Box 3. Recommendations on Safety at Sea for Small Fishing Boats in Southeast Asian Region

- Develop appropriate incident reporting and investigation systems for the purpose of improving safety at sea, taking into account the following considerations:
  - The draft Guidelines to Competent Authorities in Implementing an Accident Reporting and Analysis System for Small Fishing Vessels currently being developed by FAO;
  - The possible establishment of incentives for fishers, indemnity programs, registration systems for fishing vessels, MCS systems and subsidies to the fishing industry; and
  - The objective of the systems which should be appropriate to the size of vessels and types of fishing operations or facilities onboard.
- Promote the registration of small fishing boats.
- Promote and ensure that safety aspects, including considerations on the working conditions and socio-economic development, are incorporated and addressed by concerned authorities while improving monitoring and control of the status and use of small scale fishing vessels.
- Strengthen local authorities and local organizations and promote the application of safety at sea standards among the coastal communities.
- Promote technical and financial support from authorities, including subsidies, at all levels for issues of safety at sea, including considerations on working conditions and socio-economic development.
- Identify and promote the basic requirements for safety at sea in the following areas:
  - Research on the design and construction of small fishing boats including the modification of traditional types of boats;
  - Safety equipment including fire fighting and live-saving appliances, regular maintenance and repair of boats, gear and equipment; and
  - Development of regular boat inspection systems.
- Implement training and education programs for all stakeholders including the fishers, family members, boat builders and others, for basic requirements of:
  - Boat design and construction;
  - Equipment and its correct use (including avoidance of dangerous fishing practices);
  - Search and rescue operations;
  - Occupational health, working conditions and safety awareness; and
  - Awareness of the environmental factors.
- Promote awareness among policy makers, central authorities and the broader public on the safety hazards facing people involved in fisheries in order to:
  - Attract more attention and resources to be allocated to safety at sea aspects;
  - Provide knowledge on the working conditions and hardships faced by fishers (which are increasing following the impacts of climate change); and
  - Raise political will to address safety at sea and in strengthening the local organizations.
- Develop and promote the use of appropriate communication systems for:
  - Weather forecasting information; and
  - Search and rescue systems.

more challenging appraisal. Aquaculture in the region has undeniably eased the supply and demand gap for fish for domestic consumption, and has also benefited the export sector that revved up economic development in the region. Of the world's aquaculture production of 55 million MT in 2009, about 91% came from Asia, of which 17% was produced by the Southeast Asian countries (SEAFDEC, 2010). While direct engagement in aquaculture is not the only indicator of its contribution to the economic development, aquaculture in the Southeast Asian region is expected to contribute towards the holistic development of rural communities.

5.1 Integrating Aquaculture in Rural Development in Southeast Asia

The incidence of poverty remains high in the rural areas of many Southeast Asian countries (**Table 58**). Thus, most rural development programs are generally envisioned to address poverty, food insecurity, nutritional deficiencies, insufficient livelihood alternatives, limited human skills and environmental degradation that drag economic growth and hinder improvement of the societal welfare in rural communities. Therefore, the role of aquaculture in contributing towards rural development needs critical analysis while relevant strategies for integrating aquaculture in rural development should be determined and implemented.

Considering the scientific and technological breakthrough attained in aquaculture for the past three decades, the sub-sector is being challenged on its role in uplifting the welfare, and in particular, securing food and the livelihoods of rural folks. The most common questions being asked these days are: *Has aquaculture benefited the marginalized fisherfolk who depends on the aquatic resources for their food and livelihood? Are there specific policies that address the issues of environmental degradation and social inequities in rural communities resulting from the rapid development of aquaculture? How is the impact of climate change in rural aquatic communities being addressed by R&D institutions and government policy makers?* Nonetheless, there seems to be more questions than answers considering that data and information remain limited and yet to be organized for most countries in the region.

