CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

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Letter from the Director

Aloha,

Earlier this month, I took a vacation to attend an education-related meeting in Taiwan where I had the chance to visit a range of schools, from elementary to university. I was pleased to observe the growing implementation of high technology across Taiwan's education system, as well as the improvement of learning facilities in schools. There is a clear difference from my school days to now, and these advancements have narrowed the learning opportunity gap between the east and west. This prompted a realization that the U.S. must work harder to maintain its position as a global leader, such as in education and seafood industries including aquaculture. We must speed up the integration of AI and other high-tech resources into fish farming in order to achieve this goal.

Stronger America Through Seafood (SATS) -a coalition of industry stakeholders in offshore aquaculture- recently asked lawmakers to invest $42 million towards increasing the nation's aquaculture output. Currently, the US ranks 18th in global aquaculture production and imports more than 80% of the seafood we consume. To return to a ranking within the top ten, we need more investment in aquaculture research. CTSA is one of the five USDA regional aquaculture centers that share the mission of helping develop our industry to be prosperous again. Currently, we are solicitating ideas to complete technology development for existing and/or new seafood farming.

As announced last month, the deadline to submit a pre-proposal for CTSA FY25 funding consideration Is approaching (June 9). I hope to see an influx of submissions aimed at helping the development of our regional aquaculture industry. The Request for Pre-Proposals is linked below, and our administrative team is here to answer any questions you may have; please email us at ctsa@hawaii.edu or call our office. We must work together to address obstacles facing farmers and support their needs to grow our regional seafood production.

While we are hoping to see more seafood farms come online, I was disappointed to hear this week that Big Island Abalone is closing their NELHA-based business. They have popular aquaculture products and a strong presence in local and international markets, as well as a solid workforce and good facilities. Their decision was related to operational changes necessary to reduce production costs. Unfortunately, their permit application for operational changes hit a deadlock and the farm headquarters decided to close the Hawaii facility. This is a typical example of how regulation costs impact commercial aquaculture in the U.S. While I agree that protections for our environment are essential for any business in Hawaii and beyond, it is important to recognize that many aquaculture companies rely on imports and exports. I hope that we can find a good balance moving forward to support aquatic businesses that positively impact our local economy. Furthermore, I hope that another aquaculture farm will be able to utilize the facilities and workforce being left behind; our state benefited from these investments by Big Island Abalone, and it would be a shame for that investment to go to waste.

On that note, one of CTSA's primary focus areas is increasing the seafood supply while decreasing waste. I am pleased to see the zero-waste movement being promoted by the Norwegian Seafood Council (NSC). I agree with the comments by U.K. chef and NSC "Seafood from Norway" ambassador Michel Roux that "if you take the life of an animal, you should use all of it." I am hopeful that some of the pre-proposals we receive this year will incorporate waste reduction. We look forward to reading your ideas in the coming weeks!

Mahalo,
Dr. Cheng-Sheng Lee
Executive Director, CTSA

APPLY NOW! CTSA FY2025 Request for Pre-Proposals,

Deadline to Apply: June 9

In last month's e-Notes, CTSA released the **FY2025 Request for Pre-Proposals**. The Request lists the top priority areas and species as identified by industry stakeholders in Hawaii and the U.S. Affiliated Pacific Islands, as well as instructions for submitting a pre-proposal by the deadline of 5pm HST on Monday, June 9. CTSA uses a standard form for all pre-proposal submissions. Pre-proposal forms can be downloaded on the **CTSA website** or via request to mbrooks@ctsa.org.

Pre-proposals received by the deadline will be reviewed by CTSA's Industry Advisory Council (IAC) and Technical Committee (TC). Pre-proposals that receive significant support will move forward with requests for a full proposal.

CTSA's mission is to support aquaculture research, development, demonstration, and extension education in order to enhance viable and profitable aquaculture in the United States. Our main focus is on funding projects that will have immediate, positive impacts on the regional aquaculture industry. FY 2025 Priority Species include: seaweeds, oysters, moi, tilapia, shrimp, opakapaka, and mullet for Hawaii, and sea cucumber, rabbitfish, and mangrove crabs for the U.S. Affiliated Pacific Islands. Strategic Priority Areas include Innovations in Aquaculture Technology, Aquatic Feed Development, Finfish Farming Technology, Aquatic Animal Health, Hawaiian Fishponds, and others. As a reminder, eligible applicants include universities, community colleges, or nonprofit research institutions and organizations from the CTSA region. *New as of 2024*: commercial companies collaborating with eligible applicants in the region can serve as the prime contractor for a project pending USDA approval.

