Problem: Unsafe Water $\times$ Weak Monitoring + High Waste $\times$ Inequity = Public Health Crisis

Every morning, eight-year-old Kofi walks to school in a small town in Ghana with the dream of becoming a doctor. At school, he drinks from the shared water source, believing it to be clean. Yet every two months, Kofi falls ill, sometimes severely enough to require hospitalization, forcing him to miss lessons and fall behind academically. His mother has noticed a steady decline in his school performance, not from lack of effort, but from repeated sickness caused by unsafe drinking water.

Unsafe drinking water is a daily reality for millions of Ghanaian children. Although 79% of households technically have "basic" water access, only 19% have safely managed water, and contamination is widespread. E. coli has been found in up to 50% of samples in Accra, with rural areas showing even higher rates [1, 2]. In many communities, shallow wells, rivers, and boreholes contain microbial contamination in 61–80% of tests [3].

This directly fuels Ghana's ongoing public health burden. Globally, unsafe water and poor sanitation cause over 1 million deaths and more than 55 million DALYs each year [4]. In sub-Saharan Africa, diarrheal disease mortality among children under five exceeds 150 deaths per 100,000 children [5]. Ghana continues to report thousands of preventable cases annually, compounded by rising antibiotic resistance linked to contaminated water sources [1].

Beyond pathogens, heavy metal contamination, including mercury, lead, arsenic, chromium and iron alarmingly exceeds WHO limits in parts of southern Ghana due to mining and industrial runoff [6] Experts' analysis suggests that if water trends continue, Ghana could be forced to import water by 2030 [23]. These exposures contribute to long-term neurological, renal, and developmental issues.

The educational impacts are equally significant. Schools without reliable drinking water experience higher absenteeism, especially among girls who fetch water or lack WASH-supportive environments. Evidence from Ghana shows that improved water access can raise attendance and even exam performance; one school saw its BECE pass rate increase from 70% to 90% after water quality interventions [7].

For students across Ghana like Kofi, unsafe water is not a distant infrastructure problem, it is a daily threat to their survival, health, learning, and life opportunities every day. Without solutions that combine purification, monitoring, and long-term maintenance, the cycle of contamination and recurring illness will persist.

Progress Without Protection (Landscape Analysis)
1. State & Regional Initiatives — Access Improved, Safety Uncertain
Ghana has expanded water access through national and district-level programs such as the Ghana Education Service's WASH in Schools Model, which sets minimum water standards but relies on basic filtration without systematic quality checks [8]. Regional projects including ECOWAS-funded boreholes and district-level drilling programs have added hundreds of new water points for schools [9]. National efforts like the Water for All initiative and the GAMA Urban Water Project have connected over one million urban households to piped systems [10, 11]. These initiatives increase access but rarely guarantee safety. Most systems are installed without long-term monitoring, repair budgets, or contamination alerts. As a result, 60%+ of household water still contains pathogens, and heavy metals frequently exceed WHO limits in many regions [1, 8].
2. Clean Water Technologies — Useful but Limited and Often Unaffordable

Filtration products available in Ghana, ranging from small sediment filters to UV and RO units cost between **$100 to $1,000**, with advanced school-scale ultrafiltration systems exceeding **$4,000 plus ongoing maintenance** [13, 14]. Most remove either microbes or sediments but **rarely treat heavy metals contamination**, a critical issue in mining-affected regions [6]. Cartridge replacement and servicing are typically not included, causing units to fail within a year.

A similar water filtration program such as SmartPaani's FilterPlus model in Nepal demonstrates that filters paired with service contracts can work sustainably [15], but **no equivalent full-service model currently exists in Ghana.** The current market solves fragments of the water problem, never the whole system and places the financial and operational burden of these systems on schools.

3. Monitoring & WASH Sustainability — Inconsistent, Underfunded, and Not Scaled

Quality testing in Ghana is irregular and largely reactive. Equipment failures are common, rural areas are routinely underserved, and most schools lack any structured water-quality monitoring. Rural school access is approximately **45%**, compared to 75% nationally [2], yet these same schools experience the highest contamination and the least support.

Without routine monitoring or maintenance, contamination goes undetected, systems break down, and schools revert to unsafe sources driving disease, absenteeism, and reduced academic performance.

