



## PROJECT DOCUMENT

**Program Categories:** Departmental Programs

**Project Title:** Collaborative Projects with the Philippine Government

**Responsible Department:** Aquaculture Departments

**Total Duration:** 2018-2021

**Funding Sources:** BFAR and NFRDI

**Estimated Budget for 2020:**

### 1. INTRODUCTION

Over the years, the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC/AQD) has developed technologies in broodstock development, seed production and grow-out as well as feeds and nutrition of economically-important finfishes, crustaceans, mollusks and seaweeds in various stages of development. Several of these technologies already been successfully field-tested in ponds, pens, and cages in fresh, brackish, and marine waters in collaboration with fish pond operators, local government units, non-government organizations and other international organizations. With this, two projects were conducted by SEAFDEC/AQD to support the thrusts of its host government.

First is the collaborative project between SEAFDEC/AQD and Bureau of Fisheries and Aquatic Resources (BFAR) will be the Joint Mission for Accelerated Nationwide Technology Transfer Program (JMANTTP II).

In order to accelerate fish production and export revenues from the aquaculture sector, SEAFDEC/AQD is committed to intensifying techno-transfer of matured aquaculture technologies to stakeholders which will provide additional and alternative livelihood to fisherfolks through sustainable aquaculture technologies that are economically viable, environment-friendly and socially equitable.

Traditionally, fish meal has provided a major part of protein sources in formulated feeds because of its suitable protein quality. Since the recent scarcity and uncertain consistency of supply encourage its replacement by alternative protein sources that are of high quality, but less expensive has been investigated in many fish species. The limitations on the world's food supply provide additional motivation. Therefore, numerous studies have undertaken to examine the effects of replacing fish meal by another source of protein such as animal by-product or plant-based protein in diets.

Poultry by-product meal is one of the most important source of animal protein used to feed domestic animals, along with meat and bone meal, blood meal, feather meal and fish meal. It is made by combining the by-products coming from poultry slaughterhouses or poultry processing plants. The AAFCO (USA) defines poultry by-product meal as the ground, rendered, clean parts of the carcass of slaughtered poultry such as necks, heads, feet, undeveloped eggs, gizzards and intestines (provided their content is removed), exclusive of feathers (except in such amounts as might occur unavoidably in good processing practices). It is generally a palatable and high-quality feed ingredient due to its content in essential amino acids, fatty acids, vitamins and minerals. In addition to its use in livestock, it is in high demand from the pet food and aquaculture industries (Meeker et al., 2006).

Distiller's dried grains with solubles (DDGS) is also an alternative protein source but on the other hand, plant-based. It is a nutrient rich co-product of dry-milled ethanol production. There is an increasing interest in using DDGS in aquaculture diets around the world due to its moderately high protein content, relatively low phosphorus content, and low cost compared to fish meal. DDGS utilization as a feed ingredient is well documented as both an energy and a protein supplement.

Furthermore, it does not contain anti-nutritional factors found in other protein sources such as soybean meal (trypsin inhibitors) or cottonseed meal (gossypol). Limited studies have been conducted to evaluate the addition of DDGS to catfish, rainbow trout, tilapia, sunshine bass, Pacific white shrimp, and freshwater prawns. Adding 10 percent DDGS to all aquaculture feeds can result in excellent performance, and DDGS levels up to 20 to 30 percent can also result in excellent performance if adequate additions of some crystalline amino acids (e.g. lysine, methionine, tryptophan) are added, or other complementary protein sources containing higher levels of amino acids are included in fish feeds.

Fermented copra meal has been previously utilized as black tiger shrimp (*Penaeus monodon*) aquafeed to replace dietary protein from fish meal for up to 40% without adversely affecting growth, feed efficiency, and survival. Furthermore, the same ingredient can be used to replace soybean meal in milkfish diet for up to 20% without affecting performance parameters and when used in longer duration in commercial cage culture systems. With the increasing by-products derived from coconut oil production, copra meal has a huge potential to be an alternative, cheap, and sustainable source of protein for fish feed industry.

With this, SEAFDEC/AQD and the National Fisheries Research and Development Institute (NFRDI) will identify and utilize cost-effective feed ingredients which can be used as an alternative to fish meal.

