PROJECT DOCUMENT

Program Categories: Departmental Programs
Project Title: Maintaining Environmental Integrity through Responsible Aquaculture
Responsible Department: AQD
Total Duration: 2016-2020
Funding Sources: AQD, DA-BFAR, ACIAR
Estimated Budget for 2020: USD 142,617

1. INTRODUCTION

The phenomenal growth of aquaculture in recent decades has significantly improved the seafood supply to meet the demand of human's growing population. However, this development has caused various negative impacts to the natural environment, especially during the earlier stages of aquaculture expansion. Some of these impacts include the modifications of ecosystems, particularly of mangroves, and in some cases have caused destruction or complete loss of habitat; the unregulated collection of wild broodstock and seeds; translocation or introduction of exotic species; loss of biodiversity; introduction of antibiotics and chemicals; discharge of aquaculture wastewater causing coastal pollution; dependence on fishmeal and fish oil as aquaculture feed ingredient; spread of aquatic animal diseases, and others. In response to these issues, the Maintaining Environmental Integrity through Responsible Aquaculture Program or MEITRAP was developed by SEAFDEC to conduct scientific assessments on the adverse effects of aquaculture on the natural environment and to establish procedures on how these negative impacts can be mitigated in order to sustain healthy ecosystems in aquaculture areas. SEAFDEC/AQD has been developing aquaculture techniques and technologies for various species of finfish, crustaceans, mollusks, and new emerging aquaculture species, not only to enhance sustainable seafood production in the Philippines and other countries in Southeast Asian region, but also to safeguard the integrity of the coastal and aquatic environments.

2. PROJECT

1.1 Goal /Overall Objectives

The general objective of the program is to develop sustainable aquaculture technologies by integrating environmental factors in SEAFDEC/AQD research activities and to maintain environmental integrity by promoting responsible aquaculture practices.

The specific objectives are to:

(1) assess impacts of aquaculture on biodiversity, water and sediment qualities in the culture areas and adjacent ecosystems both in marine and freshwater systems;
(2) identify appropriate extractive species that may be used in Integrated Multi-Trophic Aquaculture (IMTA);
(3) develop and promote efficient and suitable environment-friendly culture systems; and
(4) conduct biological and ecological studies on species with potentials for resource enhancement.

1.2 Outcomes and Expected Outputs

Research and development activities of MEITRAP focus on maintaining environmental integrity while promoting sustainable and responsible aquaculture practices. In line with the program's objectives, the program involves studies on assessing impacts of aquaculture systems, evaluating prospects of potential tropical aquatic species for Integrated Multi-Trophic Aquaculture (IMTA), testing environment-friendly culture systems for various aquatic commodities, and promote resource enhancement especially of economically-important but vulnerable species.

1.3 Project Description/Framework (*for total duration of the project*)

Activity 1: *Strategic feeding of milkfish* Chanos chanos *for efficient marine cage culture production*

The compensatory growth (CG) in fish, which enables rapid growth after a period of food restriction, provides an opportunity to reduce feed input with harvests anticipated to be comparable with the traditional full daily feeding. The study, started in 2019, will determine the minimum duration of food restriction that primes CG response in milkfish fingerlings as well as the minimum duration of refeeding wherein normal physiology is regained and lost growth is fully compensated. CG response of the milkfish juvenile will be examined and a feeding technique will be established based on optimum starvation-refeeding cycle in a full grow-out culture of milkfish in marine cages.

Activity 2: *Comparison of oyster* Crassostrea iredalei *growth and survival in brackishwater pond and river using pouch*

This study was based on a recently concluded study funded by DOST-PCAARRD which identified the 'pouch method' as the best in producing single oysters with fast growth and homogenous sizes. The study aims to develop protocols for the "oyster-in-pouch" method to be potentially used in ponds that are otherwise unproductive for fish culture. As an initial activity, the study compares the growth and survival of oyster in brackishwater pond and river for grow-out culture, using pouches hung in floating rafts.

Activity 3: *Grow-out culture of abalone in pipes*

This study will verify the production effectiveness of a newly developed grow-out technique of rearing abalone using perforated PVC pipes, in collaboration with private partners around the island of Panay, central Philippines. This system only uses environment-friendly natural seaweed *Graciliariopsis heteroclada* as food for abalone. Started in March 2018, this study was successful in demonstrating the technology in an island community where some harvests were already made.

