
**Submission of a proposal for
hosting a Regional Training and Research Center (RTRC)**

for the
IOC Regional Network of Training & Research Centers on Marine Science
in the Western Pacific and Adjacent Areas

A. Summary
(Cover Page)

- 1. Title of the proposed RTRC:**
Regional Training and Research Center on Regenerative Aquaculture for Community and Ecosystems (RTRC-RACE)
- 2. Expected starting date:**
1 March 2027
- 3. Duration* (3-5 years):**
5 years (2027-2032)
- 4. Detailed domain(s) or discipline(s) of the proposed RTRC: Regenerative Aquaculture**
Research: establish evidence and methods
Training: develop scientific and technical capacity
Translation: apply research in real-world settings
Outcome: Sustainable Seafood Production
Regenerative aquaculture for Nature and People-positive Impact
Ecosystem Restoration
Nature-based Solution
Community participatory and Poverty Alleviation
- 5. Name of host institution(s):**
Centre for Marine and Coastal Studies (CEMACS), Universiti Sains Malaysia
- 6. Person(s) in charge of the “RTRC”**
Associate Professor Dr Mahadi Mohammad (Lead)
Prof. Dato’ Dr. Aileen Tan Shau Hwai (Co-lead)
Dr Abe Woo Sau Pinn (Coordinator 1)
Dr Annete Jaya Ram (Coordinator 2)
- 7. Partners (if available)**
- 8. Total budget (US\$):**
1,074,000
- 9. Funding sources (In cash and in kind)**

In cash
USD 424,000

In kind
USD 650,000

10. Summary (150 words)

The Regional Training and Research Center on Regenerative Aquaculture for Community and Ecosystems (RTRC-RACE) will be hosted at the Centre for Marine and Coastal Studies (CEMACS), Universiti Sains Malaysia, over a 5-year period (2027–2032). RTRC-RACE addresses the decline of wild fisheries and rising seafood insecurity across Southeast Asia and the Western Pacific by translating CEMACS' regenerative aquaculture research into field-ready systems for culture of sustainable and low-trophic blue food such as seaweeds, bivalves, and sea cucumbers to restore coastal ecosystems while diversifying livelihoods for coastal communities, alleviating poverty in the Western Pacific region.

Through a tiered capacity-building model spanning community practitioners, technical officers, postgraduate researchers, and regional policymakers, the Centre will deliver hands-on training, regenerative aquaculture research, postgraduate fellowships, and technical exchanges across IOC-WESTPAC member states, supported by Living Labs in Penang and Langkawi.

Expected outputs include 10+ regional training courses reaching 300 participants, 20 postgraduate researchers hosted, three regional field guidebooks, and replication of the community model in four additional WESTPAC member states, positioning RTRC-RACE as a regional hub for blue food security and ocean science capacity development.

B. Detailed Description

1. Title of the proposed RTRC:

Regional Training and Research Center for Regenerative Aquaculture for Community and Ecosystems (RTRC-RACE)

2. Domain(s) or discipline(s)

(Please indicate how the domain or discipline chosen is directly related to one or more of the following priorities for (i) national development, (ii) regional development, (iii) global agenda - sustainable development, climate change, natural hazard, marine biodiversity, health of ocean ecosystems and seafood safety. The approved IOC Medium-term Strategy (2014-2021) could also serve as a critical point of reference.)

(i) National Development

Regenerative aquaculture directly supports Malaysia's national priorities around food security, poverty alleviation among low-income coastal communities, and sustainable blue economy. By diversifying and stabilizing income for artisanal fishers through low-cost, low-trophic aquaculture and post-harvest micro-enterprises, RTRC-RACE contributes to national goals for coastal community livelihood resilience while reducing pressure on wild capture fisheries already severely overexploited in Malaysian water. The Centre's location within CEMACS also strengthens Malaysia's position as a regional leader in marine science research and human capital development.

(ii) Regional Development

RTRC-RACE addresses a shared regional challenge of the collapse of wild fisheries and rising seafood insecurity across Southeast Asia and the Western Pacific. Seafood sustains the livelihoods of over 100 million artisanal fishers across the region. As a WESTPAC-aligned training and research node, the Centre directly supports IOC-WESTPAC's mandate to strengthen regional marine scientific capacity and cooperation, offering a replicable model for translating regenerative aquaculture science into field-ready community practice across the region.

