



Republic of Kenya

**Kenya Marine Fisheries Socioeconomic Development
Project (KEMFSED)**
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**MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND COOPERATIVES
(MoALFC)**

State Department of Fisheries, Aquaculture and Blue Economy (SDF&BE)

Kenya Marine Fisheries and Socio-Economic Development Project (KEMFSED)

Credit No: 65400-KE: Project ID. No. 163980

TERMS OF REFERENCES

**FOR CONSULTANT SERVICES OF A MARINE AQUACULTURE & HATCHERY
SPECIALIST**

CONSULTANCY SERVICES – INDIVIDUAL SELECTION

Contract No. KE-MOALF-CI-2021-014-ICS

Phase I

March 10, 2022

I. Project Background

The Government of Kenya has received financial support from the World Bank for the development of the Kenya Marine Fisheries and Socioeconomic Development Project (KEMFSED) for a five years implementation. The development project overall goal is to enhance economic benefits and coastal livelihoods from marine fisheries and coastal aquaculture while safeguarding associated ecosystems' integrity. The implementing agency will be the State Department for Fisheries & the Blue Economy (SDF-ABE) on behalf of the Government of Kenya. In Kenya, five counties along the coastline have been selected to be beneficiaries for the project namely Kwale, Mombasa, Kilifi, Tana River and Lamu. KEMFSED Project seeks to empower coastal communities to improve management and value-addition of priority fisheries and mariculture and strengthen access to complementary livelihood activities. The objective of this consultancy is to support the Kenya Marine and Fisheries Research Institute (KMFRI) with marine hatchery technical support in the implementation of Phase I a hatchery facility in the National Mariculture Resource Center (NAMARET).

The Kenya Marine and Fisheries Research Institute (KMFRI) is a research body established within the provision of Science and Technology Act (1979) Cap 250 charged with the responsibility to undertake research in marine and freshwater fisheries, aquaculture, environmental and ecological studies and marine research including chemical and physical oceanography, in order to provide scientific data and information for sustainable exploitation, management and conservation of Kenya's fisheries resources.

The project is comprised of the following 3 components:

Component I: Improve Governance and Management of Marine Fisheries which will focus on improving the management of marine fisheries in Kenyan waters, support infrastructure development

to improve fisheries management and create mariculture opportunities. This consultancy will support activities of this component.

Component 2: Coastal Community Empowerment and Livelihoods will contribute to strengthening livelihoods in coastal communities through a combination of technical and financial support for the implementation of subprojects, improved access to micro-credit and complementary capacity-building and mentoring of beneficiaries.

Component 3: Project Management this Component will finance supplemental support for project management at both national and county levels to ensure coordinated and timely execution of project activities.

2. Objectives of this Consultancy

The objectives of this consultancy is to hire a Marine Aquaculture Hatchery Specialist to support the KEMFSED team for the implementation of Phase I of the development of a hatchery and resource centre at the National Mariculture Resource and Training (NAMARET) Center site in Shimoni, Kwale County.

3. PROJECT LOCATION AND LAND CHARACTERISTICS

Project site

NAMARET is located in Shimoni, in Kwale County. at Shimoni in the South Coast Kenya (4°6''S, 39°3''E). The site is about 300 meters from the shoreline and is adjacent to Shimoni Primary School and Kenya Wildlife Services, Kisite Mpunguti Marine Park and reserve offices (Fig.1). See ANNEX I for the geographical location

3.1 Land Characteristics

Property

KMFRI has set aside approximately 6 hectares of land for the construction of the National Mariculture Resource and Training Center (NAMARET) which includes; the proposed multispecies hatchery and resource Center.

The Land is owned by KMFRI.