## **2. PROJECT**

### **1.1 Goal /Overall Objectives**

The JMANTTP-II program aims to:

- (1) Promote sustainable aquaculture technologies that are economically-viable, environment-friendly and socially-equitable to increase fish production, exports revenues, employment and livelihood options for the fisherfolks;
- (2) Facilitate technology transfer by demonstrating sustainable technologies in strategic areas nationwide to serve as skill-learning centers for fish farmers, entrepreneurs, and other end-users through techno-caravan, field demonstrations and hands-on training;
- (3) Jointly implement the *Oplan Balik Sugpo* consistent with the AFMA and RA 8550.

The low-cost feed project will develop sustainable and low-cost feeds that can improve fish growth, survival, production and increase the income of fish farmers. It will specifically aim to:

- (1) Identify potential raw materials and alternatives to fishmeal and other high cost feed ingredients for feed formulation,
- (2) Formulate and develop sustainable and low cost feeds for tilapia and milkfish; and
- (3) Pilot test the formulated feeds to NFRDI national centers, BFAR regional stations and private cooperators for feed trials in pond and cage culture of milkfish and tilapia

### **1.2 Outcomes and Expected Outputs**

- (1) Be able to introduce SEAFDEC/AQD established aquaculture technologies such as:
  - a. Environment-friendly farming of shrimp in ponds;
  - b. Cage and Pond culture of economically important marine and freshwater species (pompano, grouper, seabass, snapper, milkfish and tilapia);
  - c. Hatchery production of economically important marine and freshwater species (pompano, grouper, seabass, snapper, milkfish and tilapia); and
  - d. Use of feeds containing alternative ingredients to ensure sustainable and low production cost aquaculture.
- (2) Create a manpower development pool to be trained at different aquaculture disciplines which will be deployed at several government and private aquaculture

facilities. Short term training courses will be tailored made for fish farmers, entrepreneurs as well as students interested in aquaculture science.

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

#### Activity 1: Joint Mission for Accelerated Nationwide Technology Transfer Program for Aquaculture (JMANTTP II)

The following are the general framework undergone in 2018 and 2019:

- (1) Develop a pool of technical experts to operate various aquaculture systems nationwide
- (2) Conduct feasibility study of the legislated hatcheries and site evaluation of existing and proposed aquaculture facilities (fish pond, hatchery and fish cage sites)
- (3) Create plans and design of aquaculture facilities specific in the area which will include cost of materials and construction. Renovation of existing facilities will also be included in the planning.
- (4) Operate aquaculture facilities utilizing SEAFDEC/AQD developed protocol and to be managed by SEAFDEC/AQD trained personnel.
- (5) Conduct training (techno-caravan) nationwide in areas based on the request of BFAR and LGU where aquaculture industry has a potential.
- (6) Monitor the operation of aquaculture systems to be opened nationwide.

#### Activity 2: Establishment of a feed mill for a low-cost broodstock diet

The following is the framework of the project:

- (1) Development of feed formulation for milkfish and tilapia
- (2) Identification of pilot sites (cage and pond culture)
- (3) Testing of SEAFDEC/AQD formulated feeds versus commercial feed
- (4) Conduct growth, survival, water parameters, proximate, and cost-and-return analysis
- (5) Transfer of technology to the fish farmers

### 3. PROGRESS/ACHIEVEMENTS OF ACTIVITIES IN THE YEAR 2019

Project/Activity Title	Duration	Remarks
<b>JMANTTP-II</b>		
<p><b><i>Oplan Balik Sugpo</i></b></p> <p>SEAFDEC/AQD's "<i>Oplan Balik Sugpo</i>" program aims to revive the shrimp production as well as to provide farmers with good quality shrimps for grow-out culture in the Philippines after the drastic decline of this commodity since the late 1990s.</p> <p>The technology demonstration projects will be divided into two phases. The first phase will be started in SEAFDEC/AQD Dumangas Brackishwater Station with the technology demonstration run on low/partial discharge and closed-recirculating system of shrimp farming using environment-friendly schemes at the intensive, semi-intensive and modified extensive levels of production (Baliao, 2000; Baliao and Tookwinas, 2002).</p> <p>Successful technology demonstration runs will then be followed by the implementation of Phase 2. In this phase, demonstration projects will be conducted in private commercial shrimp farms whose owners requested technical assistance on shrimp farming from SEAFDEC/AQD through the program.</p> <p>To support this program, the shrimp hatchery complex was equipped with its own spawner/broodstock facility for pathogen</p>		

