



CASE STUDY



EGYPT

Developing Smart Decentralised Sanitation Solutions in Egypt

The GSMA Innovation Fund for Climate Resilience and Adaptation

The GSMA Innovation Fund grant for BENAA has assisted in deploying smart decentralised wastewater treatment and reuse systems that turn sewage into safe irrigation water.

Country: Egypt

Sector: Water, Sanitation and Hygiene

Business model: B2C, B2G

Resilience capacity: Climate adaptation, natural resource management and environment

Digital channels: IoT devices, mobile app, mobile money payments

Problem addressed: Providing small rural communities in Egypt with a smart solar-powered decentralised wastewater treatment solution that recycles water for agricultural use to reduce pollution and alleviate water scarcity

Stakeholders: Individual smallholder farmers, agricultural workers, families that use the wastewater treatment units, governorates and the National Water Research Authority

Find out more: benaafoundation.org

**BENAA PROJECT OUTCOMES
NOVEMBER 2022 TO JUNE 2024**



10

Internet of Things (IoT) **wastewater treatment** units installed



21,180

people reached, benefitting from wastewater treatment units



2,236

farmers onboarded to an app-based agri-advisory service that helps them adapt to climate change



50,4m

litres of wastewater **treated and reused for irrigation**



During the GSMA grant period, BENAA Foundation unlocked an **additional US \$505,000 in investment** from other sources

About BENAA Foundation

Launched in 2015, BENAA began as an initiative aimed at empowering communities to achieve sustainable and inclusive development in Egypt and the Middle East and North Africa region through knowledge-based, youth-led sustainable development projects.

Registered as a non-governmental organisation in 2017, BENAA's efforts are primarily focused on small rural communities called Ezbas, which are residential clusters on the fringes of agricultural land. These locations often lack access to central infrastructure provided by the government, such as sanitation systems. The absence of adequate sanitation facilities contributes to significant soil, surface and groundwater pollution, leading to the proliferation of waterborne diseases and food contamination. Furthermore, these communities face escalating water shortages due to climate change, which severely impacts water resource availability.

To address the dual challenge of enhancing sanitation services and optimising water reuse, the BENAA Foundation has introduced solar-powered decentralised wastewater treatment units called SuWaCo that convert wastewater into safe irrigation water. These units help increase the water budget for irrigation in the area and reduce wastewater pollution, leading to improved water, food and environmental quality.



Introduction

Impacts of climate change on rural communities

Egypt is facing significant challenges due to climate change. Over the past 30 years, annual temperatures have increased by approximately 0.5°C per decade, which has had severe implications for human health, livestock and crops.¹ Additionally, precipitation in Egypt has also become less predictable, with annual rainfall decreasing by 22% in the last 30 years.²

This decline is particularly concerning for dry-land farmers who rely on rainwater for irrigation. This combination of high temperatures and decreased rainfall is expected to lead to more frequent and severe droughts, especially in Egypt's drier areas. The country is already experiencing climate change-induced water shortages, with an annual water deficit of seven billion cubic metres.³ This scarcity affects the agriculture sector, which consumes roughly 80% of Egypt's water.⁴ The resilience of rural communities is under threat as they depend heavily on agriculture for their livelihoods and incomes.

Egypt also faces significant challenges in sanitation and water management, particularly in rural areas where only about 63% of the population have access to safely managed sanitation services.⁵ Additionally, the country produces 4.4 billion cubic metres of sewage, and a substantial part of this volume is inadequately managed or treated, leading to pollution and water loss.⁶

Shifting from centralised to decentralised wastewater treatment solutions

In Egypt, a paradigm shift is underway from centralised sanitation services to decentralised small-scale wastewater treatment units.⁷ However, this transition is hindered by regulatory challenges, despite efforts from government entities including the Community Participation Taskforce (of which BENAA is a partner).

The current regulatory system does not support decentralised units and a clear participatory management system is absent, limiting their deployment. Decentralised wastewater treatment offers numerous benefits, including localised management, reuse of treated water for irrigation and significant cost savings.⁸ Nevertheless, addressing the regulatory gaps and establishing frameworks for participation is crucial to unlock the full potential of decentralised sanitation solutions in Egypt.

About the GSMA Innovation Fund project

BENAA is one of the start-ups supported by the GSMA Innovation Fund for Climate Resilience and Adaptation, which was launched in 2022. This initiative is funded by the UK Foreign, Commonwealth and Development Office (FCDO) and the Swedish International Development Cooperation Agency (Sida) and is supported by the GSMA and its members.