Activity 4: *Polychaete culture in raceway ponds*

Marine worms (Annelida: Polychaeta) are used as additive in maturation feeds to enhance reproductive performance of crustacean and fish broodstocks. Thus, culture production of polychaete needs to be enhanced. This study aims to verify culture methods of polycahaetes in raceways and assess nutrient quality, health and profitability of such a culture system. The study has established protocols like stocking density, culture duration and optimal management in producing disease-free stocks.

Activity 5: *Increasing technical skills supporting community-based sea cucumber production in Viet Nam and the Philippines*

Funded by Australian Centre for International Agricultural Research (ACIAR) and in collaboration with other research and academic institutions in the Philippines, this study seeks to improve hatchery production strategy for sandfish using micro-algae concentrates, as well as to enhance productivity of ocean nursery and sea ranch systems though understanding of the optimal environmental conditions, seasonality, food requirements, as well as establishing measures to mitigate significant predation on stocks in the field. It will also develop strategies to improve livelihood outcomes of local communities through small-scale sandfish culture and related value chain.

Activity 6: *Joint Mission for Accelerated Nationwide Technology Transfer Program for Aquaculture*

SEAFDEC/AQD is committed to intensify techno-transfer of aquaculture technologies to stakeholders. The collaborative project between SEAFDEC/AQD and BFAR (Bureau of Fisheries and Aquatic Resources) entitled, Joint Mission for Accelerated Nationwide Technology Transfer Program (JMANTTP II) aims to promote sustainable aquaculture technologies that are economically-viable, environmental-friendly and socially-equitable to increase fish production, exports revenues, employment and livelihood options for the fisherfolks and to facilitate technology transfer by demonstrating sustainable technologies in strategic areas nationwide to serve as skill-learning centers for various stakeholders.

3. PROGRESS/ACHIEVEMENTS OF ACTIVITIES IN THE YEAR 2019

Project/Activity Title	Duration	Remarks
Milkfish Strategic feeding of milkfish (*Chanos chanos*) for efficient marine cage culture production In its first year in 2019, focus was on determining indicators of starvation in milkfish juveniles using body weight loss, length, and hepatosomatic index (HSI) by comparing starved and fed milkfish. Starved fish had significantly lower mean body weight after 2 days of starvation but not on days 3 to 5. Significantly lower mean body weight in starved group was observed again on day 6, 8, 9 and 10. It is likely that the significant difference on day 2 is only due to small sample size number. Results suggest that milkfish fingerlings can withstand the lack of exogenous source of energy until about a week (~6 days). On the other hand, data on total length showed no significant differences between control and starved group throughout the trial. The hepatosomatic index (HSI) value of milkfish fingerlings in this study was highly responsive to variation in feeding. HSI value of starved fish was significantly lower compared to control group after two days of starvation and the succeeding time points throughout the trial. Within starved group, a significant reduction in HSI was observed after 1 day of starvation while minimum HSI value was observed on day 2. These observations suggest that there is depletion of energy reserve (i.e. liver glycogen) at day two and likely enough period to induce physiological changes specifically a shift to catabolic phase, a critical phase leading to CG response. To confirm results, refeeding experiments in milkfish fingerlings where in normal physiology is regained and lost growth is fully compensated will be conducted.	**Jan-Dec 2019**	
Oyster Comparison of oyster *Crassostrea iredalei* growth and survival in brackishwater pond and river using pouch This study was conducted to verify the results of a previous research which indicated that hanging pouch method in grow-out culture of oysters produced larger and more uniform premium sizes. This study explores the opportunity to utilize existing ponds that may otherwise be unproductive for fish or crustacean cultivation.	**Jan-Dec 2019**	