(iii) Global Agenda

RTRC-RACE is designed to directly advance the goals of two governing global frameworks. Under the UN Decade of Ocean Science for Sustainable Development (2021–2030), the Centre's regenerative aquaculture systems respond to Ocean Decade Challenge 2 (Protect and Restore Ecosystems) and Challenge 3 (Sustainable Blue Food), by restoring degraded coastal habitats and optimizing the ocean's role in sustainably feeding communities, while its community training and toolkit model contributes to Challenge 6 (Coastal Community Resilience) and, centrally, Challenge 9 (Capacity Development) by building local human and institutional capacity for ocean science and its application. These contributions support the Decade's outcomes of a healthy and resilient ocean and a productive ocean supporting sustainable food supply.

At the same time, RTRC-RACE operationalizes the IOC Capacity Development Strategy (2023–2030) and its vision. The Centre's tiered training model covers all types of participants spanning local coastal community, technical officers, postgraduate fellows, and regional institutions. This RTRC emphasis on capacity development at both the individual and institutional level, while its open-access field guidebooks, digital monitoring tools, and regional Living Labs advance the Strategy's routes of professional development, ocean literacy, and equitable access to knowledge and technology. By prioritizing artisanal, low-income coastal communities

and extending training to less-resourced WESTPAC member states, RTRC-RACE also reflects the commitment to equity across geography and generation.

Together, these alignments position RTRC-RACE not merely as a research centre, but as a regional delivery mechanism for global ocean science and capacity development commitments, directly linking SDG 14 (Life Below Water) with SDG 2 (Zero Hunger), SDG 4 (Quality Education), and SDG 17 (Partnerships for the Goals).

3. Context and justification (300 words)

(Analyze trends and issues related to the theme of the proposed Center, and the strengthens of the host institution in the training and research of proposed themes)

Coastal communities across Southeast Asia and the broader Western Pacific face compounded pressures from overfishing, coastal habitat degradation, ocean warming, ocean acidification, and severe seafood insecurity. Southeast Asia encompasses some of the world's most critical and biodiverse marine ecosystems including the Coral Triangle, extensive mangrove estuaries, and vital seagrass beds. However, wild capture fisheries across regions like the Straits of Malacca, the Sulu-Sulawesi Seas, and the South China Sea are severely overexploited or near collapse. In a region where marine blue food provides up to 60% of total dietary protein for coastal populations and sustains the primary livelihoods of over 100 million artisanal fishers, declining marine productivity poses an existential threat to regional nutrition, poverty alleviation, and coastal economic stability.

Historically, rapid aquaculture expansion aimed at filling this fish supply deficit has relied heavily on intensive monoculture systems (such as high-density shrimp ponds and feed-intensive marine cage finfish). In the coastal regions of Southeast Asia, open-water finfish farming has periodically triggered severe environmental disruptions due to heavy organic nutrient loading from uneaten feed and fecal waste causes acute eutrophication, driving harmful algal blooms (HABs) and bottom-water hypoxia. The aquaculture of high-trophic level seafood like grouper, seabass, and other finfish will not be able to sustain as it is highly dependent on fish feed and protein source from the sea. Furthermore, the operating costs of these systems are increasing yearly due to the continuous increment of cost from feeding fish pellets.

RTRC-RACE addresses these interconnected ecological and socio-economic crises by advancing research into regenerative aquaculture technologies and translating high-level laboratory research into actionable, community-managed regenerative aquaculture systems. The center shifts the regional paradigm from extractive monoculture to regenerative blue food systems that actively repair, enhance, and restore surrounding marine ecosystems while producing nutrient-dense food. By strategically co-cultivating native, low-trophic extractive species—such as seaweeds (*Caulerpa lentillifera*, *Kappaphycus*, *Gracilaria*), filter-feeding bivalves (tropical oysters and green-lipped mussels), and benthic detritivores (sea cucumbers), these restorative Integrated Multi-Trophic Aquaculture (IMTA) systems perform essential ecosystem functions:

4. Objectives:

The objectives of Regional Training and Research Center on Regenerative Aquaculture for Community and Ecosystems (RTRC-RACE) in Malaysia are:

- a) Building Knowledge and Research:** Advancing scientific knowledge and research capacity on regenerative aquaculture

- b) Translational Science to Field Application :** Translate complex regenerative aquaculture research into simple, field-ready technology for coastal communities across WESTPAC member states.
- c) Nature-Positive Ecosystem Regeneration:** Optimize and deploy CEMACS-designed aquaculture systems that actively remediate coastal waters, sequester nutrients, and rebuild wild marine biodiversity.
- d) People-Positive Livelihood Resilience:** Diversify income for low-income artisanal fishers through low-cost, low-trophic "blue food" production (oysters, mussels, sea grapes) and post-harvest micro-enterprises.
- e) Regional Capacity Building:** Provide hands-on training workshops, visiting professorships, postgraduate fellowships, and technical exchanges for IOC-WESTPAC member countries.

5. Type of activity (several types of activities can be included):

Short-term training	[✓]
International workshops, seminars...	[✓]
Joint research	[✓]
Visiting professorships	[✓]
Postgraduate teaching program	[✓]
Scholarships	[✓]
Institutional development	[✓]
(Including strengthening of information/library services, laboratories, etc.)	

6. Target beneficiaries:

Students	[✓]
Academics	[✓]
Technical Officers	[✓]
Other (please specify)	[✓]
Coastal communities	[✓]
Government officials	[✓]
Aquaculture Industries	[✓]

7. Expected output / results:

(Clearly identified- both quantitative and qualitative)

- At least 10 regional short-term training courses/workshops organized training for at least 300 community, practitioners, academic staffs, students and policymakers members trained
- At least 20 postgraduate/postdoctoral researchers hosted at RTRC-RACE for research in regenerative aquaculture.
- Three field guidebooks and translational manuals published on regenerative aquaculture of different species adapted for the region.
- Publication of multiple scientific journals regarding regenerative aquaculture.
- Community model replicated in 4 additional WESTPAC member states

- Strengthening the regional network and capacity building for knowledge exchange, data sharing, technology transfer and research collaboration in the field regenerative aquaculture.

8. Implementation Strategy – How the RTRC will be run?

a. management

RTRC-RACE will be hosted at the Centre for Marine and Coastal Studies (CEMACS), an established centre of excellence of Universiti Sains Malaysia (USM), Malaysia with its own governing board and management structure. The RTRC will operate as an integrated programme within CEMACS, drawing on the Centre's existing scientific staff, laboratory and hatchery facilities, research boat, and field stations at Sungai Merbok and Langkawi. This arrangement ensures institutional continuity, cost efficiency, and immediate access to proven research infrastructure from the Centre's outset.

The RTRC will be led by the CEMACS Director, who will serve as the overall head of the Centre and bear responsibility for its strategic direction and day-to-day operations. Specifically, the Director's responsibilities will include:

- i) Overseeing the design, delivery, and quality assurance of training and research programmes;
- ii) Allocating and managing RTRC funding and resources across core activities;
- iii) Monitoring implementation progress against the 5-year work plan and reporting on outcomes to relevant stakeholders; and
- iv) Representing RTRC-RACE in regional and international partnerships, including engagement with IOC-WESTPAC office in Bangkok.

Reporting to the Director, a multidisciplinary academic, science officer and research officer staff team spanning aquaculture science, ecosystem restoration, community engagement, and training/curriculum development will function as a coherent operational unit, jointly conducting regular training programmes and collaborative research activities to ensure scientific rigor is consistently translated into field-ready outcomes. The director will be assisted by two coordinators to perform executive functions in running the research activities as well as training activities.

While CEMACS' existing Board provides institutional-level oversight, RTRC-RACE will establish a dedicated **International Advisory Board (IAB)** to provide independent, specialist guidance on the Centre's technical and regional programme. The IAB's core functions will be to:

- Review RTRC-RACE's activities and outputs against its stated objectives and regional relevance;
- Assess the design and effectiveness of training programmes for WESTPAC member states;
- Facilitate and encourage cooperation with other regional and international research institutions; and
- Serve as a resolution body for any operational or strategic conflicts arising within the Centre.