The project, supported by the Innovation Fund, spanned 20 months from November 2022 to June

2024. During this period, BENAA launched the Digital Water and Sanitation Solution (DWSS) project, which focused on improving the operation, maintenance and usability of its decentralised sanitation units.

By deploying an IoT system within these units, BENAA was able to monitor and analyse the quality of treated wastewater and the concentration of nutrients in it. The IoT system allows the operations team to rapidly respond to any issues with water quality. It also provides farmers with information on the nutrient content of the water via a mobile app, enabling them to optimise fertiliser use.



“

The BENAA community is fostering social innovation for environmental sustainability. We hope to build a sustainable future by empowering, educating and enhancing the skills of youth.

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Aya Tarek Helmy, Co-Founder & Managing Director, BENAA Foundation

1. Hamzawy, A., Al-Mailam, M. & Arkeh, J. (2023). [Climate Change in Egypt: Opportunities and Obstacles](#). Carnegie Endowment for International Peace. (Accessed 20 August 2024).
2. World Bank. (2021). [Climate Risk Country Profile Egypt](#).
3. UNICEF. (n.d.). [Water scarcity in Egypt](#).
4. Hamzawy, A., Al-Mailam, M. & Arkeh, J. (2023). [Climate Change in Egypt: Opportunities and Obstacles](#). Carnegie Endowment for International Peace. (Accessed 20 August 2024).
5. UNICEF. (2023). [Progress on household drinking water, sanitation and hygiene 2000-2022: Special focus on gender](#).
6. International Trade Administration. (2022). [Water and Environment](#). (Accessed 20 August 2024).
7. Sustainable Infrastructure Partnership. (n.d.). [Egypt: Meeting the Sanitation Needs of Rural Communities Through Decentralized Service Provision in Egypt](#). Green Policy Platform.
8. Adelphi. (n.d.). [Promoting Decentralised Wastewater Treatment in Rural Areas in Egypt](#).

How does the solution work?

The DWSS solution has the following components:

- 1 Decentralised wastewater treatment units (SuWaCo):** Solar-powered units transform wastewater into safe irrigation water through an integrated treatment system. This system includes biological treatment, carbon and mechanical filtration, and UV disinfection. The treated wastewater is then released into the irrigation canal, eliminating the need for periodic removal of sewage, which was often untreated and directly discarded into the water canal. The size of the SuWaCo units vary according to the size of the communities that deploy them.
- 2 IoT monitoring systems for SuWaCo:** The IoT system in the SuWaCo unit monitors the quality and usage of the treated wastewater

in real-time. Parameters such as temperature, water flow, ammonia and total dissolved solids (TDS) are tracked. This system allows BENAA to remotely monitor the functioning of the units, improving their ability to anticipate any emerging issue in the units, facilitating timely maintenance and interventions. This saves considerable time and resources compared to manual monitoring of the units, which was putting considerable pressure on the BENAA team.

- 3 Mobile monitoring app:** Detailed information on the amount and composition of nutrients in the discharged treated wastewater is accessible to farmers through a mobile app. This allows them to quickly respond to any issues in water quality and optimise fertiliser use accordingly.

