NATIONAL FISHERIES AUTHORITY

The National Aquaculture Development Policy

2004

POLICIES, DEVELOPMENT STRATEGIES, GOALS AND PLAN OF ACTION FOR AQUACULTURE DEVELOPMENT IN PAPUA NEW GUINEA UP TO THE YEAR 2010

Executive Summary

This aquaculture policy is based on a vision to foster development of successful commercial aquaculture by the private sector, using economic profit as the motive, and subsistence aquaculture to enhance food security and provide some alternative income source. The strategy is to facilitate private sector-led development of all levels of the aquaculture sector.

Given the corporate status of the National Fisheries Authority (NFA), NFA's role is one of facilitator, policy maker and provision of direction as to options in aquaculture development. The Department of Agriculture and Livestock (DAL) will play a key role in fostering subsistence and artisanal aquaculture development as part of rural development under its food security program. Research, training and extension will be facilitated through other line departments such as the Department of Agriculture and Livestock (DAL), research institutions and other interested stakeholders.

The major thrusts of the Policies are geared towards enabling NFA to make its facilitative and advisory role a reality. As a requirement, clearly stated government procedures and guidelines on aquaculture licensing, quarantine, species introductions and transfers and environmental certification are essential. However, quarantine and environmental certification are responsibilities of the Department of Environment and Conservation and National Agriculture Quarantine and Inspection Authority (NAQIA) respectively. Given the disease free status of PNG aquaculture and the potential disease risks associated with uncontrolled importations/translocations, it is imperative that NFA enforce a strict quarantine policy. This could be realized either through Legislative changes for fish Quarantine, Introductions and Transfers to be the direct responsibility of the Authority or a shared function between the NFA and NAQIA. To implement this, a multi-disciplinary team of skilled people in aquaculture, financial management, aquaculture management is more appropriate than a single aquaculture manager. Such a unit needs to be established and operated as a sub sector company under NFA to ensure private sector type work ethics and skills are acquired and utilized to make implementation a reality. This is essential given the Authority's corporate status. Irrespective of this, the future of aquaculture development requires a private sector approach to its establishment.

Aquaculture Vision

1. Establish aquaculture as a viable business industry – Facilitate and support the private sector to establish economically, socially and environmentally sustainable aquaculture ventures, which may provide employment and income and boost export earnings and improve standards of living.

2. PNG aquaculture products to achieve recognition on the international market as eco-friendly and premium products.

3. Food Security – Produce sufficient fish or fish products to feed the people of PNG and generate cash surplus in rural areas for income generation.

4. Information and Communication - To facilitate education of Papua New Guineans about Aquaculture as an alternative means of producing fish and other aquatic products for economic profit and food.

5. Integration of aquaculture with agriculture – Existing farmers adopt subsistence/artisanal aquaculture into their existing agriculture operations.

Acronyms Used.

DAL – Department of Agriculture and Livestock

DEC – Department of Environment and Conservation.

EIA – Environmental Impact Assessment.

FISHAID – A joint UNDP/ NFA project involved in stocking exotic fish species into the Sepik-Ramu river system to increase fish stocks. The project was operational from 1993 to 1997 and a total of 7 exotic fish species were introduced.

GIFT – Genetically Improved Farm Tilapia, an improved strain of *Tilapia nilotica*. The species was selectively bred for a number of generations to select for character traits such as fast growing and slow maturing.

HACCP – Highly Acclaimed Critical Control Points

JICA – Japan International Cooperation Agency

IPA – Investment Promotion Authority

LLG – Local Level Governments

NFA – National Fisheries Authority

NAQIA – National Agriculture Quarantine Inspections Authority

PNG – Papua New Guinea

Terms Used.

Authority – refers to the National Fisheries Authority.

Aquaculture seed or seed – refers to eggs, fingerlings, spat, cuttings etc. used as initial seed for any aquaculture operations.

Board – refers the National Fisheries Board.

Artisanal aquaculture – aquaculture conducted on a small scale for household consumption, barter, domestic market trade, or sale to a person licensed as a fish buyer.

Broodstock – parent fish or aquatic organism used in propagating seeds (fingerlings, spat, post larvae, cuttings etc.) for use in aquaculture operations

Eco-friendly – Environmentally friendly aquaculture operations with little impact on the natural environment.

F1 – First generation offspring produced from parents imported as eggs, fingerlings or spat.

Fish – "fish" means any aquatic organism (animal or plant), alive or dead, and includes their eggs, spawn, spat and juvenile stages, and any of their parts, but does not include any species of whale;

Fisheries Act – refers to the Fisheries Management Act of 1998

Fisheries Regulation – refers to the Fisheries Management Regulation of 2002

Operations – refers to any Aquaculture Operations

Organic – Aquaculture products produced using environmentally friendly techniques and are free from most synthetic growth hormones, antibiotics, genetically modified strains etc.,

Phyto-sanitary requirements – sanitary requirements set by importing countries, especially for food items.

Super male – A genetically homozygous male that has been hormonally sexually reversed to enable all male production of progeny when crossed with a normal male.

Transgenic species – specie(s) of aquatic organisms that has/have been genetically altered to enhance aquaculture performance.

CONTENTS

BACKGROUND

Definition
Aquaculture is the farming of aquatic organisms including fish, mollusks, crustaceans, aquatic plants and other aquatic organisms for food and economic profit. Declining catches from the wild coupled with increasing demand for fishery products has fuelled the expansion of the aquaculture industry globally in the last two decades. Aquaculture has become an important economic sector in developing countries. However, in Papua New Guinea (PNG) aquaculture is underdeveloped but has great potential for rural development and economic/export growth. Apart from tuna, most tropical fisheries, such as the prawn and lobster fishery, beche-de-mer, trochus, reef fishery, and barramundi, harvested in PNG waters are vulnerable to overexploitation or are capable of sustaining limited production capacity, thus aquaculture can play a significant role in complementing catch from these fisheries. It is also an alternative to fisheries development especially in coastal and inland fisheries sector.

History of Aquaculture in PNG
Aquaculture was introduced to PNG in the 1950s as a means to alleviate high malnutrition levels prevalent in inland rural areas. Most government effort has since been concentrated on subsistence pond culture of carp and tilapia in inland areas, whilst commercial aquaculture development was left to the private sector, with little government support/emphasis for development. Therefore aquaculture in PNG is still underdeveloped and in the infant stage mainly due to the perceived view that PNG has abundant underutilized natural fishery resources that have to be exploited prior to pursuing aquaculture development as a fishery, and the limited government assistance and effort directed at aquaculture research and extension.

Current status of Aquaculture
Majority of the aquaculture developments to date have been concentrated on subsistence carp and tilapia and semi-commercial trout culture in the highlands. Total annual production figures per farm averages from a few kilograms to a tonne. The Lake Pindiyaundo Trout Farm (LPYTF) in Mt. Wilhelm is the only large-scale trout farm in PNG with an annual production turnover of 5 tonnes.

