Planning and management of aquaculture parks for sustainable development of cage farms in the Philippines

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AquaPark Project Activities to date

- Environmental surveys (Panabo, Sual and Quezon Province)
- Identification of stakeholder issues
- Production survey
- Wave modeling for new expansion area
- Sediment impact modeling
- Mooring design
- Oil spill contingency
- Better Management Practices
- Economic survey
- Socio-economic survey

AquaPark Mid-term meeting - interim results
AquaPark Activities for the next year

- Development of a MP Framework
- Better Management Practices
  - LGU
  - Operators
- Oil spill contingency plan for Panabo MP
- Capacity building BFAR & NIFTDC for GIS and wave modelling
- Production optimisation
- Integrated Multi-trophic aquaculture
AquaPark follow-on from EMMA 2

• This proposal is a follow-on from EMMA.
• EMMA project developed environmental monitoring surveys methodology and carrying capacity model for of 3 aquaculture areas in the Philippines that were at risk from fish kills.
• The project donated the necessary equipment and trained staff in survey methodology, data collection and analyses of data.
AquaPark Objectives

• Existing mariculture parks
  – calculate sustainable aquaculture carrying-capacity for these zones,
  – Recommend cost effective design of moorings and cages
  – develop guidelines for good aquaculture practice in these zones
  – Strengthen the planning and management of mariculture parks
  – Recommend optimal business model for Mariculture Parks
AquaPark Objectives

• Re-organisation of existing aquaculture areas into parks
  – Assess the possibility and methodology of reorganising existing aquaculture production into aquaculture parks
    • Assess carrying capacity
    • Assess present production
    • Assess most suitable sites
  – Discuss with stakeholders and LGUs on best way to organise the production to relocate to mariculture park area
AquaPark Objectives

• New areas
  – Develop the methodology to identify new aquaculture zones using
    • Wave modelling
    • Classification of site exposure
    • GIS
  – Recommend optimal mix of multitrophic integrated aquaculture
    • Fish
    • Mollusc
    • seaweed
AquaPark Objectives

To provide the local, regional and central Government of the Philippines the tools for planning responsible and sustainable cage culture.

– Site selection
– Carrying capacity
– Cage design
– Integrated aquaculture
The project will select three case study areas:

– existing mariculture park area
– existing aquaculture production area that could be incorporated into a mariculture park
– new area identified for aquaculture development
Case study sites

The project will select three case study areas:

- Panabo - existing mariculture park area
- Sual - existing aquaculture production area that could be incorporated into a mariculture park
- Quezon Provence - new area identified for aquaculture development
AquaPark Outputs

• Site selection criteria using modelling and GIS
• Carrying capacity estimation
• Integrated Multi-trophic aquaculture planning
• Socio-economic analysis (positive and negative impacts)
• Financial analysis (operator, LGU, Mariculture Park and regional differences)
AquaPark Outputs (secondary)

- Mariculture Park Planning Framework
- Better Management Practices
- Improved mooring design
- Oil Spill Contingency planning
LAYOUT PLAN OF PCMP
AquaPark Mid-term meeting - interim results
Actual Park
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Site selection criteria

Use of Geographical Information System (GIS) for objective science based site selection
Site selection criteria – Factors to consider

- Conflicting uses of area
- Shore line contour
- Depth profile
- Currents
- Maximum wave height
- Dissolved oxygen concentration
- Pollution (organic and inorganic)
- Phytoplankton and zooplankton occurrence and distribution
- Potential danger of red tides, plankton blooms, biofouling
Site selection criteria – Factor to consider

• Flora and fauna studies (indicator organisms)
• Accessibility to the site – roads, transportation, airport, port, etc.
• Infrastructure - facilities, security, communication, electricity, freshwater
• Potential for expansion - availability of adjacent area
• Environmental assessment, monitoring and control – bioremediation and mitigation
• Legal framework – policies, regulations, licenses, permits, concessions, etc.
• Public and government acceptance of project
Basemap
Basemap
Sensitive areas
Wave model
Wave model
Wave model
Criteria for cage fishfarming

• Suitable depth
  – 15 to 50 m

• Infrastructure
  – Road preferable less then 1 km away

Excluding factors

• Wave
  – More then 1 m height

• Rivers
  – Large river 3 km, other river 1,5 km

• Sensitive areas
  – Coral reef 300 m away
Criteria for mariculture park - depth
Criteria for mariculture park
Criteria for mariculture park - waves
Criteria for mariculture park - rivers
Criteria for mariculture park - corals
GIS result
Environmental impact
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Environmental impact
Nutrient balance
Inputs, uptake and outputs