In its first year, the study focused on-site selection and has successfully identified an ideal area in Arellano River at Pawa, Panay in Capiz, Philippines. In June, construction of experimental rafts and oyster pouches was completed and a preliminary culture trial commenced using 3,000 pieces of locally-sourced oyster spats divided into a total of 12 rafts in the pond and adjacent river. After three months, growth and survival was higher in the river set-up compared to pond. It was concluded that mortalities in the pond were mainly caused by predation by crabs.		
Abalone Grow-out culture of abalone in pipes As a first verification demo site, the study partnered with a private company at Sicogon Island, in northern Iloilo. The study uses an alternative culture method for abalone using perforated PVC pipes and natural food, seaweed *Graciliariopsis heteroclada*. In 2018, the study has conducted three stocking activities with a total of 3,125 abalone juveniles and has conducted two harvest activities with a total of 686 pieces. For this year, the system was able to stock a total of 5,249 abalone and has harvested 1,462 so far.	**2018-2020**	
Marine worm Polychaete culture in raceway ponds As a potential feed ingredient, polychaete needs to be disease-free which requires it to be produced in controlled environments like in land-based raceways using hapa nets. For this year, results of stocking density experiment showed that polychaetes maybe stocked as high as 2,000 ind/m^2 density with no significant differences in growth, biomass and survival performance with low density (*e.g.* 500 ind/m^2). After four months of culture, polychaete biomass reached >100 g/m^2. Soil organic matter content was also reduced from >5% to 3.8% after four months, indicating the bioremediation potential of this species.		
Sea cucumber Increasing technical skills supporting community-based sea cucumber production in Viet Nam and the Philippines The study is funded by Australian Centre for International Agricultural Research (ACIAR) in a project entitled, "Increasing technical skills supporting community-based sea cucumber production in Viet Nam and the Philippines". Its main objective is to streamline sea cucumbers *Holothuria scabra* culture by optimizing hatchery and nursery production up to resource enhancement and grow-out in sea ranch sites and community adoption. The project has a duration of five years. The first year is focused on optimizing hatchery production by utilizing algal concentrates in order to minimize dependency on live micro-algae cultures.	2019-2023	

This can potentially reduce cost and hatchery production duration for sandfish juveniles. For the preliminary experiment, three microalgae concentrate (Instant Algae® from Reed Mariculture Inc., USA) were used: (1) mono-cultured *Thalassiosira weissflogii* (Bacillariophyceae) (TW 1200®); (2) mono-cultured *Isochrysis* sp. (Isochrysis 1800®) and a mixed product called Shellfish diet® 1800. Larval feeding experiment trial 1 was conducted from June to July 2019, to compare the three commercial micro-algae products with live *Chaetoceros calcitrans* (Cc) as feed for larval sandfish. Initial trails showed promising results using ISO1800 and Shellfish1800 but not for TW1200. The two former products also showed better results than live Cc especially in the first 6 days of larval development. Additional replicate runs will be conducted to confirm the initial results together with the evaluation of water quality parameters. Assessment of influence of biofilm on early juvenile sandfish production in ocean nursery system was done by re-establishing the sandfish ocean nursery. In 2019, two nursery rearing runs were conducted. The first run yield poor growth (0.02 g/d) and survival (<30%) rates due to predators and competitors. Secondary nursery rearing runs using six pens (100 m^2 each) yield excellent growth (1.15 g/d) with 40% recovery. However, after four months, evidence of predation was again observed which yielded negative growth (0.36-0.97 g/d) with 5.22% survival only. Predation mitigation measures will be explored		
Technology Transfer Program Joint Mission for Accelerated Nationwide Technology Transfer Program (JMANTTP II) This is a collaborative project between SEAFDEC/AQD and BFAR (Bureau of Fisheries and Aquatic Resources). In 2019, the main focus activity of this project is on the site assessment and feasibility of legislated multi-species hatcheries in different regions in the Philippines. As of 2018, fifteen of these sites are to be assessed. However, as of July 2019, only three sites have successfully passed the feasibility assessments and only one (at Linging, Surigao del Sur) has completed the requirements to begin construction of facilities. The general constraints in most sites includes problems with acquisition of land, difficult accessibility, lack of LGU coordination, environmental and water quality issues. Since 2018, the project also involved capacity development and aquaculture skills enhancement for LGU staff, community members and young graduates (*e.g.* BS Fisheries) on various hands-on practical and demonstration courses in aquaculture, particularly in hatchery operations and management.		

4. PROPOSED FUTURE ACTIVITIES FOR THE YEAR 2020

4.1 Planning of the Project Activities

Project/Activity Title	Duration	Remarks
Milkfish The study on Strategic feeding of milkfish (*Chanos chanos*) for efficient marine cage culture production will continue its activities	**2020**	
Oyster The study on Comparison of oyster *Crassostrea iredalei* growth and survival in brackishwater pond and river using pouch will continue its activities	**2020**	
Abalone The study on Grow-out culture of abalone in pipes will continue its activities	**2020**	
Marine worm The study on Polychaete culture in raceway ponds will continue its activities	**2020**	
Sea Cucumber The collaborative project on sea cucumber will continue		

4.2 Expected Outcomes/Outputs

Most of the study in 2019 will continue next year and will still focus on the development and promotion of efficient and suitable environment-friendly culture systems for various commodities such as milkfish, oyster, abalone, sea cucumber, and marine worm.