Recently a number of large-scale commercial aquaculture ventures have been established on the coast e.g. the barramundi farm in Madang by Bismark Barramundi and the pearl farm on Samarai, Milne Bay by Coral Sea Mariculture (CSMC). Semi-commercial trout culture in the highlands has taken on a gold rush like mentality, most with the view that quick money can be made in aquaculture. A similar scenario is expected in the Maritime Provinces, especially relating to commercial aquaculture. The recent successful establishment of net cage culture of barramundi has resulted in a flood of requests to the National Fisheries Authority (NFA) for technical and financial assistance and additional relevant information on barramundi aquaculture. There is numerous interests from both the subsistence and commercial sector for aquaculture development. Given this increased interest in aquaculture and the government policy on commodity-based export driven industries to increase foreign earnings, aquaculture sector is expected to undergo a rapid expansion in the two decades. Therefore this policy is drafted to ensure that aquaculture development proceeds in an economically, socially and environmentally viable and sustainable manner.

OVERVIEW
This Aquaculture Policy sets out policies, strategies and guidelines for the supported sustainable development of the Aquaculture industry in PNG. Aquaculture is a key priority objective of the PNG government for both rural development and for economic/export growth. NFA as the government agency responsible for managing the nation's fisheries will pursue aquaculture development. However given its corporate status NFA's role in aquaculture development shall be an advisory and facilitatory one, ensuring that aquaculture is developed by the private sector in a environmentally sustainable manner.

The major thrust of the Policy is geared towards establishing an economically, socially and environmentally sustainable aquaculture industry using economic profit as a motive. At the same time, it will provide/facilitating avenues for the development of subsistence/small-scale aquaculture,

through line departments and other stakeholders. The policy is also geared at ensuring a disease free and eco-friendly aquaculture industry.

1. AQUACULTURE DEVELOPMENT POLICIES

Aquaculture has recently become a valuable activity providing food and as a primary source of income for many rural inhabitants of PNG. It has great potential for both rural development and export growth. Recently there has been interest in both commercial and subsistence aquaculture development. However, currently there is no approved aquaculture policy in place to ensure that aquaculture development proceeds smoothly and in an economically, socially and environmentally sustainable manner. The following policies are proposed to achieve these objectives;

a. Aquaculture development is a key priority objective of the PNG government for both rural development and economic/export growth. NFA as the responsible fisheries management agency shall coordinate policy development and facilitate/foster all levels of aquaculture development;

b. Given NFA's corporate status and the infrastructure requirements for aquaculture development (research, training and extension), NFA's main role shall be as facilitator, policy maker, provider of technical advice and conduct/facilitate/fund applied aquaculture research, targeting mainly commercial aquaculture activities;

c. Therefore the Department of Agriculture and Livestock (DAL), Provincial Governments and Non Government Organizations (NGOs) (hereafter called key agencies) will be the main agencies responsible for fostering the development of subsistence and artisanal aquaculture. NFA shall facilitate and collaborate with these key agencies to implement their respective aquaculture programs and ensure that their programs are consistent with national policies;

d. At all levels aquaculture is best developed by the private sector with NFA facilitating development when and wherever appropriate;

e. NFA shall promote and support all aquaculture developments in response to demands from end users, with emphasis on commercially orientated developments (whether small-scale community based or larger commercial operations), provided such demands are in-line with overall national policies;

f. While facilitating aquaculture development, NFA shall collaborate with the Department of Environment and Conservation (DEC) and the National Agriculture Quarantine and Inspection Authority (NAQIA) to ensure that PNG's aquatic resources are protected against any possible harmful effects of aquatic environmental pollution, risks of biodiversity loss due to inappropriate introduction of species, and other detrimental environmental problems associated with aquaculture developments. To achieve this, a thorough assessment of proposed aquaculture project's economic, social and environmental viability/sustainability will be properly scrutinized before issuing licenses;

g. NFA shall endeavor to ensure that the PNG aquaculture industry is protected against any harmful diseases that have plagued aquaculture industries elsewhere. Current NAQIA aquatic organisms quarantine and import regulations shall be maintained/revised and enforced through NAQIA in collaboration with DEC, whilst at the same time ensuring that necessary brood-stock and aquaculture seed are imported smoothly to facilitate aquaculture development;

h. To ensure that a greater bulk of the population participate in aquaculture activities, the family farm/nucleus estate concept shall be encouraged. Proposals involving community involvement and a preference for a family farm concept with a central agency responsible for extension, provision of aquaculture material, collection and processing and marketing shall be encouraged;

i. Given the large financial investment required for some operations such as prawns, barramundi etc., foreign investment in large aquaculture operations shall be encouraged. Such investments maybe in joint venture with nationals or either fully foreign owned but must meet all IPA requirements. All operations with foreign investment must include a plan clearly showing how they plan to allow nationals to acquire more than 51% share of the project after a period of preferably between 5 to 10 years.

j. Large-scale commercial aquaculture proposals involving the production of 25 tonnes or more produce annually (fresh ungutted weight) in total per individual establishment (farm), or existing facilities that reach this level of production, must be subject to satisfactory environmental impact assessments (EIA);

k. The EIA should ensure minimal possible environmental damage to surrounding areas. It should include measures to contain possible environmental damage, plan of waste treatment and discharge, possible effects on biodiversity caused by culture organism, procedures proposed for containing disease outbreaks and other necessary information;

l. For large-scale commercial cage/raft/long line culture projects, the EIA should include a detailed description of water current movement in the proposed culture site, outlining how wastes from the culture operations will be dispersed from the site by prevailing water currents. The project should also include long term environmental monitoring plans to detect any negative environmental impacts;

m. For species which production cannot be quantified in tonnage or size of culture area, the decision for EIA completion will be at the discretion of the Managing Director;

n. For reasons of environmentally friendly aquaculture (with a view to produce eco-friendly products), special preference will be given to proposals proposing to conduct aquaculture using enclosed systems with water re-circulation or those proposing good waste management plans;

o. Aquaculture should be developed on the basis of ultimate self-sufficiency within the sector with decreasing dependence on imports. In particular, the supply of feed and seed should be met preferably by the private sector from domestic sources. Initially, NFA may need to facilitate supply of aquaculture seed and feed to promote private sector involvement. This may include facilitating the import of important exotic species for aquaculture developments. In the longer-term NFA shall continue facilitating seed production only for experimental species, or improved strains etc.;

p. Depending on demand, NFA shall facilitate government support for fingerling production and distribution by key line agencies the private sector, but only under appropriate circumstances and in-line with overall government economic and social policies. This provision is aimed primarily at assisting subsistence and low-income farmers where, and if, necessary;

q. NFA shall endeavour to ensure that aquaculture operations are realistic and are economically, socially and environmentally sustainable. However, NFA shall not be liable for any aquaculture project that fails after NFA approval;

r. That all provinces adopt this national aquaculture policy and only modify it to suit local socio-economic conditions if warranted and subsequently approved by NFA.

