

Smart Recirculating Aquaculture System (RAS) farm for Cultivating *Crassostrea belcheri* oysters



Student: Miss Nakhaw Suren, Miss Thawanrat Wongpanich, Miss Piyachat Tanchinwong
 Teacher: Miss Priyanan Srisuwan, Miss Rungdaw Onchum, Mrs. Pacharee Chaipetch

Abstract

Oyster culture, particularly *Crassostrea belcheri*, is sensitive to water quality fluctuations and nitrogen accumulation during the nursing stage. This study developed a smart recirculating aquaculture system (Smart RAS) integrated with wastewater treatment to improve water quality control and reduce pollutants. The system combined physical, aerobic, and anoxic biological treatments using oyster shells as biofilter media, with real-time monitoring via ESP32 and the Blynk application. Results showed stable treated water quality, with a temperature of 27.5 °C, pH of 7.4–7.5, dissolved oxygen increasing from 6.14 to 6.38 ppm, and nitrite concentration decreasing from 3 to 1 ppm (66.7% removal efficiency). The monitoring system showed average errors of 0.36 °C (1.23%) for temperature and 0.37 (5.03%) for pH. Over 25 days, oyster shell length increased from 3.723 to 10.061 mm and the combined weight of five oysters increased from 0.057 to 0.49 g. Overall, the Smart RAS demonstrated strong potential for wastewater treatment, stable water quality control, and sustainable oyster aquaculture.

