

# Promotion of sustainable commercial aquaculture in sub-Saharan Africa

## Volume 1: Policy framework



Food  
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# Promotion of sustainable commercial aquaculture in sub-Saharan Africa

Volume 1: Policy framework

by

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## PREPARATION OF THIS DOCUMENT

As a part of its efforts to contribute to alleviation of food insecurity, hunger and poverty, the FAO Fisheries Department is promoting sustainable commercial aquaculture. The goal is to assist developing countries, with emphasis on sub-Saharan Africa, to develop and implement policies that encourage the emergence of private entrepreneurship in aquaculture. It is within this framework that this document was prepared.

Background information was obtained from reports on studies of commercial farming commissioned in Côte d'Ivoire, Nigeria, Malawi, Zambia, Mozambique, Madagascar, Costa Rica and Honduras, which were conducted by the Department and led by the Fishery Policy and Development Planning Service (FIPP). Available literature on commercial aquaculture from elsewhere was also used.

## FOREWORD

This report is the first of two volumes that will examine policies to promote commercial aquaculture in sub-Saharan Africa. In addition to discussing the concept of sustainable commercial aquaculture, its benefits and pitfalls and prerequisites for its development, the report provides a general survey of promotional policies intended to give impetus to aquaculture. Some of these policies can be applied also in sub-Saharan Africa.

FAO is pleased to present these policies as an overall guide to decision-makers. Professor Neil Ridler, a visiting scientist of the University of New Brunswick, Canada, and Nathanael Hishamunda of the FAO, Fishery Development Planning Service, prepared the report. I would like to recognize their invaluable efforts. FAO staff members: Annick Van Houtte, John Moehl, Mathias Halwart, Audun Lem, and Alhaji Jallow contributed precious advice and useful comments.

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#### ABSTRACT

The aim of this paper is to examine policies to promote commercial aquaculture, especially in sub-Saharan Africa. Commercial aquaculture is defined as the rearing of aquatic organisms with the goal of maximizing profit. Commercial aquaculture contributes to food security, directly by producing food fish, and indirectly by generating employment and income for the purchase of food. It can also contribute to a country's balance of trade as an export, or as an import substitute, and can be a source of tax revenues and a stimulus to technological advances. Commercial aquaculture may also bolster the development of isolated regions, thereby discouraging outward migration. Since it depends on private rather than public funds, it can be sustainable; its sustainability depends on adequate use of resources rather than tax revenues. However, some forms of commercial aquaculture, especially coastal shrimp farming, can cause environmental costs and social conflicts.

For commercial aquaculture to develop, macroeconomic conditions, and cultural and political attitudes must favour entrepreneurship. Cultivation practices must also be environmentally friendly. In sub-Saharan Africa, stabilization or decline of the capture fisheries, growing shortage of fish for domestic consumption, opportunities for exports, suitable land and water, and cheap labour combine to produce prospects for commercial aquaculture development. However, the sector is generally very small in some countries, or has not taken off. It is hampered by difficult access to credit, shortages and high cost of feed, lack of good quality seed, and a low flow of domestic and foreign capital to fuel investments in the sector. A mix of good governance, openness to trade, macroeconomic growth policies, emphasis on private investment as a source of wealth, guaranteed land security, tax exemptions and tax holidays, loan guarantees, debt-equity swaps, promotion of large farms, producer associations, strategic planning, and existence of transparent regulatory procedures are key ingredients in attracting investors to commercial aquaculture and in positively influencing long-term development of the sector in sub-Saharan Africa.

## **PART I. THE CONTEXT OF COMMERCIAL AQUACULTURE**

### **CHAPTER 1**

#### **INTRODUCTION**

##### **Justification and Objective of the Study**

FAO's latest studies on future demand for, and supply of, fish and fishery products predict a sizeable increase in demand for fish. The majority of this increase will result from expected economic development, population growth and changes in food habits (Ye, 1999). Supply from capture fisheries is expected to remain constant, or even to decline (FAO, 2000). Indeed, fish supply from the capture fisheries in most countries is believed to have reached or be close to the maximum sustainable yield. This suggests that an increase in aquaculture fish supply could help reduce the expected shortage of fish and the consequent relative price increases, thereby making fish available to a wider range of consumers. Aquaculture can also provide jobs, which generate income for the purchase of food and other commodities, thereby increasing food security and contributing to alleviation of hunger.

Experts agree that, with existing resources and technological advances, fish output from aquaculture can be sustainably expanded. Africa is well situated to be a part of this expansion. In terms of resources, Africa possesses vast inland waterways, with the larger bodies covering 520 000 km<sup>2</sup>. About 43% of continental Africa is assessed as having the potential for farming tilapia, African catfish and carp. Almost 15% of that area is the "most suitable", with possible yields of up to 2.0 crops/year for Nile tilapia and 1.7 crops/year for African catfish. Nearly 23% of the land area in southern Africa is suitable for commercial tilapia and African catfish farming, with less than 5% being used (Kapesky, 1994; Nath and Aguilar-Manjarrez, 1998). In addition, most countries in Africa have relatively cheap labour.

Yet, in 1998, Africa, which is home to about 12% of the world population produced an estimated 185 817 tons of fish, crustaceans and molluscs, contributing only about 0.6% of world output (FAO, 1998). Experience in Asia where about 89% of aquaculture output was produced, and elsewhere demonstrates that aquaculture developed because it was mostly commercially oriented and benefited from enabling environment. Enabling environment consisted of sound government policies. The overall goal of this study is to survey policies which were used to promote commercial aquaculture in different countries. The specific objective is to examine policies that could be used to promote commercial aquaculture in countries where it has not started, and to consolidate this activity where it exists but has not yet been firmly established. Special emphasis is placed on sub-Saharan Africa.

##### **Methodological Framework**

Information reported in this document came from two sources. Studies were commissioned in sub-Saharan Africa and Latin America. Countries in which the studies took place include Côte d' Ivoire, Madagascar, Malawi, Mozambique, Nigeria, and Zambia in Africa, and Costa Rica and Honduras in Latin America. In 1998, farmed fish from these six sub-Saharan African countries accounted for more than three-quarters of output from the Region<sup>1</sup> (FAO,

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<sup>1</sup> Throughout the text, "Region" refers to sub-Saharan Africa.

1998). The studies in Africa were aimed at gaining a thorough understanding of the socio-economic, marketing, policy, legal, regulatory and institutional aspects of commercial aquaculture. In Latin America, the goal was to learn from non-African experiences and to examine which of these experiences could be applied in Africa. Economic, political and policy factors that were conducive to the development of the aquaculture industry in these Latin American countries were analysed.

To provide a bottom-up participatory process to policy formulation, a consultant was recruited for each study to interview farmers and other stakeholders. Most of the consultants were nationals of the country studied. Survey instruments were elaborated to collect information. Because, in some countries, there is no database to confirm the total number of farms, sampling techniques had to be rudimentary. Moreover, budgetary restraints precluded exhaustive surveys. However, the surveys generally covered more than one region in each country, and a random sample of sustainable commercial farms within each region selected.

Farmer interviews identified constraints, markets and potential policies in addition to collecting technical and financial data. Farmers were asked what would prevent them from expanding their operations and what constraints faced new entrants into the industry. Attempts were made to clarify market demand and other factors necessary for successful commercial aquaculture. Farmers were asked to suggest policies that would promote the industry. Only farms with a commercial or business orientation and which appeared "sustainable" were included in the survey.

Sustainability required that a number of criteria be met. To be sustainable, a farm must be financially independent, be socially acceptable and be environmentally neutral. Thus, sustainability according to the criteria above, depends in part on the time frame. Short-run appearances of sustainability may be deceptive if negative economic, environmental or social impacts take time to materialise. In order to take into account the time dimension, it was assumed that only farms which have operated for at least three years without direct government or other financial grant have indicated sustainability. Such a period is clearly arbitrary, but only farms which met that condition were included in the national surveys.

To get an objective perspective of the industry and its constraints, other sources of information were considered desirable. Bankers, fish retailers and government officials were also interviewed. All were encouraged to give their suggestions about policies that might promote the industry.

Three species were the focus of the study, although the analysis and results can be extended to other species. The three species were tilapia<sup>2</sup>, catfish and shrimp. In 1998, they accounted for more than half of the aquaculture fish supply produced in sub-Saharan Africa.

## **About the Report**

The findings of the study are contained in four reports: (1) A policy framework for the promotion of commercial aquaculture in sub-Saharan Africa, (2) An analysis of economic feasibility of commercial aquaculture in countries surveyed including policy implications for the promotion of the sector, (3) A report describing markets and trade mechanisms of farmed

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<sup>2</sup> All genera (*Oreochromis*, *Sarotherodon*, *Tilapia*).



fish, and (4) A study of the legal framework within which commercial aquaculture could develop in sub-Saharan Africa. This Fisheries Technical Paper is the first of the two volumes of the report on policy framework for the promotion of commercial aquaculture in sub-Saharan Africa. This first volume is a general survey of promotional policies that have been implemented in several countries. The second volume will focus exclusively on sub-Saharan countries.

The report proceeds as follows. The first part discusses the concept of sustainable commercial aquaculture, the advantages and disadvantages of commercial aquaculture, and prerequisites for the development of commercial aquaculture. The second part presents policies to promote sustainable commercial aquaculture. These policies are discussed in terms of non-sector specific, sector-specific at the macro level, and sector-specific policies at the farm level. They are summarised as an overall guide to decision-makers. A short conclusion is presented at the end of the report.

## CHAPTER 2

### CONCEPT OF SUSTAINABLE COMMERCIAL AQUACULTURE

This text uses the FAO definition of aquaculture as the "farming of aquatic organisms, including fish, molluscs and crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. This study focuses on commercial aquaculture, especially commercial fish and crustacean (shrimp) farming.

Although many definitions are possible, this study defines commercial aquaculture as those fish farming operations whose goal is to maximise profits, where profits are revenues minus costs (perhaps discounted). Such operations may in fact not be profitable in the short run, but their behaviour is determined by the profit-maximising goal, and if unprofitable they will minimise losses. Commercial aquaculture is not an alternative to rural aquaculture<sup>3</sup> but rather a complement. If we view aquaculture systems as a continuum of economic activities from those exclusively oriented towards self-consumption to those that are exclusively oriented towards sale, one could argue that commercial aquaculture would be those operations whose output is exclusively for sale while the other extreme would be rural aquaculture, in which case rural aquaculture would mean subsistence aquaculture. Those farms which fall within the two extremes would be either rural or commercial depending on, inter-alia, the proportion of output sold or consumed. Yet, in rural aquaculture systems, producers may sell<sup>4</sup> all their fish and make some profits. They often perceive fish as a cash crop with which to purchase more desirable products, but the goal of rural aquaculture is less to maximise profits than utility and to disperse risks through crop diversification. Thus, though the producer's marketing and consumption behaviour is an important factor, the distinction between commercial and non-commercial aquaculture as used in this document does not hinge on whether fish is sold. It relies primarily on the existence or absence of a business orientation, and on how factors of production such as labour will be paid (Harrison, 1997)<sup>5</sup>.

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<sup>3</sup>Like commercial aquaculture, there is no universally accepted definition of rural aquaculture. Broadly speaking, rural aquaculture refers to the "poorest of the poor " aquaculture (very low cost/very low output) whereby most, if not, all of the output is consumed by the producer, and to the "less poor" aquaculture (low/medium cost, low/medium output) whereby most of the output is sold for economic profit (Martinez Espinosa, Manuel *in* FAO Aquaculture NewsLetter, November 1992, No. 2, pp. 6-10). Rural aquaculture, artisanal aquaculture and small-scale aquaculture are often used interchangeably. What is meant by rural aquaculture is again explained in Table 1.

<sup>4</sup> The produce from rural aquaculture is mainly intended for domestic consumption; large commercial farms are essentially export-oriented although there may also be domestic sales as with the dominant farm in Jamaica, Aquaculture Jamaica Ltd.

<sup>5</sup> The distinction between commercial operations, which maximise profits, and non-commercial farms which maximise utility, is not new. It has been used to explain the "dualistic" structure of agriculture (Ellis, 1988). This study expands it to aquaculture.

While non-commercial farms will be primarily family farms relying on the household for labour, commercial farms will tend to hire labour<sup>6</sup>. The source of hired labour may vary. Larger aquaculture operations tend to attract labour from distant areas, whereas medium-sized farms depend more on local labour (Mulluk and Bailey, 1996).

Perhaps because they have collateral, commercial farms can access institutional credit for capital purchase. Owners may also possess capital of their own to provide as equity, obviating the need for bank credit. On the other hand, non-commercial farms often have to rely on equity from family and friends (with its attendant high opportunity cost), or credit from informal moneylenders. Thus, commercial farms tend to have a lower cost of capital than non-commercial farms. Therefore, commercial farms will tend to have a higher wage to capital cost ratio than non-commercial farms. Hence, where there is substitutability of inputs, production techniques on commercial farms will be more capital and less labour-intensive than on non-commercial farms. In addition, because of greater capital intensity, commercial farms (particularly intensive industrial operations) will have higher output-land ratios or output-water ratios, or yields than non-commercial farms (SEMARNAP, 1999).

Different technologies and goals will determine a farm's location. Not relying much on purchased inputs, non-commercial farms can locate in rural areas; the output that is not consumed by the family will be sold to neighbours, often on the farm site. Commercial farms, on the other hand, must both acquire production inputs, generally important quantities, and sell their produce off the farm. These procurement and distribution requirements will require a site where roads are adequate and provide easy access to a good number of buyers if the produce is for domestic consumption. In many cases, this implies an urban or peri-urban location. For large-scale industrial operations that are fully integrated, both back-wards to feed and seed production and forward to processing and marketing, and produce for export, a rural and even isolated location is possible. It may even be preferable, because of lower production costs or better water quality. Shrimp that is produced in Madagascar is rated the best in the world in part because most farms are located in isolated areas where the farming environment is still unpolluted. The isolated location is also one of the means to minimise risks of diseases and theft. In addition, it may provide more liberty in the layout of infrastructure.

The above differentiation of the two aquaculture operations is compatible with classifications from a bio-technical perspective. On the one hand, non-commercial farms will tend to use extensive or semi-intensive aquaculture technologies (Ling *et al.*, 1999). On the other hand, commercial farms may range from enterprises applying semi-intensive techniques (in the case of tilapia, cultivation using both fertilisers and pelleted feed) to operations using intensive techniques (no fertiliser and only feed) (Pillay, 1997). Large industrial farms have better understanding and control of production technologies (Little, 1998). Table 1 summarises the principal distinctive features of commercial and non-commercial (rural) aquaculture.

Indicators of sustainable aquaculture are at the forefront of the literature. They include economic, social as well as environmental factors (Barg and Phillips, 1997; Tisdell, 1995).

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<sup>6</sup> Employment of hired labour does not preclude the use of family labour. A survey of shrimp farms in Thailand showed that a typical commercial farm had 1-2 family members in addition to permanent and part-time employees (Patmasiriwat, 1997).

That is, to be sustainable, commercial aquaculture must offer the prospect of adequate returns. This means that, not only should returns be positive, but also, they should be higher or at least comparable to those from similar activities. If no profits are generated, the farm will either close or have to rely on subsidies, which are a drain on government budgets. If profits are generated but are not at least equivalent to those from similar activities, farmers will have an incentive to leave the industry for better opportunities. The requirement that farms be profitable excludes farms which, because donor-funded, aim to maximise sales or output regardless of costs. Such farms often have not been sustainable once funds are withdrawn (Soma *et al.*, 1999). Hence, aquaculture must be self-sufficient financially. Second, the level of returns must be stable. That is, mortality rates and prices of inputs and outputs must not be too volatile. This is due to risk aversion behaviour of fish farmers and of potential creditors. Third, the farmed species and the methods of cultivation must be acceptable and meet general cultural, gender and social norms. This would suggest that the sector's benefits should accrue to a wide socio-economic spectrum and not be retained exclusively by a small elite. In extreme cases, profitable aquaculture has caused jealousy and led to social upheaval (Pillay, 1996). Similarly, the development of the sector has to co-exist with other activities, such as commercial fisheries. Religious concerns may also impede aquaculture. During the 1960s and 1970s, certain Indian states did not allow the stocking of fish in communal ponds because the Arya Samaj movement considered the harvesting of fish a sin. Attempts to do so actually led to violence (Bhatta, 1999). Fourth, aquaculture operations must be environmentally friendly over a long-time horizon. Sustainable development requires intergenerational equity. That is, the potential wellbeing of future generations is at least as high as the present. Intergenerational equity necessitates that both natural and man-made assets are at least maintained over time.