Figure 1
Workflow of the DWSS solution

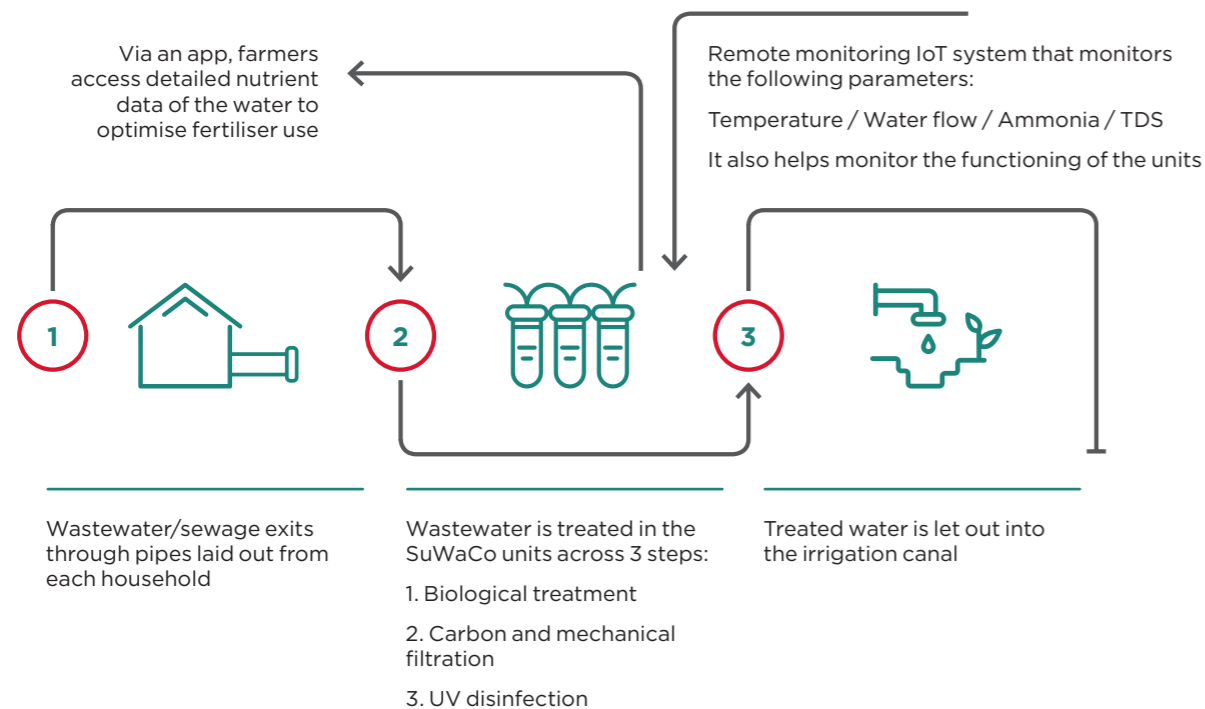


Figure 2
SuWaCo's modular plug-and-play wastewater treatment technology deployed on site

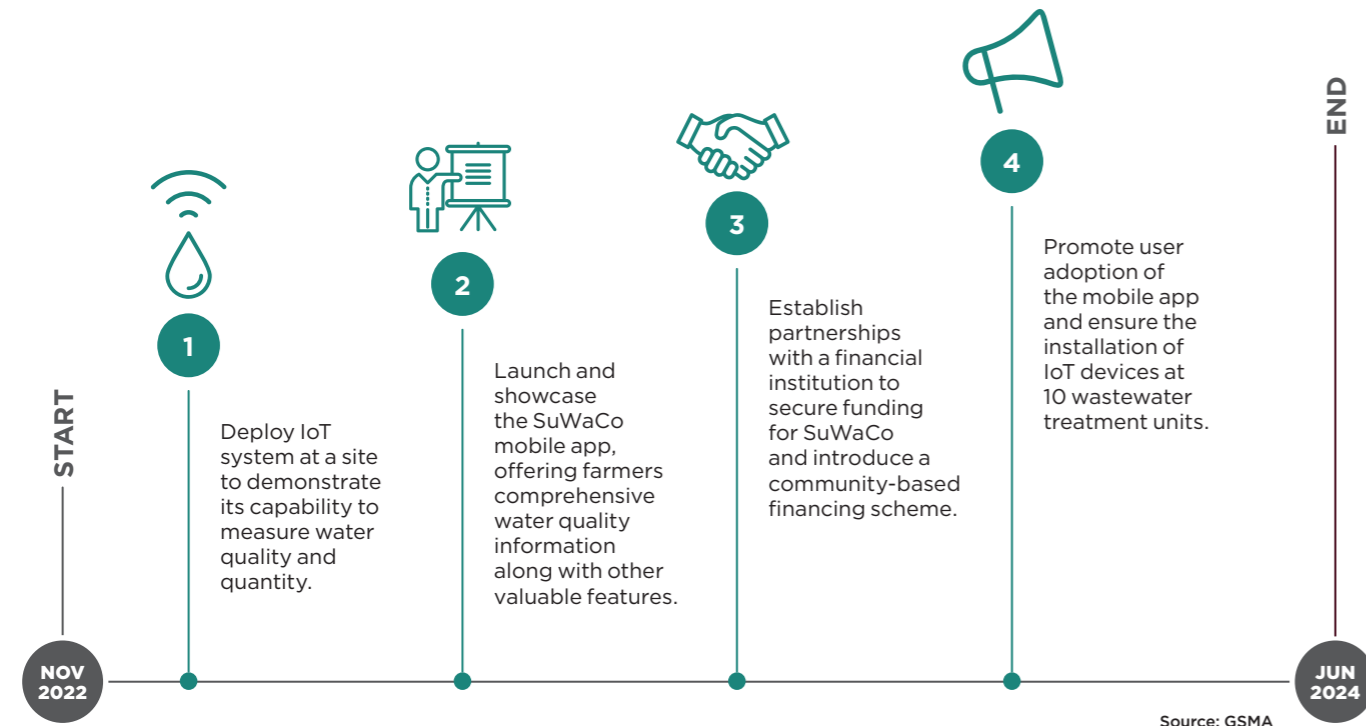


Figure 3
Treated wastewater from the SuWaCo units being released into the irrigation canal



