

VIEM Konekta Farms: connected circular hydroponic & aquaponic hubs for Timor-Leste

Fish feed the plants, waste feeds the fish, and the suco’s new connection keeps the whole loop alive — grown, monitored and sold by Timorese cooperatives.



Hero photo — VIEM farm or aquaponic unit
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VIEM demonstration unit.

Entrant	VIEM Project (Visionary Innovation for Environmental Management) — team of 4
Competition track	AI & Data (sensor monitoring + Tetum-first farm assistant)
Grand Challenge	Nominated — Statement E, <i>Tetum-first AI for public services: agricultural advice for farmers</i>
Prototype status	Idea + design; pilot-ready bill of materials
Language of delivery	Tetum first, with Portuguese and English

01 Summary

VIEM will build a network of small, solar-powered **aquaponic and hydroponic units** run by suco cooperatives, linked to one central VIEM Hub near Dili. Each unit is a closed loop: tilapia waste becomes plant nutrient, market and kitchen waste becomes black soldier fly larvae that feed the fish, and harvest residue returns as compost. The system uses up to 90% less water than soil farming and produces vegetables and protein all year, including the dry season.

What makes it work at scale is connectivity. Low-cost sensors report water quality through the suco's Vorakai link; a Tetum-first assistant, **Tulun VIEM**, sends simple alerts and answers growing questions on WhatsApp or SMS, and escalates to a VIEM agronomist when it is unsure. VIEM buys back produce at an agreed price and sells it to schools, hotels, supermarkets and restaurants — so every unit is a business for the cooperative, not a donation.

02 The problem

Timor-Leste faces four connected problems that one farm model can answer together.

- **Nutrition.** Nearly half of children under five are stunted (Timor-Leste Food and Nutrition Survey, 2020). Diets are rich in rice and poor in vegetables and affordable protein.
- **Import dependence.** Supermarkets and hotels in Dili rely heavily on imported vegetables and fish from Indonesia and Australia, because local supply is seasonal and inconsistent.
- **Water and climate.** A long dry season, erratic rainfall and degraded soils limit what can be grown in the open field for much of the year.
- **Waste and work.** Organic waste from markets and households is dumped or burned, while rural youth and women have few paid jobs close to home.

Hydroponics and aquaponics have been tried before in the region, usually as donor demonstrations. Most failed for the same reasons: **no one noticed when the water chemistry went wrong**, fish feed was imported and expensive, and there was no guaranteed buyer for the harvest. Newly connected sucos change the first reason. VIEM's circular design and offtake model address the other two.

03 The solution: one circular loop

Every VIEM Suku Unit fits on roughly 150 m² beside a suco office, school or community hall, and combines three linked systems.

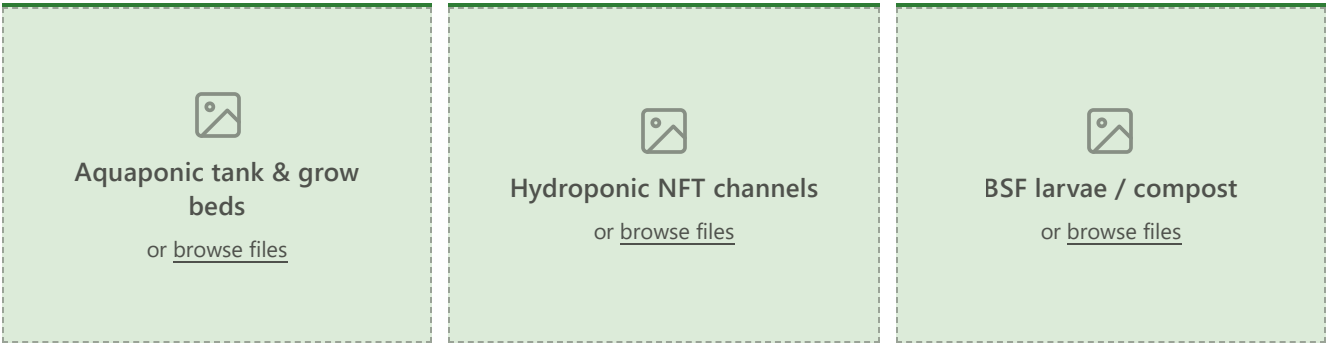


Figure 1 — Aquaponics, hydroponics and circular inputs.