Table 1. Some of the principal characteristics of non-commercial and commercial farms

Main characteristics	Non-commercial farms	Commercial farms	
		Medium <sup>7</sup>	Large
Main Goal	Maximise family utility; risk diversification	Maximise profits	Maximise profits
Main Location	Rural/Suburban/Urban	Suburban/Urban/Rural	Suburban/Urban/Rural
Main Market	Domestic (Family/Rural)	Domestic (Middle income/Urban)	Exports; Domestic Urban
Inputs Main Labour Capital Seed Fertiliser Feed	Unpaid family labour Equity Mostly external None/organic None/wastes	Paid /Local area Debt and Equity Others' Hatcheries Organic Wastes/supplement	Paid/Local and distant areas Equity and Debt Own Hatcheries None or limited (inorganic) Balanced
Pond/System Size	Small ponds	Larger ponds	Larger ponds
Dependence to others' hatcheries	Low to medium	Medium to high	Low
Main beneficiaries	Family	Owner, traders, urban consumers, local population	Shareholders, processors, governments, contract farmers, local population
Some other stakeholders	Fish seed traders	Transporters	Co-users of inputs
Main constraints	Seed and feed	Seed, feed, credit	Costs of inputs, environmental quality control
Average Employment per unit of land/water (L/N)	High	Average	Low
Average Capital-Labour Ratio (K/L)	Low	Average	High
Average Output-Labour Ratio (O/L)	Low	Average	High
Average Wages	Low (imputed)	Average	High
Average Yield per unit of land/water (O/N)	Low	Average	High

<sup>7</sup> The size classification of farm will vary according to countries. In Zimbabwe, 3- 5 hectare farms represent medium-sized operations (Machena, 1999). In Jamaica, 1-4 ha tilapia farms are small; 5-20 ha operations are medium and 21 ha and above farms are large (Hanley, in press). This classification is adapted from Little (1998). In Madagascar, shrimp farms below 50 ha are classified as small (Hishamunda, 2000).

## CHAPTER 3

### ADVANTAGES AND DISADVANTAGES OF COMMERCIAL AQUACULTURE

Discussion of costs and benefits of commercial aquaculture provides insight as to why governments might recommend policies for the promotion of commercial aquaculture. Experience in Asia and elsewhere has demonstrated the benefits of commercial aquaculture but also the pitfalls. By providing protein in the form of fish, commercial aquaculture can directly contribute to hunger alleviation and urban food security. Fish is an important item in the African diet: Africa is second only to Asia in terms of fish contribution to total animal protein consumption. While Africa has the lowest per capita food fish supply (7 kg in 1997) and the lowest contribution of aquaculture to per capita supply, food fish in 1997 provided 17.2 % of total animal protein, compared to 24.6% for Asia, 7.3% for South America and a world average of 16.5% (FAO, 1999d). Countries in sub-Saharan Africa where fish provided more than 60% of total animal protein in 1997 were; Equatorial Guinea (62%), Gambia (62%), Ghana (63%), and Sierra Leone (63%). Thus, in large parts of Africa, commercial aquaculture has a market composed of consumers already accustomed to eating fish. The explanation for the dependence on fish as a source of protein is affordability. In much of Africa, fish tend to be less expensive than other sources of animal protein. A survey in Zimbabwe indicated that while consumers prefer chicken and beef to fish, the latter's lower price ensures that it is the main source of animal protein, with meat too expensive for most consumers (Sen, 1995). This finding suggests that, for the majority of the population, fish has a lower income elasticity of demand than meat, with vegetables and beans (rather than meat) as substitutes for fish (Delgado and McKenna, 1997). There is however a wealthier segment of the population, for whom taste is as important as price, and which is willing to pay for higher value fish such as bream or trout (Sen, 1995).

Commercial aquaculture also contributes to urban food security by providing employment, and therefore, income with which food can be purchased. In Chile, commercial salmon farming employs 30 000 people most of whom are in the isolated southern urban regions of the country (Infante, 1999). World-wide, commercial shrimp farming employs about one person per ton of produce, or approximately one million (Globefish, 1999). Employment is even larger if multiplier effects are added. Indirectly, commercial aquaculture generates jobs in secondary industries. A crude estimate of the employment multiplier for salmon farming is that one indirect job is created for every two employed directly in the sector. Of the 30,000 jobs attributed to salmon farming in Chile, one-third are in ancillary activities (Infante, 1999). In shrimp culture in Sri Lanka, an estimate is one indirect job for each direct job (Siriwardena, 1999). An estimate of the employment multiplier in aquaculture in the United States is that direct jobs in production and processing account for only 10% of the total (Dicks *et al.*, 1996). The distribution, retail and service sector account for two-thirds of all jobs, with an additional 22% in forward linked activities. The overall industry economic multiplier effect of aquaculture on the total economy was estimated at 3.3 (Dicks *et al.*, 1996). Hishamunda (2000c) estimated the job multiplier effect of shrimp farming in Madagascar at 1.4.

Jobs in commercial aquaculture are relatively well paid. Due to their profit-maximising behaviour, commercial farms will have the incentive to employ and conserve labour only if it is justified by the extra output. They pay hired labour the value of its marginal physical product. Because hired workers compete among each other to maintain their jobs and/or

secure higher salaries, the output-labour ratio, or labour productivity, will tend to be higher on commercial farms. Therefore, wages on commercial farms will exceed the imputed wage or value of average physical product of non-commercial farms. It is the output-labour ratio that drives living standards and ultimately poverty alleviation. In salmon farming this output-labour ratio has been rising over time, which reduces the employment impact of additional output, but increases wages of those employed. A survey in Asia found that wages on shrimp farms were two or three times higher than the rural minimum wage (Patmasiriwat, 1997). In the Ivory Coast, both output-labour and output-land ratios in aquaculture appear to be higher than in rice farming, indicating that aquaculture offers the potential for higher wages and incomes, and a reduction of poverty (Oswald *et al.*, 1996). Similarly, in Thailand, the fact that most intensive shrimp farmers had been rice farmers or fishermen, suggests that returns are higher in shrimp culture than in some alternative occupations (Phillips, 1997). A survey in southern Thailand placed shrimp farming as second only to trading as a source of income (Boonchuwong, 1994).

In addition to beneficial impacts on labour absorption and labour productivity, commercial aquaculture contributes to national fiscal balance. On the income side, if successful, commercial aquaculture will pay taxes, thereby contributing to government revenues. In turn, tax revenues can fund social infrastructure such as health care and education, hence alleviating poverty. Evidence suggests that economic growth and poverty alleviation are circular and mutually reinforcing (Sachs, 1998). On the expenditure side, commercial aquaculture has the advantage of relying on private assets rather than public aid<sup>8</sup>. In a context of fiscal restraint, this independence from public funds gives the sector autonomy and increases chances of sustainable development of the sector. Moreover, the private sector incurs the risks and will bear the financial cost if there is default.

Commercial aquaculture can also be a source of hard currency. The value of 1995 Asian farmed shrimp exports exceeded \$5.2 billion. French Polynesia earns more foreign exchange from its cultured black pearl than from tourism (Tanaka, 1997). Chile earned more than \$700 million in foreign exchange from exports of farmed salmon in 1998. In Honduras, shrimp exports are the third largest export, earning more than US\$150 million a year. In Madagascar where the shrimp farming industry just took off and only a fraction (about 2%) of the potential is developed, export of farmed shrimp brought about \$49.2 million into the economy in 1999 (Hishamunda, 2000c). However, these may not be net exports, the appropriate indicator of a sector's contribution to foreign exchange. In those countries where machinery (i.e. aerators) and inputs (i.e. feed) are imported, foreign exchange costs of these imports should be deducted from gross export earnings. Feed alone accounts for 50-60% of the total cost of production of shrimp; so, when not only feed but also aerators, pumps and generators are imported as in Sri Lanka and most sub-Saharan African countries, these costs should be deducted. Net foreign exchange earnings from shrimp culture in Sri Lanka between 1992-1996 were three-quarters of the total foreign exchange earned (Siriwarena, 1999). A survey of fourteen Asian countries revealed that earning foreign exchange was second only to employment generation as a rationale for aquaculture (FAO-NACA, 1997). Even if consumed domestically, the output from commercial aquaculture may replace imported fish and thus save foreign exchange.

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<sup>8</sup> Non-commercial farms can also rely on the private investment, but many depend on some forms of public assistance for financial survival.

Commercial aquaculture may also generate other positive externalities. When located in isolated rural areas, it may bring about improved infrastructure, promote the development of small communities and discourage youth from migrating to cities. Madagascar's shrimp farming companies built roads, schools, clinics and freshwater wells. These amenities and employment opportunities attracted a number of people from all over the country, especially from rural communities close to the farms. When one company (AQUALMA) started, there was a small community of 30 people at the site; the population grew to a village of 3 000 people in six years.

Finally, commercial aquaculture can stimulate research and technological development; some of it funded by the industry itself. Norway, Chile and Thailand are examples.

There may also be costs associated with commercial aquaculture, particularly shrimp (Greenpeace International, 1999). Commercial aquaculture can lead to inequitable income distribution, and social conflicts. Social conflicts arise because traditional farmers experience detrimental environmental side effects of commercial farming such as salination of soil and groundwater through seepage, flooding through pond embankments, and pollution of waterways through pond effluents. They also feel threatened or jealous of the success of commercial aquaculture (Pillay, 1996). Social animosity may be most intense if a small elite, domestic or foreign, dominates the industry. In Bangladesh, shrimp farming has led to disputes over hiring practices and over land leases (Rahman, 1999). Most shrimp farms in Bangladesh prefer to hire non-local labour believing them to be more loyal; this has created friction with the local population. Land leases have become a source of conflicts because shrimp farmers have often not paid lease fees, and have used shrimp farming as a pretext to occupy land belonging to others. These social conflicts are not dissimilar to those that occurred in agriculture with the Green Revolution, and to those experienced by Britain in the seventeenth century with the enclosures of the Commons (Neiland *et al.*, 1999).

Commercial aquaculture can lead to environmental damage, which can be a major cost to society. With shrimp farming, a disregard for the environment has led to shrimp disease outbreaks in several places among which are Taiwan, Province of China, in 1987, the Philippines in 1989, Indonesia in 1991 and China in 1993. Disregard for the environment may be due to time-horizons. A long-run perspective would encourage environmental protection as a means of maximising income. However, farmers with short time horizons can afford to ignore environmental damage, especially if they can move to new areas once farms become unsustainable (Wiley, 1993). Externalities, although costless to producers, are a cost to society. If they occur, they must be evaluated at their social opportunity cost and over a long-time horizon. Ways and means should also be found for producers to internalise them. The longer-time horizon is enforced by a discount rate lower than used in private profitability calculations.

On the other hand, commercial aquaculture can actually improve the environment. This appears to have been the case in Okinawa. Rising incomes from aquaculture in reefs prompted the community to discourage over-fishing of the capture fisheries (Tanaka, 1997). In order to maintain reef resources, community restrictions, stricter than government restrictions, were imposed. Aquaculture appears to have contributed to coastal resources management.



The relationship between commercial and rural aquaculture farms, has been an issue among donors wanting to alleviate poverty directly. Donors are concerned that commercial and rural aquaculture systems might become competitive rather than complementary. It has been argued that policies focusing on commercial farmers with sufficient funds may raise incomes of certain fish farmers without alleviating poverty (ALCOM, 1994). There is also concern that most commercial farmers will be male, better educated and richer, which would exacerbate income inequality and social differentiation. However, though limited, evidence suggests that adoption of commercial aquaculture in Africa has not had a negative social effect (Harrison *et al.*, 1994). Moreover, commercial aquaculture appears to have aided rural aquaculture by diffusing knowledge to small-scale rural fish farmers. A survey of rural fish farmers in three regions in Zimbabwe found that most learnt about aquaculture while working on commercial farms (Mandima, 1995). They acquired basic expertise, and hence were trained to establish their own farms. In effect, commercial farms were acting as models for rural fish farmers to emulate.

This symbiotic relationship between commercial and rural aquaculture has existed elsewhere. In Sri Lanka, community concerns over commercial shrimp farms have prompted the government to examine sharecropping as a possible policy tool to ease conflicts (Siriwardena, 1999). Sharecropping can be mutually beneficial by guaranteeing an income to rural aquaculture farmers, and fingerlings and fish to the "mother" farm. Whether rural aquaculture farms participate in sharecropping in part depends on the price of fish they receive and on offsetting benefits. In Costa Rica, the dominant farm, Aquacorporacion Internacional, has been unable to introduce sharecropping because the price it offers is too low (Porrás, 2000). However, by its size, farm stimulated a feed industry that has benefited rural aquaculture farms. In Jamaica, the price offered to sharecroppers by the largest farm, Aquaculture Jamaica Ltd., is below the market price (Carberry, 2000). However, it has induced participation by guaranteeing inputs and an assured market. Sharecroppers also benefit from technical advice.

The impact of commercial aquaculture on women is uncertain but appears to be neutral, and perhaps positive. A factor that handicaps women's involvement in aquaculture in most countries is land tenure. Where women can obtain entitlement to resources, they have shown a willingness to invest in commercial aquaculture. In Tanzania, commercial farming of seaweed began in 1989 on Zanzibar, and in 1995 on the Mainland. Initially, both men and women participated but where there are alternatives, the men have left seaweed cultivation to the women. In Zanzibar on Unguja Island, seaweed is cultivated primarily by women; on Pemba Island, it is cultivated by men (Msuya, 2000). The difference is due to topography. On Unguja, shallow water provides ready access to the seaweed whereas on Pemba access is only possible by boat because of deeper waters. On Mainland Tanzania, both men and women participate equally. The impact on incomes has been positive. Seaweed farmers earn more than in alternative occupations such as agriculture and handicrafts, and twice as much as in the capture fisheries. However, there have been social repercussions. The women's cash income has upset traditional gender relationships, thereby causing family conflicts.

A similar uncertain picture of the impact of commercial aquaculture on women emerges from shrimp culture in India. The direct beneficiaries of shrimp farming have been men. With remuneration for labourers in shrimp farming approximately 60% higher than in agriculture, men have been attracted into shrimp farming. Women have fewer opportunities in shrimp farming than in paddy cultivation. However, because of their lower salaries, women are in high demand in paddy cultivation (Paulraj, 1998). Employment of men in shrimp cultivation

has created some opportunities for women in the rice paddy fields. Thus, while not directly benefiting women, shrimp farming may generate more job opportunities for women indirectly.

Honduras is another example. Women's participation in shrimp cultivation is low. They are employed only when male labour is unavailable and account for 38% of the 23 000 estimated direct jobs (Morales, 2000). Thus, over time, shrimp cultivation could force up wages in all sectors, including the ones that employ more women than men. In tilapia cultivation, women make up more than half the labour force, especially in processing for industrial operations (Ferraro, 2000; Morales, 2000).

## CHAPTER 4

### PREREQUISITES FOR SUCCESSFUL COMMERCIAL AQUACULTURE

Commercial aquaculture resembles any other business-oriented activity. The fundamental goal is to make as much profit as possible. For profit maximisation, business acumen must be combined with technical ability to produce efficiently.

At the technical level, the ability to produce at a low enough cost is determined primarily by species, location and feed. The species selected should meet certain biological pre-requisites. The ability to cultivate a species from fry to harvest is critical. Ideally, the species would be easily reproducible, with low mortality and low feed conversion ratios. In a survey of tilapia farmers in Bangladesh, bio/technological factors, particularly the reproducibility of tilapia, was ranked second (to economics), among the factors attracting them to the industry (ICLARM, 1992).

Among the most critical factors influencing profitability is site selection. The choice of location affects fixed costs such as construction; it also affects operating and distribution costs. Topography where water is available regularly at suitable temperatures lowers operating costs (International Center for Aquaculture and Aquatic Environments, 1996). Farms in Costa Rica and Honduras that were improperly located had to be abandoned. Alone among the South American countries, Chile is able to cultivate salmon because of its environment and geography. For the same reason, it cannot replicate Ecuador and grow shrimp (Wiefels, 1999).

Availability of quality feed and seed are also critical. Feed accounts for more than half the operating costs in most commercial operations. In most African countries, the limited demand for fish feed and the high cost of agricultural by-products have handicapped the development of a fish feed industry although there are exceptions. Feed can be imported but at the cost of foreign exchange, but imported feed is often beyond farmers' reach. Enough good quality seeds are also lacking in many countries. In sub-Saharan Africa, insufficient supplies, low quality and high cost of fingerlings, and inadequate means of seed distribution to farmers often led to disappointing harvests and abandonment of fish ponds (Moehl *et al.*, 2000).

As important as biological and technical feasibility is economic viability. Early attempts to develop aquaculture in Jamaica failed because projects had the laudable goal of providing high value protein when most farmers wanted a product that could be sold for profit and not a subsistence-level activity (Wint, 1996). The sector developed once the profit incentive was acknowledged. Farming of Atlantic salmon in Norway developed because prices of salmon increased<sup>9</sup>, creating opportunity for profit making in aquaculture. The worldwide shrimp farming industry originated when, in the 1980s, increasing demand from the main shrimp consumers such as Japan pushed up shrimp prices, creating an incentive for shrimp farming. The impetus was profitability. In fact, shrimp farming has been called a "market phenomenon" because, at the microeconomic level the motive was profit-maximisation, and at the macroeconomic level the driving force was the earning of foreign exchange (Neiland *et al.*, 1999). The implication of this finding is that for aquaculture to develop, demand for the product must exist, and with the promise that farm-gate price will exceed the per-unit

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<sup>9</sup> Because the capture fisheries of Atlantic salmon were fully exploited.

production cost. Without profits the sector is unsustainable because it will either collapse, or become dependent on subsidies from the public purse (Pillay, 1996). Subsidies are often not available and when they are, they constitute serious drains from public funds.

In addition to existing demand, there should be the potential for increased demand. This is important during the maturity stage of the market lifecycle. Existing demand is essentially a function of price and income. Own price and income elasticities can be used to gauge the potential for increased demand. If the demand for the species is price elastic, supply expansion will cause the price to decline slightly; the small decline in prices will result in proportionately higher quantities of the produce demanded. As a result, farm revenues will increase. If the demand is price inelastic, an increase in supply could cause the prices to severely fall. Yet, this substantial fall in prices will have little or no effect on quantities of the produce demanded, thereby causing farm revenues to drop dramatically. Similarly, if the species has an income elasticity of demand that is positive and even above unity, rising per-capita incomes will be reflected in increased demand. The incentive for Atlantic salmon farming developed in part because Atlantic salmon was a luxury good with income elasticity well above unity and was elastic with respect to its own price.