New Publication from CTSA Project: Recent Advances in Aquaponic Systems: A Critical Review

The following are excerpts from a review that was recently published in the Open Access journal Reviews in Aquaculture by the work group leading the CTSA project "Macroalgal Biomass Production for High-value Product Generation with Nanobubble Technology and Phase-change Materials: Lab-to-Pilot Scale Study."

Abstract
Aquaponics, a symbiotic farming of plants and fish, is a promising solution to address global food security. While aquaponics contributes to nutrient recovery, water reclamation, and reduced land and freshwater use, achieving consistent and economically viable production remains a substantial challenge. Several key issues in aquaponics include maintaining optimal water quality and dissolved oxygen concentration, delivering a balanced nutrient profile for plants, and managing solids accumulation. However, recent advances in new system designs, algal co-cultivation, micro-nanobubble technology, biofilter media, as well as system automation coupled with the Internet of Things, Artificial Intelligence, and robotics can improve the performance of these systems. Moreover, a greater understanding of the microbiome across various components of an aquaponic system is important in improving symbiotic relationships and supporting favorable ecological dynamics. This, in turn, promotes improved nutrient cycling, plant and fish growth, and overall system performance. This review highlights several such advances, critically analyzing the challenges faced during operation, and offers future research directions. Through discussion on current knowledge gaps in system operation, technological integration, and understanding of microbiomes, this review aims to provide a comprehensive framework for advancing aquaponic systems and outline potential directions for future innovations.

Section 1: Introduction
Food and nutrition security remains a critical global challenge, driven by population growth, rapid urbanization, climate-related disasters (e.g., extreme heat, droughts, floods, and storms), and pandemics such as COVID-19, among other factors. The United Nations Sustainable Development Goal (SDG) Goal 2 (Zero Hunger) aims to end global hunger by 2030 through sustainable agriculture and improved nutrition [1]. Despite 150 countries endorsing this SDG [2], approximately 783 million people remain undernourished,

representing 9.2% of the global population as of 2022 [3]. Achieving SDG Goal 2 through conventional agricultural practices is challenging because they rely heavily on freshwater, fertile land, and synthetic agrochemicals (e.g., fertilizers, pesticides, and herbicides). Currently, the agriculture sector accounts for approximately 70% of global freshwater withdrawal [4], and projections indicate that over 80% of the world's croplands will face water scarcity by 2050 [5]. Moreover, 2 million metric tons of pesticides are used worldwide annually [6]. In 2022 alone, an estimated 108, 42, and 35 million tons of synthetic nitrogen (N), phosphorus (P_2O_5), and potash (K_2O) fertilizers, respectively, were applied worldwide [7]. The excessive use of these resources makes conventional agriculture a major contributor to environmental and ecological issues, including soil degradation, greenhouse gas (GHG) emissions, biodiversity loss, and eutrophication. Therefore, agricultural practices fulfilling the three pillars of climate-smart agriculture—increased food productivity, enhanced system resilience, and reduced environmental footprints—must be adopted to sustainably achieve SDG Goal 2...

Section 2: Types of Aquaponic Systems
Understanding the types of aquaponic systems forms the basis for integrating emerging technologies and improving system performance. An aquaponic system generally consists of three components: a fish tank, a filtration unit, and a hydroponic grow bed...

Section 3: Material Flow and Mass Balance
A comprehensive understanding of the nutrient, solids, and water flow within aquaponic systems is essential for optimizing system performance. Aquaculture effluents are typically rich in dissolved and suspended organic and inorganic matter, originating from fish excreta and uneaten feed [37]. Through various biological processes such as microbial decomposition, mineralization, and nitrification, these substrates supply essential nutrients, including nitrogen and phosphorus. Usually, the primary input of nutrients is typically fish feed. In a typical operation, more than 5% of fish feed goes uneaten, while the remaining 95% is consumed and digested [38]...

Section 4: Operational Considerations in Aquaponic Systems
The successful operation of an aquaponic system depends on the management of various water quality and environmental parameters, as well as the biotic (fish and plant) species used. Water quality parameters are intricately interconnected, and balancing them presents significant challenges due to differences in the optimal conditions required by fish, plants, and beneficial microorganisms...