Aquaponics — fish and plants share one water

A 2,000-litre tank holds tilapia (or local freshwater fish). Their water flows through a biofilter where bacteria turn ammonia into nitrate, then through grow beds of leafy greens, herbs and fruiting crops. Clean water returns to the fish. No chemical fertiliser is needed.

Hydroponics — fast, high-value greens

NFT (nutrient film) channels under a shade-net house grow lettuce, pak choi, kangkung and basil in 4–6 weeks. The nutrient solution is part-supplied by aquaponic water and part by organic liquid fertiliser brewed from compost, reducing imported mineral salts.

Circular inputs — waste becomes feed and fertiliser

Market and household organic waste is collected and fed to black soldier fly (BSF) larvae. The larvae become high-protein fish and poultry feed; their residue (frass) and plant trimmings become compost. Rainwater is harvested from the shade-house roof, and a small solar array with battery runs the pumps and sensors.

INPUT	PROCESS	OUTPUT	GOES TO
Market & kitchen waste	BSF larvae composting	Protein larvae, frass	Fish feed, compost
Fish waste (ammonia)	Biofilter bacteria	Nitrate nutrient	Grow beds, NFT
Plant trimmings, roots	Compost & liquid brew	Organic fertiliser	Hydroponics, local farmers
Rain & sun	Roof capture, solar PV	Water, power	Tanks, pumps, sensors
Harvest	Grading & VIEM buy-back	Vegetables, fish	Schools, hotels, markets

Table 1 — The VIEM loop. Every output of one stage is an input to another.

04 How connectivity makes it work

Aquaponics is forgiving only when problems are caught early: a pump that stops can kill fish within hours. The suco's new connection lets a small VIEM team support many remote units without driving to each one.

Sensing on the farm

Each unit carries a low-cost sensor kit (ESP32 controller) measuring water temperature, pH, dissolved oxygen, electrical conductivity, tank level and pump current. Readings travel by LoRa radio to a small gateway at the suco office, which shares the Vorakai satellite link. The controller works **offline first**: it stores readings locally, runs safety rules on the spot (for example, switching on the backup aerator when oxygen drops), and uploads compressed batches — a few kilobytes an hour — when the link is available.



Figure 2 — On-farm sensing and the suco link.

Tulun VIEM — the Tetum farm assistant

Operators receive alerts and advice in plain Tetum on WhatsApp, with SMS as a fallback. Alerts are rule-based and always fire, AI or not: *“Oksijéniu tun. Haree pompa ar agora.”* For questions (*“Tanba sa mak alfase sira-nia tahan kinur?”*), the assistant answers only from VIEM's own vetted growing manual, attaches a photo checklist, and hands over to a VIEM agronomist when confidence is low.