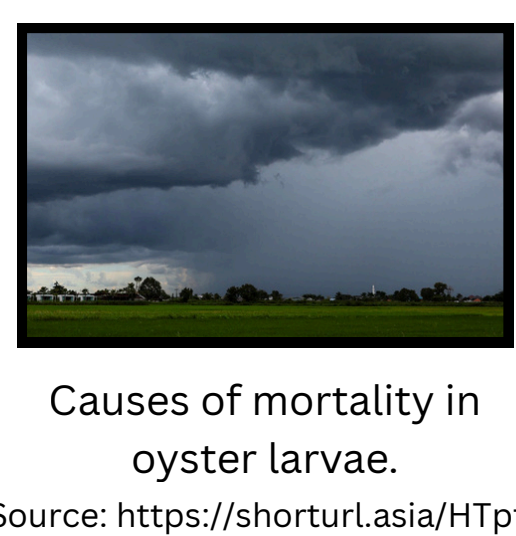
Introduction



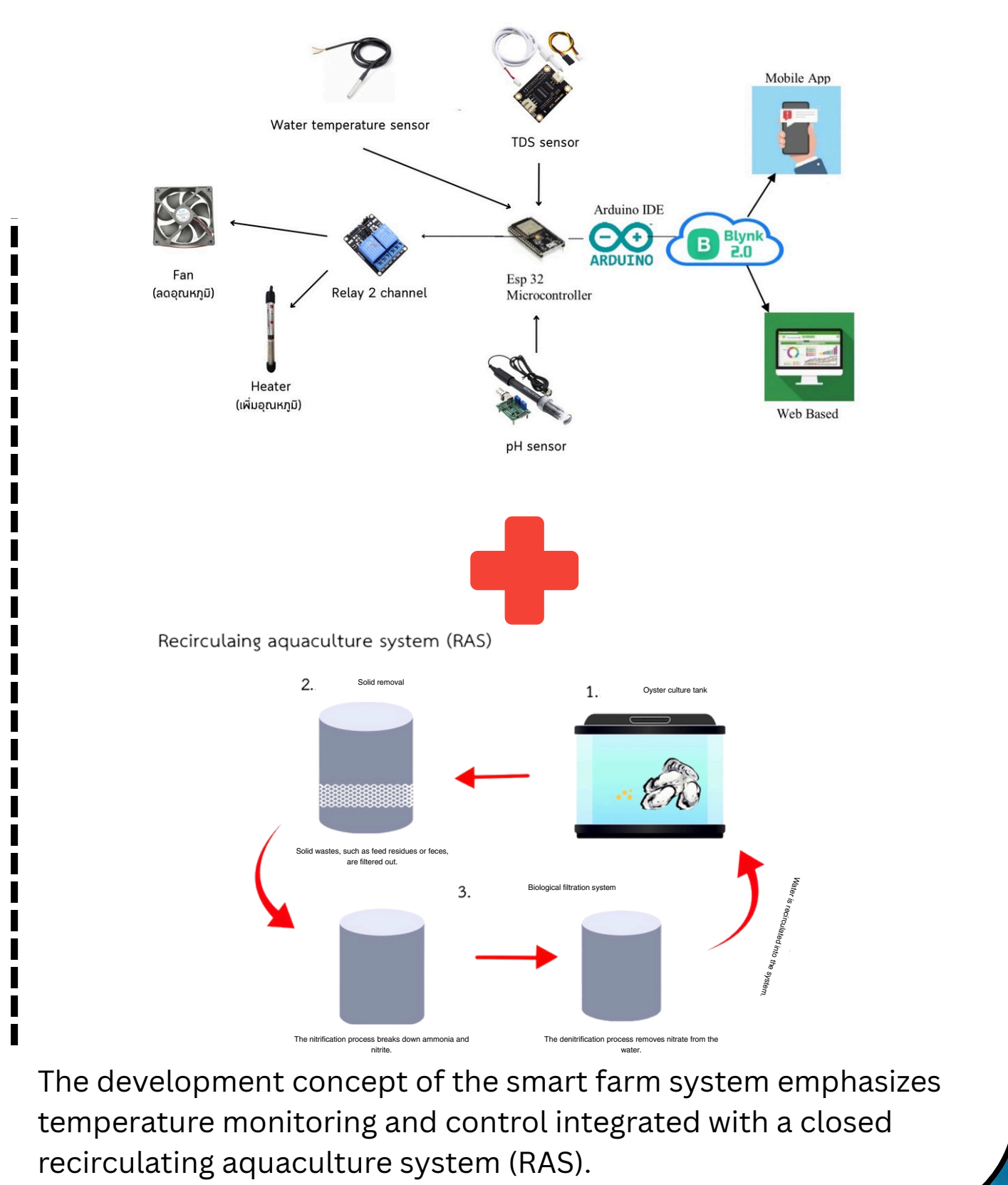
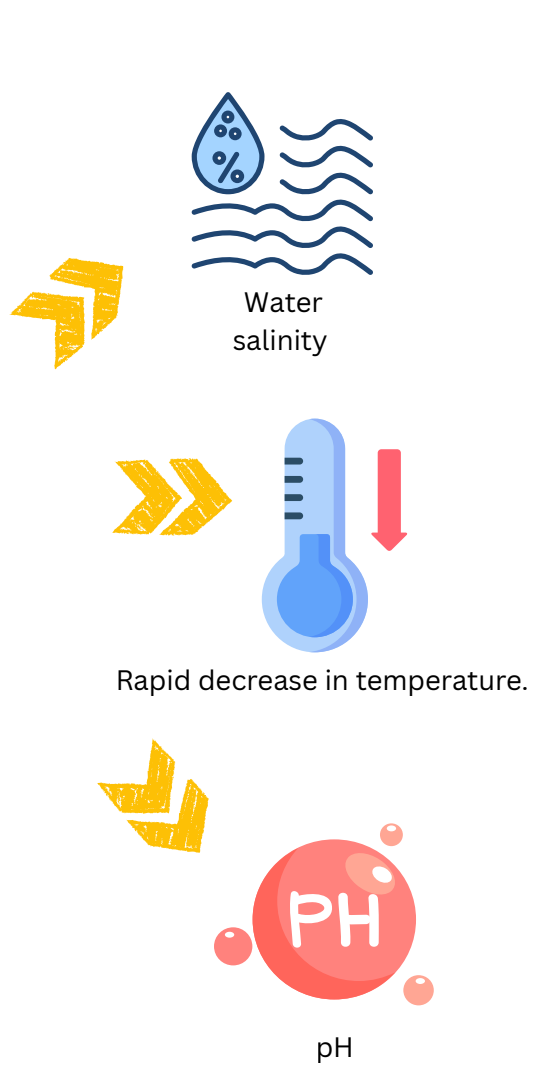
Source: <https://n9.cl/9tg6h>