detection of newly-arrived spawners. The shrimp hatchery often utilizes spawners from the wild wherein they are being processed and analyzed before and after spawning to determine if there is a presence of pathogens. After spawning, when tests resulted positive, nauplii are chlorinated and discarded. Nauplii that are positive of the disease are stocked on the modules containing tanks for larval rearing until they reached the postlarvae stage where they are being harvested. The hatchery is equipped with its several larval rearing tanks divided into two modules to allow resting of the other module after stocking. It has also several filtration systems to ensure good water quality for the stocks. Seawater from the source will first pass through the sand filter before it will reach the reservoir. From the reservoir, it will pass through the rapid sand filter, then through the UV sterilizer before it will reach the larval rearing tank with the filter bag. Fry harvesting is done when they already reached the PL 20 stage

**Potential implementation sites for Phase 2**

Institution	Province
SEAFDEC/AQD's Dumangas Brackishwater Station	Iloilo
BFAR Training Center in Lala	Lanao del Sur
BFAR Integrated Fisheries Demonstration Center (IFDC)	Surigao del Norte
BFAR Demonstration and Training Center, Calape	Bohol
BFAR Botong Fishery Biological Center in Taal	Batangas
BFAR Training Center in Pagbilao	Quezon
Negros Prawn Producers' Marketing Cooperative, Inc. (NPPMCI)	Negros Occidental

The shrimp hatchery produced disease-free fry that was stocked on the brackishwater ponds of the Dumangas Brackishwater Station last July 2019.

***In situ* Training Courses**

As part of introducing sustainable aquaculture technologies that are economically viable, environment-friendly, and socially equitable that were developed in SEAFDEC/AQD, nationwide techno-caravan, field demonstrations, and hands-on trainings shall be conducted at the help of BFAR. SEAFDEC/AQD and BFAR will conduct field evaluations of BFAR's national aquaculture centers and regional stations and identify appropriate technologies to be demonstrated thereat. This technology transfer will allow fish farmers, entrepreneurs, and other end-users to the possibility of having an additional and alternative livelihood.

Several training courses have already been conducted on different regions to promote sustainable aquaculture technologies. Fish farmers, fishpond owners and operators have been recipients of these on-site training courses which include the following:

- (a) On-site training course on Freshwater Aquaculture in

<p>University of Southern Mindanao, Kabacan, Cotabato, Philippines</p> <p>Sixty-eight (68) fishpond owners, farmers and operators from Region XII participated in the training course conducted by the collaboration of SEAFDEC/AQD and BFAR XII. The training course focused mostly on freshwater commodities like Tilapia, Milkfish, Giant Freshwater Prawn and Catfish. This 4-day training was equipped with a lecture series on the first three days and practical sessions on the fourth day. Practical sessions included packing and transport of tilapia fry, proper acclimation and stocking of fry in ponds, water quality parameters monitoring and feed preparation for sex reversal of tilapia. Participants were also given free manuals and brochures to be used for their operation.</p> <p>(b) On-site training course on Tacloban City, Leyte, Philippines</p> <p>Another on-site training course was held last 20-22 May 2019 at Hotel Alejandro, Tacloban City, Leyte. The training focused on marine aquaculture of high-valued species of fish like groupers, seabass, pompano, etc. Sixty-four participants composed of training officers and fish growers from Region VIII availed of the free training.</p>		
<p><b>Manpower Development</b></p> <p>In order to increase the number of fish farmers in the Philippines, SEAFDEC/AQD will train a batch of fisheries graduates in hatchery seed production as well as pond culture using different culture systems. Successful graduates of this rigorous and in-depth training will be deployed to SEAFDEC/AQD projects or will be recommended to various related government offices, non-government, or private business sector. The training is composed of shrimp, marine fish, and tilapia aquaculture technologies.</p> <p>Sixteen (16) graduates from different fisheries schools in Western Visayas were trained during the Training Course on Manpower Development for Shrimp, Marine Fish, and Tilapia Aquaculture to enhance their capabilities and broaden their perspectives and experiences in terms of aquaculture. They were trained on shrimp and multi-species marine fish hatchery operations, and cage and brackishwater pond culture operations. After three months of intensive training, they were assigned to different areas and hatcheries at Tigbauan Main Station. They were assigned to the Marine Fish Hatchery, Shrimp Hatchery, Crab Hatchery, Integrated Hatchery, Fish Health Section, and Natural Food Laboratory in a rotational manner to be engaged on the different operations.</p>		
<p><b>Profiling of Operating/Abandoned/Non-operating Hatcheries in the Province of Iloilo, Philippines</b></p> <p>To increase fry production within the Iloilo, SEAFDEC/AQD will offer technical assistance to BFAR Region VI regarding the rehabilitation of non-operational, abandoned, or damaged hatcheries. Site visits on the chosen hatcheries will be conducted in order to assess whether the facilities are still capable of operating. Recommendations, cost estimates, and other technical plans shall be sent to BFAR for consideration.</p>		

