ENHANCING TRACEABILITY AND TRACKING IN AQUACULTURE AND FISHERIES SUPPLY CHAIN THROUGH THE USE OF BLOCKCHAIN AND EARTH OBSERVATION

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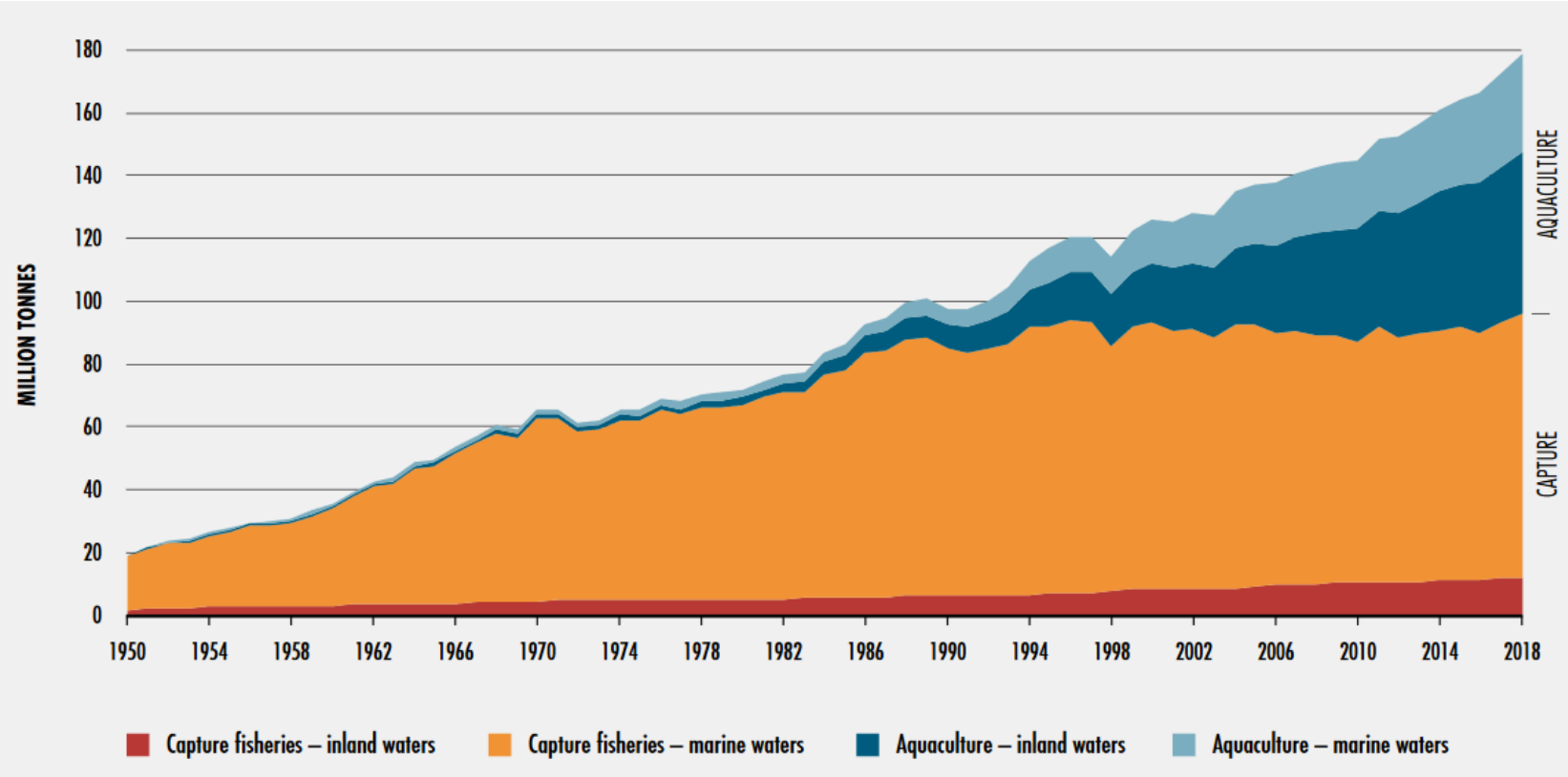
The activity is carried out under a programme of, and funded by, the European Space Agency under the Contract No. 4000134000/21/I-NB

World Capture Fisheries and Aquaculture Production



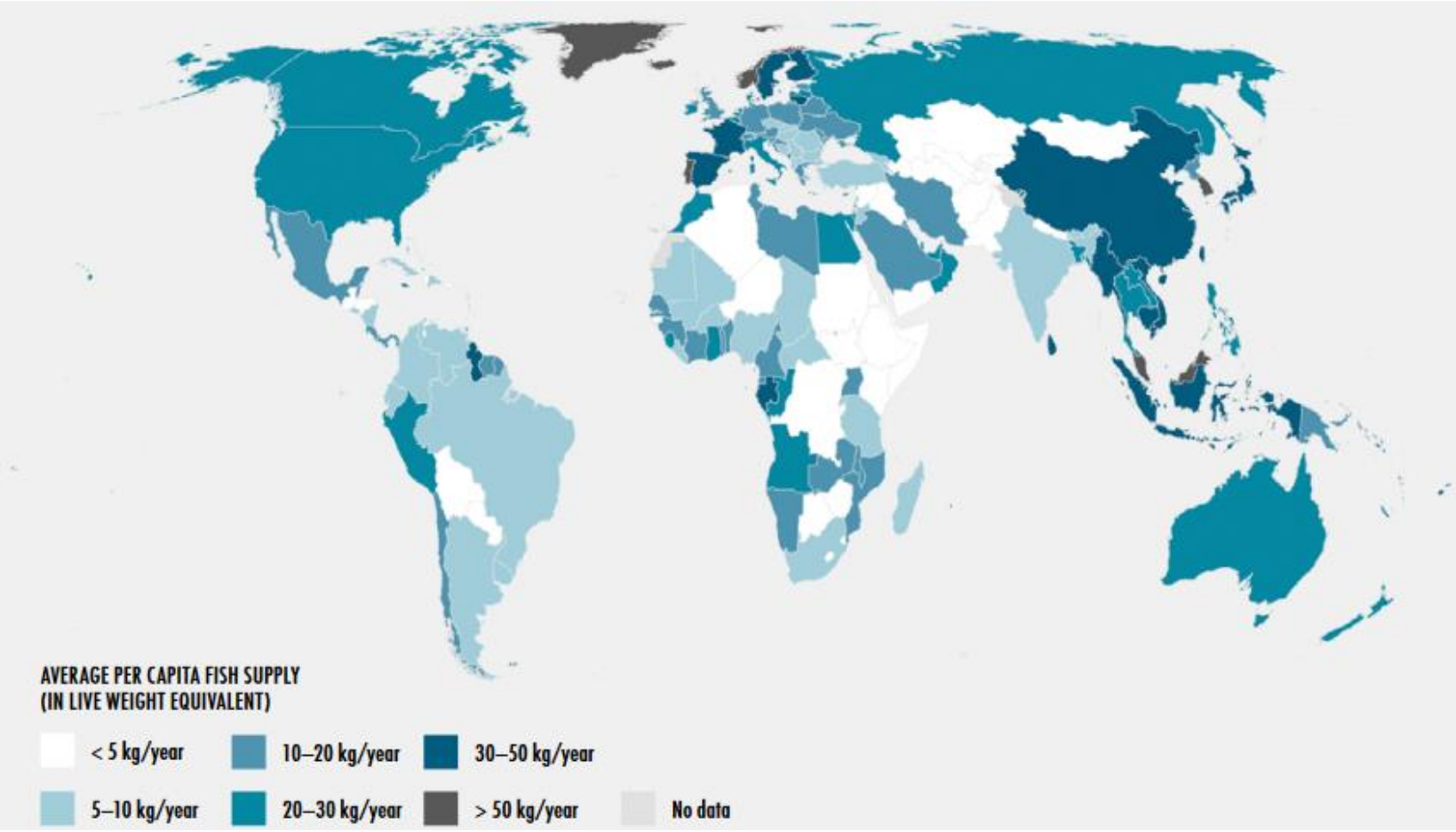
Source: FAO (2020). The State of World Fisheries and Aquaculture 2020. Sustainability in action.