Current land use

The proposed project area is characterized by

i) **Buildings**

Currently the site has a small administrative office and ongoing construction of a laboratory building see ANNEX 2

ii) **Native vegetation**

Growth habits of plants, a lifeform spectrum for the KMFRI's Shimoni site can be depicted as follows 32% trees, 30% herbs, 24% shrubs and 14% climbers. These are fragments of coastal forest which remain unprotected within the laws and statutes of Kenya, the majority of the area having been designated as communal village lands and subject to various land-use allocations and the forest has continued to be lost to slash and burn for local agriculture, private development, timber extraction and charcoal burning.

Of the flora, the most frequent species, in the order of abundance included; *Synaptolepis kirkii* (Thymelaeaceae), *Mallotus oppositifolius* (Euphorbiaceae), *Salacia elegans* (Celastraceae), *Ludia mauritiana* (Flacourtiaceae), *Coffea pseudozanguebariae* (Rubiaceae), *Uvaria acuminata* (Annonaceae), *Ochna*

thomasiana (Ochnaceae), *Millettia usaramensis* (Papilionaceae), *Markhamia zanzibarica* (Bignoniaceae) and *Lannea welwitschii* (Anacardiaceae). Overall, Euphorbiaceae and Poaceae were the most diverse families with 27 and 26 species respectively and each representing 6% of the entire species composition; d) Other well-represented families included Papilionacea, Apocynaceae, Rubiaceae, Annonaceae, Lamiaceae.

iii) **Native fauna**

Amongst the key faunal species listed at the proposed site include; small mammals, including rodents, shrews and bats. Rodent species encountered included: *Rattus norvegicus*, *Stochomys longicaudatus*, *Beamys hendei*, *Paraxerus cf paliatus* and *Mastomys natalensis*. *Rattus norvegicus* and *M. natalensis* were the most dominant. Bat species included *Rhinolophus clivosus*, *Hipposideros vittatas*, *H. caffer*, *Coleura afra*, *Triaenops afra* and *Rousettus aegyptiacus*. Bird species associated with the proposed site Fischer's Turaco, Palmnut Vulture and Silvery-cheeked Hornbill. Reptiles and amphibians associated with the proposed site include Changamwe Caecilian (*Boulengerula cf. changamwensis*), Coral rag skink (*Cryptoblepharus boutonii*), amani screeching frog (*Arthroleptis cf. stendactylus*), flap-necked chamaeleon (*Chamaeleo dilepis*) and a gastropod Coconut crab (*Birgus latro*).

iv) **Water sources**

Typically Shimoni area residents draw water from underground wells. Water source for the hatchery operations will be obtained from a borehole drawing seawater. However freshwater for operations of NAMARET facility will be through reverse osmosis plant. There is no foreseen limitations to the source. Drawing water from the sea comes with consequences from fouling organism (molluscs) which with time will clog the inlet pipes. Bore hole water is consider better is it is naturally sand filtered.

The proposed site is a typical coral rag basement supporting fragments of coastal forest which supports diverse assemblage of fauna. It has been observed that the quality of marine water in the intertidal area to the frontage of the proposed site for hatchery and laboratory was within acceptable limit for recreation. However, areas to the northern and southern sides of the site showed elevated levels of fecal coliforms and *E. coli* indicative of anthropogenic inputs. Risks associated from aquaculture systems can arise from high organic and nutrient load, suspended solids, chemical residues including feed supplements and antibiotics. The possible impacts include contamination of groundwater aquifers and surface water from release of effluents.

3.2 NAMARET

The NAMARET Centre is primarily intended to serve as a catalyst for the development of productive and profitable private mariculture ventures along the Kenya coast, especially including ventures involving coastal communities in out-grower initiatives to strengthen livelihoods.

NAMARET will consist of the following installations:

1. An administration block- financed by GoK
2. A laboratory block – financed by GoK
3. A museum centre- financed by GoK
4. A Resource Center (training centre with auditorium) – to be financed by this project
5. An accommodation block- to be financed by this project
6. A marine hatchery – to be financed by this project

The six blocks will sit inside a landscaped area bounded by a perimeter wall, with parking areas, internal roads, incinerator, septic tanks and all related facilities to function.

