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USAID's Growth with Equity in Mindanao Program

**High-Value Aquaculture (HVA)
Industry Development Plan
DAVAO ORIENTAL
2013-2020**



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Growth with Equity in Mindanao Program

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Davao Oriental, 2013-2020**

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Executive Summary

This High-Value Aquaculture (HVA) Industry Development Plan is provided by the United States Agency for International Development (USAID) to the province of Davao Oriental as part of a larger disaster recovery assistance project implemented in areas most severely affected by Typhoon Bopha (Pablo).

As a comprehensive guide for the development of an HVA industry, this compendium will be a vital tool for the provincial and municipal governments to guide planning exercises, industry policy formulation, and discussions with shareholders, agencies, banks, and investors.

It may also serve as a valuable resource for existing and potential growers and aquaculturists as it contains a wealth of technical information on the actual production of target species in the various aspects of HVA production. All the fundamental elements required to “start the business” – from seedstock sourcing, grow-out procedures, up to harvest and marketing – are detailed in this compendium.

While this plan seeks to help accelerate the restoration of livelihood and the re-development of the coastal and fisheries sector, it also aims to strengthen the climate change resilience of communities. To this end, this document defines a way forward through an alternative and more lucrative non-traditional economic activity that employs sustainable and climate-adaptive techniques. Introducing this technology to marginalized fisherfolk may also help augment their income and thus address poverty in coastal areas.

The plan initially provides a brief evaluation of Davao Oriental’s marine and coastal resources, as well as existing fisheries and aquaculture production, and concludes that high-value aquaculture is feasible in the province. It then gives a comprehensive description of high-value aquaculture and its target commodity for promotion, namely, marine grouper, which is shown to be a highly valued commodity that can bring better returns to growers compared to traditional aquaculture commodities, like milkfish and tilapia.

The industry plan for Davao Oriental is divided into three phases: short-term (1 year); medium-term (2-3 years); and long-term (5-6 years).

In each phase, specific activities are proposed, starting with development of grow-out capabilities in the first year, in which the provincial government is responsible for promoting this new industry among local growers. It may, however, take off from initial activities implemented by USAID in introducing grouper farming among select fisherfolk associations.

After its initial year of production, these plans forecasts intensification and expansion of grow-out capabilities and, consequently, yield in its medium-term phase. Simultaneously, this phase shall lay the foundation for a “full-cycle” industry through the development of nursery capabilities and set the groundwork for the eventual establishment of a hatchery.

The third phase is envisioned to have a private sector-driven business environment for high-value aquaculture, particularly in exponentially increasing grow-out capability and evolution of ancillary industries, including tourism-related enterprises that will capitalize on a flourishing aquaculture business. This stage also includes hatchery development as a major investment to be undertaken by the province.

In each phase of the overall plan, financial analyses are provided, including investment requirements and profitability estimates, as well as specific activities and implementing mechanisms (see Table below).

Summary of Major Activities, Investment Requirements, and Revenue in HVA Industry Plan.

Phase	Duration (years)	Major Activities	Investment Requirements (Php)	Projected Revenue (Php)
Short-term	1	1) Establishment of 10 4-compartment grouper cage modules	3.17 Million	3.27 Million
		2) Est. Fish Consolidation Station		
		3) Est. Live fish transport system		
Medium-term	2-3	1) Est. 10 8-compartment grouper modules	6.28 Million	6.33 Million
		2) Est. Grouper Nursery		
		3) Initiate Broodstock Collection and Development		
		4) Initiate an Applied Research Program		
		5) HVA Training Programs and Est. Aquaculture Courses		
Long-term	5-6	1) Legislation, est. of mariculture zones/parks 10 municipalities	3.02 Million	
		2) Est. and operation of at least 460 fish grow-out cage modules		
		3) Est. grouper hatchery		
		4) Est. ancillary businesses – private sector-led		

I. Introduction

The following document is a business plan for the development of the High-Value Aquaculture (HVA) Industry in Davao Oriental and neighboring provinces. It was prepared with technical assistance from the United States Agency of International Development's (USAID) Growth with Equity in Mindanao (GEM) Program and has been submitted to the provincial government of Davao Oriental.

Essentially a roadmap, this may be used by the provincial government as a guide for the development of its HVA Industry; in identifying specific projects or related business prospects for further research; and providing a logical framework to pursue business strategies over the succeeding years. It may also serve as a basis for discussion with third parties, such as shareholders, agencies, banks, and investors.

This presents a comprehensive guide for existing and potential growers and aquaculturists as it contains technical information on the actual production of target species, sources of production inputs and materials, market information and market linkages, financial analyses, and other basic practical information essential to the operation of an aquaculture business enterprise. It is important to note that due to the limitations set by the nature of this plan, it focuses on the more basic aspects of HVA production.

This compendium contains information on all the fundamental elements needed to “start the business” and provides a map for further development.

To maximize its potential usefulness to different sectors and at varying levels, this plan may be distributed and circulated within municipal and barangay levels (if appropriate). Policy makers and executives in local government will find it as useful in development planning, as will business entities interested in investing in HVA, and fisherfolk communities and individuals seeking to engage in more lucrative and non-traditional livelihood.

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II. Background and Rationale

The American people, through the **United States Agency for International Development (USAID)**, have provided economic and humanitarian assistance worldwide for over 50 years. In the Philippines, USAID works in partnership with the national government in creating a more stable, prosperous and well-governed country through programs that foster sustainable and inclusive growth, strengthen governance and combat corruption, improve access to water, energy, health and education services, increase environmental resilience and natural resource management capabilities.

Over the past five years, the U.S. Government has provided a total of US\$ 51.6 million for disaster response activities, including assistance in improving mechanisms to effectively adapt and respond to natural disasters.



Cateel, Davao Oriental in the aftermath of Typhoon Pablo, December 30, 2012

On December 4, 2012, **Typhoon Bopha (Pablo)** made landfall in the southern Philippines island of Mindanao, bringing heavy rains and sustained winds of up to 175 kph, as well as flooding and landslides to areas along its path. The storm moved west-northwestward across the country, primarily affecting Compostela Valley, Davao Oriental, and Negros Oriental provinces. The U.S. Government has provided a total of P683,844,658 (US\$16.7 million) to support emergency assistance to individuals affected by Typhoon Pablo. This funding is helping to address the humanitarian needs

of affected populations, and includes support for emergency shelter, logistics, and water, sanitation, and hygiene activities, as well as the provision of emergency relief commodities and rice.¹

In January 2013, USAID, through GEM, conducted a rapid evaluation of Typhoon Pablo's impact on affected provinces, including damage to agriculture and fisheries. During the course of the evaluation, Davao Oriental Provincial Governor Corazon Malanyaon requested the evaluation team to identify potential alternative industries in agriculture and fisheries that could be promoted in the province. For the fisheries sector, she particularly cited the high poverty incidence among coastal and fishing communities. She underscored that even prior to the onslaught of the typhoon, local research showed that poverty incidence in the province was highest among municipal fisherfolk. Thus, among the LGU's priorities is to address poverty in the municipal fisheries sub-sector by providing alternative economic opportunities that would either supplement incomes from the seasonal nature of fishing or redirect them towards more economically sustainable livelihood.²

Marine and coastal resources play very significant roles in the residents' livelihood and survival. A survey conducted by the United Nations - World Food Program in the affected provinces of Davao Oriental and Compostela Valley (March 2013) revealed that fishing accounted for roughly 17% of the people's source of livelihood. About a quarter of survey respondents said that their production system is based on the sea. This practice is most prevalent in the Boston-Cateel-Baganga area (40.8%). 16% mentioned that their fish production is largely dependent on ponds. This is can be found least in the Boston-Cateel-Baganga area (8.5 percent).

This industry plan was among the recommendations of the USAID-GEM rapid assessment report, based on findings and consultations, and as a direct result of the provincial government's request. Subsequently, a technical assistance package to complete this industry plan was provided by USAID through the Typhoon Pablo recovery assistance project being implemented by GEM, which also involves livelihood restoration activities in support of the coastal and fisheries sector. Drawing from its long and successful experience in Mindanao, particularly, in Western Mindanao and the Sulu Archipelago, USAID-GEM's technical assistance on aquaculture has HVA development at its core, which will not only provide for the economic rehabilitation and recovery from the onslaught of Typhoon Pablo, but will also offer the alternative non-traditional and more lucrative industry being sought by the local leadership.

¹ <http://philippines.usaid.gov/programs/humanitarian-assistance>

² The Louis Berger Group, Inc. Rapid Assessment for Typhoon Pablo Recovery Assistance.

III. Davao Oriental's Battle Cry: Build Back Better!

USAID-GEM's technical assistance on HVA development is consistent with the provincial government's rehabilitation framework, "Building Back Better" or *BBB*, as it transitions its relief and recovery efforts into reconstruction and development.

Under **Governor Corazon N. Malanyaon's** leadership, relief operations and international donor assistance are seamlessly transitioned to development and reconstruction efforts through the province's **Way Forward Plan**, covering three stages of commitment that promise to address the short- and long-term needs of typhoon survivors.

The plan also integrates all sectors of development, consisting of agriculture, economic and industry, health, education, and environment, among many others, as well as the moral and value recovery of the people. The concept of "Building Back Better" likewise takes climate change into consideration and incorporates it to medium and long-term plans.

"The Building Back Better phase is perhaps is the most difficult stage, but certainly the most challenging one."

"We have chosen this as our buzzword to describe our dream of making the three hardest hit towns better than what it had been before, where beauty is restored and enhanced, hearts are transformed and lives are improved."

*Hon. Corazon N. Malanyaon
Governor, Davao Oriental*



Gov. Malanyaon with Gawad Kalinga volunteers and residents of Cateel (Photo by Lester Berganio)
Source: CNN, <http://ireport.cnn.com/docs/DOC-948438>

Since the inception of the GEM-3 Program in January 2008, the Agribusiness component of GEM has achieved the following:

☐ Provided marketing assistance to Mindanao food suppliers that has increased annual international exports and domestic out-shipments of selected commodities by \$58 million, with an additional \$93 million under negotiation.

☐ Helped increase weekly domestic out-shipment of vegetables to Luzon and Visayan markets by 113 MT (126%), and weekly deliveries of selected fruits by 423 MT (41%).

☐ Helping 7,550 former MNLF combatants in 150 communities in the Sulu Archipelago and Central Mindanao double their incomes by growing high-value agricultural and aquaculture products.

☐ Provided 44 pre- and post-harvest equipment/facilities benefitting 3,500 families of predominately former MNLF communities and operational training to 750 members, and has initiated work on an additional 6 facilities.

☐ Catalyzed and assisted the establishment of a private-operated multi species fish hatchery in Tawi-Tawi that has created employment for more than 1,200 small out-growers.

☐ Assisted 10 companies prepare for, and receive HACCP certification, access new markets, and achieve a combined total of \$8.5 million in new sales within the first twenty-one months following certification.

☐ Organized 350 events, workshops and training activities attended by a total of nearly 20,000 persons.

www.mindanao.org

USAID's GEM Program

The Growth with Equity in Mindanao (GEM) Program is one of USAID's longest and most successful programs in the Philippines. It has two related principal objectives: 1) accelerate economic growth in Mindanao and help assure that as many people as possible participate in and benefit from the growth; and, 2) help bring about and consolidate peace in Mindanao.

