

# INDONESIAN AQUACULTURE DEVELOPMENT<sup>\*)</sup>

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## 1. CURRENT SITUATION OF AQUACULTURE IN THE NATIONAL ECONOMY

### 1.1 HISTORICAL DEVELOPMENT OF AQUACULTURE IN INDONESIA

Aquaculture is an important component for Indonesian fisheries which contributes to national food security, income and employment generation and foreign exchange earnings. Aquaculture has played its role as an alternative source of income for coastal fishery communities. It has also contributed for reducing the pressure on marine natural resources. Recently, aquaculture development in Indonesia has been accelerated and considered as an important sector for in supporting rural economic development.

Indonesia is an archipelagic countries with a coastline of about 81 000 km, and has a vast potential for aquaculture. At the national level, the extent of areas which are potential for aquaculture is estimated at 15.59 million hectares, composed of 2.23 million hectares of fresh-water bodies, 1.22 million hectares of brackish water areas and 12.14 million hectares of marine areas. To date, only 10.1% of freshwater, 40% of brackish-water and 0.01% of marine areas potentially suitable for aquaculture are in use.

The total national aquaculture production in 2005 was 2.16 million tonnes. Aquaculture and inland water capture fisheries contribute 29.1 percent to the country's total fish production. Total aquaculture production increased by about 20.14 percent per year from 1,076,750 tonnes in 2001 to 2,163,674 tonnes in 2005 as a result of technological innovation, area of expansion and availability of suitable quality of fish seed. Aquaculture is practiced in fresh, brackish and marine waters using a variety of production facilities and methods. Culture systems range from extensive to intensive depending on the seed stocking density, the level of inputs and the degree of management. The significant growth of the aquaculture sector is the result of the high priority given to aquaculture development since the 1980s, and this was in turn triggered by the greater demand for food-fish, especially in the remote hinterlands, and the imposition of a ban on trawl fishing in 1980.

#### 1.1.1. Freshwater Aquaculture Development

Freshwater aquaculture started with the stocking of common carp in backyard ponds in West Java during the Dutch occupation, in the middle of the nineteenth century, and subsequently spread out to other parts of Java, Sumatra and Sulawesi islands in the early twentieth century. However, it was only in the late 1970s that a remarkable increase in production from freshwater aquaculture was observed. This was a result of the introduction of new farming technologies which contributed to the availability of hatchery-produced seed,

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and the development of compound feeds. The most common culture species are common carp (*Cyprinus carpio*), Nile tilapia (*Oreochromis niloticus*) and Gouramy (*Osphronemus goramy*). Common carp is the most dominant species, with production comprising 3.5 percent of the total freshwater aquaculture output. The rapid increase in the importance of common carp followed the development of floating cage culture in the Citarum river system where a series of reservoirs is located. Nile tilapia, which was first introduced in Indonesia in 1969, is becoming important. The culture of ornamental freshwater fish has also been expanding, triggered by huge export demand and strong government support. With the outbreak of KHV (Koi herpes virus) disease affecting carp farming, many common carp hatchery, nursery and grow-out farmers and operators have been shifting to the production of ornamental fish species for the export market.

### **1.1.2. Brackishwater Aquaculture Development**

Culture of fish in brackishwater ponds, mostly on Java Island, is an ancient tradition in Indonesia which has been practiced on a subsistence basis for more than 400 years. In 1978, brackishwater pond areas increased significantly with the successful development of the eyestalk ablation technique and the rapid growth of shrimp hatcheries. Brackishwater pond areas were significantly expanded by the private sector in South Sumatera and Lampung Provinces to develop large-scale pond culture using the Nucleus Estate System. Milkfish (*Chanos chanos*) and mullet (*Mugil spp.*) were the traditional species reared. In terms of value, shrimps are the prime commodity, contributing 80 percent to total brackishwater value. However, due to outbreaks of white spot virus, which resulted in mass mortalities in ponds, particularly on tiger shrimp. To compensate for the drop production, *Penaeus vannamei* and *Penaeus stylirostris*, which are more resistant to certain disease than the tiger shrimp, were introduced by the Government and are now successfully cultured in East Java, Lampung and Bali.

### **1.1.3. Mariculture Development**

Mariculture commodity cultured in Indonesia are varies. For example finfish (seabass, groupers and snappers), shellfish, seaweeds and other species, including sea cucumber. Mariculture production of 890,074 tonnes in 2005 (DGA, 2006), are highly valued and command good prices on the export market.

## **1.2 AQUACULTURE STRUCTURE AND PRODUCTION**

The natural environmental conditions in Indonesia are very conducive to the development of aquaculture. Extending from Sabang to Merauke, intersected by the equator, Indonesia is blessed with a territory whose geophysical diversity is conducive to aquaculture. The relatively stable water temperature typical of tropical areas enables aquaculture to be carried out throughout the year. The varied typology of the land and coastal areas enables

the development of a wide variety of aquaculture commodities. Some areas which have a climate with low precipitation, long hours of sunlight and high light intensity, usually characterised by barren lands, are actually particularly suitable for fish seed production. Groups of small islands around larger islands can provide shelter from waves and be used as havens for the development of aquaculture.

The geographical position of Indonesia gives a comparative advantage, through being relatively close to the world market. At the present time there are four major markets for fisheries products which are China, Japan, the United States of America and the European Union. Two of these are located in the Asia-Pacific, close to Indonesia. The main markets for fisheries products in Asia are China and Japan. The development of newly industrialised nations in Asia such as South Korea, China/Hong Kong, Taiwan, Thailand, Singapore and Malaysia offer market opportunities for fishery products from Indonesia, and at the same time offer opportunities for Indonesia to develop her fisheries industry.