Global fish production reached **179 million tns** in **2018**

Aquaculture shares **46 %** of the **total production** and **52 %** of fish for **human consumption**.

By **2030**, **62%** of total production for human consumption will come from aquaculture.

GLOBAL FOOD FISH CONSUMPTION



FISH CONSUMPTION PER CAPITA, AVERAGE 2015–2017. Source: FAO (2020). The State of World Fisheries and Aquaculture 2020. Sustainability in action.

Significant increase
9.0 kg per capita in 1961
20.3 kg per capita in 2017

Increase in production
Technological developments in processing
Cold chain
Shipping and distribution
Rising income
Increasing awareness of the health benefits of fish among consumers

MOTIVATION – SUSTAINABILITY

Certain fish species (i.e., fish larvae) are very **sensitive to water quality** issues.

Aquaculture activities may **affect the water conditions** of the environment.

Need to comply with **high health, consumer protection and environmental sustainability** standards.

EU policies and national regulations lay out environmental conditions for aquaculture activities and oblige water quality m

Traditional in situ monitoring (collecting water sampled and laboratory analysis) is laborious and expensive – spatially and temporally limited.

Water quality/environmental conditions are **not usually tracked and monitored consistently**, and the data are of unknown quality.

TRACEABILITY AND TRANSPARENCY IN THE SUPPLY CHAIN

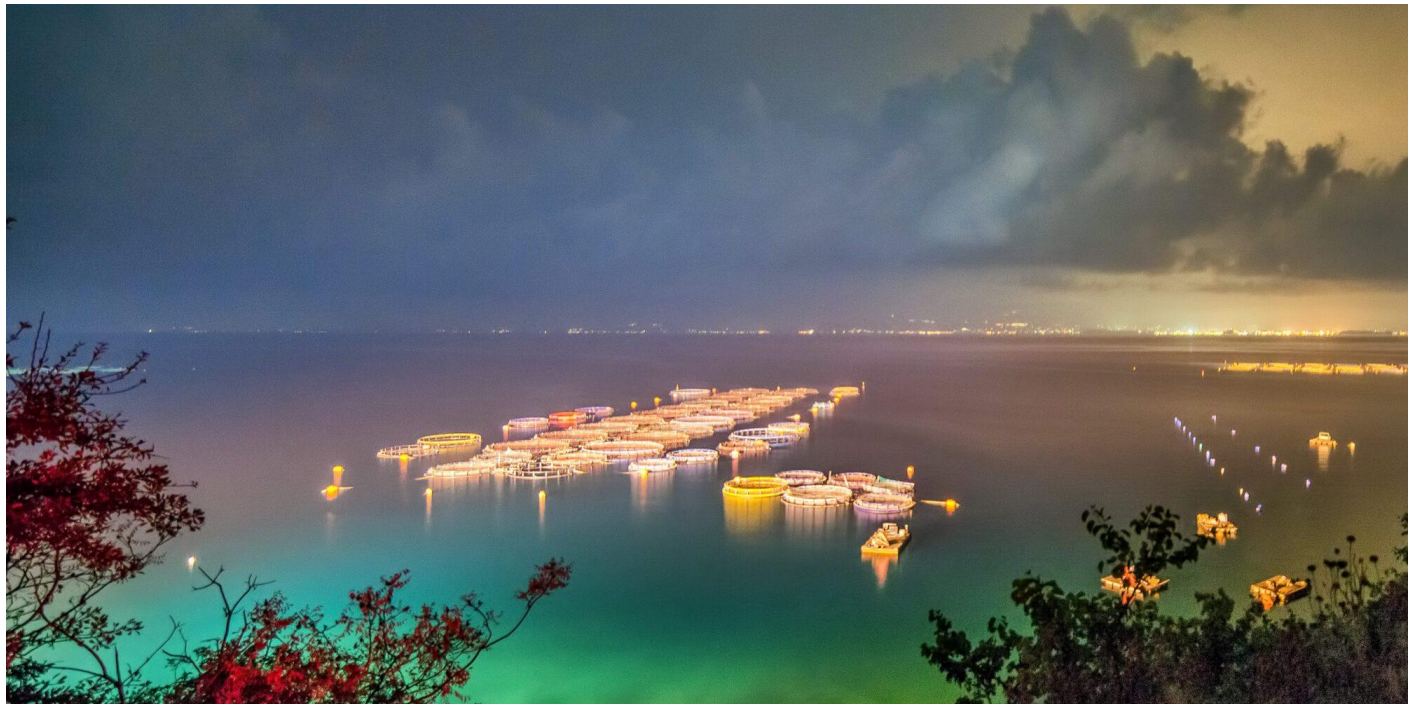
European Green Deal introduced a shift towards a more resilient and sustainable food system.

