Harnessing Earth Observation and Socio-Economic Insights for Sustainable Aquaculture Development: Lessons from Bangladesh and Kenya

ABSTRACT

Aquaculture plays an important role in fostering economic growth and addressing rural poverty in numerous regions worldwide. The AQUADMC (Optimising AQUAculture Development and Market Connectivity) project focuses on integrating diverse datasets, including EO-derived information and socio-economic data, to support the development of freshwater and coastal aquaculture in various parts of Bangladesh and Kenya. Using satellite imagery, socio-economic insights, and logistical analysis, the project seeks to optimise site selection, enhance market connectivity, and promote environmentally sustainable practices.

The methodology employs advanced satellite technologies to monitor water quality parameters in rivers, lakes and coastal areas. Indicators such as turbidity, chlorophyll-a concentrations, salinity and surface temperature are analysed to evaluate environmental suitability for aquaculture activities. Water quality data obtained through the application of algorithms on satellite imagery are complemented by historical, socio-economic data tracing the evolution of aquaculture practices in the analysed regions.

The integration of socio-economic and logistical data in the identification of aquaculture trends seems to demonstrate a strong alignment with water quality data derived from satellites for the monitoring of existing aquaculture sites and the possible location of new ponds.
The project is an interactive decision support tool, providing policymakers and stakeholders with a comprehensive resource for making informed decisions. The AQUADMC project represents an exemplary case of international cooperation in Earth observation. These efforts highlight the critical role of collaborative approaches in promoting sustainable aquaculture development in Bangladesh, Kenya and beyond.

INTRODUCTION

Aquaculture is one of the fastest-growing food production sectors worldwide, playing a vital role in enhancing food security and supporting the livelihoods of local communities. Despite its potential, conventional aquaculture practices often suffer from inefficiencies, pose risks to the environment, and present challenges in day-to-day operational management. Consequently, there is a pressing need for robust tools that can help ensure compliance with ecological standards while addressing the demands of both markets and local populations.

In this regard, EO technology presents a transformative solution. By enabling large-scale, remote monitoring, it supports more effective decision-making and planning. This technology is particularly valuable in identifying optimal locations for aquaculture development by integrating a wide range of environmental, socio-economic, and logistical data. The result is a strategic, sustainable approach that balances productivity with ecological and social responsibility.