The market must also be positively responsive to population growth and advertising, the major shifters of demand for aquaculture products. In Costa Rica, there was market resistance to *O. mossambica* because of its dark flesh and because it was fed pig manure (Porras, 2000). A new species (*O. niloticus*) was introduced and fed dry pellets. In order to convince consumers that *O. niloticus* was not tilapia, the name tilapia that had become associated with the less popular species, was dropped and replaced by a new name, St. Peter's Fish, in reference to St Peter's Farm which was a major producer of *O. niloticus*. *O. niloticus* became popular. In 1984, the red species (*Oreochromis* spp.) was introduced and was even more acceptable because it resembled the popular red coloured marine species, red snapper (Carberry, 2000). In Japan, the shrimp farming industry was transformed by a Filipino advertising campaign which persuaded consumers that the unpopular black tiger shrimp (*Penaeus monodon*) was as red as any other when cooked (Csavas, 1994). This species soon became dominant; by 1992 it accounted for approximately half of all shrimp cultured worldwide. Adroit marketing was the key behind successful catfish aquaculture in the United States. In spite of its appearance, it was extensively advertised as "catfish" and not as a generic white fillet, and this differentiation enabled it to outsell lower priced fish such as tilapia (Picchietti, 1996). In Spain, a niche market developed that prompted the intensive cultivation of trout because fish products were expensive. These same market conditions created a niche for farmed turbot (Sáinz-Rozas, 1994). There are examples of production-oriented strategies in which cultivation initially occurred without a market. In the United States, channel catfish (*Ictalurus punctatus*) was cultivated in the 1960s without an assured market and some farmers were forced to open restaurants to move their product (Avault, 1996). Market acceptance occurred but it took time and resources with no guarantee of success.

The willingness to invest requires not only expected profits but also an analysis of expected risks. Investment will occur if potential profits exceed what is perceived to be acceptable risks. Risks occur because of shocks. Shocks can be biological, such as shrimp disease which affected Taiwan, Province of China (1987), the Philippines (1989), Indonesia (1992) and China (1993-94). Biological risks increase with the intensification of production techniques. Because of the greater risks attached to intensive technology, shrimp farmers in Indonesia

were advised to adopt semi-intensive techniques (Nurdjana, 1999). In Madagascar, shrimp farmers are not permitted to produce more than 4 tons of shrimp per hectare per cycle.

Shocks can be meteorological. Hurricane Gilbert destroyed the Rio Cobra Dam that supplied irrigation water to tilapia farms in Jamaica. Seasonal flooding made access to a tilapia farm in Costa Rica impossible (Porrás, 2000). These shocks can devastate the sector, and insurance may either not be available or else be too onerous.

Other shocks may be economic. Economic risks include macroeconomic instability as with the Asian economic crisis. In early 1998, prices of imported salmon in Japan dropped almost by 30%, compared to the same period a year earlier (Bjørndal and Aarland, 1999).

Risks can also be political. Political risks include government interference with business operations, uncertainty over property rights, corruption, and a weakening of institutional factors. If there is too much government interference with private business, policy and institutional instability, associated risks will deter investment, including in aquaculture.

Aquaculture also faces social uncertainties. Cage farming in North America has faced opposition from other users of waterways. In shrimp farming in Asia, hostility from neighbouring communities erupted because of environmental impacts or envy over its success (Primavera, 1997). Lack of social acceptance can lead to economic failure of the farm through increased theft, and even poisoning of ponds (Pollnac, 1991).

Self-induced shocks also occur. Because most farmers are price-takers, by independently expanding output when prices and profits are high, they unintentionally create excess supply and cause prices to plummet. The result is an unforeseen price shock. Driven by high profitability in the early 1980's, world output of farmed salmon more than tripled between 1987 and 1992 as new farms entered the industry and existing farms expanded. That increase in supply caused farm-gate prices to fall by 40 % in nominal terms (and even more in real terms) from the 1987 peak. A similar phenomenon occurred with farmed shrimp. Import prices into Japan almost halved during the 1980s.

Knowledge of risks will vary. A farmer who is starting out in aquaculture has a higher risk premium than a farmer scaling-up an existing operation. Commercial farmers must be aware of the risks. The farmer's ability to react to changing circumstances is also important.

In addition to risk-adjusted profitability, availability of infrastructure, the farmer's access to financial resources, entrepreneurial determination and managerial expertise are important determinants of successful commercial aquaculture (Avault, 1995). The supply of water and electricity can be critical and a limiting factor for business activity. In Nigeria and Malawi, both factors are cited as severe handicaps to business activity (World Economic Forum, 1998). The largest farm in Costa Rica (Aquacorporacion Internacional) is dependent on water outlet from a hydroelectric dam whose priority is production of electricity. The farm is a secondary consideration and only with government support has supply of water been assured in periods of drought (Porrás, 2000).

Availability of road infrastructure is critical because of the need to transport inputs to the farm and output to market. This is particularly important if the output is fresh and consumers lack refrigeration. In some rural areas of Africa, dried fish such as kapenta in Zambia is the main

practical source of food fish (Sen, 1995). In Zambia, preference between fresh and dried fish is determined by distance from urban centres and is reflected in relative prices (Soma *et al.*, 1999). Where commercial operations are located in rural areas, as is often the case with large-scale industrial farms, the problem of transport can be alleviated by vertical integration. Nevertheless, even for large farms transport is critical. In Limon, Costa Rica, a farmer built 45 ha of ponds intending to cultivate tilapia for export. However, the distance from the airport made transport of inputs and fish difficult. Moreover, it was located by a river which, in the rainy season, made access to the farm impossible (Porrás, 2000). The farm closed without ever producing fish.

Accessibility to financial resources is particularly important. A commercial farm relies on hired (as well as family) labour and machinery for pond construction. In addition to capital costs, commercial farms will have high operating costs that can cause imbalances in cash flow. For most forms of commercial aquaculture, variable costs are a major component of total costs; this is so even for capital intensive operations such as cage culture of salmon. Access to credit to assist the farms during cash flow shortages can therefore be critical, particularly if the species has many months of feeding before it can be harvested.

Entrepreneurial motivation and managerial expertise are also important. The entrepreneurial component is critical because aquaculture requires perseverance and an ability to accept risks. A study of aquaculture failures in North America indicates that entrepreneurship is critical. That vision, dedication and drive are an irreplaceable aspect of commercial aquaculture (Lockwood, 1998). When corporations have tried to replace entrepreneurs with financial managers, the operations often collapse. In some rural parts of Côte d'Ivoire, commercial aquaculture failed because of the separation of ownership and management; absentee owners rely on salaried managers lacking entrepreneurial dedication (Bamba and Assouhan, 2000). In other parts of Africa, Satia (1991) reported similar cases of unsuccessful aquaculture as a result of the lack of entrepreneurial dedication by salaried managers.

The spirit of entrepreneurship and innovation has been cited as one of the determining factors in the success of shrimp farming in Thailand (Tookwinas *et al.*, 1999). Not only are farmers enthusiastic to learn new techniques, but they are keen to undertake husbandry experiments themselves. A study on tilapia cage production in Niger, which failed, found that successful farmers were young and at a minimum literate, with education particularly important for intensive technologies (Mikolasek *et al.*, 1997). The study also found that entrepreneurial motivation was undermined by over-dependence on government largesse. In parts of rural Africa, where entrepreneurial achievers are denigrated because they exacerbate socio-economic differentiation and threaten the social structure, the need for a business ethos may indeed render commercial aquaculture impossible (Harrison, 1997).

## Summary

This part of the report discussed the concept of commercial aquaculture as the rearing of aquatic organisms that aims at profit maximisation, and which can be sustainable without direct external financial assistance, whether donor or government. Such aquaculture is not an alternative to rural aquaculture; it is its complement.

Commercial aquaculture has offered economic benefits to producing countries. Through the production of aquaculture products for food, and/or the generation of income (through job

creation) by which to purchase food, commercial aquaculture contributes to increasing food security. By paying taxes, can generate government revenues and indirectly support government funding for rural aquaculture. Through export and/or import substitution, commercial aquaculture can be a source of hard currency. However, there have also been costs. By generating its own funds, commercial aquaculture offers the prospect of financial self-sufficiency.

Pre-requisites for commercial aquaculture include bio-technical feasibility and economic viability. Failure of one could cause failure of the whole project. Appendix A provides a checklist of factors that can be used by prospective entrepreneurs and bankers (Corbin and Young, 1997). Aquaculture has not always been socially acceptable, and environmentally neutral. Without these attributes, commercial aquaculture will not be sustainable, however profitable. Regulations, economic incentives and self-policing, are instruments that can promote the sector; they can also reduce adverse effects of commercial aquaculture. The following chapters concentrate on policies that governments have used to promote the sector. Some of these policies can be applied in Africa.

## **PART II. POLICIES TO PROMOTE SUSTAINABLE COMMERCIAL AQUACULTURE**

Among the pre-requisites for successful commercial aquaculture discussed in the previous chapters, some are outside the control of governments and policy-makers, and are non-policy variables. Non-policy variables are cultural factors such as the prevalence of entrepreneurship and risk-taking, and demand characteristics such as the size of a market or competition from substitutes. Other conditions can be influenced by governments. They are policy variables. Some of the enabling policies which governments can implement to promote the sector are general in scope. They are designed to reduce risks and lower costs for all business activities by creating a climate conducive to all private investments, including investment in the aquaculture sector. Such policies that are "business-friendly" to all investments are referred to as non-sector specific policies. In addition, there are sector-specific policies that focus on the promotion of a particular sector such as commercial aquaculture. Both non-sector specific and sector specific policies are discussed in this section.

### **CHAPTER 5**

#### **NON-SECTOR SPECIFIC POLICIES**

Enabling policies are designed to encourage confidence among investors. Non-sector specific economic enabling policies would include good governance, openness to trade and macroeconomic growth, and emphasis on private investment.

##### **Good Governance**

Policies that address issues of policy instability, uncertainty over property rights, corruption, and a weakening of institutional factors, such as bankruptcy laws and contract enforcement are subsumed under the term "governance" (Hong et al., 1999). In a survey of firms in Africa, foreign-owned companies ranked political and policy stability as the most important determinant of whether to invest in the Continent and among the principal causes of investment success or failure. Domestic firms also ranked political risk as a major consideration, although behind other factors such as taxes, and infrastructure. In most of the twenty sub-Saharan countries surveyed, businesses complained about political instability, the certainty of rules and laws, and the honouring of contracts by governments (World Economic Forum, 1998). Political and social stability were a determining factor in the success of commercial tilapia production in Costa Rica (Porrás, 2000).

Property rights are important because they affect incentives for producers to internalise externalities. Decisions whether to invest and whether to pollute are affected by property rights. In the coastal region of Honduras, shrimp farming has been handicapped by competing land claims (Morales, 2000). In West Bengal, India, farmers cite the plurality of land ownership as the most important constraint to aquaculture (Bhatta, 1999). To ease the constraint, certain State governments have expanded use rights through longer lease periods. Similarly, in the Pacific Islands, private ownership may be incompatible with the custom of communal tenure of coastal marine areas (Adams *et al.*, 2000). In Thailand, lack of clear tenure was a major constraint to investments in water systems, and improved water management. Overcrowding of shrimp farms had led to proposals for sea irrigation, but for



the investment in water management to be profitable, a large area was needed (Tokrisna, 1999). Unclear property rights handicapped the project.

A variety of land rights exists in sub-Saharan Africa. In some cases, land rights are not clearly defined. This can be costly and wasteful as it increases the price of land for investors, and can cause land disputes. Also, in most cases, the land acquisition process is usually long and fraudulent (Platteau, 1992; Ezenwa, 1994). Some countries, such as the Côte d'Ivoire, have individual titles with no restrictions. Others, such as Kenya and Malawi, impose restrictions. In Mozambique, Nigeria and Zambia land is vested in the state; individuals only have rights to occupancy and usage. Foreign investors are concerned that land title will not be validated, and occupiers are reluctant to lease in case the rights are transferred to the new user. Freely tradable property offers mobility, incentives and collateral. However, the issue of land rights is very sensitive, and title to land ownership may be less important for commercial aquaculture than that of guaranteed use and occupancy with a lease for a fixed number of years. In Bangladesh, there has been increased pond leasing, and since 1994/95 China has permitted the transfer of land use for a longer period. In Madagascar, shrimp farming occurs in industrial free-trade zones (IFTZ), which are located in a public domain. Foreign investors can only lease IFTZ land. Nevertheless, the land is leased for a period long enough (20 to 50 years renewable) to stimulate investment (Hishamunda, 2000c; Razafitsheno, 2000). The land usufruct is transferable.

Private investment is also inversely related to corruption. Foreign direct investment, especially, reacts very negatively to corruption (Alesina and Weder, 1999). This is particularly so for more irreversible forms of foreign direct investment such as investment in farming. By pushing firms outside the formal regulatory process and obliging managers to spend time and money with government officials, corruption raises transaction costs. If the top officials are monopolist rent seekers, the private sector can be forced into a prisoner's dilemma where the dominant strategy is to bribe (Klitgaard, 1998). A corrupt equilibrium is reached but at high social cost (Mauro, 1996).

To some extent, corruption is negatively related to the macroeconomic conditions of a country. Where officials are not paid, or are paid at a rate lower than subsistence, bribery can be a means of survival. Higher economic growth should result in higher salaries and lower corruption. Corruption is also positively related to monopolistic and discretionary power (and inversely related to accountability). By reducing arbitrary regulatory authority, structural reform packages, are a means of combating corruption. The Directorate of Corruption and Economic Crime in Botswana has also shown that public education can be an effective weapon and deterrent against corruption (Transparency International, 1999; Fombad, 1999).

Institutional factors are determinants of private investment. On the one hand, they can encourage investors to have a long-term perspective. On the other hand, they may deter investors if they reduce competitiveness, are time-consuming and encourage corruption. In some sub-Saharan African countries, businesses report that regulations are imprecise and impose a heavy burden on competitiveness. In others, almost a quarter of the time of senior management is spent obtaining or negotiating licences and regulations (World Economic Forum, 1998). Strengthening of institutions can be done through establishment of regulations and their implementation.

## **Openness to Trade and Macroeconomic Growth Policies**

Economic enabling policies would also include openness to trade and macroeconomic growth. Both are positive determinants of private investment. Research has demonstrated that economic growth can be accelerated by openness to trade, attraction of foreign investment, investment in health and education and domestic private sector investment (Sachs, 1998). These policies are as relevant to Africa as elsewhere. The flow of capital investment in sub-Saharan Africa is low. The ratio of total investment to GDP, which is approximately 17%, is below those of the developing countries of Asia (29%) and of the Western Hemisphere (22%). Moreover, private investment, which is more productive than public investment, remains small. The ratio of private to public investment in the region is significantly below that of Asia and Latin America. This relatively small access to private capital flows is one of the major constraints to the region's economic development (World Economic Forum, 1998). Internationally, Africa faces the risk of being marginalised. Africa's share of world trade has fallen from 4% in the early 1980's to 2% in 1996. The Continent attracts only 1.3% of world's total direct foreign investment, with almost three-quarters of that going to oil-exporting countries (Sachs, 1998). Countries that are non oil-exporters in sub-Saharan Africa have therefore a share of world foreign direct investment that approaches zero (0.3%).

Historically, macroeconomic conditions have not been favourable in sub-Saharan Africa. The region's economic growth was zero in the 1970's and negative in the 1980's (Calamitsis, 1999). Of the world's 48 poorest countries at the end of the 1990's, 33 were in Africa. In sub-Saharan Africa, real GDP was almost stagnant between 1992-94 with actual declines in real GDP per capita (Ouattara, 1999). Over those years, average inflation rates ranged from 44% to 61%. However, the years 1995-1999 have seen an improvement in the macro-economic performance of sub-Saharan Africa. Real growth rates averaged about 5% between 1995 and 1998; the inflation rate has fallen to 10% in 1998, and current account and fiscal deficits as a proportion of GDP have fallen. The indicators are even more positive if Nigeria and South Africa, which account for approximately half the region's GDP, are excluded (Ouattara, 1999).

Administrative reforms have been undertaken with liberalisation of the agricultural sector, increased openness to trade, and some curtailment of government intervention. Structural reforms including the dismantling of government monopolies, the establishment of market-determined interest rates and the privatisation of some government enterprises, have been implemented (Hernández-Catá, 1999). Unfortunately, lobby groups and political self-interest have not always welcomed the dismantling of state control to the benefit of the private sector. The pace of reform in sub-Saharan Africa has been determined as much by this political expediency as by economic rationality (Rotberg, 1998). However, political leadership in certain countries has demonstrated that reforms can be implemented with long-term improvements in economic growth and competitiveness (World Economic Forum, 1998).