- Vast number of actors involved
- Fraud along the food supply chain

- Emerging requirement to improve the **accessibility, integrity and validity** of food informat during the whole supply chain.

AquaLedger Approach

Integraded EO & DLT based platform towards improved and sustainable supply chain management in the aquaculture sector.



AQUALEDGER OBJECTIVES

01

EO-BASED ANALYTICAL PROCESSES TO PROVIDE VALUABLE INFORMATION ABOUT AQUACULTURE COMMODITIES

02

DLT SYSTEM USING EO DATA FOR VALIDATING & APPENDING THE CONDITIONS OF SMART CONTRACTS EXECUTION

03

ADVANCE CURRENT KNOWLEDGE AND EXPERTISE IN DLT & EO CONVERGENCE

DISTRIBUTED LEDGER TECHNOLOGY + EO INTEGRATION

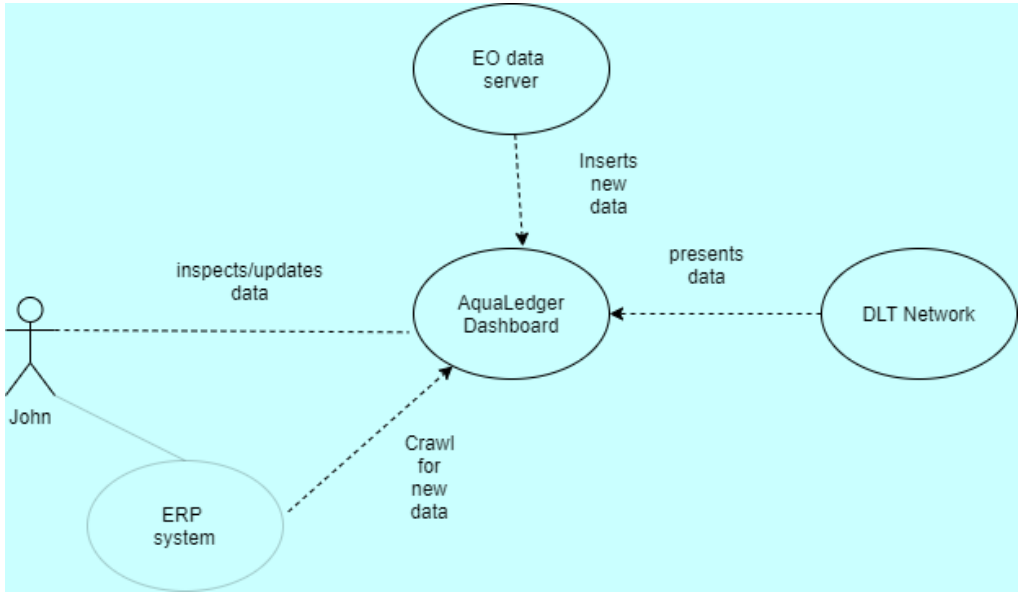
Blockchain can solve some of the coordination challenges in Supply Chain Management and logistics

- Reduce complexity
- Allow for greater transparency & trustless verification across the supply chain
- Speed up the supply chain & foster stronger relationships among partners.

EO DATA COULD BECOME FUNCTIONAL NODES BY CONNECTING THE PHYSICAL ENVIRONMENT TO DIGITAL LEDGERS.

AQUALEDGER USE CASES

- UC#1: Enhanced environmental monitoring, digital representation of food assets and immutable record keeping
  - employing EO based services towards the provision of accurate information about the water quality of aquaculture assets as well as the farming productivity
  - showcasing how EO data can connect the physical environment to the distributed ledgers

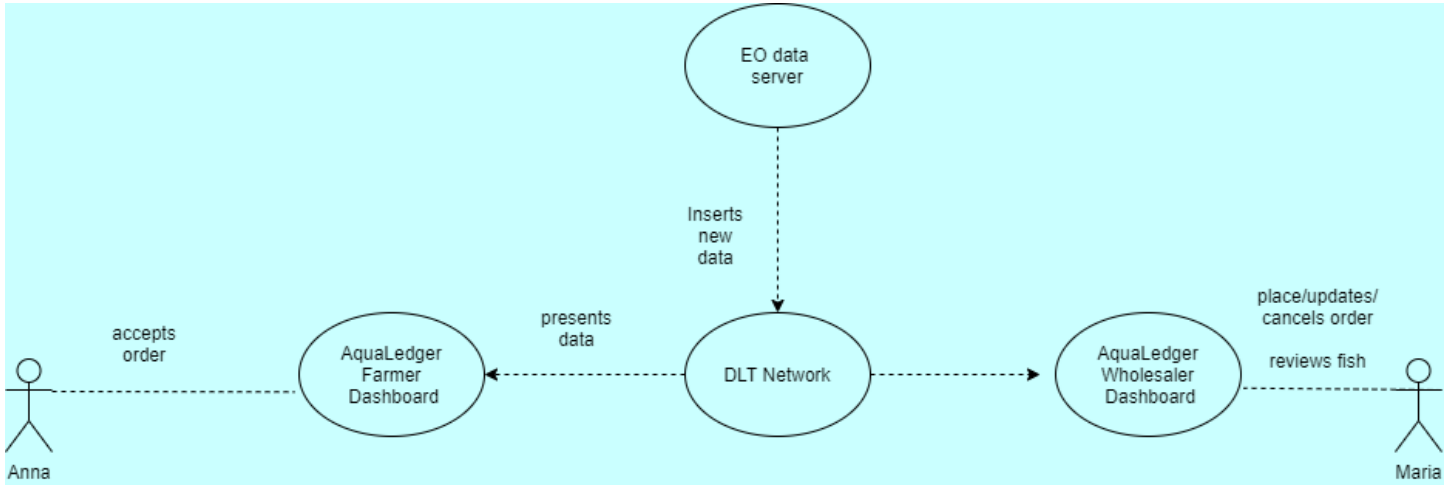


- Focus on fish farmer
- Crawling and extraction of updated information from fish farmer ERP systems
- Association of water quality data from EO service with fish farming productivity data
- Data visualisation through user interfaces/dashboards

AQUALEDGER USE CASES

- UC#2: Validating the conditions of a transaction through EO based water quality information
  - demonstrating the use of earth observation data in the conduction of a critical tracking event (sales) through a blockchain network.