Key project activities

Figure 4
Key milestones of the DWSS project



Implementation strategy

The GSMA Innovation Fund grant expanded on an existing project comprising decentralised wastewater treatment units that convert sewage into safe irrigation water. The grant aimed to tackle the operational and maintenance challenges of decentralised infrastructure by harnessing mobile technology.

BENAA's implementation strategy capitalised on their extensive regional experience built through previous engagements. By fostering strong relationships with key stakeholders, they ensured buy-in and support for the DWSS project. However, the project encountered several challenges during implementation, including Egypt's foreign exchange crisis and new government restrictions on importing electronic devices, which resulted in delays. This hindered

the procurement of necessary equipment from abroad. To overcome this, the project adapted by identifying local and competent suppliers, enabling them to move forward.

Partnership with a mobile network operator

Following the launch of the mobile app, BENAA is now integrating with Paymob, a mobile money player in Egypt, enabling users to pay for DWSS via the mobile money platform.

There has been an increase in commercial sustainability due to BENAA's transition to mobile money to collect subscription payments from communities as well as a decrease in default rates. Thus, this integration will enhance the project's accessibility and convenience for users.

Lesson 1

Given the sensitivities of land allocation, community engagement is crucial for successful SuWaCo unit installation

Active community engagement is vital to the success of DWSS, as it requires allocating community land for the installation of SuWaCo units. BENAA's community engagement representatives established and maintained relationships with local community members and leaders, building goodwill and trust. This approach was crucial due to the complexity of land allocation, which often involves multiple owners and requires several layers of approval. Strong partnerships with community leaders were forged and BENAA's reputation in the region facilitated significant community buy-in and land contributions for the project.

