PROJECT «NETWORK FOR AGRICULTURE AND RURAL DEVELOPMENT

THINK-TANKS FOR COUNTRIES IN MEKONG-SUB-REGION (NARDT)»

Regional research

Agricultural innovations review in Sub-Mekong region countries

Innovation model: Tomgoxy shrimp aquaculture at My Lan company in Tra Vinh province – Viet Nam

2023

1. General information

Aquaculture in general and shrimp farming in particular is an agricultural production activity that brings many times higher profits than monoculture rice cultivation in the Mekong Delta. Therefore, some coastal areas in Bac Lieu, Ben Tre, Tra Vinh, Ca Mau, etc. have been strongly converted from rice land to aquaculture land. People's lives have been greatly improved and the area of shrimp farming has increased dramatically.

However, from the beginning of 2002, more than 70% of intensive shrimp farms had to reduce production or stop farming due to diseases. To increase productivity, the brackish water shrimp farming industry in the Mekong River Delta has gradually shifted from the model of "extensive earth-pond" shrimp farming, to "intensive farming of HDPE lined floating ponds" and "super intensive farming of floating ponds lined with tarpaulins". HDPE covered" with the density of commercial shrimp can reach 500 shrimp/m^2. High-tech shrimp farming models require multidisciplinary knowledge, from chemistry to water treatment, biology to microbiology, shrimp farming, algae farming to business knowledge to access domestic and foreign markets.

The high-tech shrimp farming model applying 4.0 technology of My Lan Group at Salicornia SJC Company has completely changed the long-standing traditional shrimp farming process in the Mekong Delta. Vietnam Technologies RYAN is a start-up company in Tra Vinh province has been researching, developing and applying TOMGOXY intensive shrimp farming model, based on 4 criteria including: 1) mangrove conservation; 2) efficient use of land, water and energy resources; 3) circular farming that combines algae, shrimp and fish farming to reduce production costs and environmental pollution; and 4) use renewable energy to replace energy from fossil fuel sources to achieve zero carbon emissions.