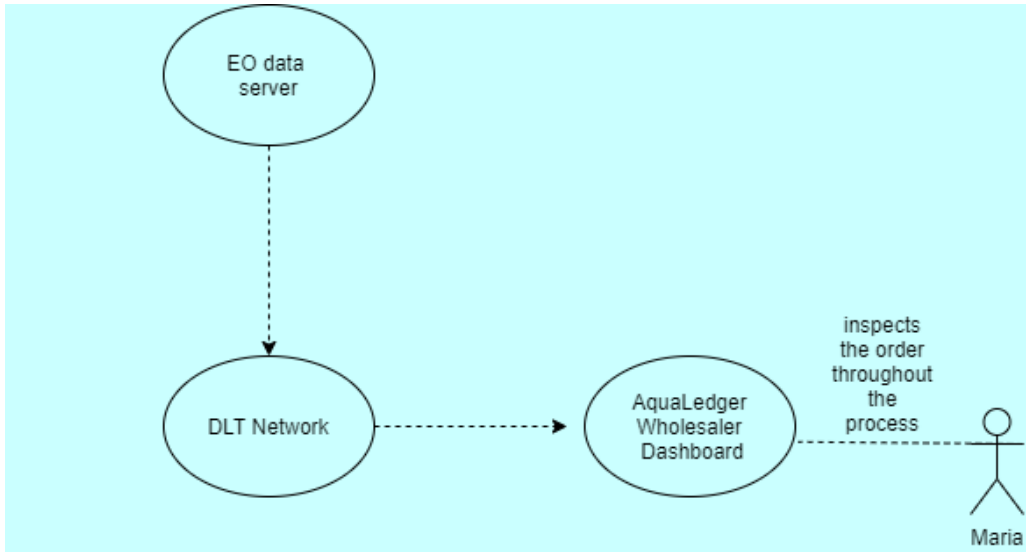
- Interaction between fish farmer & wholesaler
- Inserting and managing order characteristics through user interfaces (wholesaler)



- Assessing the water quality conditions of the farm (cages) since the ordering phase (wholesaler)
- All the necessary data (i.e. data extract from the ERP, EO water quality data, data directly inserted in the AquaLedger platform) will be gathered and form a DLT transaction, so they can be available to every involved party at a later stage

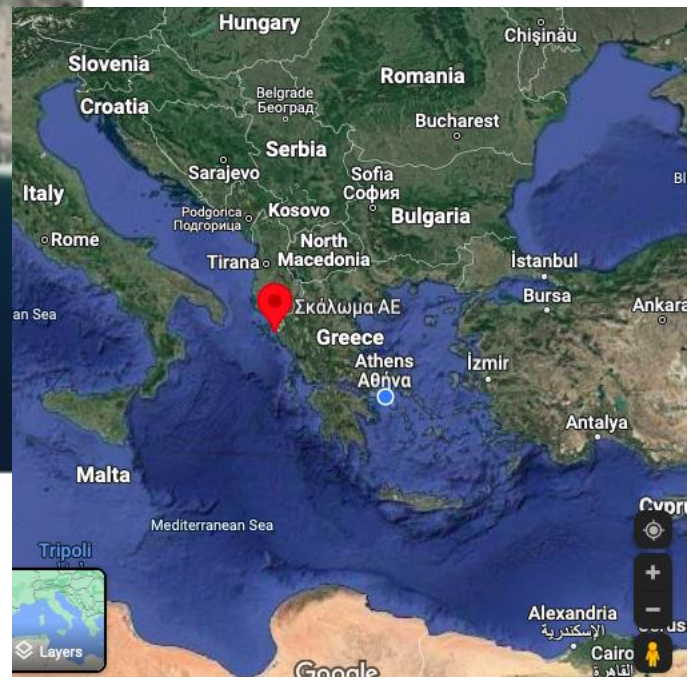
AQUALEDGER USE CASES

- UC#3: Tracking and tracing the movement of the aquaculture product
  - monitor the compliance of the food movement in the supply chain
  - extract updated information about the water quality in the fish farm following the initial sale and until the harvesting event.



- Focus on wholesaler
- Visualising different actors taking place in the supply chain
- Checking that all the transactions to the DLT and the smart contracts were triggered under the right conditions, including water quality related observations associated with the area from which the fish was harvested.
- Provision of updates with respect to the monitored water parameters until the fish harvesting date

Stakeholder Co-design Approach



- Pilot – Coastal aquaculture farm in NW Greece

High Level Architecture

Presentation Layer

- User Interfaces
- Dashboard

DLT Layer

- Smart Contracts
- Network & Communication protocols
- Membership services
- Distributed Database

