Entry to the Stockholm Junior Water Prize 2023

Eco-Friendly and Cost-Effective Water Purification for Highly Polluted and Saline Sources Using Solar Powered Distillation and Activated Carbon.

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I. Abstract:

The research project focuses on addressing the household water crisis in Bangladesh by utilizing abundant water sources and energy resources. It involves developing and implementing a solar-powered distillation and activated carbon treatment system. By harnessing solar energy and local resources, the system effectively treats highly saline water bodies and arsenic-contaminated tube wells, mitigating the adverse effects of salinity and arsenic contamination in water sources. The project aims to provide clean and safe drinking water to households facing water scarcity and contamination. The study highlights the system's ability to remove pollutants, heavy metals, bacteria, viruses, and salinity, addressing the immediate needs of affected communities. By utilizing abandoned energy resources and producing activated carbon locally, the project promotes resource optimization and sustainability. Additionally, the research findings indicate the system's versatility in treating various polluted water sources, demonstrating its potential for scalability and widespread adoption beyond arsenic-contaminated sources. This innovative solution has the potential to revolutionize water purification techniques and offer a sustainable remedy for global water-related challenges. The successful implementation of solar-powered distillation and activated carbon treatment systems has significant implications for solving the household water crisis in Bangladesh. By utilizing abandoned resources, both in terms of water sources and energy, the project provides a practical and efficient approach to addressing water scarcity and contamination.

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II. Key Words:

1. Household water crisis
2. Abandoned water sources
3. Abandoned energy resources
4. Solar-powered distillation
5. Activated carbon treatment system
6. Cost-effectiveness
7. Salinity
8. Sustainability
9. Eco-friendly
10. Public health
11. Arsenic contamination
12. Resource optimization

III. Abbreviations and Acronyms:

1. BOD (Biological Oxygen Demand)
2. COD (Chemical Oxygen Demand)
4. EC (Electrical Conductivity)
5. DPHE (Department of Public Health Engineering)
5. TDS (Total Dissolved Solids)
3. DO (Dissolved Oxygen)
8. As (Arsenic)

IV. Acknowledgements:

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We would like to express our deep appreciation to our teacher, Mr. Bipul Chandra Mandal, S.M Afik Hassan for inspiring and motivating us to explore innovative solutions to real-world problems. His guidance and mentorship have played a crucial role in shaping our research project.

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V. Biography:

Author: Alman Sikder Institution: BNMPC;

Alman Sikder, a talented Class XII student, is passionate about Physics and Mathematics. He has a strong interest in science and enjoys exploring new concepts and applying them in practical projects. Alman has experience in building science projects and demonstrates a remarkable understanding of complex scientific concepts. He is also an enthusiastic learner and actively develops his coding and programming skills. Alongside his academic pursuits, Alman enjoys cycling, reading, and writing poetry. He embraces calculated risks and embraces life to the fullest. With his ambition, hard work, and dedication to science and technology, Alman is poised for a successful career in the field.

Author: Mir Mohammad Ali; Institution: BNMPC;

Mir Mohammad Ali is a diligent and disciplined team member with a passion for exploration and extracurricular activities. He is always eager to learn new things and has a natural curiosity about the world around him. His enthusiasm for discovery extends to his work, where he approaches every project with a sense of wonder and a desire to find innovative solutions. In addition to his intellectual pursuits, Mir Mohammad Ali is also an accomplished. He believes that a well-rounded education includes both academic and non-academic activities, and he works tirelessly to excel in both. His discipline and dedication make him a valuable asset to any team. He has a strong work ethic and is committed to achieving his goals, no matter how challenging they may be. Mir Mohammad Ali's passion for exploration, coupled with his commitment to excellence, makes him an ideal collaborator for any project.

Introduction

Access to clean and safe drinking water is a formidable challenge for households in Bangladesh, exacerbating the water crisis and impacting public health. The presence of salinity and arsenic in water sources further compounds this issue, necessitating an urgent and sustainable solution. Our research project aims to address these critical challenges by developing a robust, cost-effective, and environmentally friendly water filtration system. The people living on the coast of Bangladesh rely on three significant international rivers, as well as rainfall and groundwater, as the primary sources of freshwater in the region [1]. The severe water crisis in Bangladesh has been exacerbated by the adverse impacts of climate change, including salinity intrusion, arsenic contamination, drought, and cyclones [1].

Household water scarcity due to salinity and arsenic in Bangladesh presents a dire situation. The intrusion of saline water into coastal areas and the presence of high levels of arsenic in groundwater have resulted in the limited availability of safe drinking water. This scarcity poses significant challenges to the population, impacting their health and overall quality of life. Different degrees of salinity affect approximately 53% of the coastal region in Bangladesh [2]. The consumption of saline water can lead to dehydration, electrolyte imbalances, and kidney problems, while long-term exposure to arsenic-contaminated water can cause severe health issues, including skin lesions, various cancers, and organ damage. The gravity of the situation calls for immediate attention and effective solutions to address the household water scarcity crisis. Resolving this issue is paramount to improving well-being and ensuring a healthier future for millions of people in Bangladesh who currently depend on contaminated water sources for their daily needs. The global population faces a significant health risk as millions of people are currently exposed to high concentrations of arsenic in their drinking water, increasing the likelihood of developing serious health issues [3]. Due to the scarcity of safe alternative water sources, the urgent need for treating arsenic-contaminated water is evident in many areas [3].

Our project focuses on harnessing abandoned energy sources and utilizing local resources to develop a highly efficient water filtration system. By employing a parabolic sunlight reflector, we concentrate solar energy onto a purpose-built boiler, heating the water and generating steam. This steam is then condensed back into purified water through a cooling process in a condensing pipe. To eliminate impurities, activated carbon derived from abundant coconut shells is used as a powerful filter.

This innovative system mirrors the natural water cycle, effectively removing salinity and contaminants and producing clean, safe drinking water. By leveraging abandoned energy sources and local resources, our solution offers affordability, sustainability, and scalability. The system's environmental benefits are significant, as it relies on renewable solar energy and utilizes locally available activated carbon.

To optimize the system's performance and impact, further research and development are essential. Our goal is to enhance scalability, efficiency, and cost-effectiveness to meet the needs of households throughout Bangladesh. By effectively addressing the salinity and arsenic crises, our water filtration system has the potential to transform lives, improve public health, and empower communities across the country.

