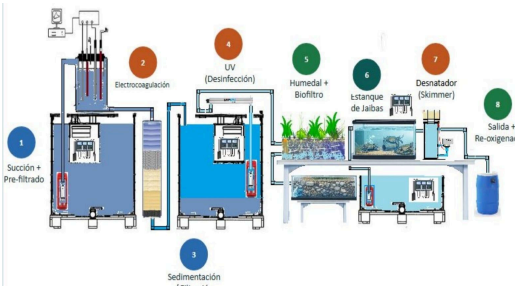
Future of Work Initiative

Jaiba Viva – IoT Technologies and Nature-Based Solutions for Eco-Equity

Global STEAM & Leadership Challenges – Case Study



> *"True environmental sustainability cannot be achieved without social justice; when we equip young women with the tools of technology, we transform them from witnesses of ecological decline into the architects of community resilience."*

—**Jose Carlos Luna Tovar**, STEAM educator and Enseña por Colombia Alumnus

Context & The Urgent Challenge

Globally, the water crisis is deeply tied to social and gender equity. According to a joint report by the WHO and UNICEF, women and girls bear the responsibility for water collection in 7 out of 10 households lacking direct water access. This immense daily burden restricts their educational access, limits economic mobility, and increases exposure to physical and safety risks.

On a local scale, this systemic vulnerability collides with severe ecological degradation in the Colombian Caribbean. The Mallorquín Marsh is a vital coastal ecosystem that acts as a natural climate shield, a biodiversity haven, and the primary economic foundation for the community of La Playa. However, rapid urban encroachment, climate change, and heavy water pollution have caused severe deterioration in water quality. This contamination directly threatens the blue crab (Callinectes sapidus), a cornerstone species for local biodiversity and the regional fishing economy. In response to this interconnected crisis, Jaiba Viva was established to overturn the narrative. The initiative transforms the traditional conservation paradigm by training young women and girls to actively lead the design, implementation, and analysis of high-tech environmental solutions.

The Solution: Hybrid Technology & Nature-Based Engineering by Students

The project implements an integrated, community-managed engineering model that combines advanced telemetry with nature-based wastewater treatment systems. Rather than treating technology as a tool designed entirely by external experts, the Jaiba Viva initiative positions young girls as the primary co-designers, builders, and operators of this infrastructure. Working alongside local fishermen and

community elders, our female student researchers translated complex environmental data into a tangible, multi-stage filtration and monitoring workflow. This collaborative, human-centered design process ensures that each technical phase directly respects the local ecosystem while building youth leadership.

- **Intake & Pre-Filtration (Succión + Pre-filtrado):** Raw marsh water is drawn into the facility. Student teams worked with local fishermen to design and install physical mesh screens that catch large debris and floating plastics.
- **Electrocoagulation (Electrocoagulación):** An electric current destabilizes suspended contaminants and heavy metals for easier removal. During classroom labs,students calibrated the precise voltage levels required to treat urban runoff safely.
- **Sedimentation & Filtration (Sedimentación / Filtración):** Particulates settle out via gravity-fed filtration beds. Students calculated the ideal ratios and physically assembled the filtration layers using sustainable, locally sourced sand, gravel, and charcoal.
- **UV Disinfection (UV Desinfección):** Clarified water flows past a targeted ultraviolet light field, neutralizing pathogens without chemicals. Young women specialized in data tech configured the digital alerts that monitor bulb intensity on the community dashboard.
- **Artificial Wetland + Biofilter (Humedal + Biofiltro)**: Water passes through a constructed saline wetland populated with native, salinity-tolerant plants. Students interviewed community elders to identify the best local plant species to naturally absorb excess nutrients.
- **Crab Habitat Simulation (Estanque de Jaibas)**: Purified water enters a testing environment to monitor blue crab health. The young women manage this simulated nursery, taking full ownership of biological tracking to protect this vital local species.
- **Skimming (Desnatador)**: A surface skimmer continuously clears away organic surface debris. Student engineering teams maintain this apparatus, ensuring mechanical components sync perfectly with biological systems.
- **Re-Oxygenation Discharge (Salida + Re-oxigenación):** Clean, oxygen-rich water returns to the marsh. The discharge valve is monitored directly by the community, serving as visible proof that youth-led science can restore La Playa's economy.

Implementation: Classroom to Ecosystem Co-Design

The educational rollout shifts students away from passive consumption, moving them through three progressive phases of active research:

- **Community-Led Immersion:** Students conduct intensive field assessments of the Mallorquín Marsh alongside local fishermen and elder community leaders. This initial phase grounds scientific inquiry within immediate local history, exposing students directly to the realities of mangrove loss, water contamination, and plastic waste accumulation.
- **Biological & Computational Fieldwork:** Classrooms transform into dynamic laboratories. Students identify and categorize native flora, investigating the biological mechanisms that allow specific plants to naturally filter high-salinity water. Concurrently, they learn to calibrate IoT sensors and interpret incoming data packets from the LoRaWAN network, bridging biology with data science.
- **Collaborative Decision-Making:** Armed with real-time data trends, student research teams run community information workshops. When sensory arrays show drops in dissolved oxygen or

spikes in turbidity, the students work directly with local residents to coordinate conservation efforts, facilitate evidence-based decisions, and protect vulnerable crab nurseries

Impact Indicators & Future Vision

The program's success is tracked through a comprehensive framework designed to measure environmental outcomes alongside educational equity:

- **STEM Access:** Over 200 girls and young women from vulnerable districts actively trained in environmental analytics and IoT network configuration.
- **Confidence & Career Interest:** Documented shifts in student surveys regarding self-efficacy in scientific activities and an increased interest in pursuing long-term engineering and STEM careers.
- **Data-Driven Protection:** Establishing a continuous environmental baseline for the marsh, empowering community members to use hard data for collective resource management.

Over the next 12–24 months, Jaiba Viva plans to scale this model to other vulnerable coastal communities across Latin America and the Caribbean, creating a connected regional network of young women environmental scientists. To achieve this, we are packaging our technology into an open-source "Ecosystem Blueprint," making our LoRaWAN dashboard configurations and biofilter schematics freely accessible online. Furthermore, our current cohort of young women will lead this expansion, transitioning into regional mentors who will virtually train and onboard youth cohorts in newly partnering coastal schools. By collaborating with international climate networks and local Teach For All network partners, we aim to secure micro-grants that fund the initial hardware deployment for these sister communities.

For **more information** about the **Future of Work initiative**, visit the official website.
Join the **Global STEAM Community** through this link.