EO Layer

- Download
- Atmospheric Correction
- Water quality retrieval
- Validation

Infrastructure Layer

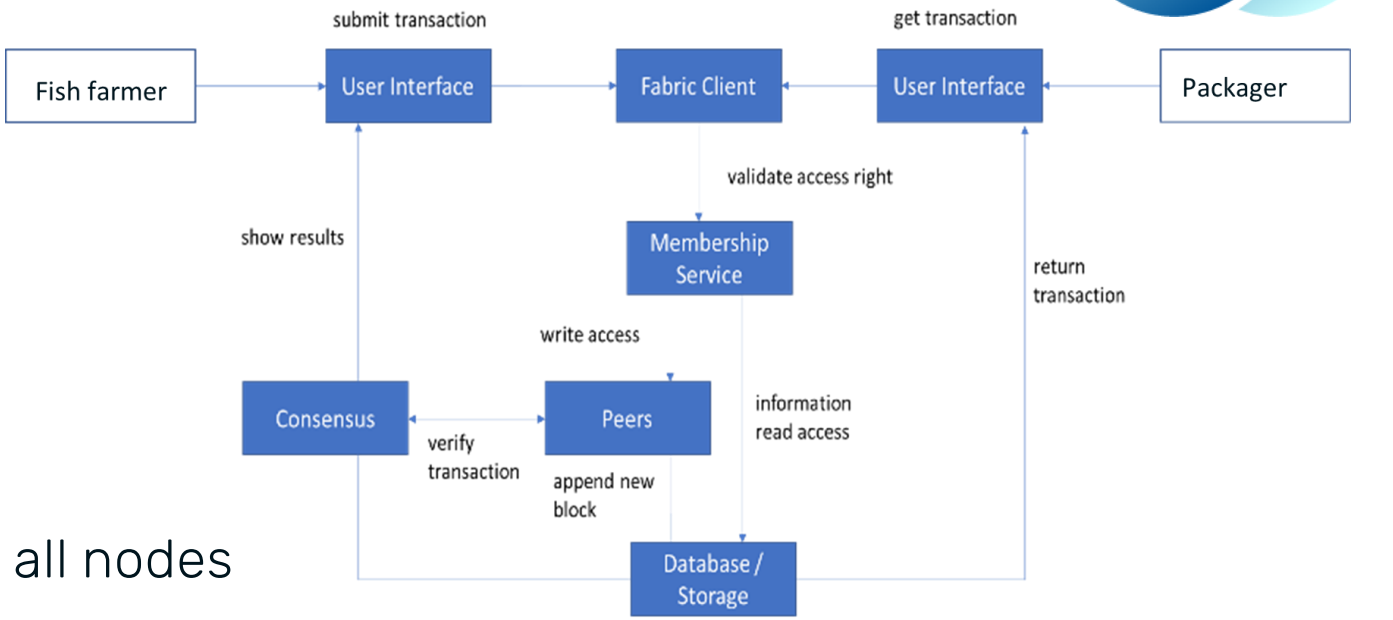
- Containers
- Virtual machines
- Cloud

External interfaces

- ERP
- EO Data Providers
- In-Situ Data

DLT Subsystem

HYPERLEDGER



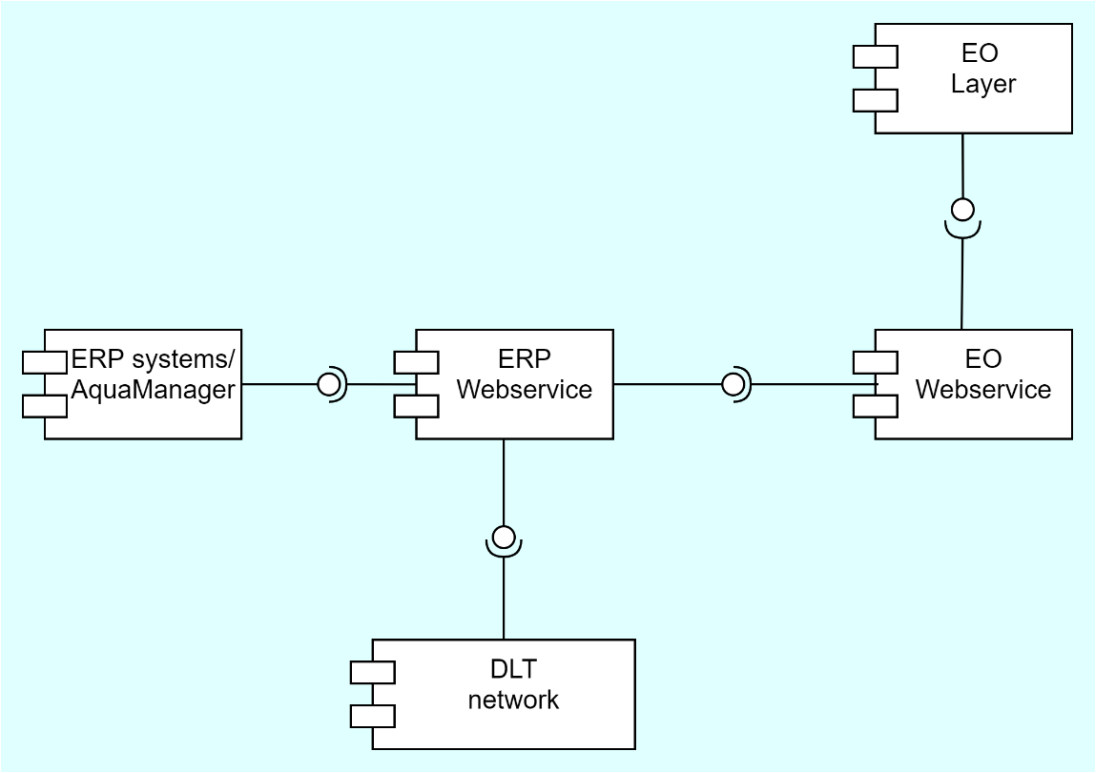
- Hyperledger approach to blockchain
- Business transactions are replicated to all nodes
- Ledgers recording the transactions execution sequence in respective blockchains are in sync on what happened in the network
- Obtaining transaction from client applications, processing them and updating the world state
- Smart contrasts are deployed as docker containers that provide a remote procedure call interface through which transactions can be triggered

