DOST Form 2 (for Basic/Applied Research)
DETAILED RESEARCH & DEVELOPMENT PROJECT PROPOSAL

(1) PROJECT PROFILE

Program Title: Grant-in-Aid Program
Project Title: Sea Cucumber Hatchery for Enhanced Sustainable Aquaculture
Project Leader/Sex: Paloma D. De Chavez/F
Project Duration (number of months): 36 months
Project Start Date: June 2024
Project End Date: June 2027
Implementing Agency: Marinduque State College
Address/Telephone/Fax/Email: Bahi, Gasan, Marinduque/ 09072580955/pam14dechavez@gmail.com

(2) COOPERATING AGENCY/IES

Marinduque State College
DOST-MIMAROPA

(3) SITE(S) OF IMPLEMENTATION

IMPLEMENTATION SITES NO.	COUNTRY	REGION	PROVINCE	DISTRICT	MUNICIPALITY	BARANGA
1.	Philippines	MIMAROPA	Marinduque	Lone	Gasan	Bognuyan
2.						
3.						
4.						
5.						

(4) TYPE OF RESEARCH

___/__ Basic
___/__ Applied

(5) R&D PRIORITY AREA & PROGRAM (based on HNRDA 2017-2022)

_____ Agriculture, Aquatic and Natural Resources
Commodity: _____
_____ Health
Priority Topic: _____
_____ Industry, Energy and Emerging Technology
Sector: _____
_____ Disaster Risk Reduction and Climate Change Adaptation
___/__ Basic Research
Sector: _____

Sustainable Development Goal (SDG) Addressed

Life below water
GAD
Food Security

(6) EXECUTIVE SUMMARY (not to exceed 200 words)

The proposed project “Establishment of Sea Cucumber Hatchery in Marinduque” will be proposed primarily for the purpose of having a continuous supply of the species and thus, to avoid depletion of such resources in the province. Sea cucumbers are highly valued marine commodities, with prices reaching up to US$ 2,000 per kilo, when processed and dried into

trepang or beche-de-mer. A great majority of traded sea cucumbers comes from wild harvest causing severe decline in stocks. Sea cucumber mariculture using hatchery-bred juveniles can offer an alternative income source and will result in employment opportunities for island communities and provide potential source for exports. Likewise, a hatchery-based sea cucumber production is to make available for stock enhancement program and for aquaculture-based farming enterprises, while protecting the remaining wild populations.

Sandfish is the common English name for one particular tropical species of sea cucumber called *Holothuria scabra*. It is one of the most threatened tropical species because of its high price and ease in collection. It is typically found in shallow intertidal sandy-muddy shores, commonly associated with seagrass beds and sand flats. Sandfish has one of the highest potential for aquaculture because hatchery production technology of this species has been establish at SEAFDEC/AQD and other BFAR National and Regional Training Stations.

(7) INTRODUCTION

Sea cucumbers are among the most important and highly priced marine invertebrate resources (Bautista, et al., 2017), due to the high market demand which forms a multi-million dollar export industry of trepang or dried sea cucumbers (Gamboa et al., 2004). Since the Philippines is the second largest exporter of sea cucumbers in the world (Casilagan & Juinio-Meñez, 2007), it becomes one of the among heavily exploited invertebrates.

In the province in particular, significant reports were noted of having continuous harvest of the resource. Their fishery also serves as a significant source of livelihood for many of the coastal communities in the country (Domantay, 1934; Trinidad-Roa, 1987; Nievales, 2007) and in the province in particular. Having limited efforts to effectively regulate and manage the fishery on a national scale, unsustainable fishery practices have led to a rapid decline of its populations throughout the Philippines and in many parts of the world (Lawrence et al., 2004; Battaglene & Bell, 2006). Likewise, their collection is unregulated due to poor implementation of pertinent laws and information on its populations is likewise limited (Jontila et al., 2017).