In summary, our research project endeavors to tackle the pressing water crisis in Bangladesh by developing a sustainable and efficient water filtration system. By focusing on salinity and arsenic problems, we aim to provide safe drinking water to households in need, mitigating waterborne diseases and fatalities. Through our innovative approach, leveraging abandoned energy sources and local resources, we strive to make a lasting impact on the lives of millions, contributing to a healthier and more prosperous future for Bangladesh.

Materials and Methods:

Materials used in the project include:

1. Parabolic TV dish - used to reflect sunlight onto the boiler.
2. Foil paper tape - used to cover the parabolic dish to increase the reflectivity of sunlight.
3. Transparent glass jar - used as a boiler to heat the contaminated water.
4. Black-painted metal shavings – used inside the jar to convert sunlight into heat.
5. Foldable steel pipe - used as a condenser to cool and condense the steam from the boiler.
6. Bucket - used to work as a cooler by filling it with cold water.
7. Activated coconut shell carbon - used to filter the water further to remove any remaining impurities.
8. Filter paper - used to filter out any fine particulate matter that may still be present in the water after passing through the carbon filter.
9. Coconut shell – abundant coconut shell was used to create the activated carbon.

All of these materials were chosen for their availability, low cost, and effectiveness in creating a solar-powered water distillation system and activated carbon.

The methodology for this study involved the following steps:

1. **<u>Sampling:</u>** Water samples were collected from various sources, including an arsenic-containing tube well [12], the highly polluted Buri Ganga River [11], the saline Rupsha River [9], and the highly saline Bay of Bengal [10], to test the effectiveness of the solar-powered distillation system in removing contaminants from different water sources. The locations were selected based on their levels of salinity, arsenic contamination, and pollution. The water samples were collected in sterile containers to ensure there was no post-contamination.

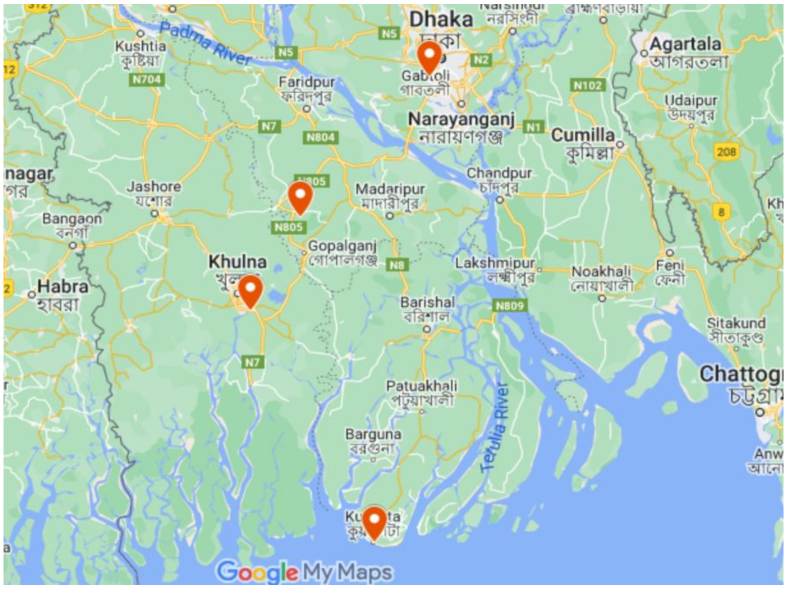

Figure 01: *Sampling Map Source (Google map).*

Pictures of Sampling Sites

Figure 02: Arsenic Tube Well.

Figure 03: Polluted Buri Ganga River.

Figure 04: Saline Rupsha River.

Figure 05: Highly Saline Bay of Bengal.

2. **Solar-Powered Distillation Process:** The collected water samples were treated with a solar-powered distillation to remove harmful substances such as salinity, arsenic, heavy metals, oil, bacteria, and viruses. The predicted monthly average daily radiation in Bangladesh is 4.36 kWh/m2 [4]. And the distillation process was carried out from 9 a.m. to 4 p.m., when there was enough sunlight to power the parabolic reflector [5]. The first 100 mL of water was not collected to ensure that any harmful substances that vaporized before the water did not get mixed with the treated water.

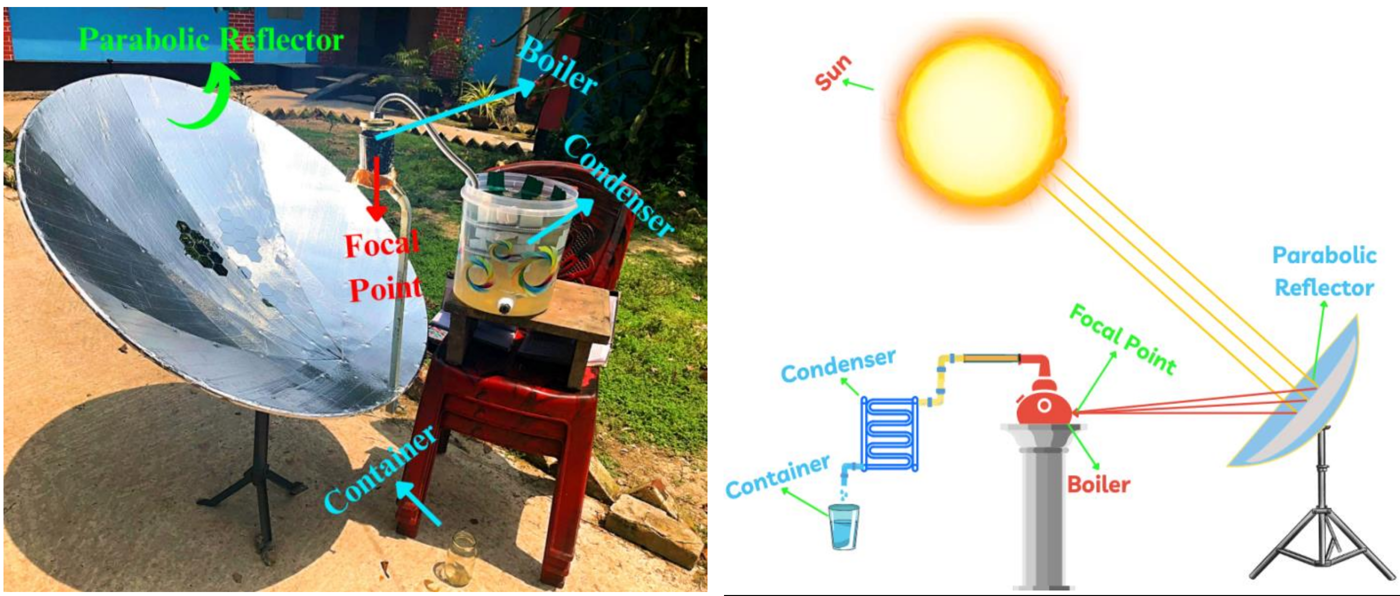

Figure 06: ***Solar Powered Distillation System with Parabolic Sunlight Reflector (prototype & design).***