Since 2005, through its Targeted Commodity Expansion Project (TCEP) and Sustainable Aquaculture and Fisheries Effort (SAFE), USAID-GEM has effectively promoted and developed High-Value Aquaculture as a means to accomplish specific objectives, such as increasing rural incomes and tripling international exports and domestic out-shipments (volume and value) of targeted commodities, including grouper. TCEP also enabled former MNLF combatant communities with pre- and post-harvest facilities and training needed to achieve more profitable farming or fishing.³

IV. Objectives

This document has been prepared to provide the provincial government of Davao Oriental with a plan for the development of its High-Value Aquaculture (HVA). Specifically, it aims to:

1. provide a logical framework within which the government and/or business can develop and pursue business strategies in HVA;
2. serve as a basis for discussion with third parties, such as shareholders, agencies, banks, and investors; and,
3. serve as a comprehensive guide for existing and potential growers and aquaculturists as it contains technical information on the actual production of target species, sources of production inputs and materials, market information and market linkages, financial analyses, and other basic practical information essential to the operation of an aquaculture business enterprise.

³ www.mindanao.org

V. High-Value Aquaculture

A. Definition

There are three main components of fisheries in the Philippines: commercial fishing, municipal fishing, and aquaculture. Unlike the first two, aquaculture deals with the rearing – rather than capture – of fish. It is defined broadly as any intervention in the life cycle of aquatic organisms to increase production. Republic Act 8550 (The Philippine Fisheries Code of 1988) defines aquaculture to include all fishery operations involving all forms of raising and culturing fish and other fishery species in fresh, brackish and marine areas.⁴

Aquaculture is either partial or full cycle. The first is when wild-caught, undersized juveniles are held and reared in confinement until they reach market size. As this practice still requires some sort of fish capture (that of catching juveniles from the wild), this is not as sustainable a practice as full-cycle aquaculture, which entails spawning the fish from a hatchery and subsequently rearing them until they reach market size. In terms of technological innovation, it is likewise the latter that is more challenging as it is the early stages of an aquatic organism's life cycle that is harder to replicate in a controlled environment.

Nonetheless, it is full-cycle aquaculture that our industry must strive to achieve to meet food and market requirements, as well as address the issue of decline in natural fish populations.⁵

Another sub-sector of capture fisheries – in which the Philippines is a major, albeit unacknowledged contributor – is the **live reef food fish (LRFF) trade**. Live fish have traditionally been traded around Southeast Asia as a luxury food item, with 50-70% wild caught. Most LRFF are imported into Hong Kong either for local consumption or for transshipment to the mainland of the People's Republic of China (PRC). Target species for this trade are usually a variety of grouper (lapu-lapu) species and humphead wrasse (*Cheilinus undulatus*), which the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has classified as vulnerable.⁶ CITES is an international

Aquaculture
has enabled me
to provide for
the needs of my
family and show
that good things
come to those
who work hard
and choose the
path of peace.

- Isni Undin
*Fish farmer, former
combatant, and USAID-
GEM beneficiary
Basilan*

⁴ Republic Act 8550

⁵ Ilagan, Lauro. 2008. Aquaculture in Mindanao: Transcending the Barriers. Tambara Research Journal. Ateneo de Davao University. Philippines.

⁶ CITES. 54th meeting of the Standing Committee Geneva (Switzerland), 2-6 October 2006 SC54 Doc. 43.2 (Rev. 1)

agreement between governments whose aim is to ensure that global trade in specimens of wild animals and plants does not threaten their survival.⁷

High-Value Aquaculture, which refers to the farming and rearing of species considered to be of high market value, caters primarily to the LRFF trade.

Other desired non-fish species in this trade are lobster (*Panulirus sp.*), sandfish (*Holothuridae* and *Stichopodidae*) and abalone (*Haliotis sp.*). The most in-demand fish, the groupers, are relatively rare and long-lived, and mature late in life, thus, can be depleted rather quickly in their reef habitats. Some grouper species form spawning aggregations, which are sometimes fished heavily with consequent negative effects on the reproductive component of the population. In other cases, the capture of a large proportion of juvenile fish or young adults — being protogynous hermaphrodites, most groupers are females at this time, changing sex as they grow larger — also potentially reduces the reproductive population. The primary sector engaged in catching these fish are municipal fishermen and gleaners using fish traps, although the high demand has wrought a number of illegal and dangerous practices, such as cyanide fishing and “compressor” diving.



Left: Typical display at a Hong Kong live fish restaurant; Right: groupers on display

Although the LRFF trade has been around for decades, trade information is meager and imprecise. For most source countries, including the Philippines, LRFF exports are not disaggregated at a per species level, are either misreported or underreported, and sometimes combined with non-live reef fish trade. Moreover, since species like humphead wrasse are CITES-covered but caught and exported nonetheless, exports are at times undocumented.⁸

⁷ *Cheilinus undulatus* was included in CITES Appendix II at the 13th meeting of the Conference of the Parties (Bangkok, 2004). To better implement the listing of the species, the “Western Pacific Workshop on policy, enforcement and sustainable trade for the CITES Appendix-II listed Humphead/Napoleon Wrasse, *Cheilinus undulatus*” was held in Hong Kong from 5 to 7 June 2006. Participants included delegates from CITES Management and Scientific Authorities, and other relevant agencies of China, Indonesia, Malaysia, Papua New Guinea and the Philippines, as well as representatives of the CITES Secretariat, FAO, WWF, IUCN, TRAFFIC and the local fisheries. Participants in the workshop agreed on the need for further actions in the fields of regional cooperation, non-detriment finding, trade monitoring, legislation and law enforcement.

⁸ Sadovy et al. *While Stocks Last: The Live Reef Food Fish Trade*. Asian Development Bank. 2003

Why High-Value Aquaculture?

Majority of aquaculture growers in the Philippines produce traditional foodfish for the domestic market. These are usually freshwater and brackishwater species, such as milkfish, tilapia, catfish, and, in Western Mindanao, seaweeds.

The preponderance in production of these low to medium-value culture species, which reflect high total accumulated value, but, comparatively low per capita income, have been due, in part, to government efforts to promote aquaculture as a livelihood and income-generating activity. These efforts include the Bureau of Fisheries and Aquatic Resources' (BFAR) programs in the dispersal of Genetically Improved Farm Tilapia (GIFT) and Genetically Enhanced Tilapia (GET EXCEL) strain fingerlings, as well as the technology transfer imparted by the local government unit (LGU) and supported by state universities focusing research and development (R&D) efforts on more established foodfish.⁹

While some corporate producers or medium-to-large growers may find it commercially viable to retain prawn or milkfish species as core commodities due to expansive production area and established export markets, the majority -- small growers and pond operators -- are unable to garner sufficient income due to lack of production area and capacity, as well as low farmgate price of traditional culture species.



Coral trout grouper at a live fish buying station

On the other hand, culture of tropical marine species is gaining ground in other Asian countries as an alternative aquaculture activity. Many tropical marine species are depleted due to the growing demand of the Asian market -- with resultant high market prices. The international market presents numerous possibilities for niche market species with a diminishing productive capacity on the part of its traditional producers.

The increasing diversity of aquaculture production can be seen in the list of species groups registering the largest growth from 2002 to 2004, with other countries (such as China, Thailand, and even countries that we were at par with or had once surpassed in terms of aquaculture production, like Indonesia and Malaysia) recognizing the vast opportunities in the more lucrative export market.

⁹ Ilagan, 2008

Table. 1. Top ten species groups in aquaculture production: quantity and emerging growth

Group	Volume (MT)		APR (%)
	2002	2004	
Sea urchins and other echinoderms	25	60,852	4,833.6
Abalones, winkles, conchs	2,970	287,720	884.3
Frogs and other amphibians	3,074	76,876	400.1
Freshwater molluscs	13,414	142,346	225.8
Sturgeons, paddlefishes	3,816	15,551	101.9
Miscellaneous aquatic invertebrates	12,593	42,159	83.0
Flounders, halibuts, soles	35,513	109,342	75.5
Miscellaneous coastal fishes	386,160	878,589	50.8
Miscellaneous demersal fishes	16,638	31,531	37.7
Shrimps, prawns	1,495,950	2,476,023	28.7

Source: FAO, "State of World Fisheries and Aquaculture 2006"

Note: Data exclude aquatic plants. APR refers to the average annual percentage growth rate for 2002–04.

B. Target Species/Commodities

For purposes of this industry plan, focus will be given on **grouper** (*Epinephelus spp.*) varieties, locally known as "lapu-lapu." Among high-value seafood, grouper presents the most potential for promotion and development for the following reasons:

1. **High market price** –

Groupers have the highest value in the trade, making them the most sought after commodity by both fishers and growers. Live grouper fetches a very high price, even at the farm gate. Current ex-farm value of green grouper (*E. coioides*) and tiger grouper (*E. fuscoguttatus*), which are the most common farmed species, are P450/kg and P550-600/kg, respectively. The more expensive coral trout grouper (*Plectropomus leopardus*) and humpback



There are many suitable sites for grouper mariculture

grouper (*Cromileptes altivelis*) range from P1,500-3,500/kg.¹⁰

2. **There are many suitable sites for grouper mariculture** – either for high-salinity species, like coral trout grouper, humpback grouper, and tiger grouper, or the more saline-tolerant green or "mangrove" grouper, coves in coastal areas or reef flats

¹⁰ Domestic market survey, April 2013.

provide the most ideal places to install fish cages. Some grouper varieties can also be raised in ponds nearby the sea.

3. **High-value marine species of grouper are endemic or indigenous in many areas** – since they are indigenous in many places, it follows that the existing marine conditions are suitable and conducive for their survival and optimal growth.
4. **There is a thriving local and export market for high-value, live marine species like groupers** – as earlier mentioned, HVA production caters primarily to the live food fish trade, both domestic and international, particularly, Hong Kong and the Asian market. This plan also provides a more detailed discussion of markets.
5. **There have been developments and advances in aquaculture technology that make it conducive to diversify into mariculture of grouper**, specifically:
 - a. *Efficient grow-out culture protocol* – the industry has made sufficient advances in technology to enable grouper to be farmed up to market size within a commercially acceptable timeframe;
 - b. *Availability of hatchery-bred seedstock* – grouper farming can be done full-cycle, with local hatcheries that have successfully achieved captive breeding and production of juveniles of a number of commercially important species, like *E. coioides* and *E. fuscoguttatus*, up to higher-value varieties like *P. leopardus* and *C. altivelis*; and,
 - c. *Availability of efficient commercial formulated feeds* – unlike the traditional method of using “trash” fish as feed, modern and sustainable grouper culture employs a readily available formulated diet manufactured by commercial feed companies. These feeds have adequate feed conversion ratios (FCRs), ensuring cost-effective production, and are readily available, unlike trash fish.¹¹



Left: Grouper grow-out culture can be done in cages; Right: A grouper farmer shows a sample of his stock

¹¹ Andigan, Cary. Presentation on “Opportunities in Grouper Culture.” 1st Mindanao Techno Forum on Mariculture, Aug. 26-27, 2010, Cagayan de Oro City, Philippines

Hong Kong is the largest consumer of LRFF worldwide, and some 60% of the trade arrives into Hong Kong by air.

In 2008, the import by air of live groupers alone into Hong Kong totaled 6,766 MT (reported) worth HKD788 million (USD101 million). Austrade reports that in 2009, Hong Kong imported more than 38,000 MT of live fish.

Singapore is the second largest market in the region for live groupers, importing in 2008 1,228 MT worth SGD\$14.097 million (USD10 million).

China imported 6,111 MT live food fish in 2008 (mainly reef fish), and 7,711 MT in 2009.