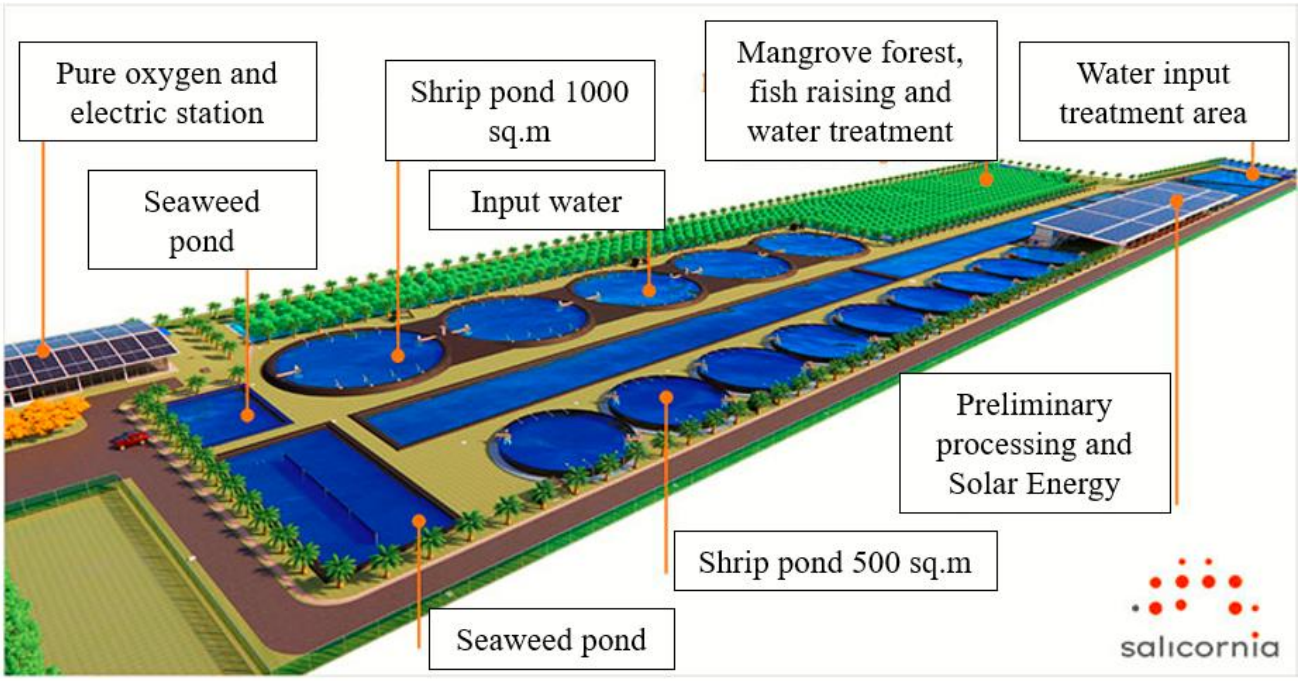
2. Model development

On an area of more than 6 hectares of land, the TOMGOXY (oxygen-rich shrimp) shrimp farming site has a closed construction facility to ensure the cycle of the high-tech shrimp farming process.

The input water treatment area includes water treatment ponds with chemicals, sedimentation, sand filtration and is ready with a volume of 10,000 m^3 of water equipped with a microwave system to kill cyanobacteria without chemicals. The commercial shrimp farming area consists of 5 semi-submerged round ponds, each with an area of 1,000 m^2 and 10 floating ponds on the ground, each with an area of 500 m^2. These shrimp ponds have an inverted conical bottom, lined with HDPE tarpaulin with a siphon in the

middle that effectively collects insoluble organic waste. Shrimp can be reared at a density of 300-500 shrimp/m^2 per period. The ponds are supplied with oxygen with a purity of over 90%, with a system that separates oxygen from the air with a capacity of 1,000 kg/day.

Shrimp farm of My Lan Group in Tra Vinh province – Viet Nam



Source: My Lan Group.

Each shrimp pond has 2 multifunctional systems used to:

- Create one-way laminar water flow.

- Dissolve oxygen in water.

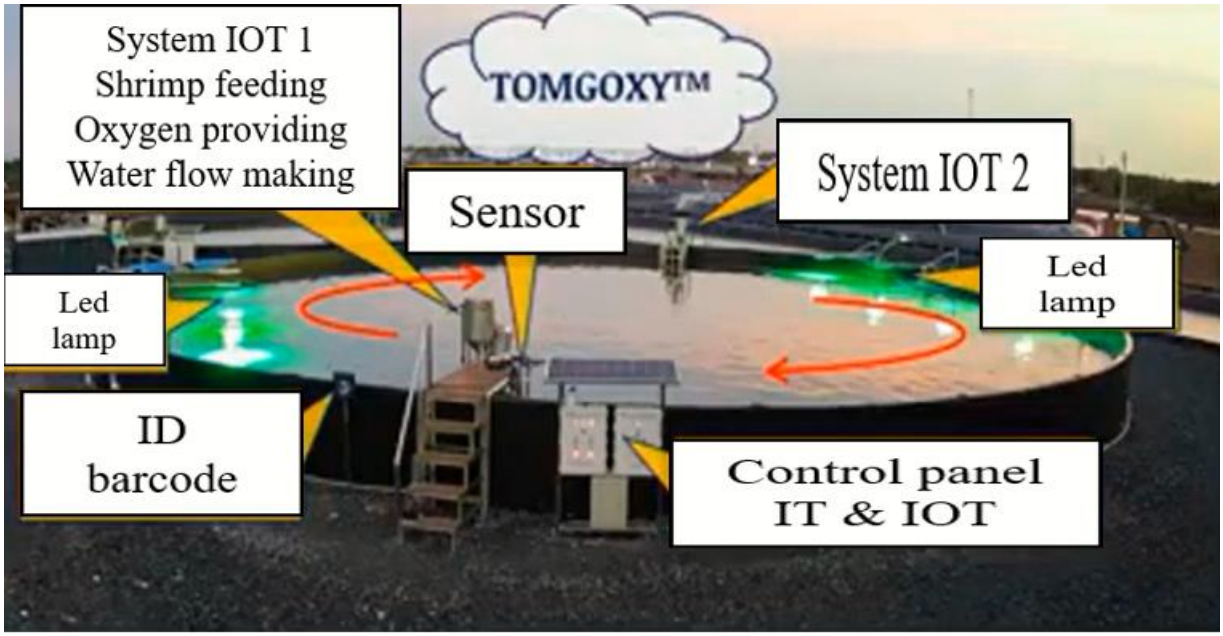
- Feed shrimp with automatic dosing unit.