3. **Activated Coconut Shell Carbon Treatment:** The collected water was further treated with activated coconut shell carbon [6] to remove any additional harmful substances such as oil and odor.

Figure 07: ***Activated Coconut Shell Carbon.***

4. **Analysis:** The treated water samples were analyzed using digital meters for pH, temperature, TDS, EC, and salinity. Additional tests such as BOD, COD, DO, and arsenic [7] were carried out in our college lab.
5. **Quality Control:** To ensure the accuracy of the results, blank samples were included in the analysis to control for any laboratory contamination. The analysis was repeated three times for each water sample.
6. **Data Analysis:** The results of the water analysis were recorded and analyzed using statistical software to determine the effectiveness of the solar-powered distillation system and activated coconut shell carbon treatment in removing different types of contaminants.
7. **Limitations:** The study had some limitations, including the fact that the parabolic sunlight reflector used in this project was not properly parabolic, resulting in scattered light that had a lower efficiency. And the prototype can't work in the absence of sunlight.

Overall, this study demonstrates the potential of solar-powered distillation systems and activated coconut shell carbon treatment for removing salinity and other harmful substances from water. The study also highlights the need for further research to improve the efficiency and cost-effectiveness of such systems.

Results:

The results of the study indicate that the solar-powered distillation system and activated coconut shell carbon treatment were highly effective in producing drinkable water [8]. The treated water samples exhibited a significant reduction in various parameters, including pH, TDS, EC, DO, BOD, COD, salinity, and arsenic, making them safe for consumption.

The pH values of the treated samples were found to be close to neutral, aligning with the recommended range of 6.5-8.5 by Bangladesh Standards for Drinking Water [8]. Furthermore, the levels of Total Dissolved Solids (TDS) and Electrical Conductivity (EC) were significantly reduced in all treated samples, bringing them within acceptable limits [8]. The solar-powered distillation system and activated carbon treatment were successful in improving the water quality by removing impurities and dissolved solids.

The treated samples exhibited notable improvements in dissolved oxygen (DO) levels within three days of treatment compared to the initial values. This improvement indicates the effective removal of organic matter and pollutants, leading to improved oxygen content in the water. Additionally, the levels of Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were significantly reduced after treatment, indicating a substantial decrease in organic pollutants.

The salinity levels in the water samples from the Rupsha River and the Bay of Bengal were initially very high [09] [10]. However, the treatment process successfully reduced the salinity levels to acceptable ranges, indicating the removal of dissolved salts. The activated coconut shell carbon treatment also proved effective in eliminating additional harmful substances such as oil, resulting in an improved taste and odor of the water.

Table 1 shows the quality of the water samples before and after treatment, including parameters such as pH, temperature, TDS, EC, DO, BOD, COD, salinity, and arsenic.

Water Sample	Temperature (°C)	pH	DO (mg/L)	TDS (ppm)	EC (μS/cm)	BOD (mg/L)	COD (mg/L)	Salinity (ppm)	As (mg/L)
Bangladesh Standards	---	6.5-8.5	6.5-8	<500	<1000	<6	<10	<600	<10
Tube Well Before	24.3	6.22	3.21	542	1041	---	---	539	66.5
Tube Well After	23.6	7.28	7.30	32	50	---	---	32	6.7
Buri Ganga River Before	24	6.43	2.3	582	1548	53	267	578	2.1
Buri Ganga River After	23.9	6.88	6.6	18	43	0.034	0.23	18	1.0
Rupsha River Before	23	8.78	6.4	8297	16280	4.3	129	8740	5.76
Rupsha River After	24.7	7.1	6.98	21	51	0.017	0.12	21	2.3
Bay of Bengal Before	22.4	7.73	7.8	32892	53971	2.14	24.42	33497	15
Bay of Bengal After	24.6	7.06	7.21	28	53	0.012	0.13	28	3.2

Table 1: Quality of the water samples before and after the treatment.

The graphs show the effectiveness of the project within these parameters from the above table.