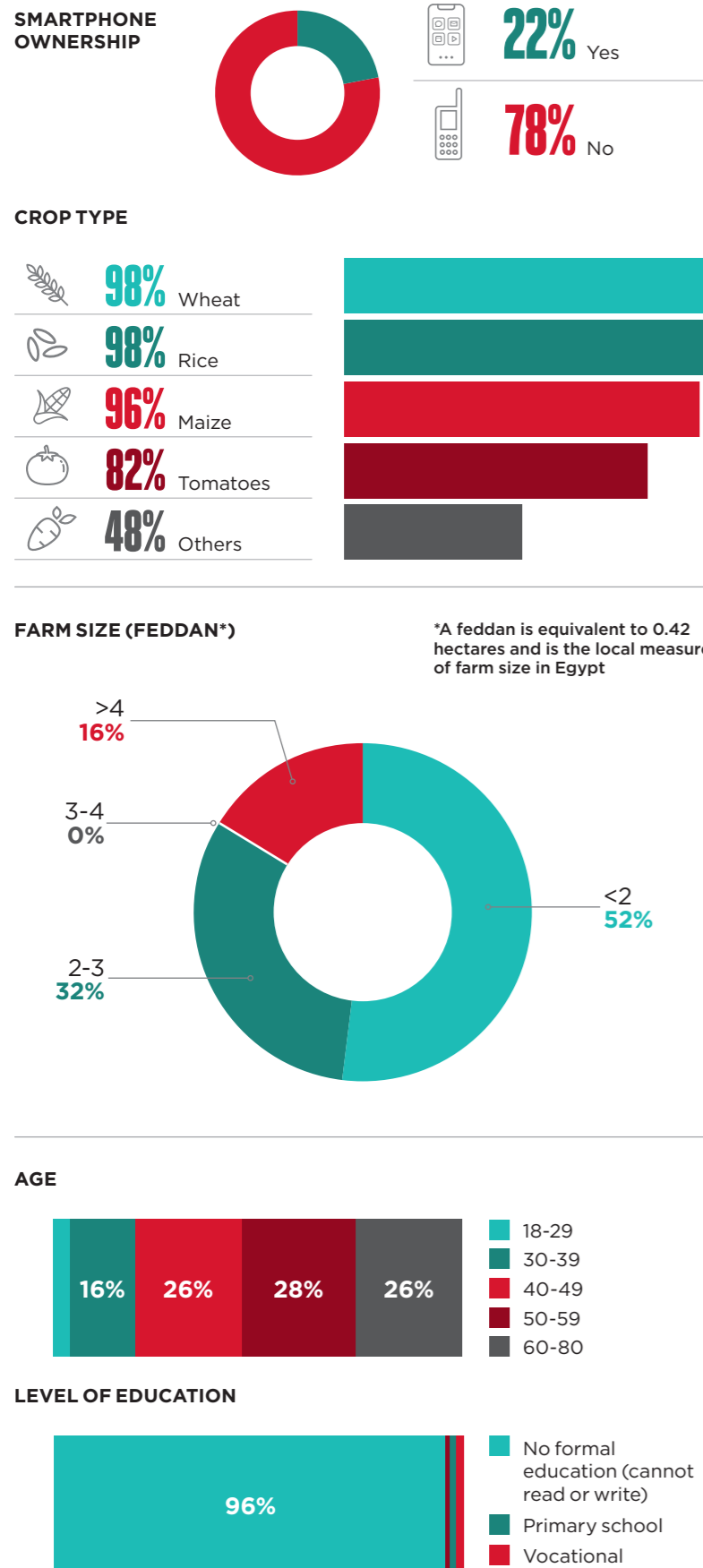
Lesson 2

Building strong partnerships with the government is crucial for the success of rural sanitation projects

BENAA's achievements in implementing the decentralised sanitation units also hinges on cultivating strong relationships with government entities across all levels. Close coordination with authorities is inherent to wastewater treatment projects, making government involvement essential. BENAA invested significant effort in building a positive relationship with government agencies and securing crucial partnerships, such as with the National Water Research Authority, to obtain necessary permissions. This approach ensured access to rural communities and reaffirmed political will in implementing their solution. BENAA recently also secured a partnership with the government through its holding company for operation and maintenance services for other wastewater treatment units. This helped improve their credibility in the market. As there is no centralised unit in the government that they can partner with, BENAA essentially acts as a pilot project with every governorate that they move into.



Figure 5
BENAA user statistics



Building climate resilience

Overall impact

BENAA's DWSS project helps address the growing water deficit faced by small-scale farmers due to climate change by introducing treated wastewater as a safe, alternative water resource. By providing a reliable source of water for irrigation, this project contributes to safeguarding agriculture, improving food and livelihood security. It also mitigates water scarcity and enhances environmental health by reducing contaminant discharge into the water canals. The system's ability to prevent wastewater overflow eliminates a common source of disease, contributing to the improvement of public health.

BENAA user profile

BENAA's users include farmers and their families, and others who use water from the irrigation canal. A typical user of BENAA's services is a smallholder farmer, approximately 50 years old, with no formal education. They are unlikely to own a smartphone. These farmers commonly cultivate wheat, rice, maize or tomatoes.

It is important to note that this profile is based on a specific, small and socially connected community. This community, situated far from urban centres, has faced challenges such as recurrent sewage overflows and legal issues due to inadequate wastewater treatment. Despite these difficulties, they are more collaborative, even donating land for the project. This community also experiences less severe irrigation water shortages compared to other communities that BENAA works with.

Outcome 1: BENAA's DWSS solution has improved water quality and quantity, strengthening community climate resilience

GSMA research found that by effectively treating wastewater, BENAA's DWSS project has substantially reduced the discharge of contaminated water into the irrigation canal. The introduction of recycled water is a valuable addition to the community's water budget. This approach not only mitigates the escalating water scarcity in Egypt but also enhances the climate resilience for local communities.

The project's impact is evident in its numbers. During the grant period, 50,408,093 litres of wastewater were treated and reused for irrigation, benefitting 21,180 people. By transforming wastewater from a pollutant to a resource, BENAA plays a crucial role in building sustainable and resilient communities in the face of climate change-induced water stress while providing critical sanitation services.



I am satisfied with the BENAA sewage treatment unit. It ensures that the water we use on our crops is clean and safe. What I like is that it reduces the health risks associated with using untreated wastewater

Male farmer, 18 years



Well, before having a BENAA unit, our village used to have a septic tank in each house, and when it got filled, each house would request for it to be emptied at a cost of EGP 150-200 each time. Sometimes, they wouldn't come upon request and would arrive after a week or so, which would result in our house being filled with wastewater and a really bad smell all the time. Even our lands and crops were affected because this wastewater would reach the soil, causing the crops to go bad or be wasted. But now, we don't suffer from any of those issues. We no longer pay the high cost of emptying the septic tank two or three times monthly, and we have access to clean water as well. We've gotten rid of the bad smell, and we no longer have to see our house get drowned in wastewater. We couldn't be more thankful and grateful for this unit.

