only a tenth being either not sure or negative[14].



Ultimately, as predicted from the very beginning, respondents were less supportive of the idea of reusing wastewater even if it is treated. Upon analyzing the charts, we counted that more than two thirds of all voters did not support this idea; making it difficult to gain public trust on this matter. However, they were less hostile rather than positive to utilizing treated wastewater for agricultural purposes[14].



To effectively analyze and visualize this data, we leaned towards using Microsoft Excel, which allowed for much efficient categorization; charts were made using google docs special features that allow for a clear and understandable presentation of the data. These statistical findings reveal mainly a positive attitude towards wastewater reuse, particularly when the safety is guaranteed. Additionally, respondents are generally supporting the investments on the projects related to necessarily having wastewater treated for reuse. However, the concerns expressed by some voters are the need to keep it safe(using it for non-drinking purposes).

Overall, the data analysis underscores the importance of addressing public perception in wastewater reuse projects. By quantifying and interpreting the responses, this section provides an understanding of societal readiness for sustainable water management practices.

Throughout the collection of primary data, ethical principles were considered. Consent, anonymousness, and voluntary participation were adhered to during the study. Survey forms educated participants about the topic, giving additional background information where it was needed. The confidentiality of each surveyed person was protected. Online overall results were shown, without any reference to participants. Further steps were taken to protect survey participant's anonymousness, such as storing interview transcripts of professors from local universities. Only researching bodies could access interview information. Additionally, any questions given by online participants were stored in Microsoft sheet, and only researchers could review it. Before interviewing professors in universities, permission from university principles was given. After this, only volunteer professors were selected. Study information – both numerical and qualitative data from online surveys and in-person interviews – are well protected to secure confidentiality rights of surveyed bodies.

Despite being carefully designed, the methodology of the study may introduce the possible gaps. Firstly, the implementation of wastewater reuse in Uzbekistan was not viewed through a monetary lens. Though some international case studies were studied focusing on the financial investments, their applicability in the context of Uzbekistan was not studied through primary data. Given the constraints in resources, government bodies were not interviewed. Financial feasibility is one of the most crucial factors to adopt new projects. So, additional research, specifically, on the financial side of wastewater treatment strategies in the country may be needed. Another challenge faced during the study of the topic is lack of first-hand research on limitations, unique to the wastewater systems. Though some professors in universities were surveyed, their experience may be irrelevant due to a difference in the fields. Mostly, professors in irrigational institutes were surveyed. Once again, due mainly to financial limitations, professional environmentalists or engineers were not interviewed. That may lead to region-specific challenges. Therefore, next studies are advised to give a particular focus to above listed limitations, increasing the reliability and viability of their research.

The methodology provides a clear framework for investigating wastewater reuse in Uzbekistan. It uses data collection and analysis to answer leading research questions. By focusing on both technical feasibility and societal factors, the approach tries to provide a practical and localized understanding of wastewater reuse potential. Statistical data was found to be crucial when analyzing the public's opinion on the matter.

Government Interests

It has become a commonplace phenomenon for countries worldwide to take wastewater reuse strategies into consideration when tackling the global problem of water scarcity. Not only does this approach satisfy environmental but also economic objectives. In Uzbekistan, where water resources are under significant strain due to huge agricultural demands and climate challenges, governmental policies and initiatives play a crucial part in the promotion of wastewater reuse for long-term sustainability. This section attempts to explore the role of governments in successfully implementing strategies for wastewater reuse, focusing on policy frameworks, financial investments, and strategic specificities with an emphasis on the context of Uzbekistan.

Setting clear regulations and legislations is paramount to implement wastewater reuse strategies. Setting explicit guidelines could promote investment in the field, reach community appeal, and impede possible unfavorable outcomes. Policies, regulations, and collaboration underscore Israel's international success in wastewater management. According to the U. S. The Environmental Protection Agency, Israel has set national standards for water quality[15]. It considers important aspects such as public health, plant health, soil health. Moreover, the Israeli government encourages universities to explore wastewater reuse in various ways, thereby improving soil health, reducing treatment costs, and lowering energy consumption. Another indication of importance of policy frameworks and legislations comes from the European Union."The European Union (EU) has been taking steps to protect and conserve its water resources, and one key piece of legislation in this effort is Regulation (EU) 2019/1056, which establishes a framework for water reuse. This regulation provides a clear framework for the safe and sustainable reuse of treated wastewater and other water, including rainwater, and it is a crucial part of the EU's wider water management and environmental policy" writes WAREG Newsletter[22]. Reviewing existing water management policies and embracing new legislations and regulatory frameworks for wastewater reuse may serve as a model for Uzbekistan and significantly bolster governmental efforts.