Measures that maintain a constant real effective exchange rate and stability of the exchange rate are also important macroeconomic growth enabling policies. Inappropriate exchange rates adversely affect business confidence and viability. An overvalued exchange rate is an impediment to exports; it also encourages the import of tradable imports. In most sub-Saharan countries, output from commercial aquaculture competes against imported fish from the capture fisheries. Thus, an overvalued exchange rate reduces the competitiveness of aquaculture output by lowering the domestic price of fish imports. An example of the impact

of an overvalued exchange rate was the surge of imports of an estuarine fish from Guyana, the "Banga Mary", into Jamaica in the mid-1990s. Because of high interest rates, the Jamaican currency appreciated. Overvaluation of the Jamaican dollar caused the price of the imported Banga Mary to fall to half that of domestically cultured tilapia. By 1997, Banga Mary had established itself as a cheap fish, displacing a quarter of the restaurant trade in tilapia. Unable to sell its product, the tilapia industry in Jamaica stagnated (Carberry, 2000). With the creeping devaluation of the currency later, tilapia recovered its market share.

In the Africa's CFA zone, not only was the CFA franc overvalued prior to 1994, but the fixed exchange rate regime required a recessionary fiscal policy in order to maintain macroeconomic equilibrium. Thus, the reduction in the market for aquaculture outputs caused by competition from imports was compounded by declining real incomes. With positive income elasticity of demand for fish, lower incomes had a depressing impact on demand for output from commercial aquaculture. An enabling policy would avoid fluctuating and appreciating real effective exchange rates. A-300% devaluation of Costa Rica's dollar in 1981/1982 forced farms that had dollar credits to abandon their investment rather than incur the foreign exchange cost. The devaluation also forced the closure of a tilapia cage project because it was dependent on imported feed (Porrás, 2000).

### **Emphasis on the Private Sector as the Source of Wealth Creation**

Traditional development policies stressed market failures and the necessity for governments to intervene. Increasingly, however, this approach created inefficiencies and administrative gridlock. Incentives were ignored, and often results were contrary to the intentions. Throughout the 1980s and 1990s, approaches to economic development have evolved away from reliance on government towards greater emphasis on the private sector. The new development paradigm uses the neo-classical free market prescriptions to induce a more efficient allocation of resources. In the case of aquaculture development in sub-Saharan Africa, where public provision of inputs is jeopardised by fiscal retrenchment, the market model would be reflected in the privatisation of fingerling production and fish stations as well as in the production and distribution of feed by the private sector. Few countries can afford subsidies for feed, whatever the merits (Entsuah-Mensah *et al.*, 1999).

A further factor behind greater reliance on the private sector has been pressure on government spending. For some countries in sub-Saharan Africa, the pressure to curtail government spending was imposed by the International Monetary Fund as part of structural adjustment packages. These packages focussed on budget and current account deficits. They produced adjustment shocks typically greater in Africa than in Asia (FAO, 1995). At the end of 1996, the total number of adjustment packages in sub-Saharan Africa had reached 163 (Diabré, 1998). For other countries, an overvalued fixed exchange rate with the French franc, which was only eased in 1994, forced governments to cut spending. The fixed exchange rate put pressure on government spending as the residual policy tool for maintaining macroeconomic and exchange rate stability.

## CHAPTER 6

### SECTOR-SPECIFIC POLICIES AT THE MACRO LEVEL

Sector-specific policies can be defined at the macro and micro levels. This chapter discusses those policies that are specific to aquaculture, and which are meant to guide the development of the sector as a whole. We refer to them as sector-specific policies at the macro level. At the macro level, policies can be regulatory/legal, administrative, and economic; the industry can also regulate itself. They are intended to provide an orderly development of the sector. Macro-level sector-specific policies can also be defined in response to existing or perceived issue on the supply or demand side of the industry. We refer to these policies as supply and demand-driven policies.

#### **Regulatory/Legal, Administrative, Economic and Self-policing Frameworks**

The aim of regulating aquaculture is to provide an orderly and sustainable environment for its development. Regulations reduce negative externalities such as pollution or conflicts over water rights, land rights, and seabed areas caused by open-access property regimes. Alternatively, regulations may aim for positive externalities as in the case of Norwegian licensing for salmon farming. The intent of imposing licences was to preclude industry concentration and enable entrepreneurs in the capture fisheries or agriculture to participate in small-scale farming. Licences were also allocated on a regional basis. This was to foster coastal development in northern regions.

Command and control regulations predominate in curbing environmental effects of aquaculture. In its use of public land and waterways, aquaculture can be a threat to the other users. In the Northwest of Spain, salmon (*Salmo salar*) and turbot (*Scophthalmus* sp.) cage culture compete with mussel (*Mytilus edulis*) rafts. In eastern Canada, salmon farms and herring (*Clupea harengus*) weirs compete for sites. The legal system may resolve such conflicts, but a more common approach is government intervention through zoning and permits (Millar and Aiken, 1995). One technique is to prioritise the use of water. Off Northwest Spain where shallow seas preclude extensive flushing, zoning has assigned salmon cages to more distant locations. In Chile, separate sea areas are zoned for salmon farming and the capture fisheries. In Zambia, protected areas exist because of concerns for water conservation, in Ecuador for defence reasons. In other countries, such as Malawi, a distinction is made between private and public water. The purpose is to ensure that aquaculture development will be sustainable economically, socially and environmentally.

A common feature of aquaculture regulation is the obligation to acquire permits to establish a farm. Permits are a means of regulating the industry through use rights, and of minimising negative interactions where there are conflicting land or water uses. Another use of permits is data gathering. An obligation attached to approval of permits could be the provision of statistics on production and on technical matters. In the Philippines, certain producers must supply quarterly reports on production (Bonucci *et al.*, 1993). However, costs of monitoring and enforcement may be prohibitive. In Costa Rica, to help plan the sector, farms must register with INCOPESCA. Farms are expected to provide details on sales, inputs used, dates of harvest and production systems in a Register (Porrás, 2000). However, the Register has not been implemented. There is no neither penalty on those who fail to register. Nor is there

enough personnel to encourage compliance. Similarly in Thailand, registration of shrimp farms has not been fully implemented. Part of the problem has been unclear land title, but also concern over taxation (Tokrisna, 1999). To make farmers comply, a strategy would be to tie the renewal of permits to provision of information.

Procedures to obtain permits differ. To grant aquaculture permits, most countries have in common the obligation to furnish documentation on administrative and economic aspects, geographical location and technical data such as the species to be cultivated. In Chile, Mexico, Mozambique, the Philippines and Venezuela, environmental impact assessments are required before a permit is granted. This requirement may be limited to farms above a certain size, which could ignore the cumulative environmental impacts of many small farms. There may be a reluctance to require impact assessments because of their cost, and concern that the cost may deter investment or undermine the industry's competitiveness. In Chile, a five-year business development plan is also required with the application. Other countries require information on nationality, with Mexico and the Philippines restricting permits to citizens and France to members of the European Union (Bonucci *et al.*, 1993). France also requires evidence of expertise in aquaculture. For unitary states, the application is addressed to the ministry of fisheries or an alternative, but who that is may depend on whether the application is for fresh water or marine sites. Most countries have a common permit for all species but some (France, New Zealand and the Philippines) require different permits for different species or for certain aquaculture techniques.

Obtaining the necessary permits may involve a number of different departments, be time-consuming and ultimately be discouraging to prospective investors. This suggests that regulations should not be overly burdensome. Regulatory measures frequently cover access to public land, the right to use water, the discharge of wastewater and even the quality of water. In some cases as in the Congo (Brazzaville), permission to establish an aquaculture grants, at the same time, the right to use public land and water. In other countries, distinct permits are required. As a minimum, regulations should cover a few key legal issues such as the general place of aquaculture in the legal system, access to land and water, environmental regulations, import of live fish and the introduction of non-indigenous species (Andreasson, 1997).

The duration of permits varies, but most are valid for several years. Permits that are for short periods, such as only one year as is the case in Singapore, may be too brief to provide sufficient incentive for investment in the sector (DeVoe, 1991). In Western Australia, aquaculture leases can extend up to twenty-one years, but licences are necessary and are only for twelve months. The short licence period enables regulators to control the site while the longer lease period provides time for farmers to amortise their investment.

In some countries, permits are tradable, which encourages efficiency and consolidation. The more efficient farms can acquire permits while the less successful farmers sell their licences and find alternative occupations. Nevertheless, protection of the public interest may require that transfers be approved as in New Zealand and Madagascar. This enables the government to prevent over-concentration of the industry. It also facilitates terminating the lease if regulations are not being implemented. In Chile, licences are given for an indefinite period and are tradable. However, the profitability of salmon farming encouraged speculative trading of licences and the government was forced to impose a moratorium on the issuance of new permits (Bjorndal and Aarland, 1999).

Regulation can produce inefficiency and bureaucratic rigidity, which impedes development and expansion, and can be difficult to enforce. Inefficiency and bureaucratic rigidity may be due to overlapping laws, regulations and jurisdictions. Overlapping jurisdictions complicate applications and have a dissuasive effect on the development of aquaculture. The danger is high in federal states. In Canada, to clarify responsibilities, the federal government has jurisdiction over the ocean environment while provincial governments have responsibility for the fresh water environment. Even so, one of Canada's priorities is rationalising aquaculture legislation to reduce the regulatory burden on the industry (Canadian International Development Agency, 2000). When the Fisheries Act was drafted, there was no aquaculture industry. Currently, there are 17 federal departments and agencies (in addition to provincial departments) with responsibilities for the sector (INFOFISH, 1999). Regulatory duplication is inevitable. Hence, a comprehensive review of aquaculture legislation is planned. In some other federal states such as Germany, India, Nigeria and the United States, responsibility for aquaculture is at the local level, but regulations over the environment or the transport of fish across boundaries are within federal jurisdiction. In Malaysia, marine aquaculture is primarily regulated by the federal government whereas riparian aquaculture (including shrimp culture) is primarily the responsibility of the States (Van-Houtte-Sabbatucci, 1999).

Where there are numerous regulations, applicants can be assisted by one-stop administrative procedures where all information is easily accessible. In India, the Aquaculture Authority, which was established as a result of a 1996 Supreme Court ruling and has the responsibility for coastal aquaculture, has extensively published its rules of procedures and shrimp farm application forms in newspapers and local languages (Sakthivel, 1998). It has also published guidelines on desirable shrimp density, feed and pond design. The aim (not always successful) is to expedite investment proposals. In Jamaica, several government agencies regulate aquaculture but to expedite applications, one agency (the Jamaica Promotions Limited), developed a brochure explaining exactly what was needed. The brochure, with its procedural information, eased the regulatory approval process, particularly for foreign investors (Wint, 1991). In the absence of a single document integrating regulatory material, an alternative is to have staff from different agencies at one site. In the Philippines, potential aquaculture investors can obtain details of all regulations at one office. In Canada, similar "one-stop shops" have been established to assist investors navigate overlapping federal and provincial jurisdictions in aquaculture. The "guichet unique" plays a similar role in Madagascar.

In some countries approval can take years because each permit is completely reassessed by each department (Filho, 1997). Slow regulatory approval has impeded the growth of the Chilean salmon farming industry. In 1997, only 15% of licensing applications submitted in 1995 had been processed (Bjorndal and Aarland, 1999). In Puerto Rico, aquaculture is a priority sector and farms are given tax holidays and loans. Yet, a new aquaculture enterprise needs, on the average, 2 to 3 years to acquire twenty permits (Wint, 1991). This suggests that once the proposals have been submitted, the approval process should be as quick and transparent as possible. This reduces the potential for corruption and increases the likelihood of investment. Deadlines should be imposed and each agency screen only within its area of competence. In addition, because monitoring and enforcement are time-consuming and expensive, the regulatory framework should be kept to a minimum. In fact, weak enforcement, rather than the absence of legislation, may be a contributing, if not the primary, factor of unsustainable practices in aquaculture (FAO, 1999c). Resources for monitoring may be lacking or there may be overlapping jurisdictions among departments. Thus, simple

classifications may be optimal in countries where resources and personnel are limited (Neiland *et al.*, 1999). Ideally, regulations should be cheap to monitor and enforce, and application procedures rapid.

There are many instances in sub-Saharan Africa where aquaculture comes under more than one department. This has led to duplication, rivalry and wastage (Coche *et al.*, 1994). For example, in Zimbabwe, aquaculture extension comes under agriculture, but aquaculture development is under tourism. A preferable situation is to have one government agency responsible for the development of aquaculture. The agency would keep informed about other government departments that are related to food production and natural resources, and would co-ordinate the sector. In Costa Rica, INCOPESCA has been responsible for the development, regulation and research of aquaculture since 1994. In Honduras, DIGEPESCA not only regulates the sector but also prepares the aquaculture plan.

Compounding the problem of overlapping administrative jurisdictions is the frequent lack of a legislative framework specific to aquaculture. This is because aquaculture is in its infancy in many countries and plays only a minor role in the countries' economies. An overall explicit legislative framework for aquaculture exists in the majority of developed countries, some countries in Eastern Europe and in some countries in Asia such as the Philippines. Many countries in Africa have little or no aquaculture legislation. In the early 1990s, of twelve sub-Saharan countries surveyed, only three (Kenya, Madagascar, and Nigeria) had specific legislation, another three (Malawi, Tanzania, and Zimbabwe) had limited legislation, and some (Cameroon, Central African Republic, Congo, Côte d'Ivoire, and Zambia) had no specific aquaculture legislation (Coche *et al.*, 1994). Instead, there is an enabling power to regulate the industry, and laws and regulations that have been drafted without aquaculture in mind are applied. Often, the power enables an individual, such as the Director of Fisheries, to regulate aquaculture. In Zambia, regulatory power is given to the Minister of Agriculture, Food and Fisheries under the 1974 Act (Mudenda, 2000). In Malawi, aquaculture is regulated under the 1973 fisheries legislation (Bonucci *et al.*, 1993; Kapeleta, 2000).

The absence of specific legislation also results in aquaculture being administered usually under regulations of the capture fisheries (Andreasson, 1997). In fact, a more appropriate legislative framework for aquaculture, at least for land-based fish farming, might be agricultural. Like agriculture, aquaculture is concerned with food production with the main difference being the chief growing medium: water rather than soil. Issues such as access to land and water and treatment of effluents are similar. Therefore, an agricultural framework would appear appropriate, particularly for pond aquaculture. However, such a framework might not be suitable for coastal, inland waterways and marine aquaculture because of open-access property issues. Moreover, brackish water aquaculture such as shrimp farming may cause irreversible damage and justify particular regulations safeguarding coastal regions. In certain cases such as France and Spain, mariculture and fresh water aquaculture come under different legislation and in others such as Ecuador, only certain areas (coastal areas for shrimp) are regulated.

The absence of a legal status for aquaculture, which legally recognises that land and/or water can be used for aquaculture, may handicap development of the sector. In a survey of nine Near-East countries, weak legislation, particularly for environmental protection and the movement of aquatic animals, was cited more than any other problem as a constraint to the development of aquaculture (El Gamal, 2000). The lack of legislation was exacerbated by

administrative impediments such as heavy bureaucracy and lack of co-operation between agencies controlling aquaculture. On the other hand, benefits from a legislative framework that is too complex may not be worth the cost. In 1984, consultants wrote an extensive 25-page document of legislative proposals for the Bahamas. However, as of the early 1990s, none of the proposals was enacted, because the size of the aquaculture industry was too marginal (Thompson, 1991).

Complementary measures to command and control techniques, are economic incentives, and self-policing by the industry itself. Economic incentives rely on prices as a signalling device to guide appropriate behaviour (Willman, 1999). They obviate some of the expense of monitoring and enforcement. As a positive incentive, Ecuador offers tax exemptions if waste water is treated; other countries levy a tax on waste water (FAO, 1999c). Other incentives include performance bonds, or deposits that are required and refunded if the environment remains undamaged. Taxes to discourage over-use of environmentally unfriendly substances, such as antibiotics, can be effective if demand for the aquaculture product is price elastic. Subsidies can also be used although they have the disadvantage of incurring a cost to governments (or donors). Loans at subsidised interest rates are offered in Sri Lanka for installing water treatment systems.

Self-policing through peer pressure can also be effective, particularly for those farmers with a long time-horizon. Best Management Practices are self-regulating management codes that may derive from government or could devolve from a producers' organisation (FAO, 1999c). In Yokohama, enforcement is community-based (Hideyuki, 1999). Fish farmers have an incentive to produce responsibly, and are more likely to internalise environmental externalities than many other activities because environmental damage directly affects their own output. From enlightened self-interest, farmers themselves have an incentive to reduce pollution. The use of antibiotics in Norwegian salmon farming has fallen dramatically since 1987 and is now almost negligible. Its use was a negative environmental externality but also a threat to the image of (and markets for) Norwegian farmed salmon (Bjørndal *et al.*, 2000).

Another example of a result of self-policing is the decline in environmental damage from feed waste. Feed accounts for approximately 50% of total costs in Norwegian salmon farming. The burden of high feed costs, and the lower yields caused by pollution from excess waste encouraged lower feeding rates (Asche *et al.*, 1999). In turn, lower feeding rates reduced feed wastage and ensuing environmental damage.

## **Supply and Demand-driven Sector-specific Policies**

### ***Divestiture from Fish Stations***

One of the characteristics of aquaculture in sub-Saharan Africa is the existence of government-owned fish stations, many of which are derelict. Fish stations serve a number of purposes. In the first place, they produce fingerlings, which may be distributed free or subsidised to farmers. In the second place, they are a source of food fish. A third purpose is to provide a demonstration of aquaculture technology and practices to farmers. This is important in those areas where water management and husbandry practices are recent innovations. Other purposes of the stations are training and research.