The Training center will have the capacity of training about 120 farmers/students per batch and accommodate about 20 scientists/technicians at a time.

ANNEX I illustrates the Masterplan for the National Mariculture Resource & Training Center at Shimoni, Kwale County.

The KEMFSED project will finance only the construction of

- i) Marine Hatchery (1.5 ha) that is planned to include broadly the following components:
 - a. Hatchery
 - b. Feed production section
 - c. Wetland

- ii) Resource center (1.0 ha) that is planned to include the following components:
 - a. Six training rooms with a capacity of 30 people,
 - b. 3 break away rooms for each training room.
 - c. One auditorium with a sitting capacity of 200,
 - d. Library section

- iii) Accommodation Building
 - a. Accommodation facility of 20 visiting scientists (self contained rooms)
 - b. 60 self-contained shared rooms for 2 persons,

4. DETAIL CHARACTERISTICS OF THE PROPOSED WORKS

I. Marine Hatchery

The proposed marine hatchery is one of the key components of the National Mariculture Resource Centre (NAMARET) since it will provide key inputs for seed production, technology verification and research dissemination. The main species targeted to be raised in NAMARET will initially be shellfish (prawns, mud crabs), holothurians (sea cucumber) and finfish (milk fish, rabbit fish etc.) – see table below

Common name	Scientific name	Order	Native species (yes, no)
Giant tiger prawns	<i>Penaeus monodon</i>	Decapoda	Yes
Indian prawns	<i>Fenneropenaeus indicus</i>	Decapoda	Yes
Mud crab	<i>Scylla serrata</i>	Decapoda	Yes
Sea cucumber	<i>Holothuria scabra</i>	Synallactida	Yes
Rabbitfish	<i>Siganus sutor</i>	Perciformes	Yes
Milfish	<i>Chanos chanos</i>	Gonorynchiformes	Yes

Hatchery Expected Characteristics

The hatchery will hold facilities for broodstock maturation, spawning and rearing facilities for each developmental phase of each species, as well as feed production for these species.

The proposed hatchery will consist of an algal room, artemia production, fish feed production unit, hatchery and broodstock tanks, nursery and grow-out tanks and ponds.

Other units include water pumping system, recirculating and filtration systems, water reservoirs and a biological waste-water treatment.

Hatchery Estimated production

The Hatchery will be designed to produce a combination of about 6.5 million seeds per cycle. With 3 cycles per year the Hatchery is planned to produce 19.5 million seeds per year.

It is provisionally estimated that the hatchery will be able to produce:

- 100 mud crab brooders with an estimated production of 1.5 million crab-lets per cycle (3-months),
- 80 finfish brooders with an estimated production of 1.5 million fingerling per cycle,
- 50 brooders of sea cucumbers with an estimated production of 1.0 million seed per cycle
- 100 prawn brooders producing 2.5 million seed per cycle.

Other productions

- 1000 kg of fish feed per day.
- Algae and artemia

2. Resource Center

The Resource Center is planned to host:

- Students
- Visiting scientist
- Farmers
- National and International scientific conferences
- Workshops

5. SCOPE OF THE ASSIGNMENT

The Consultant will implement the following activities:

- Undertake discussions with the KMFRI/SDFABE team responsible for development of NAMARET to ensure full understanding of the assignment, and of the objectives and anticipated functioning of the proposed marine hatchery. This shall include site visits to the NAMARET Centre at Shimoni as required; and to other hatcheries that can be an example to NAMARET.
- Perform a Technical review of the proposed schematic designs for the marine hatchery (saltwater system), **Annexes 1 and 2**, consult with AquaConstruct Ltd as needed; provide international best practices for hatchery development and consult other experts as needed.
- Prepare technical report (see Section 5 below for details) on the observations and proposed improvements to the existing AquaConstruct design - for the proposed marine hatchery. Proposed improvements should ensure the institutional objectives of the proposed marine hatchery are still met, within prevailing spatial, environmental, financial and other operational parameters.
 - The report should include recommendations for a modular approach that would allow some elements of the hatchery complex to be reserved for a later project initiative, in case of financial constraints. It is essential nonetheless that, at a minimum, a functional hatchery facility able to produce seed for target species in compliance with the project indicators; national regulations and the ESIA to be implemented.
 - The consultant will use his/her expertise in aquaculture to review the technical aspects of the proposed designs (including potential use of RAS), proposals related to tanks, aeration and oxygenation, UV and ozone Disinfection, mechanical or biological filtration systems, auto-feeders, pumps, etc.
 - The consultant will also consider how to reduce labor and operational cost (reducing energy cost, use of water), minimizing risks (death of stocks), feed optimization, optimal waste management from the circular tanks to improved stock health, etc. consider best national and international practices in salt-water hatcheries.
- Prepare a manual with the recommended protocols for reproduction, spawning and culture of the 6 selected target species (species to be agreed with the KFMRI and NAMARET team).
- Prepare presentations and material (compile them as a manual) and coordinate at least 2 webinars with hatchery experts to increase management capacities of the KMFRI/SDFABE and KEMFSED

team for the reproduction of the selected species, understanding the challenges of hatcheries management and other topics to agree.

- vi. Deliver training using the material prepared in (v) to provide technical support and capacity-building to the KMFRI/SDFABE, KEMFSED team and other stakeholders relevant to the project. Time for these trainings to be agreed with consultant.
- vii. Perform field visits to Mombasa and Shimoani and Zanzibar, to meet government, consultants and operators of other hatcheries facilities. If not possible coordinate virtual meetings.
- viii. Coordinate virtual meetings with the KMFRI/SDFABE, KEMFSED teams and other consultants to understand the scope of the proposed designs of AquaConstruct.

6. CONSULTANT QUALIFICATIONS

The Consultant should have:

- Master's degree or equivalent in an area related to tropical mariculture/ aquaculture or hatchery management, with specialisation in shellfish, holothurian and finfish breeding or other aquaculture expertise
- Degree or equivalent in an area related to tropical mariculture/ aquaculture or hatchery management, with specialisation in shellfish, holothurian and finfish breeding or other aquaculture expertise
- At least 10 years' experience in aquaculture construction, design or management of marine (saltwater and land) hatcheries from Africa or other continents.
- At least 10 years' experience and knowledge of tropical marine aquaculture production techniques including significant demonstrated experience in breeding and production of shellfish (prawns and mud crabs), holothurians (sea cucumber), and marine finfish (rabbit fish and milkfish);
- Proven experience in working with African species and technical knowledge how to reproduce them in NAMARET, Kenya
- Proven experience in preparation of high-quality technical documents/reports in English, for submission to government clients and/or multi-lateral development projects;
- Proven experience and ability to work in different cultural contexts;
- Significant demonstrated experience in providing extension support to grow-out farmers for producing concerned species will be an advantage;
- Practical experience of small-scale hatchery technology transfer to technicians from local institutions, private sector and/or NGOs will be an advantage;
- Excellent communication skills to reach a broad spectrum of social and professional categories;
- A high level of proficiency in English language (speaking, writing, reading)
- Experience in training in aquaculture topics and on the target species

7. ESTIMATED TIME OF THIS CONSULTANCY

A total of about 3 months (90 days) is estimated for this consultancy. The time taken by the team to review the reports are not counted in the time for this consultancy.

8. OUTPUT AND DELIVERABLES

- Deliverables expected under this consultancy:
- Contents for each deliverable will be agreed with the consultant.