Section 5: Microbial Communities in Aquaponic Systems
In aquaponic systems, microbial communities develop in distinct microenvironments that are shaped by varying environmental factors and water quality profiles [82]. These microenvironments support communities of autotrophic and heterotrophic microorganisms [83, 84], which are essential for organic matter decomposition, nutrient transformation, and regulation of water alkalinity [85]. This section examines key microbial pathways as well as microbial community composition and distribution within an aquaponic system....

Section 6: Innovative Approaches and Novel Technologies
Optimizing an aquaponic system to produce high-quality plants and fish is challenging. It requires careful monitoring and control of various interdependent parameters. Integration of advanced technologies and innovative strategies can substantially improve the performance of aquaponic systems. In recent years, several advances in aquaponics have been made, including innovative fit-for-purpose system designs, algal co-cultivation, MNB technology, system automation, renewable biofilter media, and cutting-edge approaches to understanding microbial ecology. This section critically discusses the application of these approaches and technologies...

6.3 Micro-Nanobubble Technology
Maintaining adequate DO concentration is crucial for water quality and the health of fish, plants, and beneficial microorganisms. Fish obtain oxygen through their gills, and low DO concentration can cause severe stress. Likewise, aerobic microorganisms, such as nitrifying bacteria, require oxygen to carry out key metabolic processes. DO is also essential for plant root function and nutrient uptake.

MNB technology is a promising alternative to conventional aeration methods for effectively delivering DO in aquaponic systems [66, 165-167]. MNBs include microbubbles (1–100 μm) and nanobubbles (< 1 μm), which are characterized by their high negative zeta potential and high gas–liquid mass transfer rate [166, 168]. Unlike larger bubbles, MNBs persist in the aqueous phase for extended periods, from weeks to months [168, 169]. MNBs facilitate various phenomena, including hydrophobic interactions (i.e., adsorption of hydrophobic molecules or particles, which concentrates these substances near the bubble surface) and the generation of reactive oxygen species (ROS), which can enhance seed germination and potentially plant growth within aquaponic systems [170]. Several studies have demonstrated that MNB generators outperform conventional aerators by providing higher DO concentration for a longer period of time [66, 171]. Several reviews have discussed the mechanisms and applications of MNB technology across various fields, including agriculture and aquaponics [166, 170, 172].

This technology is highly adaptable for use in hydroponics, aquaponics, and aquaculture systems, as it can easily be incorporated into nutrient reservoir tanks and grow beds. In MNB systems, air is often preferred because it can be easily and cost-effectively supplied using a simple compressor. However, oxygen can increase DO concentration by up to five-fold compared to air [173]. To utilize oxygen-MNB, MNB generators often employ portable oxygen concentrators to extract and purify oxygen from ambient air. This setup

eliminates the need for continuous air supply, as intermittent pure oxygen supply can sufficiently meet the system's DO requirements...

Click here to read the full publication: https://doi.org/10.1111/raq.70029

AquaClip: EPA approves permit for Ocean Era's Velella Epsilon fish farming project

After years in development, mariculture startup Ocean Era has secured the key permit from the U.S. Environmental Protection Agency (EPA) that allows its red drum offshore fish farm pilot off the coast of Florida to move forward.

According to the EPA permit, Ocean Era has been approved to raise up to 20,000 red drum over the course of a year in a single net pen located roughly 40 miles off the coast of Sarasota, Florida, U.S.A. The agency estimated that the total estimated fish harvest weight for the project is 46,750 pounds based on an 85 percent survival rate.

Hawaii-based Ocean Era has been pushing U.S. regulators to approve its Velella Epsilon project since the first term of U.S. President Donald Trump.

In 2023, the company decided to switch from almaco jack to red drum, claiming that the latter had a larger market opportunity in the U.S.

However, the company has faced difficulties in securing the needed approvals to actually start the pilot program; offshore aquaculture advocates have repeatedly stated that the U.S. government needs a clear and consistent process for approving aquaculture operations in federal waters.

On 15 May, the EPA issued the final permit needed to launch Velella Epsilon and begin raising fish in federal waters.

Source: Seafood Source // Read Original Article

This newsletter is written and prepared by the CTSA Information Specialist Meredith Brooks.
The Center for Tropical and Subtropical Aquaculture (CTSA) is one of five regional aquaculture centers in the United States established and funded by the U.S. Department of Agriculture's National Institute of Food and Agriculture (NIFA) under active grants 2020-38500-32559 and 2022-38500-38099. The regional aquaculture centers integrate individual and institutional expertise and resources in support of commercial aquaculture development.
CTSA was established in 1986 and is administered by the University of Hawaii.

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