5.1.1 Aquaculture and Rural Development in Southeast Asia

Why is aquaculture being challenged to pay attention to rural development in Southeast Asia after decades of remarkable production growth rates and profitability? What has transpired in the sector? FAO (2010) noted that the level of development of aquaculture has varied widely across nations, with positive bias towards countries and localities where private entrepreneurs have been successful or where growth was driven by the capital-rich private sector. A review of literature in aquaculture conducted through a commissioned study by FAO in 1997 "Aquaculture Economics in Developing Countries: Regional Assessments and an Annotated Bibliography"

Table 58. Incidence of poverty in selected economies in Southeast Asia, 1997-2002 (%)

Country	Year	Incidence of poverty (%) using national poverty line			
		Total	Urban	Rural	Contribution of rural poverty to total poverty
Cambodia	1999	35.9	18.2	40.1	93.8
Indonesia	2002	18.2	14.5	21.1	70.3
Lao PDR	1997	38.6	26.9	41.0	80.7
Malaysia	1999	7.5	3.4	12.4	69.3
Myanmar	1997	22.9	23.9	22.4	70.4
Philippines	2000	34.0	20.4	47.4	72.4
Thailand	2002	9.8	4.0	12.6	91.3
Vietnam	2002	28.9	6.6	35.6	92.3

Source: *Asian Development Bank (2004)*

(Charles *et al*., 1997) revealed that majority of the studies focused on the evaluation of aquaculture production systems or farm-level economics that aimed to find the most efficient techniques to culture fish. Various culture techniques have been developed and verified either in paddies, fresh and brackishwater ponds, reservoirs, irrigation canals, tanks, cage nets and pens in freshwater and marine water bodies. Various species combination and agri-aquaculture integration have also been studied. The most economically efficient methods under different culture scenarios have been determined and promoted through aggressive extension methods. Credit packages have been offered to national governments down to local entrepreneurs to boost aquaculture investments and development. Rural areas have been host to various aquaculture systems and have witnessed the conversion of its landscape to suit the most technologically suitable and economically viable aquaculture operations.

Despite the increase in world aquaculture production, the benefit distribution from aquaculture was not a prominent consideration in rural development planning not until the onset of the new millennium. The human dimension of aquaculture has since then became a focus of policy and government programs to concurrently address the food security and poverty question more upfront than in previous years. Most governments in Southeast Asia began providing institutional and infrastructure support to rural communities to enable access to resources such as land and water, integration of production systems (fish breeding, nursery and grow-out). Governments in the region also got involved in the development of input markets and post-harvest and value-adding facilities that are accessible for resource poor households in rural areas (Ahmed and Lorica, 2002). The issues of environmental degradation and the resource use conflicts of the late 1980s and early 1990s had governments reviewing their policies and taking steps to address such issues.

Possibly arising from this redirected attention, a more recent study noted some contradictions to what has been suggested in earlier literatures about the inequalities brought about by aquaculture. Irz, *et al*. (2007) noted that aquaculture demands a large number of relatively unskilled labor which in the context of rural communities offer opportunities for employment, either directly or indirectly in fish farming and post-harvest activities. Poor households engaged in aquaculture obtain larger portion of their income from fish farming than the non-poor and those doing other forms of farming. Since aquaculture is suggested to be inequality-reducing, policy-makers and local government units in inland aquatic and coastal communities who aim to counter poverty should give attention to the effects of adopting new policies and aquaculture technologies. Nevertheless, these results could be limited to situations where aquaculture is done without compromising the environment, as this will change the impact of evaluation outcomes.

Furthermore, recent gender studies in the mid-1970s to early 1990s showed evidences aquaculture provided avenues to enhance the role of women in rural areas as owners and managers of aquaculture enterprises as well as active participants in community-management of fishery resources aside from being homemakers. Although issues on environmental degradation and resource use conflicts of the late 1980s and early 1990s had been reviewed by the governments, valuation assessment of natural resources that could influence policies on sustainable use of fishery and aquatic resources in rural setting remain insufficient. Issues on how climate change will impact people and aquaculture in rural development should also be studied, requiring equal attention considering the very fragile but important connections between people and the environment in rural communities.

5.1.2 Integrating Aquaculture in Rural Development: Issues and Opportunities

Expressed in gross domestic product (GDP), the economic growth in Southeast Asia during the past decades has been remarkable, with GDP in 2002 of 4.7% compared to the whole of Asia (3.2%) and the world (2.4%). In 2000-2002, the average contribution of agriculture including fisheries to GDP was 13.8% which was much higher than the whole of Asia (7.9%) and the world (5.1%). Empirical data show that although economic growth reduces poverty, however, poverty still persists in rural Southeast Asia, where about 70-90% of the poor come from the rural areas. Moreover, in most fishing communities in Southeast Asia, the rural poor have limited access to land and water resources, technology, services, capital, markets, and centers of governance.