- All documents will be delivered in word
- All drawings will be delivered in Autocad, PDF and jpg format
- All documents will be delivered in hard copies (3 copies) and electronically (word version).
- All photos, maps, will be submitted to the client.
- All documents will be reviewed by designated KEMFSED team members and KMFRI team. The World Bank could also provide comments on the deliverables.

Specific Measures under Covid19

Covid-19 is causing quite some restrictions in arranging travel, meetings, field visits and surveys. In their proposal, the Consultant will have to indicate how to deal with these restrictions, while still generating results of expected quality. In particular, clarification is needed on how the limitations in organizing field visits will be overcome in order to obtain sufficient insight into field conditions.

Consultant's damages sustained by Covid-19 related problems are the sole responsibility of the Consultant, even those that would follow from Covid-19 lockdown measures taken by the GoK.

Deliverables (all in English)	Number of days after contract signature	Number of Copies to be Delivered
1. Inception report (proposed workplan)	5 days following contract signature	English
2 Draft Technical report on the Review report of existing Aquaconstruct design with clear advice for designers of the proposed issues, improvements and new requirements	20 days following contract signature	3 hard copies and 4 soft copies
3. Final Technical Report the Review report of existing Aquaconstruct design with clear advice for designers of the proposed issues, improvements and new requirements	35 days following contract signature	3 hard copies and 4 soft copies
4. Draft Reproduction and farming manual of the six target species agreed with the client	51 days following contract signature	3 hard copies and 4 soft copies
5. Final Reproduction and farming manual of the six target species agreed with the client	70 days	3 hard copies and 4 soft copies
6. Training Plan report on the training provided and Training Manual developed, including results of the webinars, case studies and best practices in mariculture hatcheries and research centers around the world.	90 days following contract signature	3 hard copies and 4 soft copies

9. PROPOSED PAYMENT

The consultant will be responsible for services that are or may be needed, including:

- Local transport; internet;
- National, and international telecommunication.
- Editing, design and Printing of reports
- Costs for materials for the training
- Other means required for performing the services, etc.

The assignment will be paid as per the deliverables below;

Deliverable No.	Reports	Proposed Payment as percentage of lump sum contract value
1	Inception report (proposed workplan)	10%
2	Draft Technical report on the Review report of existing Aquaconstruct design with clear advice for designers of the proposed issues, improvements and new requirements	20%
3	Final Technical Report the Review report of existing Aquaconstruct design with clear advice for designers of the proposed issues, improvements and new requirements	20%
4	Draft Reproduction and farming manual of the six target species agreed with the client	20%
5	Final Reproduction and farming manual of the six target species agreed with the client	20%
6	Training Plan report on the training provided and Training Manual developed, including results of the webinars, case studies and best practices in mariculture hatcheries and research centers around the world.	10%

10. COORDINATION AND SUPPORT TO THE CONSULTANT

KMFRI will assist the Consultant as may be necessary for the effective preparation and implementation of this consultancy. KMFRI will be the responsible agency to review and agree on the deliverables of the consultant. Reports will be shared with KEMFSED and World Bank teams for recommendations. The project team will assist the Consultant with the following:

- Provide copies of all key documents relevant to the existing hatchery design;
- Facilitate meetings with all relevant stakeholders;
- Provide office space for coordination meetings at the Consultant's request;
- Assist with site visits as requested by the Consultant;
- Provide the Consultant feedback within 10 days on the draft and final reports and deliverables.

11. DOCUMENTATION TO BE SHARED WITH THE CONSULTANT

The consultant will be given relevant information for this consultancy

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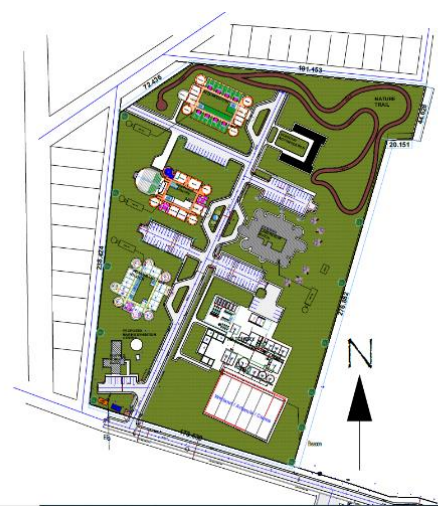
- Drawings
- Strategy of NAMARET.
- Technical reports: reproduction requirements of species, business plan, etc.
- Preliminary ESIA