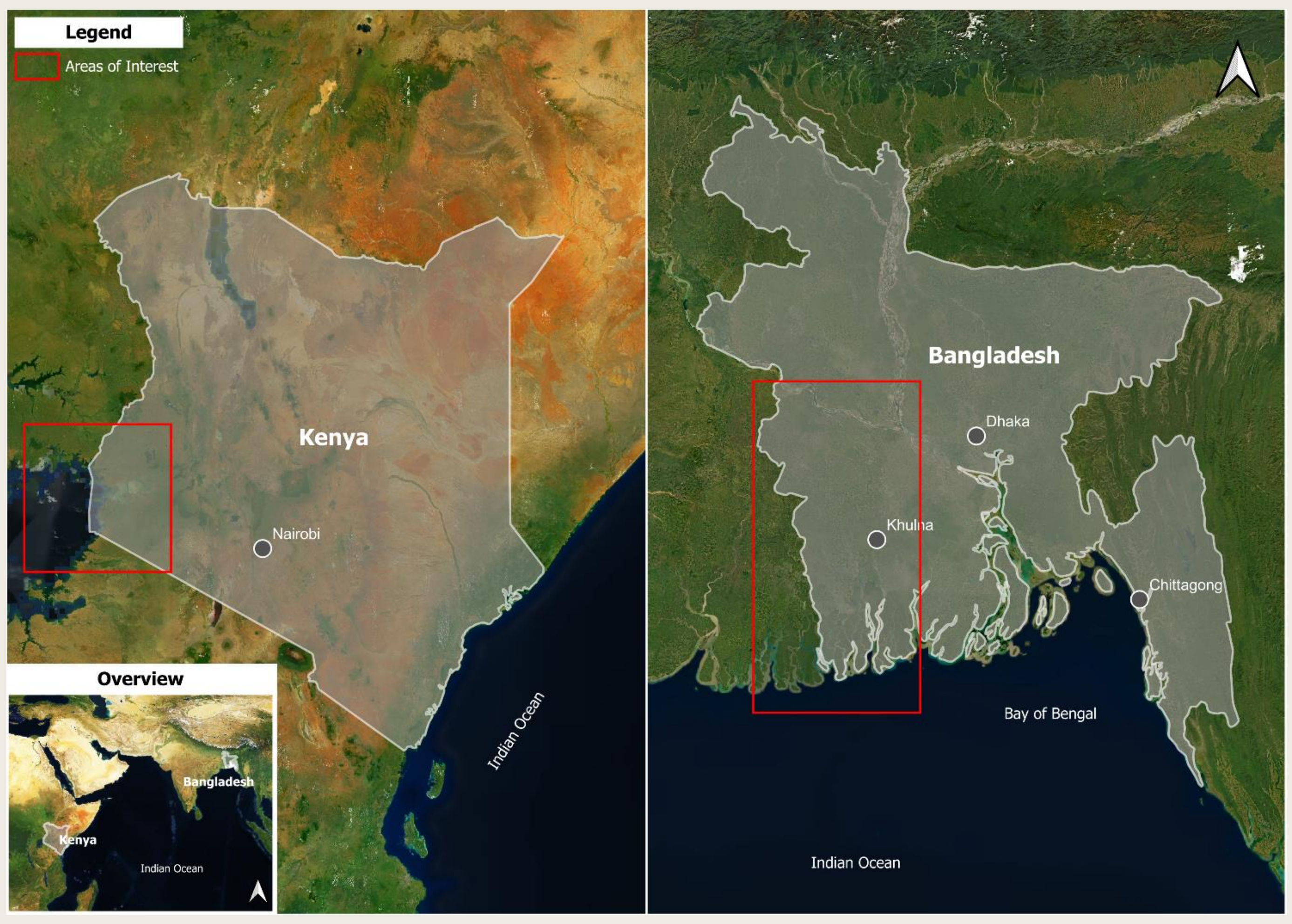


Figure 1 – Areas of Interest.