<http://www.aquanue.com/live-reef-food-fish-trade/>

In the Philippines, the more common species being farmed are the green and the tiger groupers. Culture systems range from hatchery, nursery and grow-out (cages and ponds). A significant high percentage of fry and fingerling stocks that find their way in nursery and grow-out areas, however, are still wild-caught.

Table. 2. Wholesale Prices of Live Marine Fish in Hong Kong

English Name	Scientific Name	Wholesale Price (HK\$/Kg)			Ave. Price	Ave. Price
		Highest	Lowest	Average	US\$	PhP
Brown Marbled Grouper	<i>Epinephelus fuscoguttatus</i>	230.00	160.00	193.33	24.94	1,221.85
Brown-spotted grouper	<i>Epinephelus areolarus</i>	180.00	90.00	150.17	19.37	949.07
Camouflage Grouper	<i>Epinephelus Polyphekadion</i>	280.00	200.00	243.83	31.45	1,541.01
Gold-lined seabream	<i>Sparus sarba</i>	66.00	60.00	63.00	8.13	398.16
Green grouper	<i>Epinephelus coioides</i>	190.00	80.00	117.50	15.16	742.60
Head grunt	<i>Pomadasys kaakan</i>	65.00	40.00	54.50	7.03	344.44
Leopard coral grouper	<i>Plectropomus leopardus</i>	595.00	370.00	495.67	63.94	3,132.63
Malabar Red snapper	<i>Lutjanus malabaricus</i>	60.00	30.00	50.50	6.51	319.16
Mangrove snapper	<i>Lutjanus argentimaculatus</i>	60.00	30.00	50.17	6.47	317.07
Painted sweetlip	<i>Diagramma pictum</i>	66.00	28.00	53.67	6.92	339.19
Pompano	<i>Trachinotus blochii</i>	65.00	43.00	52.33	6.75	330.73
Rabbit Fish	<i>Siganus oramin</i>	66.00	28.00	51.50	6.64	325.48
Red grouper	<i>Epinephelus akaara</i>	661.00	160.00	429.00	55.34	2,711.28
Rusell's snapper	<i>Lutjanus russellii</i>	66.00	32.00	54.00	6.97	341.28
Yellow-finned seabream	<i>Acanthopagrus latus</i>	165.00	149.00	157.00	20.25	992.24

Note: as of January 2013

Source: Fish Marketing Organization, www.fmo.org.hk

C. Existing and Potential Markets

1. Export

The demand for live grouper mainly comes from China, Hong Kong, and to a lesser extent Malaysia, Singapore and Taiwan.

World production of groupers in 2004 was about 58,000 MT valued at US\$ 199 million¹², where Hong Kong and the southern part of China were the main markets. Most of the production was from China, Taiwan, Indonesia, Malaysia and Thailand. In 2000, market demand for cultured groupers was about 20,000-25,000 MT. Since then production has been steadily rising with increasing global demand.

¹² FAO, 2005

Market demand may soar to about 100,000 MT per year by 2020, as evidenced by the growth in China's consumption of aquatic products, which is outpacing growth in production of such products, according to the Agriculture Information Institute at China's Academy of Agricultural Sciences.



Live reef food fish (LRFF) trade transport routes to HK and China

Accordingly, the shift to urbanization of rural residents is driving consumption among previously low-level consumption segment of society. The institute claims that China's current consumption of aquatic products, at 16.5 million MT (compared to 7.56 million MT in 2000), represents 30 percent of the country's total aquatic output, and at a growth rate of 5.71 percent is growing significantly faster than overall output of aquatic products. Rising at an average 3.83 percent a year between 2000 and 2011, growth in China's seafood output has slowed from the highs seen in 1980-90 (10 percent a year) and 1990-2000 (6 percent).

The institute further predicted rising incomes and increased spending on dining out by Chinese consumers will further drive the pace of consumption.



Higher incomes and urbanization are obvious drivers of China's growing taste for seafood. Data shows rural consumers eating 5.36 kg in 2011, compared to just 3.82 kg a year in 2000. By contrast the country's urbanites were eating 14.62 kg in 2011 compared to an average 10.34 kg in 2010.¹³

Moreover, new research from the Earth Policy Institute shows that public consumption of seafood is building on a trend started in 2011, and projects that in

¹³ "China eating more seafood than it produces." SeafoodSource.com, June 14, 2013. <http://www.seafoodsource.com/newsarticledetail.aspx?id=21047>

2013 people will eat more farm-raised fish than wild. The trend of increased fish farming grew obvious in 2011, when according to the institute farmed fish production in raw tonnage worldwide surpassed beef. By 2012, fish farming was recorded at 66 million MT, compared to 63 million MT of beef.

With the world's population and worldwide demand for animal protein growing exponentially, the institute said that farmed seafood (including high-value commodities) may well be play a more significant role in food supply in the coming years, more so than beef and more so than wild seafood.¹⁴

In the Philippines, most of live grouper sold for export are done through local buyers and traders, who generally purchase at a lower value. Traders either have buying outlets in areas where a lot of high-value seafood are caught or grown (such as in Zamboanga City, Surigao City, and Bongao, Tawi-Tawi) or utilize live fish carrier boats to procure live harvest directly from the growers (as in the case of the Sibutu Mariculture Park, in Sibutu, Tawi-Tawi).



A typical live fish buying station

Local ex-farm market rates, however, are still relatively competitive. For instance, live green grouper sells at P450/kg, tiger grouper at P550-700/kg, while the more expensive coral trout and humpback are priced locally at P1,500-3,500/kg.

2. Domestic

Domestic demand for live grouper is primarily from live seafood restaurants, and wet markets and grocery stores for fresh/frozen/chilled products (at a much reduced value). Although no actual market study has yet been done on volume, demand for live groupers is sufficient enough that local suppliers are able to consider local restaurants and live seafood markets as regular buyers and competitive alternative to exporters.

Due to limited display space however, such establishments can only absorb a limited quantity per delivery. The market values used by such outlets do not differ from those applied by exporters.

¹⁴ "Study: Farmed fish will rule the plate." <http://www.seafoodsource.com/newsarticledetail.aspx?id=21054>, June 14, 2013

VI. Profile of Davao Oriental



A. Marine and Coastal Resources

Davao Oriental has a very extensive coastal area, the longest in Region 11, at 586 km and the largest municipal waters, about 5,135.04 km² or 49 percent of the total municipal waters of the entire region. All municipalities, including its capital – Mati City – have coastal shores. (See Fig. 1.)



A typical commercial fishing vessel in Baganga, Dvo. Ortl.

The coastal resources of the province of Davao Oriental, however, have generally been showing symptoms of degradation and depletion. For this reason, it was selected as a project site, along with 6 other provinces in the Philippines, in the Integrated Coastal Resources Management Project (ICRMP).¹⁵

¹⁵ The ICRMP is a 6-year project (July 2007 to June 2013) implemented by the Department of Environment and Natural Resources (DENR), Bureau of Fisheries and Aquatic Resources (BFAR) and Municipal Development Fund Office (MDFO).

The marine waters of the province are abundant in fish. Fish species present can be grouped into 3 ecological clusters: target, indicator and miscellaneous. Target fishes are species that are caught for their commercial value. The major target fish families include: grouper (*Ephinephelinae*), goatfish (*Mullidae*), triggerfish (*Balistidae*), wrasses, and surgeonfish, parrot fish (*Scaridae*), soldier fish, coral breems (*Nemipteridae*), and fusiliers (*Caesionidae*).

Other commercially important fish and marine organisms found in its waters include lobster, mackerel, blue crab, tridacna, sea cucumber, tuna, octopus, and scad.

Indicator fishes observed include butterfly fish and moorish idol. Miscellaneous fishes or those with low commercial value are mostly damselfishes.

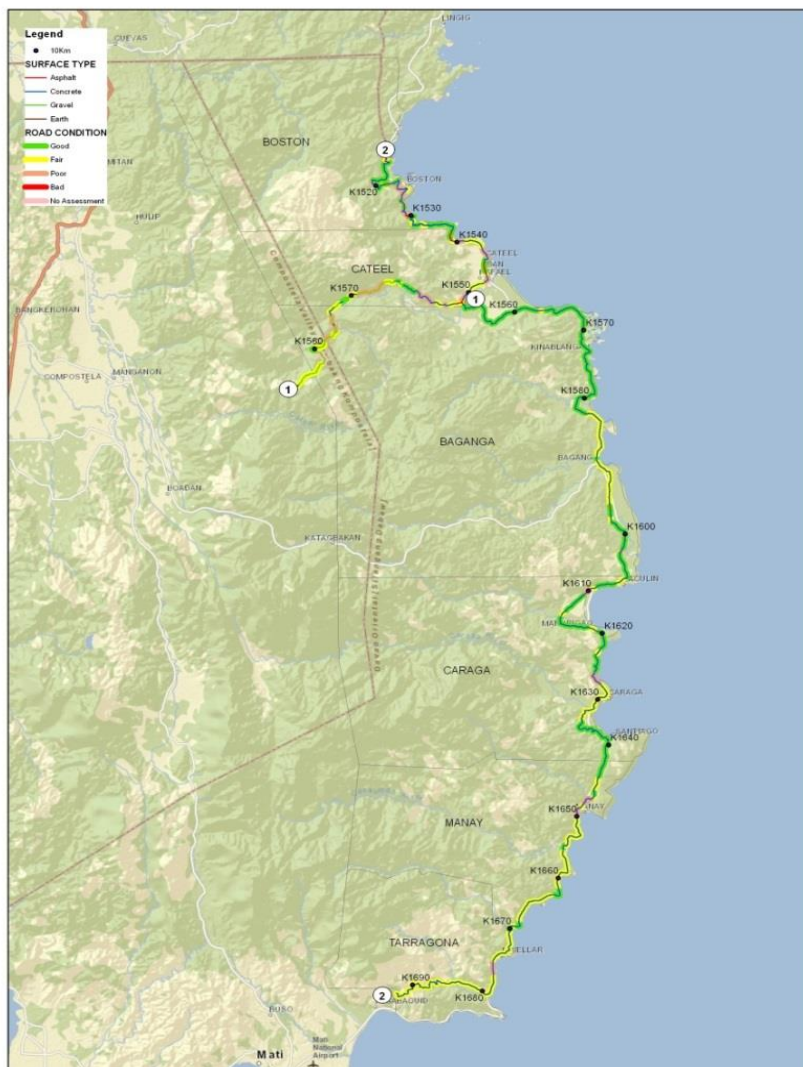


Fig. 1. Davao Oriental's coastline

B. Socio-economic Description of Fisheries Sector

Marine and coastal resources in Davao Oriental play very significant roles in the residents' livelihood and survival. In a survey conducted by the United Nations-World Food Program in March 2013, it was reported that fishermen accounted for roughly 17 percent of the population in the survey areas. About a quarter of the respondents said that their production system is based on the sea. The largest percentage of people relying on the sea is found in Boston, Cateel, and Baganga (40.8 percent). Approximately 16 percent mentioned that their fish production is largely dependent on ponds, although people using ponds are smallest in number in Boston, Cateel, and Baganga (8.5 percent).

Similarly, agriculture and fishery activities are ranked as the number one economic activity most people engaged in to survive. Respondents from Boston, Cateel, and

Baganga identified it as the fourth economic activities they resorted to in order to survive.¹⁶

Most of the province's coastal residents are municipal fisherfolk, engaged full-time in capture fisheries (hook-and-line, bagnet, traps, etc.). Most of them belong to lower-income brackets due to the generally meager incomes derived from fishing.