12. ANNEXES

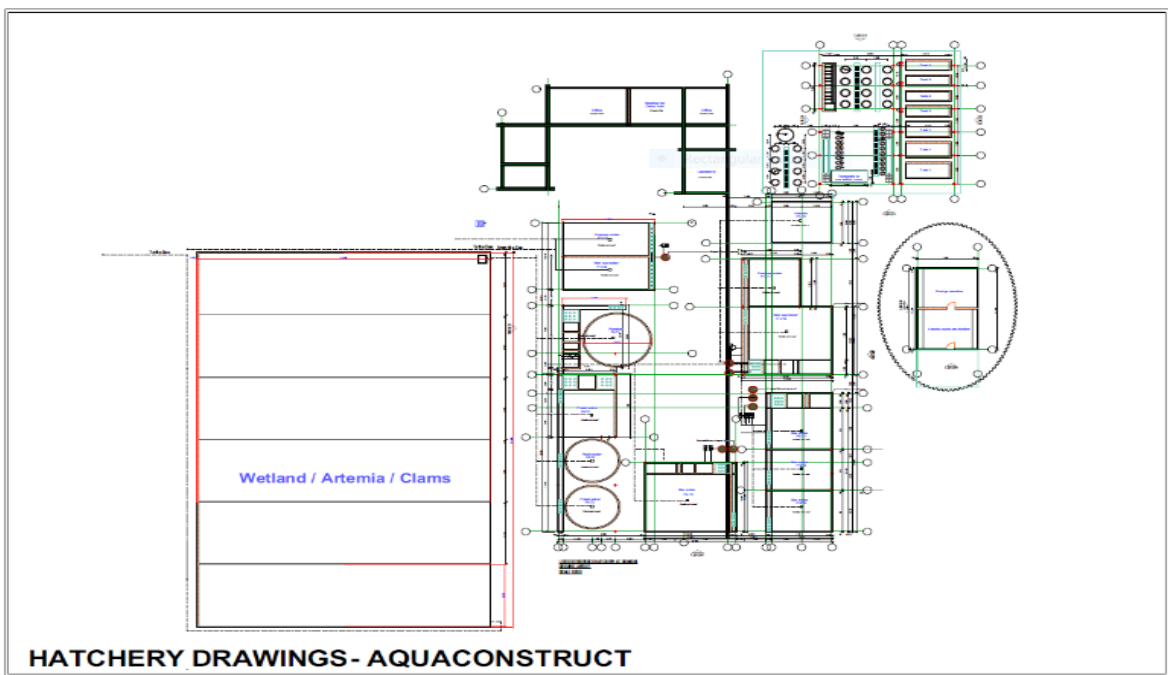
ANNEX I Location map and 2 D master plan