Aquaculture has big potentials in alleviating poverty and attaining food security, as it can provide food of high nutritional value especially for women and children, livelihood and "own-enterprise" employment opportunities, and incomes from sale of relatively high-value species. The sustained promotion and wider adoption of aquaculture among fishing families will result in positive impacts especially improving household food security. Thus, aquaculture as a supplier food and tradable goods has the potential of improving the food and nutritional security of people in three ways, namely: (1) adoption-income linkage; (2) adoption-employment linkage; and (3) adoption-consumption linkage (Ahmed and Lorica, 2002).

Although adoption of appropriate aquaculture technologies may be slow among the rural folks, empirical evidence in Vietnam, Philippines, and Lao PDR shows that aquaculture has been providing additional income to the poor. The impact of aquaculture on employment including wages is not well documented except for some aquaculture economic analysis that indicates a ratio of one technician for every 5 ha of ponds. In one Mariculture Park in southern Philippines, one technician is hired for every 1-5 units of fish cages. Self-employment in seaweeds farming has also demonstrated a big potential, especially considering that almost all seaweed farms in the Philippines and Indonesia are family-operated. Abundant labor in rural areas can therefore be tapped to supply the needs of aquaculture, but the wages for hired labor in aquaculture enterprises should be documented.

The consumption effects of aquaculture depend on many factors such as price, and consumer taste and preferences. High-value species such as crustaceans is more price elastic and has high rate of substitutability compared to low value species like tilapia. The consumers, especially in developed western countries have become health conscious in their eating habits. Fish is considered as a health food and consumption is expected to increase in both fish producing and fish importing countries. Home consumption of aquaculture production is estimated to be 30-40% in Bangladesh (Gupta in Ahmed and Lorica, 2002), while in Tonle Sap in Cambodia, small-scale aquaculture provides food for families and incomes from excess production for sale.

Traditions and practices associated with aquaculture in rural areas generate some important nutritional benefits for households that engage in various ways in aquaculture. The practice of allowing the collection of "free fish" or residual and non-target species after harvest by the young and the poor in the communities happen to provide fish food and nourishment. These benefits are highly appreciated by many rural residents in the Philippines, although occasional and limited (Irz *et al*., 2007). This shows an example of non-market mechanisms in the practice of aquaculture in rural communities making fish available and improving the nutrition of poor households.

Many of the developing countries have moved away from the centralized strategic approach to development that received heavy emphasis in the 1950s and 1960s. Since government services and control have not reached remote areas especially the fishing communities, such situation led to mismanagement and destruction of the fishery resources. As a result, paradigm shift from central governance to a decentralized form of resource management has been adopted by many Southeast Asian countries (*e.g.* Philippines, Indonesia, Thailand, and Cambodia). The shift to devolve government control of fishery resources is a responsive act towards addressing the issues regarding property rights arrangements over bodies of waters for fishing and aquaculture.

Since marine and freshwater bodies are technically state-owned, they become an "open access" property where any individual or entity can undertake personal and enterprise activities. The open access nature of the fishery resources does not augur well for the security of small-holder fish farmers. With devolution and decentralization, local government units are now in better position to provide policy support in the management the coastal waters and inland bodies of water through enactment of ordinances indicating the zone for exclusive use of fisherfolk for aquaculture livelihood. In addition to policy support, government should provide technical and extension services, market accessing and guides to micro-financing schemes, and disaster-preparedness mechanisms because of the vulnerability of coastal dwellers to the impacts of climate change. As a matter of fact, one of the key reasons for the flourishing aquaculture industry driven by the private sector in one jurisdiction but not in the others is governance (FAO, 2010) because in the past two decades considerable progress has been made in addressing aquaculture governance issues. This progress has been made possible by an international corporate effort and by several nations that have pushed for the aquaculture agenda forwards in an orderly and sustainable manner through good governance.