Marinduque State College-Department of Fisheries is planning to embark on establishing a hatchery for sea cucumber. But, there is insufficient data on sea cucumber in the province of Marinduque, hence, basic information on the community assemblage of sea cucumbers and the level of the current exploitation on the resources will likewise to be established in this proposal.

Status of Sea Cucumber in Marinduque

In Marinduque, sea cucumber resources have been exploited for decades due to the animal's many health and nutritive benefits. It is traditionally used in local dishes or to derive products of local medicinal value. There have been very few studies conducted on the fishery of sea cucumber in Marinduque. Manual harvesting of sea cucumber, constitutes a minor to major fishery in the province which takes place somewhere in Gasan and Sta. Cruz. In fact, there is an existing market with which catch of the locals are dried and sold directly in their so called "supplier" which ships the product outside the province. However, due to the increased demand for this species in the area, more locals tend to continuously collect sea cucumber since the harvest is only done manually and does not incur additional effort and

expenses.

Despite the lack of regulations in the harvesting of sea cucumbers in the province, some general fishery management rules are being practiced such as restriction on the use of SCUBA for harvesting any marine resource. Sea cucumbers are only collected by hand during lowtide or by skin-diving in deeper areas. The peak months for harvesting sea cucumber are from September to January, despite the lack of scientific studies to impose specific closed season and other regulations.

(7.2) SCIENTIFIC BASIS/THEORETICAL FRAMEWORK

Different facilities intended for Broodstock conditioning, Spawning induction, Larval Rearing and Nursery will be following the protocols established by SEAFDEC-Iloilo (Figure 1).

1. Broodstock conditioning
2. Spawning Induction
3. Larval rearing
4. Nursery rearing

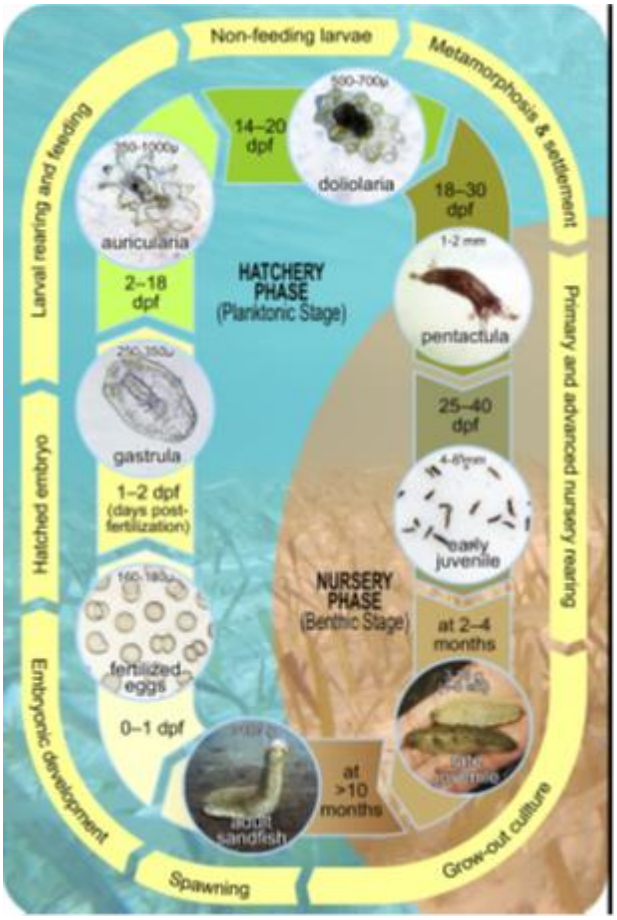

Figure 1. Broodstock conditioning, Spawning induction, Larval Rearing and Nursery established by SEAFDEC-Iloilo

(7.3) OBJECTIVES

General: To establish a hatchery for potential sea cucumber aquaculture in Marinduque.

