BUILDING THE FUTURE OF FOOD SECURITY

An intelligent RAS blueprint for sustainable aquaculture

> ***Kochi as the proving ground. UAE as the scale market.***

KELENO RAS TECHNOLOGY CASE STUDY

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Building the Future of Food Security

A UAE business group partnered with Keleno Labs to design an intelligent aquaculture ecosystem in Kochi—combining RAS, IoT, automation and analytics to create a scalable model for sustainable seafood production.

One pilot. One intelligent operating model. A blueprint for the Middle East.

Industry: Aquaculture & Food Sustainability
Technology: Recirculating Aquaculture System (RAS), Industrial IoT, Cloud Analytics, Automation
Location: Kochi, Kerala, India
Customer: Large UAE-based Business Group
Technology Partner: Norway based RAS consultancy
Solution: Keleno AquaSense™ for RAS

1. The Business Challenge

A large business group in the UAE was exploring a fundamentally different approach to food production in the Middle East.

With limited freshwater resources, harsh climatic conditions and increasing dependence on imported food, the group wanted to establish a **sustainable and scalable source of high-quality seafood** that could eventually be replicated within the UAE.

The objective was not simply to build a fish farm.

The group wanted to develop a **controlled, technology-driven aquaculture model** that could:

- Produce fish consistently throughout the year
- Minimize dependence on freshwater
- Reduce land requirements
- Operate independently of external weather conditions
- Improve control over water quality and fish health
- Reduce biological and operational risks
- Enable real-time monitoring of farm operations
- Generate data that could support better production decisions
- Serve as a blueprint for future deployment in the UAE

The proposed approach was to establish a **pilot RAS facility on an island in Kochi, Kerala**, leveraging Kerala's aquaculture ecosystem and using the pilot to validate the technology, operating model and sustainability potential before replication in the Middle East.

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2. Why Recirculating Aquaculture?

Traditional aquaculture can require significant land and water resources and is exposed to environmental and biological variables.

The presentation highlighted the fundamental advantage of **Recirculating Aquaculture Systems (RAS)**: water is continuously filtered, treated and recycled within a controlled production environment.

According to the source presentation, an RAS facility can potentially produce substantial quantities of fish on a much smaller land footprint than traditional pond-based systems. The presentation cites a model where **up to 60 tonnes of fish per year could be produced using approximately 1/8 hectare and 1/6 of the water requirement**, compared with traditional production methods.

For a region such as the Middle East, where water availability and environmental conditions are critical considerations, this offered a compelling technology pathway.

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3. The Strategic Vision

The project was conceived around a simple strategic principle:

Build and validate the future of sustainable aquaculture in Kochi, then replicate the model in the UAE.

Kochi would serve as the **technology and operational proving ground**.

The proposed model would allow the customer to understand:

Technology → Operations → Fish Performance → Water Management → Energy → Economics → Scalability

before committing to larger-scale deployment in the UAE.

This transformed the project from a conventional aquaculture investment into a **technology validation and food-sustainability initiative**.

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4. The Solution

Keleno Labs, in partnership with Norwegian technology company , developed the concept around an integrated RAS and Industrial IoT architecture.

At the heart of the digital layer was **AquaSense™**, Keleno's Industrial IoT platform designed specifically for commercial aquaculture and RAS environments.

The presentation describes AquaSense as an Industrial IoT platform intended to integrate data from aquaculture operations, generate insights and support business decision-making.

The solution combined four layers:

1. Physical RAS Infrastructure
2. Sensors & Automation
3. AquaSense IoT Platform
4. Analytics, Alerts & Farm Management

This created a connected production environment in which the physical farm and digital intelligence worked together.

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5. The RAS Technology Stack

The proposed RAS incorporated multiple interconnected systems responsible for maintaining the fish production environment.

The architecture presented by Keleno included:

- Fish tanks
- Mechanical drum filtration
- Biological filtration
- Protein skimming
- Ozone generation
- Residual ozone removal
- Water pumping
- Oxygen generation
- Oxygen cones
- CO_2 degassing
- UV sterilization
- Chilling and heating
- Air blowers
- Water-quality monitoring
- Electrical control systems

These components collectively supported a controlled aquatic environment where water could be continuously treated and recirculated.

The operating principle

Fish Tanks → Mechanical Filtration → Biological Filtration → Water Treatment → Oxygenation → Temperature Control → Water Quality Monitoring → Fish Tanks

The system was designed as a **closed-loop production environment**, significantly reducing the need for continuous water replacement.