Built by donors to diffuse knowledge of aquaculture to farmers, the operating costs could not be met by governments when donor funds were exhausted. They were then abandoned. In some cases, lack of money has forced managers to be entrepreneurial selling fish in the market. However, this revenue-generating practice may provoke opposition from senior administrators. Managers have been obliged to remit revenues from fish sales to the department, thereby undermining incentives. Moreover, the practice of selling fish from publicly funded stations does not provide a "level playing field" for commercial farmers who face unfair competition. Because of the precarious condition of some stations, an appropriate strategy is the divestiture of many fish stations to the private sector. In fact, there are recommendations that the number of government stations should be reduced by at least half within five years from 1999 (Moehl *et al.*, 2000). While certain of the roles of these stations discussed above could and should devolve to the private sector, others, such as basic research and training, belong in the public domain. Because of the uncertain outcome of research and the impossibility to internalise all benefits, development research is not attractive to the private sector, at least at the early stages of the industry development. Also, maintaining the quality of broodstock requires government stations if private fingerling production is more interested in productivity than quality (Little, 1998). In Costa Rica, government stations undertook much of the development research on tilapia that the private company Aquacorporacion was able to apply. The experience of Costa Rica suggests that some government stations remain to undertake development research.

The advantage of privatising where possible is that privatisation relieves governments of operating costs. Privatisation also tends to boost efficient management. This has been the experience when parastatal operations in agriculture have been privatised (Cleaver, 1993). If there is no interest from investors, management at least could be privatised. With the efficient management, the station could become profitable thereby sparking interest from local investors.

There are also disadvantages of privatisation. Privatisation will, at least initially, lead to higher prices of fingerlings. This is almost inevitable in the initial stage. Over time, however, these higher prices should prompt interest from entrepreneurs, increased supply and an easing of prices. This has been the experience in Madagascar where all fingerling production has been privatised. Privatisation is also likely to lead to job losses because the private sector hires only if labour productivity matches wage rates. However, those workers remaining will receive higher wages, which at least partially compensates for the loss of jobs.

The procedure for divestiture could follow that of parastatal institutions in agriculture, many of which have been returned to the private sector in restructuring programmes (Cleaver, 1993). The first step is to settle liabilities and also often restructure management. The aim is to eliminate debt and offer the prospect of profitability before sale or lease. If there are to be job losses, workers should be fired by governments before the sale or lease. This removes the stigma from the new private company. As for the actual sale, there are a number of possibilities. One approach is for the government to set a price. If there is to be a price set, transparency is important; private investment bankers are often better equipped than governments to evaluate assets and organise privatisation. Another option is a sale by auction. Both procedures pose risks to small-scale farmers. An alternative is to give first right of refusal to local small-scale farmers and to encourage them to acquire stations through producer co-operatives. This approach was followed in Madagascar. Another alternative is to proceed first with a joint private-public venture with governments selling their shares over

time. This requires less initial equity from investors and may be a suitable approach if the intention is to encourage local ownership. It also allows time for management learning and reduces risks. There must however be a commitment for full divestiture eventually.

### ***Privatisation of Extension Services and Training***

Viable commercial aquaculture does not obviate the need for extension services, but may alter the source of funding. Some of the funding could come from the private sector. In Costa Rica, the extension services have undertaken research on sites and species. The resulting know-how was passed to Aquacorporación. This was critical to the success of the farm (Porras, 2000). In Jamaica, the publicly funded extension services were instrumental in establishing the tilapia industry through the provision of services such as site evaluation, advice on harvesting schedules and supply of seed stock (Carberry, 2000). Once the industry was successfully established, the University of the West Indies increasingly provided technical training activities. In addition, the largest commercial farm, Aquaculture Jamaica Ltd, gives small-scale sharecroppers technical advice, and provides private funding complementing publicly funded extension services. In the Philippines and Thailand, feed companies provide technical advice to farmers. In Samut Sakhon, Thailand, a Taiwanese (Province of China) company established a feed plant and then introduced shrimp culture. By providing information on culture techniques and pond management to farmers, the number of shrimp farms sharply increased in the 1980s with concomitant demand for feed (Tokrisna, 1999).

An alternative is a "fee-for-service" charge by which farmers pay for extension services according to usage. User-fees have the advantage of rationing scarce personnel and funds. User-pays policy also gives an incentive for up-grading technical advice. In addition, the private sector can assist with extension services, especially by encouraging better training of personnel and farmers. In the Philippines, feed companies train tilapia farmers. Clearly, this is not devoid of self-interest, but it can also serve the public gain. The user-pays method has equity and distributional implications, but it off-loads costs from the public sector, leaving publicly funded extension services able to concentrate on the non-commercial sector. This may be particularly appropriate in sub-Saharan Africa where there is concern that aquaculture technical competence will be diluted as budgetary pressures oblige aquaculture extension services to merge with the more important agricultural sector into a unified service (Entsua *et al.*, 2000).

### ***Promotion of Large Farms***

In order to develop, commercial aquaculture requires infrastructure and inputs that may not be readily available. Madagascar's experience in shrimp farming indicated that successful shrimp culture requires hatcheries, nurseries, processing plants, and either feed manufacturing, or facilities for stocking imported feed. To meet these constraints, Madagascar's strategy was to encourage investment from large-scale industrial operations (Kasprzyk *et al.*, 1993). Only large operations had access to their own sources of capital and expertise, and could undertake the infrastructure investment profitably.

Large farms can also accelerate movement down the learning curve and, by their example, encourage others to enter the industry. Even though tilapia had been introduced into Honduras in 1932, output was still less than 200 tons until 1990. With the establishment of three large domestic farms in 1991, the industry developed; output increased to exceed 1500 tons in 1995.

(Morales, 2000). In the Pacific islands, the culture of pearl oysters appears to have benefited from the existence of large producers. Small-scale coastal cultivators have faced market obstacles. By their volume and their regularity in producing quality pearls, large producers opened the market and developed the industry. To obtain the advantages of market access provided by large firms in French Polynesia, the many small-scale producers of marine pearls provided spat to the large firms (Tisdell, 1998).

Another example of the importance of large farm sizes in the development of the industry is commercial tilapia production in Jamaica. Initially, aquaculture development strategies focused on rural aquaculture, which is small-scale. The development was slow because farmers wanted to produce for profit (Wint, 1996). The government then focussed on large-scale farms. In the early 1980s, two large farms were established. Tollgate was a joint venture between the National Investment Bank of Jamaica and an Israeli group, and Aquaculture Jamaica Ltd (AJL) a subsidiary of the Jamaica Broilers Group. The principal motivation of the Jamaica Broilers Group diversifying was to earn foreign exchange by exporting tilapia (Carberry, 2000). The Broilers Group later acquired Tollgate. Currently, its output accounts for approximately 90% of the annual national production of 3 600 tons. Because of its large size, the company was able to manage shocks. In 1998, when feed prices rose sharply, AJL was able to defer the impact through forward purchase arrangements (Carberry, 2000). It was also able to develop a marketing network through its export company, Jabexco, and exports almost half its output to the United States, Canada, the United Kingdom, Germany and Belgium. Its dominance of the industry has not had deleterious effects on the sector; indeed, the impact appears to have been positive. The farm has established a reputation for quality in its five export countries, with positive repercussions for the reputation of other Jamaican products (Wint, 1996). It has also encouraged others to produce tilapia. In order to increase exports, it has contracted some tilapia production to small and medium-scale farms in a scheme similar to its poultry operation. Currently, there are 11 such farms producing 850 tons annually (Carberry, 2000). Farmers receive a price lower than the retail price, but they are guaranteed inputs and a market. AJL also provides extension services to its contract farmers, sharing its husbandry practices and technological knowledge. Moreover, by its success, the company has stimulated interest by other large-scale firms in commercial aquaculture.

### ***Promotion of Foreign Investment***

If there is no or limited domestic involvement in commercial aquaculture, as is the case in sub-Saharan Africa, one strategy is to entice direct foreign investment. It expedites the acquisition of technology and expertise and can be the impetus for the whole sector. Joint ventures could be encouraged; they bring in foreign capital and expertise while offering domestic investors the opportunity to participate and gain technological knowledge.

However, foreign investors will require guarantees of profit and capital repatriation, and unrestricted currency conversion. Repatriation of profits is of singular concern to foreign investors (World Economic Forum, 1998). They may also expect tax exemptions and other incentives. Such incentives could be debt-equity swaps and tax holidays. Investors in aquaculture within the European Union can obtain reimbursement from the Union and their national governments of up to 40% of fixed capital costs. In addition, there may be interest rate subsidies. Unless returns in Africa are high enough to compensate for the risks of investing in the region, and for the additional equity invested, incentives may be necessary.

Incentives have economic cost. In addition, there may be the social cost of resentment against foreign domination of the sector. Some resentment by local people in the Tenth Region in Chile was created by foreign investment in salmon farming, although mitigated by upward pressure on all wages due to competition by aquaculture for the relatively scarce labour (Ridler, 1994). Also foreign investors may employ expatriate managers, leaving local workers to do unskilled labour jobs. There is also the likelihood that research and development will be undertaken at the head offices and not in the recipient country. These costs must be weighed against the benefits of acquiring technology, generating foreign exchange and developing a growth industry.

Chile has demonstrated that commercial aquaculture can develop by encouraging foreign investors. In the early 1990s, the ownership of Chilean salmon farms was primarily domestic, but the largest companies were predominantly foreign owned. In addition to Marine Harvest (Unilever), there were Salmons Antartica (Japanese) and Mainstream (British). Norway, the United States, Holland and New Zealand were also involved in the industry. Foreign investors were permitted to repatriate profits at any time, and all capital after three years (Chocair, 1991). There was a debt-equity agreement, which was designed to encourage foreign involvement in salmon farming by giving foreign investors a premium in Chilean pesos for foreign debt. By buying Chilean debt denominated in foreign currency in the secondary market, foreign investors were reimbursed the debt at face value in pesos. Not only did this policy reduce Chilean external debt denominated in hard currency, but it also prompted the industry development. The industry became a good source of foreign exchange with more than 90% of Chilean salmon production being exported<sup>10</sup>. By enticing large international firms to invest in the industry, Chile obviated the need to finance domestic producers through incentives and subsidies. The risks inherent in establishing a new industry and the costs of acquiring technology and knowledge were borne by the private sector.

Costa Rica also has developed its commercial aquaculture through encouraging foreign investment. As in Chile, most of its output is exported. One foreign firm from Europe, Aquacorporacion Internacional, dominates its tilapia industry. The foreign company's demand for feed was sufficiently large to stimulate feed production by domestic manufacturers. The company also prompted interest in the industry from domestic farmers, encouraging emulation and domestic investment in the sector (Porras, 2000).

In Honduras, tilapia farming was introduced in 1936 when a tilapia brood stock was imported from El Salvador. The focus was domestic small-scale farms. However, the industry failed to develop until 1990 when the interest shifted to commercial farming following government policies to encourage foreign investment in the sector. Also, the development of the shrimp farming industry was prompted by enabling government policies on foreign direct investment. In 1999, aquaculture was the country's fourth export earner after bananas, coffee and palm oil. On the average, it brings about 90 million US dollars gross per year into the national economy (Morales, 2000). In 1997, shrimp exports alone earned US\$164 million (Hishamunda, 2000a).

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<sup>10</sup> The role of the Chilean government was that of a facilitator. The exchange rate was on a sliding peg to avoid over-valuation, thereby facilitating exports. Except for distance limitations between farm sites, regulations including those covering the import of salmon eggs, was at a minimum.

In Africa, Madagascar's shrimp farming is rapidly growing because the government has put in place policies that attract foreign investment. Of the three shrimp farms in Mozambique, one is privately owned by a national of Mozambique; the two largest belong to foreign (French) investors. Foreign investment appears to assist commercial aquaculture to take off and as a contributor to employment generation, transfer of technologies and diversification of exports. The Nigerian fish farming industry, which is one of the major fish producers in sub-Saharan Africa, developed because of foreign investment.

### ***Introduction of Alien Species Policies***

Among the most important questions for a farmer or a government policy-maker interested in promoting aquaculture is what species should be cultivated (Sandifer, 1991). As discussed previously, three factors should guide the choice of species for commercial aquaculture. The first factor is the market. Can the product be sold; what is its competitive advantage and will the market change. The second factor is technological. Can one produce the species? The third factor is the choice between an endemic and an introduced species. The latter choice arises if, to be economically viable, commercial aquaculture needs to introduce a non-indigenous species. Then, a balance must be struck between the ecological dangers from the import of alien species and potential benefits. This follows the approach of agriculture where much of modern output comes from introduced crops.

In its Database on Introductions of Aquatic Species, FAO has information on 3 150 introductions of 654 aquatic species. Evidence suggests that, while adverse effects from the introduction of new species for aquaculture are the exception, they have occurred, particularly with inland species (Bartley and Casal, 1999). The introduced species may become a pest, damaging the environment and even the farming of other species. The introduction of diseased shrimp into Taiwan (Province of China) adversely affected the marine shrimp industry. The introduction of Pacific oyster to Australia damaged farming of Sydney rock oyster by displacing the latter (Tisdell, 1998). Escapees also change the ecosystem. To protect against disease, most countries have regulations covering the importation of live fish and the introduction of exotic species. Zambia requires authorisation for the importation of live fish and Malawi has a prohibition on movement of live fish, which impinges on aquaculture (Bonucci *et al.*, 1993).

Yet, in many countries, successful commercial aquaculture has occurred through the importation of a marketable species. This was the case of Costa Rica, Jamaica, Zambia and Zimbabwe with the *O. niloticus*. In these countries existing species were unpopular with consumers, but the introduction of *O. niloticus* and adroit marketing gave the industry impetus. In fact, the choice of tilapia as the target species in Jamaica was a critical factor in determining the industry's success (Carberry, 2000). Salmonids are not indigenous to Chile. However, the country's salmonid industry developed through import of salmonid eggs. In 1992, Chile became the world's second largest producer of farmed salmon with an output of more than 50 000 tons, from less than 3000 tons five years earlier. Because farming Atlantic salmon (*Salmo salar*) was more attractive than Pacific salmon due to lower mortality rates, higher cage density, and market opportunities in the United States, Chile switched away from Pacific to Atlantic salmon. By 1992, Chile was cultivating more Atlantic than Pacific salmon. In spite of its liberal access to imported salmon eggs, Chile has been fortunate so far in avoiding negative effects. The benefits in terms of jobs, income and foreign exchange have been considerable.

This information suggests that policy makers must weigh costs and benefits in their decision whether to introduce a new species for aquaculture, giving due attention to a thorough and proper *a priori* risk assessment according to recommended rules. Economic benefits of introducing a new species may outweigh ecological risks with net benefits in favour of introducing an alien species. However, risk management would suggest that the emphasis should be on prudence, alien species being introduced only as a last resort. FAO has established guidelines for the introduction of alien species.

### ***Marketing Policies***

In addition to providing incentives for foreign direct investment, governments can "kick-start" commercial aquaculture through marketing. Governments may opt to establish a market for the hygienic handling and selling of fish. The Fish Marketing Organisation in central Bangkok is a state enterprise for the selling of fish. Fish are sold through fish agents who must be registered with the Department of Fisheries. As the industry has developed, the role of marketing has increasingly passed to private assembly markets (Piumsombun, 1999). In China, the government has played an active role in investing in trading markets. There are more than 300 located in both consuming and producing areas (Huang, 1999). However, as in Thailand, the private sector is displacing the public sector in the marketing channel. In Jamaica, the government appointed a marketing officer. The objective was to create a market for the farmed fish. Taste tests were tried at government functions, recipe booklets were produced and cooking demonstrations were held on radio and television (Wint, 1996). To help with logistics, the Inland Fisheries Unit provided transport for the big buyers, and also ice. These facilitating activities declined as the industry developed, with marketing and transport increasingly falling on the private sector as larger firms entered commercial aquaculture.

### ***Promotion of Producer Associations***

In most countries, aquaculture does not have the economic weight of agriculture or even the capture fisheries. Thus, its interests are often overlooked. Producer organisations can be useful just as a lobby group. Also, they are frequently used as a means of exchanging information and diffusing technical knowledge. For tradable species, a major role of producers associations is to increase market share by product differentiation. Brand marketing to differentiate products, perhaps according to the pristine growing environment, is an attempt to move away from commodity pricing towards monopolistic competition and price setting. In addition, producer associations can collaborate to increase the demand through generic marketing. Through their associations, rival salmon producers from Canada, Chile and the USA have completed a three-year marketing campaign to promote farmed salmon in the USA, their major market. Approximately 30 million consumers were reached in a number of target cities. The evidence indicates that the campaign has been successful with young consumers of an income of more than \$50 000 a year (Infante, 1999). Consumption of farmed salmon in the targeted cities grew by an average of 9% more than in control cities where there was no generic campaign. There are projections that the US market for farmed Atlantic salmon will more than double between 2000 and 2005 (Kontali Analyse, 1999).

In its most effective form, a producer organisation markets the product ensuring that the quality is consistently high, self-polices regulations and even funds applied research. Examples of associations that provide a gamut of services are the Chilean Salmon and Trout

Growers' Association, the Fundación Chile and Costa Rica's TILACOOOP. In Chile, marketing was one of the main tools for promoting the industry, but through producer associations. In 1986 when output was 1,000 tons and exports were only worth 5 million dollars, the Association of Chilean Salmon and Trout farmers was established. Producers contributed \$0.03 per kilo. In return, the Association maintained HACCP (hazard analysis and critical control points) quality standards and advertised. The quality standards aimed at ensuring that all products exported were of a uniformly high quality, and thereby reassuring buyers. By 1989, the Association was spending 2.8% of sales revenues on marketing; more (as a percentage) than Norway and Scotland combined. In 1998, output had grown to more than 200 000 tons and exports were worth 714 million dollars (Shaw and Gabbott, 1999).

