

# Boosting Resilience in the Seaweed Industry

## Focus on Risk Management Policies and Practices in South Korea and Other Regions

\*Jae Young Ryu<sup>1,2,3</sup>, Nidhi Nagabhatla<sup>2,4,5</sup>, Elizabeth J. Cottier-Cook<sup>3,6</sup>, Gwang Hoon Kim<sup>7</sup>, Ju-Hyoung Kim<sup>8</sup>, and Sil K. Maslov Lescauwae<sup>2,4,9</sup>

<sup>1</sup> Sciences et techniques, Nantes Université, Nantes, 44300, France

<sup>2</sup> United Nations University Institute on Comparative Regional Integration Studies (UNU-CRIS), Bruges, 8000, Belgium

<sup>3</sup> University of the Highlands and Islands, Dunbeg, Oban, PA37 1AQ, UK

<sup>4</sup> University of Ghent, Ghent, 9000, Belgium

<sup>5</sup> School of Geography Earth Science and Society, McMaster University, Hamilton, ON L8S 4L8, Canada

<sup>6</sup> Scottish Association for Marine Science, Oban, PA37 1QA, UK

<sup>7</sup> Department of Biological Sciences, Kongju National University, Gongju 32588, South Korea

<sup>8</sup> Department of Aquaculture and Aquatic Science, Kunsan National University, Gunsan 54150, South Korea

<sup>9</sup> Flanders Training Program, Brussels, 1210, Belgium

\*Correspond author: janery801@daum.net

## Introduction

### Eco-friendly and sustainable seaweed

- As of 2022, global seaweed aquaculture production reached 36.5 million tons, and seaweed is in global demand as a sustainable, low-carbon solution to climate change and food insecurity.

### Seaweed production in Korea

- In 2023, Korea's seaweed production reached 1.74 million tons, and laver (*Pyropia* spp.) export value recorded almost USD 1 billion to over 120 countries in 2024.
- Jeollanam-do Province produces about 1.6 million tons of seaweed, which is about 91.5% of the national production. Wando is a region particularly suitable for seaweed farming and is considered the largest producer (Fig. 1).

## Purpose

### Need for research

- The seaweed aquaculture industry faces risks such as climate change and market volatility. To address these challenges, financial instruments like Aquaculture Disaster Insurance (ADI) have been proposed as potential solutions, however, their application in the seaweed aquaculture sector remains limited.

### Research purpose

- This paper aims to analyse how ADI and related financial policies contribute to building resilience and supporting sustainable growth in the seaweed industry, using South Korea's relatively stable and growing seaweed sector as a case study.
- It also identified lessons for addressing climate change and advancing sustainable seaweed aquaculture in alignment with UN Sustainable Development Goals (SDG) 14: Life below water.

## Results

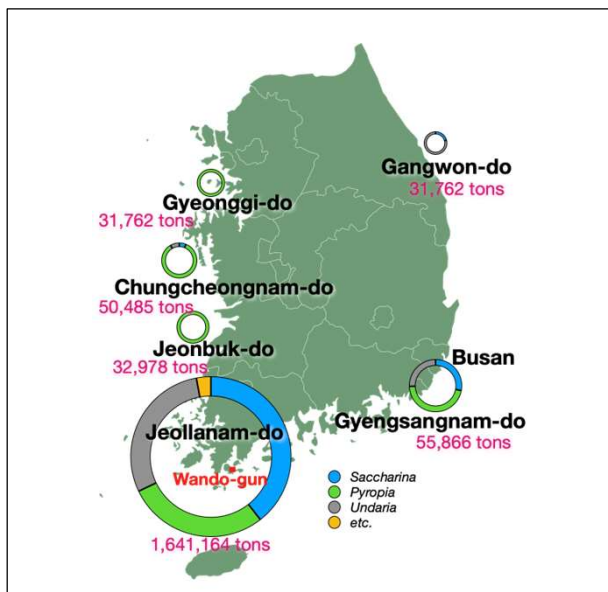


Figure 1. Map to show the distribution of seaweed production in South Korea. (C. S. Park & Hwang, 2022. Data Source : KOSIS)

### Factors that enhance the resilience and sustainability of the Korean seaweed industry

#### Technological innovations

- Traditional method of seaweed farming was the rack system, but productivity has since been enhanced through the development of various techniques, including floating net aquaculture method (Fig. 2).
- In response to climate and environmental changes, the country is now pursuing the development of land-based *Pyropia* spp. farming systems through public-private partnerships, with an investment plan of approximately USD 27 million by 2029.

#### Tenure rights and other regulatory norms, such as farm site licensing

- In South Korea, Seaweed aquaculture farmers are required to obtain aquaculture licenses. A total of 2,150 seaweed-related aquaculture licenses nationwide, covering an area of 90,571 hectares in 2023.