Specifically, this aims to:

1. determine the species composition; relative abundance, community structure and distribution
2. develop capability for the project management team on sea cucumber hatchery operations
3. determine the possible source of wild stocks for hatchery;

develop hatchery protocol for high value sea cucumber species existing in the province;

(8) REVIEW OF LITERATURE

Market revenue of sea cucumber is 1054M USD with 5.28% compound annual growth rate (Absolute Reports Pvt Ltd, 2022) in the global market. The lucrative nature of this commodity becomes the gate to its overexploitation almost to the degree of extinction (Baker-Médard & Ohl, 2019) in some areas. In the late 19th century, the Philippines is the top producer of dried and processed sea cucumber. It is claimed that large proportion of sea cucumber fishery are located in the developing countries (Altamirano, J. et al., 2018) like the Philippines. The harvest is solely from the wild which results to overexploitation of the stock (ACIAR, 2022). Status of the wild sea cucumber stocks in Mindanao shows a rapid decline in population trend (Arriesgalo, et al., 2022). Passive conservation of wild sea cucumber population have been recorded, implemented; in the form of 'no-take zone' (Jupiter, SD. 2013), conservation measures including total ban of collection (Altamirano, et al., 2018) from the wild habitat do not show any recovery in some studies areas (Brown, K. 2022). This is attributed to the biological characteristic of sea cucumbers being sessile organisms and their reproductive strategy. The sea cucumber Pacific Community (SPC) established a threshold of 10-50 individuals ha-1 to avoid reproductive failure (Shedrawi, G. 2021). In the Philippines, the computed catch per unit effort of harvesters mainly by gleaning and skin diving by the locals of the coastal communities averages to 3-4pcs/diver/hour (Alpasan & Billiones, 2015). This rate of harvest coupled with the number of gatherers in the coastal communities amplifies the rate of loss in the wild population as induced by reproductive overfishing.

Both offshore and surveys in the forms of focus group discussion have been used in assessing the wild population and the status of the demersal species particularly the sea cucumber (Ajik. et al., 2021; Shedrawi, G., et al.,2022) shows individually significant result and it would enable to lay a picture of holistic perspective by integrating both modes of assessment tool to tailor a concrete plan of action for the sound management of the sea cucumber fishery of the province. Offshore assessment will use Belt transect method for intertidal and timed-search method for subtidal zones marked by GPS. Stock enhancement programs under several categories have proved in developed countries to be the most important and successful tool in management of demersal fisheries as demonstrated by sea urchin stocks in Japan (Agatsuma, 2013; Keesing, et al., 2016).

(9) METHODOLOGY

Study 1. Assessment of the Sea Cucumber Resource.
This study will be guided by the protocols adapted from Olavides et al. (2010) with few modifications which will serve as the method in site selection and survey method and in generating and analyzing data to wit:

A. Site Selection and Survey Method

Sampling stations will be selected from three broad habitat types, particularly seagrass, coralline and mixed habitats in each municipalities (Gasan, Boac, Buenavista, Mogpog, Torrijos and Sta. Cruz) in the province. Each municipality will be having three (3) sampling points. Manta tows will be undertaken to ground-truth preselected sites. GPS coordinates of sampling stations will be plotted in mapping software. Three replicate 500 m^2 (100 m x 5 m) belt transects per sampling station will be laid perpendicular to the shore and surveyed by pairs of observers during daytime and within 1-5m depth range. Identification to genus and species level will be done through examination of external morphology thru World Register of Marine Specie)s (WORMS) online portal. *Aspidochirotes* or those species belonging to families *Holothuriidae* and *Stichopodidae* will be measured in its relaxed state either in situ or in the boat. To minimize the sea cucumbers from contracting as a result of being disturbed, some specimens will be placed in 90L bins with seawater in the boat for a few minutes to relax the specimen to its normal size prior to measuring length and width. Total body length (from mouth to anus) and maximum width will be measured to the nearest cm using-a tape measure following its body contour. Prior to weighing, the specimens will be taken out of the water for a few minutes to allow some water from its gut to be released and will be weighed to the nearest gram using a digital scale for individuals below 100 g and to the nearest 10g for specimen weighing more than 100g.