Extensive human resources, in terms of numbers, are available to support the development of aquaculture businesses using low-cost manual processes. From a cultural perspective, Indonesian communities have traditionally earned a living from farming (agrarian) for generations, and are not unused to the husbandry of plants and animals. These farming activities and the associated cultural habits have become part of their way of life for a large proportion of the Indonesian population, so that when people change to aquaculture as a livelihood option, it does not usually take very long for them to adapt.

### **1.2.1. Aquaculture Potential Areas**

With a coastline of around 81,000 km, Indonesia has extensive potential for mariculture development, although this potential is variable and unevenly spread across the Provinces. In Western Indonesia, rainfall in coastal zones is high, and the estuaries of many major rivers tend to carry heavy suspended sediment loads which result in muddy substrates, while the seabed tends to be formed of shallow continental shelves which provide potential locations for the culture of greasy grouper (*Epinephalus tauvina*), barramundi (*Lates calcarifer*) and shellfish. In Eastern Indonesia, especially in Sulawesi, Bali, Nusa Tenggara, Maluku and Papua, the extensive coral reefs and clear waters have potential for developing the culture of seaweed, abalone, reef-associated fish and pearl oysters. In parts of the coastal waters of Sulawesi, Nusa Tenggara, Papua and Maluku, where the substrate is formed of sand and silt, and there are no major estuaries, there is great potential for developing seaweed and sea-cucumber (*teripang*) farming. Based on research by the Directorate General of Aquaculture in the year 2004, it is estimated that Indonesia possesses an indicative potential of 8.4 million hectares in extent, of which 3.8 million hectares are considered to have effective potential for development as mariculture areas as shown in Table 1.

**Table 1 . Extent of Potential Mariculture Development Areas**

No	Commodity	Potential Extent (Ha)	
		Indicative	Effective
1	Fin Fish	812,000	8,000
2	Seaweed	770,000	385,000
3	Shellfish	4,720,000	2,350,000
4	Sea cucumber	175,000	88,000
5	Pearl Oyster	1,890,000	945,000
<b>Total</b>		<b>8,367,000</b>	<b>3,776,000</b>

*Source : Master Plan Budidaya Laut,2004*

The extent of areas with potential for brackishwater potential is calculated based on technical suitability criteria and areas which are already in use for brackishwater aquaculture. Based on research by the Directorate General for Aquaculture in the year 2003, the total potential area is 1.2 million hectares, composed of 450,000 hectares which are already in use and 774,000 hectares which are available for development (Table 2)

**Table 2. Extent of Potential Brackishwater Pond Areas**

No	Island	Area (hectares)		
		In Use	Undeveloped	Total Potential
1	Sumatra	104,000	325,000	429,000
2	Java	151,000	16,000	167,000
3	Nusa Tenggara	31,000	33,000	64,000
4	Kalimantan	34,000	253,000	287,000
5	Sulawesi	124,000	124,000	248,000
6	Maluku	5,000	19,000	24,000
7	Papua	1,000	5,000	6,000
<b>Total</b>		<b>450,000</b>	<b>775,000</b>	<b>1,225,000</b>

*Source : Master Pengembangan Budidaya Air Payau di Indonesia, 2003*

The potential areas for freshwater aquaculture (Table 3) consist of freshwater ponds, paddy fields (combined fish/rice farming) and publicly owned fresh water bodies (public waters). The potential area for pond culture is calculated based on the area of land which receives water from technical irrigation systems. Based on the use of around 20% of this irrigation water for freshwater pond aquaculture, the potential area is 526,400 hectares. The greatest extent of freshwater pond development is in East Java with 92,400 hectares, followed by Central Java with 83,000 hectares. In Eastern Indonesia,

the greatest potential for freshwater pond aquaculture is in South Sulawesi with 34,800 hectares.

The potential for aquaculture in public waters includes floating cage and fixed cage culture. The publicly owned freshwater bodies considered appropriate for aquaculture include rivers, marshes, lakes, reservoirs and others. Aquaculture activities which are carried out in these public waters must be environmentally benign, productive and take into account other uses of these common water resources. Based on these considerations, it is estimated that around 1.5% of the total extent of public waters in Indonesia are suitable for the development of aquaculture activities, which is 158,200 hectares.

**Table 3. Extent of Potential Freshwater Aquaculture Areas**

No	Type of Aquaculture	Potential Extent (Ha)
1	Freshwater ponds	526,400
2	Public waters	158,200
3	Paddy fields	1,545,900
<b>Total</b>		<b>2,230,500</b>

*Source : Hasil Survey Ditjen Perikanan, 1998*

### 1.2.2. Aquaculture Production

Aquaculture production increased from 1,076,750 tonnes in the year 2001 to 2,163,674 tonnes in 2005 or in other words experienced a growth rate of 20.14 %, which is higher than over the period 1995-1999 when the growth rate was only 4.95 %. The dominant commodity which has undergone a relatively steep increase is shrimp, a production of 143,750 tonnes in the year 2000 which rose to 279,375 tonnes in 2005.

The value of aquaculture production rose from IDR 12.36 trillion in the year 2001 to IDR 21.45 trillion in 2005, an average increase of 14.85% per year. The highest average annual growth rate in terms of value was 32.94%, in fixed cage culture.

In addition to consumption to meet in-country demand, fisheries produce is also marketed abroad (exported) in ever increasing quantities. Several major fisheries export commodities include shrimp/prawn, grouper, tilapia, seaweed, shellfish, crabs, frogs, ornamental fish and pearls. Other aquaculture commodities which enter the export market and have good market prospects include pangasius, cat fish, milkfish, gouramy, and abalone.

Over the period 2000-2004 the growth rate in Indonesian fisheries produce exports was quite fast. In the year 2000, the volume of Indonesian fisheries exports was 519,415 tonnes with a value of US\$ 1.67 billion, which

rose to 902,358 tonnes with a value of US\$ 1.78 billion, which equates to an average yearly increase of 16.69 % in volume and 1.67 % in value.