## Results

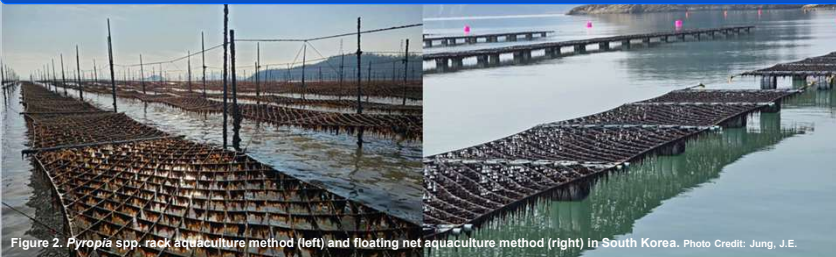


Figure 2. *Pyropia* spp. rack aquaculture method (left) and floating net aquaculture method (right) in South Korea. Photo Credit: Jung, J.E.

### Aquaculture and Fishery Disaster Insurance (ADI)

- Since 2008, South Korea has implemented the Aquaculture Disaster Insurance (ADI) system to promote the sustainability and financial stability of the seaweed aquaculture industry. Initially covering only one species (olive flounder), the program expanded to 28 species by 2018, and four seaweed species, *Pyropia* spp., *Undaria* spp., *Saccharina* spp. and *Sargassum fusiforme*, were added.
- MOF has established a mid- to long-term plan aiming to expand the number of covered species to 35 and increase the registration rate to 45% by 2027 (Table 1).

Table 1. ADI Comparison in Other Countries and Regions compiled from various sources by the authors

Country/Region	Subsidy scope	Source of funds	Policy support	Challenges
South Korea	> 50%	Ministry of Oceans and Fisheries (MOF)	Production covered due to natural disasters and diseases. Facility covered due to natural disasters	Low registration from seaweed farmers, and huge registration gap between each species (0% to > 80%)
Indonesia	Up to 100%	Small Fish Farmer Insurance (APPIK)	Natural disasters, diseases outbreak, impacts of climate change	Low awareness and insured area
Philippines	For the farm up to 0.1 ha	Crop Insurance Corporation (PICIC) under the Government Owned and Controlled Corporation (GOCC)	Coverage from stocking to harvest due to natural disasters and others	Detailed guidelines required for document preparation, delays in timely support
Vietnam	Varies depending on the levels of farmer's income	Ministry of Finance (MOF), Ministry of Agriculture and Rural Development (MARD)	Coverage against natural disasters and named diseases, with government premium subsidies for farmers	Risk sharing and limited participation
China	Varies by province	Provincial and national government subsidies	Index-based insurance covering environmental triggers, while promoting good practices	Uneven adoption across provinces, marine aquaculture underinsured
USA	Waiver of service up to 50	Noninsured Crop Disaster Assistance Program (NAP) under the U.S. Department of Agriculture (USDA)	Limited coverage, mainly to losses caused by natural disasters	HAB not covered, accessibility issues for small-scale farmers
EU	Private insurance schemes EU funding mechanisms	European Maritime Fisheries and Aquaculture Fund (EMFAF)	Funding support, sustainability incentives	No dedicated aquaculture insurance scheme
Africa	No formal insurance mechanisms	No structured funding	Focus on community resilience strategies (Madagascar) rather than direct insurance	High financial risk for small-scale farmers
Latin America	Private insurance schemes primarily limited to large-scale aquaculture	National governments (e.g. Brazil) private insurers for large-scale aquaculture	Focus on limiting wild harvesting, research and development rather than insurance	Limited accessibility for small-scale seaweed farmers

### The role of monitoring technologies in boosting resilience

- Advanced satellite technology is being utilised to effectively monitor and manage the frequency of red tide and HAB outbreaks. For example, the Geostationary Ocean Color Imager (GOCI) plays a key role in detecting and tracking red tide occurrence and spreading in real-time with the HAB early warning and management system.

### Improvements in wider ecosystem health

- South Korean government has supported the restoration of seaweed habitats through the "Marine Forest Project." Since its launch in 2009, the project has successfully established marine forests across 228 sites, covering approximately 30,000 hectares by 2022. It has achieved notable outcomes, including a 94.5% average increase in seaweed biomass and a 19.5% increase in species diversity.

### Certification - Aquaculture Stewardship Council (ASC)

- ASC is an international certification standard for environmentally sustainable and socially responsible aquaculture. In South Korea, there are 16 ASC-certified seaweed farms, and 6 processing companies have obtained the ASC Chain of Custody (CoC) certification for seaweed.

## Conclusions

- Globally, various strategies are being employed to strengthen the resilience of the seaweed aquaculture industry, depending on regional characteristics and government capacities. However, implementation remains limited.
- South Korea stands out as a leading example of enhancing industry resilience through a combination of strategic public policy support, including ADI. Its model offers valuable lessons for other countries aiming to build a resilient and sustainable aquaculture industry.
- By identifying policy lessons and resilience strategies that carry the potential to support sustainable marine resource use globally, these insights contribute to advancing the UN Sustainable Development Goal (SDG) 14.