LOCATION MAP

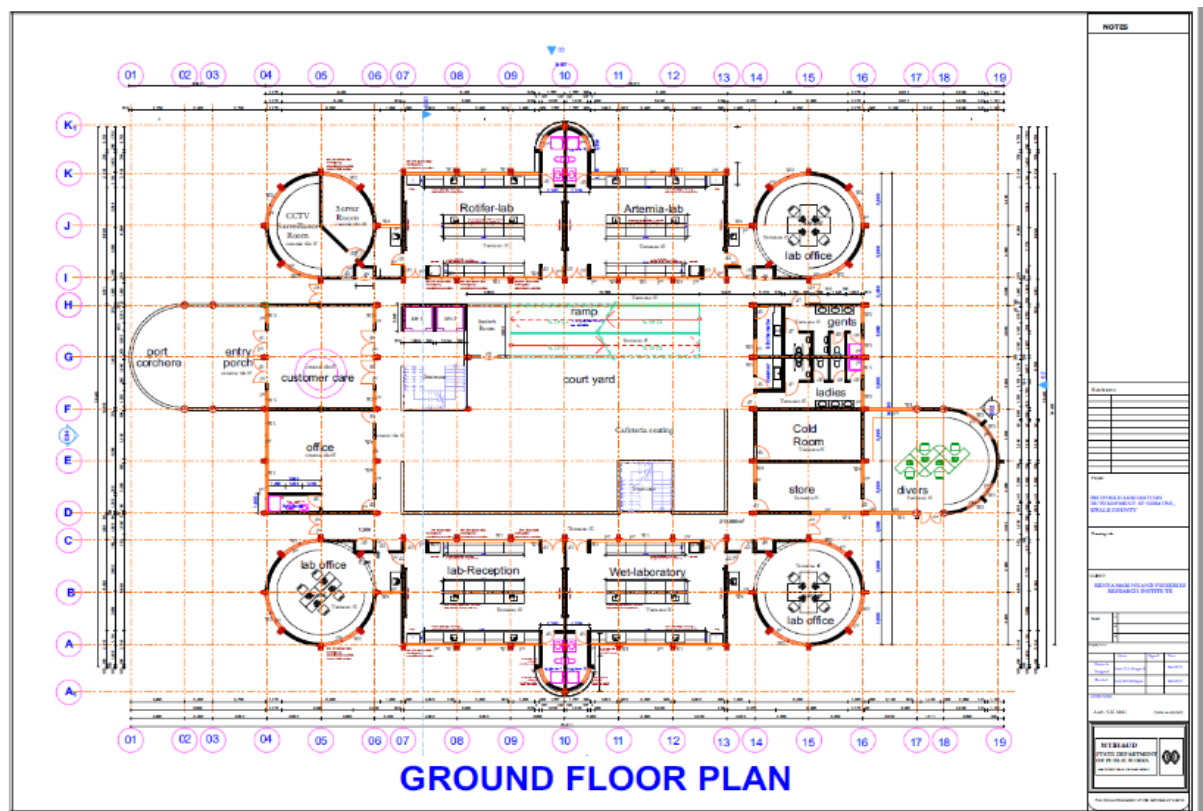


ANNEX 2. Latest Drawings available of Hatchery and Laboratory



HATCHERY DRAWINGS- AQUACONSTRUCT

Ground Floor Plan



Available data from the target species

Mariculture was introduced in Kenya in 1980s to provide economic opportunities to coastal communities to bring about development in the rural coastal areas. Target mariculture species for culture have been milkfish, mullets, mud crab, prawns, artemia, seaweeds and marine tilapia. The most commonly farmed fish species is milkfish (*Chanos chanos*), which accounts for about 90% of production, followed by mullet (*Mugil cephaus*) contributing about 10% of aquaculture production. These species are found in the mangrove systems especially during the rainy season and demand is increasing among coastal communities interested in mariculture. Experimental trial is ongoing for culture of Rabbitfish (*Siganus sutor*) since 2018. Results of cage growth trials are showing good prospects with possibilities of upscaling. Available ready market, acceptability of this fish with the local are the key drivers towards its promotion in mariculture. Other finfish species under consideration for growth trials is *Trachnotus blochii* (Silver pompano) in cages. Other species cultured are mud crabs (*Scylla serrata*) which are cultured in floating cages in the mangrove ecosystems and prawns on earthen ponds. Common species being *Penaeus monodon* and *Fenneropenaeus indicus*. Other species found incidentally in the ponds are silver pompano *Trachnotus blochii* indicating that potential for culture in ponds is high.