The growth in fisheries exports, especially in terms of volume, is still dominated by the two commodities shrimp/prawn and tuna/mackerel. In the year 2000, the shrimp/prawn export volume from Indonesia was 116,187 tonnes which had risen to 139,450 tonnes by 2004. Although the export value of prawn/shrimp fell continuously from 2000 to 2002, there was an upward turn and positive growth in 2003 - 2004.

Conversely, over the same period, there was a reduction in import of fisheries products into Indonesia, especially fish meal. A number of edible products such as agar-agar and tinned fish still dominate Indonesian fisheries product imports. In the year 2000, imports of these commodities was 179,463 tonnes with a value of US\$ 111.48 million, and in 2004 the volume of imports was 136,040 tonnes, with a value of US\$ 154.03 million. This means that over the period 2000-2004 average imports of edible fisheries commodities fell by 5 % in terms of volume but increased by 12.51 % in terms of value.

Over the period 2000-2004 the number of fish farmers (aquaculturists) rose on average by 3.43 % per year. The number of fish farmers rose from 2.19 million in the year 2001 to 2.51 million people by 2005. The increases achieved to date in aquaculture production have already contributed to an increase in per capita consumption of fish which rose from 22.47 kg per capita in the year 2001 to 22.67 kg per capita in 2005.

### **1.3 MAJOR PRODUCTION ORGANIZATION**

Most fish products, whether fresh or processed are distributed through the traditional marketing system and usually end up in the domestic market and dominate in the rural areas. Producers for export have functional links to large-scale, industrial-type seafood companies which operate under a vertical integration of sales, with all activities handled by the companies. Shrimp companies operate under a nucleus estate scheme, with joint venture agreements with fish farmers whose produce is purchased by the companies for export.

In the traditional fish marketing system, fish products change hands several times until the point of last sale. A lot of people are involved in the purchase and distribution, from fresh fish, to processed fish products, to the retailer. In the remote areas, access to fresh fish distribution channels is limited, so fish is marketed in some processed form, for example traditional salting and sun-drying or boiling in water with large quantities of salt.

In most cases, small fish farmers do not have access to a wide range of possible buyers and processing opportunities. Private traders, collectors or agents market most of the aquaculture products, including fish fry or fingerlings,

with little involvement of women in processing. Local collectors have been playing the role of marketing from production site to processing plants and supermarkets; village-based collectors who usually belong to the village themselves work as local agents who supply fish as raw material to regional collectors. The latter usually provide loans to the processing unit to pay for the raw materials, or extend small-scale credit, or advance money to small farmers to ensure that they sell to them.

In most district capitals, there are public markets with areas specifically designated for fish. The fish retailers usually sell their products to the market. In the big cities, the public markets cater to the day-to-day needs of the public for seafood, particularly for the middle- to low-income consumers. Modern supermarket chains have been established throughout the cities and are mostly for the middle-to high-income classes. There are concerns regarding hygiene and sanitation in the fresh or wet supply of fish.

#### **1.4 GOVERNMENT ORGANIZATION AND SUPPORT SERVICES FOR AQUACULTURE**

The Ministry of Marine Affairs and Fisheries (MMAF or *Departemen Kelautan dan Perikanan*) is the principal agency responsible for marine and fisheries sector planning, management and administration in Indonesia. The Ministry comprised of: (i) five Directorate Generals - of Aquaculture; Capture Fisheries; Marine, Coastal and Small Islands; Marine and Fisheries Resource Controls; and Capacity Building and Marketing; (ii) two Agency for Marine Affairs and Fisheries Research; and Human Resource Development, (iii) Secretariat General, (iv) Inspectorate General, and (iii) Advisory Staffs providing expertise to the Minister in specific fields.

Responsibility for local-level marine fisheries management rests with the Provincial Marine and Fisheries Service (*Dinas Kelautan dan Perikanan Propinsi*) which has offices at province, district and sub-district levels. With the adoption of Law No. 22/1999, the Provincial Marine and Fisheries Services have been given more responsibilities as well as greater autonomy in carrying out their functions, being no longer under the technical supervision of the MMAF.

Many types of organization play an important role in the successful development of the aquaculture sector in Indonesia, such as policy-making institutions, institutions producing technological advances (research and development), institutions involved in the dissemination of technology (extension), organizations which apply these technologies (fish-farmer groups) and service-providing institutions (financing, processing, marketing, peer-group associations related to the fisheries sector and others). The Directorate General for Aquaculture is the government policy-making institution for the development of aquaculture in Indonesia, under the coordination of the Ministry of Marine and Fisheries. Whereas at the Provincial and District/City levels, aquaculture

development policy is in the hands of the Fisheries and Marine Services of the Provinces and Districts/Municipalities concerned.

In policy-making regarding technical matters, the Directorate General for Aquaculture is supported by 12 Technical Implementation Units (UPT) which are distributed across the Indonesian territory. The main function of these UPT units is to produce appropriate technological packages within their respective fields of expertise, comprises of 4 units of Freshwater Aquaculture Development Centre in Jambi, Sukabumi, Mandiangin and Tatelu; 4 units of Marine Culture Development Centre in Batam, Lampung, Ambon, and Mataram; and 4 units of Brackishwater Aquaculture Development Centre in Aceh, Jepara, Takalar and Situbondo. These UPT together with the local technical implementation units (UPTD) operated by the Fisheries and Marine Services at Provincial/District/City level are responsible on disseminating these appropriate technologies to the communities surrounding their work zones. The number and type of UPTD are shown in Table 4.