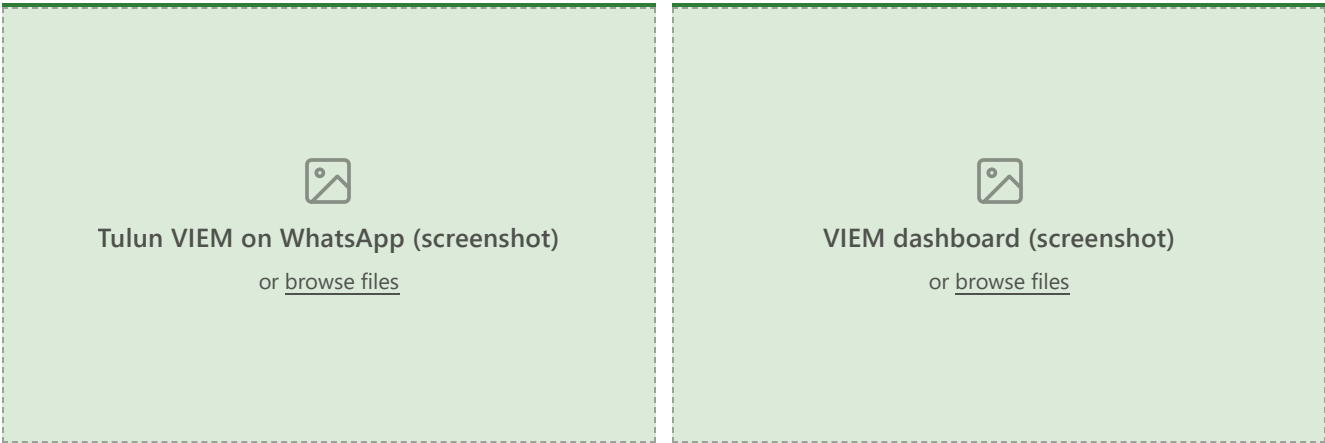


Figure 3 — Tetum alerts for operators and the Hub dashboard.

TULUN VIEM MAY	TULUN VIEM MAY NOT
Explain sensor alerts and first-response steps	Recommend chemicals, medicines or pesticides
Answer from the vetted VIEM manual, with sources	Invent answers outside the manual
Log harvest weights and send buy-back orders	Change prices or payments
Escalate to a named VIEM agronomist	Close an alert without human confirmation

If the model or the link fails, the service degrades step by step: numbered SMS menu → printed laminated guide on site → phone call to the VIEM Hub. Every AI answer is logged and reviewed weekly; wrong answers become manual updates. The VIEM operations manager is accountable for advice given.

The VIEM dashboard

At the Hub, a lightweight dashboard shows every unit’s health, harvest forecast and buy-back orders. This lets VIEM plan collection routes, promise weekly volumes to buyers, and spot which cooperatives need a field visit — turning scattered small farms into one reliable supplier.

05 Social impact

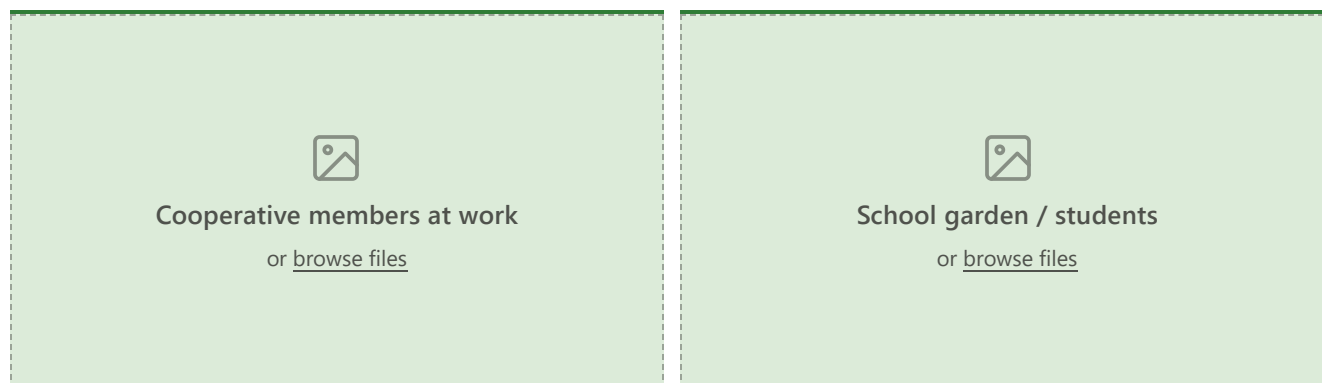


Figure 4 — Local jobs and school nutrition.

- **Jobs close to home.** Each Suku Unit employs 3–5 cooperative members, prioritising women and young people. Operators earn a share of sales rather than a stipend.
- **School nutrition.** Units sited at schools supply fresh greens and fish to school meals (Merenda Eskolar) and double as a living classroom for biology, maths and business.
- **Skills.** The VIEM Academy at the Hub trains operators in fish care, water chemistry, basic electronics, record-keeping and digital tools — skills that transfer to other connected-economy jobs.
- **Cleaner sucos.** Each unit diverts an estimated 50–100 kg of organic waste a week from burning or dumping.
- **Climate resilience.** Year-round production that does not depend on rainfall or soil fertility, using a fraction of the water.