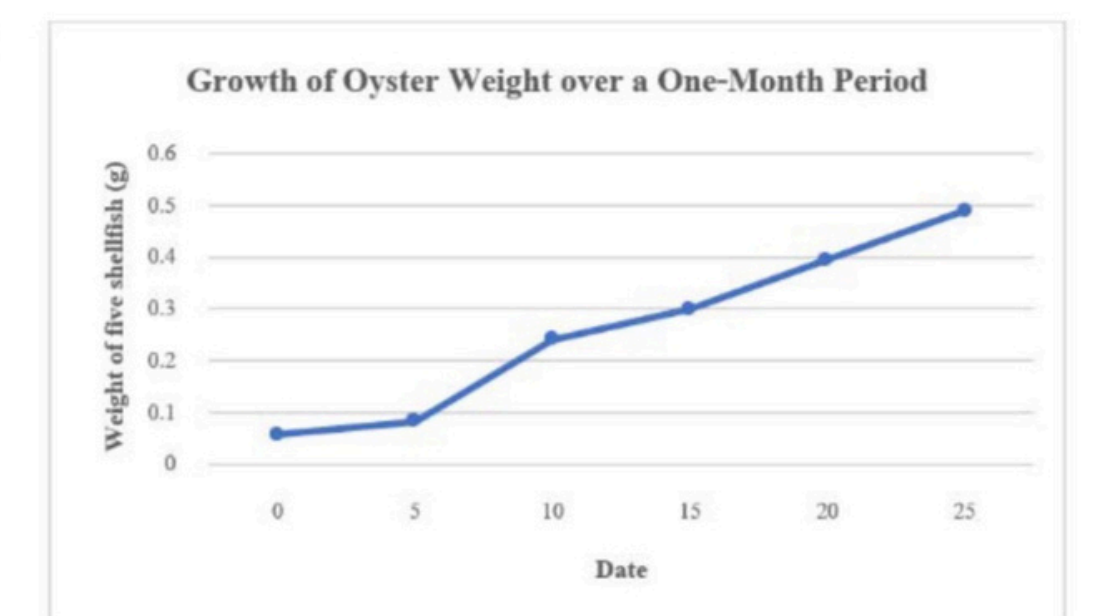
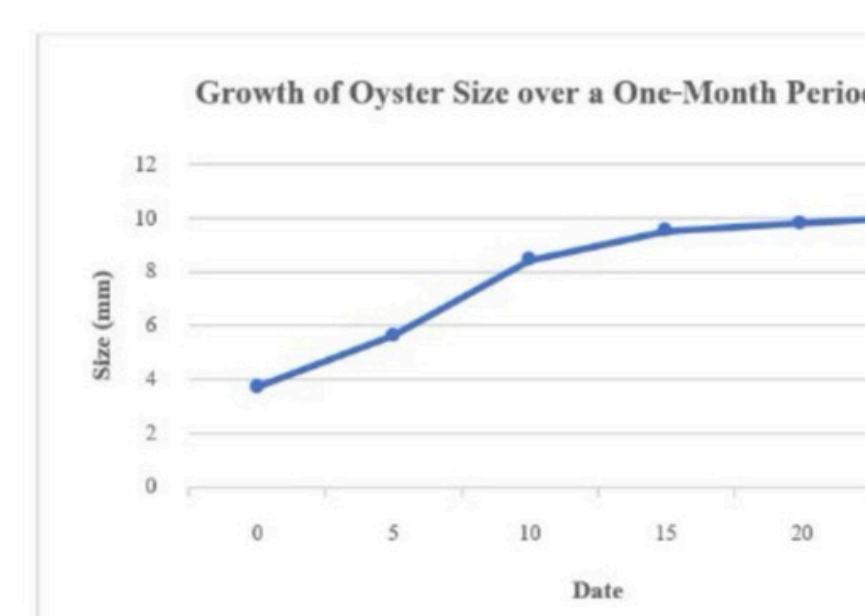
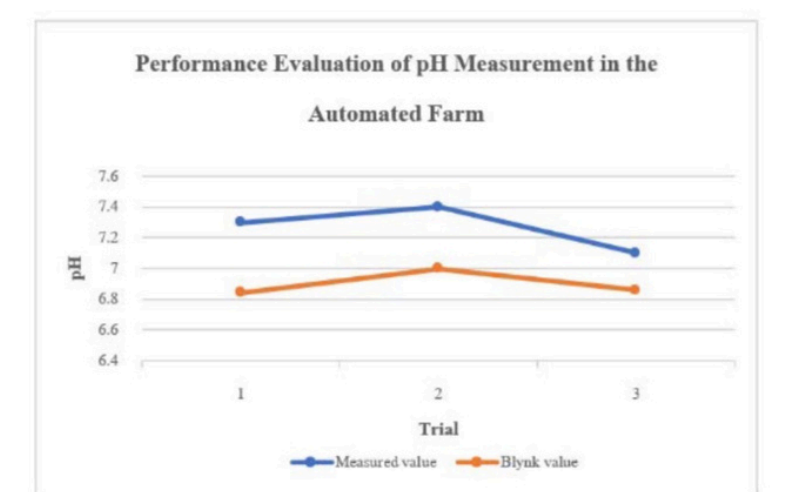