Less than 30% of inputs are retained by the fish. The remainder go into the environment.
Impact on the sediments

- Sustainable levels – slight build up of organic layer on the seabed
- Unsustainable level - Build up of thick organic layer on the sea bed
- Smothering of seagrass
- Smothering of corals
Impact on water column

- Increasing nutrient concentration in the water
- Sustainable levels lead to algae production – zooplankton production – increased wild fishery production
- Unsustainable levels leads to high algae production – algal bloom – algae die off – low/no oxygen – fish kill
Environmental survey - Sual
Natural sediment

Heavily impacted sediment
Corer 800 m from cage no black layer
Corer at cage 20 cm black layer
Cumulative impact

- Increasing disease problems
- Lower survival
- Poor food conversion rate

Often blame

- Poor fry quality
- Poor food quality

But the problem is usually high environmental impact
Monitoring – Sediment and Water

Monitoring of the MP is necessary

• To check the level of impact on the environment
• Check if the impact is getting worse, staying the same or getting better
• Early warning of future problems
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Estimation of carrying capacity
Carrying capacity

How much production is sustainable on the long term so that it does not over impact the environment or increase the risk of fish kills?

Depends on

• Level of production
• Food conversion rate
• Water exchange rate – flushing
Carrying capacity factors

Other nutrient inputs

- Rivers
- Agricultural run-off
- Livestock production
  - Pig pens along the river
Modelling carrying capacity
TROPOMOD predicted flux (deposition) of waste feed and faeces for Panabo.

The colours show different amounts of flux.

Model predictions - Panabo

Flux (g m⁻² d⁻¹)

- Benthic Community
  - Severe impact (no animals)
    - 150
  - High impact
    - 75
  - Moderate impact
    - 15

Higher flux and predicted impact in the inshore areas.
Nutrient build up in an aquaculture zone

- High residence time, low flushing
- Low residence time, high flushing

Residence time

Refreshment

Nutrient levels

Eutrophic
Bathymetry
Other factors

- Good site selection
- Water depth
- Extractive species
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Integrated Multi-trophic Aquaculture
Theory

• Fed species
• 70% of feed nutrients are released to the environment
• Nutrients > Algae > Plankton > Fish
• Extractive species can capture some of these excess nutrients
• Nutrients extracted directly by algae
• Algae and zooplankton by molluscs (oysters, pearl oysters)
• Zooplankton by fish
Integrated Multi-trophic Aquaculture

- Developing Integrated Multitrophic Aquaculture practice into Mariculture Parks
IMTA

- Fish
- Molluscs
- Seaweed
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Socio-economic factors
SOEOECONOMIC FRAMEWORK - ADVANTAGES & BENEFITS

UPSTREAM OPPORTUNITIES / ACTIVITIES:
• Feeds Suppliers; Fry / Fingerlings Suppliers
• Development of Fish Hatcheries/Fish Nurseries
• Sellers/Suppliers of Bamboos, Nets, Ropes, Twines, boat makers
• Create employment (support staff)

DOWNSTREAM OPPORTUNITIES / ACTIVITIES:
• Fish Traders, Fish Vendors
• Fish Processors; Ice Sellers
• Transport rentals
• Marketing channels and locations

EFFECTS / DIRECT BENEFITS:
• Create employment opportunities to local communities; Livelihoods
• Incremental change of income for marginal fishing families – as caretakers, harvesters, cage makers, feeders, cage repairers, security guards, net washers, etc.
• Opportunity for cage workers to organize and unify into an alliance – strong support group to LGUs & MPs

PERIPHERAL EFFECTS / INDIRECT BENEFITS:
• Establishments of General Merchandise (sari-sari) Stores; Bakeshops
• Establishments of coffee shops, restaurants, etc.