Table 4. Type and Number of UPTD

No.	Type of Institution	Number of units	Status
1	Central Hatchery	30	Local Government UPT
2	Coastal Hatchery	23	Local Government UPT
3	Local Hatchery	422	Local Government UPT
4	Penaeid Shrimp Hatchery	25	Local Government UPT
5	Freshwater Prawn Hatchery	7	Local Government UPT
6	Fish Health Laboratories	109	Pusat & Daerah

Recently, the institutional aspects of extension services, which play a vital role in the dissemination aquaculture technology, have not functioned properly, as a result the flow of aquaculture technology related information from the UPT to the farmers is often interrupted. One reason for this is the fact that since the Directorate General of Fisheries became a part of the Marine and Fisheries Department, the extension network which was previously polyvalent, serving both agriculture and fisheries, has become less effective in providing fisheries extension services. Because of this, UPT and UPTD in addition to developing technology can now also serve as extension institutions. The institutional development of existing farmer groups is needed in order to raise their function in the facilitation of extension activities, business counselling/guidance and provision of training which are aimed at building the capacity of the farmers. The organisation of these groups is not only relevant to fish-farming activities but also within the field of small-scale fish/prawn seed production, including community hatcheries (UPR) and back-yard hatcheries (HSRT). In addition to the organisation of fish-farmer groups, a number of Development Service Units (UPP) have been set up in several districts and municipalities, in which the fish-

farmer groups in the district/ municipalities area, representatives from the relevant Government Services (Dinas) and technical extension officers are the principle members. UPP has responsibilities for providing services to the membership, for example in the procurement and distribution of production equipment and supplies, the arrangement and channelling of finance, and providing advice and guidance to fish farmers group members.

Existing professional and commercial societies and associations which play a key role as partners with the government and entrepreneurs in the field of aquaculture include (1) *Masyarakat Perikanan Nusantara (MPN)*, Indonesian Fisheries Society (2) *Masyarakat Akuakultur Indonesia (MAI)*, Indonesian Aquaculture Society (3) *Komisi Udang Indonesia (KUI)*, Indonesian Shrimp Commission (4) Shrimp Club Indonesia (SCI), (5) *Gabungan Pengusaha Perikanan Indonesia (Gappindo)*, Fisheries Entrepreneur Association along with all the Associations under its auspices such (a) *Asosiasi Rumput Laut Indonesia (ARLI)*, the Indonesian Seaweed association; (b) *Asosiasi Pengusaha Cold Storage Indonesia (APCI)*, the Indonesian Cold Storage Association and (c) *Asosiasi Pengusaha Pakan Udang Indonesia (APPUI)* The Indonesian Association of Shrimp Feed Producers.

## **1.5 LEGAL FRAMEWORK FOR AQUACULTURE**

Regulation is in the form of legislation which is directed towards the implementation of the aquaculture development, with priority given to regulating the management of activities which involve all stakeholders. Fields in which legislation has or will be passed in the framework of implementing the revitalisation programme include the following:

### **1. Creating a conducive business environment**

- a. Government Regulation Number 54 of the year 2003 regarding Fisheries Enterprises, in which the issuing of business licenses for aquaculture enterprises has already been transferred to the decentralised Governments with the goal of expediting the process of investment in aquaculture at the local level. The Central Government only issues business licenses for foreign investment (PMA).
- b. In keeping with the delegation of the above-mentioned authority to issue licenses, the Government has also promulgated Ordinance Number 32 of the year 2004, regarding Local Government. In the aforesaid Ordinance, management of coastal waters up to 12 nautical miles from land is undertaken by local governments. In addition, spatial planning within their respective administrative territories is also regulated by the local governments.

### **2. Establishing rules and regulations for the standardisation of aquaculture activities and fisheries products.**

- a. In order to make possible the implementation of a responsible and sustainable aquaculture system, a set of Directives (*Pedoman Umum - Pedum*) has been issued covering proper procedures for brackish water shrimp culture and fish culture in reservoirs. In addition Implementation Guidelines (*Petunjuk Pelaksanaan - Juklak*) and Technical Guidelines related to environmentally friendly aquaculture have been issued, in particular for grouper farming, seaweed farming and freshwater aquaculture.
  - b. Within the framework of implementation of a fisheries product quality control system, the Ministerial Decree Number KEP.01/MEN/2002 has been issued, which addresses quality control management systems for regulating the handling of aquaculture produce throughout processing to ensure finished products which meet the standards of hygiene and sanitation rules and regulations for human consumption.
3. Regulation of Seed Production  
In order to promote the availability of seed of the vaname strain shrimp to fulfil the needs of implementing the revitalisation programme, the Ministerial Decree Number KEP. 41/MEN/2001 has been issued to regulate the entry, procurement and distribution of broodstock of this prawn variety.
  4. To ensure the continuity of fish culture, a regulation has been issued which addresses the export of milkfish fry from the Republic of Indonesia (Ministerial Decree Number KEP.04/MEN/2003), with the goal of ensuring that in-country needs are continuously fulfilled.
  5. Management of fish and environmental health  
The Ministerial Decree Number KEP.28/MEN/2002 regarding the establishment of areas affected by epidemic disease was issued to prevent the spread of the epidemic disease koi herpes virus which affects carp species. In addition, the Ministerial Decree Number KEP. 26/MEN/2002 regulates the procurement, supply, distribution, use and surveillance of medicines and other chemicals related to fish health. General guidelines (*Pedoman Umum*) to support the implementation of the aforesaid Ministerial Decree have already been published, so that aquaculturists can adopt the proper procedures for storing and using these products.
  6. Capacity Building of Aquaculture (Fish farmer) Groups  
Regulations related to promoting capacity building of fish farmer groups include Ministerial Decree KEP.40/MEN/2003 regarding small-scale and large-scale fisheries enterprises (companies), the General guidelines (*Pedum*) for Development Service Units (*Unit Pelayanan Pengembangan - UPP*), and the General guidelines (*Pedum*) regarding Technical Support Officers (*Tenaga Teknis Pendamping - TPT*).

List of legislation on aquaculture development is described in Appendix 1.