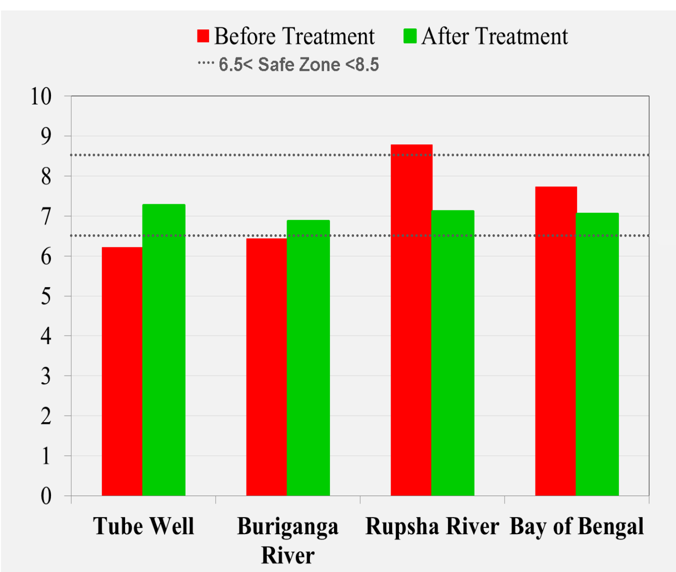

Figure 08: *pH (Source: Table-1)*

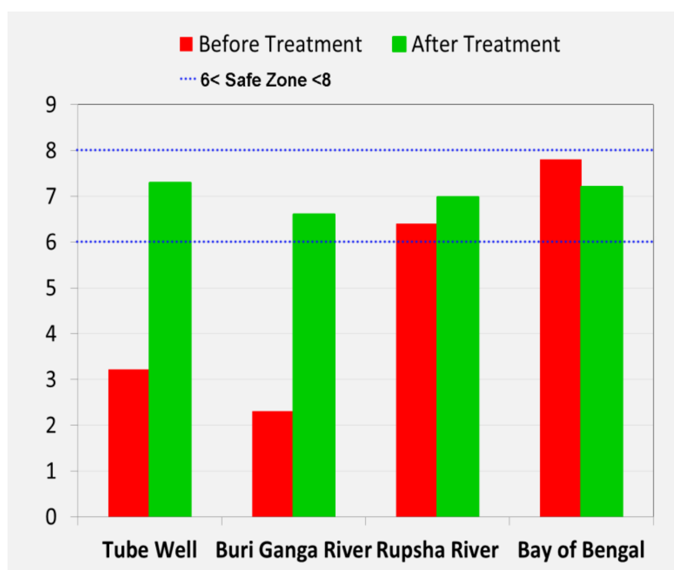

Figure 09: *DO in mg/L (Source: Table-1)*

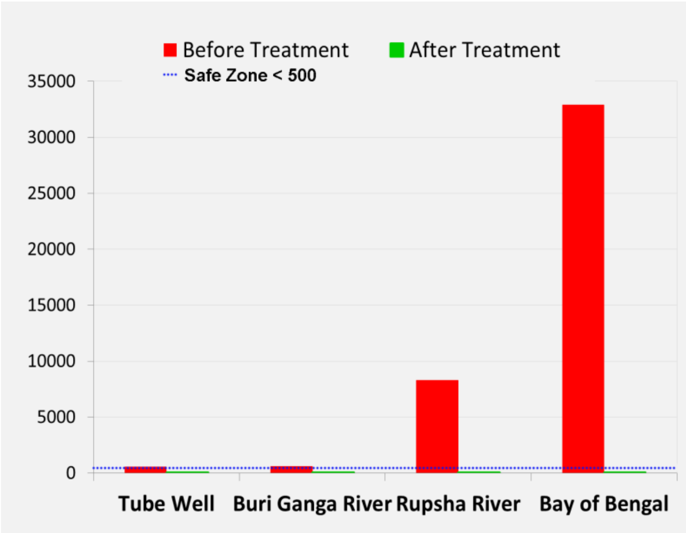

Figure 10: *TDS in ppm (Source: Table-1)*

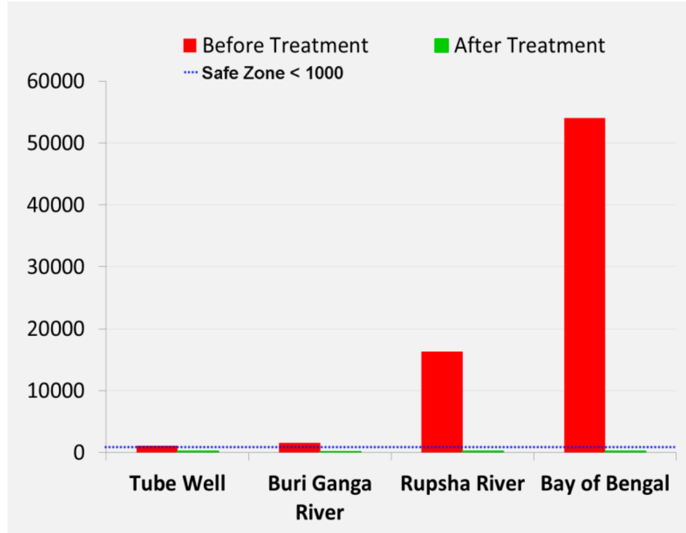

Figure 11: *EC in μS/cm (Source: Table-1)*

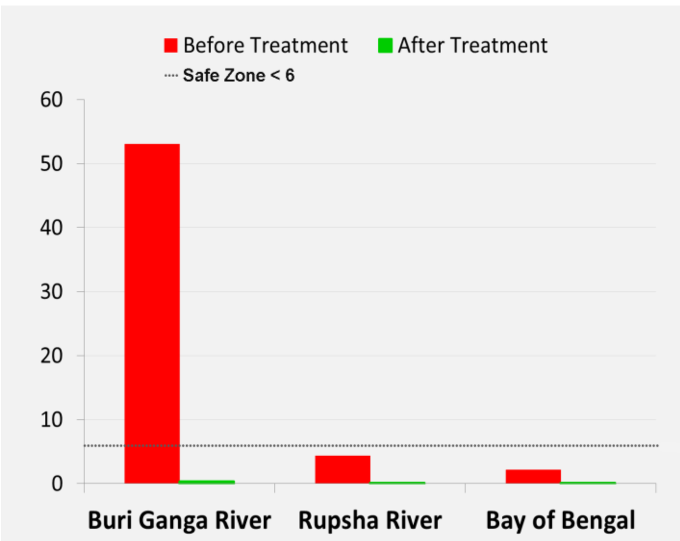

Figure 12: *BOD in mg/L (Source: Table-1)*

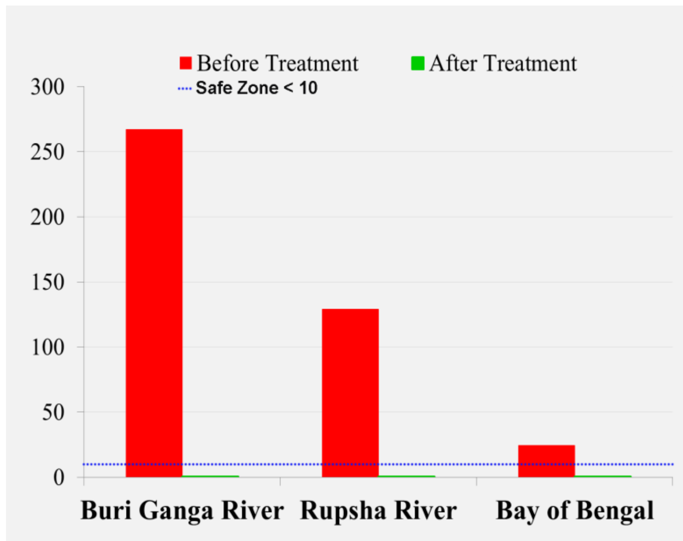

Figure 13: *COD in mg/L (Source: Table-1)*

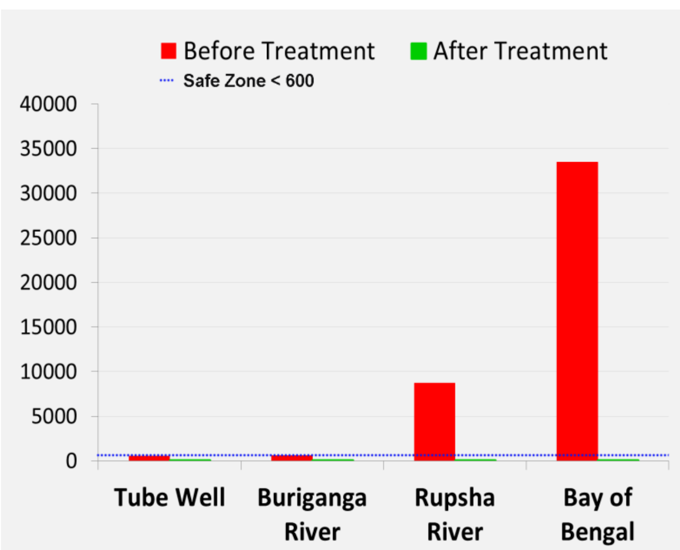

Figure 14: *Salinity in ppm (Source: Table-1)*

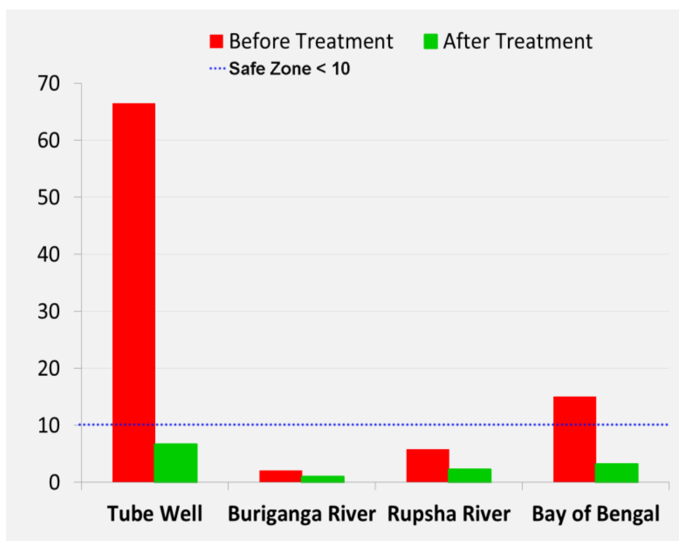

Figure 15: *Arsenic in mg/L (Source: Table-1)*

1. **pH:** The pH values of the water samples ranged from 6.22 to 8.78. The WHO standards recommend a pH range of 6.5-8.5 for drinking water. After treatment, the pH values of the samples shifted toward the neutral range [8], with values ranging from 6.88 to 7.28.
2. **DO (mg/L):** The DO levels indicate the amount of dissolved oxygen in the water, which is crucial for aquatic life [14]. The initial DO levels varied between 2.3 mg/L and 7.8 mg/L. After treatment, the DO levels increased, ranging from 6.6 mg/L to 7.3 mg/L, indicating an improvement in water quality.