The province has at least 15,000 municipal fisherfolk in all of its municipalities operating around 10,000 boats, 50 fish corrals, and 22 stationary bagnets. The province also has 26 commercial fishing operators, mainly based in Mati City, operating 35 fishing vessels, and employing around 2,700 fishermen.

Fishing is seasonal, in municipalities of District 1 (Baganga, Boston, Caraga, Cateel, Manay, and Tarragona) experiencing the east to west-driven wind, locally known as "*Amihan*," and are normally able to fish only from April to November. Fishing in District 2 (Banaybanay, Gov. Generoso, Lupon, San Isidro, and Mati City), on the other hand, is influenced by the southwest monsoon wind ("*Habagat*") and generally allowable from November to May.



Post-Pablo Caraga Bay (Source: <http://news.davaooriental.com.ph>)

The province's fish production from capture fisheries in 2010 was 32,814.6 MT, of which around 70 percent was from commercial fishing (longline, ringnet, etc.). Major fishing grounds include Davao Gulf, Pujada Bay, Mayo Bay, Manay Bay, Baculin Bay, Caraga Bay, and Cateel Bay.

¹⁶ Emergency Food Security, Nutrition, and Livelihoods Assessment for Typhoon Bopha (Pablo). March 2013. This survey was conducted with funding support from UNICEF, UNDP, FAO, ILO and WFP. Survey design was led by WFP. Data collection field staff and supervision was supported by the National Nutrition Council, ACF, World Vision, Department of Social Welfare and Development, Department of Labor and Employment, and Department of Health. The assessment was led by WFP.

In terms of volume of fish production, aquaculture production ranks third in Davao Oriental, after municipal fishing and the local commercial fishing industry.

Local fish growers are engaged in the production of a variety of low-to-medium-value freshwater, brackish, and marine products.

C. Aquaculture Production

In terms of volume of fish production, aquaculture production ranks third in Davao Oriental, after municipal fishing and the local commercial fishing industry.¹⁷ Local fish growers are engaged in the production of a variety of low-to-medium-value freshwater, brackish, and marine products. Davao Oriental has the second largest aquaculture area in Region 11, with 16.07 square kilometers of inland fresh/brackishwater pond area. It comprises 31% of the total fishpond areas of the region. Cultured species range from freshwater (tilapia, catfish, mud crab) to brackishwater species (milkfish, white shrimp).



Milkfish cage in Brgy. Kinablangan, Baganga, Davao Oriental

Around 80 percent of the province's aquaculture production comes from brackishwater sources. Fish reared in existing coastal brackish water ponds are mainly milkfish, catfish, tilapia, crabs, and prawn.

Mariculture (aquaculture at sea, in fish cages or fish pens) is mainly practiced at the Mati Mariculture Park in Brgy. Badas, Mati, Davao Oriental, which had 29 cage modules devoted to milkfish production. Fish cage farming was also existent in Gov. Generoso and Baganga.

¹⁷ NEDA-XI, Regional Physical Framework Plan, Region XI, 2003-2030, ANNEX F, Fish Production, By Category, By Province/City, Region XI, 1999-2002

Aquasilviculture (environment-friendly mangrove aquaculture system) using fish pens and fish ponds, with polyculture of crabs and milkfish, was also introduced by BFAR in Baganga, Boston, and Cateel. However, most structures were destroyed by Typhoon Pablo.

Around 80 percent of the province's aquaculture production comes from brackishwater sources. Fish reared in existing coastal brackish water ponds are mainly milkfish, catfish, tilapia, crabs, and prawn.

Aside from grow-out ponds, there is currently no other similar aquaculture infrastructure (such as hatcheries or nurseries) in Davao Oriental. However, pond and cage operators in the province have been able to source their juveniles from several existing freshwater

hatcheries in neighboring Compostela Valley province (for tilapia, catfish, and freshwater prawn), as well as milkfish fry from the BFAR Regional Fisheries Training Center (RFTC), located at the Panabo Mariculture Park in Panabo City, which is also relatively nearby.



Left: BFAR-RFTC Hatchery in Panabo City; Right: Provincial Freshwater Hatchery at Brgy. Libasan, Nabunturan, Compostela Valley

VII. High-Value Aquaculture (HVA) Industry Development Roadmap

This section will comprehensively tackle the steps and activities required to develop the **High-Value Aquaculture Industry** in the province. It will provide specific information on the sub-components to be developed at a given timeframe, as well as where these may be undertaken.

This plan will propose a gradual and strategic development of industry sub-components, with corresponding revenue potential from each proposed industry sub-component.

The standard model of a fully-developed HVA industry postulates a hatchery (for sustainable supply of seedstock) at the core of the industry, serving as its driver. The community participates the most and derives its income from grow-out operations. Other industry components, such as nursery operations, juvenile distribution, processing (or consolidation), and marketing and distribution, are integral “rings” in the HVA Industry model, but are also in themselves “sub-industries” that are profit-centers. (See Diagram 1. HVA Industry Model)

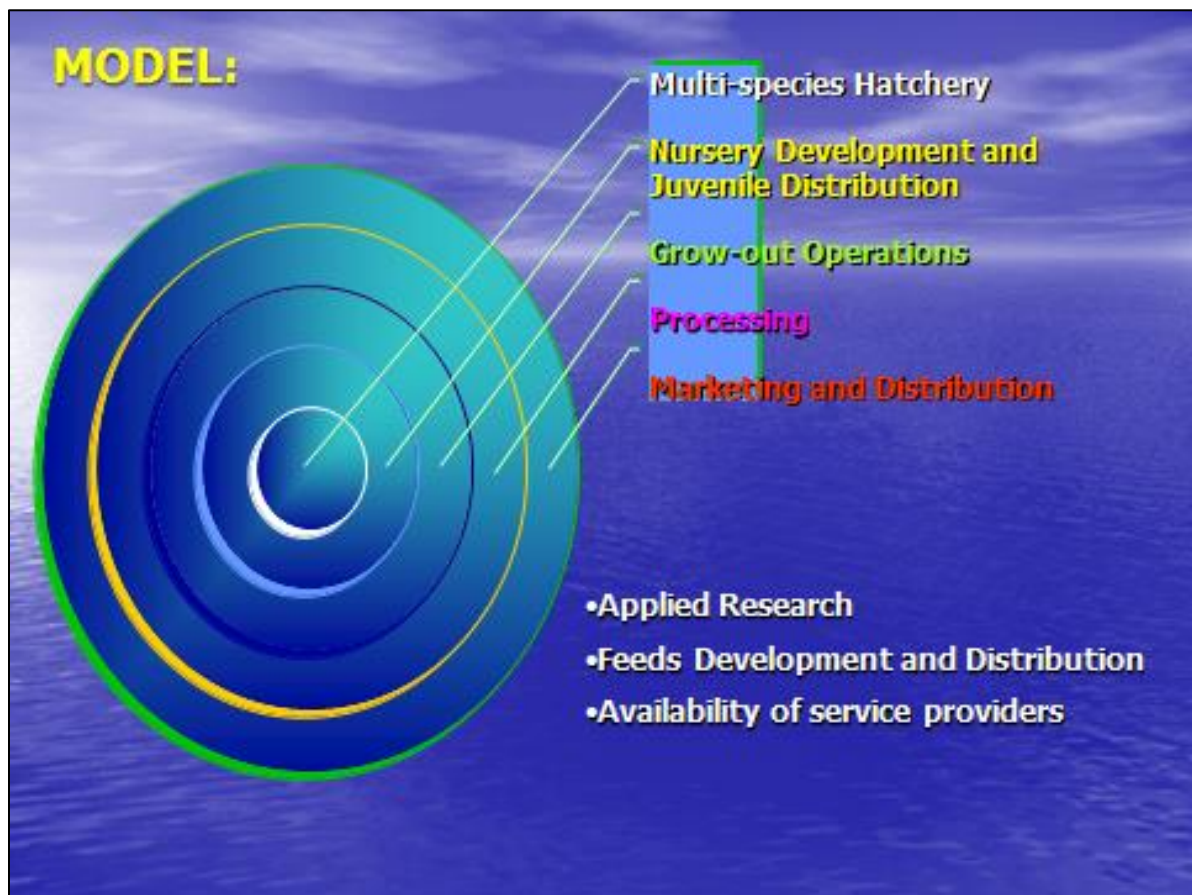


Diagram 1. HVA Industry Model (Source: USAID-GEM)

A. Short-term Development Plan (Year 1)

This period will mark the province's initial foray into the HVA industry, starting with grow-out production of a specific commodity range. This will be the determining stage in the eventual progress of the industry as a viable and sustainable income-earner for the province.

This phase takes off from initial efforts by USAID (through the GEM Program) to establish grouper culture in the province under its Typhoon Pablo disaster recovery assistance project, starting with grow-out production. As such, the evolution of its value-chain will emanate from grow-out production, with other components (such as hatchery development, processing/consolidation, etc.) to follow in subsequent phases (see Diagram 2. Value-chain for Grouper Production).

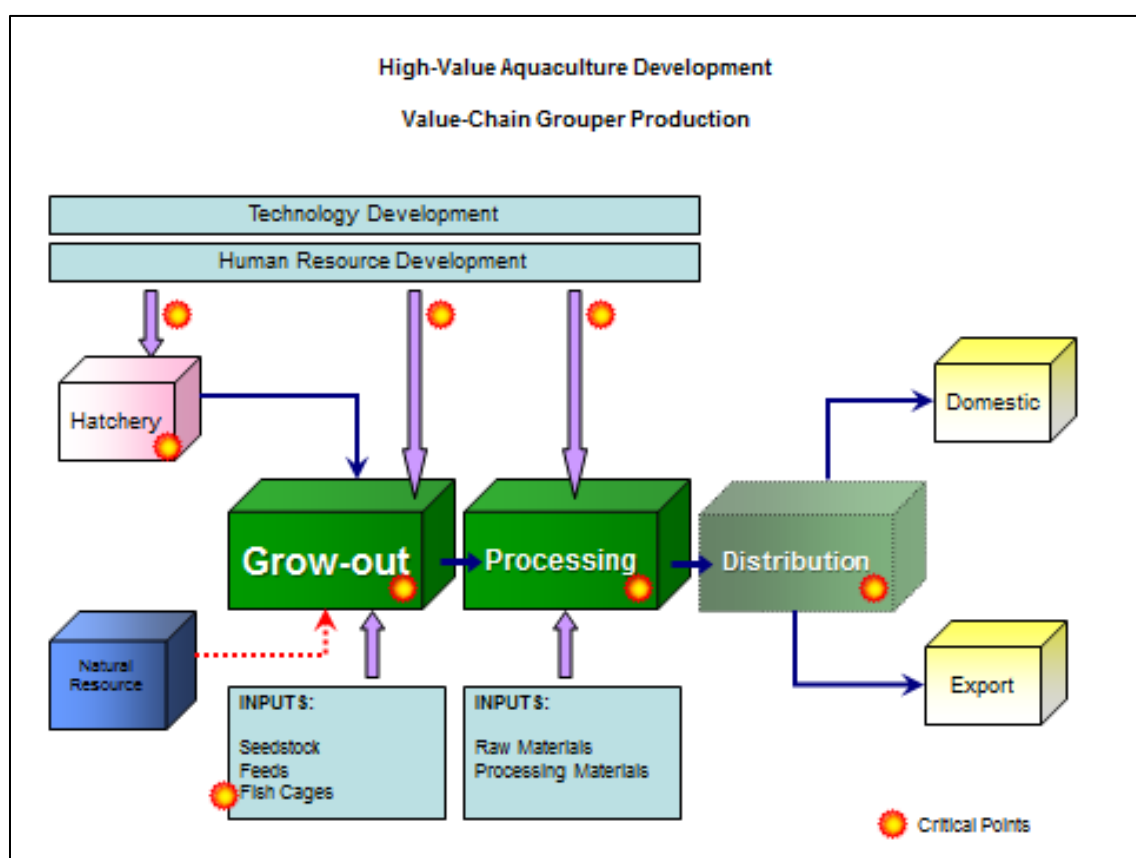


Diagram 2. Value-chain for Grouper Production (Source: USAID-GEM)

1. Grow-out Production

Grow-out refers to the stage in aquaculture in which juveniles of adequate size and age are stocked and reared until grown to a size required by the market. Grow-out production utilizes either water-based systems (cages and pens, inshore/offshore) or land-based systems (rainfed ponds, irrigated or flow-through systems, tanks and raceways).