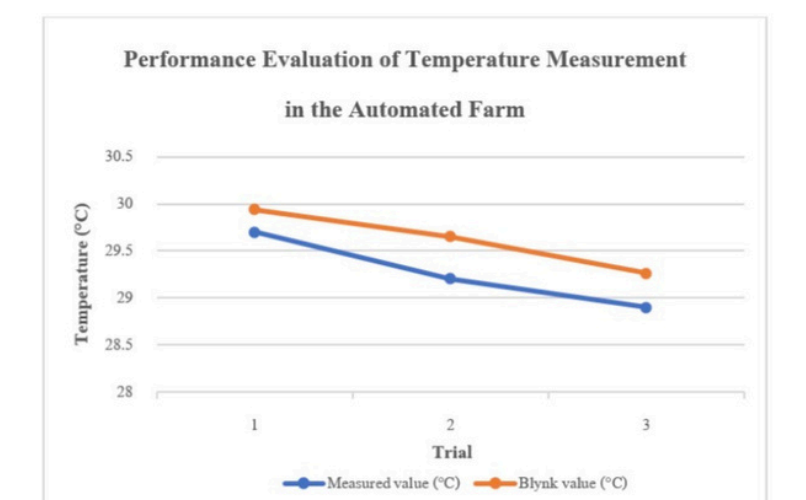
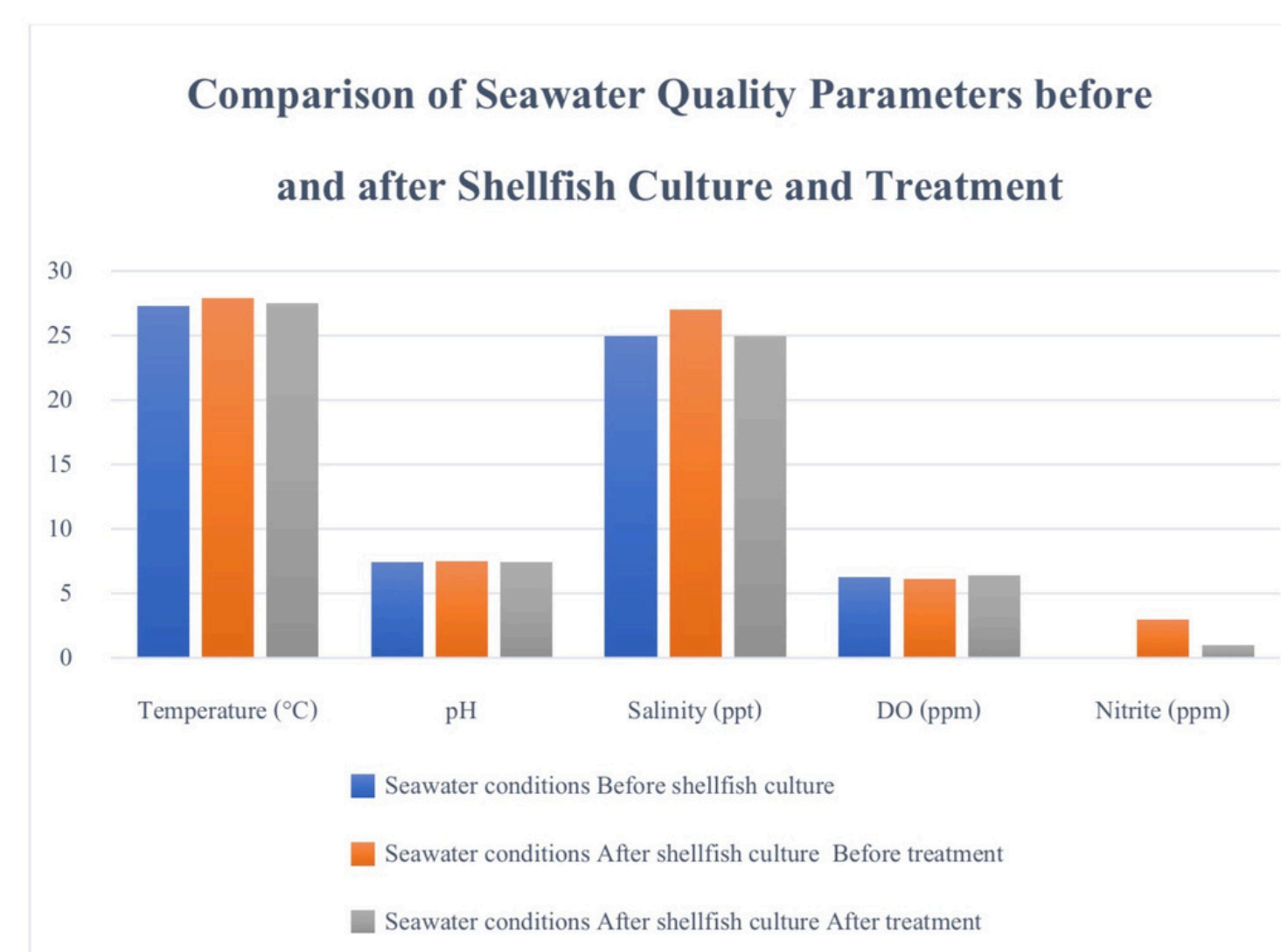
Oysters are an economically important aquatic animal.