3. **TDS and EC:** Total dissolved solids (TDS) and electrical conductivity (EC) are indicators of water salinity and the presence of dissolved substances [8]. The initial TDS levels ranged from 18 ppm to 32,892 ppm, and the EC levels ranged from 43 µS/ cm to 53,971 µS/cm. After treatment, there was a significant reduction in both TDS and EC levels, indicating a decrease in salinity and the removal of dissolved substances.
4. **BOD and COD:** BOD and COD are measures of organic pollution in water. The initial BOD and COD levels varied between 0.034 mg/L to 53 mg/L and 0.12 mg/L to 267 mg/L, respectively. After treatment, there was a substantial decrease in both BOD and COD levels, indicating a reduction in organic pollutants [8].
5. **Salinity:** Salinity levels in the samples ranged from 18 ppm to 33,497 ppm before treatment. After treatment, the salinity levels decreased significantly, ranging from 18 ppm to 32 ppm.
6. **Arsenic:** The initial arsenic levels varied from 1.0 mg/L to 66.5 mg/L. After treatment, the levels decreased to a range of 1.0 mg/L to 6.7 mg/L, indicating a successful reduction in arsenic contamination.

The analysis of different parameters demonstrates the effectiveness of the treatment process in improving water quality. The treatment resulted in pH levels within the WHO standards, increased dissolved oxygen levels, and decreased levels of TDS, EC, BOD, COD, salinity, and arsenic. These improvements signify the successful treatment of water sources contaminated with salinity, arsenic, and other pollutants, making the water safer for consumption and reducing potential health risks [14].