Hydrographic Factors for Grouper Culture:

- ✓ pH 7.5-8.3
- ✓ Temperature 25-32 °C
- ✓ Salinity 20-32 ppt
- ✓ Dissolved oxygen (D.O.) 4-8 ppm
- ✓ NO₂-N (Nitrite nitrogen) 0-0.05 ppm
- ✓ Unionized ammonia (NH₃-N) <0.02 ppm

a. Potential Production Areas

In determining suitable areas for grouper fish cage operations, the following parameters must be taken into consideration:

- Seawater depth of at least 5 meters (during low tide);
- Adequate protection from strong winds, waves, currents, typhoons, floods and siltation – as such, coves and inlets are preferred when installing fish cages;
- Good seawater quality, i.e., appropriate salinity (20-32 ppt), free from pollution, like run-off influx from industrial, agricultural and domestic waste;
- Continuous seawater exchange at high and low tides;
- Supply of freshwater;
- Readily accessible and secure.

In a survey of coastal areas in the province, several suitable sites were identified (see Table 3).

Table 3. List of Potential Sites for Grouper Grow-out Production

Municipality	Area of Mun'l. Water (ha.)	Length of Coastline (km.)	Potential Barangays	Notable Sites
Baganga	347.89	44	11	Ban-ao Kinablangan San Victor
Banaybanay	20,592.0	22	6	
Boston	9,177.31	18	5	Kabugao Isl.
Caraga	-	34	6	Caraga Bay
Cateel	-	-	0	
Gov. Generoso	-	60	14	Monserat
Lupon	-	-	4	
Manay	35,578.0	35	4	
Mati	-	-	16	Mati Mar. Park
San Isidro	2,700.0	18	7	
Tarragona	-	-	3	
TOTAL	68,395.20	231	76	

Source: USAID-GEM

Groupers

Class Actinopterygii
Order Perciformes
Family Serranidae
Sub-family Epinephelinae

- Comprise 14 genera and 449 species of the subfamily Epinephelinae, or roughly half of all species in the family Serranidae (groupers and sea basses)
- There are 16 major grouper species that are cultured; the dominant species vary somewhat regionally.
- The most consistently abundant species that are captured for culture purposes and also reared in hatcheries are *Epinephelus coioides*, *E. malabaricus*, and *E. fuscoguttatus*
- Other important species are *E. bleekeri*, *E. akaara*, *E. awoara* and *E. areolatus*. *E. amblycephalus*, *E. lanceolatus*, *E. sexfasciatus*, *E. trimaculatus*, *E. quoyanus*, *E. bruneus*, *Cromileptes altivelis*, *Plectropomus leopardus* and *P. maculatus* are cultured in small amounts.

Source: Tupper, M.; Sheriff, N. 2008. Capture-based aquaculture of groupers. In A. Lovatelli and P.F. Holthuis (eds). Capture-based aquaculture. Global overview. FAO Fisheries Technical Paper. No. 508. Rome, FAO. pp. 217–253.



Potential site in Brgy. Kinablangan, Baganga, Davao Oriental

b. Target Species/Commodity

Grouper species to be introduced at this phase will be the varieties whose juveniles are readily available from existing commercial hatcheries and with established culture protocols for full-cycle aquaculture, **green or “mangrove” grouper** and **tiger or “camouflage” grouper** (see Boxes 1 and 2).

c. Culture System

For purposes of this industry plan, the grow-out system to be introduced will be water-based, using floating fish cages. Fish cage design is important, owing to the fact that designs vary according to the cultured fish and their habits. For instance, the typical fish cage design for the ubiquitous milkfish (*Chanos chanos*) is either circular or square, but with a large area (10x10x5 m) because milkfish are consistently swimming around.

Grouper, on the other hand, are sedentary creatures, tend to stay at the bottom and, thus, can be reared in smaller, more manageable compartments. As such, a typical cage module would have 4 to 8 separate “small” compartments (3x3x3.5 m).

For this province, USAID-GEM is promoting its *low-cost, all-weather resilient 4-compartment floating fish cage module* as part of its introduction of climate-adaptive aquaculture. See Annex A for fish cage design.



Left: 4-compartment cage module with bamboo frame and horizontal floats; Right: 8-compartment cage module with wooden frame and vertical floats

Box 1. Species Description: Green grouper



Epinephelus coioides

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Common names:	Orange-spotted grouper, estuary/mangrove grouper, green grouper
Vernacular:	<i>inid, kugtong, pugapo</i>
Size and age:	120 cm TL (male/unsexed; Ref. 47613); max. published weight: 15.0 kg (Ref. 11228); max. reported age: 22 years
Environment:	Reef-associated; brackish; marine; depth range 2–100 m
Climate:	Subtropical; 37°N - 34°S, 28°E - 180°E
Importance:	Important for commercial fisheries and aquaculture throughout Southeast Asia; major species in China Hong Kong SAR live fish markets.
Resilience:	Medium, minimum population doubling time 1.4–4.4 years (K=0.17; tmax=22).
Biology and ecology:	Inhabit turbid coastal reefs and are often found in brackish water over mud and rubble. Juveniles are common in shallow waters of estuaries over sand, mud and gravel and among mangroves. Feed on small fishes, shrimps, and crabs. Probably spawn during restricted periods and form aggregations when doing so. Eggs and early larvae are probably pelagic.

Box 2. Species Description: Tiger grouper

¹⁸ Tupper, M.; Sheriff, N. 2008. Capture-based aquaculture of groupers. In A. Lovatelli and P.F. Holthus (eds). Capture-based aquaculture. Global overview. FAO Fisheries Technical Paper. No. 508. Rome, FAO. pp. 217–253.



Epinephelus fuscoguttatus¹⁹

Common names:	Brown-marbled grouper, tiger grouper, dusky grouper, flowery grouper, flowery cod
Vernacular:	<i>pugapo, kulapo, mantis, garupa</i>
Size and age:	120 cm TL; max weight 35.0 kg, max. age >40 years
Environment:	Reef-associated; marine; depth range 1–60 m
Climate:	Tropical; 35°N - 27°S, 39°E - 171°W
Importance:	Minor commercial fisheries, moderate importance in aquaculture and live reef fish trade. Cultured in Singapore, Philippines and Indonesia.
Resilience:	Medium, minimum population doubling time 1.4–4.4 years (K=0.16-0.20).
Biology and ecology:	Occurs in lagoon pinnacles, channels, and outer reef slopes, in coral-rich areas and with clear waters. Juveniles in seagrass beds. Feeds on fishes, crabs, and cephalopods. May be ciguatoxic in some areas. Mainly active at dusk.

d. Maintenance During Culture Period

One production cycle for the target species involves is 5-6 months to reach market size of around 0.6 kg per piece. This means that 2 production cycles can be implemented in a year.

As a carnivorous (and even cannibalistic) species, grouper requires either the use of “trash” fish or commercial formulated feeds. The latter is more advisable for the following reasons:

- Use of commercial feeds improves survival as fish become domesticated and mortalities due to cannibalism are minimized.
- Disease transmission from highly perishable trash fish is reduced.
- Pollution of culture environment from fouling by unconsumed trash fish is prevented
- Formulated diet provides for the complete nutritional requirements of the stock.
- More efficient in terms of feed-conversion-ratio (FCR)

¹⁹ ibid

See Annex B for a comprehensive guide on Grouper Grow-out Culture, Feeding, and Harvest & Transport.²⁰

e. Profitability Analysis

Table 4. Profitability Estimate for Grouper Grow-out Production (4-compartment Module).

A. Technical Assumptions		
Culture Volume (Cu.m.)		108
Cage Capacity Utilization (%)		100%
Stocking Density (pc./cu.m.)		10
No. of Stocks (pc.)		1,080
Survival Rate (%)		80%
Average Body Weight @ Harvest (Grams.)		500
Days of Culture (Mo.)		6
Yield Per Crop(Kg.)		432
No. of Crops per Year		2.0
Feed Conversion Ratio		2.2
B. Operating Cost		
Variable Cost		
1. Seedstocks (pc.)		1,080
Size		7.5 cm.
Unit Cost (P)		48
Total Cost		51,840
2. Feed (Kg.)		950
Unit Cost (P)		63
Total Cost		59,850
3' Harvest cost		4,320
Total Variable Cost		116,010
Fixed Cost		
1. Labor : Salaries & Wages (1pax handles 2 modules)		15,000
2. Materials & Supplies (Fuel, Oil, etc.) @ P500/mo.		3,000
3. Repairs & Maintenance P300/mo.		1,800
4. Depreciation		22,175
Total Fixed Cost		41,975
Total Operating Cost		157,985
C. Profitability Estimate		
Yield per Crop (Kg.)		432
Selling Price (P/Kg.)		500
Revenue per Crop (P)		216,000
Less: Operating Cost		(157,985)
Net Profit per Crop		62,335
No. of Crops per year		2.0
Net Profit per Year		124,670
Initial Investment		280,330
Estimated ROI		39%

²⁰ APEC/SEAFDEC. 2001. Husbandry and health management of grouper. APEC, Singapore & SEAFDEC, Iloilo, Philippines. 94 p.


As a contributor to rural livelihoods, particularly those of coastal fishers, grouper aquaculture can generate potentially large financial benefits. The high value of grouper on the export market ensures that farmers are able to generate a profit even when stocks suffer mortalities. Despite high initial investment costs, studies have shown that with appropriate support, even the poorest can benefit from grouper culture, with implications for both household well-being and community development.²¹

2. Production Inputs and Logistical Requirements

a. Juvenile Sources and Delivery Systems

At this stage when the province does not have its own grouper hatchery or nursery yet, juveniles can be sourced from existing commercial hatcheries and/or nurseries that breed grouper.

Fingerlings are usually delivered packed in oxygenated bags and, depending on the packing density and degree of temperature reduction, can last 8-12 hours.



Recommended density of fingerling to be transported for at least 8 hrs. at 20-22°C:

2.5 cm (1 in) size - 100-150 fish/L

5 cm (2 in) size - 30-50 fish/L

7 cm (3 in) size - 10-15 fish/L



Left: grouper hatchery; Right: hatchery-bred grouper fingerlings

For a list of grouper hatcheries and nurseries that are near the province or can easily supply fingerlings (either by land or by air), see Table 5.

²¹ Tupper, 2008

Table 5. Sources of Grouper Fingerlings.