## 2. TECHNOLOGICAL DEVELOPMENTS IN FISH FARM MANAGEMENT AND PRODUCTION OF SAFE AQUACULTURE FOODS

### 2.1 TECHNOLOGICAL DEVELOPMENTS IN FISH FARM MANAGEMENT

Given the high potential in terms of areas where it can be cultured, the government is committed to promoting the production of shrimp, as it has high economic value and competitiveness in the world market. Technology used for tiger shrimp culture consists of low (extensive), middle (semi-intensive) and high (intensive) levels, according to differences in among others, pond construction, density, water and feeding management.

Pond culture is usually done traditionally, in backyards or nearby ponds. With a size of around 1 000 m<sup>2</sup>, 5-10 pieces/m<sup>2</sup> fish density, 8-12 cm size of seed, and 3-4 months culture period, the pond shows an 80 percent survival rate, 1.2 feed conversion ratio and 2 tonnes/crop production with a size of 250-300 g/piece. Since 1960, the running water system, adopted from Japan, has been developed in Indonesia. Generally, in this system, the concrete pond is square or trilateral in form, with sizes of 50-100 m<sup>2</sup>/unit, and 100 g seed density of 5-10 pieces/m<sup>2</sup>. Common carp is the main commodity, and production is about 1 tonnes/unit/crop, or more.

Cage culture is a more commercial effort and a main livelihood for those involved in it. In the rivers or canals which are generally found in Java, the size of the cage is about 4x2x1 m/unit, while in Sumatra and Kalimantan, the size is larger, at 4x2x2 m/unit. Floating net cage culture has been developed in lakes and reservoirs. The cages are put down adrift in territorial water using a construction of bamboo or iron bars, and a net is bound to form a floating cage containing drums/containers/styrofoam. The cage is made from polyethylene net with a size of 4 units of 7x7x2.5 m/unit, a density of 50-70 pieces/m<sup>3</sup> and seed size of 30-50 g/piece. After 3-4 months, the production is 5-6 tonnes/unit/crop.

Rice-fish culture involves establishing a nursery of seed, before these are cultured in cages or floating net cages. Culture species vary according to the requirement of fish farmers, i.e. common carp, java carp, spotted gouramy, even tilapias, and the rearing period is 30 days. Rice-fish culture is differentiated into three types: 'Penyelang' (before paddy planting), 'Tumpang Sari' (at the same time as paddy planting) and 'Palawija' (between 2 seasons of paddy planting).

Mariculture is generally done by using rafts or cages to culture either fish or seaweed. The cages are constructed as square cages 8x8 m in size, consisting of 4 units of 3x3x3 m each. The cage frames are made using bamboo, wood, steel or plastic pipes, and are equipped with floats. The fish species commonly grown are brown-marbled grouper (*Epinephelus fuscoguttatus*) and humpback grouper (*Cromileptes altivelis*). For brown-marbled grouper, seed density is 150-200 pieces/m<sup>3</sup> at 5-25 g size. After 7 months, the fish achieves 95 percent

survival, production of 1 000 kg/cage/cycle with a harvest size of 400-500 g. For humpback grouper, with the same density and seed size, after a 12-month culture period, the fish gains 90 percent survival and production of 1 000 kg/raft/cycle, with 400-500 g harvest size.

Seaweed culture is usually done by four methods, i.e. free base method applied in sandy base territorial areas or sandy mud, floating method (rafting) in composite territorial and wavy areas, longline method which is the most common due to its greater durability and easy availability of appliances and materials, and a combination of floating and longline methods. Each application depends on the condition of the territorial water where the culture is practiced.

## **2.2 TECHNOLOGICAL DEVELOPMENTS IN PRODUCTION OF SAFE AQUACULTURE FOODS**

Indonesia is attempting to introduce quality system certification procedures to certify that aquaculture products are safe to consume and farmed in accordance with certain standard. Also already has been implementing certification quality system to asses compliance to the standard and to certify farms. The quality system encompasses some aspect such as technical (Good Aquaculture Practices and biosecurity Implementation), management, food safety, social and environmental responsibility. Quality System Implementation have been develop for shrimp and other aquatic comodities such as tilapias, catfish, gouramy etc. The certification quality system is still voluntary practices in Indonesia as farmers should be supported and facilitated to implement quality system suited to local conditions. This support is needed, particularly, for the small-scale aquaculture farming sector, many of whom may face considerable constraints including technical, financial, knowledge etc.

Indonesia has applied better management practices in environmental management of aquaculture start from license application, farming and post harvest handling. In shrimp culture business, Ministry of Marine Affairs and Fisheries had released shrimp culture business in tambak regulation through KEP.28/MEN/2004, for :

- Using suitable technical and lawland aspect for shrimpculture area;
- Good applied strategies in for stocking;
- Using certified shrimp post larva for farming;
- Sterilized shrimp farm water system applied;
- Using registered and certified of all inputs shrimp farm production;
- Avoid to use antibiotic and prohibited chemical;
- Applied biosecurity.

### 3. EMERGING NEEDS AND FUTURE DIRECTION

The financial requirements for the Revitalisation of Aquaculture Development (RPPB) up to the year 2009 is IDR 13.41 trillion, consisting of Government Capital Investment and Business Finance of IDR 3.06 trillion and IDR 10.35 trillion respectively. The government investment capital will be used for repairing and building aquaculture infrastructure. The business finance component will comprise IDR 2.92 trillion in capital investment and IDR 7.43 trillion in working capital and will be sourced from government funds, private sector and personal funds, the banking sector and other sources of finance.

Out of the total IDR 10.35 trillion of business finance required, IDR 9.70 trillion will be used for financing small-scale farming activities and IDR 656 billion will be allocated for large-scale businesses specifically for black tiger prawn and vaname shrimp farming using intensive technology. The business finance requirements are shown by commodity and scale in Table 5.