DLT Subsystem

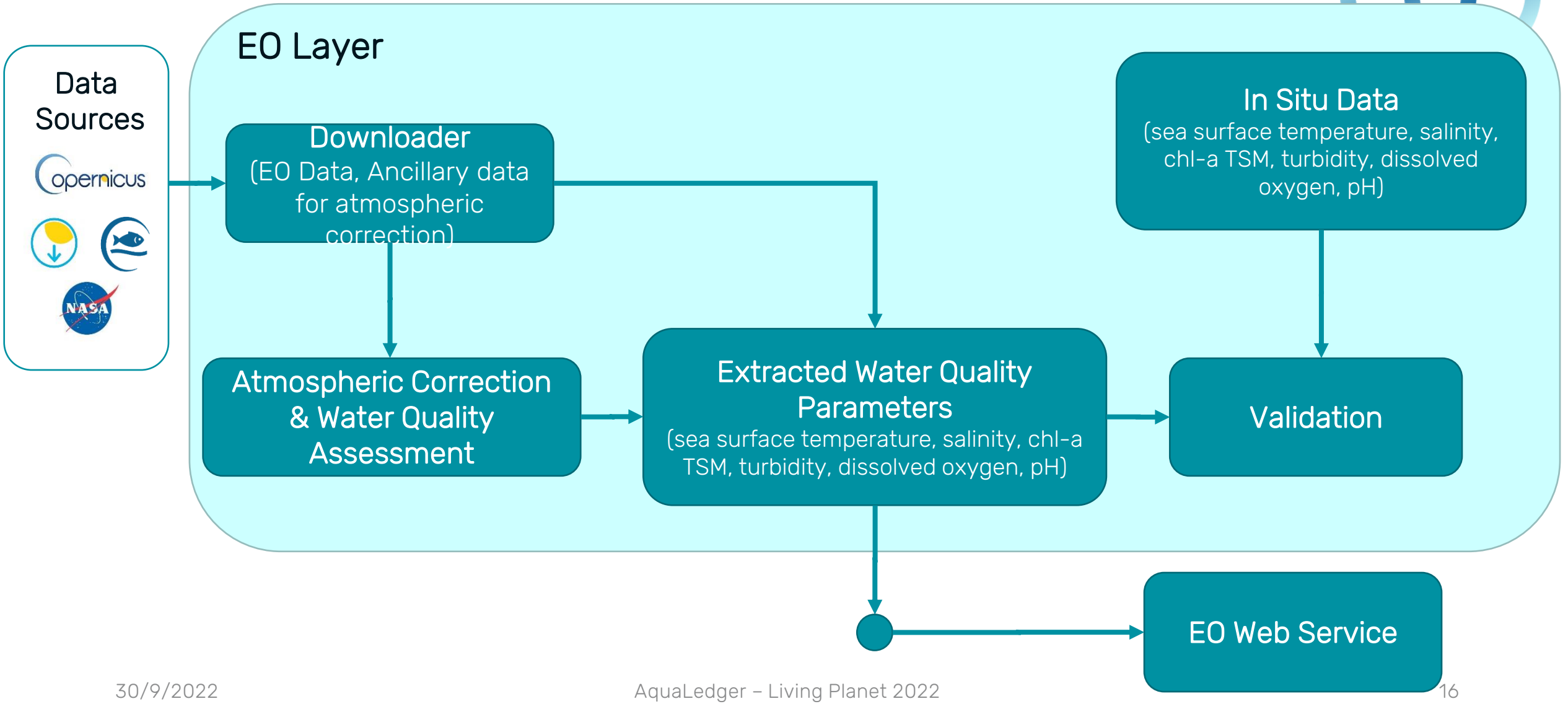
Two external (off-chain) web services

- ERP web service: It is responsible for retrieving data from the ERP systems of the fish farm (crawling the database in a regular base). This component is also responsible for collecting data also from the EO Layer and the in-situ sensors installed at fish farming cages. Finally, it is going to make a transaction and store the collected data to the DLT network.

- EO web service: It is responsible for retrieving the EO data in a daily basis and providing them to the ERP web service.



EO Subsystem



EO Subsystem

Chl-a concentration, Turbidity and Total suspended matters

- Sentinel 2 MSI Level 1
- Sentinel 3 OLCI Level 1
- C2RCC Atmospheric Correction Algorithm
- Empirical methods (trained with in situ data) & Semi-empirical (pretrained)

Temperature

- Sentinel 3 SLSTR Level 2
- CMEMS Forecast (MEDSEA_ANALYSISFORECAST_PHY_006_013)

Salinity, Dissolved oxygen, pH

- CMEMS Forecast (MEDSEA_ANALYSISFORECAST_PHY_006_013, MEDSEA_ANALYSISFORECAST_BGS_006_014)