2. AQUACULTURE DEVELOPMENT STRATEGIES

2. 1. Aquatic Animal Health Management

Disease is a major constraint to aquaculture development which has impacted greatly on both socio-economic development and rural livelihood in both developed and developing nations elsewhere. Given the disease free status of the PNG aquaculture industry, addressing animal health issues, especially in relation to disease prevention is an urgent and important priority for sustainable development of the industry. However, animal quarantine, including fish quarantine is a function of NAQIA. Therefore, NFA shall in collaboration with/through NAQIA undertake disease prevention approaches and measures and effective cooperation at provincial, national and regional levels to minimize disease transmission. These can be achieved through;

a. Develop, harmonise and enforce appropriate and effective national policies and regulatory framework on the introduction and transfer of live aquatic organisms and products to reduce the risks of introduction, establishment and spread of disease pathogens which can impact on aquatic biodiversity and the aquaculture industry. This will include revision of current NAQIA aquatic animal quarantine and translocation regulations and guidelines;

b. Capacity building both at the institutional and farmer levels through awareness, training and extension. This should target procedures for disease control, monitoring, quarantine etc.;

c. Adopt, develop or modify appropriate sensitive diagnostic methods, safe therapeutants and effective disease control methodologies through training and in collaboration with reputable institutions both domestically and overseas;

d. Promote holistic systems approach to aquatic animal health management, emphasing preventative measures and maintaining clean culture environment.

2.2. Aquaculture Feed Development

Feed is the single most expensive component of any aquaculture operation and often constitutes nearly 70% of total production costs. Currently, PNG lacks an aquaculture feed industry. Most feed especially for barramundi and trout culture is currently imported. Given the weak kina coupled with transportation and related costs, feed is a major impediment to aquaculture development in PNG. It is therefore imperative that appropriate measures be taken to reduce feed costs and increase total aquaculture production. These can be achieved through;

a. In the short term NFA shall facilitate the importation of tax free affordable aquaculture feed targeting export orientated aquaculture operations;

b. Conduct research on developing farm made suitable feed utilizing readily available local feed materials in collaboration with reputable domestic and international organizations;

c. Conduct research into appropriate culture methods (fertilization trials etc.) to reduce dependence on feed, especially for socially important species such as carp and tilapia;

d. In the long term facilitate the establishment of a domestic aquaculture feed industry by the private sector;

e. Conduct research on developing appropriate feed utilizing locally available materials with a view to reduce feed costs in collaboration with reputable institutions;

f. Feed research should target;
   i. Development of species-specific brood-stock diets that allow complete domestication and maximum reproductively and larval quality of economically and socially important species;

   ii. Better understanding of larval nutritional requirements in order to develop suitable compound feeds;

iii. Utilization of readily available plant materials as feed ingredients for feed formulation with a view to reduce dependence on fish meal;

iv. Improve understanding of nutrient retention and release into the environment thereby develop environmentally friendly feed;

2.3. Aquaculture Training

Aquaculture is a new and developing sector in PNG, thus majority of the personnel associated with it have limited or lack the necessary technical skills to effectively participate in aquaculture development. Therefore investment in aquaculture education and training are essential to build the knowledge, skills and attitude of all people involved in the sector. This can be achieved through;

a. Facilitating the annual farmer and extension officer training courses on trout and carp culture currently conducted by the Highlands Aquaculture Development Centre (HAQDEC) with funding from Japan International Cooperation Agency (JICA). At the termination of this assistance, NFA in collaboration with DAL should facilitate the continuation of this program;

b. To equip PNG nationals, a training program for technicians and farmers be drawn up with a view to utilize overseas training facilities in Northern Australia or Asia, which are appropriate;

c. NFA shall collaborate with education institutions in PNG to develop and introduce aquaculture curriculum preferably incorporated into biology or agriculture curriculum taught in these institutions;

d. In the short term the National Fisheries College shall conduct tailor made aquaculture training courses depending on demand and request form the industry;

e. Facilitate postgraduate training in aquaculture for graduates with the proposed Nago mariculture facility or private facilities such as CSMC. Where private facilities are involved, NFA shall liaise with parties concerned on what arrangements can be applied to enable students to conduct their research. Such research shall be undertaken when there is a perceived need for certain information required for effective management and development of the industry;

f. NFA shall facilitate the implementation of an extension and training program for small-scale farmers and where appropriate contract international aquaculture specialists to provide technology and information transfer.

2.4. Improving Food Security and Poverty Alleviation

Aquaculture has an important role in enhancing food security and alleviating poverty in rural areas. Fish is a highly nutritious food, which can form an essential, if not indispensable component of the diet of rural people. However, in PNG aquaculture is a recent activity as compared to agriculture and animal husbandry, but with well-coordinated awareness and training it can play an important role in improving food security and contribute to sustainable rural livelihoods. This can be achieved through promotion of the following in collaboration with the DAL;

a. To promote aquaculture systems to farm low-value fish species affordable to the rural people, particularly small-scale household aquaculture production in rural areas where it maybe the only source of protein due to isolation and poor infrastructure;

b. Promoting rural and small-scale house hold centered development focus in aquaculture development;

c. Dissemination of information and extension support to encourage low input aquaculture systems for rural household based small scale aquaculture operations;

d. Conduct research into low input aquaculture systems, such as pond fertilization trials using readily available materials, or utilization of herbivorous fish species such as Chinese carp species which require little feed input;

e. Dissemination of information about nutritional advantages of eating fish to vulnerable groups such as pregnant and lactating women, and families with infants and pre-school children;

f. Empower rural small-scale stakeholders to actively participate in policy-decision making.

2.5. Environmentally Sustainable Aquaculture Development

Experience from developing countries, especially in Asian, have shown that uncoordinated and unplanned rapid development of aquaculture activities can be environmentally destructive. Give the pristine nature of the PNG environment, there is a need to develop and adopt policies and practices that ensure environmental sustainability, including environmentally sound technologies and resource efficient farming systems. These can be achieved in collaboration with DEC to;

a. Develop, adopt and apply environmentally, economically and socially sustainability assessment criteria and indicators of aquaculture development for use in assessing aquaculture proposals. Aquaculture proposals shall be assessed in collaboration with DEC, NAQIA and other reputable organization and individuals to ensure this;

b. Develop strategies to ensure that aquaculture operations in coastal areas and inland watersheds are within environmental carrying capacities;

c. Adopt/develop resource efficient farming systems which make efficient use of water, land, and aquaculture inputs such as feed and seed;

d. Adopt/develop and facilitate implementation of improved aquaculture management practices and code of good practice for aquaculture sectors which are supported by enforceable aquaculture regulations;

e. Promote good practices for environmental management of aquaculture operations as a means of improving environmental quality and resource.