**Table 5. Business Finance Requirements by Commodity and Scale**

No.	Commodity	Scale of Enterprise (Rp. million)		
		Small	Large	Total
1	Shrimp/ Prawn	3.539.930	656.550	4.196.480
2	Seaweed	237.127		237.127
3	Tilapia	2.043.563		2.043.563
4	Catfish	683.626		683.626
5	Pangasius	938.839		938.839
6	Gouramy	324.949		324.949
7	Grouper	1.299.480		1.299.480
8	Milkfish	166.677		166.677
9	Ornamental Fish	178.583		178.583
10	Abalone	286.563		286.563
<b>Total</b>		<b>9.699.337</b>	<b>656.550</b>	<b>10.355.887</b>

**Rp = IDR**

From Table 5 above, the financial support for enterprise under the revitalisation strategy needs to be focused towards building the capacity of small-scale enterprises. Because the level of government financial support is still relatively low and in general aquaculture is a profitable business activity which can quickly become profitable, these activities are suitable for financing by the banking sector.

The government investment of IDR 3.06 trillion will be used for the following activities: (1) the rehabilitation of community-owned brackish-water pond irrigation systems covering and area of 18,751 hectares, (2) the optimisation of

168 government freshwater local hatchery units, (3) the optimisation of 15 fish and environmental health laboratories, (4) the development of mariculture areas covering 36,450 hectares, (5) the development of brackish water aquaculture over 72,600 hectares, (6) the development of freshwater aquaculture over 31,375 Ha, (7) **Operational task forces (SATGAS)**, (8) the establishment of 640 Development Service Units (UPP), (9) extension/outreach by 660 Technical Extension Officers (TPT) and (10) stimulation through working capital for 1000 of small scale hatcheries. The required government investment is set out in more detail in Table. 10.2.

**Table 10.2. Required Government Investment (IDR Billion)**

No.	Target/Activity	2006	2007	2008	2009	Total
<b>Government Capital Investment</b>						
1	Rehabilitation of <i>tambak</i> irrigation systems	95.00				95.00
2	Hatchery Optimisation	42.00	42.00	42.00	42.00	168.00
3	Fish and Environmental Health laboratory Optimisation	4.75	4.75	4.75	4.75	19.00
4	Development of Seaweed Farming Areas	51.95	99.30	194.00	383.40	728.65
5	Development of brackish water farming areas	61.69	105.28	192.46	366.82	726.25
6	Development of freshwater farming areas	87.05	169.50	334.40	664.20	1,255.15
7	Operational Task Forces (SATGAS)	5.00	5.00	5.00	5.00	20.00
8	Establishment of Development Service Centres (UPP)	2.00	2.00	2.00	2.00	8.00
9	Technical Extension Officers (TPT)	5.00	5.00	5.00	5.00	20.00
10	Working Capital Stimulus for Community and Backyard Hatcheries (UPR & HSRT)	6.00	6.00	6.00	6.00	24.00
<b>Sub Total</b>		<b>360.44</b>	<b>438.83</b>	<b>785.61</b>	<b>1,479.17</b>	<b>3,064.05</b>
<b>Business finance Requirements</b>						
1	National Budget	53.32	68.34	78.71	110.30	<b>310.68</b>
2	Local Government Budgets	35.55	45.56	52.48	73.53	<b>207.12</b>
3	Private Sector/Community	177.74	227.81	262.38	367.65	<b>1,035.59</b>
4	Banking Sector	1,475.25	1,890.84	2,177.75	3,051.54	<b>8,595.38</b>
5	Other Sources of Finance	35.55	45.56	52.48	73.53	<b>207.12</b>
<b>Sub Total</b>		<b>1,777.41</b>	<b>2,278.12</b>	<b>2,623.80</b>	<b>3,676.55</b>	<b>10,355.88</b>
<b>Total</b>		<b>2,137.85</b>	<b>2,716.95</b>	<b>3,409.41</b>	<b>5,155.72</b>	<b>13,419.93</b>

### **3.1. OPERATIONAL POLICY FOR AQUACULTURE FINANCING**

The operational policy for capital investment and business finance for aquaculture is as follows:

1. Increasing efforts to promote micro, small and medium (UMKM) enterprises in the aquaculture field in order to: (a) provide increased employment in the field of aquaculture; (b) strengthen family businesses and (c) reduce poverty.
2. Promoting the involvement of larger enterprises in the processing sector and in the marketing of fisheries produce, especially for export. This policy is based on the recognition that this type of enterprise requires: (a) substantial investment, (b) specialised knowledge and experience of operating in the international marketplace and (c) capability to apply product standards in compliance with the demand from overseas consumers.
3. Government must create conducive conditions and provide facilitation in order to achieve harmonious and mutually beneficial relationships between farmers and processing companies. This is important because the farmers have to be able to produce aquaculture products within specific qualities and in given quantities on a continuous basis, in line with the demands of the global market.

### **3.2. STRATEGY FOR AQUACULTURE FINANCING**

Based on current conditions and paying attention to developing trends, the strategy which will be followed to revitalisation is as follows:

1. Development of Demonstration Units / field trials as a learning laboratory for fish farmers.
2. Development of partnerships between farmers as the plasma and processors/exporters as the nucleus.
3. Use of funds (financial support) from the National Budget APBN as “security” or collateral, so that the business finance which farmers can obtain is increased.
4. Working with the banking sector to reduce the interest rates charged on loans for aquaculture-related business development.
5. Increase the training of farmers through increases in technical outreach and extension activities to ensure the success of aquaculture revitalisation.
6. Development of aquaculture zones (*kawasan*) in order to facilitate extension/outreach, increase the cost-efficiency of production, processing and marketing, and facilitate environmental management.
7. Increase promotion and investment opportunities through printed and electronic media.
8. Apply standards with the goal of increasing business success.

