

ULVA VALUE CHAIN DEVELOPMENT FOR SUSTAINABILITY AND LIVELIHOODS IN INDONESIA

By Sudari Pawiro, Lideman and Maria Gigih

Various species of *Ulva* (sea lettuce) are being farmed successfully in some countries under controlled and intensive conditions, but the challenge is how to develop low-investment farming systems for coastal communities. Addressing this concern, UNIDO-GQSP Indonesia has recently launched several pilot projects in the country focused on building the capacity of small-scale farmers and processors. Though still in the early stages, the results so far have been encouraging for the organisation and the communities involved with regard to the farming of *Ulva* in tanks as well as the successful marketing of products in big cities in Indonesia at significantly higher prices than before.



Wild *Ulva* harvesters/collectors in Gunung Kidul district of Jogjakarta Indonesia



Credit: Julius, Sambung Asa

Indonesia is well known as the world's largest producer of tropical red seaweed species, mainly *Kappaphycus alvarezii* (*Eucheuma cottonii*), *E. spinosum* and *Gracilaria* spp., comprising around 45% of the global red seaweed production in 2022. These species are mainly utilised for carrageenan and agar production. At the same time, the country is also seeing significant growth in the edible green seaweed sector, involving species such as sea grape (*Caulerpa* spp.) and sea lettuce (*Ulva* spp.).

Sea grape is very popular in some parts of Indonesia, particularly in South Sulawesi and the northern coastal areas of Central Java; it is eaten fresh as a salad vegetable and is available from wild harvests as well as farmed.

Sea lettuce is also abundantly available in Indonesia, being harvested from the wild in the coastal areas of Sulawesi, Lombok and the southern coastal areas of the island of Java. The main species harvested is *U. lactuca*, and to a lesser quantity, *U. reticulata*, *U. linza* and *U. compressa*. Traditionally, harvesters collect *Ulva* along the coastal areas during low tide, sell it in dried form to local traders who then send it to processors/traders/exporters supplying local and export markets for food, feed, fertiliser and pharmaceutical purposes.

Potential uses of *Ulva*

Categorised as a green seaweed, *Ulva* contains chlorophyll and beta carotenoid, as well as being rich in nutrients and bioactive compounds that can potentially be used as food or as an ingredient in feed, cosmetics, bio-fertilisers and pharmaceutical products. Its nutrition content varies depending on the season, geographic location, and the amount of dissolved nutrients in the water where it grows, as well as its age. Plenty of studies have been done which show that *Ulva* contains macro- and micronutrients, in addition to having a high protein content of reportedly up to 20%, carbohydrates, lipids and fibre.

One of its important active ingredients is ulvan, a water-soluble polysaccharide which can be used as an antioxidant, antimicrobial pathogen and anticancer agent, as well as possessing a high phenol content. In addition to its nutritional value, *U. lactuca* can also be used for bioremediation because it has a high growth rate in a wide range of environmental conditions and is able to absorb nutrients from liquid waste arising from farming activities. Furthermore, as an edible seaweed, *Ulva* in Indonesia is used to make food products, including chips, flakes

and sea vegetables; as a healthy salt source; and as a bio-stimulant (for example, a company in Bali uses harvested wild *Ulva* as a bio-fertiliser and bio-stimulant).

Reportedly, most of the dried *Ulva* exported from Indonesia is used as a feed ingredient in countries such as Vietnam. Considering its potential for various usages as food and non-food, the Global Quality and Standards Programme (GQSP) Indonesia, a project jointly implemented by UNIDO (United Nations Industrial Development Organization) and the Ministry of Marine Affairs and Fisheries (MMAF) in collaboration with private partners, supports the development of a sustainable *Ulva* value chain to protect biodiversity and improve the livelihoods of coastal communities in selected locations.

Sustainable farming trials

In the absence of harvest control regulations for wild *Ulva* and the growing demand for its products in recent years, there is a potential danger of over-exploitation that can lead to extinction. The wild *Ulva* harvested or collected seasonally from the seashore exhibits several weaknesses; for example, the content of impurities in the dried *Ulva* is generally high, and the quality is inconsistent depending on the season and location; hence it is usually classified as non-food grade and only used as feed or fertiliser. Buyers also often request for laboratory testing to ensure that the *Ulva* is not contaminated with toxic substances from alga blooms (red tide) during its growing period. Against this background, it is crucial to ensure that the *Ulva* is farmed sustainably to reduce harvesting pressure on wild stocks, and at the same time, to work towards a stable and consistent supply in terms of volume and quality.