Hatchery/Nursery	Location	Contact Details
Alsons Aquaculture Corp. / Finfish Hatcheries, Inc.	G/F, Alsons Building, 2286 Chino Roces Extension Makati City, Metro Manila Philippines 1231 Maribulan, Alabel, Sarangani Province	(02)9823000 (02)9823019 (083)508-2314 fhi_mkti@alcantaragroup.com
SEAFDEC-AQD	Tigbauan, Iloilo	(033) 511-9170 to 71 loc 361 or 358 aqdchief@seafdec.org.ph
KGMC Nursery	Kabasalan, Zamboanga Sibugay	09161963271
RM Hatchery & Nursery	Nasipit, Agusan del Norte	09108135252 romel.hipolito@yahoo.com

Source: USAID-GEM

b. Feeds Sources and Delivery Systems

At this stage when the province does not have its own feed mill yet, feeds can be



sourced from existing commercial feeds manufacturers or retailers. Commercial feeds usually come in 25-kg bags and in different pellet sizes and nutritive value (with emphasis on protein content), depending on the age/size of the stock (Table 5). Therefore, when planning feeds procurement, it is best to plan ahead and project feeds requirement for a production cycle.

Table 5. Grouper Feed Types

Feed Type	%CP* (min.)	Particle / Pellet size (mm)	Ave. Body Weight (ABW) of Stock (g)	Feed Rate (% Body Weight)	Feeding Frequency
Fry Mash	50	0.5-0.7	Tiny – 2	20-12	6x
Crumble	50	1.2-2.3	2 - 20	12-7	6x
Starter 1	48	2.6-3.0	20 - 35	7-6	5x
Starter 2	48	4.0-4.5	35 - 50	6-5	5x
Grower 1	47	5.0-5.5	50 - 150	5-4.5	2x
Grower 2	47	7.3-7.8	150 - 350	4.5-3.5	2x
Finisher	46	10.1-10.5	350-up	3.5-3.0	2x

* Crude Protein

Source: www.tateh.com

See Annex C for a comprehensive guide on feeding management using grouper formulated feeds. For possible sources of commercial feeds, see Table 6.

Table 6. Sources of Grouper Feeds.

Supplier/Manufacturer	Location	Contact Details
Santeh Feeds Corp.	Manila Office: Santeh Feeds Corporation 601 West Trade Center 132 West Avenue Quezon City	Tel (02) 3751560 to 62 Fax (02) 3748031 09177915478
Oversea Feeds Corp.	Plaridel, Cebu City	Tel (032)2541519 09224867407
San Miguel Corp. / B-Meg Feeds	18th Floor, JMT Corporate Condominium, ADB Ave., Ortigas Center, Pasig City 1605	Tel (02)702 5000 Telefax (02) 634 3036 info@b-meg.com

Source: USAID-GEM

3. Market and Market Linkages

a. Market Destinations

As mentioned in Chapter V Section C, live grouper are primarily for the export market, particularly, Hong Kong and China. However, whether for export or the domestic market, there are usually local traders that act as intermediaries. This has both advantages and disadvantages.

The disadvantage is obviously the lower value that intermediaries normally peg for commodities. However, as explained earlier, prevailing local market rates are still competitive. The advantage, on the other hand, is the convenience of selling stocks since local buying stations are easier to reach (ergo, reducing your transport costs). Moreover, some traders are willing to purchase harvested stocks ex-farm, thereby, totally eliminating growers' costs and additional effort in packing and transport of harvest.

Growers in the province may also directly bring their harvest to nearby live seafood restaurants.



Live seafood restaurant in Tagum City, Davao del Norte

b. Live Fish Buyers

Live fish buyers usually set up buying stations where high-value seafood are produced in sufficient quantities, either from capture fisheries or aquaculture. For a list of high-value seafood buyers / buying stations that are proximate to or can easily access the province, see Table 7.

Table 7. Live Grouper Buyers.

	Company	Owner/ Manager/ Representative	Address	Contact Nos.
1.	Ocean World Marine Products	Nancy Gonato/ Bobby Gonato	Baliwasan Chico, Zamboanga city	(062) 981-0347
2.	J. Maramba Marine Products	Benito sy/ Jackilou Maramba	Varela St., Zone I, Zamboanga city	(062) 993-2029
3.	Cibeles Marine Products Corp.	Paz Mondragon	Macrohon Baliwasan, Zamboanga city	(062) 993-2417
4.	Crustacean Trading, Inc.	Frederick Daculan	Raja Muda Mandi St., Zamboanga city	(062) 991-0762
5.	Yeong Marine Products, Inc.	Armando Bajacan, Operation's Manager	Johnston St., San Jose, Manila Address: 4450D Campos st., Don Galo, Parañaque City	0927-3365196, 0918-9335721, (632) 853-0520
6.	Golden Union Aquamarine Products, Inc.	Merel Tabujara	Baliwasan Chico, Manila Address: 1020 Maura St. Factor Cmpd., Don Galo, Parañaque City	(062) 990-1327
7.	Kenneth Aquamarine Products, Inc.	Consuelo Rectin	Zamboanga city; Surigao City	(062) 991-3135
8.	Marine Dragon Export	Kenneth Salazar	Zamboanga city; Surigao City	(062) 9269072
8.	Nena Baniquid	Nena Baniquid	To be confirmed	To be confirmed
9.	GC-Unimarine Products	Glenn Chua	Zamboanga city; Surigao City Mati City	09177228876
10.	Gold Coast Marine Products	Mr. Anjong, Sorter/ Sizer	Magay St., Zamboanga city	0908-2208209
11.	Star Island	Antonio B. Yanga	Baliwasan seaside, Zamboanga city	To be confirmed

Source: USAID-GEM

c. Logistical Requirements

Harvest and transport requires facilities that can consolidate and deliver live grouper to the market, whether final or intermediary. For the province, common facilities can be developed for the benefit of growers. These can be managed by the local government or private groups.

- **Fish Consolidation Station** – for conditioning of harvest prior to packing, a convenient area to conduct packing, and a holding area for harvested stocks.

This facility may also be utilized to consolidate harvested stocks from different growers in order to meet a required volume; essentially a land-based facility that has access to seawater and equipped with the necessary holding tanks and life-support systems (aeration, filtration, etc.).



Small-scale fish consolidation station, with holding tanks equipped with aeration, filtration, and water supply systems

- **Live Fish Transport System** – especially for outlying areas, a live fish transport system will facilitate transport of live stock from the production area to the consolidation station. It may also be utilized to bring stocks to buying stations. The system can be installed in land-based vehicles (ex. fish car) or pumpboat.

For detailed costs on the abovementioned facilities, see Annex D. Live Fish Transport System and Consolidation Center.²²



Live fish transport system installed on boat

d. Market Information

A common problem of growers is lack of knowledge on current market rates and trends. Consequently, they are preyed upon by unscrupulous traders, who artificially depress prices, claiming that the low value is caused by off-season rates or depreciations in the export market. This can be avoided if the grower is armed with adequate and up-to-date market information and studies. For on-line information on current market rates in the export market, the following websites may be accessed:

- Hong Kong Fish Marketing Organization
http://www.fmo.org.hk/index/lang_en/page_price-sea/
- Network of Aquaculture Centres in Asia-Pacific
http://www.enaca.org/modules/news/article.php?article_id=904
- China Fisheries and Seafood Expo
<http://www.chinaseafoodexpo.com/index.php/seafood-news>

²² Nobillos, Joselito. 2012. Proposed High-Value Aquaculture Production Sites in Eastern Mindanao. SOEMCO

4. Program Plans and Targets

a. Specific Activities

- a.1. Installation of **ten** 4-compartment grow-out modules – these will provide the volume of live grouper to generate the initial economy of scale. These may be managed by duly accredited fisherfolk associations/cooperatives nominated by the LGU. Installation will include procurement of production inputs for 1 cycle production.

Table 8. Proposed Areas for Fish Cage Module Installation

Municipality	Potential Barangays	Notable Sites	No. of Modules
Baganga	11	<i>Ban-ao</i>	1
Banaybanay	6		1
Boston	5	<i>Kabugao Isl.</i>	1
Caraga	6	<i>Caraga Bay</i>	1
Gov. Generoso	14	<i>Monserat</i>	1
Lupon	4		1
Manay	4		1
Mati	16	<i>Mati Mar. Park</i>	1
San Isidro	7		1
Tarragona	3		1
	76	TOTAL	10

- a.2. Establishment of **1** central Fish Consolidation Station (with **1** Live Fish Transport System) – this facility will be strategically located to access all production areas, as well as target market destinations. This can be managed as a profit-oriented operation by either a cooperative or a private enterprise. Aside from consolidating harvest, the facilities may also be utilized for juvenile conditioning and distribution to grow-out sites.

b. Investment Requirements

Table 9. Investment Requirements for Year 1 Projects/Activities

Project/Activity	Unit	Unit Cost (Php)	Qty.	Total (Php)
Grow-out modules (4-comp., including prodn. inputs)	modules	261,000.00	10	2,610,000.00
Fish Consolidation Station	unit	319,500.00	1	319,500.00
Live fish transport system	unit	248,100.00	1	248,100.00
				3,177,600.00

c. Projected Revenue

Table 10. Projected Annual Revenue from Year 1 Projects/Activities

Project/Activity	Projected Revenue (Php) (Annual)		
	<i>Revenue per Unit</i>	<i>Total</i>	<i>Net Profit</i>
Grow-out modules (4-comp., including prodn. inputs)	124,670.00	1,246,700.00	1,246,700.00
Fish Consolidation Station	2,489,400.00	2,489,400.00	2,269,900.00
Live fish transport system	-	-	(248,100.00)
			3,268,500.00

5. Implementing Mechanisms

a. Investment and Local Government Operationalization

The provincial government may opt to fund the establishment of the required facilities and costs for this phase. It may also explore the possibility of securing counterpart investment from the private sector for these projects, such as financing programs for grow-out operations.

The fish consolidation center, as a business enterprise, may also be assumed by the private sector, considering the revenue potential.

Credit programs, specifically, the Development Bank of the Philippines' (DBP) Sustainable Mariculture Investment Program (SMIP) may also be taken advantage of by the provincial government, since it has special arrangements for LGUs, like IRA-intercept payments, re-credit systems extended to end-user beneficiaries (the grower cooperatives), etc.

b. Institutional Mechanisms

b.1. **LGU** - The provincial government, through the Provincial Agricultural Office, may take the lead in overall project supervision. It may also consider the establishment of something like an "HVA Resource Center" that can act in an administrative capacity, coordinating and supervising overall project implementation, as well as be a local technical resource extending technical and support services to growers, investors, and other stakeholders.

b.2. **Consulting Firm** - As this is a crucial phase in the HVA Industry's development in the province, the LGU may well be advised to retain the professional services of an experienced aquaculture consulting firm or individual to minimize the impediments invariably brought about by an inevitable learning curve.

- b.3. **Local Resources** – a number of cooperatives have been trained by USAID (through GEM) and provided with techno-demo grow-out modules. Members of these cooperatives may be optimized and commissioned by the LGU to act as local technical resources in the provision of technical services and guidance to incipient growers.

Table 11. Fisherfolk Associations Trained by USAID-GEM in HVA

Association	Brgy.	Municipality
1. Islander Fisherfolk Association	San Victor	Baganga
2. Kinablangan Development Cooperative	Kinablangan	Baganga
3. Kinablangan Seaweed Growers Association	Kinablangan	Baganga
4. Boston Lobster growers Association	Poblacion Boston	Boston
5. Baybay Fisherfolks Association	Baybay	Cateel
6. Mati Fish Culturist Association	Badas	Mati

Source: USAID-GEM



Left: USAID-GEM Aquaculture Team conducts training on High-Value Aquaculture production in Brgy. San Victor, Baganga; Right: Officers of the Kinablangan Devt. Cooperative receive materials for construction of grouper cage module from USAID representatives (June 2013)

B. Medium-term Development Plan (2-3 years)

After its initial year of production, this plan forecasts intensification and expansion of grow-out capabilities and yield. Simultaneously, this stage shall lay the foundation for a “full-cycle” industry whilst ensuring profitability from the other components to be established.