9. Increase the work effectiveness of technical implementation units (UPT) in perfecting and producing aquaculture technology packages for farmers in order to reduce the likelihood of business failures.
10. Increase the role of Local Government in providing financial assistance to farmers from Local Budget Allocations (APBD).
11. Promote foreign investment to support the types of aquaculture enterprise which cannot be developed by small-scale entrepreneurs, such as the establishment of processing plant for fisheries produce which can provide added value and improve market access both in-country and abroad.
12. Provide incentives for investors who make capital investments in the aquaculture sector.
13. Increase the organisational capacity of Development Service Units (UPP) as a first step towards the incorporation of aquaculture activities in rural areas.

### **3.3. ACTION PLAN FOR AQUACULTURE FINANCING**

In order for this revitalisation programme to work as intended, efforts must be made to ensure the necessary finance is made available. The steps to be taken in this regard include:

1. Developing working partnerships with banking institutions;
2. Improving the budgeting structure from Province to District/City;
3. Implementing the partnership concept between parties from the centre and from the regions;
4. Promote fish-farmer friendly banking regulations

## **4. STRATEGY DEVELOPMENT**

Based on the existing conditions in terms of natural potential and diversification, the opportunities and constraints to be faced now and into the future, the Vision for the Development of Aquaculture is to shape Indonesian **AQUACULTURE as a COMPETITIVE and SUSTAINABLE MAINSTAY of ECONOMIC GROWTH.**

In order to achieve this development vision, the three-pronged aquaculture development mission to be carried out is : (1) to create business opportunities and provide employment; (2) to produce quality fish/fishery produce efficiently; and (3) to develop an aquaculture sector which is responsible and environmentally friendly.

In line with the Vision and Mission above, three development goals have been set for the aquaculture sector, which are: (1) to increase foreign exchange, income, and create employment and business opportunities, (2) to improve the

nutritional quality of the nations diet through the consumption of fish and (3) to protect, restore and conserve and fisheries resources.

Three main policies will be followed in order to achieve the goals, undertake the mission and realise the vision for aquaculture development, which are:

1. Increase aquaculture production for export, with especial focus on increasing competitive advantages through the development and application of super efficient and environmentally friendly technology;
2. Development of aquaculture production for in-country consumption, with especial focus on increasing and strengthening the farming of area-specific (local) commodities and improving community-built ponds
3. Establishing mechanisms for controlling the use (exploitation) of aquaculture resources, with especial focus on increasing the attention paid towards the conservation of fish and other aquaculture resources.

The implementation of these three policies will be undertaken through an aquaculture zone (region) approach, which will employ competitive and sustainable business practices and develop a number of strategic commodities. The aquaculture development programme will be carried out through **3 (three) Core Programmes**, which are: the programme for increasing aquaculture production for export (PROPEKAN), the programme for increasing aquaculture production for in-country consumption (PROKSIMAS) and the protection and rehabilitation of aquaculture resources (PROLINDA).

The orientation of the programme for increasing aquaculture production for export (PROPEKAN) is towards the creation of a movement involving all stakeholders, working together to develop aquaculture activities based on partnerships and cooperation between farmers within each zone to increase the productivity and quality of produce through intensification, extensification (increases in farmed area), rehabilitation and the efficient application of sustainable technology for increasing the production of aquaculture commodities destined for export. The choice of commodities to be developed under PROPEKAN is based on 4 (four) criteria, which are : (a) high economic (market) value; (b) well-developed (applied) aquaculture technology; (c) high market demand both abroad and in-country; and (d) suitable for mass participation in farming and development .

The programme for increasing aquaculture production for in-country consumption (PROKSIMAS) is directed towards the development of participatory movements within aquaculture zones, bringing together a number of interested parties in order to develop the farming of food fish through intensification, extensification (increased area), and rehabilitation, and through efficient use of sustainable technology. The chosen commodities were selected based on ease of cultivation, high growth rates, affordability and with priority given to fulfilling the need for in-country consumption.

The programme for the protection and rehabilitation of aquaculture resources (PROLINDA) is focussed on activities for the rehabilitation of aquaculture zones,

to achieve optimum environmental conditions for supporting the development of aquaculture in freshwater, brackishwater and marine environments.

These three core programmes are supported by **6 (six) Support Programmes** which are: (1) the Development of Infrastructure for Aquaculture; (2) The Development of Seed Production Systems ; (3) The Development of Production Systems; (4) The Development of Fish and Environmental Health Management Systems; (5) The Development of Aquaculture Business Systems; and (6) The Development of Administrative and Organisational Systems.

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## Appendix 1.

### Legislation which Supports Revitalisation

No	Type of Legislation	Subject
Ordinances		
1	No. 31 of 2004	Fisheries
2	No. 32 of 2004	Local Government
Government Regulations		
2	No. 54 of 2002	Fisheries Enterprises
Presidential Decree		
3	No. 8 of 1975	Taxation of Fisheries Activities and Taxation of Fisheries Produce for Foreign Investors and Domestic Investors in the Fisheries Sector
4	No. 23 of 1982	Development of Mariculture in Indonesian Waters
Presidential Instructions		
5	No. 2 of 1990	Simplification of the Procedures for Quality Control of Fresh and Frozen Fish
Ministerial Decrees		
6	KEP.33/MEN/2001	Guidelines for the Implementation and Use of Food Security Credit in the Marine and Fisheries Sector
7	KEP.41/MEN/2001	Release of the Vaname Shrimp Variety as a High Quality Variety
8	KEP.01/MEN/2002	Integrated Quality Control System for Fisheries Produce
9	KEP.06/MEN/2002	Rules, Regulations and Procedures for Inspecting the Quality of Fisheries Products entering the Republic of Indonesia.
10	KEP.08/MEN/2002	Establishment and Development of an Information and Management System for the Marine and Fisheries Department
11	KEP.09/MEN/2002	The Intensification of Aquaculture
12	KEP.10/MEN/2002	General Guidelines for Integrated Coastal Management Planning
13	KEP.15/MEN/2002	Release of the Rostris Prawn Variety as a High Quality Variety
14	KEP.18/MEN/2002	Strategic Plan for Marine Development 2000 – 2004
15	KEP.26/MEN/2002	The Procurement, Distribution, Use and Surveillance of Chemicals used in Fisheries
16	KEP.27/MEN/2002	The Establishment of a Fisheries Chemicals Commission
17	KEP.28/MEN/2002	Entry and Exit Ban and Declaration of Java as an Area affected by an Epidemic of Parasitic and Viral Disease of Carp and Koi Carp
18	KEP.40/MEN/2002	Declaration of Java and Bali as Areas Infected with the Herves Viral Disease of Carp and Koi Carp.
19	KEP.41/MEN/2002	The Organisation of Competitions within the scope of the Marine and Fisheries Department aimed at Fish Farmers and Fishers, Fishery Landing Places/Harbours, Fish and Shrimp Hatcheries and technical staff in the Technical