One of the major impediments in promoting aquaculture for food and livelihood in rural Southeast Asia is the inaccessible and unaffordable financial packages for small-scale fish farmers. Some governments in the region have provided subsidies such as interest-free loans to farmers to boost adoption of agricultural technologies. However, many such programs are not self-sustaining and subsequently failed because of poor repayment rates. The traditional collateral-based lending schemes of banks also

do not meet the financing needs of rural farmers, especially the fishers in island communities without material and financial assets (Farrington *et al*., 1997). A relatively recent development is the entry of NGOs in the lending of cheap and accessible loans to break the barriers faced by the rural poor in accessing formal financing packages. The micro-financing innovations introduced by some NGOs appear to be more promising than previous attempts to induce lenders to serve this clientele group, where the scheme heavily relies on the social assets of individual borrowers and the community. Such micro-financing scheme engages a group of 5 to 15 individuals, each of them accountable to the loan repayment failure of any member of the group. This scheme has generally worked and has induced collective action among the group of borrowers in protecting the group's interest. The loan is usually short-term which covers the production cost for one production run where its utilization is often supervised by the lending agency. For example, to avoid misuse of loans, some NGOs supply the inputs (seed and feeds) needed by small fish farmers the costs of which are charged to the loan, which is payable upon harvest. This way, loans are used for fish farming livelihood activities instead of other non-productive purposes which could result to non-payment of the loans. Nevertheless, one big challenge is for the government and private sector to invest in infrastructure and ancillary services, *e.g.* cold storage, processing plants and other downstream investment to support the marketing of the produce of aquaculture farms, big and small. Public-private partnership investment modalities should be encouraged for long-term capital investments to upgrade production and processing facilities to meet the growing global fish market.

Mainstreaming the rural communities into the aquaculture industry will require building their capacities to adopt appropriate aquaculture technologies. However, most countries in the Southeast Asian region are constrained by many factors, which include: ineffective government extension programs; lack of facilities and logistical support; inadequate and ill-prepared extension workers because of the lack of skills and knowledge on new aquaculture technologies; lack of "easy-to-understand" information materials on aquaculture and ineffective delivery systems to the rural folk; and remoteness of rural areas from knowledge centers such as government and private facilities.

In 2008, SEAFDEC with support from the ASEAN Foundation initiated and implemented a project on "Human Resources Development (HRD) for Poverty Alleviation and Food Security by Fisheries Intervention in the ASEAN Region", which had rural aquaculture as one of the thematic areas. Under the rural aquaculture portion, training was conducted on two phases, with the first phase focusing on "Trainers' Training" conducted at the Tigbauan Main Station of AQD in Iloilo, Philippines for selected senior fishery extensions workers representing the Southeast Asian countries.

The second phase involved on-site training courses in eight countries, which had been facilitated by the Senior Extension Officers who participated in the Trainers' Training with experts from AQD providing the technical assistance. Moreover, AQD also implemented a project on "Institutional Capacity Development for Sustainable Aquaculture (ICDSA)" to promote appropriate aquaculture technologies for improving the livelihoods of fishing communities through strategic partnership with "on-the-ground" institutions such as local government units, fisherfolk organizations, NGOs, micro-finance companies, and schools of fisheries. A "Season-long Training" approach was adopted in order that the fisherfolk could experience the full aquaculture production cycle including post-harvest and simple value-adding techniques. An important component of the training program is the establishment of demonstration set-ups (*e.g.* fish culture in cages, ponds and other systems) where the aquaculture system to be introduced to communities could be demonstrated for its technical and financial viabilities. Impact assessments are then conducted to determine the effectiveness of technology transfer strategy to rural folks in adopting aquaculture as a sustainable livelihood alternative and source of food.

Climate Change

Sea level rise is expected to reach 1.0 m or more by 2100 due to global warming, glacier melting, and accelerated decline in polar ice sheet mass. The resulting disastrous impacts on low elevation coastal zones are certain, but the ability of society to cope via adaptation remains uncertain. Moreover, observations on climate change show that rapid environmental change has coincided with shifts in the food web from its base to the apex. This complicates the management and protection of marine resources that have direct negative impacts on coastal communities. The climate change phenomena have been observed in many Southeast Asian countries through flash floods, increase in sea levels and temperature, stronger waves, and longer dry season. Therefore, there is a need to conduct social research on the vulnerability and resiliency of the small-scale fish farmers on the impacts of climate change which will not only affect their aquaculture livelihood but may endanger the safety of their families. In order to know the adaptive mechanisms for reducing or mitigating the effects of climate change, technical research should also look into the aquaculture systems and species that have better chances of withstanding the negative impacts of climate change.