ADDITIONAL REVENUE TO LGUs (permitting, licensing system)
SOCIOECONOMIC BENEFITS FROM MARINE PARK:

• Generate employment opportunities to trained local people and to those from outside that deliver the required support services to the MPs

• Opportunity for marginal fishers to organize & unify

• Provide direct benefits to marginal fishing families and community stakeholders (*directly engaged to the MP and those that have availed from government-initiated livelihood projects*)
SOCIOECONOMIC BENEFITS FROM MARINE PARK:

- **Upstream Activities:**
- Opportunities to engage
- fry/fingerlings suppliers & feed suppliers;
- establishments of fish hatcheries & fish nurseries;
- suppliers of bamboos, fish nets, twines, ropes, plastic floaters, fish tubs, etc.
• **Downstream Activities**: Create eventual livelihoods activities to Fish Processors, Fish Traders, Fish Vendors, Ice Sellers, etc.

• **Peripheral Activities**: Establishments of general merchandise stores, *sari-sari* stores, bakeshops, coffee shops, etc., that create strategic spread of additional income and human welfare;

• Also, create an opportunity to have a community-based efforts for a healthy marine resources and contribute to reverse the declining fishery
POSITIVE EFFECTS / IMPACTS:

- Marginal fishing families in the locality have the opportunities to avail government-sponsored training, capacity building to be engaged with MP activities.

- Effects of MP establishments enhanced **Upstream Activities** that also create additional employment to qualified people supporting MPs ongoing activities.

- Effects of MP operations create **Downstream Activities** that provide additional livelihoods opportunities and income to local people.
POSITIVE EFFECTS / IMPACTS:

• Due to increasing purchase power, new **Peripheral Activities** are also established and provide additional income.

• Promotes functional partnerships among LGUs and private investors interested in MPs.

• Develop / strengthen local special bodies (LSB’s) (e.g., Executive Management Council, Marine Park TWG, FARMC’s, Bantay Dagat [seawatch]Task Force).

• Promotes functional partnerships among LGUs and private investors interested in MPs.
POSITIVE EFFECTS / IMPACTS.....continued

• Develops management partnerships among municipal LGUs, between municipal LGUs & provincial LGU, with community stakeholders, concerned NGA’s (DA-BFAR, DENR).... leading to effective and sustainable MP co-management

• Generate revenues to LGUs (e.g., licensing, permitting, penalties (if any), etc.)

• Modeling the way for good local governance practices (e.g., transparency, accountability, participatory, predictability) – enhances sustainable socioeconomic activities
ECONOMIC IMPACT OF MARICULTURE PARK

AquaPark – Norad funded project
I. Economic implications of MPs
   A. For the different types of locators
   B. For the Local Government Units
   C. For BFAR in terms technical and infrastructure support.

II. Impacts of MPs on the economy of the municipality
   A. Job generation
   B. Establishment of infrastructure
   C. Trading/Marketing

III. Cost comparisons
   A. Local and regional market analysis comparisons.
   B. Differences in regional input cost comparisons.
   C. Cost/benefit and breakeven analysis for support infrastructure/technical services
ECONOMIC ASSESSMENT OF THE FOLLOWING:

1. Different aquacultural farming systems in the MPs;
2. LGU and BFAR support for setting up and providing support of the MP
3. Differences in regional input cost comparisons,
4. Cost/benefit and breakeven analysis for support infrastructure
5. Local and regional market analysis comparisons.
ECONOMIC IMPLICATIONS OF MPs

For the different types of locators

A. Marginalized group
   1. Cooperatives
      • Agricultural Cooperatives (Bien coop)- self-finance - 1 unit
      • Agrarian Reform Beneficiaries (DARBCO)- self-finance 1 unit
   2. Women organization(KABIAC)- DIDP funded project 1 unit
   3. Out-of-school Youth (Caretaker’s Assn)- BFAR funded unit
   4. FARMC/Bantay Dagat ------------------ (BFAR funded) unit
   5. Fisherfolk Families and Organization/associations- 10 units (BFAR/LGU financed)
   5. Panabo Coastal Schools-Coastal Resource Management 2 units (CRM)- DepEd/BFAR/LGU funded

➢ Most of the activities of the Marginalized Group will be production of fish for sustenance and for sale to earn money
B. PRIVATE INVESTORS*

1. Small/Medium-scale businessmen (self finance) - 90 units
2. Civic Organization – (group finance) - 8 units
3. Medical practitioners – (self-finance) - 30 units
4. ACES Polytechnic College – (self-finance) - 8 units

• Local and foreign investors
Project Implementation (2006-2010)