Causes of mortality in oyster larvae.
 Source: <https://shorturl.asia/HTptk>



Result



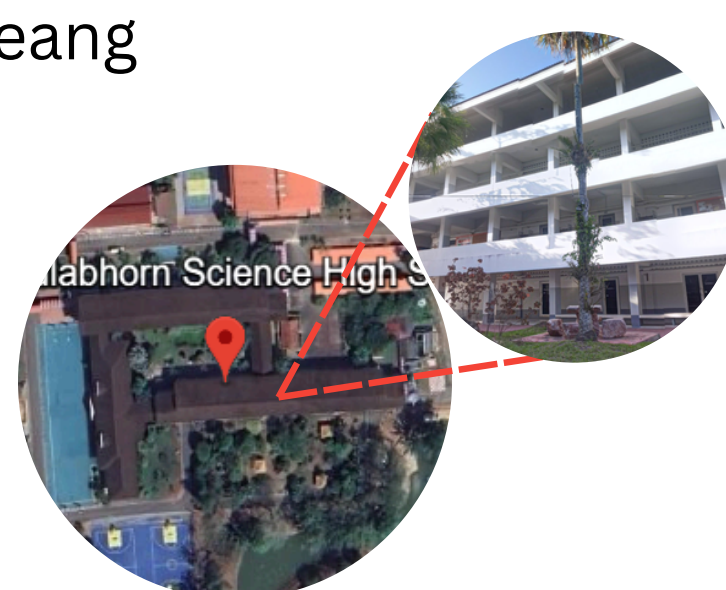
Both methods showed decreasing temperature trends, with the Blynk IoT system recording higher temperatures (29.3–30.0 °C) and lower pH (6.8–7.0) than manual measurements (28.9–29.7 °C; pH 7.1–7.4). Over 30 days, oyster shell length increased by 4.2 mm in the first 10 days and reached 10.1 mm, while the combined weight of five oysters increased from 0.06 to 0.49 g. Water treatment reduced nitrite from ~3.0 to <1.0 ppm and maintained salinity (27–25 ppt), dissolved oxygen (6.2–6.4 ppm), temperature (~27.5 °C), and pH (~7.5).