<p>Staff from SEAFDEC/AQD conducted the profiling of abandoned, operating or non-operating hatcheries in the first district of Iloilo. Nine hatcheries in the first district of Iloilo are operating and are culturing tilapia, <i>Litopenaeus vannamei</i>, <i>Penaeus monodon</i>, milkfish and seabass. On the other hand, twelve hatcheries were listed as abandoned or non-operating due to sickness or death of owner, bankruptcy or lack of finances to continue operation. Most abandoned hatcheries cultured <i>Penaeus monodon</i> when there was a high demand of this commodity. The profiling of hatcheries is done to serve as baseline information with regards to the rehabilitation of non-operational hatcheries in the area in order to maximize the production of milkfish fry in the industry.</p>		
<p><b>Feasibility Study of Legislated Multi-Species Hatchery</b></p> <p>In accordance with the Memorandum of Agreement between BFAR and SEAFDEC/AQD, areas of selected legislated multi-species hatcheries from the 16th and 17th Congress shall be evaluated. This activity is in line with the “Bangus (milkfish) Fry Sufficiency” program of BFAR which aims to give emphasis on the current and future milkfish fry requirement of the Philippines. Once constructed, the legislated multi-species hatchery will serve as one of the central milkfish hatcheries providing the seed requirement of grow-out facilities, like ponds, pens or cages within its region. Each marine hatchery is capable of producing 25 million milkfish fry annually, however, even though the facility is designed for milkfish, it is still capable of accommodating other marine species (i.e. shrimp, pompano, mangrove crab). Aside from fry production, the hatchery facility will also serve as a training facility for interested private groups that plan to put up hatcheries of their own or for University/College students undertaking on-the-job training. Hands-on training can be provided by the resident technicians on the various aspects of the hatchery operation. The hatchery facility can also serve as a demonstration facility to show timely innovations that might be developed through years of operation.</p> <p>In accordance with the Memorandum of Agreement between DA-BFAR and SEAFDEC/AQD, continued sites assessments has been conducted on the legislated areas. New proposed sites in Hinatuan and Surigao City in CARAGA have been evaluated, as well as additional areas in Quezon province.</p> <p>Another three sets of detailed engineering layout plan and detailed feasibility studies have been turned over to the BFAR Central Office and the respective BFAR Regional Offices and LGU. The new legislated areas that have received their detailed feasibility study are: Perez, Quezon (RA 10945); Sultan Naga Dimaporo, Lanao del Norte (RA 10860); and Jose Dalman, Zamboanga del Norte (RA 10859). Six (6) out of the 15 legislated areas listed in the MOA have already received their engineering plans and feasibility study.</p> <p>The construction of the multi-species marine hatchery in Lingig, Surigao del Sur, under RA 10787, has started. It is expected to finish around the second quarter of 2020. Meanwhile, the hatchery in Del Carmen, Surigao del Norte, under RA 10825, is also set to begin its construction around the last quarter of the year. The only</p>		

freshwater multi-species hatchery in Jabonga, Agusan del Sur, under RA 10813, is also ready to start once the bidding process is finished.

**Low-cost feeds**

**Milkfish in floating net cages**

The initial growth trials for milkfish was conducted at SEAFDEC/AQD's Igang Marine Station (IMS) in floating net cages on 15 May 2019 (6 June 2019 is the actual start of the growth experiment). Milkfish juveniles with an average body weight of 33 g were stocked in six (6) 5 x 5 x 3 m floating net cages at a stocking density of 33.4 fish per m<sup>3</sup> (2,500 fish per cage). Two dietary treatments (SEAFDEC/AQD formulation and commercial grower feeds) were used wherein each treatment has three replicates. The experiment will be terminated once the fish obtains a marketable body weight of 350-400 g. Sampling of stocks will be conducted every 30 days. The preliminary results of the experiment are the following:

	<b>AQD Diet</b> <i>(average body weight for three cages in grams)</i>	<b>Commercial Diet</b> <i>(average body weight for three cages in grams)</i>	<b>Date (2019)</b>
1	35.11	31.33	6-Jun
2	236.70	212.19	15-Aug
3	393.45	325.35	3-Oct
<b>Ave WG (%)</b>	<b>1,021.66</b>	<b>950.875</b>	

**Tilapia in ponds**

In partnership with NFRDI Muñoz, the feeding experiment for tilapia was initiated at Munoz, Nueva Ecija on 27 June 2019. Tilapia fingerlings with an average body weight of 21 g were stocked in 6,300 m<sup>2</sup> ponds at a stocking density of 5 fish per m<sup>2</sup> (1,500 fish per pond). Two dietary treatments (SEAFDEC/AQD formulation and commercial grower feeds) were used wherein each treatment has three replicates. The experiment will be terminated once the fish obtains a marketable body weight of 300-350 g. Sampling of stocks will be conducted every 30 days. The preliminary results of the experiment are the following:

	<b>AQD Diet</b>	<b>Commercial Diet</b>	<b>Date</b>
1	21.11	20.89	24-Jun
2	107.58	109.89	27-Jul
3	151.98	166.59	27-Aug
4	263.60	233.23	26-Sep
<b>Ave WG (%)</b>	<b>1,150.80</b>	<b>1,016.56</b>	

The second feeding experiment for tilapia was conducted at Lala, Lanao del Norte on September 17, 2019. Tilapia fingerlings with an average body weight of 11 g were stocked in 6,200 m<sup>2</sup> ponds at a stocking density of 5 fish per m<sup>2</sup> (1000 fish per pond). Two dietary treatments (SEAFDEC/AQD formulation and a commercial grower feeds) were used wherein each treatment has three replicates. The experiment will be terminated once the fish obtains a marketable

body weight of 300-350 g. Sampling of stocks will be conducted every 30 days.		
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#### 4. PROPOSED FUTURE ACTIVITIES FOR THE YEAR 2020

##### 4.1 Planning of the Project Activities

Project/Activity Title	Duration	Remarks
<p><b>JMANTTP-II</b></p> <p><b><i>Oplan Balik Sugpo</i></b></p> <p>Continued production of disease-free fry by following strict biosecurity protocols and the possible acquisition of SPF spawners.</p> <p>Program objectives that will be achieved:</p> <ol style="list-style-type: none"> <li>(1) The promotion of sustainable aquaculture technologies that are economically-viable, environment-friendly and socially-equitable to increase fish production, exports revenues, employment and livelihood options for the fisherfolks;</li> <li>(2) By jointly implementing the Oplan Balik Sugpo consistent with the AFMA and RA 8550; and</li> <li>(3) Introduction of environment-friendly farming of shrimp in ponds that was developed by SEAFDEC/AQD.</li> </ol>	<b>2020</b>	
<p><b><i>In situ Training Courses</i></b></p> <p>There are still <i>in situ</i> training courses that are planned to push-through including the Training Course on Milkfish Culture to be held at the National Mariculture Center, Panabo City, Davao del Norte from 15-18 October 2019. This training course will only focus on milkfish culture with topics on Biology of milkfish, Broodstock management and seed production, pond preparation, and nursery and grow-out culture in ponds and cages. Other relative topics will also be discussed including the biosecurity measures/protocols and fish health management. Practical sessions such as harvesting and transport of fry as well as water quality parameters monitoring will also be conducted.</p> <p>Extension work and technology transfer of aquaculture technologies developed at SEAFDEC/AQD shall continue on 2020. Potential areas that require such seminars, hands-on workshops, trainings will be identified by BFAR</p> <p>Program objectives that will be achieved:</p> <ol style="list-style-type: none"> <li>(1) The facilitation of technology transfers by demonstrating sustainable technologies in strategic areas nationwide to serve as skill-learning centers for fish farmers, fisherfolks, entrepreneurs, and other end-users through techno-caravan, field demonstrations and hands-on training</li> <li>(2) The introduction of SEAFDEC/AQD established aquaculture technologies such as: (a) environment-friendly farming of shrimp in ponds, (b) cage and pond</li> </ol>		