1. Grow-out Production (Expansion and Diversification)

a. Culture System



All-weather resilient 8-compartment floating fish cage module (photo courtesy of C. Andigan)

Aside from the existing 4-compartment “community” modules, the province may significantly boost its production by investing in commercial-scale 8-compartment modules (see Annex E. 8-compartment Module Design, Cost, and Profitability).

b. Profitability Analysis and Budgetary Requirements

Grouper grow-out using 8-compartment modules is much more profitable than the 4-compartment design, not just because of the bigger stocking capacity, but also because this bigger module allows growers to implement multiple cycles simultaneously.²³ Multi-cycle production, which involves redistribution of stock and harvest every three months, while more complex than straight-run production, will enable systematic harvest every quarter, and equates to increased profits, as well as faster and more frequent incomes for growers.

See Annex E for budget requirements and profitability.

²³ This production technique was developed by Lauro Tito Ilagan, Sr. Aquaculture Specialist of USAID- GEM's Sustainable Aquaculture and Fisheries Effort (SAFE) and introduced to assisted growers during the implementation of the USAID-GEM 3 Program (2008-2012).

2. Nursery Development

At this stage, the province can start gearing towards sustainability of production. Therefore, a local source of seedstock becomes necessary.

A nursery is a facility where fish at either the pre-flexion larval stage or post-flexion larval stage (1.5-2 cm) are bought from a hatchery and reared to 70-80 day old juvenile fingerling stage (10 cm); the nursery then sells the fingerlings to grow-out farmers.²⁴ USAID-GEM, as part of its Sustainable Aquaculture and Fisheries Effort (SAFE), conceived the idea of developing off-site nurseries for pre/post-harvest distribution as the next “ring” in SAFE’s economic model. There was a need to establish nursery stations for:

- Distribution of juveniles to grow-out areas
- Facilities for nursery-rearing of larvae
- Freeing up of tanks of post-larval stock in hatcheries to accommodate more spawned larvae



A grouper nursery with a fully-stocked indoor nursery tank (photo courtesy of C. Andigan)

Unlike hatcheries, nurseries are less expensive to construct and operate because they do not possess or maintain “broodstock” or spawners. They can either be land-based, sea-based, or a combination.

²⁴ Ilagan, Lauro Tito. March/April 2012. Green Groupers in Mindanao: KGMC in Focus. Aquaculture Asia Pacific Magazine. ISBN 1793-0561. Singapore.

a. Production Areas

In determining suitable areas for grouper nursery operations, the following parameters must be taken into consideration:

- Access to good seawater;
- Supply of freshwater;
- Accessible by land; and
- Availability of electricity and telecommunications
- With adequate space for land-based structures (such as indoor tanks), land-based ponds, and near the coast (for sea-based nursery cages)



In itself, a nursery can be a very viable enterprise

b. Target Species/Commodity

Nursery production relies on availability of hatchery-bred fry. Therefore, this project will focus on species that are readily produced by existing hatcheries, namely, tiger grouper (*E. fuscoguttatus*) and green grouper (*E. coioides*).

c. Culture System

The grouper nursery will be composed of both sea and land-based rearing facilities. Land-based tanks outfitted with aeration, filtration, and water-circulation equipment will be stocked with grouper larvae and early juveniles for rearing under controlled parameters.

After a certain period, these will be transferred either to sea-based cages or land-based ponds for secondary nursery-rearing. The secondary nurseries will be situated in a protected area with minimal water current to allow the juveniles to gradually adapt to a marine environment.

d. Feeding and Maintenance

The stock will be reared using a combination of natural and formulated feed to eventually “train” them to thrive on a purely formulated diet.

e. Profitability Analysis

Establishing a nursery will essentially have the objective of ensuring the sustainability of the industry by making available a regular supply of juveniles. However, in itself, a nursery can be a very viable enterprise.

Grouper fry will be reared for approximately 2-3 months and transferred to the grow-out area upon reaching the desired size of 3-4 inches per fish, which would then be ready for sale and distribution to grow-out operators. Assuming a 90% survival rate, the initial yield will earn a net profit of around P150,000 per cycle, or P450,000 per year for 3 production cycles. Operating the facility at full capacity can yield a net profit of around P450,000 per cycle, or P1.35 Million annually.²⁵



A USAID-GEM aquaculture specialist shows a sexually mature male green grouper spawner.

f. Budgetary Requirements

See Annex F.

g. Marketing

At this juncture, the province can already initiate exploratory discussions with live fish buyers and also do trial runs of supply to live fish carrier vessels. Establishing a supply route using this system offers a number of advantages to local growers, including reduced cost in post-harvest packing and transport.²⁶

3. Broodstock Development

In preparation for when the province can establish its own hatchery, developing “broodstock” or spawners of desired grouper species may now be initiated. Broodstock are specimen or species, from which a first or subsequent generation may be produced in captivity, whether for growing as aquaculture or for release to

²⁵ Andigan, Cary. 2013. A Beginner's Guide to Grouper Aquaculture in Mindanao, Philippines. Philippines (pending publication).

²⁶ *ibid*

the wild for stock enhancement.²⁷ The term “development” refers to rearing and conditioning desired species of both sexes to become sexually mature.²⁸

Grouper are protogynous hermaphrodites, maturing initially as females, and then changing sex to male at a later age, which is why preparing spawners for use ultimately in hatchery production requires the early collection and accumulation of several pieces of fish of the same species.

Based on USAID-GEM’s survey among fishing practitioners in Davao Oriental, it has been determined that a variety of grouper species, including target species for aquaculture, are indigenous and endemic in the coastal waters of the province. Hence, the province should commence collection activities at this stage. Broodstock can be acquired from the wild, through fishermen, and maintained either in sea cages or in land-based facilities. However, wild-caught fish for broodstock development must have been caught using only fish traps (*bobo*) or hook-and-line, undamaged by the fishing, and not subjected to harmful chemicals, like cyanide.



A special large-sized fish trap (*bobo*) designed by USAID-GEM, specifically, for capture of wild grouper to be used as broodstock.

Another method of acquiring broodstock is to grow fish produced in the hatchery. Cage, pond or tank-reared fish are already accustomed to culture conditions and consequently easier to develop into suitable broodstock. However, it can take 4 years to grow juvenile grouper up to broodstock size.²⁹ In the Philippines, the smallest recorded size of sexually mature tiger grouper (*E. fuscoguttatus*) grown in captivity and fed on dry pellets is 2.2 kg (female) and 3.5 kg (male).³⁰

In preparation for eventual upgrading into a full-blown hatchery, collected broodstock may be kept and reared at the provincial nursery. Further, this will save costs on procurement of additional equipment.

²⁷ Food and Agricultural Organization (FAO). <http://www.fao.org/fishery/aquaculture/en>

²⁸ Sugama K., Rimmer M.A., Ismi S., Koesharyani I., Suwirya K., Giri N.A. and Alava V.R. 2012. Hatchery management of tiger grouper (*Epinephelus fuscoguttatus*): a best-practice manual. ACIAR Monograph No. 149. Australian Centre for International Agricultural Research: Canberra. 66 pp.

²⁹ Sugama et al, 2012

³⁰ Andigan, 2013

4. Applied Research and Development (R&D)

The province may, through local academic centers, like the Davao Oriental State College of Science, promote studies and applied research activities to further develop and support its incipient aquaculture industry.

5. Human Resources Development

Similar to R&D, the province may endeavor to encourage local technical-vocational schools and universities to offer courses related to aquaculture, using existing aquaculture (National Certificate 2) training regulations of the Technical Education and Skills Development Authority (TESDA). This is to develop future aquaculture practitioners in the province.

To match academic training with actual local industry requirements, aquaculture students may undergo workplace training, practicum, or on-the-job training in grow-out production areas or the nursery facilities.

6. Legal Framework and Policy Modification

To create the policy environment conducive to high-value aquaculture production and as a business, the LGU may create and enact local issuances that would help promote the industry, such as creating more mariculture parks and/or zones. However, the province may anticipate possible excesses and adverse impacts to the environment, hence, it is prudent to also develop regulations to ensure sustainability. These may include ordinances on the following:

- a. Zoning regulations
- b. Regulations on the indiscriminate catching of grouper fry in the wild
- c. Increased sanctions against illegal and harmful fishing (that may cause harm to nearby fish cage operations)
- d. Setting regulations on the number of cages operating in an area to meet carrying capacity limitations
- e. Regulations on the trade, transport, and sale of grouper species not produced through aquaculture

7. Program Plans and Targets

a. Specific Activities

- a.1. Installation of **ten** 8-compartment grow-out modules – these will enable the volume of live grouper produced to reach the economies of scale to enable the establishment of a live fish carrier route. These modules may either be owned and financed by private investors or managed by duly accredited fisherfolk associations/cooperatives nominated by the LGU.
- a.2. Establishment of a grouper nursery to provide for the fingerling requirements of the province – the nursery may be initiated by the provincial government and leased to a private operator for commercial operations.

- a.3. Broodstock collection and maintenance – the province will procure and maintain grouper for broodstock development
- a.4. Initiate an applied research program – to be spearheaded by the provincial government and involve local universities and research institutions.
- a.5. Conduct training programs on high-value aquaculture and establish aquaculture courses in local schools – the Provincial Agriculture office can regularly hold training workshops on high-value aquaculture, as well as encourage local schools to offer aquaculture as a tertiary or diploma course.

b. Investment Requirements

Total investment requirements for the abovementioned activities will reach **P6.2 Million** for the 3-year medium-term development phase. Some activities, such as broodstock maintenance, are cost centers, whose benefit will not yet be realized over this period.

However, from all other operations, the province will generate revenues (net) of around **P6.33 Million**.

See Annex G. Investment Requirements and Projected Revenues for Medium-Term Phase (3 Years).

8. Implementing Mechanisms

Implementing mechanisms will still be the same, with the provincial government taking the lead in the overall implementation of the industry development plan, with the option of obtaining the services of a private aquaculture technical group.

Public-Private-Partnership (PPP) arrangements may also be explored in nursery development, as well as the 10-compartment modules to be installed.

C. Long-term Development Plan (5-6 years)



This phase in the Development Plan foresees the industry to be fully sustainable and has expanded to include ancillary industries, such as feeds production, juvenile production, intermediary, and downstream/forward industries that can be developed.

1. Grow-out Production

a. Production Areas

It is envisioned that most municipalities will establish their respective mariculture zones to ensure that biological limits of marine ecosystems will not be exceeded. Most of the investment in grow-out production will now come from the private sector.

b. Target Species/Commodity

Local growers will have become very sophisticated in their production methods, diversifying their cultured species to other high-value commodities, like coral trout grouper (*Plectropomus leopardus*) and humpback grouper (*Cromileptes altivelis*). Both species already have full-cycle technology with recent advances in hatchery protocols (even in the Philippines). However, grow-out period of these species in aquaculture is relatively longer. While coral trout may be grown out to reach market size in 7 months, humpback growth rates are much smaller and can take 1.5 to 2 years to culture (boxes 3 and 4).