2.6. Investment in Aquaculture Development

Private sector investment in any industry often make the biggest contribution to development of that industry. However, adequate public funding for capacity building, institutional development and infrastructure is indispensable for development of a vibrant and efficient industry. Therefore sound public sector investment in aquaculture should include;

a. Facilitate and encourage private sector funding and investment in aquaculture development and infrastructure which would facilitate or increase rural sector aquaculture development;

b. Establish credit schemes/or soft loans that support sustainable aquaculture especially for artisanal aquaculture development;

c. Foster a greater understanding on aquaculture development and financial needs by domestic financial institutions to educate them of the commercial viability of large-scale aquaculture investments. Currently most financial institutions are understandably reluctant to fund large commercial projects given the lack of information on the commercial success of aquaculture projects due to the recent nature of aquaculture industry in PNG;

d. Facilitate foreign investment in aquaculture given the large financial requirements of some operations such as barramundi, prawns, pearls, etc;

e. Develop programs to efficiently utilize/lure international donor funding in aquaculture and rural development. Presently most international development assistance is directed towards

poverty alleviation, gender equity, environmental sustainability, technical feasibility, economic viability and good governance.

2.7. Investment in Aquaculture Research

There is a need to invest in aquaculture research to undertake applied aquaculture research for PNG conditions and needs. This can be achieved through;

a. Establishment of a aquaculture research and development company under NFA, which will be responsible for aquaculture research and provide advice on aquaculture development. Initially funded through donor or joint government funding and will operate as a business;

b. Establish aquaculture research station for both marine and freshwater species to conduct appropriate aquaculture research into indigenous species;

c. Collaborative multidisciplinary research with private sector, reputed national and international institutions and organizations;

d. Collaborative funding arrangements between institutions and public and private sector organizations;

e. Have in place training programs to build the skill of aquaculture researchers;

f. Improve linkages between researchers, extension officers and farmers to effectively disseminate and implement research results.

2.8. Effective Communication

Efficient dissemination of information is essential for effective management and development of the aquaculture sector. Increased information flow avoids duplication of efforts, saves costs, and ensures effective dissemination of research information etc., while at the same time fosters consistencies in areas such as training, policy making, planning and application of regulations and procedures. It also increases awareness and capacities to deal with emerging issues. This can be achieved through;

a. Establishing means to share data with stakeholders or have easy access to sector information;

b. Provide effective means for access to relevant and reliable information to all stake holders;

c. Establish means to disseminate aquaculture information through awareness, trainings etc.;

d. Utilized new technologies to improve information flows and management policies and practices in the aquaculture sector, for instance establishing a aquaculture portal on the NFA web site for stakeholders to access aquaculture information

e. Publish aquaculture newsletter to inform stakeholders of events and issues on aquaculture in PNG.

2.9. Market Development and Trade Promotion of PNG Aquaculture Products

Development of market and trade for aquaculture produce increases demand for aquaculture products, add value and increase returns for aquaculture products. Therefore market development and promotional strategies for aquaculture products be developed both domestically and overseas. These can be achieved through;

a. Working closely with NAQIA to reduce trade barriers of aquaculture products, for instance ensuring that products meet international phyto-sanitary and quarantine requirements.

b. facilitate producers, manufacturers and processors to identify and develop markets for PNG aquaculture products. Develop niche markets especially in relation to PNG aquaculture strengths such as; pristine environment, disease free status, eco-friendly products etc.,

c. invest in technology based market-information systems, such as a web portal under NFA site, that advertises PNG products and provides lists of producers;

d. research and provide information on consumption patterns, market trends and emergence of new markets and products.

2.10. Aquaculture Food Quality and Safety

Improved product quality enhances product safety and nutritional value. Incentives for this are potentially higher prices, increased product demand and related benefits. This can be achieved through;

a. promotion, application and adoption of international food safety standards in line with international requirements, such as the EU requirement for HACCAP.

b. adopt international protocols for residue monitoring in aquaculture products. Residue monitoring of mercury, organo chlorides, antibiotics, hormones, pesticides, etc.,

c. informative labeling of aquaculture produce including information on feed additives, growth promoters and other ingredients used in aquaculture production.

d. collection, analysis and dissemination of relevant information to enable producers to make informed decisions and ensure customer confidence in food safety of aquaculture products from PNG.

3. AQUACULTURE DEVELOPMENT MONITORING AND CONTROL

Monitoring of aquaculture development activities is indispensable in ensuring that operators are operating within established guidelines and regulations. These can be achieved through;

3.1. Licensing

Section 41 (1) of the Fisheries Management Act of 1998 (hereafter called "the Fisheries Act or Act") requires that all commercial fishing activities including commercial aquaculture operations be licensed. Therefore under this policy, the aquaculture facility licence is applicable. However for operations processing and exporting their produce, the fish processing facility and export facility licences are applicable. Except otherwise specified all provisions of the Fisheries Act and Fisheries Management Regulation of 2000 (FMR) as in force from time to time, regarding these three licences are applicable;

a. This policy does not cover the culture of crocodiles and turtles since they fall under the jurisdiction of the DEC. Licence applications for culture of these animals should be directed to DEC;

b. NFA shall collaborate closely with DEC for fast processing of aquaculture licence applications, especially when DEC approved EIA is a perquisite for licensing large commercial operations as specified in Section 1j – 1m. Applicants must ensure that they meet all relevant requirements for respective authorities before submitting licence applications;

3.1 1. Aquaculture facility licence

a. All commercial aquaculture operations with an annual production turnover of 10 tonnes or more or utilizing more than 1 hectare of land or water surface area, whether in sole use for aquaculture or multiple use for other activities must be licensed;

b. Small non-commercial or semi-commercial projects with an annual production capacity of less than 10 tonnes require no national licence to operate. However, they must be registered financial members of a Provincial Fish Farmers Association. Their farming operations must satisfy any Provincial or LL Government requirements and must comply with national guidelines/regulations;

c. All sea cage, pear/pearl shell, oyster, aquarium species and other species not covered in 3.1.1a and 3.1.1b and deemed appropriate by the Managing Director must be licensed regardless of size;

d. Aquarium dealers, whether small or large require licence to operate. Licensing requirements for aquarium fish should comply with the Aquarium Fish Management Plan. Import of all exotic species for the aquarium industry must comply with all NFA, DEC and NAQIA requirements;

e. Aquaculture licences shall be issued for a period of 10 years but subject to review annually. The operator shall pay the annual licence fees annually as specified in the FMR or as in force from time to time. Any operators violating the terms of the licence will be penalised as specified in the FMR. The Managing Director may impose additional penalties depending on the severity of violation;

f. The operator/owner shall indemnify the NFA against any legal suit arising from any environmental, social or other impacts due to the operator's aquaculture activities.