As the industry matured, the Chilean Association that has been active in brand and generic marketing and maintaining quality standards has encouraged self-regulation of the industry in order to minimise government interventions. Self-regulation is done through successful enforcement of its equivalent of a Code of Conduct for best aquaculture management practices. It has also funded research on environment issues and diseases that are of direct concern to the industry, and encouraged the transfer of technology through its Salmon Technology Institute, which was founded in 1993.

Fundación Chile was instrumental in promoting salmon farming by establishing farms that were later sold, and has actively encouraged technology transfer. Its present research is on disease and nutrition (Bjørndal and Aarkland, 1999). In Costa Rica, small-scale tilapia producers have formed a co-operative, TILACOOOP. It is funded through a share of the crop. Its services include supplying fingerlings, sourcing cheaper feed, co-ordinating technical assistance and conducting demand-driven research. As its counterpart in Chile, TILACOOOP markets both domestically and internationally.

In sub-Saharan Africa, a review in the early 1990s found that as many as 4 000 co-operatives existed in Nigeria alone with the earliest dating back to 1907. However, although numerous, they have not usually been effective because most were mismanaged and politicised (Turtianen and Hussi, 1992). In at least Ghana, Kenya, and Nigeria co-operative legislation needed revision to permit management autonomy from government, and the marketing of crops. The experience from agricultural associations is that when associations have management autonomy and a business reason to exist they can succeed as with the coffee co-operatives in Kenya (Cleaver, 1993). Self-sufficient financially, and paying market interest rates, farmer's associations have been particularly successful in managing shared water supplies in Kenya and Nigeria, and diffusing processing technology. There exist also some farmer-managed co-operative savings and loans associations. Co-operative credit institutions in countries such as Benin, Burundi, Cameroon and Ghana have been most successful; mobilising farmer savings and lending at rates that reflect costs and risk (Cleaver, 1993).

Producer groups and model farmers may be required to assist more with extension services and training (Moehl *et al.*, 1999). Increasingly in sub-Saharan Africa, the cost of separate extension services for agriculture and aquaculture is forcing amalgamation of the two and a unified service. The disadvantage of a unified extension system is that extension workers may be unfamiliar with the less significant sector, aquaculture. To provide adequate technical assistance while minimising public expenditures, extension services focussing on farmer groups and farm leaders could prove advantageous.

### ***Research and Technical Development Policies***

Research in aquaculture has two major aspects, including basic and applied research. Where research funds should be spent and who should finance research will vary with the development stage of the species and with the procedures for allocating funds.

Experimentation into species and techniques may occur over several decades, and may not even result in a successful outcome. Three stages are generally defined. Throughout the initial development stage of a species, if positive, returns to research tend to be low. During this stage, not only will research be primarily publicly funded, but also it will usually be limited. This is, in part, because of the relative infancy of the industry and because of the industry's small weight in national economies. In the Philippines, research intensity, as measured by the amount of research spending as a proportion of aquaculture revenues, approximates 0.3% (Olalo, 1999). In Australia the planned figure is 0.5% (Ogburn and Evans, 1998).

During the development stage of a species, funding will be primarily public. This is because research has many features of a common property. Results cannot be retained only by the funding agency. Because research-funding farms cannot appropriate research results, and non-contributing and competing farms enjoy "free-rider" benefits, there is little or no incentive for the private sector to fund research during the development stage (Bjorndal *et al.*, 2000). As a result, the government has to fund research. The rationale for publicly funded research is that it will encourage the establishment of firms and society will enjoy positive externalities. Before it established its farm, Aquacorporación in Costa Rica applied results of the research on soils, markets and tilapia cultivation that the public sector produced (Porras, 2000). Also, both Aquacorporacion and smaller commercial farms have adopted monosex tilapia technology that was developed with public funds by INCOPESCA (Instituto Costarricense de Pesca y Acuicultura).

In addition to the amount of money devoted to research, policy -makers can influence the efficacy of the money spent<sup>11</sup>. In sub-Saharan Africa, while aquaculture is a recent introduction, it has been studied at least as far back as the 1940s and 1950s in certain countries (Entsua-Mensah *et al.*, 1999). Yet, the impact of research, as reflected in output, has been limited. The low output can be partly attributed to disregard for economic incentives to producers. However, part of the problem has been poor research co-ordination and problematic diffusion of research results within sub-Saharan Africa (Coche, 1994). A solution proposed has been to establish a regional information network (Coche and Collins, 1997). Another factor affecting research efficiency has been the lack of demand-driven research (Entsua-Mensah *et al.*, 1999). If the agenda is determined by a top-down approach, existing expertise and personal interests will orient publicly funded research. This is not unique to Africa. In Asia, a survey of more than a dozen countries found that most research personnel in aquaculture were biologists, which contributed to the predominance of biological and technical research (FAO-NACA, 1997). The research agenda was supply-driven, which was not in the interest of the industry. Of 330 research projects studied in the survey, more than 80% were oriented to aquaculture technologies and systems. Less than 3% of the remaining

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<sup>11</sup> Estimating research efficiency requires calculating consumer and producer surpluses and attributing market changes to research (Kabir and Ridler, 1989). This depends on the demand and supply elasticities of the species, on the commercial stage of the species and on the diffusion of research.



total went to areas such as policy, planning, socio-economics and management. To obtain demand-driven research, the private sector has to be involved, either as a source of funds, or as one of the stakeholders setting the research agenda.

After the development stage, there may be a relative decline in publicly funded technical research as profit-driven enterprises internalise the research costs. As the industry expands and retail prices fall, conserving market share and shifting demand upward become increasingly important for the industry. Research focus may then change towards marketing. Marketing research is generally done by private enterprises. In addition, research and technical development are a means of coping with movements down the demand curve. If demand for a product is price elastic, a movement down the demand curve<sup>12</sup> will increase profits if costs fall (Kinnucan, 1995).

According to product cycle theory, initial development of knowledge-intensive industries that produce tradable goods will occur in industrialised countries (Vernon, 1987). This is particularly the case for high-income goods because only those countries will have sufficient middle income consumers to form a market. Over time, however, technology increasingly becomes embodied in purchased equipment and is diffused to other countries, including the developing world. The diffusion of technology will encourage production in low-cost countries, namely developing countries because of their low wages. Ultimately, if there is technological stagnation, developing countries gain comparative advantage. This implies that continued research and development can negate the product cycle and maintain a leader's advantage.

An example where research and development negated the product cycle is salmon farming in Norway. Farmed salmon is an internationally tradable good. Yet, the decline in output from Norway, as suggested in the product cycle model, has not occurred. Most Norwegian farmers have not relocated to developing countries. They have continued to produce domestically because of continued technological advances. Norway has continued to focus research on increasing labour productivity and reducing costs through lower mortality rates, improved feed conversion rates and genetic improvements. This has allowed Norway to maintain, and even increase, output. Preliminary figures suggest that Norwegian output exceeded 390,000 tons in 1999, and its potential output (even with existing sites) has been estimated at 740,000 tons (Hempel, 1995). Technological advances have lowered costs sufficiently to maintain competitive advantage with Norwegian labour productivity increasing from 50 tons to 300 tons per man-year. The real cost of cultivating and processing farmed salmon has more than halved between 1987 and 1998 (Kontali Analyse, 1999). Even a further decline in farm-gate prices of one-third would leave salmon farming in Norway profitable (Hempel, 1995).

A factor that accelerates private research funding is industry consolidation. From more than one thousand Norwegian salmon farmers in the 1980s, the number had fallen to 230 in the mid-1990s (Hempel, 1995). Since then, there has been further consolidation and four producers now dominate Norwegian exports. During the same period, the number of companies involved in Atlantic salmon farming approximately halved in Chile, and declined even faster in Canada and the United Kingdom (Muir *et al.*, 1996). As industries consolidated, they funded more research. Industry structures where farms are perfectly or monopolistically

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<sup>12</sup> Following an outward shift in supply.

competitive lack excess profits for research. At equilibrium, average revenues equal average costs for the typical farm and excess profits are zero. Moreover, farms in a perfectly competitive industry can sell all they wish at the given price; they have little incentive to innovate. Unlike monopolistic and perfectly competitive farms, oligopolistic farms have both the means to fund research and the incentive to innovate. Often, research can only be undertaken in large discreet units, and oligopolies have the excess profits for private funding. Moreover, demand-driven, the research can provide technological gains and early-mover advantage.

### ***Strategic Planning***

Because promotion of aquaculture requires a holistic approach, a strategic plan is useful. It provides a comprehensive set of policies to achieve designated objectives and ensures that inter-related activities, such as agriculture and fisheries, are included, that environmental issues, such as access to water and land, are addressed and that the policy-mix is consistent (Corbin and Young, 1997). One advantage of a strategic plan is to mitigate institutional overlapping of jurisdictions. Where there are several institutions responsible for aquaculture with all the attendant rivalry and duplication, a sector plan can encourage consensus over goals and strategies.

Given the marginal nature of aquaculture in most sub-Saharan countries, it is not surprising that most have no plan. In a review conducted in the early 1990s, most of the then ten SADC-countries did not have a development plan for aquaculture (ALCOM, 1994). A more recent review of some sub-Saharan countries found that, with the exception of Madagascar, there was little aquaculture planning (Moehl *et al.*, 2000).

A "good" plan is a pro-active strategy for the development of the industry and should be realistic and enforceable, with scenarios and policy options. In some jurisdictions, there is multi-year indicative planning in which aquaculture output is projected and a development strategy outlined (OECD, 1989). By providing targets, a strategic plan assists policy-makers in evaluating progress and in indicating where there are bottlenecks. In Madagascar, a physical tonnage is forecasted, which assists policy-makers in evaluating progress. The Master Plan of Aquaculture in Tunisia not only describes the expected supply of cultivated species, but also it develops a strategy for marketing fish species domestically and internationally (Gazbar, 1996).

A plan should, in general, have the following six characteristics. Be relevant and oriented to the industry; openness with other agencies and stakeholders; definition of goals, issues and constraints in meeting the goals and addressing the issues; definition of actions to address issues and accomplish goals; specification of a time frame for actions; have a broad scope; be flexible. A hypothetical development plan is indicated in Table 2 below (FAO-NACA, 1997).

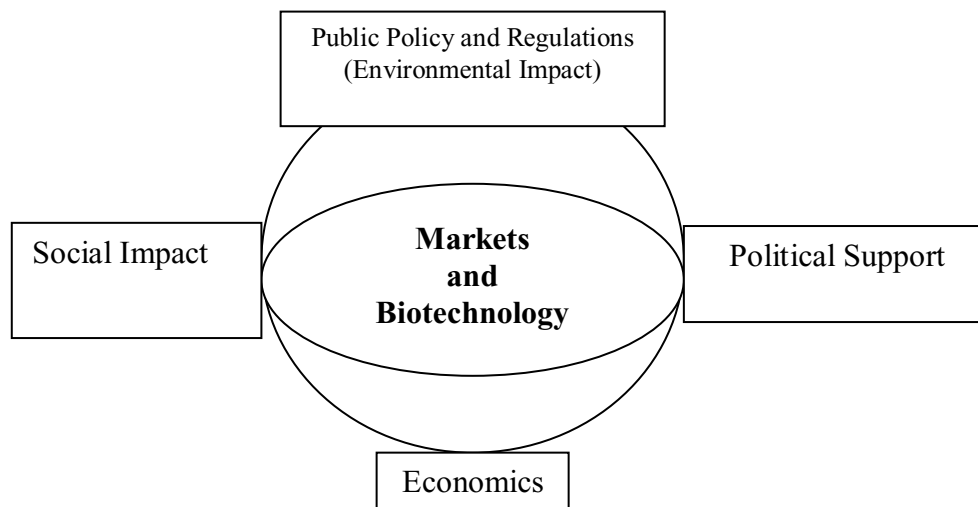
Table 2. A hypothetical development plan

Issue category	Issue	Constraint	Action required	Time frame
Administrative and institutional	Poor enforcement of regulations	Personnel	Rely more on producer associations	Medium term
Technical	Shortage of quality feed	No feed factories Right mix unknown	Lower tariffs on feed ingredients;	Short term
			Research feed	Long term
Socio-economic	Lack of credit	Lack of collateral; Banks convinced aquaculture is too risky	Encourage land entitlement;	Long term
			Give loan guarantees	Medium term
Physical	Shortage of suitable sites	Limited land and water	Increase productivity of existing sites;	Medium term;
			Encourage cage culture	Medium term
Environmental	Pollution		Zoning	Medium term
Human resources	Lack of skilled managers	Training too expensive	Encourage cooperative training programmes	Medium term
				Long term

To achieve openness, there are two different approaches: the top-down and the bottom-up. Most countries in Asia use the top-down method. With this approach, central government agencies decide the issues and needs for the industry (FAO-NACA, 1997). With the bottom-up approach, stakeholders are encouraged, through a participatory process, to discuss issues and objectives. In Bangladesh, which uses a bottom-up approach, consultations are with research institutions, NGOs and producer associations. In the Philippines, species are separated (i.e. shrimp, tilapia, and seaweed) and consultations with stakeholders connected with each species are conducted. The advantage of the bottom-up approach is that stakeholders can identify constraints and needs. Another advantage is that the plan is more likely to be implemented because it comes from end users (Neiland *et.al.*, 1998). However, the bottom-up approach is more costly in money, personnel and time.

When formulating a development strategy, an objective analysis of advantages and constraints of the sector is necessary. This enables a jurisdiction to focus on the most competitive sectors. In Hawaii, the process is called ADN (Aquaculture Development Niche) (State of Hawaii, 1993). ADN is defined as a group of broadly based business opportunities that possess similar characteristics and have similar development potential. In ADN, opportunities for species are examined and constraints evaluated. All the pre-requisites for commercial aquaculture development, as discussed previously, are evaluated. This is illustrated in the diagram below.

Figure 1. Illustration of an aquaculture development niche



The advantage of this approach is that it integrates all facets of aquaculture. One is not merely answering the question of how can enough fish be produced to meet the growing demand, but whether production can be sustainable. A holistic approach including ecological considerations reduces the chances of resource use conflicts and resource exhaustion (Greenpeace International, 1999). Zoning can be implemented, and limitations placed on aquaculture development if it is beyond the carrying capacity of an area. Using ADN, Hawaii has assessed aquaculture, ranging from earthen ponds to offshore mariculture and geothermal exploitation. Potential species have also been selected according to the criteria above.

A similar holistic approach to aquaculture planning occurs in Australia, where not only there is a national plan, but also plans for aquaculture development in States and within States exist. The national plan places aquaculture within the context of the food industry and Australia's resources and constraints, suggesting goals and policies (Commonwealth of Australia, 1994). The Aquaculture Committee reviews the plan regularly to identify new priorities<sup>13</sup>. (Gillespie, 1998). This indicates that planning is an on-going process.

There are similar plans within the States, such as the plan for regions Gascoyne and Kimberley in Western Australia (Government of Western Australia, 1999). The potential for aquaculture is examined with possible species prioritised. For each species, the production technology is summarised for its adaptability to the region. It is also specified whether or not research will be needed. The market analysis covers price sensitivity, competition from alternative food sources and market potential. Economic aspects include input costs and economies of scale. Finally, the potential species is judged for its overall suitability. If the species is of high priority, policies to promote its development are recommended. An example is given in Table 3.

<sup>13</sup> The Plan identified ten areas for strategic management. The ten areas were: industry structure and organisation; the relationship between aquaculture and the capture fisheries; government framework; environmental management; land and water planning; research and development; marketing and product development; education and training; extension services; and quarantine and movement.

Table 3. Example of a holistic approach to aquaculture planning

Species	Technology	Culture system	Market potential	Economic potential	Comments/ Outlook
Eels ( <i>Anguilla</i> sp.)	Well established; Dependent on wild elvers	Fresh water All systems Pond/tank	No domestic market; Small export market	Limited profit potential; Smoked has potential	Need to expand markets; Little potential
Argyle bream ( <i>H. jenkinsis</i> )	Some research needed	Fresh water All systems Pond/tank Polyculture	Very good domestic market; Export market; Price elastic	Unknown but probably good; Asian market very price elastic	Very good candidate; Production costs are low; Freezes well; Fish are robust

For sub-Saharan Africa, a similar plan would focus on assessment of opportunities and constraints. Among the advantages of most countries in sub-Saharan Africa is the existence of indigenous species with a known culture technology in most cases. There are also suitable sites and climatic conditions (Oswald *et al.*, 1996). However, as indicated earlier, most countries suffer enormous constraints. Among these are problems of governance, infrastructure such as transport, availability of quality feed and seed, and access to credit. In addition, in many countries, construction costs are high, as are real interest rates. Policies to deal with the former constraints were discussed in previous sections. The latter constraint indicates that the choice of technology should focus on economic as well as on technical efficiency.

Another advantage is the existence of an unsatisfied domestic market for fish. The Region imports about 1 million tons of fish per year. Over time, growing demand could increase the shortage. Income elasticity of demand for fish in sub-Saharan Africa is positive though less than unity (Delgado and McKenna, 1997). If per capita economic growth continues at historic rates, total demand for fish could increase by 2.7% a year, which is higher than historical world growth rates of 2.0%. Higher real prices of substitutes would still further increase demand. In addition, there is a population factor. With a growth rate of 2.4% a year, Africa's population is projected to reach 1.36 billion by 2025, from 750 million in 1998 (United Nations, 1998). Additional population will result in additional demand for fish. Growing demand and the limited potential for growth of both the marine and inland fisheries could almost double fish imports to 2 million tons by 2010, without any allowance for rising per-capita consumption (FAO, 1996).

