AquaLedger: Enhancing traceability and tracking in Aquaculture and fisheries supply chain through the use of blockchain and earth observation

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The goal of the AquaLedger project is to demonstrate the integration and connection between Distributed Ledger Technology (DLT)/blockchain and earth observation (EO) technologies in the sector of supply chain management. More specifically, automated earth observation based analytical processes will be employed to provide valuable information about the tracking and tracing of fishery and aquaculture commodities and/or the verification and appending of transactions recorded in the blockchain. Thus, the activity aims to advance current knowledge and expertise in DLT and EO convergence resulting in an integrated system that will be demonstrated in real life conditions while also addressing the needs of the relevant actors in the supply chain management of the aquaculture sector. The implemented system is validated in the context of near-shore aquaculture activities.

A sustainable supply chain can be defined as a process of providing services to the aquaculture users during a way that fosters continuous and reliable water quality information and indicators. Water quality remote sensing constitutes a fast-growing field spurred by major investment into satellite observation capabilities. In aquaculture, water quality monitoring is required not only for sea farms but also for hatcheries that pump water from the ocean, especially because of certain species (i.e. fish larvae) that are very sensitive to water quality issues. The quality of the water where the aquaculture activities take place, affects the final products, jeopardizing the security of the food that reaches the consumer. However, despite its undeniable value, this type of information is not usually tracked and monitored during the supply chain of the food.

Thus, the main use cases of the implemented system involve i) employing EO based services towards the provision of accurate information about the water quality of aquaculture assets as well as the farming productivity ii) showcasing how EO data can connect the physical environment to the distributed ledgers and be utilised for validating the conditions of transactions between actors in the supply chain and iii) monitoring the compliance of the food movement in the supply chain

Among the abovementioned water quality parameters, sea surface temperature is a key factor because it influences the variation of many physical and biochemical seawater properties as well as the entire life cycle of the fish. Sea surface temperature is monitored through the use of the Sea and Land Surface Temperature Radiometer (SLSTR) of Sentinel 3 with a spatial resolution of 1 km. Additionally, turbidity, chlorophyll-a and nutrient concentration are very important parameters for health and growth whilst the monitoring of pollution factors is essential for preventing their catastrophic impact (i.e. high mortality rate) on fish farms. Various algorithms (empirical, semi-empirical and analytical) were tested to generate the essential water quality information from atmospherically corrected Sentinel 2 MSI and Sentinel 3 OLCI data which have been widely used in the context of water quality monitoring studies. The most appropriate algorithm was selected through the use of field observations collected at the fish farming site. In the context of this application case, the Case 2 regional Coast Colour (C2RCC) processor and empirical algorithms were utilized for the acquisition of water quality parameters from Sentinel 2 MSI. The sea skin temperatures values extracted from Sentinel 3 SLSTR were also considered accurate if prior outlier detection and removal is performed. It must be noticed that the Sentinel 2 data were able to extract valuable water quality information both with analytical and empirical algorithms. Sentinel 3 OLCI data did not achieve competitive results given that it has a limited performance when it comes to coastal areas or similar ecosystems laying within a short distance from the land.

Last but not least, in order to serve the AquaLedger application cases for seafood supply chain, different DLT/Blockchain platforms have been analysed towards the realisation of the most effective solution. External events being provided by EO component and other external data sources (i.e. Enterprise Resource Planning software) are incorporated in the DLT system through the realisation of web-services.