No	Type of Legislation	Subject
		Implementation Units
20	KEP.43/MEN/2002	Changes to the Appendices of the Marine and Fisheries Ministerial Decree No. KEP.06/MEN/2002 regarding the Rules, Regulations and Procedures for Inspecting the Quality of Fisheries Products entering the Republic of Indonesia.
21	KEP.02/MEN/2003	Establishment of the Working Group for Integrated Development of Fishing/Fish Farming Villages Through Cooperation Between Districts 2003
22	KEP.04/MEN/2003	Rules and Regulations for Exporting Nener (Milkfish Seed/Fingerlings) from the Republic of Indonesia
23	KEP.20/MEN/2003	The Classification of Chemicals Used in Fisheries
24	KEP.40/MEN/2003	Small Scale and Large Scale Fisheries Enterprises
25	KEP.42/MEN/2003	Rules and Regulations for the Import of Carrier Media in the Form of Live Fish
26	KEP.43/MEN/2003	Establishment of the Steering Committee for Technical Assistance to The Republic of Indonesia for Sustainable Aquaculture Development
27	KEP.02/MEN/2004	Licensing of Aquaculture Enterprises
28	KEP.07/MEN/2004	Procurement and Distribution of Fish Seed
29	KEP.08/MEN/2004	Procedures for Importing New Fish Species/Varieties into the Territory of The Republic of Indonesia
30	KEP.18/MEN/2004	General Guidelines for The Implementation of Economic Empowerment Programmes for Coastal Communities
31	KEP.21/MEN/2003	Quality Surveillance and Control System for Fisheries Products Destined for the European Union Market

Directives / Technical Guidelines / Implementation Guidelines which Support the Revitalisation of Aquaculture

No	Subject
Directives	
1	Shrimp/Prawn Farming in Brackish Water Ponds (Tambak)
2	Fish Farming in Reservoirs
3	Grouper Farming
4	Seaweed Farming
5	Guidelines for the Establishment and Strengthening of Development Service Units
6	Guidelines for Aquaculture Standardisation Systems
7	General Guidelines and Procedures for Importing and Exporting Fish into and from the Territory of The Republic of Indonesia
8	General Guidelines for Testing Production Equipment and Supplies for use in Seed Production (Hatcheries)
9	General Guidelines for the Establishment of Hatchery Facilities
10	Survey Guidelines for Operations and Maintenance (OP)
11	Data Base Guidelines for Brackish Water Pond Infrastructure

No	Subject
12	Planning Guidelines for Aquaculture Infrastructure
13	Manual for Infrastructure Statistics
Implementation Guidelines	
14	The Intensification of Aquaculture (INBUDKAN)
15	Integrated Fish Farming (BUDINTEG)
16	Implementation Guidelines for the Distribution, Development and Rotation of Revolving Funds for Institutional Strengthening (SE.Dj.PB.5013/DPB.5/HK1500 D5/XII/2004).
17	Shellfish Sanctuaries
18	Culture Based Fisheries
19	Implementation Guidelines for Detail Desain
20	Implementation Guidelines for the Establishment of Coastal Hatchery Facilities
21	Implementation Guidelines for Identifying Aquaculture Infrastructure Development Potential
Technical Guidelines	
22	Tiger Prawn Farming
23	Intensive Milkfish Farming
24	Seaweed Farming in Brackish Water Ponds (Tambak)
25	Bio Security in Shrimp/Prawn Farming
26	Organic Shrimp/Prawn Farming
27	Pangasius (Pangasius Sp) Farming
28	Pangasius Jambal (Pangasius djambal) Farming
29	Cat fish (Clarias Sp) Farming
30	Sangkuriang Cat fish Farming
31	Tilapia (Oreochromis nilotica) Farming
32	Cage Aquaculture
33	Gouramy Farming Leaflet
34	Floating Cage Aquaculture
35	Floating Cage Fish Farming in Ponds
36	Running Water Fish Farming
37	Tilapia Farming Leaflet
38	Gouramy Farming Leaflet
39	Grouper Farming
40	Seaweed Farming
41	Abalone Farming
42	Technical Extension Officers
43	Fisheries Seed Production Sector Standards for Equipment and Supplies, Physical Facilities and Operations for Central Hatcheries (BBIS) and Standards for Equipment and Supplies, Physical Facilities and Operations for Coastal, Fresh and Brackish-Water Fish, Prawn/Shrimp and Central Hatchery Facilities (BBIP, BBI, BBUG, BBIS)
44	DAK (Special Budget Allocation) for Local Hatcheries, Marketing of Fish Seed, Prawn/Shrimp Hatcheries, Irrigation for Aquaculture
45	Fish Seed Surveillance Officers

No	Subject
46	Waste Water Management of Brackish-Water Ponds (Tambak)
47	The Management of Aquaculture Infrastructure
48	Introduction to the Application of Regional Development (SIG)
49	Compilation of The Aquaculture Master Plan
50	Technical Implementation Guidelines for the Development of Aquaculture Infrastructure
51	Applied Management of Hatchery Development