Study Site



Princess chulabhorn science high school Trang
 Trang–Sikao Road, Bang Rak Subdistrict, Mueang Trang District, Trang Province.

Kantang
 Ban Tae Ram, Kantang, Trang Province.



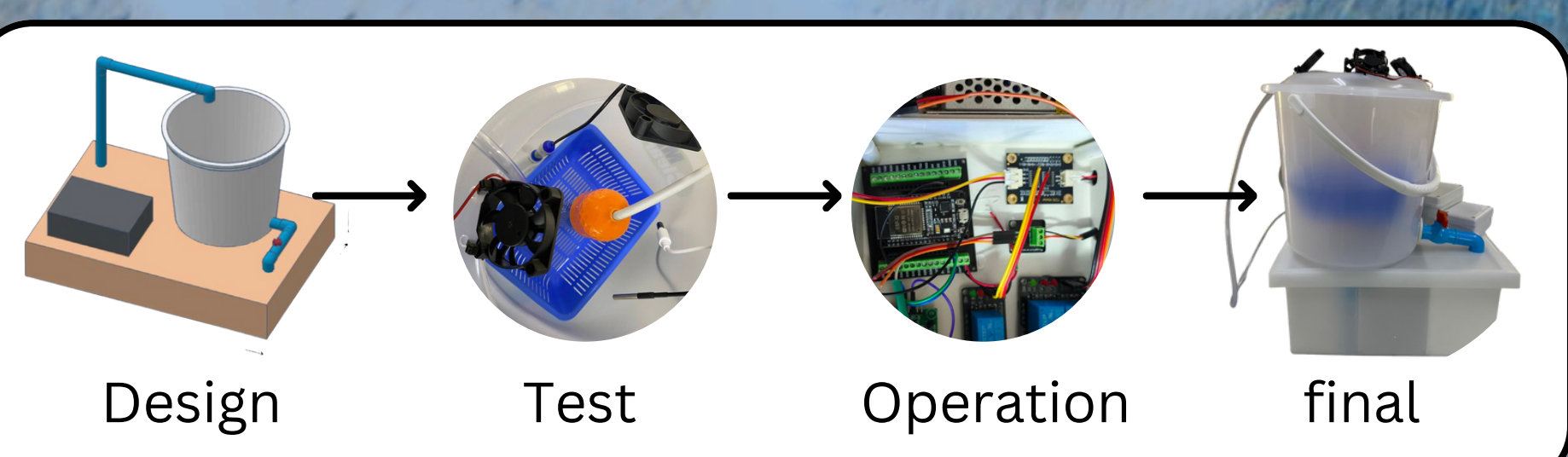
Research Question

1. How can a smart Recirculating Aquaculture System (RAS) integrated with wastewater treatment be designed and developed for oyster culture?
2. How efficient is the smart RAS in terms of wastewater treatment and water quality control for oyster culture?