3.1.2. Licence Application

a. Unless otherwise specified all conditions and procedures for licence application outlined in the FMR are applicable. Applicants must therefore be familiar with the FMR and the Fisheries Act and all licensing conditions set out therein;

b. In addition licence application must accompany; a) a DEC issued water use permit, b) a project proposal, which shall include a DEC approved EIA plan as specified in Section 1j – 1m and c) with a Business Plan;

c. The Business Plan must describe the manner in which the applicant(s) propose to conduct aquaculture, outlining the project's commercial nature, viability and long-term strategy of the operation. Large-scale operations (>100 tonnes annual production output) must include plans on how they propose to involve local community participation in the development;

d. Applicant(s) must be a PNG company or a PNG registered company. Proof of incorporation certificate and list of shareholders from IPA showing percentage of ownership must be accompanied with the application.

e. Licence applications must accompany endorsement from resource owners and or Provincial Executive Councils (PEC) or proof of ownership of the land on which the proposed development will be conducted. Although PEC endorsements are acceptable, endorsements from resource owners are preferred;

f. In addition the application must specify the following information;
   - ?? The location of the farm,
   - ?? The species and/or strain cultured/proposed for culture,
   - ?? Disease history of cultured/proposed species,
   - ?? Movement of live aquatic organisms to and from the farm,
   - ?? List of chemicals (antibodies, prophylactics, waste water treatment drugs, sanitation drugs etc), used/proposed for use on the farm, their use and their implications to human health and the natural environment.

3.1.3. Fish Factory Facility and Export facility Licences

a. In addition to aquaculture facility licence all commercial operators planning to process their produce on site will require a fish processing facility licence. Operations selling their whole crop immediately after harvest to fish buyer with an approved fish processing facility licence require no facility licences;

b. Where operators export their produce they shall require an export licence as required by the Fisheries Act and the FMR;

c. The licensee shall comply with all provisions of the Fisheries Act and FMR as in force from time to time and other requirements which the Managing Director may impose depending on the type of facility as appropriate during the issuance of the licence

3.2. Quarantine

Given the disease-free status of the PNG aquaculture industry and the potential risks associated with diseases, NFA shall endeavour to ensure that it is protected against any major diseases that have devastated aquaculture industries elsewhere. However, all animal and plant quarantine is a function of NAQIA by an act of Parliament, thus NFA will collaborate closely with NAQIA on fish quarantine matters relating to issuing of import permits, domestic translocation of species, disease testing and identification, disease control and other related matters.

3.3 Environmental Certification

DEC is the agency responsible for matters relating to environmental protection. NFA shall collaborate with DEC to facilitate proper completion and approval of EIA plans for speedy processing of aquaculture licences. Unlike Western countries, most land and water resources in the Pacific are tribally/communally owned. Any operator proposing to develop aquaculture must seek approval/endorsement from traditional resource owners and/or the provincial government or must have the property leased to them.

Provincial and LLGs must ensure that streams, rivers and other water bodies are not polluted. To ensure that projects are environmentally sustainable, NFA shall screen license applications to ensure that proposed projects are established in areas free from potential disputes. Proposals considered to be highly likely to cause disputes with resource owners shall be rejected or referred for endorsement from resource owners or parties concerned.

4. NATIONAL GUIDELINES FOR AQUACULTURE OPERATIONS

All aquaculture operations must comply with national guidelines and regulations relating to:

4.1. Aquaculture Activities

a. Release of aquaculture-raised organisms into the natural environment, including reseeding is prohibited unless with prior written authorization from the Managing Director;

b. All operators must exercise appropriate caution to prevent escape of culture organism into the natural environment. Mass escape of culture organisms into the natural waterways should immediately be reported to NFA, stating the cause and time of escape;

c. For reasons of bio-security and genetic pollution of indigenous species, culture of transgenic (genetically modified) organisms is prohibited, unless with prior written authorization from the Managing Director. This includes attempts to genetically alter organism under culture for improved culture performance.

d. For disease prevention and environmental pollution including prevention of fish kills, all wastewater from aquaculture facilities must be discharged into settling ponds and

appropriately treated before discharging. Such settling/treatment ponds must be located in areas restricted from public access and sheltered from flood/heavy rains;

e. Where such is impossible especially for flow through systems with high water exchange as that of intensive trout culture, appropriate treatments must be done prior to discharge. The type of treatment shall be determined by the Managing Director depending on circumstance and with advise from the National Aquaculture Development Monitoring and Advisory Committee (NADMAC);

f. For cage culture operations, cages/rafts/lines etc. must be placed in areas away from areas of communal use such as boating or recreational fishing to avoid conflict between different user groups.;

g. For prevention of fish kills and eutrophication of water bodies, cages/rafts/lines etc. be located in areas where there is sufficient water mixing to disperse wastes from culture sites;

h. Capture of fish species (brood-stock, fingerlings, spat etc.) from the wild for use in aquaculture operations is prohibited unless with prior written authorization from the Managing Director. This maybe in the form of written authorization, fishing license or a condition of the aquaculture licence;

i. Operations culturing indigenous species must comply with the relevant management plans in operation at the time;

j. Disease outbreaks should be reported immediately to NFA and NAQIA stating the time of occurrence, disease symptoms, culture conditions, water quality parameters at the time of diseases and other necessary information;

k. For disease identification purposes fresh moribund specimens of sick fish/organisms chilled on ice should be freighted to the NAQIA laboratory manger preferably within 24 hours. Samples should not be frozen or have been dead for more than 24 hours;

l. On identification of the disease, NFA and NAQIA may decide the fate of the culture organisms. In cases where the disease is considered a threat to the national aquaculture industry, all culture organisms maybe destroyed and the culture facility disinfected;

m. During a disease outbreak the whole culture pond or facility must be isolated from other farms or ponds. All equipment used must be either properly disinfected or incinerated destroyed. Prior to reoperating final inspection and approval must be obtained from NAQIA and NFA. For offshore cage culture caution should be exercised to prevent accidental transmission to other farms via contaminated equipment or clothing.