Before and After Pictures of the Treated Water Sample

Figure 16: *Tube Well Water*

Figure 17: *Buri Ganga River's Water*

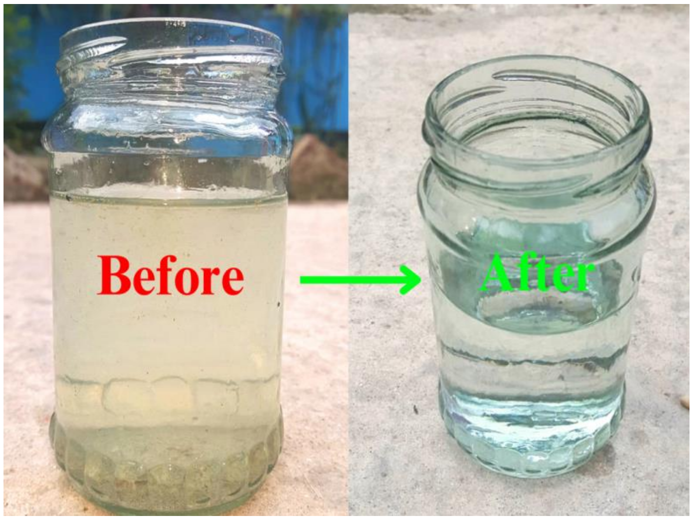

Figure 18: *Rupsha River's Water*

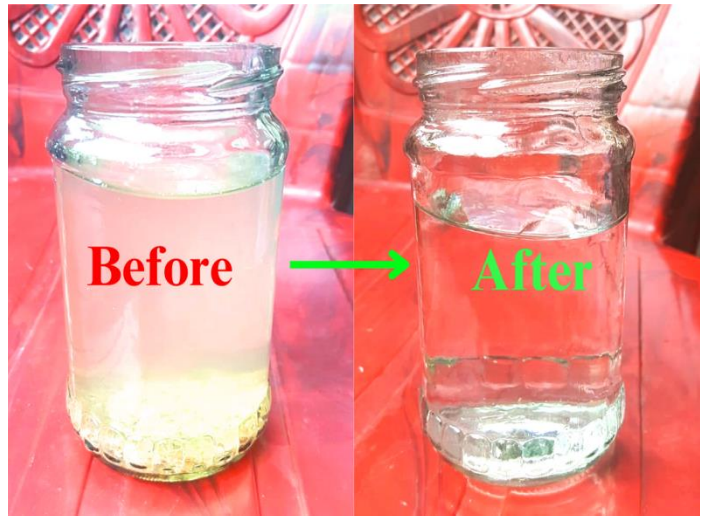

Figure 19: *Bay of Bengal's Water*

Residuals after Distillation

Figure 20: *Residue of Buri Ganga Water*

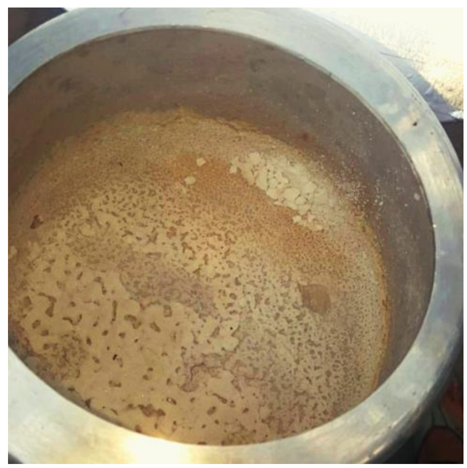

Figure 21: *Residue of Bay of Bengal Water.*

Figure 22: *Residue of Rupsha River Water*

Discussion:

The solar-powered distillation system coupled with activated carbon treatment represents a promising solution to address the pressing global water crisis. This section provides an overview of the project's objectives, the design and operation of the prototype, the system's eco-friendliness and cost-effectiveness, comparison, data analysis, estimation of daily distilled water production using a 5 square meter parabolic reflector, and an assessment of the system's advantages and disadvantages.

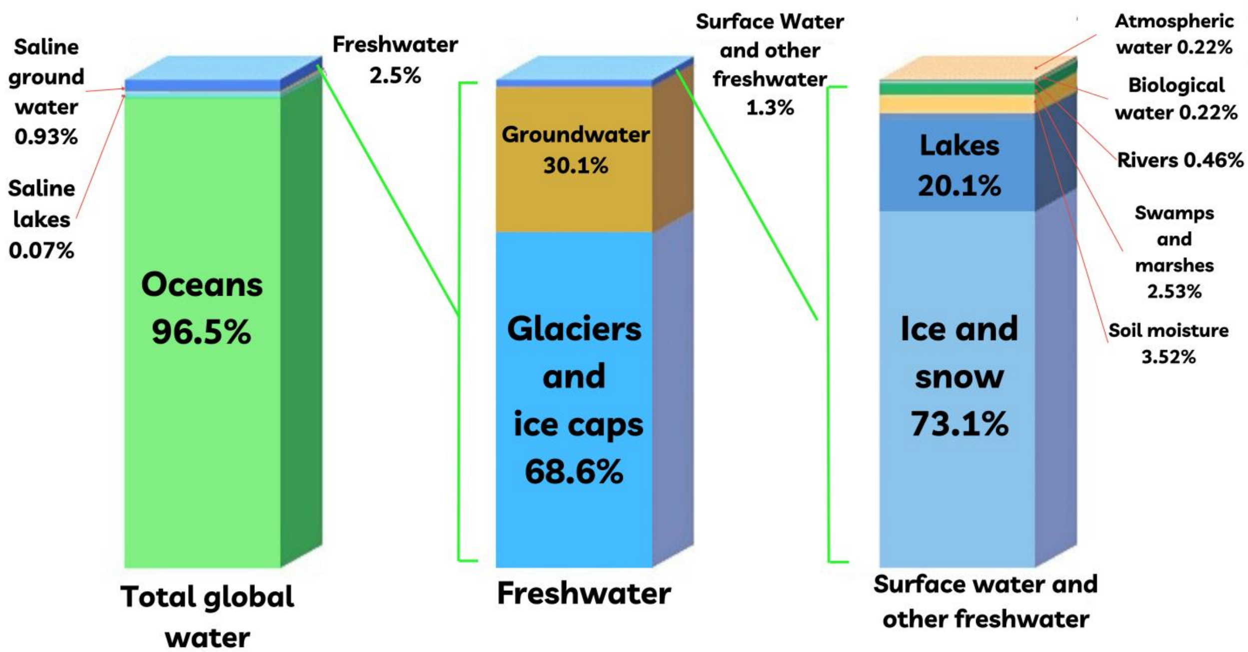

Figure 23: *Distribution of Earth's Water* Source [24].

Project Objectives:

The objective of this project is to tackle the significant household problem of salinity and arsenic contamination in water sources, with a particular focus on Bangladesh [15], [12]. The country is grappling with a dire situation where a large population lacks access to clean drinking water due to high levels of salinity [15] and arsenic in their water sources. The project aims to address this crisis by implementing a solar-powered distillation and activated carbon treatment system.

Through the utilization of renewable energy sources and the application of advanced treatment technologies, the project seeks to provide a sustainable and cost-effective solution to improve water quality. By removing harmful contaminants such as salinity and arsenic, the system aims to ensure that households have access to clean and safe drinking water. This, in turn, will help mitigate the risks of waterborne diseases and improve the overall health and well-being of the affected population.