<p>culture of economically important marine and freshwater species (pompano, grouper, seabass, snapper, milkfish and tilapia), and (c) hatchery production of economically important marine and freshwater species (pompano, grouper, seabass, snapper, milkfish and tilapia)</p>		
<p><b>Manpower Development</b></p> <p>The previous trainees of the Manpower Training Course on Manpower Development for Shrimp, Marine Fish, and Tilapia Aquaculture are now assigned to a specific area or hatchery at TMS. Some of them are deployed to different areas in the Philippines to provide technical assistance to the projects related to the collaboration of SEAFDEC/AQD to other government agencies.</p> <p>Since the construction of some legislated hatcheries are still on-going, there is a plan to conduct another training course to produce another batch of trainees. This time, fisheries graduates from different fisheries schools mostly in Mindanao area are the target individuals to be trained and to be deployed on the constructed legislated hatcheries near their area.</p> <p>Program objectives that will be achieved:</p> <ol style="list-style-type: none"> <li>(1) The creation of a manpower development pool to be trained at different aquaculture disciplines which will be deployed at several government and private aquaculture facilities. Short term training courses will be tailored made for fish farmers, entrepreneurs as well as students interested in aquaculture science.</li> </ol>		
<p><b>Profiling of Operating / Abandoned / Non-operating Hatcheries in the Province of Iloilo, Philippines</b></p> <p>The profiled operating, abandoned or non-operating hatcheries in the province of Iloilo will be assessed based on the stability of the tanks, the accessibility of the area, ownership rights, etc. Some of these abandoned or non-operating hatcheries will be repaired and improved to be one of the legislated hatcheries in the province. The repair and improvement or rehabilitation of these hatcheries is under the collaboration of SEAFDEC/AQD, BFAR and the private sector.</p> <p>Program objectives that will be achieved:</p> <ol style="list-style-type: none"> <li>(1) The promotion of sustainable aquaculture technologies that are economically-viable, environment-friendly and socially-equitable to increase fish production, exports revenues, employment and livelihood options for the fisherfolks;</li> <li>(2) The hatchery production of economically important marine and freshwater species (pompano, grouper, seabass, snapper, milkfish and tilapia) using aquaculture technologies developed by SEAFDEC/AQD</li> </ol>		
<p><b>Feasibility Study of Legislated Multi-Species Hatchery</b></p> <p>Site evaluations and creation of engineering layouts on the</p>		

<p>remaining legislated areas shall be continued. Bidding for the multi-species marine hatcheries in Perez, Quezon (RA 10945) and Sultan Naga Dimaporo, Lanao del Norte (RA 10860) under the supervision of BFAR shall commence; if successful, construction of the said facilities may also start in 2020.</p> <p>The construction of the multi-species marine hatchery in Lingig, Surigao del Sur will be finished in 2020 and the hatchery in Del Carmen, Surigao del Norte is also expected to complete its construction around the later part of 2020. Once necessary evaluations and other requirements for the eventual operation are finished, the first run of the hatchery may already start.</p> <p>Program objectives that will be achieved:</p> <ol style="list-style-type: none"> <li>(1) The promotion of sustainable aquaculture technologies that are economically-viable, environment-friendly and socially-equitable to increase fish production, exports revenues, employment and livelihood options for the fisherfolks;</li> <li>(2) The hatchery production of economically important marine and freshwater species (pompano, grouper, seabass, snapper, milkfish and tilapia) using aquaculture technologies developed by SEAFDEC/AQD.</li> </ol>		
<p><b>Low-cost feed</b></p>		
<p>The project will continue in 2020 beginning with a second run of test feeding of AQD formulated feed versus commercial feeds in selected sites. Analysis of growth, survival, water parameters, proximate, and cost-and-return will be tackled.</p> <p>Upon successful experimentation, the feed formulation will be mass produced with the assistance of project partners and will then be transferred to fish farmers.</p>	<p><b>2020</b></p>	

#### 4.2 Expected Outcomes/Outputs

The collaborative projects with Philippine Government agencies aims accelerate technology transfer through new thrusts. In 2020, AQD will continue strategizing to harmonize relevant research and development studies with the priorities of the host government. Through this collaborations, DA-BFAR, NFRDI and other government agencies will assist AQD in transferring adoptable and sustainable technologies to the industry and stakeholders. Fish farmers are expected to benefit from the projects as they will immediately reap the benefits of the research done by the department.