Ulva has been farmed and commercialised in some countries under controlled and intensive conditions. The challenge is how to develop farming systems for coastal communities, requiring low investment and appropriate technology. Several factors that affect its growth include water salinity and temperature as well as nutrients, light intensity, water movement and the microbiome in each site. The temperature determines the biochemical processes in the cell; salinity is related to osmotic pressure; light is closely related to the photosynthesis process to produce energy; and water movement is related to the process of nutrient absorption for cell formation. Fortunately, *Ulva* easily adapts to a wide range of environments, changing its morphological characteristics quickly in the process.

Farming *Ulva lactuca* in Indonesia has been tried on a small-scale in fiberglass, concrete, and tarpaulin tanks, mainly carried out by researchers of government R&D centres and higher education institutions. In trials, *U. lactuca* was found to have a relatively fast growth rate and under ideal conditions, it should increase in weight by 5–10 times within seven days after the seeds are stocked in the growing tanks. Furthermore, it is envisaged that a tank which can contain 10 tonnes of seawater and stocked with 10 kg seeds, will produce 50–100 kg of wet biomass in a week, or 200–400 kg of wet biomass per month.

To commercialise and up-scale *Ulva* farming, GQSP Indonesia, in collaboration with a researcher from the National Research and Innovation Agency (BRIN) and private partners, recently (October 2024) launched pilot projects in the Takalar district of South Sulawesi; the Gunung Kidul district of Jogjakarta; and the Buleleng district of Bali. Investment in the construction of all necessary production facilities (tanks, pumps, aerators



Piloting *Ulva* farming in tanks in Gunung Kidul, Buleleng and Takalar districts

Credit: Lideman, Boedi Sardjana/GQSP Indonesia

etc.) was supplied by the private partners while GQSP Indonesia provides the technical assistance, starting from the construction of the production facilities and through the farming and monitoring stages.

Though the results have not yet achieved the ideal target, the overall performance has been encouraging: after a few harvests, the biomass reached around 2.5 times of the initial weight of seeds. The main challenges so far have been how to design the tanks so as to allow optimum water movement and circulation of nutrients; maximum penetration of sunlight into the tanks; and preventing predators from entering the tanks. To train operators to take charge of daily monitoring activities is also another challenge. By gaining more experience from the pilot projects, GQSP Indonesia expects that the target production can be achieved in the near future.

Empowering communities

Hundreds of local communities along the coastal areas of Gunung Kidul district facing the Indian Ocean, depend on *Ulva* for their income as harvesters/collectors, traders and processors. Gunung Kidul is well-known as one of tourist destinations in Jogjakarta province due to its nice beaches and famous seafood-based products including chips (deep-fried *Ulva* flavoured with spices) that are popular snacks among locals and also tourists. The increasing demand for these snacks has led to rampant harvesting of wild seaweed resources. This overexploitation has, unfortunately, resulted in a gradual decline in *Ulva* stocks in the area. However, there has been little effort to improve the livelihood of the locals. This highlights the urgent need for alternative approaches that can support both environmental conservation and protect the livelihoods of the community.

GQSP Indonesia, in collaboration with PT. Winner Perkasa Indonesia Unggul, has established a project to assist 50 small-scale women processors of *Ulva* chips from five beaches in Gunung Kidul, and at the same time to promote the farming of *Ulva*. The project aims to support the processors in improving their chip product quality and packaging as well as help them to obtain the necessary certificates to enable their products to access wider markets in modern retail outlets and through online platforms. Other major objectives were to showcase the possibility of farming to the locals as an alternative source of more sustainable income and better quality of raw materials; as well as reduce dependency on the wild stocks.