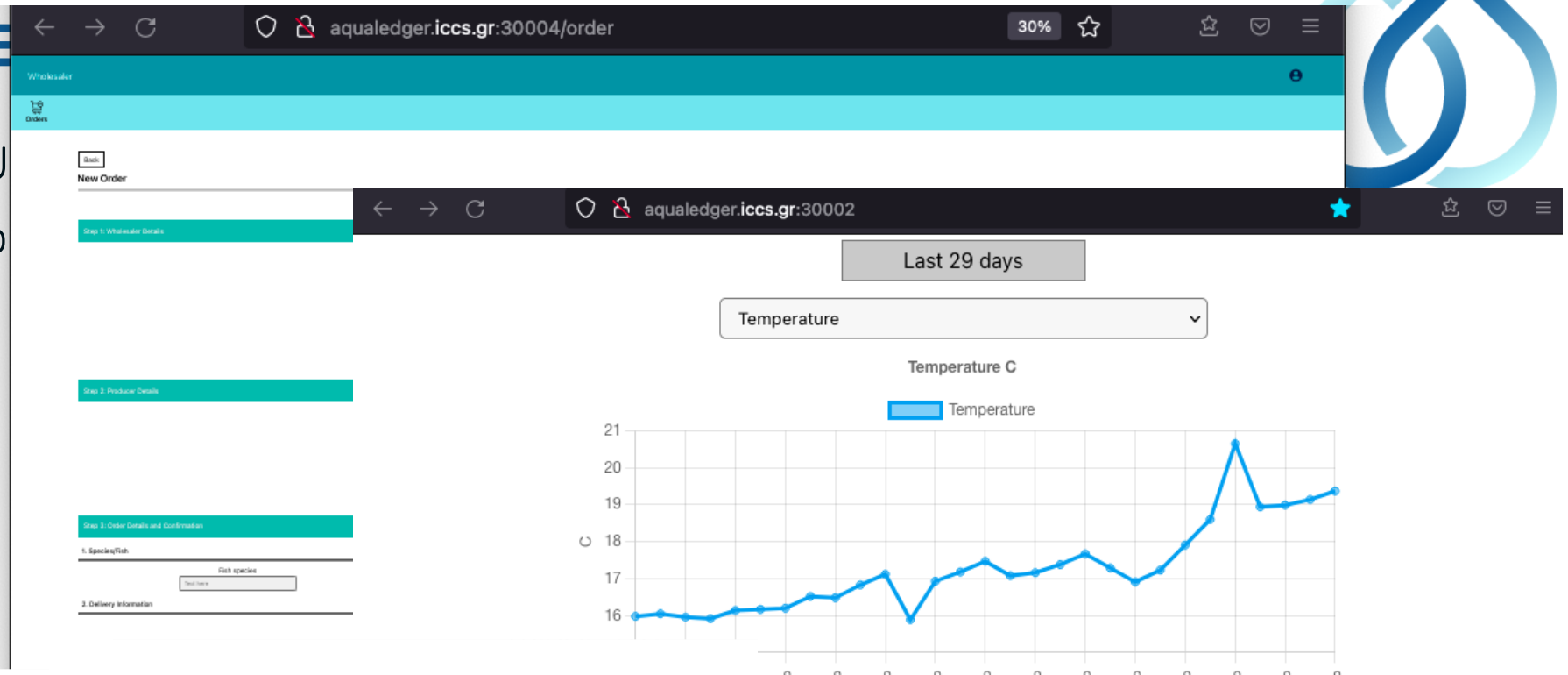
User Interface

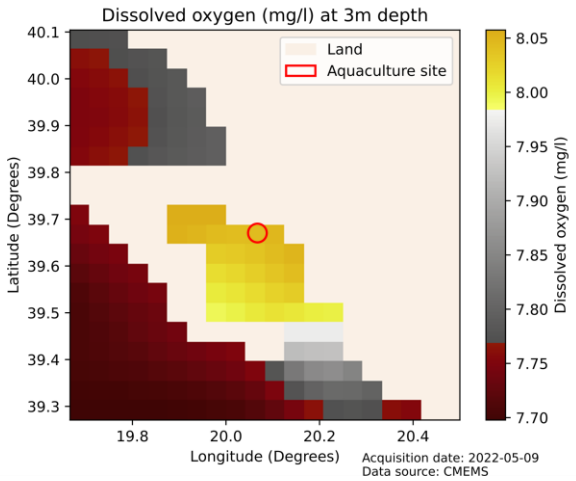
Aquaculture Farmer U

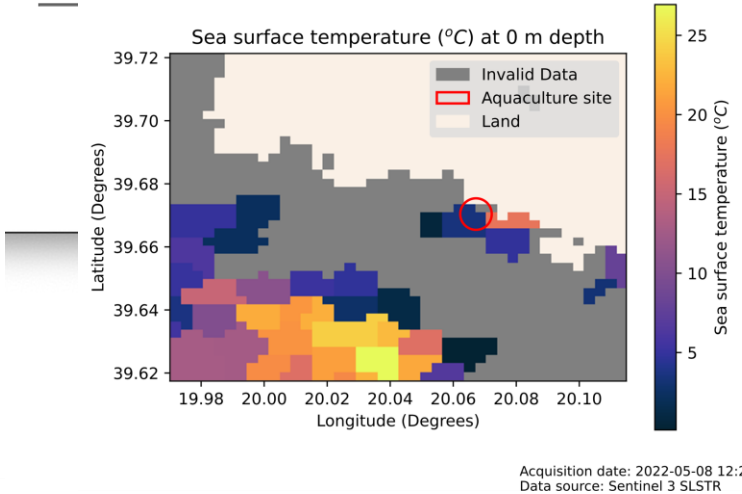
- Water quality indicato
- Incoming orders

