

6 Case Study: Application of a Sustainable Nori Farming Model

6.1 Overview of the case study area and farming model design

The case study area can be framed as a nutrient-influenced coastal zone suitable for *Porphyra/Pyropia* cultivation, with model design guided by the dual goals of biomass production and environmental service delivery. Seaweed aquaculture is already recognized as a large and growing component of global mariculture, and it is increasingly valued for climate mitigation, eutrophication control, and broader circular-bioeconomy functions (Duarte et al., 2021). For nori specifically, site suitability depends strongly on temperature, irradiance, and nutrient availability, because these drivers regulate photosynthesis, reserve accumulation, and final yield under field conditions.

Accordingly, the farming model was designed as a seasonal, ecosystem-based production system that combines offshore or nearshore cultivation with controlled nursery support and adaptive capacity limits. Early-stage *Porphyra* production is commonly stabilized in indoor nurseries where stocking density, temperature, light, and aeration are controlled before scale-up (Cortez et al., 2026). At the farm scale, sustainable layout also requires matching cultivation density to environmental carrying capacity and using scenario-based planning tools that can forecast biomass performance under changing field conditions (Tac et al., 2025).

6.2 Implementation of sustainable farming techniques and management measures

Implementation centered on three linked measures: controlled seedling production, nutrient-efficient cultivation, and integrated environmental management. Nori cultivation is inherently challenging because of its heteromorphic life cycle, so reliable hatchery control over the conchocelis, spore, and young blade stages is essential for stable commercial output (Cortez et al., 2026). Where full conchocelis control is difficult, simplified propagation pathways such as neutral-spore-based culture can reduce technical barriers and support low-cost local expansion of *Pyropia* farming.

Field management emphasized water-quality regulation, spacing, and timing in order to maximize nutrient uptake while limiting stress and crop quality loss. Large-scale *Porphyra* cultivation in open coastal waters has been shown to reduce dissolved inorganic nitrogen and phosphorus substantially, with reported reductions of 50%-94% for ammonium and 42%-67% for phosphate relative to controls (He et al., 2008). Because farming outcomes are highly site-specific, operational practices such as net depth, seeding timing, and periodic exposure or other anti-fouling measures must be adjusted to local current, light, temperature, and water-quality regimes rather than transferred unchanged across sites.

6.3 Analysis of application results and summary of experience

The application results indicate that a sustainable nori farming model can generate both production and ecological gains when cultivation intensity is aligned with local environmental conditions. *Porphyra* farming can function as an extractive component in integrated multi-trophic aquaculture, recycling excess nutrients and improving the environmental performance of aquaculture sites while adding total biomass value. More broadly, seaweed cultivation in China has been estimated to remove large nutrient loads and sequester substantial carbon, although the magnitude of benefits depends on spatial management and local water quality.

The main lessons from the case study are that sustainable nori farming depends on adaptive site selection, biological risk management, and realistic economic planning rather than on yield maximization alone. Long-term resilience requires attention to disease, pests, governance, and climate-related stressors, because short-term success can be undermined if environmental and operational risks are underestimated (Zhu et al., 2025). It also requires protecting genetic resources and avoiding overly narrow cultivation bases, since reduced diversity and unmanaged farm-wild interactions can weaken resilience over time (Brakel et al., 2021).

7 Challenges in Promoting Green *Porphyra* Farming Models

7.1 Insufficient technology integration and standardization

A central constraint on promoting green *Porphyra* farming models is that many enabling technologies remain fragmented rather than integrated into standardized production systems. Reviews of seaweed aquaculture show that