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6. Making the Farm Intelligent

The major differentiator was not RAS alone.

It was the **digital intelligence layer around RAS**.

Keleno's AquaSense platform connected the physical equipment and sensors to an IoT gateway and cloud platform.

The architecture presented in the original solution followed:

Devices → Keleno Edge Gateway → Keleno Cloud → Web / Mobile Applications

The platform was designed to capture operational data, analyze it and provide actionable information to farm operators.

This enabled the farm to move from:

Manual Monitoring

to

Connected Monitoring

and ultimately toward:

Data-Driven Farm Management.

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7. Real-Time Water Quality Intelligence

Water quality is one of the most critical variables in intensive aquaculture.

The AquaSense solution monitored parameters including:

- Dissolved Oxygen
- Ammonia
- Salinity
- pH
- Temperature
- Nitrites
- Nitrates
- Electrical conductivity

The presentation specifically identifies biological, economic and engineering parameters as key monitoring dimensions for RAS operations.

Instead of depending entirely on periodic manual measurements, the proposed system enabled **continuous online monitoring**.

This allowed operators to identify abnormal conditions earlier and respond before they translated into significant fish losses.

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8. From Monitoring to Automated Response

AquaSense was designed not merely to collect data but to enable operational intervention.

The solution included:

Automated Control

- Automated feeders
- Pump control
- Automated paddle control
- Manual override

Connectivity

- 3G/4G
- ZigBee-based connectivity

Alerts

- SMS
- Email
- Rule-based alerts
- Automated actions based on predefined setpoints

Farm Management

- Feeding schedules
- Expense tracking
- Multisite management
- Best-practice integration
- Farm images and notes
- Historical logs and analytics

These capabilities were intended to reduce dependence on manual intervention while giving farm operators greater visibility and control.

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9. The Data-to-Decision Model

The solution was designed around a simple philosophy:

Sense → Analyze → Predict → Inform

Sensors continuously captured information from the farm.

The platform then transformed this raw operational data into:

- Trends
- Historical information
- Dashboards

Alerts

- Analytics
- Operational insights
- Decision-support information

This created the foundation for a **digital operating model for aquaculture**.

The presentation specifically positions AquaSense around data-driven architecture and the integration of data to generate insights and support business decisions.

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10. Addressing the Customer's Sustainability Objectives

The RAS approach directly addressed several of the customer's strategic priorities.

Water Sustainability

Continuous filtration and recirculation significantly reduces dependence on fresh water compared with conventional open systems.

Land Efficiency

RAS allows intensive fish production in a comparatively small footprint.

Climate Independence

A controlled indoor environment reduces exposure to adverse external weather conditions.

Biosecurity

Controlled water treatment and environmental conditions provide greater control over disease and biological risks.

Traceability

Digital monitoring creates a historical record of production and environmental parameters.

Resource Efficiency

Data-driven feeding, monitoring and automation can help reduce feed wastage, manpower requirements and unnecessary equipment operation.

These advantages are specifically identified in the presentation's RAS advantages and industry-challenge analysis.

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11. Economics Was Built Into the Technology

The solution was not designed as an engineering system alone.

Economic performance was treated as an integral part of the model.

The presentation identifies **facility scale, labour, electricity, feed and feed conversion ratio (FCR)** as important factors affecting RAS economics.

It also notes that production scale and selling price have significant influence on profitability, while survival rate is critical to economic performance.

The cost analysis presented in the original study identified:

Cost Component	Share of Total Cost
Electricity	29.0%
Feed	19.3%
Slaughtering	7.0%
Water Analysis	3.9%
Labour	3.5%

This highlighted why **energy optimization, feed management and fish survival** were critical to the commercial viability of the proposed model.

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12. Digital Technology as a Cost Optimization Layer

The digital platform was therefore designed to contribute directly to operational efficiency.

The original AquaSense concept identified potential improvements including:

- Reduced feed wastage
- Reduced manpower requirements
- Reduced electricity consumption for pumps and paddles
- Faster response to abnormal conditions
- Reduced fish stress
- Improved production yield
- Better harvest timing
- Better access to production information

The presentation also illustrated indicative potential savings of **30–35% in energy**, **20–25% in feed** and **10–15% in loss reduction** for the proposed digital solution. These should be treated as **target/illustrative figures from the original presentation, not independently validated project results**.