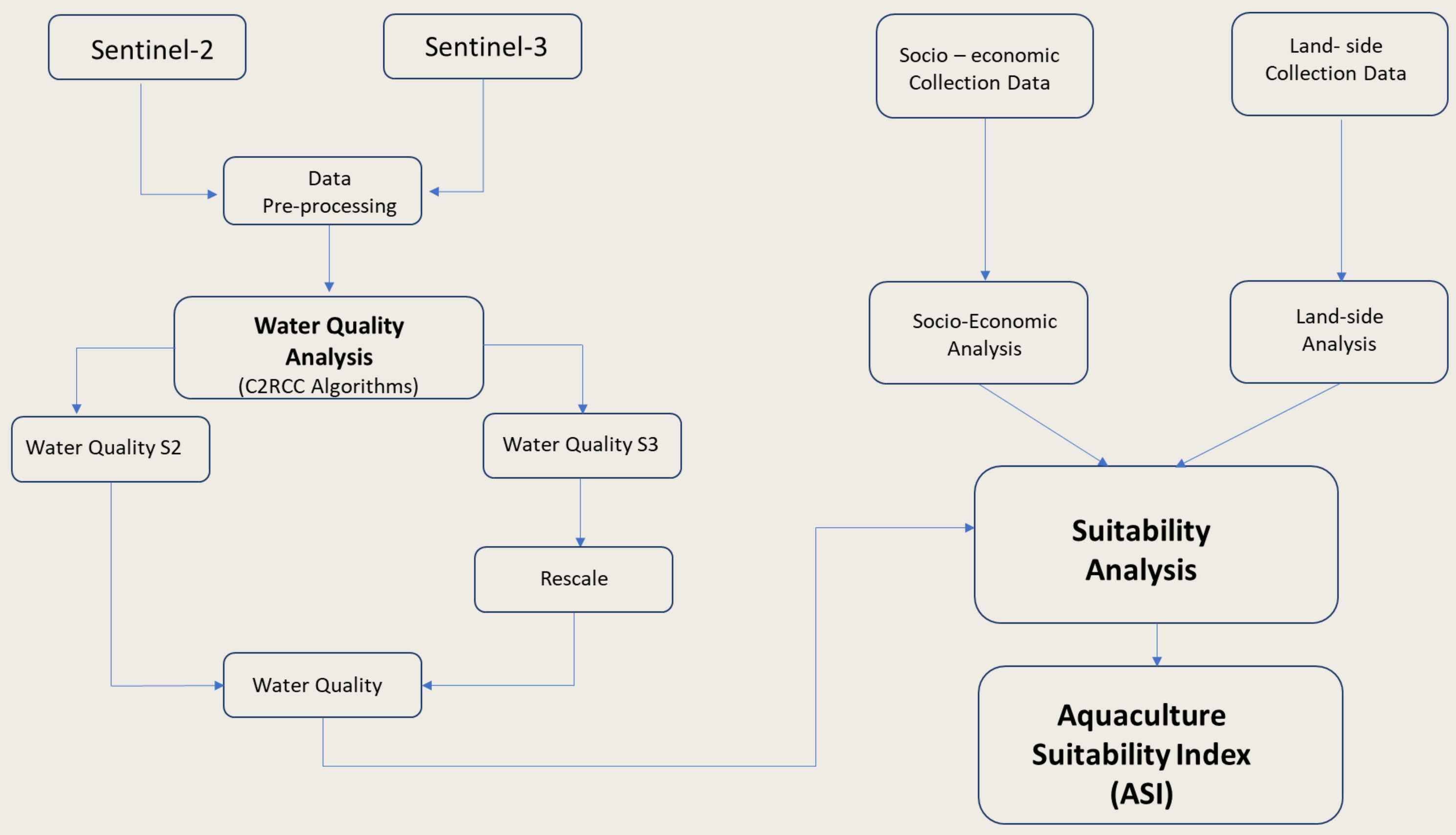


Figure 2 – Aquaculture Suitability Index workflow.