Market Opportunity: A Wide, Unserved Space Across all three domains, access, technology, and monitoring, the same structural problem persists: **no solution combines purification, heavy-metal removal, real-time monitoring, and long-term service at a price schools can sustain.** This is the whitespace Aqua Health fills. Aqua Health exists to make safe drinking water a basic guarantee for every student in Ghana, through reliable filtration, real-time monitoring, and sustainable service delivery at an affordable price.

Proposed Innovation: Aqua Health – Integrated Filtration + Real-Time Monitoring

Aqua Health combines **proven, commercially available filtration technologies** into a single, durable unit designed for low-resource settings. The system will combine a sediment pre-filter, activated carbon, UF/nano-filtration membranes, and an adsorption/ion-exchange layer for heavy metals, removing bacteria, viruses, turbidity, and toxins already documented in Ghanaian water sources. A UV-C sterilization module provides final-stage disinfection. Our innovation is not inventing new membranes, but **engineering these existing components into one modular, serviceable device** with standardized replacement cartridges and predictable performance. This reduces development risk and increases reliability. Each unit also includes a **basic sensor and data module** (turbidity sensor, flow-rate tracker, WQI monitor and a filter-life counter). These feed into a lightweight **Aqua Health Dashboard**, a simple web interface that displays usage, maintenance needs, and high-level water safety indicators. This will give us access to **data on the status of water contamination nationwide** which we can later $commercialize to research organizations.

1. Leasing Model: Affordable, Predictable, and Scalable

Aqua Health operates on a **"Clean Water as a Service"** model: instead of schools paying large upfront costs, they lease a filtration unit for **$30 per month**. This fee covers installation, routine servicing, and monitoring. One unit serves roughly **200 students**, allowing even low-income

schools to access reliable water treatment without capital barriers. A 10-unit pilot generates **$3,600 per year** in recurring revenue while validating the model. Over 3–5 years, scaling to **500 schools** creates a sustainable local enterprise with **$180,000 in annual predictable revenue**, enabling job creation, reinvestment, and long-term operational stability. The leasing structure ensures incentives are aligned: schools receive uninterrupted safe water, and Aqua Health maintains high service quality.

2. Technology Innovation: A Smart, Modular Water System

Aqua Health integrates **simple filtration hardware with lightweight digital monitoring** to create a reliable system suitable for resource-limited settings. Filters use off-the-shelf components (sediment removal, activated carbon, membrane filtration), making replacements inexpensive and locally manageable. Sensors track flow rate, turbidity, and maintenance needs, feeding into a **web dashboard** for real-time oversight.

Our First year focuses on practical, field-tested innovation rather than complex engineering.
 Months 1–4: Build functional prototypes and deploy the basic dashboard.
 Months 5–10: Pilot 5–10 units in selected districts, tracking performance, water quality outcomes, user interaction, and maintenance cycles.
 Months 10–12: Refine hardware modules, update software, and finalize the scalable leasing + servicing model. The results in a system that is durable, easy to maintain, and optimized for school environments where reliability and low upkeep are essential.

3. Social-Impact Partnerships + ROI/SROI: Turning Clean Water Into Measurable Health Gains
The core value of Aqua Health lies in its **public health impact**. One filtration unit serving ~200 children is projected to **avert 7–11 DALYs** (Disability-Adjusted Life Years) annually by reducing exposure to pathogens and heavy metals. A 10-school pilot serving ~2,000 students would avert **70–110 DALYs per year**, translating into measurable social returns fewer missed school days, reduced household healthcare costs, improved childhood health trajectories, and lower long-term risk of kidney and gastrointestinal diseases

As adoption grows to 500 schools in 5 years, Aqua Health would avert **3,500–5,500 cumulative DALYs**, a scale of impact that directly supports Ghana's education and public health goals. This DALY-based framework enables robust **SROI modeling**, helping donors, district authorities, and NGOs track real health improvements per dollar invested. To achieve this,we will build **impact-centered partnerships** with district education offices, community leaders, NGOs, and private-sector supporters. These partners help integrate clean water access into school development plans, expand trust, and ensure long-term community ownership.

Long-Term Vision Aqua Health will expand in practical phases, first 5–10 schools, then 50, then 500, strengthening demand through performance data, community engagement, and visible health improvements. Over time, the program becomes both a **health intervention** and a **self-sustaining social enterprise**, using local technicians, local servicing, and locally grounded partnerships.

By transforming water safety into a reliable service, Aqua Health delivers impact that is **scalable, financially viable, and life-changing** for Ghanaian schoolchildren.