06 How it works as a business



Figure 5 — From the Hub to the buyer.

VIEM runs a **hub-and-spoke** model. The VIEM Hub near Dili is a commercial demonstration farm, training centre, BSF feed plant and packing house. Suku Units are owned and run by local cooperatives, supplied and supported by VIEM, which buys their harvest at a pre-agreed floor price.

Revenue streams

STREAM	CUSTOMER	HOW VIEM EARNS
Fresh greens & herbs	Supermarkets, hotels, restaurants	Margin between buy-back and wholesale price
Fresh fish	Markets, restaurants, households	Margin on cooperative fish, plus Hub production
School supply	Schools, municipal meal programmes	Contracted weekly supply
BSF feed & compost	Fish, poultry and pig farmers	Direct product sales from the Hub
Unit kits & setup	Cooperatives, NGOs, government, donors	Kit sale or financed lease, installation fee
Training & support	Operators, schools, development partners	Academy courses; monthly support subscription

Indicative unit economics — one Suku Unit

ITEM	US\$ (ESTIMATE)
Set-up: tanks, NFT, shade house, solar & battery, sensors, gateway share	3,500 – 4,500
Monthly sales: greens, herbs, fish	350 – 500
Monthly costs: fingerlings, seed, top-up nutrients, maintenance	90 – 130
Monthly VIEM support fee (monitoring, assistant, visits)	25
Monthly net to cooperative	235 – 345
Payback on set-up	12 – 18 months

Table 2 — Planning estimates at Dili wholesale prices, to be validated during the pilot. Set-up is financed through a lease repaid from sales, a donor grant, or a municipal partnership.

VIEM breaks even at the Hub level once roughly 20 Suku Units supply the network, because aggregated, predictable volumes let VIEM sign supply contracts that small farmers cannot win alone.

07 Rollout plan

PHASE	WHAT HAPPENS	SUCCESS MEASURE
Pilot · 3 months	VIEM Hub demo system plus 2 Suku Units at Vorakai-connected sites (one school, one suco office); sensors and Tulun VIEM live	Fish survival > 90%; alerts answered < 2 hours; first buyer contract
Year 1	10 Suku Units in 3 municipalities; BSF feed plant at Hub; school supply agreements	50 operators trained; 40% feed from BSF
Years 2–3	30+ units; second hub outside Dili; kit sales to partners	Hub break-even; operators earning above minimum wage

08 Assumptions and how we test them

ASSUMPTION	KNOWN OR GUESSED	CHEAPEST TEST
Buyers in Dili will pay near-import prices for reliable local greens	Guessed — riskiest	Sign letters of intent with 3 buyers before building; sell Hub produce for 4 weeks
BSF larvae can replace much of imported fish feed	Known elsewhere in the region	One BSF bin at the Hub; measure feed conversion over one fish cycle
Cooperatives will keep daily routines without VIEM on site	Guessed	Pilot with weekly remote check-ins only; log missed tasks
Tetum operators will trust and use WhatsApp alerts	Partly known	Paper prototype of 10 alert messages tested with 5 operators
Solar sizing survives the wet season	Calculated	Run the Hub unit on solar only through one rainy month

09 Alternatives we considered

- **Soil greenhouses only.** Cheaper to build, but still depend on soil fertility and far more water, and produce no protein. Rejected as the core, kept for Hub nursery crops.
- **Hydroponics with imported mineral nutrients only.** Simpler to run, but ties every farm to imported inputs and breaks the circular model. Rejected.
- **Full cloud IoT platform with live streaming.** Rich data, but fails on shared satellite links and outages. Replaced by offline-first local rules and small batch uploads.
- **Donated units to communities.** Fast to launch, but past donor units were abandoned once support ended. Replaced by cooperative ownership, lease repayment and guaranteed buy-back.