The IAB will comprise experts drawn from regional and international partner institutions, ensuring RTRC-RACE's programme remains scientifically credible, regionally responsive, and aligned with best practice in governance.

b. capacity building

Capacity building sits at the core of RTRC-RACE's mission to translating regenerative aquaculture technology and science into skills that coastal communities, technical officers, and regional researchers can apply directly. Rather than a single training programme, the Centre adopts a tiered capacity-building model that matches the depth of training to the role of the learner from beginners up to advanced learners incorporating hands-on field skills for artisanal fishers to postgraduate research capacity for future regional scientists.

Tier-1 Community Practitioners will involve coastal communities, artisanal fisherman, coastal community cooperation, entry-level aquaculturist, fresh graduate. This tier participants will learn introductory to regenerative aquaculture, operation of a regenerative aquaculture system, water quality monitoring, growth measurement and post-harvesting processing.

Tier-2 Technical Officers, hatchery operators, industries, experienced aquaculture operators, regional and fisheries officer, coastal managers. This tier will learn advanced technology involving operating a sustainable and regenerative aquaculture set-up that complies to best-practices, sustainable aquaculture certification, operating hatcheries, advanced spawning and larvae rearing.

Tier-3 Academic staffs, early-career researchers, postgraduate students. This tier will be exposed to research methodologies on regenerative aquaculture, hatchery science, ecological monitoring and modelling, data analysis, community engagement techniques.

Tier-4 Regional institutions, policymakers, fisheries agencies, partner institutions, national resource managers. This tier will learn about frameworks, national policies, programme scaling, marine spatial planning, and cross-border knowledge exchange.

Delivery of the training can be in different mechanisms as below :

- **Short-Term Hands-On Training Workshops:** Structured courses at CEMACS and Living Lab sites (Langkawi, Sungai Merbok, Teluk Bahang, Batu Maung) covering bivalve/seaweed/sea cucumber etc. culture, regenerative aquaculture system assembly, and environmental monitoring.
- **Postgraduate Fellowships & Visiting Professorships:** Structured research placements at CEMACS for WESTPAC-affiliated postgraduate students and visiting academics, embedding them within ongoing regenerative aquaculture and ecosystem restoration research using nature-based solution.
- **Technical Exchanges & WESTPAC Partners Learning:** Rotational exchanges of researchers and community leaders across WESTPAC nodes, allowing successful models (e.g., Malaysian Living Labs) to be adapted for other member states
- **Toolkits, Manuals & Digital Resources:** Open-access field translation manuals and standardized WESTPAC guidebooks, paired with smartphone-linked monitoring apps, to support self-directed learning between formal training sessions.

- **Living Labs as Experiential Classrooms:** Co-managed demonstration sites where trainees learn by working alongside CEMACS scientists and cooperative members on active regenerative farms, rather than through classroom instruction alone.
 - **Workshops, Conference:** policy-level conference, already planned in the work plan, convening WESTPAC agencies, research institutions, and industry to integrate outputs into regional policy and to plan post-project scale-up
- c. sustainability
- i. linkages with other relevant activities at institutional, national, regional and international levels

RTRC-RACE is embedded within CEMACS, USM, drawing on its existing infrastructure and reinforcing rather than duplicating the university's marine science mandate. At the national level, the Centre collaborates with the Fisheries Research Institute (FRI) Malaysia and national fisheries authorities to align its community interventions with Malaysia's blue economy priorities especially in regenerative aquaculture. Regionally, it operates as a node within the UNESCO/IOC-WESTPAC network, with its training model designed for replication across WESTPAC member states and strengthened through partnerships with WorldFish and the UKRI WAVES network (<https://waves.stir.ac.uk/>) and CAINA (<https://www.worldfishcenter.org/project/climate-adaptive-inclusive-nature-based-aquaculture-caina-malaysia-and-solomon-islands>). Internationally, its research outputs, fellowships, and participation in policy connect local outcomes to the global blue food security and climate adaptation agenda.