5.1.3 Perspectives in Integrating Aquaculture in Rural Development

Taking into consideration the issues and constraints faced by the aquaculture industry, especially on the need to enhance the role of aquaculture in securing food and income which is critical in rural development in the region, the *ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security Towards 2020 "Fish for the People 2020: Adaptation to a Changing Environment"* in June 2011 in Bangkok, Thailand adopted the new *Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020*. Included in the new Plan of Action is a provision on aquaculture which stipulates the guideline for the development of programs, projects and activities for the implementation of the new Resolution. The provisions in the Plan of Action specific for aquaculture are expected to compliment and update existing technical guidelines, policies and regulations in the practice and promotion of aquaculture in the Southeast Asian region (SEAFDEC, 2011b). Thus, the relevant future directions in the new Plan of Action could broadly be classified into: enhancing support for sustainable aquaculture in national through to local programs and policies; motivating governments to mainstream aquaculture in rural development; and applying precautionary and ecosystems approach in aquaculture. The new Plan of Action also enjoins that national programs and policies on aquaculture in the Southeast Asian countries should address the pressing social, economic and environmental aspects of sustainable aquaculture that directly impact rural development, *i.e.* that aquaculture programs should contribute to improved food security, livelihoods, employment and poverty alleviation. Such programs should envision to: provide the mechanisms and enabling environment for good aquaculture practices, efficient markets and fair trade; strengthen the capacity of small-holder farmers; and promote inter-agency collaboration.

Meanwhile, measures to manage the sustainability of aquaculture will include the implementation of strategies at the national and local levels to monitor and regulate aquaculture operations, prevent its over-development, and ensure that aquaculture practices are conducted in a manner that will not compromise the environment (BFAR-PHILMINAQ, 2007). In particular, governments at all levels have been encouraged to integrate aquaculture into rural development planning within the context of multiple uses of land and water resources, as well as the strengthening of inter-agency coordination in policy formulation, project planning and implementation, stakeholders consultation, extension services and technology transfer. Mainstreaming aquaculture in rural development requires the participation and support of the governments to regional initiatives that will assess the role of aquaculture in poverty alleviation for better policy formulation. In addition, in order to realistically integrate aquaculture activities in community development plans, compliance to national employment practices, facilitation of financial incentives and credit schemes, and promotion of investments in ancillary and other support structures to motivate aquaculture enterprises are also stipulated in the new Plan of Action. Moreover, public-private modalities to catalyze integration of aquaculture in rural development are also encouraged.

Recently, the FAO together with regional and national partner agencies has been promoting the precautionary approach through the ecosystems approach to fisheries management (Christie *et al*., 2007). This principle in effect applies a preventative approach to safeguard the environment from rapid development of offshore aquaculture, and likewise consider development of regional guidelines on responsible marine (inshore and offshore) aquaculture. In rural development scenarios, a precautionary and ecosystems principle will benefit protective and conservation measures that are critical in the practice of aquaculture in fragile environments. Natural resources are very critical and often fragile, assets being used for generating economic benefits in rural communities. Ecosystems approach therefore beneficially magnifies the interconnectedness between the human and ecological dimensions in the utilization of natural resources in aquaculture in rural areas.

The fundamental way forward in integrating aquaculture in rural development in the Southeast Asian countries is to collaborate through organizational networks in the promotion and implementation of the new Plan of Action. The technological breakthroughs and economic benefits from the growth and success of aquaculture in the region cannot be emphasized if aquaculture cannot significantly contribute to rural development. For several decades now, aquaculture technology has been introduced in many communities in inland aquatic resources and coastal areas in the region. However, the social dimension of aquaculture in improving the welfare of the poor in rural communities has been below par. Thus, while CCRF which stipulates sustainable aquaculture development in Article 9, remains to seek voluntary compliance, where governments at the national through to local levels would benefit from referring and adhering to the recommended aquaculture practices (SEAFDEC, 2005).

For most countries in Southeast Asia where rural development in inland aquatic and coastal areas is hampered by overfishing and lack of livelihood opportunities, the options could be diverse but should be coordinated. Since there is a need for aquaculture to be mainstreamed in the rural development planning, governments and development planners at the national

through the local level should harmoniously ensure that their fisheries and aquaculture development policies include the need to: encourage optimal use of harvest from capture fisheries; reduce post-harvest losses; and enhance aquaculture benefits by engaging and supporting rural communities in farming and processing fish to generate local nutritional and economic gains. Support from governments should also include: cohesive and comprehensive policies and guidance to promote responsible aquaculture including generous measures for mitigating impacts of climate change to small-holder aquaculture livelihoods initiatives; development and implementation of supervised micro-financing schemes for small-holder aquaculture entrepreneurs; and aggregation of small-scale producers to facilitate participation in market and trade.