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13. Why Kochi Was the Right Pilot Location

The proposed Kochi deployment served a strategic purpose.

Rather than immediately attempting a large-scale deployment in the UAE, the customer could use the Kochi facility as a **controlled innovation and validation environment**.

The pilot could help establish:

- RAS operating procedures
- Water-quality management protocols
- Feeding strategies
- Fish-growth models
- Energy consumption benchmarks
- Feed conversion performance
- Mortality and survival benchmarks
- Automation requirements
- Digital monitoring requirements
- Operational manpower requirements
- Economic viability

The learnings could subsequently be translated into a UAE deployment model.

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14. From Kochi Pilot to UAE Deployment

The long-term ambition was to create a **replicable aquaculture blueprint**.

Phase 1 — Design

Develop the RAS architecture and digital monitoring model.

Phase 2 — Kochi Pilot

Deploy and validate the solution in a controlled environment.

Phase 3 — Data & Optimization

Capture production, environmental and economic data and optimize the operating model.

Phase 4 — UAE Adaptation

Adapt the validated architecture to UAE climatic, infrastructure and operational conditions.

Phase 5 — Scale

Replicate the model across additional sites and potentially develop a distributed network of technology-enabled aquaculture facilities.

This creates a powerful strategic proposition:

Kochi becomes the proving ground. UAE becomes the scale market.

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15. The Role of Keleno

Keleno's contribution extended beyond conventional software development.

The project brought together:

Aquaculture + Industrial IoT + Automation + Data Analytics + Farm Management

Keleno's role was to create the digital intelligence layer that connected the physical RAS infrastructure with operational decision-making.

The original presentation describes Keleno as an AgriTech company from Kochi with experience in Industrial Internet, IoT platforms and large-scale data ingestion, providing the foundation for the AquaSense approach.

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16. The Partnership Model

The project also demonstrated the value of combining domain and technology capabilities across geographies.

Keleno Labs

Digital & IoT Innovation

- Industrial IoT platform
- Sensor integration
- Data architecture
- Analytics
- Cloud platform
- Mobile/web interfaces
- Farm management

, Norway

Technology & Aquaculture Partnership

- RAS technology expertise
- Aquaculture technology collaboration
- International technology ecosystem

UAE Business Group

Investment & Market Vision

- Food-security strategy
- Pilot investment
- Commercial deployment
- Middle East market access
- Future UAE replication

Together, the partnership created an ecosystem for developing a **technology-enabled sustainable aquaculture model**.

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17. Expected Strategic Outcomes

The project was designed to help the customer achieve several long-term objectives:

Sustainable Food Production

Develop a controlled and resource-efficient method of producing seafood.

Reduced Water Dependency

Use recirculation and treatment to minimize freshwater requirements.

Controlled Production

Reduce dependency on external climatic and environmental conditions.

Operational Intelligence

Provide real-time visibility into critical production parameters.

Improved Risk Management

Detect abnormal water-quality and operational conditions earlier.

Better Economics

Optimize feed, energy, labour and production efficiency.

Replicable Technology

Develop a standardized model that can eventually be deployed in the UAE.

Food Security

Create a pathway toward greater regional food-production resilience.

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18. The Bigger Vision

What started as an RAS project was ultimately a much larger proposition.

The vision was to demonstrate that **food production can be redesigned around technology, resource efficiency and data**.

For the UAE business group, the Kochi project could serve as the first step toward developing a new generation of controlled-environment aquaculture facilities in the Middle East.

The underlying principle is simple:

Produce more food with less water, less land and greater control.

And with AquaSense, the objective extends further:

Make every production decision measurable, connected and intelligent.

19. Case Study at a Glance

Customer	Large UAE-based Business Group
Strategic Objective	Sustainable seafood production and Middle East food security
Pilot Location	Kochi, Kerala
Future Market	UAE / Middle East
Industry	Aquaculture
Production Technology	Recirculating Aquaculture System (RAS)
Digital Platform	AquaSense™
Technology Partner	Norwegian consultancy
Digital Capabilities	IoT, monitoring, analytics, alerts, automation, farm management
Key Parameters	DO, ammonia, salinity, pH, temperature, nitrites, nitrates, conductivity
Connectivity	3G/4G, ZigBee
Interfaces	Cloud-based web and mobile application
Strategic Model	Kochi pilot → validation → UAE replication

Contact & Usage Policy

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