- Online monitoring of DO, pH, salinity, water temperature, water level and sunshine with smart sensor.

Shrimp ponds are also equipped with LED lights to increase the time for shrimp to eat industrial food to help shrimp grow quickly.

The mangrove reserve is planted with 20,000 mangrove trees in combination with fish farming, helping to decompose organic waste in wastewater discharged from shrimp ponds. Water from the mangroves is pumped to the inlet, treated and reused for shrimp farming. The mangrove forest is capable of sequestering 246 tons of CO_2.

Equipments in shrimp pond



Source: My Lan Group.

The roof of the preliminary processing area is fitted with a solar battery with a capacity of 642,142 kWh/year with 500kWp. Each kWh of electricity in Vietnam emits 0.52 kg of CO_2. Thus, this solar battery system can reduce emissions of 335 tons of CO_2/year.

The smart devices in the model are connected to the internet via LoRa and 4G networks manufactured by RYNAN Technologies Vietnam Company in Tra Vinh City.

Shrimp production at this farm can reach from 240 tons to 300 tons/year. The production of fish harvested from the mangroves is about 40-50 tons/year. Producing each ton of shrimp requires about 2,400 kWh of electricity and 3,000 m^3 of water from mangroves.

Conserving mangroves, increasing energy efficiency with oxygen technology instead of aeration, shrimp farming that combines algae, fish farming, and using solar cells, can increase shrimp production on arable land and achieve zero CO_2 emissions.

The key point of this model lies in the very small and detailed application and innovation that will affect productivity, production costs and the environment. The first difference is the change of the water circulation system, replacing the turbulent flow into laminar flow to reduce the loss of dissolved oxygen. At the same time, the familiar aerators in traditional shrimp ponds were replaced by oxygen generators (which bring pure oxygen into the water so that dissolved oxygen is at a higher concentration than saturated). As a result, if until now, people could not raise shrimp in an oxygen environment of more than 7.6 mg/L, with this technology, shrimp can now be cultured

at concentrations of 12, 13, 14 or even 20 mg/L, a higher dissolved oxygen concentration is also fine.

Normally, just raising shrimp at an oxygen concentration of 8 to 14 mg/L, shrimp is already very healthy, less sick. Moreover, because no aeration technology is used, instead of having to use up to 5500 kWh/ton shrimp, the electricity consumption will be about 2500 kWh/ton shrimp or less. With the use of laminar water circulation system, it does not break shrimp feces and leftovers into very small solid particles suspended in the water, so it is easy to collect into the siphon system out of the pond, thereby saving money. lots of water. This model has also been cared for to better suit the behavior of the shrimp and the purpose of each stage. Instead of completely using natural light, shrimp ponds are combined between natural light and artificial light, in which the "daytime" period will last 18 hours, and the evening time is 6 hours. According to the author of this model, Mr. Nguyen Thanh My, "the shrimp is greatly affected by sunlight. If there is sunlight, they will follow in groups and eat industrial food, otherwise they will be solitary hunters and only eat algae and zooplankton. If shrimp eat a lot of natural food, the quality of shrimp is better, they eat better, but if they eat a lot of industrial food, they will grow faster."

The artificial light source and color will not be fixed but can be programmed to change automatically depending on the age and growth of the shrimp. In addition, with this model, shrimp ponds will also be controlled by digital technology to automate and report directly to shrimp farmers important parameters such as pH, salinity, dissolved oxygen concentration, etc. via mobile phone.