By focusing on the specific challenges of salinity and arsenic contamination, the project aims to make a meaningful impact on alleviating water scarcity and improving the quality of life for millions of people [14].

Design and Operation:

The prototype system uses a transparent glass jar and a parabolic reflector to focus sunlight. Inside the jar, black metal shavings absorb the sunlight, converting it into heat [16]. The water inside the jar vaporizes as it reaches its boiling point and travels through a coiled steel pipe. The steam condenses back into liquid form in a bucket of cold water, resulting in pure water [17]. The collected water is further treated with activated carbon to remove any remaining impurities. This solar-powered distillation system effectively harnesses sunlight to produce clean and safe drinking water.

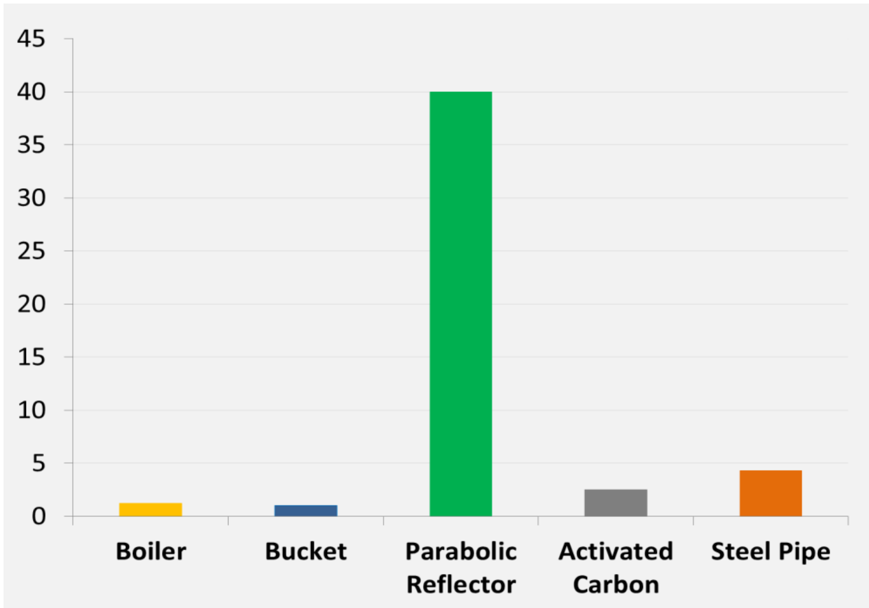

Figure 24: *Cost analysis of the prototype in USD*

Eco-Friendly and Cost-Effective:

The solar-powered distillation and activated carbon treatment system is eco-friendly due to its utilization of renewable solar energy, reducing carbon emissions, and promoting environmental sustainability [18]. Additionally, the system operates without the use of chemicals or harmful substances, making it a clean and environmentally responsible solution for treating water. By incorporating eco-friendly design principles and harnessing natural resources, this system represents an environmentally conscious approach to addressing water scarcity and contamination, contributing to a healthier and greener future.

The cost analysis of the prototype revealed that the total expenditure for the components was as follows: boiler ($1.2), cooler ($1), steel pipe ($4.3), activated carbon ($2.5), and reflector ($40). Despite the initial investment, the system proves to be cost-effective in the long run. The use of renewable solar energy eliminates ongoing energy expenses, reducing operational costs significantly. Additionally, the low maintenance requirements contribute to further cost savings. The combination of affordable components and minimal operational expenses makes the solar-powered distillation and activated carbon treatment system a cost-effective solution for providing clean and safe drinking water.

Comparing Solar-Powered Distillation with Salinity Treatment Systems:

Existing salinity treatment methods, such as Reverse Osmosis (RO) [20], Electrodialysis [20], and ion-exchange [21] processes, have notable limitations. RO systems are energy-intensive, requiring significant electricity consumption, while Electrodialysis systems are also energy-intensive and require complex infrastructure. Ion-exchange processes often involve the use of chemicals that can be costly and environmentally harmful.

In contrast, the solar-powered distillation and activated carbon treatment system offer a more sustainable and cost-effective solution. By harnessing solar energy, it eliminates the need for electricity or chemicals, reducing both operational costs and environmental impact. Its reliance on renewable energy sets it apart from conventional methods, including Electrodialysis, and provides a greener alternative for salinity treatment.

Quality Analysis:

The parameters measured include pH, DO, TDS, EC, BOD, COD, salinity, and arsenic. Bangladesh's water quality standards for these parameters are also provided.

Overall, the results demonstrate that the system is highly effective in reducing the levels of contaminants in the water. The most significant reductions were observed in the Bay of Bengal sample, with TDS levels decreasing from 32,892 ppm to 28 ppm, EC levels from 53,971 µS/cm to 53 µS/cm, and salinity levels from 33,497 ppm to 28 ppm. These reductions represent a decrease of more than 99.91% for TDS and EC levels and a decrease of more than 99.9% for salinity levels. The Tube Well water sample also showed substantial improvements, with an 89.92% reduction in arsenic levels from 66.5 mg/L to 6.7 mg/L. The Rupsha River sample showed a decrease of 99.972% in BOD levels, from 4.3 mg/L to 0.12 mg/L. Overall, the quality of the treated water was 97.36% pure based on the above parameters.