Government financial support is fundamental to initiating wastewater reuse projects, especially in regions where financial resources are limited. High amounts of investments ensure the construction of advanced wastewater treatment constructions, support researching, and promote public awareness. For instance, in Beijing, substantial government investments for wastewater treatment plans have greatly facilitated the widespread use, integrating the water into both urban and agricultural systems[17]. Likewise, in South Africa, investments targeted mainly non-potable reuse applications for industrial and irrigation purposes[18]. These examples demonstrate how strategic financial choices can lead to impactful outcomes. In Uzbekistan, a large amount of attention and money is conventionally dedicated to water management systems, given the country's dependence on agriculture. However, funding for wastewater reuse infrastructure is still limited and underdeveloped. Despite recognizing the potential of reclaimed water, a lack of financial support restricts large-scale implementation and technological advancements. To overcome these challenges, Uzbekistan can look up for the strategies like fostering public-private partnerships (PPPs) to share costs and risks, as well as leveraging international funding sources, such as grants or loans from global organizations. Increased governmental focus on wastewater reuse investment can bring economic and environmental benefits, ensuring sustainable water management in the long run.

Setting specific priorities and goals is essential to mock the success of other countries in wastewater reutilization. Strategic goals and long-term planning render the whole process much clearer, narrowing the focus to most important objectives. Additionally, comprehensive guidelines may yield improved decision-making, leading to the best course of actions. Setting priorities, in turn, may impede waste of valuable resources. Given unique issues with Uzbekistan's climate and economic troubles, minimizing input and maximizing output is important not only for adoption of wastewater management strategies, but also for the state's overall sustainable development. Furthermore, thorough planning may help the country bypass various challenges. Complying with international water standards, for example, may reduce possible health risks such as contamination. Technological appropriateness can also be evaluated through careful planning, and a comprehensive set of goals may prioritize the best technological advances aligning to Uzbekistan's current infrastructure. Therefore, integration of wastewater reclamation concept into

a broader water management planning could help Uzbekistan reserve a place as an international wastewater reuse practitioner.

Government's role in fostering collaboration with stakeholders and raising public awareness about the benefits of wastewater reuse is of paramount importance. Alignment of priorities between policymakers, industries, and communities can be reached by effectively engaging stakeholders, while public education campaigns sort out misconceptions and gain trust in reclaimed water systems. For instance, have had a positive impact on people's perception about wastewater reuse government-led awareness campaigns in Australia systems, showcasing the influence of proactive strategies[19]. In Uzbekistan, public awareness of wastewater reuse and its benefits are currently capped. This gap demonstrated the urgent need for government-led initiatives to educate citizens and have stakeholders involved. Existing efforts have largely been concentrated on agricultural water management, leaving a gap in public outreach specifically to wastewater reuse. To further enhance stakeholder engagement, the government could implement targeted campaigns, workshops, and community programs. Collaborating with local organizations, media influencers, and academic institutions can also amplify these efforts. This would assist in building public trust and ensuring the successful adoption of wastewater reuse initiatives.

Governments role is undeniably pivotal in advancing wastewater reuse by developing stringent policies, having to ensure adequate investment, and fostering public acceptance. These efforts are critical in shaping sustainable water management systems and solving the growing water scarcity challenges. For Uzbekistan, to realize the full potential of wastewater reuse, proactive government action is essential. Strategic policy development, increased investment, and comprehensive stakeholder engagement can completely transform current challenges into opportunities. By prioritizing wastewater reuse initiatives, Uzbekistan's government has the potential to address water scarcity, promote environmental sustainability, and secure a resilient future for its citizens.

Conclusion

This study has explored the feasibility of implementing wastewater reuse in Uzbekistan, focusing on the success from other countries. Climate conditions, economic state, and public attitude were also taken into account. Worldwide, countries like Israel, China, India, and many European nations have implemented concise water management strategies. Facing similar challenges, those countries have demonstrated the feasibility of wastewater reuse strategies. Israel, for example, is an arid region with 60% of its land covered by desert. Though, by adopting wastewater reuse strategies, it is now producing 20% more water than needed for a sustainable development of a country. Example of Israel in water management demonstrates that with technological innovations, water scarcity can easily be mitigated[20]. China, similarly to Uzbekistan, is facing water shortages because of its fast-growing population. Beijing – one of the most water-demanding regions of China – has embraced wastewater reuse on both residential and industrial scale[21]. Making use of one of the largest water treatment networks in the world, Beijing is planning to recycle 100% of its wastewater. To repeat the international success of those countries, Uzbekistan must prioritize regulatory frameworks, carefully planned investments, and public education.

This research highlights the potential of Uzbekistan to implement wastewater reuse strategies to address the country's short supply of pure water. By leveraging international practices and adopting globally successful technologies and innovations, Uzbekistan could be able to cope with

the constantly growing need for freshwater, while developing the other sectors sustainably. While there are plethora of benefits from reusing wastewater, limitations should be taken into account. The lack of funding and public trust may significantly influence manageability of the project, though with proper planning and campaigns launched to enhance public awareness, success is quite achievable. Concise wastewater management offers a valuable solution for Uzbekistan to lessen the growing impact of water scarcity. Therefore, immediate actions should be taken to guarantee a secure and prosperous future for upcoming generations.

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