5.2 Good Quality Seeds for Aquaculture

World fisheries production was estimated to have reached 145.1 million MT in 2009 of which 55.1 million MT came from aquaculture (FAO, 2010). In addition to China, the major contributors to global aquaculture production from Southeast Asia are Vietnam, Indonesia, Thailand, Philippines, and Myanmar. Production from Asian aquaculture accounted for about 89% of world's production from aquaculture. Although noted to be a relatively young food production sector, annual aquaculture production has rapidly increased from 1.0 million MT to 50.2 million MT after six decades (FAO, 2010). Aquaculture production covers not only freshwater and marine fishes, crustacean and molluscan species but also includes aquatic plants, mostly seaweeds. Breeding and culture requirements for most of the commercially important aquaculture species especially those found in freshwater environments have been well studied (Siriwardena, 2007) thus accounting for a steady growth in production. Ironically though, in many Asian countries, several species that are economically valuable are not indigenous. Tilapia for instance, is a major national aquaculture product in the Philippines, Indonesia, Thailand, Malaysia, and China. In the last five years, apart from tilapia, the whiteleg shrimp (*Penaeus vannamei*) from the U.S.A. became a major culture species in Southeast Asia replacing the black tiger shrimp (*P. monodon*). The interest in whiteleg shrimp can be attributed to the fact that the shrimp industry was in need of a species which when cultured, can earn profits that may be enough to compensate for the losses in tiger shrimp production brought about by disease problems.

5.2.1 Status of Seed Production

Aquaculture production is mainly reliant on seed availability. Seedstocks for the aquaculture of different species could be obtained from the wild or from captive stocks in hatcheries (**Appendix 2**). For species with undetermined or no established breeding technologies, and possibly low seed production capabilities, the source of seedstock will be a limiting factor as commercial production would depend entirely on wild seeds. Seed production is primarily affected by several factors, from genetic to non-genetic or extrinsic causes such as the presence of diseases and sub-optimal hatchery and nursery methods or extreme changes in the environment. However, low seed production in the hatchery can be improved particularly if appropriate interventions are made. For some species such as catfish in Cambodia, milkfish and grouper in Indonesia, tilapia in the Philippines and Malaysia, grouper and sea bass in Thailand as well as in Vietnam, and shrimp in Malaysia, Myanmar and Vietnam, aquaculture production is constrained by seed supply and quality (Hishamunda *et al*,. 2009).

5.2.2 Issues and Concerns

A logical solution to the issue of decreasing aquaculture yield caused by poor survival and slow growth is to use good quality seedstocks. Quality seeds are fish fingerlings, crustacean post-larvae, molluscan spats or aquatic plantlets that are robust or hardy apart from having the same beneficial traits such as the capacity to grow fast, tolerate stress and feed efficiently as the case may be. Good quality seeds can be intentionally produced through the use of good quality spawners; suitable broodstock maturation diets; appropriate broodstock management methods that can minimize inbreeding; conventional selection such as hybridization, mass selection, within family and family selection, or combined selection; genetic manipulation methods; and improved hatchery and nursery rearing protocols.

For aquaculture in the Southeast Asian region, genetic methods have been employed through major selective breeding programs and several of these technologies have been known to generate improved stocks that are either in the process of field testing or have already been disseminated. For example, the Nile and red tilapias, some carps, Clariid catfishes, penaied shrimps, abalone and seaweed species have been the subject of genetic improvement research in Asia although in varying levels of development and adoption (**Appendix 3**).

Nevertheless, some countries have considered genetics as an important component in improving quality of seeds and as such have designated national genetic improvement centers to undertake research to further improve aquatic breeds. Indonesia for one, has assigned institutes specific to species, *e.g.* Sukabumi Aquaculture Development Center and Bogor Research Institute for Freshwater Aquaculture are designated to do genetics research on tilapia, catfish, carp and gourami, and other centers to engage in grouper, seaweeds and tiger shrimp improvement. Apart from these