B. Data Handling and Analysis

The following formula will be used in the calculation of different parameters:

Population density per species (D):

$D = ni / A$

where:

n_1 = total number of individuals per species

A = total area covered in hectares

Relative abundance per species (% Ab):

$\% Ab = D / \Sigma D$

The Shannon index of general diversity was calculated using the formula:

$H = -S\ ni /N \log ni /N$

where:

n_1 = importance value for each species (i.e number of individuals)

N = total of importance values

C. Assessment of the Sea Cucumber Fishery

Consultation meetings and orientation with stakeholders will be held in coordination with the local governments. The stakeholders as identified by the LGUs will include individuals involved in the sea cucumber fisheries either as traders, processors or fishers. Key informants interview will be done using stratified survey questionnaires and unstructured discussions on site. To augment on-site interviews, focus group discussions (FGD) will also be undertaken with a group of sea cucumber collectors, and the middlemen traders, wholesale and retail buyers per municipality. Documentation of local fishery methods and knowledge/perceptions of the fishers and the traders/buyers will also be assessed.

Study 2. Resource Mapping of Sea Cucumber

An open source geographic information system software (Quantum ArcGIS v. 10.3) will be used to produce sea cucumber resource mapping map in the different sampling sites.. The said map would aid in easy monitoring and surveillance of the status and abundance of sea cucumber in the province.

Study 3. Establishment of Sea Cucumber Hatchery

Since the hatchery and culture of sea cucumber has long been established at SEAFDEC-Iloilo and other BFAR National and Regional Training Centers, sending of the person in charge in seminars and trainings will be conducted to acquire the skills needed for the successful operation of the proposed hatchery. This will be composed of different facilities intended for Broodstock conditioning, Spawning induction, Larval Rearing and Nursery following the protocols established by SEAFDEC-Iloilo.

Broodstock conditioning

Broodstock collected from the wild are conditioned in tanks with sandy-mud substrate and flow-through seawater. They are fed with a mixture of powdered Sargassum, formulated feed and *Navicula sp*. slurry. After spawning, they are returned to the field where they were collected for natural recovery.

Spawning induction

A pre-defecated spawning group of 20-60 sexually mature sandfish will be induced to spawn using non-lethal thermal and food stimulations. Males are expected to spawn first by releasing a steady stream of white milt with sperm through the gonopore – a small genital opening above the anterior or front end of the body. This may last up to 3 hours. Females spawn by releasing quick bursts of eggs after a characteristic bulging around the gonopore. Females typically perform 2-3 bursts at about 5 minutes interval.

Larval Rearing

Fertilized eggs are stocked in tanks filled with filtered and UV-treated seawater at 100-500 eggs/L at optimum temperature (26-30°C) and salinity (28-33 ppt). Auricularia stage larvae are fed daily with Chaetoceros calcitrans. Water exchange (20-50%) is done every two days while siphoning out wastes from the tank bottom. At Doliolaria stage, corrugated plastic sheets painted with Spirulina paste are added into the rearing tank to induce settlement. Metamorphosed Pentactula are fed with Navicula sp. slurry.

Nursery Rearing

Post-metamorphic or early juvenile sandfish (4-10 mm), at 30-45 days old, are transferred from larval tanks in the hatchery into floating hapa nets (1 m x 2 m x 1.2 m) in sea-based or tank-based nurseries. Nursery hapas are made of fine-meshed (>1 mm) net suspended with a floating PVC frame. In good sites, sandfish juveniles grow to 2-4 g within 1-2 months, depending on season and sea conditions. At this size, they are ready for advanced nursery rearing in pens or ponds.