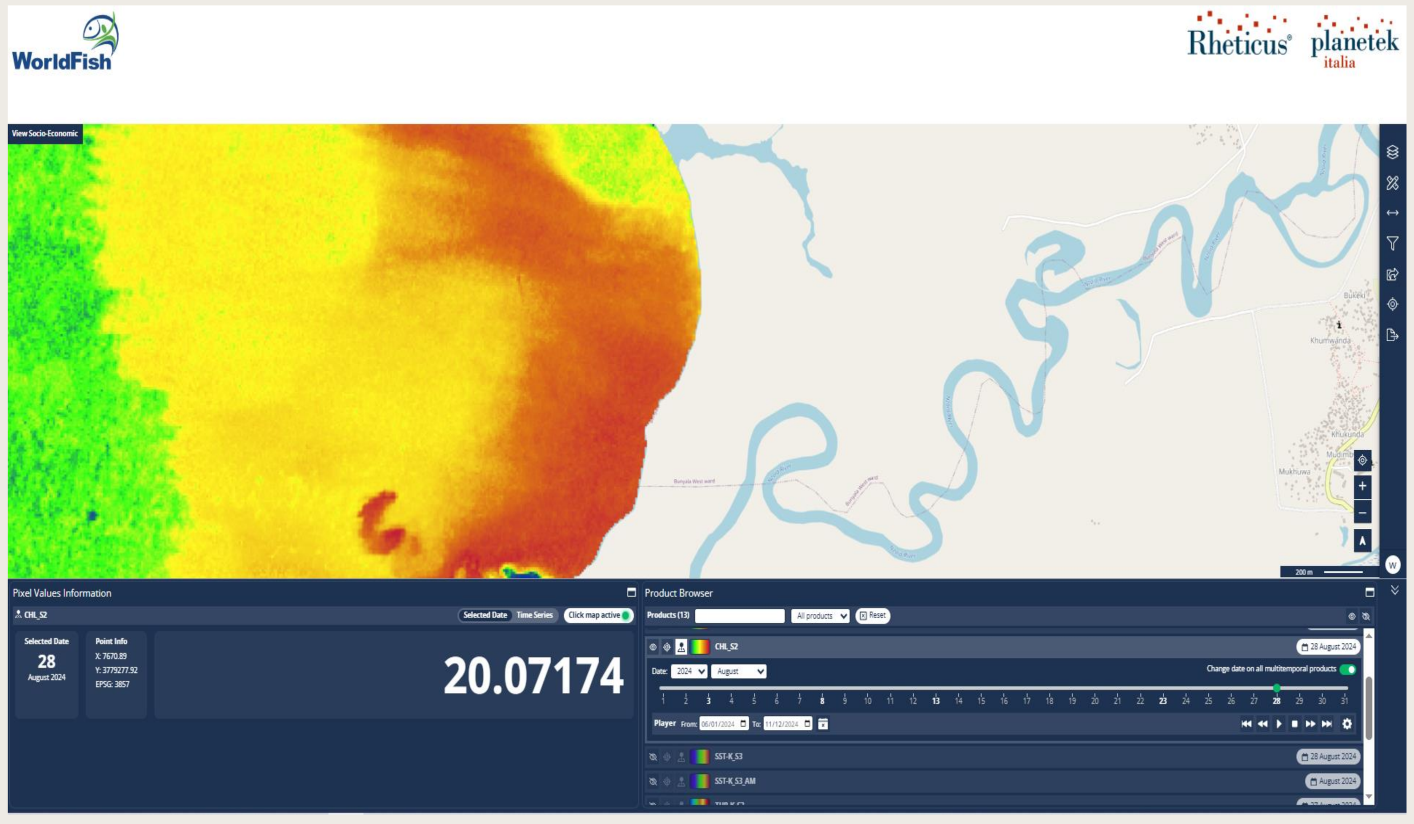
METHODOLOGY

Water Quality in coastal and in land areas was assessed using multispectral satellite imagery and optical remote sensing algorithms, based on empirical relationships derived from surface reflectance.

Key parameters included chlorophyll-a, total suspended matter, turbidity, water transparency, and sea surface temperature (SST). Satellite data were collected and pre-processed from multiple sources: Sentinel-3A/3B (OLCI, SLSTR), Sentinel-2A/2B (MSI), and the Copernicus Marine Environment Monitoring Service (CMEMS).

Monthly composite maps were produced using arithmetic and geometric means, along with 90^{th} percentile values, to capture spatial and temporal variability. Time series and trend analyses were applied to detect seasonal and interannual patterns relevant to aquaculture planning.

Remote sensing outputs were integrated with historical socioeconomic data and geospatial layers, including transportation infrastructure. These inputs informed the development of an Aquaculture Suitability Index (ASI): a composite metric combining environmental, socio-economic and logistical factors to classify areas by their potential for sustainable aquaculture development.



THE GEOSPATIAL PLATFORM

The AQUADMC geospatial web platform, developed by Planetek Italia in collaboration with WorldFish, integrates environmental, socioeconomic, and logistical data into an interactive and user-friendly interface.

Users can visualize aquaculture suitability maps, customize selection criteria, and generate actionable insights in real time.

Designed to support policymakers, investors, and local communities, the platform facilitates informed decision-making for sustainable aquaculture development.

Figure 3 – The AQUADMC Geospatial Platform.

CONCLUSIONS

The AQUACMD project demonstrates a robust, data-driven approach to advancing sustainable aquaculture. By integrating satellite-based EO with socioeconomic and logistical datasets, the project offers a comprehensive framework for informed site selection and environmental monitoring.

Case studies in Bangladesh and Kenya illustrate how geospatial technologies can effectively guide aquaculture planning while enhancing rural livelihoods.