Hypothesis

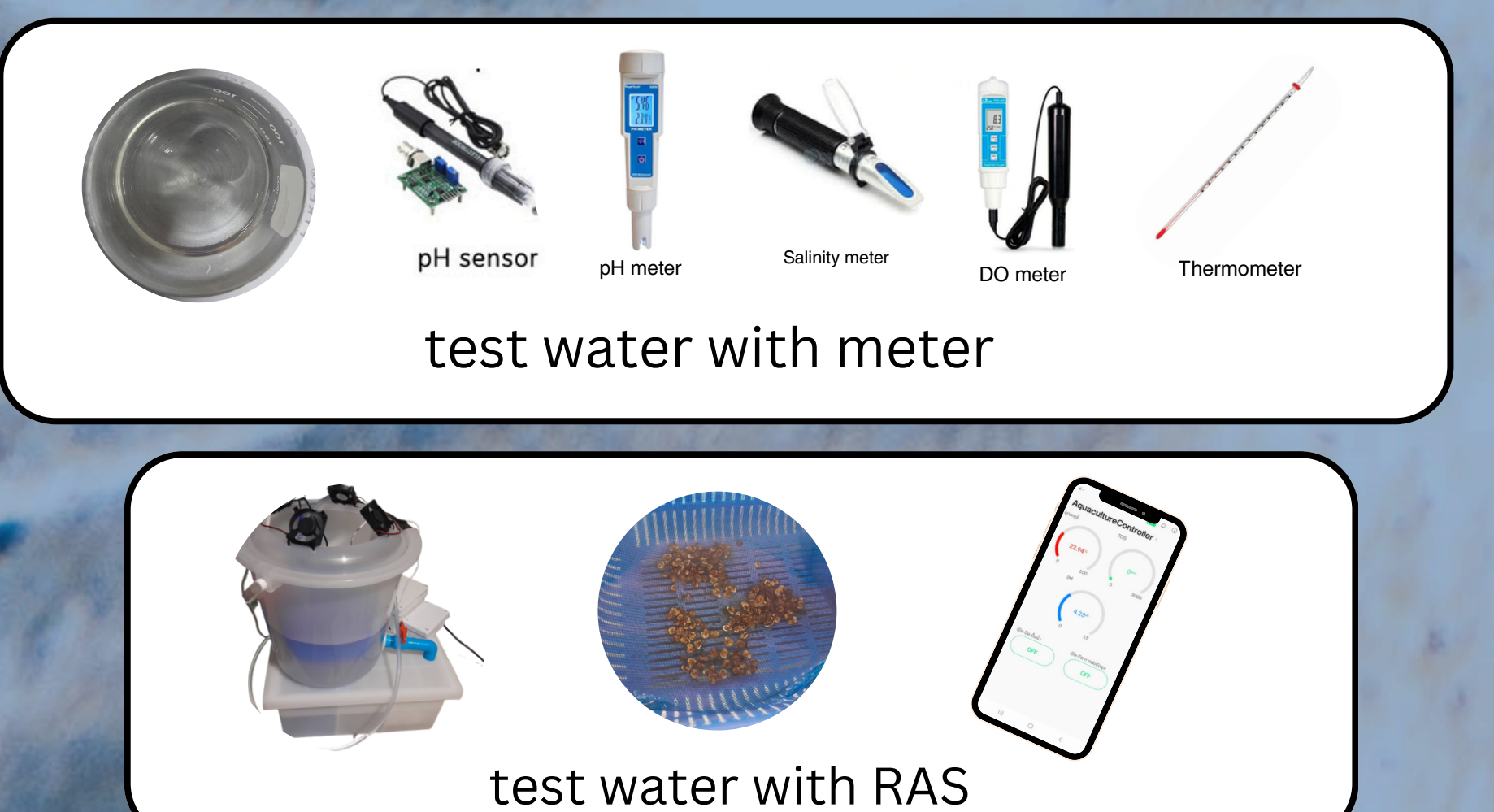
1. The smart RAS is suitable for oyster culture and effectively supports water quality control within the system.
2. The smart RAS can reduce pollutant loads from oyster culture wastewater and maintain stable water quality within the culture system.

creat RAS



Method

Test RAS



Conclusion and Discussion

The recirculating aquaculture system (RAS) effectively controlled water quality and reduced pollution from oyster culture. Water temperature showed minimal variation and stabilized at approximately 27.5 °C, while pH remained within 7.4–7.5 and salinity decreased from 27 to 25 ppt within suitable ranges. Dissolved oxygen increased from 6.14 to 6.38 ppm, and nitrite (NO₂⁻) was reduced from 3 to 1 ppm, corresponding to a removal efficiency of 66.7%, demonstrating effective treatment enhanced by oyster shell biofilter media. The automated monitoring system showed acceptable accuracy, with errors of 0.36 °C (1.23%) for temperature and 0.37 (5.03%) for pH. Oyster growth over 25 days confirmed suitable water conditions, with shell length increasing from 3.723 to 10.061 mm and the combined weight of five oysters increasing from 0.057 to 0.49 g.

Citations

- Chusak, W., et al. (2021). **Effects of water temperature on the growth of oyster spat *Crassostrea belcheri***. Journal of Marine Science, 8(1), 21–34.
- Chusiangaew, S. (2021). **Development of a high-density oyster culture system to enhance the local economy of the Palian River Basin, Wangwon Subdistrict, Kantang District, Trang Province**. Faculty of Fisheries Science and Technology, Rajamangala University of Technology.
- Department of Fisheries. (2019). **Oyster culture manual**. Bangkok, Thailand: Department of Fisheries.