Since June 2024, capacity-building sessions have been provided for the selected small-scale processors, including training on processing and packaging technology; quality assurance; product development; diversification; value-addition and marketing as well as promotion. Research was carried out on enhancing the taste of the chips while retaining the distinctive, natural taste of *Ulva*; producing *Ulva* flour for various culinary applications; and producing *Ulva* flakes and other derivative products. Close technical guidance was also given, aimed at improving the harvesting methods for wild *Ulva* to achieve better yields and quality.



Capacity building for small-scale *Ulva* processors in Gunung Kidul district

Meanwhile, the packaging design development for *Ulva* chips serves two primary goals: to preserve the product's freshness and quality, while ensuring that the chips are safe for consumption outside the district; and to create an eye-catching design that attracts customers. To enable the products to be sold at modern outlets, the programme also helps to obtain necessary certificates such as the halal certificate and sales permits from the authorities.

In the meantime, marketing and promotion efforts have been intensified on-line and off-line, including participation at national exhibitions, bazaars and joining on-line market platforms. As a result, various *Ulva* products (chips, flour and flakes) from these small-scale women processors have successfully been marketed outside of Gunung Kidul, including to Jakarta, Bali, Semarang, and other big cities in Indonesia. A comparison of the sales volume before and after the training is presented in Table 1. The total value of the sales after the capacity building is estimated at around IDR 110 million (USD 7 100), a sum that really meant a lot for the community.

Table 1. Sales of various *Ulva* products before and after the training sessions

| Products | Before Training | After Training |
|-------------------------------------|-----------------|----------------|
| <i>Ulva</i> Chips (Packaged/pack) | 600 pcs | 6 698 pcs |
| <i>Ulva</i> Chips (Bulk/kg) | - | 192 kg |
| Dried <i>Ulva</i> (Raw Material/kg) | - | 862 kg |
| <i>Ulva</i> powder (100gram) | - | 1 000 gram |
| <i>Ulva</i> Flakes (20gram) | - | 200 gram |



1



2



3



4

Credit: Maria Gigih, GQSP Indonesia

Ulva chips produced by the small-scale processors in Gunung Kidul before (Photos 1 & 2) and after (Photos 3 & 4) the capacity building.

The way forward

In supporting the development of sustainable *Ulva* value chains in Indonesia, it is crucial to give more attention to its sustainable farming to alleviate pressure on harvesting wild stocks. Towards this end, pilot farms have been launched in selected locations, and written guidelines (SOPs) are being prepared by UNIDO-GQSP Indonesia, aiming to demonstrate the economic viability of farming, and to eventually encourage its replication and upscaling in other parts of Indonesia. Since the results of the pilots are yet to be fully realised, the programme will continue to assist the partners technically in the meantime.

In addition to farming in tanks, trials will also be carried out with regard to farming *Ulva* in the outlets of shrimp farming ponds. The purpose is to make use of rich nutrients in the wastewater of shrimp farms to grow *Ulva* and at the same time to "clean" the wastewater before it is discharged. The *Ulva* harvested from the outlets can then be used as animal or fish feed. Farming *Ulva* in open sea water along the coastal areas is also being explored as an alternative, which might be cheaper compared to farming in tanks. 🌊

GQSP Indonesia Phase 2, in collaboration with the Ministry of Marine Affairs and Fisheries (MMAF) and the National Standardization Agency (BSN) as well as with other government agencies and fisheries associations, supports three selected aquaculture value chains, namely seaweed, shrimp, and milkfish. The Programme carries out its activities in 22 districts and 11 provinces across Indonesia; it aims to build upon the foundations laid during GQSP Phase 1 and deepen interventions by focusing on new species, new products and addressing climate change mitigation and adaption. Aligned with the national Blue Economy focus, GQSP Phase 2 enhances economic development, livelihoods, and ecosystem resilience. The Programme also supports the country to strengthen its quality infrastructures in the areas of standardisation, accreditation, certification, and national quality policy (www.gqspindonesia.org).



Sudari Pawiro is the National Chief Technical Advisor of UNIDO-GQSP Indonesia.



Lideman (PhD) is a researcher attached to the National Research and Innovation Agency and also a GQSP Indonesia consultant.



Maria Gigih is Director of PT Winner Perkasa Indonesia Unggul, a seaweed consultant and practitioner.