While the principal market for farmed finfish in sub-Saharan Africa is the urban domestic market, there is the potential for exports to Europe or North America. For internationally tradable products, transport costs are critical in determining comparative advantage. The price of the delivered product includes both production and transport costs. High transport costs have been a factor impeding the export of fresh tilapia fillets from Fiji to the United States. This was in spite of excellent growing conditions for tilapia (Costa-Pierce, 1998). Sub-Saharan Africa suffers from a disadvantage given its distance from markets in Europe and North America. Load factors, competition and flight frequency are other factors that handicap airfreight from Africa. The cost of air freighting fresh tilapia fillets from Africa to Europe is 8% -40% higher than air freighting from Jamaica to Europe (Carberry, 2000).

However, international transport costs are not an insuperable handicap to successful exporting. In spite of high transport costs, Chilean farmed salmon has a lower delivered price in the United States than its Canadian competitor because higher transport costs are more than offset by lower production costs<sup>14</sup> (Ridler, 1994). Moreover, the processing of fish, with fresh fillets having a 30% price premium over frozen fillets, lessens any transport disadvantage.

Zimbabwe's Lake Harvest Aquaculture exports between 10 and 12 tons of fresh tilapia fillets to Europe each week. Planned expansion has a target of more than 50 tons of fillets exported a week. Thus, sub-Saharan Africa may have an absolute disadvantage in exporting whole tilapia but a comparative advantage in exporting fresh fillets.

This suggests that a high transport cost-easing strategy in sub-Saharan Africa would have to focus on one or any combination of the following four options. The first option is to focus on a high-valued species that could absorb the cost of freight to major markets in Europe or the United States. Because of its high value, farmed shrimp from Madagascar can be air freighted to the Europe; possibilities to deliver to the United States are under assessment. The second option would be a unique species. This is the case of black pearl oysters exported from French Polynesia to Japan. Another alternative is a processed product that can be transported by ship rather than air, thereby lowering transport costs. This would be a frozen or dried product. The fourth choice could be a processed product that is weight losing. Filleting is weight losing, which lowers costs of air transport and permits fillets to be air freighted fresh (e.g. Nile perch in the case of capture fisheries).

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<sup>14</sup> Labour, feed and seed costs are low in Chile; they compensate for freight charges.

## CHAPTER 7

### SECTOR-SPECIFIC POLICIES AT THE FARM LEVEL

#### Rationale for Government Intervention at the Farm Level

While government's intervention in commercial aquaculture at the macro level is self-explanatory, the question arises whether governments should intervene in the industry at the farm level. Commercially produced fish from private farms are not a public good. They belong to the producers. A public good might be the fish from stocking of rivers where there are no riparian property rights. An individual who cannot be excluded from fishing in the waterways does not have the incentive to pay the stocking or rearing costs. So, governments must provide such services. If governments did not provide re-stocking services, waterways might become depleted of fish. The argument for government intervention in commercial aquaculture at the farm level is more complex. As discussed previously, aquaculture can generate negative externalities at the farm level. These may include pollution or the interference of aquaculture with other users of the waterway and land. These spin-offs would not be included in a farm's balance sheet; yet, they may be an important cost to society.

If property rights were assigned and transaction costs were low, externalities could be solved without government intervention. Those causing negative externalities (such as adverse effects from pollution) would pay compensation to those adversely affected. Compensation would be quantified and enforced through litigation. Often, however, the Coase conditions<sup>15</sup> of assigned property rights and low transaction costs do not apply. Responsibility for damage from non-point sources of pollution is difficult to assign, and transaction costs are often prohibitive. Then, negative spin-offs become difficult to settle through the courts. Thus, government's intervention becomes necessary. Similarly, the potential of positive externalities from commercial aquaculture (tax revenues, foreign exchange earnings, jobs, social amenities) prompts governments to intervene.

Government intervention in aquaculture at the farm level has many facets. In some countries, it has included direct subsidies to producers in the form of start-up grants to kick-start the industry. In others, it has incorporated policies to help the industry expand. In other instances, governments have intervened to shield domestic producers against foreign competition, and help the industry compete internationally. However, it is worth noting that, although they can be effective and even efficient, many of these policies require expenditures. Some may be so onerous that they can be impracticable in the context of fiscal austerity of sub-Saharan Africa. Others do not require direct expenditures, although they have opportunity costs. They may be more appropriate for the region. Thus, these policies must be selectively employed.

#### Start-up Policies

The extent and type of public intervention in the industry in part depends on the development stage of the industry. As discussed in the previous chapter, commercial aquaculture typically develops in three or four stages (Poxton, 1992). The stage progression is measured by total output. It goes from infancy to growth, maturity and perhaps to decline (Csavas, 1994). In the

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<sup>15</sup> Coase argued that assigned property rights and low transaction costs obviate the need for government intervention in reducing negative externalities. These two conditions are referred to as the "Coase Conditions".

initial stage, which will normally last for 10-15 years, small projects are developed, often with very little capital. This is the research and development phase. Gradually, if biologically and commercially successful, output expands into the second phase. If the species is internationally tradable, the technology will diffuse to other countries that are potential competitors. During this third phase, there will be rapid expansion followed by a slower growth. The final phase could be a decline in output as price declines force less efficient operations to leave the industry.

Government financial assistance, in the form of start-up funding, may be critical in the first and second phases. The argument for start-up funding in the first and second phases is that aquaculture, as an “infant industry”, may need support until it reaches a stage at which costs are competitive. The need to assist infant industries has been recognised at least since Hamilton in the eighteenth century. If industries learn by doing, costs will decline with experience, and so the argument goes, such industries need government assistance in their early years. Such assistance may be in the form of research, start-up costs, or tariff and non-tariff protection. With maturity will come economies of scale and international competitiveness. Then, in theory, government assistance should end.

Reinforcing the argument for government assistance is the inability of infant industries to obtain private funding. Financial institutions are naturally prudent. Faced with biological and other uncertainties, they are unwilling to provide credit until risks are known. Without bank loans, development will be slow. Government funding to such infant industries is then not a substitute for private funding because the latter will only occur as the industry matures.

To ease financial constraints, start-up funding is often provided to farmers in the form of cash grants. In salmon farming, most countries provided start-up funding to producers. In Norway, there were regional grants. There was also a tax exemption, which was equivalent to a government loan of approximately US\$400 000 per farm (Heen, 1993). This encouraged expansion, enabling Norway to maintain its leadership in the industry. In eastern Canada, twenty-one salmon farms received each approximately US\$50 000 in cash grants to supplement their equity financing. They also received publicly provided extension services and research. An ex post evaluation of the cash grant component found that discounted net benefits of providing start-up funding were positive (Ridler, 1998). However, many African countries in sub-Saharan Africa lack the resources to provide initial grants and monitoring personnel.

Rather than cash grants, an alternative form of start-up funding is to issue bonds. For governments, bond financing has the advantage of not requiring immediate cash outlays. In Connecticut, United States, commercial oyster farming developed through an initial bond authorisation in 1987 (Volk, 1998). Farmers obtained their leases through competitive bidding. The money from the initial and later bond issues has allowed the leases to be planted with seed. In addition to initial funds raised from the bond issues, farmers pay 10% of the sale value of the harvest to sustain the planting. Benefits in terms of jobs and incomes have greatly exceeded the amount governments must repay on the bonds (Volk, 1998). Bond financing could be a possible option in certain countries of sub-Saharan Africa.



## **Expansionary Policies**

Once aquaculture has taken off, often farmers experience difficulties to expand. In sub-Saharan Africa, several constraints impede the development of commercial aquaculture. The most important ones include availability and high cost of inputs. Inputs referred to here include feed, seeds, and capital. There are specific policies that governments can undertake to address these issues.

### ***Policies Dealing with Unavailability of Inputs***

Absence or limited availability of necessary inputs may prove a serious impediment to the development of aquaculture. Often, it is more critical than cost. Government policies that are aimed at assisting farmers to overcome the issue shall target the increase in supply of the limited/lacking input.

Availability of good quality feed is important because, in most commercial operations, feed accounts for more than half the operating costs. In most sub-Saharan countries, the limited demand for fish feed and the high cost of agricultural by-products have handicapped the development of a fish feed industry, although there are exceptions (Entsua-Mensah, 1999). In Nigeria, Malawi and Zambia, large farms produce their own fish feed. One policy to develop a feed industry is to encourage investment in aquaculture from a large farm. By its size, Aquacorporación in Costa Rica guaranteed a large enough market for profitable feed production, and feed companies developed. At Man in Côte d'Ivoire, there is a plan to generate sufficient demand for a private feed mill from small and medium-scale project commercial farms. However, the project is externally funded; the strategy of relying on small-scale farms to generate demand for quality feed may not be transferable to non-donor funded aquaculture.

An alternative policy is to encourage livestock companies to diversify into aquaculture and feed production. In Jamaica, the Jamaica Broilers Group diversified from poultry to fish. In Thailand, two large poultry-feed producing companies, CP and Laem Thong, diversified from poultry to shrimp. Not only did they start producing shrimp feed, but the companies extended their experience of contract farming from poultry to shrimp (Tokrisna, 1999). In Madagascar, a company specialised in livestock feed production is producing shrimp feed on an experimental basis.

If feed can be imported, but at the cost of foreign exchange, import substitution policies may be desirable. In the Philippines, a domestic feed industry has developed as a result of levying tariffs on imports of feed and feed ingredients. To encourage domestic production, initially, 30% and 10% tariffs were respectively levied. Because tariffs raise production costs, there was concern that tilapia exports could shrink. Thus, tariffs have since been lowered to 10% and 3% in order to lower feed prices. However, as is common with protectionist policies, the new domestic feed producers have resisted complete elimination of the tariffs (Olalo, 1999).

As with feed production, the availability of seed in sub-Saharan Africa, especially fingerlings, faces issues of quantity and quality. Reproducibility of tilapia is high in that the species can easily be reproduced in captivity and without high technology. Initially, catfish required hatchery techniques, but now farmer-friendly techniques are possible (Moehl *et al.*, 1999). To ensure enough seed supply and maintain high quality fingerlings, an appropriate policy would

be to induce a number of farmers to specialise in seed production and to train them in modern hatchery techniques. Initially, a few government stations could be used for broodstock, but increasingly, the private sector will have to replace the stations as a source of fingerlings for small-scale rural aquaculture and commercial operations.

Commercial aquaculture has high capital needs. With industrial techniques, the need is for start-up fixed capital. The need is also for operating capital to cover cash-flow shortages. Unfortunately, in sub-Saharan Africa, financial institutions are reluctant to provide credit to aquaculture. One of the arguments against lending to aquaculturists is that, in most countries aquaculture is either new, or unknown, with risks unquantified. The problem is compounded by past negative experience. For example, in the 1980s, as part of its policy to encourage fish farming, the government in Ghana instructed banks to lend money for pond construction. Unfortunately, poor management and inappropriate technology caused many farms to default. The repercussions were still felt in 1990s, with bankers insisting on physical assets as collateral. The value of the collateral was to at least equal the amount of the loan (Wijkström, 1990). The lack of collateral remains one of the major factors blocking aquaculture farmers access to loans<sup>16</sup>. In other countries, the lack of reliable business plans has deterred banks from lending to aquaculture farmers. Instant consultants appeared to assist with business plans that proved unreliable. The result has been a high degree of scepticism among lenders<sup>17</sup>. Lending was also often politicised, at negative real interest rates and with little regard to loan recovery (Cleaver, 1993).

To increase accessibility of commercial farms to bank credit, a number of policy options exist. One policy is to demonstrate to bankers that commercial farms that are financially viable exist. By demonstrating the actual profitability of aquaculture, the intention is to create awareness of the sector and encourage lending. The banks targeted should be those which have a high ratio of their loan portfolio in agriculture, and are responsive to alternative agriculture. Banks that are open to alternative agriculture appear to be the most likely to also lend to commercial aquaculture (Bacon *et al.*, 1998). Such targeting of credit to a sub-sector has succeeded in China, Japan and Korea (Cleaver, 1993).

An alternative or a complementary policy is to have business plans evaluated for their technical merits by government officials. That reassures bankers who lack aquaculture expertise. This practice has produced good results in Madagascar. Another policy is to involve bankers from the beginning of the project rather than wait until a loan is needed because of financial need (Mellac, 1995).

If financial institutions remain reluctant to lend, government loan guarantees are possible. They address the issue of collateral. With government loan guarantees, the risk of default by the borrower is passed from banks to taxpayers. Among OECD countries, Canada Holland and Spain have encouraged commercial aquaculture with loan guarantees (OECD, 1989).

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<sup>16</sup> In some countries such as Canada, the reluctance to lend money was compounded by legislation, which precluded underwater animals from being considered as collateral.

<sup>17</sup> Problems with bank credit are not unique to aquaculture. There has been widespread credit failure in agriculture projects, particularly with parastatal credit institutions.

### ***Policies Dealing with High Cost of Inputs***

If the high cost, rather than availability of inputs, is a principal constraint to the commercial sector's viability, the industry may never be sustainable. The industry may illustrate a lack of absolute advantage vis-à-vis other competing countries. For an internationally traded product such as farmed shrimp, high seed and feed costs can place sub-Saharan Africa at a competitive disadvantage compared to Asian shrimp producers. For tilapia production, sub-Saharan Africa has a feed cost disadvantage compared to Latin America. Subsidising inputs can be both costly and inefficient. In the Philippines, fertiliser production has been subsidised since the 1970s, but the high fiscal cost and resulting distortions have forced its curtailment. Subsidies may also discourage the private sector. Government stations that provide free or subsidised fingerlings create a disincentive to private investment in hatcheries. However, if the conclusion is that after support during infancy input costs will fall, perhaps because of economies of scale or of scope, input subsidies can be temporarily targeted towards the industry. Policies that lead to increased supply of feed and seed may also lessen the problem of high costs.

An input that has commonly been subsidised is financial credit. Financial capital is not only scarce in sub-Saharan Africa, but it is also expensive. With economic reform, distortions in financial markets have been reduced, with artificially low interest rates increasingly replaced by lending rates that reflect capital scarcity and expected inflation. Interest rates, both nominal and real, can therefore be high particularly for ventures such as aquaculture for which risks are often unknown. In addition to providing start-up funds to eliminate or lessen the need to borrow, a policy that has been widely followed in many countries has been providing an interest rate subsidy. France, Greece, Jamaica, Portugal and Spain are among countries that have used this policy to promote aquaculture. In Jamaica, the Inland Fisheries Unit initially provided funding to producers at reduced rates to encourage pond construction. Over time, however, credit arrangements were between farmers and retailers, or between farmers and input suppliers (Wint, 1996). An indirect social cost of interest rate subsidies is to bias the choice of production techniques. Where there is elasticity of technical substitution, lowering the cost of capital (vis-à-vis other factor prices), can induce the choice towards more intensive technology with higher capital-labour ratios. However, interest rate subsidies are preferable to cash grants because the burden of default falls on the producer as well as the taxpayer.

### **Export Promotion Policies**

Aquaculture expansion may be international (if the species is internationally traded), and may cause a dynamic evolution of market shares internationally. From wooden cages and moist-feed, and from high mortality rates and poor feed conversion rates, the salmon farming industry has expanded globally, spawning continual technological advances. Usually, in this expansion stage, there is little role for direct government assistance. However, government intervention may be needed to make the industry maintain its share of the international market.

If acceptable under international trade agreements, policies to encourage exports are less distortionary than import substitution policies<sup>18</sup>. They mainly consist of economic incentives

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<sup>18</sup> Readers/users of this document are advised to consult appropriate documentation from the World Trade Organisation on subsidies and countervailing measures.

such as tax exemptions, tax holidays and import duties. While economic incentives basically are used as an attractive magnet for foreign investment in the sector, they can, at the same time, stimulate exports. Although taxes rank below governance and stability as determinants of business investment in Africa, they are a major grievance (Sachs, 1998). When questioned about grievances, business executives in Africa cite taxes as either the major problem (domestic companies) or as the second most important problem (foreign companies). Therefore, tax relief can be an effective incentive. For governments, tax relief has the advantage of incurring no direct expenditures although there is the cost of lost revenues.

Such incentives may be obligatory if competing countries offer tax exemptions. Unlike many South American countries, Ecuador does not offer tax exemptions on inputs for shrimp farmers, which puts them at a competitive disadvantage (Cámara Nacional, 1999). To provide a "fair playing field" for its exporters, Ecuador has exempted 43 shrimp farms from payment on part of corporate taxes.

Governments may allow companies a period of grace before corporation taxes are levied. This period is referred to as a tax holiday. In Costa Rica, companies, including the foreign Aquacorporacion Internacional, are exempt from corporate taxes for 10 to 15 years (Hishamunda, 2000a). In Puerto Rico where aquaculture is a priority sector, farms receive 90% tax holidays for up to twenty years (Wint, 1991). In Iran, where the private sector has an increasing role in the production of carp and rainbow trout, the 80 private rainbow farms that were operational in 1996 received not only preferential loans and a feed subsidy but also tax free status for twenty years (Rana, 1997).