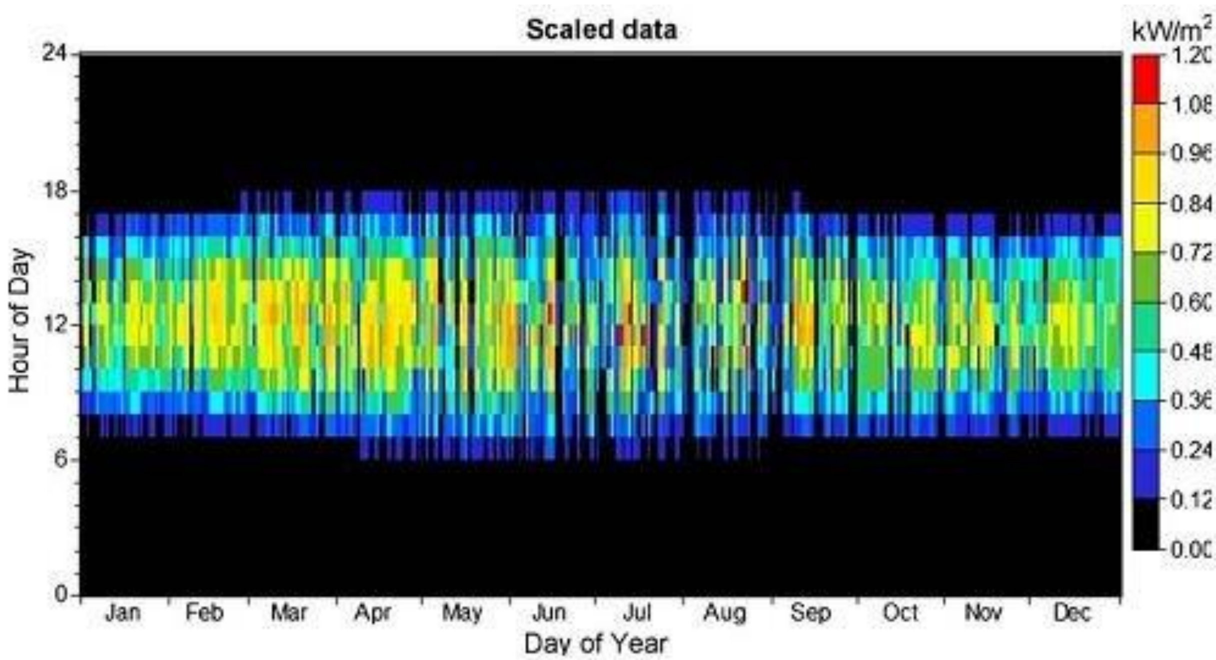

Figure 25: Monthly average sunshine hours in Bangladesh [22].

Estimation of Daily Distilled Water Production:

A 5 square meter parabolic reflector distills water with 80% efficiency in generating solar energy, and 60% of the generated energy is used by the water in the boiler. The energy needed to distill 1 gram of water is approximately 2594.8 J/g. On average, we get 4.5 kWh/m2 in Bangladesh [22].

Total solar energy received: 5 * 4.5 = 22.5 kWh
Energy generated by the reflector: 22.5 * 0.8 = 18 kWh
Energy used by the water: 18 * 0.6 = 10.8 kWh
Convert to Joules: 10.8 * 3,600,000 = 38,880,000 J

Amount of water: 38,880,000 / 2594.8 ≈ 14,986 g

Advantages:

1. Highly effective: The distillation process removes up to 99.9% of contaminants, including bacteria and viruses [23].
2. Consistent water quality: Distillation collects only pure steam, ensuring consistent high-quality water with no drop in quality over time [23].
3. Reliability: Long lifespan and no physical barriers that can break down or fail.
4. Versatility: The quality of distilled water is independent of source water quality, making it a versatile solution for various water contamination problems [23].
5. Endorsed by experts: Recommended by doctors and nutritionists and endorsed in various publications.
6. Scalable: Adaptable to different capacities, from small-scale household use to larger community systems.
7. Adaptability: Treats various water sources, including highly saline, arsenic-contaminated, and polluted ones.
8. Cost-effective & Eco-friendly: The system offers a cost-effective and eco-friendly solution by requiring low initial investment and minimal maintenance while operating using renewable solar energy and avoiding the use of chemicals or harmful substances.

Disadvantages:

- Sunlight Dependency: One limitation of the solar-powered distillation system is its reliance on sunlight, which can vary depending on the weather and season. This variability may limit the system's efficiency and applicability in certain geographic locations or during specific times of the year.
- Initial Setup Cost: Although the overall cost of the system is low, there may be initial setup expenses that could pose a challenge for users with limited resources. However, the long lifespan and minimal maintenance requirements of the system can ultimately lead to cost savings in the long run.

Future Research:

While solar-powered distillation and activated carbon treatment systems show great promise in addressing the global water crisis, further research is necessary to optimize its effectiveness and applicability. Potential areas of research could include:

1. Integration of energy storage solutions: To overcome the dependence on sunlight, it is essential to integrate energy storage solutions that will maintain the system's functionality during periods of low sunlight availability.
2. Assessment of the system's long-term durability: Research is required to evaluate the system's long-term durability and optimize maintenance protocols.
3. Exploration of alternative materials and designs: The development of alternative materials and designs for the parabolic sunlight reflector and other components could reduce costs and improve efficiency.

Conclusion:

In conclusion, the solar-powered distillation and activated carbon treatment systems represent a promising and sustainable solution to address the household problem of salinity and arsenic contamination in Bangladesh. With millions of people lacking access to clean drinking water and facing the devastating consequences of waterborne diseases, this innovative technology offers a reliable and effective approach to purifying water from highly saline and arsenic-contaminated sources.

By harnessing the power of the sun and utilizing locally sourced activated carbon, this system provides an eco-friendly and sustainable solution. The solar-powered distillation process utilizes renewable energy, reducing reliance on conventional energy sources and minimizing the carbon footprint. Additionally, the use of activated carbon effectively removes contaminants such as arsenic, ensuring the production of safe and drinkable water.

Moreover, the cost-effectiveness of this system makes it a viable option for widespread implementation. Compared to other treatment methods like reverse osmosis or UV systems, solar-powered distillation and activated carbon treatment offer a more affordable and efficient solution. The low energy requirements and minimal maintenance contribute to the system's long-term viability and accessibility for communities facing water scarcity.

By addressing the household problems of salinity and arsenic, this technology can significantly improve the quality of life for affected communities. Access to clean and safe drinking water will reduce the prevalence of waterborne diseases, particularly among vulnerable groups like children. The system's scalability and potential for widespread implementation offer hope for addressing the water crisis not only in Bangladesh but also in other regions facing similar challenges.

Investing in further research, development, and deployment of the solar-powered distillation and activated carbon treatment systems will pave the way for a more sustainable future. By ensuring universal access to clean and safe drinking water, we can protect the health and well-being of countless individuals, promote economic development, and create resilient and thriving communities.

In summary, the solar-powered distillation and activated carbon treatment systems present a reliable, eco-friendly, cost-effective, and scalable solution to the household problem of salinity and arsenic contamination. By embracing this innovative technology, we can bring about positive change, improve lives, and work towards a future where clean drinking water is accessible to all.

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