However, as earlier mentioned, these are the more expensive grouper varieties, with prices ranging from P1,500-3,500/kg, which make them still very attractive to growers.³¹ Juveniles of these species will have to be sourced either from hatcheries outside the province or from local gleaners.

³¹ Domestic market survey, April 2013

Moreover, depending on how technology will have advanced by the time this stage is in implementation, other high-value seafood that might become viable for full-cycle aquaculture and introduced in the province include lobster (*Panulirus ornatus*), tropical abalone (*Halitios asinina*), king crab (*Scylla serrata*), and sea cucumber (*Holothuria scabra*).

Box 3. Species Description: Humpback grouper



***Cromileptes altivelis*³²**

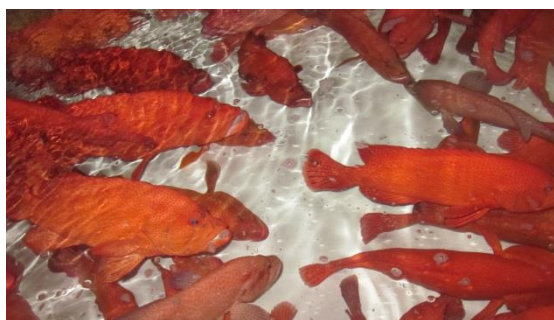
Common names:	Humpback grouper, panther grouper, mouse grouper, highfin grouper
Vernacular:	<i>kubing, senyorita</i>
Size and age:	Max size 70.0 cm TL
Environment:	Reef-associated; marine; depth range 2–40 m
Climate:	Tropical; 32°N - 23°S, 88°E - 168°E
Importance:	Juveniles are commonly caught for the aquarium trade while adults are utilized as a food fish. Very high value in China Hong Kong SAR live fish markets.
Resilience:	Low, minimum population doubling time 4.5–14 years.
Biology and ecology:	Generally inhabits lagoon and seaward reefs and are typically found in dead or silty areas. Also found around coral reefs and in tide pools. Growth is very slow. Feed on small fishes and crustaceans.



Other high-value seafood: Left – abalone; Right - lobster

³² Tupper, 2008

Box 4. Species Description: Coral Trout grouper



*Plectropomus leopardus*³³

Common names:	coral trout grouper, leopard grouper, red grouper, 7-star
Vernacular:	<i>kubing, senyorita</i>
Size and age:	120 cm TL; max weight 35.0 kg, max. age >40 years
Environment:	Reef-associated; marine; depth range 1–60 m
Climate:	Tropical; 32°N - 23°S, 88°E - 168°E
Importance:	Very high value in China Hong Kong SAR live fish markets. High importance in aquaculture and live reef fish trade. Cultured in Taiwan, Philippines and Indonesia.
Resilience:	Medium, minimum population doubling time 1.4–4.4 years (K=0.16-0.20).
Biology and ecology:	Occurs in lagoon pinnacles, channels, and outer reef slopes, in coral-rich areas and with clear waters. Juveniles in seagrass beds. Feeds on fishes, crabs, and cephalopods.

2. Hatchery Development

A hatchery is a facility where fish eggs are hatched and the fry raised, especially for stocking in grow-out ponds and/or cages.³⁴ Its primary difference from a nursery is in its capability to spawn eggs or larvae.



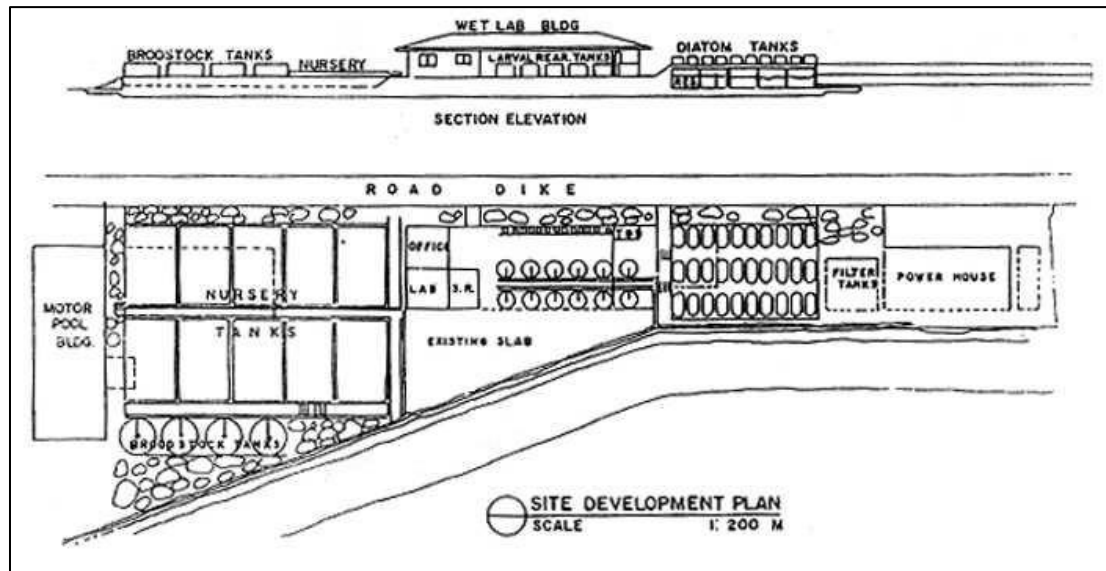
The Tawi-Tawi High-Value Multi-species Hatchery in Bongao, Tawi-Tawi is primarily a grouper hatchery.

For purposes of this development plan, the existing nursery can be upgraded to become a full-blown hatchery (albeit small-scale), rather than set up an entirely different facility. This way, the province will save on costs by just adding to existing

³³ ibid

³⁴ Andigan, 2012

facilities and equipment. Moreover, nursery personnel will already have garnered sufficient experience in the nursery part of operations and will be easy to train in additional operations, such as broodstock maintenance, egg collection and hatching, larviculture, natural food production (phytoplankton and zooplankton), and other hatchery systems. The collected spawners from the previous phase will be used for this hatchery's operations.



Sample grouper hatchery lay-out

Hatchery design and operations are much too extensive to be discussed in this plan, but a typical hatchery is generally composed of the following:

- Sea water pumping and distribution system;
- Aeration machinery and distribution system;
- Holding tanks for broodstock;
- Spawning tanks;
- Phytoplankton and zooplankton production laboratory and culture tanks;
- Larval rearing tanks;
- Nursery tanks;
- Wastewater disposal system;
- Office;
- On-site housing for critical personnel.

Suffice to say that if and when the province reaches this stage in its implementation of the industry plan, it will necessarily have to obtain the services of a grouper hatchery specialist or aquaculture institution like the Southeast Asian Fisheries Development Center – Aquaculture Department (SEAFDEC-AQD). This will be discussed more in *Implementing Mechanisms*.

a. Target Species/Commodity

The hatchery will be for the production of primary target species, tiger grouper (*E. fuscoguttatus*) and green grouper (*E. coioides*), although at a later stage it may evolve into a multi-species hatchery.

b. Budgetary and Other Requirements

To upgrade the province's existing nursery into a small-scale 8-LRT³⁵ hatchery will require an estimated cost of P3.02 Million. For details, see Annex H.

c. Profitability Analysis

Although a detailed profitability analysis would require a more comprehensive identification of financial details based on projected industry requirements, costs, and other expenses specific to the locality, a general idea of profitability of grouper hatchery operations is presented in Annex I (Grouper Hatchery Projected Balance Sheet).



Indoor LRTs in a typical grouper hatchery

3. Ancillary Industries and Business Opportunities

a. Natural food production

As the hatchery's production requirements increase, it will make sense for it to outsource some of its subordinate operations, such as natural food production. Natural food refers to phytoplankton and zooplankton required by hatcheries in large volumes and often times needing large outdoor space for tanks.



Hatcheries need plenty of outdoor natural food tanks

An alternative would be to provide natural food "starters" and enrichment media to coastal households with backyard tank space and later buying back fully populated culture media for hatchery use (sold on a per liter basis).

³⁵ Larval rearing tank

b. Wild juvenile collection and consolidation

Coastal fisherfolk may participate in a fingerling collection enterprise, wherein gleaners and fish trappers sell to the nursery grouper fingerlings collected from the wild. The nursery can then rear the juveniles and condition them to captive conditions for an easy transition to grow-out cages. This operation will have to be heavily regulated and limited, however, so as not to deplete local populations or cause harm to coastal and marine habitats.



Gleaners can earn from selling wild-caught fingerlings

c. Live fish/seafood trading

Some local entrepreneurs might be interested in establishing their own market channels, purchasing

pure live fish trading by live harvest from growers, and selling them direct to restaurants or exporters, along with other fresh/chilled seafood for wet markets.



This business would entail having a fully equipped live fish holding station for consolidation and conditioning of stock, as well as adequate refrigeration equipment.

Live fish trading would garner gross revenues ranging from P2.7 to 6.4 Million per month (less expenses), depending on the species to be sold. For an indicative presentation on profitability estimates, see Annex J.



An illustrative presentation of a beachside restaurant for tourists (photos above and below right taken in Coron, Palawan, courtesy of Lauro Ilagan)

d. Beachside and Resort Seafood Restaurants

Complementing the recent passage of Republic Act 10560, declaring Davao Oriental as a tourism development area, the province can capitalize on the high-value aquaculture industry by establishing restaurants specializing in live seafood in beach resorts or beachside properties.

Such establishments would invariably increase the appeal of the province by not just offering exotic beaches, but also tropical seafood cuisine.



4. Program Plans and Targets

a. Specific Activities

- a.1. Creation of legislation and establishment of mariculture zones and parks in 10 municipalities in the province.
- a.2. Installation and operation of at least **460** fish grow-out cage modules (based on initial survey of potential grow-out areas in the province) in the province.
- a.3. Establishment of **1** grouper hatchery
- a.4. Establishment of ancillary businesses – private sector-led

b. Investment Requirements

This plan will not attempt to comprehensively present all of the investment requirements for all 5-6 years of this stage in the plan. However, it is anticipated that the main investment requirement by the province at this stage – given that all other investments will be private in nature – will only be for the construction of the grouper hatchery at P3.02 Million (see Annex H).

5. Implementing Mechanisms

- a. **Private Investment** – at this stage, it is anticipated that the main driver for further business development will be the private sector, especially for small-to-medium enterprises like restaurants, live fish trading, and more grow-out modules.
- b. **BFAR** – BFAR, through its mariculture park program, would provide technical and financial assistance to the province by setting up more mariculture parks. BFAR normally appropriates a total investment of P5 Million for a 200-ha. Park (including moorings, demonstration cage modules, and technical services).
- c. Establishing a commercial hatchery would be more difficult considering the technical and financial requirements involved. Thus, it would again be necessary for the provincial government to initiate this component, possibly through PPP or build-operate-transfer (BOT) arrangement. A good model to follow would be the Tawi-Tawi High-Value Multi-species Hatchery in Bongao, Tawi-Tawi. Built in partnership between the provincial government of Tawi-Tawi and BFAR, it was then leased to a private company for management. Technical assistance was provided by USAID-GEM and **SEAFDEC-AQD**.

SEAFDEC-AQD's Agree-Build-Operate-Transfer (ABOT) Negosyo Program. The country's premier research institution for aquaculture offers LGUs and private investors the opportunity to avail of its technical expertise in various components of an aquaculture business, with flexible remuneration arrangements. For more information about SEAFDEC's ABOT Program, access: http://www.seafdec.org.ph/wp-content/uploads/2011/08/abot_20-July-2012_final.pdf

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