In Sri Lanka, aquaculture is recent with virtually no output until 1980 (Siriwardena, 1999). A few large multinational companies, and some small-scale farms, started shrimp farming in the early 1980s; by mid 1990s, more than 3 000 tons was being exported. However, in 1996 disease closed 90% of all shrimp farms. Only 25% restarted and the Sri Lankan government has offered a number of incentives to revive the industry. Farms enjoy five years tax holiday and a tax discount for fifteen years after the tax holiday. Farms are also exempt from duty on imports and turnover taxes, and from exchange controls. Banks also offer discounts on loan rates and accept deferred payments. To be entitled to this tax relief, farms have to export at least 90% of their production. Thus the strategy is both to revive shrimp farming and provide incentives to export. In Madagascar, export-oriented shrimp farming enterprises, most of which operate in industrial free-trade zones, have several benefits. They are exempt from import duties, consumption, transaction, export, professional and excise taxes. They are given tax holidays on dividends for 15 years, period after which a 10% tax is levied (Hishamunda, 2000c).

Tax exemptions may extend to duties on imported inputs. They may allow remission of permit fees. In Honduras, as a stimulus to the sector, aquaculture is exempt from taxes on imported machinery, equipment, brood stock, larva feed and fertiliser. Processing plants do not pay taxes on exports or imports (Morales, 2000). In Costa Rica, companies that export outside Central America enjoy a number of exemptions. Sales taxes, custom duty, stabilisation taxes, and local taxes are among some of the exemptions exporters enjoy. Aquacorporación Internacional also benefited from a tax regime which paid the company 15% of the fob value of exports (Porrás, 2000). In the Philippines, where aquaculture policy is outward looking in that the sector is valued more for its contribution to exports than for its satisfaction of the domestic demand, investment is encouraged if it is export oriented.

Aquaculture companies that have more than 40% foreign ownership can benefit from incentives provided that at least 70% of output is exported (Olalo, 1999). For domestic companies, the minimum exports must be 50%. In addition, export taxes and permit costs are reduced.

## Summary

This part of the report discussed non-sector and sector-specific policies that can be used to promote commercial aquaculture. Under non-sector specific policies, governance is recognised as a key ingredient in attracting investors to commercial aquaculture and in influencing long term economic growth. Good governance reassures investors that their capital is secure and offers an incentive for further investment. Stability, political and policy, is of particular concern to investors in sub-Saharan Africa. Enabling policies such as guaranteed rights to land usage if not land ownership, and an appropriate exchange rate, are all factors that encourage investment. Recent data show that those countries in sub-Saharan Africa that undertook administrative reforms have experienced higher growth. Some of these reforms included openness to trade and emphasis on the private sector as source of wealth creation.

There are some aquaculture specific policies governments in sub-Saharan Africa could use to regulate the development of the industry. The main ones include zoning and the obligation to acquire permits to establish farms. A general principle is to have a legislative framework compatible with monitoring and enforcement constraints, and which will ensure environmental sustainability. Over-regulation should be avoided; it can be detrimental to the industry, and is fiscally costly.

Most countries in sub-Saharan Africa lack specific aquaculture legislation. Yet, the absence of legislation can be a deterrent to investors because it creates uncertainty. The problem is compounded when obtaining regulatory permission is administratively cumbersome. Where no legislation exists, laws relating to land and water access for pond aquaculture could be modelled on those for agriculture.

To administer the sector, a co-ordinating lead agency is optimal. Given the marginal nature of aquaculture in sub-Saharan Africa, such a specialised agency is implausible. A co-ordinating committee composed of personnel from different departments could be an interim arrangement. It could develop an information sheet describing what requirements are needed for a permit and where forms can be obtained. The committee could have responsibility for processing the permit, alleviating duplicating reviews. Economic incentives and self-policing can complement command and control of aquaculture development.

Whenever possible, research and development/extension should be conducted by the private sector and co-ordinated by producer associations. The advantage of producer associations co-ordinating research is that the results of the research can be internalised to all members thereby giving an incentive to contribute research funds.

In much of the sub-Saharan countries, many government stations have been abandoned, which has prompted many experts to recommend that they be divested of their role as seed producers, as suppliers of food fish and as demonstration centres. Fingerling production would become the responsibility of the private sector. The method of privatisation depends on

equity as well as efficiency. An auction or direct sale might exclude local communities. Where there is community interest a preferable method is a joint venture with scheduled disengagement by the government.

An appropriate strategy where access to bank loans is difficult is to encourage investment by large farms. In fact where there are a number of constraints to aquaculture, large operations may be essential to support small-scale farming. These could be an agribusiness that has the "know-how" to produce its own feed, and to market its output abroad. By its success it should entice new entrants into the industry, or at least establish sharecropping. Large farms could be domestic or foreign.

Many producer associations have been politicised and mismanaged yet they can be instrumental in promoting the industry. Well-managed and accountable producer associations should be encouraged. They are a medium for lobbying and diffusing technical know-how. They should also be used as marketing agents, and as monitors for environmental self-policing.

These and other policies are summarised in Table 4 for a quick reference. The list is not exhaustive, but covers some of the more widely implemented policies for aquaculture promotion. Many require additional expenditures, and although they can be effective and even efficient, they may be impracticable in the context of fiscal austerity of sub-Saharan Africa. Others require no extra financial outlays, although there will be opportunity costs such as lost tax revenues; these may be more appropriate for the Region. Because a time frame should be part of a plan, the list of policies indicates whether their impact on output is immediate (within one year), medium-term (1-5 years) or long-term (more than five years).

Table 4. Indicative list of policies that could be used to promote commercial aquaculture

Constraint/Issue	POLICY INSTRUMENTS			
	Involving additional outlays	Impact	Not involving additional outlays	Impact
Reduce Administrative duplication	Lead agency Sectoral plan	Long Medium	Legislative framework for aquaculture	Medium
Ease permit applications			Improve access to regulations Expedite processing of applications	Medium Medium

Constraint/Issue	POLICY INSTRUMENTS			
	Involving additional outlays	Impact	Not involving additional outlays	Impact
Encourage environmental sustainability			Land/water legislation Legislation on imports of alien species Environmental Impact Assessment Self policing Economic incentives Zoning	Long  Long  Long Medium Medium Long term
Availability of feed	Subsidise feed mills	Long	Attract a large firm with a demand for feed Encourage livestock firms to diversify Encourage domestic production with tariffs	Long  Medium  Medium
Availability of seed	Use of government fish stations	Short	Disinvestiture of stations to the private sector	Medium
Availability of land	Aquaculture Estates	Medium	Zoning Culture systems other than pond culture (if possible)	Medium  Short
Availability of bank credit	Loan guarantees (default involves outlays) Transaction cost subsidies Generate and diffuse info. about the profitability of aquaculture	Medium  Medium  Medium	Involve bankers at the beginning of the project Credible business plans Have departmental personnel vet business plans Guaranteed land rights (for collateral)	Medium Medium  Medium  Medium
Cost of bank credit	Start-up grant Loan subsidy	Short Medium		
Cost of feed/seed	Subsidies Cash grants	Short Short	Exemption from sales taxes/custom duties on inputs	Medium
Promotion of investment	Start-up grant Export subsidies	Short  Medium	Tax holidays Tax relief on imports Tax relief from other taxes	Medium Medium Medium Medium

Constraint/Issue	POLICY INSTRUMENTS			
	Involving additional outlays	Impact	Not involving additional outlays	Impact
Encourage foreign investors			Currency convertibility Capital/ profit repatriat. Debt/equity swaps Joint ventures Taxes exemptions	Medium Medium Medium Medium Medium
Marketing	Market agent Direct marketing Market outlets Introduce species	Medium Medium Long Medium	Product promotion by producer associations	Medium
Research	Increase research intensity Improve diffusion, and networks	Long Long	Increase demand driven research Increase private sector funding	Medium Medium
Training and extension	Extension based on model farmers Training at colleges/ professional schools	Medium Long	Training/extension provided by the firms supplying inputs Training/extension provided by the producer associations Use of technical assistance paid for by producers	Medium Medium Medium



## OVERALL SUMMARY AND CONCLUSIONS

Commercial aquaculture, which, for this paper is defined as the rearing of aquatic organisms that is profit oriented and primarily by the private sector, contributes to food security, directly by producing food fish, and indirectly by generating employment, and thus, income for the purchase of food. In addition, commercial aquaculture can be sustainable because it depends on private, rather than public funds that are usually lacking or scarce. Commercial aquaculture produce can also contribute to a country's balance of trade as an export, or as an import substitute. In many countries, aquaculture is a source of tax revenues and a stimulus to technological advances. It has also bolstered the development of isolated regions and halted migration to cities. However, commercial aquaculture can cause environmental costs and social conflicts. Shrimp farming, in particular, has created social tensions and caused mangrove losses in several countries.

Commercial aquaculture will flourish only if macroeconomic conditions, and cultural and political attitudes favour entrepreneurship. Low and volatile economic growth, overvalued exchange rates, policy and political instability and poor governance, such as corruption and lack of transparency, adversely influence investors. Property rights also influence investment especially in operations that are land or water intensive, such as commercial aquaculture. Other critical factors that determine the success of commercial aquaculture include the species selected, the location of farms and the choice of cultivation techniques. The species should be easily reproducible and have a ready market. As for any other type of aquaculture, location of farms must not only take into account physical attributes such as soil and water, but also access to infrastructure, particularly transport for input procurement and output distribution. For production technology, elasticity of technical substitution implies that intensive methods may not always be appropriate, however technically efficient.

This study led to the following main conclusions:

1. The low wage to capital cost ratio in most countries of sub-Saharan Africa suggests semi-intensive techniques may be more economically efficient than intensive techniques.
2. Governments receptive to the private sector should at least provide an enabling environment. A framework should cover access to land and water, the importation of exotic species and environmental regulations. Because of the cost of monitoring and enforcement, regulations should not be too complicated and can be complemented by other measures, such as economic incentives and self-policing. Administration should be facilitated, with easy access to regulations, transparent approval procedures and rapid processing of permits. Authority for aquaculture should preferably be vested in a single agency. That agency would oversee the development of the industry, and would be responsible for sector planning that should involve all stakeholders
3. For countries with scarce public investment capital, the appropriate strategy to promote commercial aquaculture might be to attract large operations, domestic or foreign. Large farms have access to their own equity financing, obviating the need for bank credit. They have the resources to exploit appropriate technology and to develop marketing networks. By their size, they can have backward linkages stimulating the establishment of feed and

fingerling industries. By their success, they can encourage small-scale entrepreneurs to enter commercial aquaculture.

4. Foreign direct investment in commercial aquaculture may be desirable, even necessary. Foreign firms often introduce new technologies, which provides knowledge to the domestic labour force. They will tend to be export-oriented and develop marketing channels. In return, foreign firms will expect, inter-alia, capital and profit repatriation as well as full currency conversion. Debt/equity swaps and joint ventures have also proven effective in attracting foreign investment.
5. One of the main constraints to commercial aquaculture in sub-Saharan Africa is the reluctance of financial institutions to provide loans, and the high interest on bank loans. To ease the problem of access to, and affordability of, credit, a number of policy options exist. Loan guarantees eliminate risks for banks, and incur no cost to government (unless there is default). Providing information about the sector, evaluating business plans by departmental technical staff, and diffusing financial data about successful commercial farms are other possibilities. To lower the cost of credit, subsidies on interest of bank loans have been offered to commercial producers in a number of countries. Credit subsidies have the advantage of spreading risk between governments and producers. However, in general, subsidies for inputs should be avoided. They contribute to dependence and misallocation of resources. Tax burden is also ranked among the principal concerns of domestic investors in sub-Saharan Africa. Tax holidays provide time for the cash flow to become positive while tax exemptions on inputs reduce operating costs. These economic incentives have acted as a stimulus to commercial aquaculture in Latin America. They could be equally useful in sub-Saharan Africa because they do not require additional government expenditures, although they have an opportunity cost.
6. The lack of data is frequently cited as a handicap for public support to aquaculture in sub-Saharan Africa. Requiring aquaculture permit lessees to submit production information could redress the problem. Costs of data collection would be passed to producers.
7. Marketing has been used as a policy in several countries. It has involved direct intervention through a marketing agent, generally a marketing association, or the construction of a central selling point. For the long run development of the industry, marketing associations have been used as an interface between the government and private sector. They have an incentive to maintain quality, to diffuse technological knowledge, to search for new markets and to maintain environmental sustainability. Associations can assist with bottom-up planning, demand-driven research, and environmental self-policing. Reliance on associations and model farmers can improve the effectiveness and efficiency of training and extension.
8. Planning of the aquaculture sector is not common in sub-Saharan Africa. Yet, it can be a device for focussing attention on constraints and for assessing comparative advantage. A plan should be multi-disciplinary and participatory. Because commercial aquaculture is market driven, a holistic planning ensures that all the constraints and opportunities are assessed. A participatory process empowers producers, and reduces the risk that particular disciplinary interests will dominate policy and research

9. Introducing alien species poses a risk to the ecosystem, but that should not inevitably be a binding constraint. If there are countries where a constraining factor is the lack of a marketable species, and the alternative to importing an alien species is abandoning commercial aquaculture, the appropriate strategy is to compare potential costs and benefits. An inter-disciplinary body should make such a decision, taking into account the precautionary approach and FAO guidelines.
10. Most countries in sub-Saharan cannot afford to increase funding on research and training. Thus, the focus must be on higher efficiency in existing research and training activities. Research must be demand-driven. It therefore should be allocated by the lead agency for aquaculture or by a supervisory committee. Members on the committee could include producers. Research conclusions should be diffused to producers perhaps by their association. Where possible, results from research in other countries should be obtained in order to avoid duplication. As the industry develops research and training should be funded where possible by the private sector.
11. At the macro level, governments in sub-Saharan Africa have little discretionary funding for the sector. This suggests that policies in the region should focus almost exclusively on those that incur few budget expenditures. At the micro level, although in some countries start-up funding has been effective in stimulating investment in commercial aquaculture, governments in sub-Saharan Africa lack the resources to implement the policy. Also, while producers frequently request subsidies on feed, seed and interest rates, the cost is usually prohibitive. Moreover subsidies distort market signals, and are difficult to eliminate. Subsidies are unrealistic in the context of fiscal retrenchment of sub-Saharan Africa.
12. In spite of the caveat on government fiscal limitations, however, there are policy options that are feasible. Among the most promising are tax holidays and exemptions. Relieving companies of the burden of corporate income taxes enables them to become financially secure in their infancy. If selectively targeted at commercial aquaculture, an incentive is provided to diversify into that sector. The government loses access to tax revenues in the short run, but gains potential long- term benefits. A similar choice exists by exempting farmers from sales taxes or custom duties. The impact on output will take longer because the reduction in variable costs occurs over a number of years.

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## APPENDIX A

### Checklist of factors by potential investors and bankers

<u>Factors</u>	<u>Choices</u>
<u>Species selection</u>	
Water type	Freshwater, brackish or marine?
Biotechnology	Spawning, maturation and nutrition known?
Marketability	Does market exist: local, national or export?
<u>Production technology</u>	
Location	Land-based or offshore?
Management intensity	Efficiency Extensive, semi-intensive or intensive?
Scale	Economies of scale? Small, medium or large?
Scope	Economies of scope? Integration, polyculture?
<u>Bio-Physical</u>	
Sunlight, rainfall, air temperature	Growth rates, pond productivity and salinity, flooding?
Wind	Water temperature and oxygenation?
Land soil	Water loss and quality, pumping costs, growth rates?
Source water	Growth rates, water quality and pollution?
<u>Risks</u>	
Administrative	Will administrative procedures be lengthy/costly?
Property Rights	Will land/water usage be guaranteed?
Governance	Will corruption/theft be a problem?
Firm Finance	Are interest rates/exchange rates volatile?
Prices	Are others entering the industry causing a price shock?
<u>Economic</u>	
Feed and Fingerlings	Availability and cost of feed and fingerlings?
Labour	Quality and wage rates?
Land	Availability, cost and security of tenure?
Water	Availability, competing uses and cost?
Finance	Is bank credit available and at what cost?
Transport	Will expansion funds and working capital be available?
Demand	Is the market/procurement centre accessible?
Distribution	What is the farm gate price? Will it change?
Processing	How will produce be sold? Direct sales, brokers etc?
	In what form will produce be sold? Whole, fillet, frozen?
<u>Social</u>	
Competing activities	Is there compatibility? Competition for resources?
Communal structure	Are family/community relationships affected?
Traditional values	Is there compatibility?

This document examines policies that encourage sustainable commercial aquaculture in developing countries, especially in sub-Saharan Africa. Commercial aquaculture – the rearing of aquatic organisms with the goal of maximizing profit – can contribute to food security and alleviation of hunger, directly by producing food fish and indirectly by generating income for the purchase of food, government revenues, improving a country's balance of trade as an export or as an import substitute, stimulating technological advances and bolstering the development of isolated regions. In addition, since it depends on private rather than public funds and is likely to use resources adequately, it is sustainable. However, some forms of commercial aquaculture can cause environmental damage and social conflicts. Stabilization or decline of the capture fisheries, the growing shortage of fish for domestic markets, export opportunities, suitable land and water and cheap labour offer prospects for commercial aquaculture in sub-Saharan Africa. Limited access to credit, shortages and high cost of feed, lack of good quality seed and a low flow of capital investment hamper its development. Good governance, openness to trade, macro-economic growth policies, emphasis on private investment as a source of wealth, land security, tax exemptions and holidays, loan guarantees, debt-equity swaps, promotion of large farms, producer associations, strategic planning and transparent regulatory procedures can stimulate the development of the sector.

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