AQUACMD sets a precedent for how digital innovation can support resilient, inclusive, and environmentally sound aquaculture strategies in emerging economies.

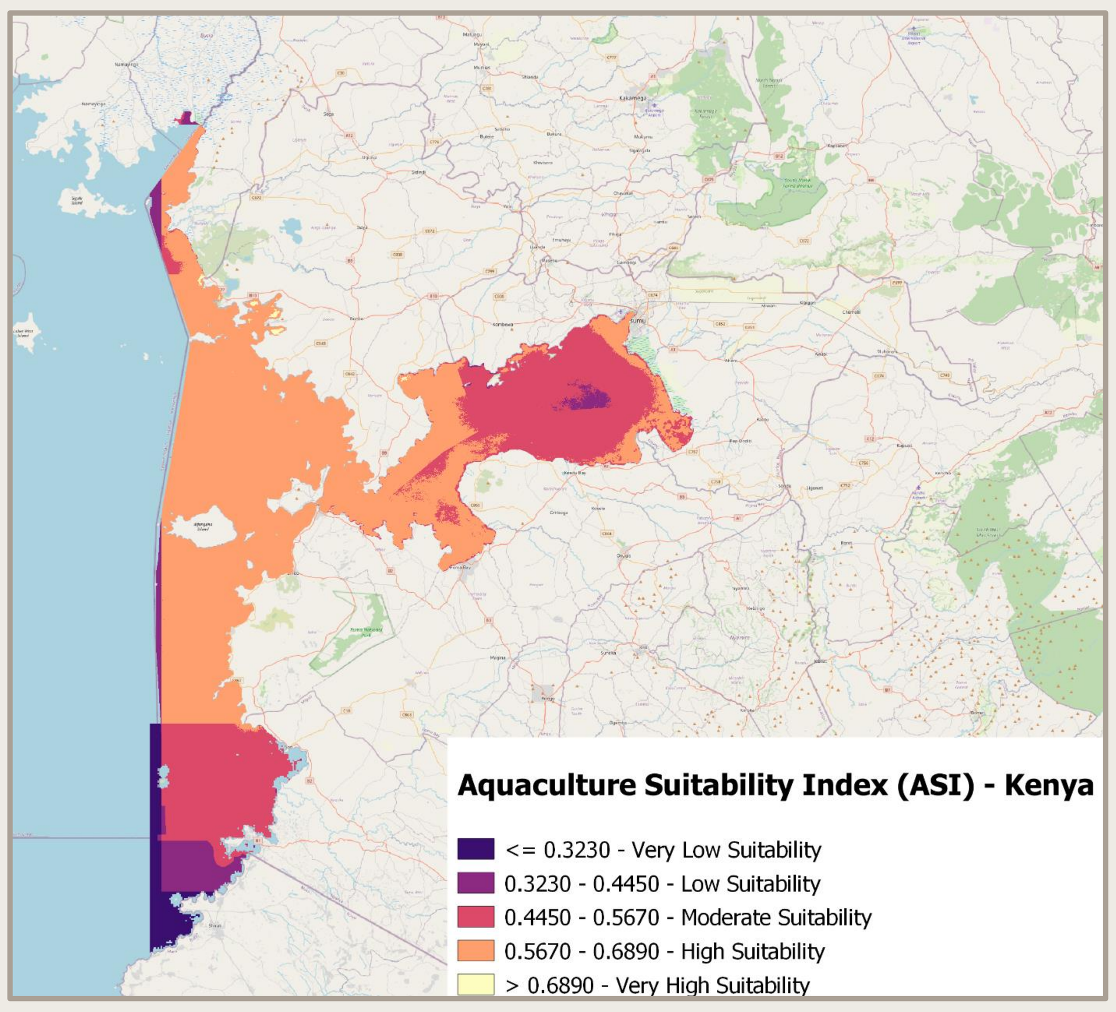


Figure 4 – The Aquaculture Suitability Index for Kenya.

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