Packager

- Incoming orders



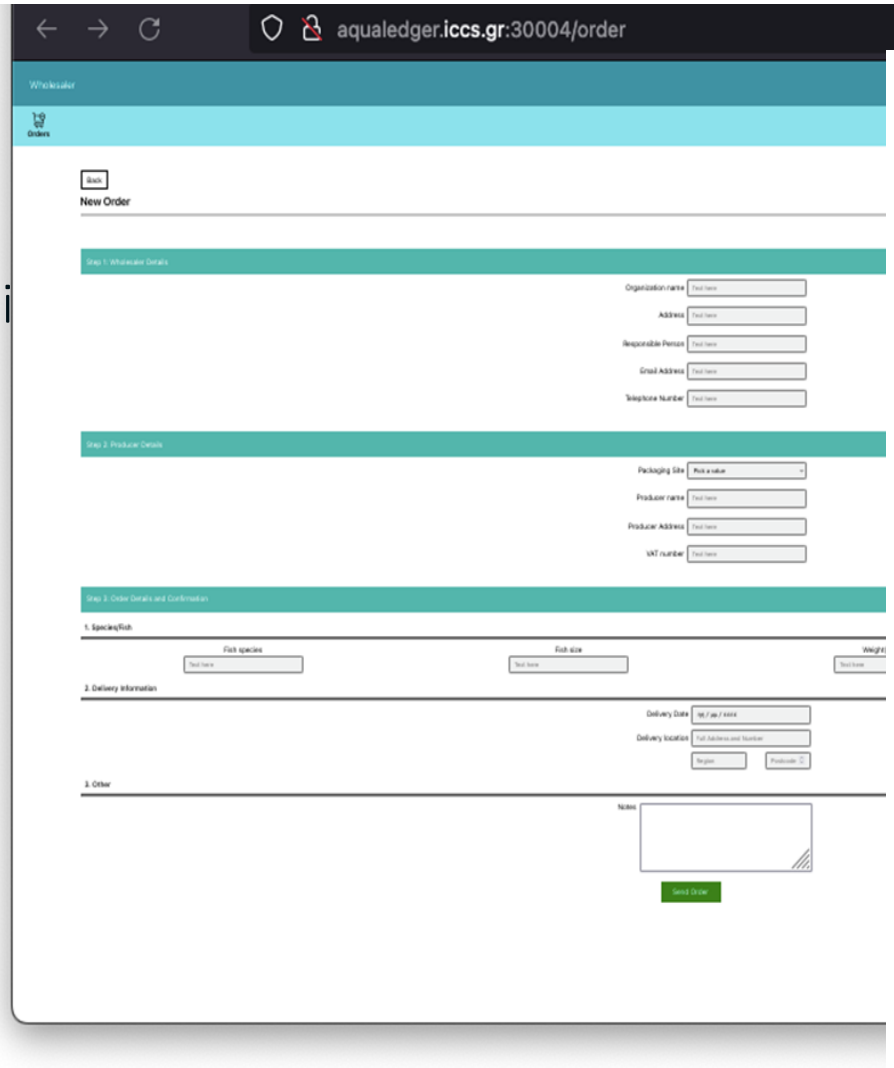


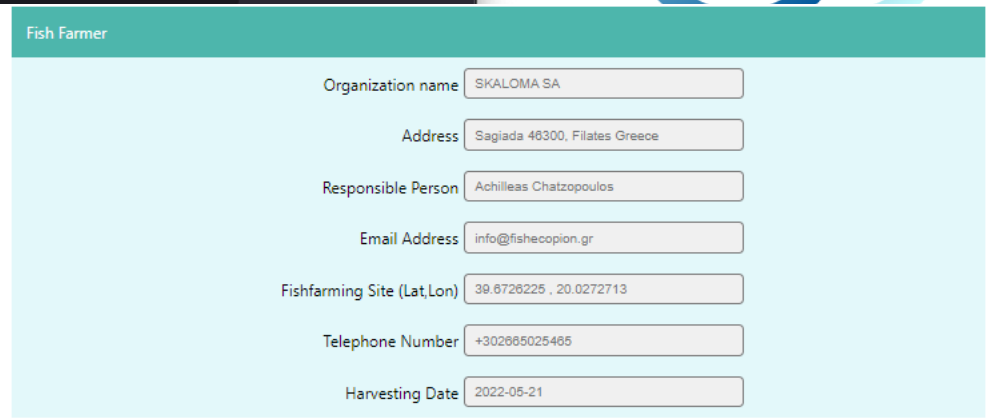


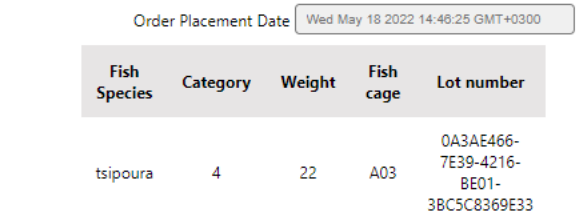
User Interfaces

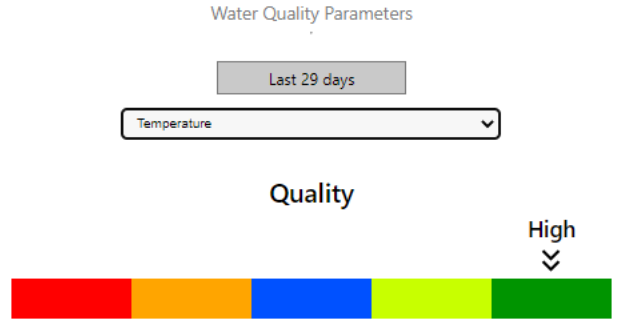
Wholesaler

- Place new orders
- Track orders
- Inspect water quali conditions



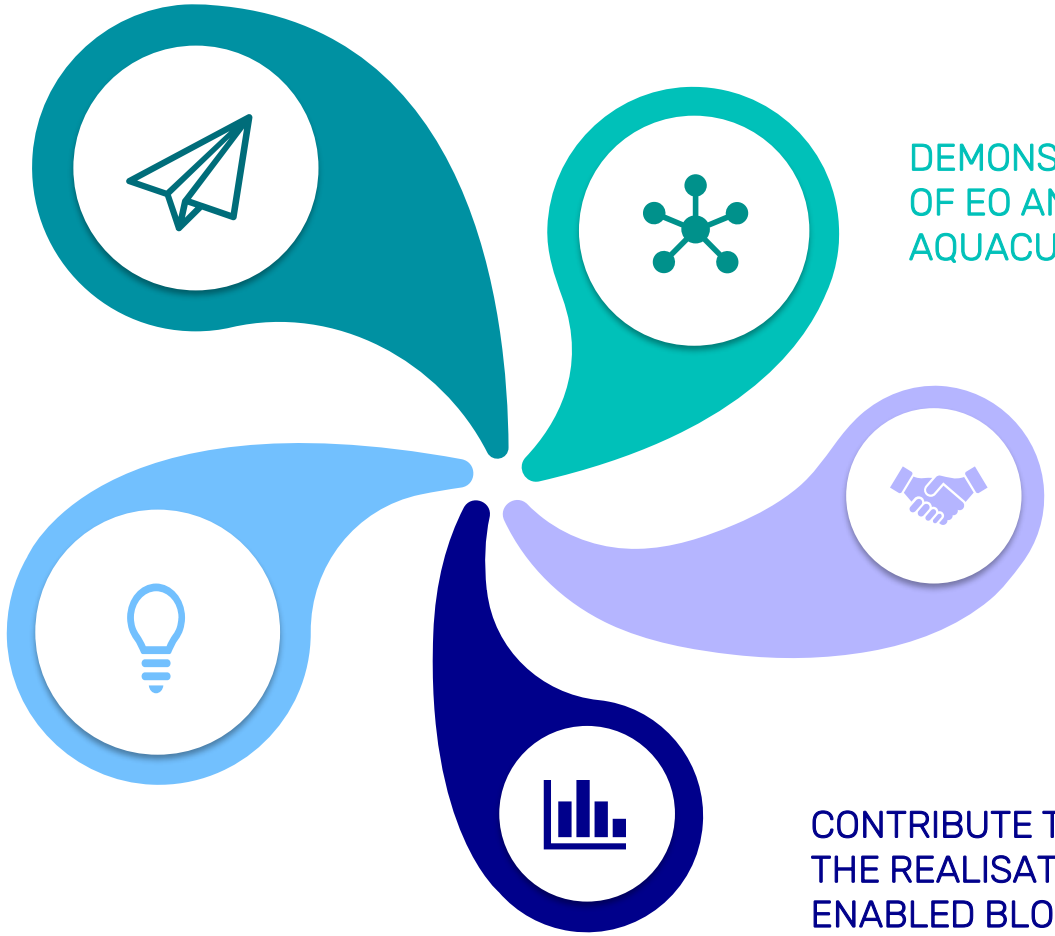






SUMMARY

SHOWCASE HOW EO SOLUTIONS CAN BRIDGE & CONNECT THE PHYSICAL ENVIRONMENT TO DIGITAL LEDGERS



DEMONSTRATION OF THE ADDED VALUE OF EO ANALYSIS TO TRACK AND TRACE AQUACULTURE COMMODITIES

CREATE AN INTEGRATED SYSTEM ATTEMPTING TO MINIMIZE EXISTING LIMITATIONS OF SUPPLY CHAIN PROCESSES

ENCHANCING FARMED FISH AND SEAFOOD TRACEABILITY & TRACKING & DEVELOPING BEST PRACTICES

CONTRIBUTE TO POLICY OBJECTIVES THROUGH THE REALISATION OF INNOVAIVE GEOSPATIAL ENABLED BLOCKCHAIN APPLICATIONS

AquaLedger

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THANK YOU!

Any Questions please?

Maria Dekavalla

Researcher / Project Manager, I-SENSE Group | ICCS

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