(10) TECHNOLOGY ROADMAP (if applicable) (use the attached sheet)

(11) EXPECTED OUTPUTS (6Ps)

Publication	1 Hatchery Operations Manual 1 Scientific paper
People Service	5 student interns/researchers; 10 fisherfolks;4 faculty/staff; 6 LGU fishery technicians
Partnership	1 MOU/MOA with LGUs Marinduque
Patent/Intellectual Property	1 Copyright of the Manual 1 Utility Model for the culture management of sea cucumber
Policy	Policy support for the conservation of sea cucumber
Product	Produce good/export quality hatchery-reared sea cucumber

(12) POTENTIAL OUTCOMES

1. Produced IEC material such as pamphlet and flyers;
2. One scientific publication
3. Scientific basis for strict implementation of BFAR Administrative circular No. 248 s.3013 **(**Size regulation for sea cucumber collection and trade)
4. Ensure population sustainability of sea cucumber in municipal waters of the Province.

(13) POTENTIAL IMPACTS (2Is)

Social Impact	Community awareness on the importance of sea cucumber resource in the locality
Economic Impact	Alternative livelihood for additional income in the local communities and other stakeholders

(14) TARGET BENEFICIARIES

The target beneficiaries of the project are the following:

- MSC-Faculty & Staff Researchers
- BS-Fisheries Students
- Sea Cucumber traders, operators and processors
- Municipal Agriculture Offices

(15) SUSTAINABILITY PLAN (if applicable)

The project will have a partnership in the form of Memorandum of Agreement with the DOST-Marinduque and different LGUs with their respective Municipal Agriculture's Office. In terms of funding, DOST-MIMAROPA will provide funding assistance and monitoring and evaluation.

On the other hand, MSC will create its Project Management Team (PMT) who will be In-Charge of the project implementation, monitoring and evaluation. Regular meetings will also be conducted to ensure that the project is on track and shall prepare progress and terminal reports for submission to concerned agencies.

LGU partners and other related agencies (e.g., BFAR) would take part for granting of permits and other necessary documents needed (sampling, collection, conduct of meetings and interviews). They will also provide personnel who may assist the team in their sampling and other related activities.

(16) GENDER AND DEVELOPMENT (GAD) SCORE (refer to the attached GAD checklist)

(17) LIMITATIONS OF THE PROJECT

The project is focused mainly on conducting breeding trials on potential sea cucumber species available in the province. The stocks to be collected are the mature ones, which will be tested out for breeding up to spawning period. The project intends to capture the embryonic development of the would be produce from the breeders.

Grow-out culture will not be included yet as the project intends to test out if the species collected will survive the hatchery conditions.

(18) LIST OF RISKS AND ASSUMPTIONS RISK MANAGEMENT PLAN (List possible risks and assumptions in attaining target outputs or objectives.) (pls see attached file)

(19) LITERATURE CITED

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Shedrawi, G. et al., (2022) An Assessment of Sea Cucumber Populations at Lord Howe Atoll (Ontong Java), Solomon Islands to inform the development of the Community-based management plan. Pacific Community. New Caledonia.

(20) PERSONNEL REQUIREMENT

Position	Percent Time Devoted to the Project	Responsibilities
Paloma D. De Chavez (Project Leader)	**30%**	• Heads the project team; • Plans and supervises and facilitates the implementation of the project by all the members of the project team; • Ensures the timely implementation of project activities in accordance with the approved workplan; • Coordinates major project concerns with PCAARRD and Consortium Management; • Coordinates the administrative and financial concerns of the project with the College Administration and/or concerned administrative personnel; • Manages and responds to project related communications; • Drafts a MOA between MSC and key partners and facilitates the signing of the MOA; • Facilitates project-related seminars and other meetings with the local partners; • Prepares articles, and presentations if needed; • Reviews data and reports received from the project team members; • Summarizes project results; • Prepares and submits reports (quarterly and terminal) to PCAARRD (cc: College Administration and Consortium Management); • Leads the sample and data collections in the field sites Conducts project meetings.