4.2. Importation/Translocation of Fish or Aquatic Organisms

In an event that an operator wishes to import certain aquatic organisms for the purpose of aquaculture/aquarium industry, the following guidelines must be followed in conducting the import;

a. NAQIA is the legally mandated authority to deal with all animal translocation and quarantine issues, thus all individuals wanting to import or translocate aquatic organisms should be familiar with and comply with all NAQIA conditions;

b. Importation/translocation of aquatic organisms for the purpose of aquaculture, reseeding and aquarium industry require an import permit issued by NAQIA subject to conditions set by NFA and DEC. All importers should be familiar with NAQIA's general import condition Agriculture Quarantine circular No. 1 and the "Animal Quarantine Circular No. 19/99" before considering any import;

4.3. Quarantine

NAQIA is the legally mandated authority to deal with animal quarantine issues, thus all concerned parties should be familiar with and comply with all NAQIA fish quarantine conditions.

5. AQUACULTURE DEVELOPMENT PRIORITIES

5.1. Artisanal/Subsistence Aquaculture

Artisanal/subsistence aquaculture is an important component of aquaculture development. However, given the infrastructural and staffing requirements for research and extension and the corporate status of NFA, the development of this sector shall be facilitated through collaboration with key agencies. NFA shall assist/facilitate these key agencies to implement their artisanal aquaculture programs. The main goal is to eliminate rural poverty and improve living standards through increased fish productivity and availability.

a. Trout

Trout is an important aquaculture species in high altitude areas. Given the high interest in inland areas where the bulk of the population reside, artisanal trout culture shall be perused through DAL Food Security branch and other key agencies. Current production potential from existing operations based on pond area is around 250 tonnes valued at K4 million (wholesale price of K16/kg). However, this potential is not realised due to technical difficulties of fingerling availability, feed and extension, fingerling transportation and training. To realize this potential production, the following priorities are proposed;

i. Correct the current problem of acute fingerling shortage by facilitating key agencies and interested stakeholders to establish trout hatcheries in easily accessible central locations such as Goroka and Mt. Hagen;

ii. Formulate and develop a suitable and affordable trout feed utilizing locally available ingredients such as fish meal from tuna canneries. Reduced feed costs would increase production, reduce retail price and other related benefits. Currently LPYTF is importing trout feed from Australia at a cost of K5000 per tonne landed in Madang. This price is beyond the reach of most average farmers;

iii. There is some possibility of exporting trout targeting niche markets such as, under eco-labelled or organic trout or value added products such as smoked trout. These opportunities be researched and their viability assessed in collaboration with reputed organization such as INFOFISH;

iv. Given the disease free (viral) status of PNG trout, the pristine tropical environment and the biannual trout-breeding seasons, there is potential to export disease free and eco-friendly trout eggs overseas. This potential be researched and encouraged.

b. Semi-commercial tilapia culture

Tilapia species are hardy and require little technical management, thus are ideal species for village based small-scale operations. Recently the genetically improved strain of the Nile tilapia (*Tilapia nilotica)* was imported from the Philippines. This stain is fast growing and late maturing, thus reduces the problem of overcrowding and stunted populations experienced with other strains. Trial culture in Aiyura, Yonki and Erap proved both economically and technically feasible. It is envisaged that this species will have a big impact on the artisanal aquaculture in PNG. To facilitate this, the following priorities are proposed;

i. Production of all male tilapia fingerlings - Tilapia is a prolific breeder and causes stunted populations in mixed sex culture operations. The use of all male tilapia culture has proven economical overseas using super male tilapia. Thus NFA shall facilitate seed production of all male progeny by private farmers or key agencies;

ii. Semi-commercial tilapia culture by village based family operations be encouraged;

iii. Facilitate the establishment of a central collection, processing and marketing operation by the private sector, DAL or NFA to collect and market tilapia produce;

iv. There is some limited market for *T. nilotica* traded as Saint Peter's fish in Australia. The feasibility for utilizing this market be researched and encouraged if feasible;

c. Selection of better performing species

NFA shall facilitate the importation of other economically/socially important species such as Chinese carps, which can serve as alternative species to carp, tilapia and rainbow trout currently culture in inland areas. In addition facilitate research on aquaculture potential of indigenous species and already introduced exotic species.

d. Seaweeds

Seaweed culture, especially *Eucheum* and *Kappaphycus spp*. require low input and has major potential for development at the village level, especially on outer islands where there is no other income generating activities. NFA in collaboration with key agencies and interested stakeholders shall facilitate seaweed cultivation, processing, collection and export. Licensing (buyer licence) and marketing will be similar to Beche-de-mer. Initially NFA/provincial governments may facilitate the buying and marketing of dried seaweed.

In addition a resource survey of indigenous seaweeds shall be conducted and those of social and economic importance be identified for culture. There is also the option to introduce and culture of other commercially important species apart from *Eucheuma* and *Kappaphycus spp,*. whose culture is already established in other countries.

e. Aquarium species

Recently there has been a surge in demand for several aquarium fish species. Of notable importance is the Saratoga *(Sclerophages gardinii)*, a freshwater species found in the Bensbeck and Fly River Systems of the Western Province. It is reportedly fetching up to US$100.00 per 5 gram fingerling in Europe. Unconfirmed reports indicate its illegal exploitation and trade across the border in West Irian, which has seen the depletion of wild stocks in the Bensback River System and now stocks in the Fly River system are under stood to be under threat of depletion.

NFA has received licence application to trade in live Saratoga from a company on a fly in fly out basis with the Obo fish project in Middle fly. However, given the species' limited distribution and it's suspected over exploitation, NFA shall ban its trade until such time when the species' current population structure in the wild is determined and or the technical feasibility of domestication and culture is established. Domestication and culture of the species will provide control on the market of this species as well as restocking the depleted wild stock.

Rainbow fishes belonging to the family Melanotaeniidae are another group of freshwater fish, which are commercially significant in the aquarium trade. PNG boasts a total of 38 species of rainbow fish of which 8 species are reported to be traded on the international aquarium market with little benefit to PNGans. Thus research into breeding and domestication of indigenous rainbow species for the aquarium trade be pursued. Not only known species but there are probably other undiscovered rainbow species in PNG that have not been discovered.

Other aquarium species such as giant clams, sea horse and other similar species of importance in the aquarium industry shall be pursued.