i) Milkfish

Milkfish has been fronted as one of the key culture species because of its faster growth, tolerant to high fluctuations in salinity and temperature and availability of seeds from the wild. Comparatively, mullets have similar characteristics, but they grow at a slower rate in the local conditions thus not preferred by farmers. Commercialization of mariculture especially of milkfish and seaweeds was mainly achieved through a World Bank-funded project “Kenya Coastal Development Project” (KCDP) implemented between 2012 and 2017 (Mirera, 2019; Mirera et al., 2020). The main challenges faced in finfish culture include inadequate seeds, seasonal availability of seeds, inadequate extension services amongst others.

With conservative estimates of total pond area of between 60-120 ha available for each species, it is estimated that demand for milkfish fingerlings is most likely in the region of 278,125 and prawns 2.14 million per annum (Hecht et al 2019). If the industry expands from 20 to 160 ha in 5 years, then the demand will increase to 4.5 to 34.3 million (Hecht et al 2019) generating substantial income for the hatchery and profoundly increasing the production of milkfish and prawns by farmers and private partners.

ii) Prawns

Prawn farming in Kenya is continuously being undertaken in earthen ponds in small-scale farms after the collapse of the large-scale farm at Ngomeni. The prawn species cultured are *P. monodon* and *Fenneropenaeus indicus* and seed is obtained from the wild. Recent advances to obtain prawn seed has seen the development of backyard marine prawn hatchery at Vipingo, Kilifi County by Mtoni Ltd. (Munguti et al 2020). Currently, prawn production at the coast is low and varies between semi-intensive and extensive levels since most of the ponds are below 0.1 ha while the feed is mostly from natural productivity resulting in production below 1600 kg/ha/yr. Prawn production by communities in Kibokoni under KCDP have varied between 0.02–0.05 kg prawns/m² in 2013 and 0.25 kg in 2019 respectively. Challenges faced in prawn farming include low production was associated with the inability to stock at the required densities, low technological knowhow, limited extension work and lack of trained manpower, inadequate/lack of seeds. (Munguti et al. 2020)

iii) Mudcrab

Mud crab farming in Kenya is largely dependent on crab fattening in cages and ponds. Few are being produced in earthen ponds lately in Kilifi county. Current challenges being faced in crab farming are seasonal seed supply and high maintenance cost of the cages and ponds in addition to inadequate feeds. Commercialization of mud crab farming and consumption in Kenya has been enhanced through development of eco-restaurant by Dabaso crab shack that has also increased the income from the sale of crabs from value added products e.g. crab samosas, crab sausages and cooked whole crab. To address high maintenance costs, KMFRI is now testing the use of plastic crab cages fabricated and modified from plastic crates. The plastic cages potentially have lower maintenance costs and would, therefore, improve the profits from the culture (Munguti et al 2020). Recent development in crab fattening has been taken up by private developers like CheShale company in Kilifi County.

iv) Sea cucumbers

Sea cucumber farming is still at infancy stage in Kenya due to lack of technology and seeds for culture. Most of the sea cucumbers are caught from the wild and exported. The sea cucumbers are sold fresh from the sea to local first level middlemen who process and sell them to the second level middlemen and exporters in Mombasa. The fishers occasionally borrow money from first level middlemen especially when they fail to catch sea cucumbers but this in turn creates conditions of dependence and possible exploitation. Almost all sea cucumber fishers have stated that they are not willing to make sea cucumbers part of their daily diet. The economic value of the product was substantial; the average monthly revenue for dry sea cucumbers in the area was estimated to US\$ 8000. The relative highest profits are derived from juvenile species, thus there is an economic incentive hindering local stocks to reach sexual maturity, which in turn may create a situation in which recruitment success is highly dependent on faraway populations (Ochiewo et al. 2010). Currently experiments are ongoing in the culture of sea cucumber in ponds (community) in Kilifi and in tanks in KMFRI.