- ii. how benefits will be sustained?

Benefits will be sustained through integration into CEMACS' core operations rather than as a parallel, project-dependent structure, supported by a train-the-trainer model that embeds skills directly within communities and reduces reliance on CEMACS staff over time. Community-owned blue food cooperatives are designed to be commercially self-reliant, giving communities an ongoing economic incentive to continue regenerative practices, while open-access field guidebooks and manuals allow new communities and institutions to adopt methods independently. As the model is replicated across WESTPAC member states, ownership distributes regionally, and the growing network of trained trainers, fellows, and partner institutions forms a durable community of practice that can sustain momentum beyond any single funding cycle.

- d. knowledge sharing

Knowledge sharing is a core function of the Centre, disseminating its findings, tools, and lessons learned through open-access field guidebooks and translational manuals that let communities and institutions across the region adopt similar methods without requiring direct technical support, alongside peer-reviewed publications that contribute the Centre's ecological and socio-economic evidence to the wider regenerative aquaculture literature. Annual conferences, technical workshops, and the Summit provide structured venues for exchanging results and lessons across WESTPAC member states.

9. Proposed schedule of major activities (annual work plans over the duration):

(There should be a clear link between the activities and the objectives to be achieved. The schedule should show activities, timing and expected outcomes)

***Non exhaustive list of activities planned for RTRC-RACE**

Year	Proposed Activities	Date and Venue	Specific objectives	Expected Outputs (Tangible products)	Expected Outcomes
1	Introductory Training workshop on regenerative aquaculture for Tier-1	One week in July 2027, CEMACS, USM	introductory to regenerative aquaculture, operation of a regenerative aquaculture system, water quality monitoring, growth measurement and post-harvesting processing	- Practical Modul for oyster aquaculture in mangrove ecosystem - 30 trained community practitioners, coastal fishermen or fresh graduates	At least 3 new participants in regenerative aquaculture across Western Pacific Region
2	Training workshop on Oyster and Sea cucumber Hatchery Operation	One week in November 2028, CEMACS, USM	Introductory workshop on operation and techniques of spawning, larviculture for bivalves and sea cucumbers	- 30 trained community practitioners, coastal fishermen or fresh graduates	Enhance the capacity and culturing interest for more hatchery in the region to supply to regenerative aquaculture farms
3	Advanced Training workshop on regenerative aquaculture for Tier-2	One week in July 2029, CEMACS, USM	To strengthen capacity for regenerative aquaculture, operation of a regenerative aquaculture system, water quality monitoring, growth measurement and post-harvesting processing	- 30 trained experienced aquaculture operators, regional and fisheries officer, academic staffs and postgraduate students	Enhanced capacity of production and employ best practices for
4	Training workshop on framework and management of regenerative aquaculture for Tier-4	One week in July 2030, CEMACS, USM	To strengthen the understanding of regenerative aquaculture program framework, policies, scaling, marine spatial planning, and cross-border knowledge exchange.	- 30 trained policymakers, fisheries agencies, partner institutions, national resource manager across the region	Enhance the capacity policy, management, scaling up and MSP for regenerative aquaculture.

5	Regional conference on Blue Food and Regenerative Aquaculture	One week in July 2030, Penang	Knowledge exchange, technical sharing, and promotion RTRC experiences in scaling regenerative aquaculture with community participatory.	- Launch of report and special issue for regenerative aquaculture and community participatory in the western pacific - Participation from academics, practitioners, local communities and policy makers totaling about 100 participants	Widespread adoption and interest for transition towards regenerative aquaculture that uses nature-based solution for sustainable aquaculture for nature and people positive
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****Non exhaustive list of activities planned for RTRC-RACE***

10. Partnerships / Networking

(This initiative encourages partnerships (North-South, South-South) among National Oceanographic Institutes, Universities, NGOs, Private Sectors, etc.)