5.2. Commercial Aquaculture

a. Aquaculture of Marine Prawns

i. There is great potential for commercial aquaculture of marine prawns targeting the export market. Current annual production from the wild is around 1,000 metric tonnes, which is exported as frozen headless prawns. This quantity is probably the carrying capacity of the

fishery and cannot sustain additional catch. Thus aquaculture production can increase prawn exports, probably double or even quadruple current prawn export volume.

ii Aquaculture produced prawns can target the Japanese sashimi and sushi markets in addition to the traditional markets. There is also potential for export to the European Union and US Markets. Prawn producers in Asia are now hit by diseases and the subsequent high levels of antibiotic residues in cultured prawns, which have resulted in banning of Asian prawn exports to the EU and US markets. PNG has some competitive advantage given its disease free status as well as absence of antibiotic residue levels in aquaculture prawns.

iii. *Environmental care* - The Asian experience has proven prawn aquaculture to be environmentally destructive (destruction of mangroves and nursery grounds), thus prawn culture should be pursued with caution and in an environmentally friendly manner with a view to produce eco-friendly prawns. Other issues such as diseases and antibiotics residues must be considered when developing prawn culture. Domestic supply of post larvae (PL) is a prerequisite to developing a disease free prawn culture industry. Therefore NFA shall facilitate the establishment of prawn hatcheries to domestic culture species such as the giant tiger prawn (*Penaeus monodon*), banana prawns (*P. merguiensis*), Indian banana prawns (*P. indicus*), brown tiger prawns (*P. semisulcatus*) and other species of commercial significance.

iv. *High Investment Costs* - Initial capital investment and operational costs for prawn culture involve large financial investments in the order of K5 million or more which is beyond the average PNG farmer's capability. Therefore where possible NFA in collaboration with the Investment Promotion Authority (IPA) seek foreign investment for joint venture projects or establish credit facilities to help fund prawn aquaculture operations.

b. Barramundi

Cage culture of Barramundi has been proven feasible by the Bismark Barramundi project in Madang. All barramundi culture should comply with the Barramundi Management Plan. Given the current high interest in barramundi culture, all caution should be exercised in establishing net cages and ponds for barramundi faming.

c. Tuna (big eye, yellow fin etc.), Cobia, Mahi-mahi (Dolphin fish) etc.

Recent technical advances in off shore cage culture of tuna, dolphin fish and other pelagic species look promising and probably have potential for development in PNG. Given the high technical requirements and capital input, foreign and domestic investment shall be encouraged. Unlike capture fishery, high value species like tuna can be processed immediately, just hours before freight to niche markets such as the sashimi and sushi markets in Japan.

d. Oysters and mussel culture

Oysters are cultured in the Pacific (New Caledonia, Australia and New Zealand). In PNG some limited culture trials were initiated in Milne Bay Province but abandoned due to problems of predation, silting and other factors. NFA has received requests for technical assistance on oyster and mussel culture in New Ireland and Milne Bay Provinces. Thus Oyster and mussel culture potential in PNG be researched and interested operators encouraged. Caution should be exercised to prevent viral and bacterial contamination as well as poisoning due to red tides (algal blooms), which pose a health threat.

e. Freshwater Prawns

Although not as lucrative as marine prawns, culture of freshwater prawns especially those of the genus *Macrobrachium* be pursued for the domestic market as well as some limited export potential. Culture techniques have been established and can be adopted by the knowledgeable farmer. In comparison to marine prawns *Macrobrachium* spp. are hardy and easy to culture.

f. Yabbies.

There has been some interest in the culture of the freshwater crayfish utilizing both indigenous *Cherax* species (in the Western Province) and the popular Australian red claw, *Cherax quandricarinatus*. Research into their culture be identified and pursued in collaboration with regional institutions based on demand from the private sector. However both domestic and overseas markets be assesses before pursuing their culture.

g. Groupers, Cods, Snappers, and other species

The culture potential of groupers, mullets, cods and other species of social and economic importance be identified and their culture pursued, provided there is demand from the private sector and inline with overall NFA policies. With the increase in live reef food fish trade, there is the possibility of over-exploitation, therefore seed propagation culture and restocking of important live reef food fish should be pursued.

h. Sedentary Resources

Sedentary resources such as beche-de-mer, green snail, giant clams, trochus, etc., are important artisanal fishery and heavily exploited by majority of the coastal rural population. Their sedentary nature and the difficulty in enforcing management plans make these species highly susceptible to overexploitation. Thus seed production and reseeding programs shall be pursued in collaboration with provincial governments, reputable research organizations and private facilities such as CSMC. However caution should be exercised to minimise species contamination. The aquaculture potential of these sedentary species should also be investigated and encouraged, provided there is sufficient demand from the private sector and consistent with overall NFA policies.

i. Pearls/Pearl Shell

Pearls are a lucrative jewellery industry globally. NFA shall facilitate the expansion of the existing operations, research into spat availability, seed propagation, site selection, culture techniques and other related research to enable the industry to develop. These shall only be implemented provided there is demand and consistent with overall NFA policies.

j. Eels

Six species of freshwater eels of the genus *Anguilla* are found in PNG waters. Anecdotal reports indicate annual migration of large numbers of elvers up the Sepik. The possibility of utilizing these elvers for aquaculture should be researched and encouraged. NFA shall facilitate collection of baseline information on the seasonality, abundance and areas of recruitment of commercially important species for aquaculture purposes.

6. AQUACULTURE RESEARCH PROGRAMS

6.1. Aquaculture Research and Development Company

a. NFA initiate and establish a aquaculture research and development company under the Authority, with the purpose of undertaking applied research to provide quality advise on aquaculture developmental options and planning based on NFA policies. The company shall be staffed by a team of multi-disciplinary people, drawing from the formal and informal sectors. A project approach shall be adopted to implement policies. The company will operate on business principles in terms of expected productivity and meeting set objectives of the Authority. Funding will be sought from the private sector as well as government and donor funding;

b. Up to the year 2010 that PNG draw upon international expertise in aquaculture to undertake applied research. Employment may be through short job contracts or for longer periods depending on research requirements. Most experts will be employed under the Aquaculture Research and Development Company. The employment costs are to be considered for cost sharing with sponsor governments. This is to be phased out once PNG is considered to be technically equipped in all target tropical species. However, research should be considered through private sector companies making data available to the NFA;

c. That NFA undertakes applied research that meet the needs of aquaculture and that these projects are properly researched and appraised and documented showing costs and expected outputs;

d. That NFA is the owner of all applied aquaculture research results and where several works are being reported; that the cover of the Research Bulletin etc. must state that the work is the report of the Research activities of the NFA. The Board reserves the right to decide if a scientific research can be internationally published as public monies are spent to provide information to better PNG not for individual pursuits of academia.

6.2. Possible Programs for Aquaculture Research

a. Seed propagation

Seed for aquaculture is a prerequisite for aquaculture operations. Given the risks associated with importing aquaculture seed, it is imperative that PNG produce all its aquaculture seed domestically. Therefore, NFA shall facilitate the establishment of domestic seed production facilities for all aquaculture species where feasible. This will involve establishment of seed propagation techniques for both indigenous and exotic species of importance to aquaculture and stock enhancement purposes. Species for immediate consideration include; Genetically Improved Farm Tilapia (GIFT) (all male tilapia), trout, pearl oyster, marine prawns (*P. monodon)*, the giant freshwater prawn (*Marchrobrachium rosenbergii)*, beche-de-mer, trochus, green snails, and giant clams;

b. Feed development.