10 How it could fail — and what we do about it

TYPE	FAILURE	DESIGN RESPONSE
Technical	Pump or power failure kills fish	Battery-backed aerator; local rule triggers without internet; loud on-site buzzer
Technical	Satellite link down for days	Controller stores 30 days of data; SMS fallback; printed response guide
Technical	Sensor drift gives false readings	Monthly calibration kit; weekly manual test strip logged in the app
Financial	Buyer drops out or prices fall	Spread across 5+ buyer types; school contracts as base demand
Financial	Cooperative cannot repay the lease	Repayment as a share of sales, not a fixed amount; grace period in the wet season
Social	Disputes over income or control	Written cooperative rules agreed with xefe suku; transparent sales records on the dashboard
Social	Operators leave for other work	Train 2 back-up operators per unit; certificates that reward staying

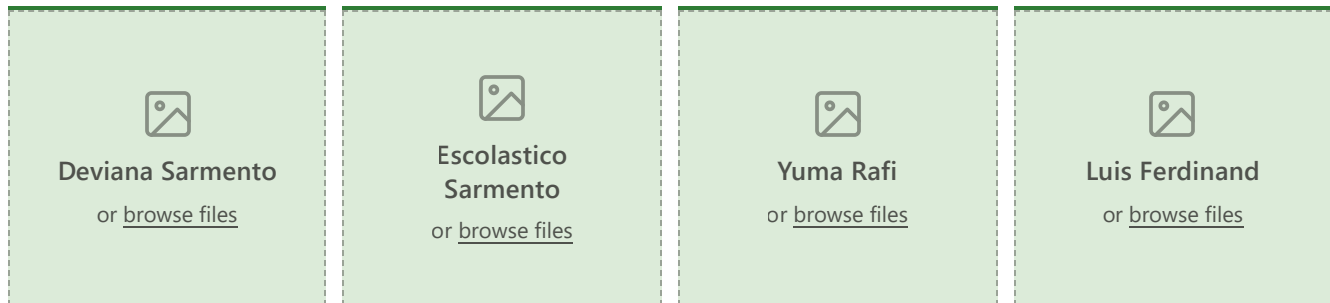
11 If the constraints change

- **Budget halved.** Drop fish from the first units and run hydroponics with compost-brewed nutrients; share one sensor kit across two neighbouring units.
- **No grid or weak solar.** Switch to a gravity-fed, low-pump design with timer-based flow and a manual aerator; fewer fish per litre.
- **Severe drought.** Closed-loop design already recycles water; add a covered storage tank and prioritise high-value, low-volume crops.
- **Remote suco, hours from Dili.** Sell locally first (school, market, clinic), aggregate only surplus fish, and let the dashboard schedule fewer, fuller collection runs.

12 Fit with the judging criteria

CRITERION	WHERE THIS PROPOSAL ANSWERS IT
Technical correctness & deployability · 30%	Off-the-shelf parts, offline-first sensing, pilot-ready plan (sections 03, 04, 07)
Critical thinking · 20%	Assumptions, alternatives, failure modes, live adaptation (sections 08–11)
Timor constraints · 20%	Solar power, dry season, shared satellite link, Tetum-first, suco governance
Clarity & supportability · 15%	Small data footprint on Vorakai links; VIEM runs support, not Vorakai
Impact on connected sites · 10%	Every connected school or suco office can host a unit
Communication · 5%	Plain-language Tetum alerts and cooperative training

13 Team



VIEM core team.

Deviana Sarmento Director	Finance and operations; business model, cooperative finance and buyer contracts
Escolastico Sarmento General Manager	Marketing and distribution; offtake with supermarkets, hotels and schools
Yuma Rafi Commissioner	Operational systems across Indonesia and Timor-Leste; Hub set-up and scaling
Luis Ferdinand Developer & IoT Implementation	Sensor kits, LoRa gateway, Tulun VIEM assistant and the VIEM dashboard; on-site installation and technical support

“We cultivate today, regenerate along the way, restore what matters, and sustain tomorrow.”

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