Male farmer, 52 years.

Lesson 3

Low literacy levels and smartphone ownership hinder the adoption of advisory and water monitoring features

The adoption of BENAA's advisory and water monitoring features, available exclusively through the BENAA mobile app, has faced hurdles due to low levels of literacy and smartphone ownership.

As evidenced by a GSMA survey of the users, their limited interest in technology further compounds the issue, as farmers are generally content with the minimal role technology currently plays in their lives. To address this, BENAA has changed the module design in its mobile app to be more visual and less text-intensive, making it easier for users to understand and utilise.

Moving forward, BENAA could expand its offline engagements through workshops to support community members in understanding and using essential phone features, while adapting the technology to match the community's digital literacy, such as using Interactive Voice Response messages in addition to app-based advisories.

Lesson 4

Understanding project benefits drives community uptake and impact

BENAA's implementation highlighted the importance of communicating project impacts to target users. Despite the success of the treated wastewater irrigation system, farmers were unaware that the water they were using had improved due to the sanitation project. This lack of awareness underscored the need to amplify efforts in educating the target population about the benefits and how it addresses the challenges they face. BENAA is designing awareness campaigns to bridge this gap in understanding, which will help them foster a greater acceptance and adoption of their solutions.

Lesson 5

Talent sourcing and retention presents a barrier to scaling

BENAA faced some difficulties in recruiting skilled workers, particularly those with the technical expertise needed, as talent increasingly migrates out of Egypt. To address this, BENAA could explore creating internal career pathways that encourage employees to remain within the organisation and advance to leadership positions. Additionally, exploring grants or partnerships that provide access to consultants and technical support could further strengthen the skill sets available to the team.

What's next for BENAA?

Scaling up and diversifying

Looking forward, BENAA plans to scale by onboarding new users and enhancing its existing solution with additional features, such as IoT functionality developed during the GSMA Innovation Fund grant period.

The team is currently piloting a sludge reuse component which will enable them to increase reliance on the by-products of wastewater treatment to offset operational and maintenance costs of the units. This will help BENAA reduce the monthly subscription, making the solution more attractive to a wider audience. While international expansion is a long-term goal, BENAA is prioritising its work within Egypt for the next five years.

Unlike other projects in the wastewater treatment space that have failed due to inadequate technology and unsustainable impact, BENAA's development of a robust operation and maintenance technology has ensured the viability of their work. This has garnered interest from prospective partners, setting the stage for a promising future. BENAA's priority is to build on its success and leverage its expertise to drive a positive change in Egypt's wastewater management landscape.

Transitioning to operation and management services

Upon the advice of the GSMA's Digital Utilities programme, BENAA is exploring a less asset-intensive model. This involves using the technology developed through the GSMA Innovation Fund to operate, monitor and maintain existing decentralised wastewater units owned by other stakeholders that have gone out of service due to operation and maintenance problems.

This strategic shift helps BENAA to reduce capital expenditures and enhancing scalability. By leveraging their expertise to manage existing wastewater treatment units, BENAA can diversify revenue streams and explore new opportunities.

As BENAA looks to branch out into this service-based model, it is poised to capitalise on the political will in Egypt for their innovative solution, even in the absence of a centralised government institution that they can partner with.

Conclusion

As a part of its long-term goals, Egypt aims to achieve 100% safely managed sanitation coverage and improved water quality. Achieving these targets necessitates the adoption of diverse solutions, including decentralised sanitation systems that fit local needs and capacities.

BENAA's DWSS project, supported by the GSMA Innovation Fund for Climate Resilience and Adaptation, exemplifies that decentralised wastewater treatment can be an effective solution for rural Egypt. Decentralised systems can be easily adapted to local conditions, helping reach remote and underserved communities, while minimising water pollution and maximising water reuse. Additionally, for many communities, decentralised wastewater treatment systems can be more cost-effective than a centralised system.

One significant challenge with decentralised wastewater treatment systems is operation and maintenance, which has been effectively addressed through BENAA's integration of IoT functionality. BENAA's DWSS project therefore provides a compelling case for decentralised sanitation in rural Egypt.

9. Early Warning System. (2018). Sustainable Rural Sanitation Services Program for Results - Additional Finance.

BENAA CORE VALUES



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