Table 1. Comparision between various shrimp farming methods in Vietnam

SHRIMP FARMING	NATURAL	INTESIVE (CHEMICAL	SUPER INTENSIVE (BIOCHEMICAL)	TOGOXY (DIGITAL PHYSICAL BIOCHEMICAL)
Farming pond structure	Soil	Floating pond lined with HDPE manual siphon	Floating pond lined with HDPE and roof manual siphon	Floating pond lined with HDPE and roof; automatic siphon
Farming area	100%	<20%	20-30%	50%
Shrimp density	10-30 con/m^2	100-300 shrimps/m^2	300-500 shrimps/m^2	>500 shrimps/m^2
Operation	Manual	Manual	Manual/semi-automatic	Automatic with digital technology and AI
Material input	Algae, Plankton	Industrial food Antibiotic Mineral	Industrial Food Antibiotic	Industrial Food Functional food

SHRIMP FARMING	NATURAL	INTESIVE (CHEMICAL	SUPER INTENSIVE (BIOCHEMICAL)	TOGOXY (DIGITAL PHYSICAL BIOCHEMICAL)
		Vitamins	Microorganisms and algae Herbal Mineral Vitamins	Microorganisms and algae Herbal Mineral Vitamin
Method of generating dissolved oxygen in water	Natural	Aeration DOm <7.6 mg/L Troubled water ~5,000 kWh/ton of shrimp	Aeration DOm <7.6 mg/L Troubled water ~5,000 kWh/ton of shrimp	Oxidized with pure oxygen DOm = 10-20 mg/L Floor flowing water <2,000 kWh/ton of shrimp
Lighting	Natural	Natural <12 hours/day	Natural <12 hours/day	Natural and artifical >18 hours/day
Investment capital	Low	Medium	High	Medium

Source: Nguyen Thanh My, My Lan Group.

With all these changes, shrimp farmers can increase the stocking density per farming area to over 500 shrimp/m^2; At the same time, it is possible to replace chemicals with physical and biological methods in water treatment and shrimp disease prevention, protect the ecological environment and reduce investment costs compared to the current super-intensive shrimp farming model.

Thus, this new model of super-intensive shrimp farming has solved a number of problems in traditional intensive shrimp farming, including:

- Difficulty siphoning organic waste out of shrimp ponds because shrimp manure and leftovers are broken down into very fine particles and evenly dispersed into the water, combined with an almost flat pond bottom and the presence of many diffuse clusters.

- Blowing away a large amount of water-soluble molecular oxygen produced by photosynthesis of algae during the day

- Creates airborne particles that can be carried by wind blowing to neighboring shrimp ponds.

- Diffusing clusters with micro holes and blowing air placed on the bottom of the pond are ideal media for the rapid growth of vibrio bacteria.

- Causing serious noise pollution for people working and living near shrimp farming.

Moreover, this model has a stronger advantage in applying the advances of the 4.0 revolution to high-tech agricultural farming.

3. Opportunities and challenges

The model of super-intensive shrimp farming TOMGOXY will create many opportunities for the development of Vietnam's aquaculture industry in general and the Mekong Delta shrimp industry in particular.

- First of all, it will solve the difficult limitations that the shrimp industry is facing such as water pollution and diseases.

- Create conditions to increase the stocking density on limited land and water resources: it is possible to raise more than 500 fish/m^2 compared to the current maximum of 200-300 fish/m^2.

- Improve productivity to create large output for processing and export so that Vietnam can be the world hub of shrimp production.

- Solve water pollution as well as shrimp disease pollution in shrimp farming areas, reducing risks for farmers.

However, this model will also face some challenges such as:

- Investment costs are too high compared to shrimp farmers' ability to pay. The estimated investment cost for a shrimp pond (500 m^2) is about 1.2 billion VND, which is not small even though the super-intensive shrimp farmers are often economically well-off households in the area.

- The level of understanding and application of current high-tech equipment in rural areas is not much while shrimp farmers are often elderly household heads (over 50 years old) with a limited level of education. limited, often cultivated by experience.

4. Conclusion

The TOMGOXY super-intensive shrimp farming model is a big step forward in building an advanced aquaculture process by overcoming the urgent limitations of traditional farming processes through progressive applications of aquatic farming techniques which are applied to the achievements in physics, chemistry, biology and especially the achievements of the industrial revolution 4.0. This is a model of high-tech shrimp farming in the coming years in the Mekong Delta. In order to replicate this model quickly in production, it is necessary to propose policies to support shrimp farmers such as credit loan with preferential interest rates for activities applying science and

technology or promoting the link between technology enterprises, trading enterprises and shrimp farmers.