Aquaculture feed development with a view to reducing feed costs and increasing aquaculture production is one of the strategies proposed for aquaculture development. Therefore where feasible both technically and economically research into feed formulation and development shall be pursued. Depending on demand research shall include specialized feed development, for instance larval or brood stock feed.

c. Research into aquaculture potential of indigenous species.

The aquaculture potential of indigenous species for both commercial and social importance be researched. Aquaculture potential of commercially important food fish such as groupers, snappers etc. for the live reef food fish trade be investigated.

d. Technical feasibility studies for aquaculture projects.

Major aquaculture operations require feasibility studies on economic, technical and environmental sustainability before their establishment. Often average interested PNGans lack skills and funds to fund such technical studies. Therefore NFA shall commission studies on the technical and economical viability of farming certain aquaculture species, for instance, the technical and economical viability of prawn farming in PNG.

e. Diseases.

Currently there is no major disease problem affecting the aquaculture industry in PNG. Given the anticipated aquaculture development and intensification of culture activities, diseases are expected to occur. Under such NFA shall in collaboration with NAQIA and reputed institutions both domestically and overseas to conduct research into possible disease treatments disease methods and development of disease resistant strains.

7. AQUACULTURE MANAGEMENT AND CONSULTATION

To develop and effectively manage aquaculture in an economically, socially and environmentally sustainable and manner, the following bodies shall either be established by NFA or NFA shall facilitate their establishment by the private sector.

7.1. National Aquaculture Development and Management Advisory Committee

NFA has recently established the NADMAC as provided for under section 16(5) of the *Fisheries Act*. It is comprised of representatives from the private sector (farmers; both commercial and

subsistence), provincial governments, other line departments (DAL & NAQIA), universities, NFA and other stakeholders. The body is responsible for;

a. The identification and discussion of management problems and possible solutions for issues affecting the national aquaculture industry. NADMAC is expected to bring together a truer perspective of aquaculture development from different stake holder groups and organizations so that a wide range of issues are considered before any developmental and management recommendations are agreed upon;

b. NADMAC shall provide ongoing advice on the development and management of aquaculture sector in the country and give advice on the inland fishery if directed by the Managing Director;

c. NADMAC shall also serve as the body responsible for controlling import of aquaculture organisms, feed and fish for environmental and quarantine reasons as outlined in the Aquaculture Development Strategies. These shall be done in collaboration with NAQIA;

d. NADMAC will be responsible for determining aquaculture practice guidelines and code of conduct in the aquaculture industry;

e. NADMAC shall appraise all new commercial scale aquaculture ventures and provide formal comment to the Managing Director.

7.2. Fish Farmers' Associations/Aquaculture Cooperatives

Initially NFA shall facilitate the establishment of Fish farmers' association with a view to assist farmers to collaborate with one another on issues affecting aquaculture development. This may include lobbying for assistances; research or management plans etc., which are of benefit to the sustainable development of the industry. As the aquaculture sector grows, NFA may consider facilitating the establishment of Aquaculture Cooperatives with a view to establish support industries such as feed and equipment supply industries, a central collection, processing and marketing operation and possibly fund applied research. The cooperative may look at niche marketing potentials such as; organic aquaculture products, eco-labelling and other selling points for unique PNG produced aquaculture products.

7.3. Aquaculture Newsletter

NFA will produce an aquaculture newsletter, which will serve as a medium to exchange news and information on aquaculture developments and issues in the country. It will also be a means for farmers and all interested stakeholders to express their views and their experiences on aquaculture development in the country.

8. RESEARCH AND OTHER SUPPORT SERVICES

a. Nago Island research facility

The proposed Nago research facility will be the main NFA mariculture research facility. It will conduct research into seed propagation, culture methods, feed and other aspects of aquaculture of marine organisms of socio-economically important species. Research will be conducted in collaboration with interested organizations and donors depending on demand from the private sectors (farmers).

b. Coral Sea Mariculture Hatchery Facility

From time to time as the need arises NFA shall facilitate collaborative research with the facility and interested stakeholder into propagation of beche-de-mer, trochus, giant clams and other sedentary resources for stock enhancement purposes as well as trial culture of important species.

c. Bismarck Barramundi Project Facilities

Facilitate collaborative research and extension on barramundi culture, fish and prawn culture, barramundi feed development and others. Collaborative research on aquaculture aspects with postgraduate students from educational institutions in the country.

d. DAL Erap – Facility

As part of its food security program DAL has established a lowland aquaculture station at Erap. NFA as part of its overall development shall conduct/facilitate expansion of the facility and assist DAL to conduct applied aquaculture research and carryout extension work on the lowland areas.

e. Highlands Aquaculture Development Center

This covers the Aiyura and Yonki cage culture projects. Formerly they were NFA's main freshwater aquaculture research stations but were transferred to the department of Eastern Highlands. In 2003 EHP, DAL and JICA have signed a MOA to conduct collaborative aquaculture research, training and extension for inland aquaculture development. NFA shall facilitate/assist with the Centre wherever possible to achieve these.

f. Credit Facilities

i. Given the high facility establishment and initial operation costs required by aquaculture operations, there is a need to establish/facilitate credit for the average farmers. At present financial institutions are reluctant to fund aquaculture operations due to its uncertain future, aquaculture is a new activity. NFA should therefore investigate the possibility of facilitating soft loans through the Rural Development Bank or other commercial financial institutions in the country;

ii. To enhance confidence in aquaculture by financial institution, NFA fund/facilitate feasibility study on the economic and technical viability of specific aquaculture operations under PNG conditions. Such studies should outline market conditions both domestically and overseas;

iii. Facilitate donor or other assistance such as the Incentive fund assistance for projects that are of benefit to a bulk of the population.

9. GOALS FOR AQUACULTURE DEVELOPMENT

a. Satisfy current demand for aquaculture seed by facilitating the establishment of hatcheries by the private sector, or key line agencies for socially important species such as rainbow trout, carp, and GIFT tilapia in central locations, preferably one for the lowlands and one in the highlands. This should be achieved by the end of 2004.

b. By the year 2010, establish a prawn culture industry that is self-reliant in post larvae production. Target to out produce total annual catch from the wild, i.e. production should exceed the 1,000 metric tonnes caught from the wild annually

c. By the year 2020, total aquaculture production be increased to 10, 000 tonnes per year; 3000 tons of which should be low-priced fish for low-income groups.

d. By end the end of 2004, that this aquaculture policy may be adopted.

e. By the end of year 2004, that an aquaculture strategy and plan be established to state developmental options, identify potential aquaculture sites, education and training of human resources.

f. By year 2010, suitable and affordable feed for important commercial aquaculture species such as trout, tilapia, prawns and barramundi be sourced or developed and manufacture domestically by the private sector.

g. Gain access to overseas markets and establish reputation that PNG aquaculture export products are of superior quality and meet international quarantine and phyto-sanitary requirements.