CEMACS is well-connected and in partnership with institutions such as WorldFish, Fisheries Research Institute, SEAFDEC (Philippines), PMBC (Thailand), Prachuap Khiri Khan Coastal Aquaculture Research and Development Center (Thailand), Can Tho University (Vietnam), Research Institute of Aquaculture No. 1 (Vietnam), University of Southampton (UK), University of Stirling (UK), Swire Institute of Marine Science, Hong Kong University (China). The proposed RTRC-RACE will also make efforts to develop network and partnerships with major marine laboratories and environmental institutes in WESTPAC region.

11. Funding of the proposed RTRC in support of its activities

- 1 Total budget – Full details – categories of expenditure, etc.
Expected Total Budget for 5 years

Budget categories	Amount (US\$)	Remarks
Staffing	336,000	One research staff as coordinator for RTRC, one research and one clerical staff are required to oversee the daily operation of the newly established center and to provide administrative and research support to the relevant activities.
Equipment and Consumables	168,000	Use of equipment and facilities for chemical or molecular analysis
Workshop organization	150,000	Two workshops per year
Overseas travel (for supporting teachers and research exchange)	200,000	
Development of guidebook, manual and knowledge dissemination tool	120,000	
Research Grants	100,000	Postgraduate, Postdoctoral, research

and Fellowship		collaboration
Total	1,074,000	

- 2 Contribution of your institution
 - Budgetary provision (in US\$)
Partly operation of CEMACS will be contributed into running, sustaining and organizing workshops to achieve the objectives of RTRC-RACE (USD\$ 424,000.00 for five years)
 - In-kind services
CEMACS staff and academic staff of will serve as trainers and speakers at training workshops. Administrative staff of CEMACS will at the same time do day-to-day operation of the. CEMACS hatchery, facilities and laboratory will be used and provided as in-kind contribution for RTRC to run workshops, training program and even hold meetings. In total, the estimated in-kind contribution would be US\$650,000.00 for five years
- 3 Extra-budgetary resources to be mobilized (Please refer to the total project budget under 11.1 and indicate items for which you will mobilize extra-budgetary resources)

Potential funding sources:

- Universiti Sains Malaysia
- Ministry of Higher Education
- Ministry of Agriculture and Food Security
- Ministry of Science, Technology and Innovation
- Department of Fisheries, Malaysia

12. Support

- **Institutional**

The RTRC-RACE established at CEMACS is aligned with the university's vision for CEMACS to be not just a centre serving the interests and needs of Malaysia, but to be a regional hub for blue food security. The RTRC is well-supported by the host university.

- **IOC and IOC Sub-Commission for the Western Pacific**

IOC Sub-Commission for Western Pacific will co-organize these regular trainings and workshops, including the development of training announcements, selection of trainees with the host institute, assistance in the identification of regional and international lecturers, and fundraising from various financial sources.

- **Others**

We intend to work with other RTRC that is relevant such as Regional Training and Research Center on Marine Toxins and Seafood Safety (RTRC-MTSS) and Regional Training and Research Center on Marine Biodiversity and Ecosystem Health (RTRC-MarBEST) for cross and transdisciplinary approaches in our training and research

13. Evaluation and reporting

Yearly reporting will be done and shared with the secretariat of IOC-WESTPAC. Evaluation will also be done through the International Advisory Board and reported back to the secretariat

14. Visibility

Please indicate how the activities of the project will be given visibility – websites, brochures, publications, etc.

The activities, outputs, and impact of RTRC-RACE will be given sustained visibility through a dedicated Centre website providing up-to-date information on forthcoming and past activities, training opportunities, Living Lab updates, annual reports, and calls for research collaboration, complemented by active social media accounts across major platforms used to publicize events, training opportunities, and research milestones to communities, partners, and the wider public. Brochures, posters, and info-sheets will be produced for major programmes and training activities, while programme outcomes will also be broadcast through the CEMACS/USM institutional website, ensuring visibility across both the Centre's own platforms and its host institution's wider audience. An annual report documenting RTRC-RACE's activities, training outcomes, and research outputs will be published and distributed via the website, social media, and direct email to partners and the WESTPAC network, and RTRC-RACE and IOC-WESTPAC will be formally acknowledged in all scientific publications, technical reports, and field guidebooks arising from research and training conducted under the Centre.

15. General

Please add any information relevant to the proposal which has not been covered by the above points.

None