Requirements and Procedures for investors to operate marine fish cages

- Letter of Intent
- Application to operate marine fish cage (form at BFAR and LGU)
- Evaluation of applications (TWG-BFAR/LGU)
- Approval of applications (Mayor and BFAR Regional Director) 1-3 days;
- Payment of Permit at LGU Panabo;
- Lease Agreement (LGU/BFAR/Investor)
- Investors meeting (project construction, feed and fingerlings supply arrangement, caretaker, etc);
- Construction (schedule, materials, labor, etc) – 3 days
LOCAL GOVERNMENT UNITS

1. Investment on infrastructure (e.g. roads, markets, etc.,
2. Investment on services
3. Power supply, etc.

GOVERNMENT AGENCIES (BFAR, DAR, DENR, etc.)
1. Technical services
2. Legal services
3. Manpower development

PRIVATE SECTOR
1. Feed companies
2. Fish seed production
3. Laboratory services (fish disease lab, analytical lab, etc.)

*How can these infrastructures and services improve the life of the stakeholders? Are these investments economically viable?
IMPACTS OF MPS ON THE ECONOMY OF THE MUNICIPALITY

1. Job generation
   a. Operations in the MP
   b. Laboratory services of private sector
   c. Marketing of materials needed in the MPs
   d. Sales personnel of feed and seed companies
   e. Food and restaurants
   f. Others

2. Establishment of infrastructure
   a. Power supply (investment from private sector and the LGUs)
   b. Construction of roads, bridges, jetties, etc.
   c. Feed mills for the manufacture of feeds
   d. Others

3. Trading/Marketing
   a. Creation of trading/marketing within the municipality
   b. Others
### Table 1. Results of Financial Analysis in PCMP

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Less than 10 Cages</th>
<th>10-20 cages</th>
<th>More than 20 Cages</th>
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</thead>
<tbody>
<tr>
<td>Average Fixed Expenses (% of sales)</td>
<td>24%</td>
<td>17%</td>
<td>17%</td>
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<tr>
<td>Average Variable Expenses (% of sales)</td>
<td>50%</td>
<td>26%</td>
<td>29%</td>
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<tr>
<td>Average Other Operating Expenses (% sales)</td>
<td>6%</td>
<td>14%</td>
<td>5%</td>
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<tr>
<td>Recovery from Depreciation</td>
<td>(4%)</td>
<td>(3%)</td>
<td>(2%)</td>
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<tr>
<td>Average Net Profit (% of sales)</td>
<td>24%</td>
<td>46%</td>
<td>51%</td>
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<tr>
<td>Average Net Profit Per cage (Php)</td>
<td>185,741</td>
<td>230,507</td>
<td>287,776</td>
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<tr>
<td>Average Return on Investment</td>
<td>72%</td>
<td>117%</td>
<td>112%</td>
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Table 2. Results of Financial Analysis of Grouper Culture in PCM

<table>
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<td>Cages</td>
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<tr>
<td>Average Fixed Expenses (% of sales)</td>
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<tr>
<td>Average Variable Expenses (% of sales)</td>
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<td>Average Other Operating Expenses (% sales)</td>
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<td>Recovery from Depreciation</td>
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<td>Average Net Profit (% of sales)</td>
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<td>Average Net Profit Per cage</td>
<td>(Php)286,363</td>
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<td>Average Return on Investment</td>
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Table 5. Sensitivity of Specialty Products in SMP

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<th>Rate of Increase In Variable Cost Only</th>
<th>Decrease in Net Profit (%)</th>
<th>Resulting Net Profit Margin</th>
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<tbody>
<tr>
<td>Base Case for MILKFISH FRY</td>
<td>18 %</td>
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<tr>
<td>10%</td>
<td>(5%)</td>
<td>13%</td>
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<tr>
<td>20%</td>
<td>(8%)</td>
<td>10%</td>
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<tr>
<td>Rate of Increase in All Costs</td>
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<tr>
<td>Base Case for MILKFISH FRY</td>
<td>18 %</td>
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<tr>
<td>10%</td>
<td>(10%)</td>
<td>8%</td>
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<tr>
<td>Base Case for GROUPER</td>
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<tr>
<td>10%</td>
<td>(7%)</td>
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<td>(2%)</td>
<td>38%</td>
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<td>Rate of Increase in All Costs</td>
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<td>Rate of Increase in All Costs</td>
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<td>Base Case for TIGER LOBSTER</td>
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SALAMAT PO