Doreen R. Mascareñas (Project Staff, Level 2)	**30%**	• Assist project leader (technical and financial reports, concerned study • Administrative aspects? • Conducts regular and close monitoring of the project implementing team (research assistant, laborer and student aides) in the project site; • Sees to it that the targeted activities are implemented and corresponding project deliverables are achieved on time; • Reports significant concerns to the Project Leader; • Contributes to the preparation of reports and publication, and • Attend project meetings
Orlen M. Mallen (Project Staff, Level 2)	**30%**	• Assist project leader (technical and financial reports, concerned study • Administrative aspects • Conducts regular and close monitoring of the project implementing team (research assistant, laborer and student aides) in the project site; • Sees to it that the targeted activities are implemented and corresponding project deliverables are achieved on time; • Reports significant concerns to the Project Leader; • Contributes to the preparation of reports and publication, and • Attend project meetings • Perform other related functions;
Regie F. Mampusti (Project Staff, Level 1)	**30%**	• Assist project leader (technical and financial reports, concerned study • Administrative aspects? • Conducts fieldworks and regular and close monitoring of the project implementing team (research assistant, laborer and student aides) in the project site; • Assist the Project Team in ensuring targeted activities are implemented and corresponding project deliverables are achieved on time; • Reports significant concerns to the Project Leader; • Assist in the development of hatchery protocols • Contributes to the preparation of reports and publication, and • Attend project meetings • Perform other related functions;
Harvey A. Dulay (Project Staff, Level 1)	**30%**	• Assist project leader (technical and financial reports, concerned study • Administrative aspects • Conducts regular and close monitoring of the project implementing team (research assistant, laborer and student aides) in the project site; • Assist the Project Team in ensuring targeted activities are implemented and corresponding project deliverables are achieved on time; • Reports significant concerns to the Project Leader; • Assist in the development of hatchery protocols • Contributes to the preparation of reports and publication, and • Attend project meetings • Perform other related functions;
Job Order	**100%**	• Conducts fieldworks • Manages the hatchery operations; • Reports immediate concerns to the On-site Project Coordinator; • Collects and analyses data; • Maintains accurate data records; • Provides ready access to all experimental data for the faculty

		and student researchers; • Supervises student-interns and student aides; • Prepares progress reports; • Assists to field works to collect data and/or samples for the project; • Maintains laboratory equipment; • Contributes to publication; • Develops hatchery protocols; • Attends project meetings; and • Performs miscellaneous job-related duties as assigned.
Jyka Mae S. Labrador Project Support Staff (Level 2)	**50%**	• Maintains the cleanliness and orderliness of the laboratory and hatchery; • Assists in the hatchery operations; • Attends project meetings; and • Performs miscellaneous job-related duties as assigned.
Dennis M. Dela Cruz Project Support Staff (Level 2)	**50%**	• Maintains the cleanliness and orderliness of the laboratory and hatchery; • Assists in the hatchery operations; • Attends project meetings; and • Performs miscellaneous job-related duties as assigned.

(21) BUDGET BY IMPLEMENTING AGENCY

IMPLEMENTING AGENCY	PS	MOOE	EO	Total
Year 1				
Year 2				
Year n				
TOTAL				

(22) OTHER ONGOING PROJECTS BEING HANDLED BY THE PROJECT LEADER: _____ (number)

Title of the Project	Funding Agency	Involvement in the Project

(23) OTHER SUPPORTING DOCUMENTS (Please refer to page 2 for the additional necessary documents.)

I hereby certify the truth of the foregoing and have no pending financial and/or technical obligations from the DOST and its attached Agencies. I further certify that the programs/projects being handled is within the prescribed number as stipulated in the DOST-GIA Guidelines. Any willful omission/false statement shall be a basis of disapproval and cancellation of the project.

	SUBMITTED BY (Project Leader)	ENDORSED BY (Head of the Agency)
Signature		
Printed Name	**PALOMA D. DE CHAVEZ**	**BERNARDO T. CARINGAL**
Designation/Title	**Department Head (Fisheries) Marinduque State College**	**Provincial S&T Director PSTO Marinduque**
Date		

Note: See guidelines/definitions at the back.